

Attachment 3

Mission Bay

Watershed Management Area

Water Quality Improvement Plan

Mission Bay Watershed Management Area Water Quality Improvement Plan

**Submitted to the San Diego Regional
Water Quality Control Board by:**



Draft

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With:



ACKNOWLEDGMENTS

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Executive Summary

Water Quality Improvement Plan for the Mission Bay Watershed Management Area

The Water Quality Improvement Plan proposes a comprehensive watershed-based program to improve surface water quality in the Mission Bay Watershed Management Area (WMA) and in receiving waters in Mission Bay and nearby beaches. The Water Quality Improvement Plan implements the Federal Clean Water Act's objectives to protect, preserve, enhance, and restore water quality for beneficial recreational, wildlife, and other uses.

The Mission Bay WMA encompasses almost 64 square miles of urban land and undeveloped open space extending from Mission Bay to east of the I-15. The watershed includes La Jolla, Pacific Beach, University City, Clairemont Mesa, and Miramar. Rose Canyon, San Clemente Canyon, Tecolote Creek, and smaller canyons and urban drains carry runoff in this watershed downstream to Mission Bay and the Pacific Ocean, as shown on Figure ES-1. Figure ES-1 details the four main subwatersheds selected to help focus the determination of priority water quality conditions and implementation the jurisdictional storm water runoff management program. These subwatersheds are Rose Canyon, Tecolote Creek, Mission Bay, and Scripps. Additionally, Figure ES-1 highlights potential water quality strategies that could be used to improve water quality.

The Mission Bay WMA receiving waters collect storm runoff from land areas and urban storm drains that are owned and operated by the City of San Diego, the California Department of Transportation (Caltrans), and other non-municipal parties. The City of San Diego and Caltrans are responsible for managing storm water runoff from land areas within their jurisdictions that they have regulatory authority over through permits issued by the State of California. There are other non-municipal parties within the WMA, such as industrial facilities and construction sites that manage storm water runoff under separate regulatory authorities. The City of San Diego and Caltrans understand the importance of collaborating with non-municipal parties within the WMA, and the appropriate regulatory agencies that regulate them, to make sure all parties are doing their fair share to improve the water quality in the Mission Bay WMA.



The Mission Bay WMA encompasses 64 square miles of urban land and undeveloped open space, draining primarily into Mission Bay, a treasured community resource with heavy recreational use.

Photo by Phil Konstantin

The Water Quality Improvement Plan Process

The Water Quality Improvement Plan identifies goals and strategies to correct impairments in the quality of urban runoff waters. These improvements to water quality are achieved through the consistent process of evaluation, goal setting, and monitoring and reporting, according to the following process:



Step (1) determines the *priority and highest priority water quality* conditions that pose the highest threat to water quality in the affected water bodies in the WMA (e.g., a creeks or bay) based on evidence showing a water body is being polluted by runoff from the municipal separate storm sewer system (MS4). Step (2) identifies the sources of pollution of the *highest priority water quality* conditions. Step (3) formulates goals, strategies, and schedules to address the highest priority water quality conditions. As part of this step, the City of San Diego estimated the funding needed to implement the jurisdictional strategies to achieve the goals identified.



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The final three steps of the Water Quality Improvement Plan are designed to evaluate the progress made in addressing the priority and highest priority water quality conditions. Step (4) provides ongoing monitoring and assessment to evaluate the overall progress made in the WMA, including success in meeting the goals identified for the highest priority water quality conditions. Step (5) updates the Water Quality Improvement Plan as needed through an Adaptive Management Process¹, which can entail adjustments to goals and strategies, as needed, to increase effectiveness. Step (6) reports on the findings of the assessments, along with any adjustments to the Water Quality Improvement Plan. Through these steps, the Water Quality Improvement Plan provides a long-term program to measurably improve overall water quality within the Mission Bay Watershed Management Area.

Highest Priority Water Quality Conditions and Solutions

Through use of the Water Quality Improvement Plan, the following conditions and locations are identified as highest priorities for improvement within the Mission Bay WMA:

- ❖ High bacteria levels in creeks, including Tecolote Creek.
- ❖ Bacteria accumulations as measured during both wet and dry weather at beaches, including La Jolla, Pacific Beach, and Windansea Beach.
- ❖ Erosion and transport of soil and sediment into the Area of Special Biological Significance near La Jolla Shores

Both structural and nonstructural solutions and strategies to address these conditions/pollutants are included in the Water Quality Improvement Plan and include:

Nonstructural strategies, such as outreach programs and site design guidelines mandating better storm water controls, are intended as the preferred first step for addressing the highest water quality priorities because of their relatively lower costs. These solutions do not involve construction or implementation of a physical structure to filter and treat storm water, to prevent pollution.

Structural strategies, defined as solutions that are physically constructed to address water quality conditions, are intended for distribution as needed and as possible throughout the watershed area. These facilities remove pollutants through a variety of chemical, physical, and biological processes, including filtration and infiltration.

¹The Adaptive Management Process outlines how the Water Quality Improvement Plan will be revised when new priorities and/or highest priorities are added, how goals will be adjusted or new goals will be added, and how strategies will be modified to meet the latest goals.

Water Quality Improvement Goals, Strategies, and Schedules

To address the highest priorities within the Mission Bay WMA, this Water Quality Improvement Plan includes the following goals, along with some selected strategies and their proposed schedules to improve water quality.

Goals

- ❖ Prevent further degradation of water quality in the Mission Bay WMA and subwatersheds to protect creeks and beaches from pollution.
- ❖ Reduce bacteria levels in Tecolote Creek (by FY 2021 for dry weather and by FY 2031 for wet weather).

Strategies and Schedules

Ongoing:

- ❖ Require BMPs, including installation of rain barrels and downspout disconnections, landscape-based rebates, and irrigation reduction incentives.
- ❖ Expand public outreach to educate homeowners and community groups about the Water Quality Improvement Plan's requirements and to share information on incentives.
- ❖ Focus green infrastructure improvements, including bioswales, basins, catchments, and filter strips, on right-of-way and public land to physically reduce pollution via runoff.
- ❖ Enforce storm water construction requirements for builders to install sediment total maximum daily load (TMDL) limitations and physical barriers to contain potential polluted runoff.
- ❖ Identify other strategies available, including large-scale multiuse treatment areas (such as adapting a field or large park to include a detention basin), as well as creek, stream, or habitat restoration projects.

By FY 2016:

- ❖ Create 101 total acres of treated drainage via:
 - Installation of a green lot in Kellogg Park (completed 2014). A green parking lot includes generously landscaped areas and increases pedestrian and cycling infrastructure, while managing storm water onsite.
 - Installation of green streets on Mount Abernathy Avenue and Camber Drive. A green street is a street that incorporates open space and pedestrian circulation, while treating storm water runoff onsite using low impact development approaches.
 - Installation of green streets along Bannock Avenue.

- ❖ Requirement for slope stabilization and repair to prevent pollution and sedimentation from avoidable erosion sources.
- ❖ Addition of five dry weather flow diversions in the Tecolote and Scripps subwatersheds.

By FY 2018:

- ❖ Implement new and enhanced BMPs for development in the Mission Bay WMA, including:
 - Creation of 3 acres of bioretention and permeable pavement.
 - New green infrastructure projects to capture and treat key drainage areas in the Mission Bay WMA.

By FY 2025:

- ❖ Install multiuse treatment areas and green infrastructure projects within the WMA to achieve the goals of the Water Quality Improvement Plan.

Public Participation and Outreach

The development of the Water Quality Improvement Plan includes substantial input from stakeholders and community leaders throughout the Mission Bay WMA. This outreach included formation of a Consultation Committee consisting of representatives from community organizations, neighborhood groups, and businesses sharing a commitment to improve water quality.

How to Stay Involved

Any questions, comments, or requests for more information regarding the Water Quality Improvement Plan may be submitted via email to Jim Harry at JHarry@sanidiego.gov.

In addition, once the Water Quality Improvement Plan is submitted to the Regional Water Quality Control Board (Regional Board), comments will be formally collected by Regional Board staff during the 30-day comment period. More information is available on the Regional Board's website: www.waterboards.ca.gov.

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Acronyms and Abbreviations

Acronym or Abbreviation	Definition
%	percent
303(d) list or listing	Clean Water Act Section 303(d) list of impaired waters
AB 411	California Assembly Bill 411 (Beach Safety Act)
Ag Waiver	Conditional Waiver of Discharges from Agricultural and Nursery Operations
ASBS	Area of Special Biological Significance
ASBS 29	La Jolla Area of Special Biological Significance
ASBS General Exception	State Water Resources Control Board Resolution No. 2012-0012, <i>General Exception to the California Ocean Plan for Areas of Special Biological Significance Waste Discharge Prohibition for Storm Water and Nonpoint Source Discharges, with Special Protections</i>
Bacteria TMDL	San Diego Regional Water Quality Control Board Resolution Number R9-2010-0001, <i>Revised TMDL for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek)</i>
Basin Plan	<i>Water Quality Control Plan for the San Diego Basin</i>
Bight '13	Southern California Regional Bight '13 Monitoring Program
BIOL	Preservation of Biological Habitats of Special Significance (beneficial use)
BMI	benthic macroinvertebrates
BMP	best management practice
BOA	business owners association
CalRecycle	California Department of Resources Recycling and Recovery
Caltrans	California Department of Transportation
CEDEN	California Environmental Data Exchange Network

Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
CIP	Capital Improvement Projects
City	City of San Diego
CLRP	Comprehensive Load Reduction Plan
Consultation Committee	Water Quality Improvement Plan Consultation Committee
Copermittee	Operator of a municipal separate storm sewer system in San Diego County that is party to the MS4 Permit.
CRAM	California Rapid Assessment Method
CWA	Clean Water Act
DDT	dichloro-diphenyl-trichloroethane
DEH	Department of Environmental Health
DPR	California Department of Pesticide Regulation
FIB	fecal indicator bacteria
FY	Fiscal Year
GF	General Fund
GI	gastrointestinal illness
GIS	geographic information system
HMP	Hydromodification Management Plan
HOA	home owners association
HPWQC	Highest Priority Water Quality Condition
IBI	Index of Biological Integrity
IC/ID	illicit connection/illicit discharge
IDDE	illicit discharge detection and elimination
IGP	Industrial General Permit
JRMP	Jurisdictional Runoff Management Program (2013 MS4 Permit)

Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
JURMP	Jurisdictional Urban Runoff Management Program/Plan (2007 MS4 Permit)
LID	low-impact development
LTEA	Long-Term Effectiveness Assessment
MAR	Marine Habitat (beneficial use)
MEP	maximum extent practicable
MLS	mass loading station
MPN/mL	most probable number per milliliter
MS4	municipal separate storm sewer system
MS4 Permit	San Diego Regional Water Quality Control Board Order Number R9-2013-0001, <i>National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer System (MS4) Draining the Watersheds Within the San Diego Region</i>
MST	microbial source tracking
MWD	Metropolitan Water District of Southern California
NA	not applicable
NAL	non-storm water action level
NCTD	North County Transit District
NIH	National Institutes of Health
NLCD	National Land Cover Database
NOI	Notice of Intent
Non-MS4	Non-Phase I MS4s
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance

Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
OAL	California Office of Administrative Law
PDP	priority development project
PFC	permeable friction course
PGA	pollutant-generating activity
Porter-Cologne	Porter-Cologne Water Quality Control Act
POTW	publicly owned treatment works
PUD	Public Utilities Department
PWQC	Priority Water Quality Condition
QMRA	Quantitative Microbial Risk Assessment Study
REC-1	Contact Water Recreation (beneficial use)
REC-2	Non-Contact Water Recreation (beneficial use)
Regional Board	San Diego Regional Water Quality Control Board
Responsible Agency	Responsible Agencies include parties subject to the Bacteria TMDL and participating in this Water Quality Improvement Plan, specifically City of San Diego and Caltrans
RHMP	Regional Harbor Monitoring Program
ROWD	Report of Waste Discharge
RSAA	Reference System Antidegradation Approach
RWL	Receiving Water Limitation
SAL	storm water action level
SANDAG	San Diego Association of Governments
SCCWRP	Southern California Coastal Water Research Project
SDCWA	San Diego County Water Authority

Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
Sediment Control Plan	State Water Board's <i>Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality</i>
SHELL	Shellfish Harvesting (beneficial use)
SMARTS	Storm Water Multiple Application and Report Tracking System
SMC	Southern California Stormwater Monitoring Coalition
SMC Regional Bioassessment Program	SMC Regional Freshwater Stream Bioassessment Monitoring Program
SOP	standard operating procedure
SQO	Sediment Quality Objective
SSID	stressor/source identification
State	State of California
State Board	State Water Resources Control Board
Strategic Plan	City of San Diego Strategic Plan for Watershed Activity Implementation
SUSMP	Standard Urban Storm Water Mitigation Plan
SUSTAIN	System for Urban Stormwater Treatment and Analysis Integration
SWAMP	Surface Water Ambient Monitoring Program
SWMP	Storm Water Management Plan
T&SW	City of San Diego Transportation and Storm Water Division
TC-MLS	Tecolote Creek Mass Loading Station
TDS	total dissolved solids
TIE	toxicity identification evaluation
TMDL	total maximum daily load

Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
TRE	toxicity reduction evaluation
TSS	total suspended solids
TWAS	temporary watershed assessment station
UC	University of California
USD	University of San Diego
USEPA	United States Environmental Protection Agency
VA	Veterans Administration
WAMP	Watershed Asset Management Plan
WARM	Warm Freshwater Habitat (beneficial use)
WDR	Waste Discharge Requirement
WLA	waste load allocation
WMA	Watershed Management Area
WMAA	Watershed Management Area Analysis
WQBEL	water quality based effluent limitation
WQIP	Water Quality Improvement Plan
WQO	water quality objective
WRI	World Resources Institute
WURMP	Watershed Urban Runoff Management Program

1 Introduction

Local government agencies work hard to protect water quality throughout the San Diego region. New regulations along with existing environmental protections create the need for new plans and programs that will address concerns about pollution in local rivers, streams, and other waterways leading to the ocean. Local agencies worked to develop Water Quality Improvement Plans that will help protect and improve the quality of waters in each community of San Diego. These plans address protections in what are known as Watershed Management Areas. A Watershed Management Area (WMA) includes the lands, stream systems, and other tributaries draining to a specific ocean or bay shoreline (or other receiving water). This document is the Water Quality Improvement Plan for the Mission Bay WMA.

The Mission Bay WMA is a highly urbanized 64 square mile portion of central San Diego County. It includes four distinct hydrologic areas draining to Mission Bay and the Pacific Ocean. Two local agencies share jurisdictional authority in this WMA and worked collaboratively to prepare this Water Quality Improvement Plan.

Water Quality Improvement Plans are required for each WMA under regulations adopted by the San Diego Regional Water Quality Control Board (Regional Board). The plans address only water flows and discharges from the storm drain systems maintained by the local agencies sharing authority in each area. Other discharges and sources of pollution are considered in the plan to the extent that they affect conditions in the storm drain system.

Following the passage of the Federal Clean Water Act (CWA) in 1972, surface water

Section 1 Highlights

- ❖ This Water Quality Improvement Plan helps to protect and improve waters in the Mission Bay Watershed Management Area.
- ❖ The plan specifically addresses conditions within storm water systems and receiving waters of this area.
- ❖ Mission Bay WMA = 64 square miles
- ❖ Main Subwatersheds:
 - Rose Canyon
 - Tecolote Creek
 - Mission Bay
 - Scripps (includes drainage to Pacific Ocean and Mission Bay)
- ❖ Responsible Agencies:
 - City of San Diego
 - Caltrans (participating voluntarily)
- ❖ Other Discharge Impacts:
 - Phase II Permittees – University of California at San Diego; Veterans Administration (VA) San Diego Healthcare System; North County Transit District; Marine Corps Air Station Miramar
 - Construction General Permits
 - Industrial General Permits
 - Federal/State Lands
 - Agricultural Lands
- ❖ This document will serve as the Bacteria Total Maximum Daily Load Comprehensive Load Reduction Plan for the Scripps and Tecolote Creek subwatersheds.

quality throughout the United States has improved substantially. However, poor water quality still impairs some beneficial uses of surface waters in the Mission Bay WMA. Beneficial uses are “the uses of water necessary for the survival or well-being of man, plants, and wildlife” (Regional Board, 1994).

1.1 Jurisdiction and Responsibilities

The Water Quality Improvement Plan outlines a framework to improve the surface water quality in the Mission Bay WMA by identifying, prioritizing, and addressing impairments related to urban runoff discharges. On May 8, 2013, the San Diego Regional Water Quality Control Board adopted Order Number R9-2013-0001, *National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer System (MS4) Draining the Watersheds Within the San Diego Region* (MS4 Permit), establishing requirements for discharges from MS4s in the San Diego region. On February 11, 2015, the Regional Board adopted Order Number R9-2015-0001 amending the MS4 Permit. The amended MS4 Permit became effective on April 1, 2015.

This MS4 Permit affects local agencies, including those with jurisdictional responsibilities in the Mission Bay WMA. As defined in the MS4 Permit, a permittee to an NPDES permit is responsible only for permit conditions relating to the discharges for which it is an operator. In the case of the MS4 Permit, this responsibility includes discharges from Copermittees (jurisdictions party to the MS4 Permit) in the San Diego region. The San Diego County Copermittees are listed in Table 1a of the MS4 Permit and the Copermittee with jurisdictional area within the Mission Bay WMA is as follows:

❖ City of San Diego

Each Copermittee must comply with the MS4 discharge prohibitions and receiving water limitations outlined in the MS4 Permit through timely implementation of control measures, other actions specified in the MS4 Permit, and adherence to this Water Quality Improvement Plan.

The Mission Bay WMA also includes land area and MS4s that are owned and operated by parties other than the Copermittees or that are regulated by separate NPDES permits.

Discharges from non-municipal sources and activities (e.g., runoff from agriculture and industrial land uses, federal and state facilities, the California Department of Transportation [Caltrans]), and Phase II storm water permittees (small MS4s) are regulated separately. For example, facilities designated as Phase II permittees are regulated under the Phase II General Permit (State Water Resources Control Board [State Board] Order No. 2013-0001-DWQ). Phase II permittees in the Mission Bay WMA include a transit authority, a medical facility, a university, and a military installation. In California, industrial and construction activities are regulated under the General Industrial Permit (State Board Order No. 2014-0057-DWQ) (State Board, 2014a) and General Construction Permit (State Board Order No. 2012-0006-DWQ) (State Board,

2012a). Finally, conditional waivers that remove the need to file a report of waste discharge and that avoid coverage under the NPDES permit program are given to activities such as agriculture and nursery operations, onsite disposal systems, silvicultural operations, and animal operations. Recently, draft general water discharge requirements for commercial agricultural and nursery operations were released for public review. The tentative draft order may be finalized during the development of this Water Quality Improvement Plan, affecting the ways in which discharges from commercial agricultural and nursery operations are managed.

Under this regulatory framework, there are two general areas of storm water management responsibilities: (1) jurisdictional inspection and oversight (such as education, enforcement, and other Illicit Discharge Detection and Elimination (IDDE) activities), as described in the Jurisdictional Runoff Management Program (JRMP) in the MS4 Permit, and (2) control of pollutant discharges.

- (1) The Mission Bay WMA Copermittees require minimum Best Management Practices (BMPs) and have inspection responsibilities over all lands within their jurisdictional boundaries (including industrial lands and construction sites), except for NPDES Phase II, agricultural, state, federal, Caltrans, and Indian reservation lands. The United States Environmental Protection Agency (USEPA), State Board, and Regional Board are responsible for inspections of Phase II, agricultural, state, federal, and Indian reservation lands. Caltrans is subject to its own State of California (State)-issued MS4 Permit. In addition, the USEPA, State Board, and Regional Board have dual permitting and oversight responsibilities over industrial lands and construction sites.

Copermittees do have limited regulatory oversight over industrial lands, construction sites, Phase II MS4s, and agricultural, state, federal, and Indian reservation lands. For example, the Copermittees implement IDDE activities to identify, investigate, and enforce discharges to their MS4s, as shown in Table 1-1. Discharges to receiving waters from non-municipal sources and activities (e.g., runoff from agriculture and industrial land uses, federal and state facilities, Caltrans, and Phase II storm water permittees) are not regulated or controlled by the Copermittees when they do not enter a MS4. Accordingly, the scope of the Water Quality Improvement Plan is limited to the regulatory oversight of the Copermittees specified above.

- (2) In regard to controlling pollutant discharges, various NPDES permits or conditional waivers regulate storm water and non-storm water discharges within the Mission Bay WMA, as shown in Figure 1-1. The Copermittees are responsible for controlling pollutant discharges from lands within their jurisdictional boundaries, except for agriculture and industrial land uses, federal and state facilities, Caltrans, and Phase II storm water permittees. The Copermittees do not have regulatory authority under the MS4 Permit to require entities regulated by other permits issued by the USEPA, State Board, or Regional Board to implement and/or construct BMPs to treat wet/dry weather

pollutant discharges originating from their properties, facilities, and/or activities. However, the MS4 Permit requires the Copermittees to control pollutants originating from Non-Phase I MS4s (Non-MS4) or non-municipal lands if those pollutants ultimately discharge into the MS4. Therefore, the Copermittees recognize the need to collaborate with and improve communication between non-municipal entities within the WMA and the appropriate regulatory agencies to ensure that discharges are appropriately regulated before entering the MS4, and to improve water quality throughout the Mission Bay WMA.

To help identify non-municipal sources, the Copermittees are participating in special source identification studies to determine potential sources (including non-municipal sources) of pollutants entering the MS4; these studies are presented in Section 5. Additionally, the Copermittees are conducting additional watershed modeling to quantify the amount of pollutant loads coming from non-municipal sources and activities, and the results are presented in Section 4.

This document incorporates and replaces the Tecolote and Scripps Comprehensive Load Reduction Plans, which were submitted to the Regional Board in July 2012 to satisfy the requirements of the *Total Maximum Daily Load (TMDL) for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek)*, Resolution No. R9-2010-0001 (Regional Board, 2010), referred to as the Bacteria TMDL. The Mission Bay WMA Water Quality Improvement Plan represents an update to those plans as it provides more recent programmatic guidance for the implementation of the Bacteria TMDL. A goal of the Water Quality Improvement Plan is to describe the programmatic and adaptive management approach developed by the Responsible Agencies to meet the requirements of the Bacteria TMDL. This includes the implementation strategies needed to achieve the pollutant load reductions identified in the TMDL. Therefore, this document now serves as the compliance plan for the Bacteria TMDL for the Tecolote and Scripps subwatersheds.

Caltrans has partial responsibility for the implementation of the Bacteria TMDL Caltrans and is therefore included as a Responsible Agency, but is not listed in the MS4 Permit as a Copermittee. Caltrans is under a separate storm water permit from the State of California to reduce or eliminate the discharge of pollutants to storm drainage systems and receiving waters (Order No. 2012-0011-DWQ). Caltrans is voluntarily participating in Water Quality Improvement Plan development across the San Diego region.

This plan has been prepared, as required by the MS4 Permit, by the Responsible Agencies in the Mission Bay WMA. The Responsible Agencies that are party to the development of this Water Quality Improvement Plan are:

- ❖ Caltrans
- ❖ City of San Diego

Table 1-1
City of San Diego Inspection and Oversight Authority Under the MS4 Permit

City of San Diego Can:	Non-municipal Sources and/or Activities					
	Industrial Facilities	Construction Sites	Agricultural Lands	Federal/State/Indian Reservations	Caltrans	Phase IIs
Conduct storm water inspections [MS4 Permit Provisions E.4.d and E.5.c]	✓	✓	–	–	–	–
Require minimum BMPs [MS4 Permit Provisions E.4.c and E.5.b.]	✓	✓	–	–	–	–
Implement Illicit Discharge Detection and Elimination Program ¹ [MS4 Permit Provision E.2]	✓	✓	✓	✓	✓	✓
Educate [MS4 Permit Provision E.7]	✓	✓	✓	✓	✓	✓

1. The Illicit Discharge Detection and Elimination Program (IDDE) includes the identification, investigation, and confirmation of sources of illicit discharges to the MS4. Investigation can include monitoring and sampling of discharges. After confirmation, follow up activities can include notification, education, notice of violation, and/or monetary fines. Discharges and/or non-filers under the Industrial General Permit can be reported to the Regional Board. The City of San Diego's Storm Water Ordinance provides the legal authority to implement its IDDE Program.

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Currently, some of the Copermittees are pursuing a subvention of funds from the State to pay for certain activities required by the 2007 MS4 Permit, including activities that require Copermittees to perform activities outside their jurisdictional boundaries and on a regional or watershed basis. Nothing in this Water Quality Improvement Plan should be viewed as a waiver of those claims or as a waiver of the rights of Copermittees to pursue a subvention of funds from the State to pay for certain activities required by the 2013 MS4 Permit, including the preparation and implementation of the Water Quality Improvement Plan. In addition, several Copermittees have filed petitions with the State Board challenging the requirement to prepare Water Quality Improvement Plans that are not voluntary and that are not linked to a receiving water limitations language compliance path. Nothing in this Water Quality Improvement Plan should be viewed as a waiver of those claims. Because the State Board has not issued a stay of the 2013 MS4 Permit, Copermittees must comply with the MS4 Permit's requirements while the State Board process is pending.

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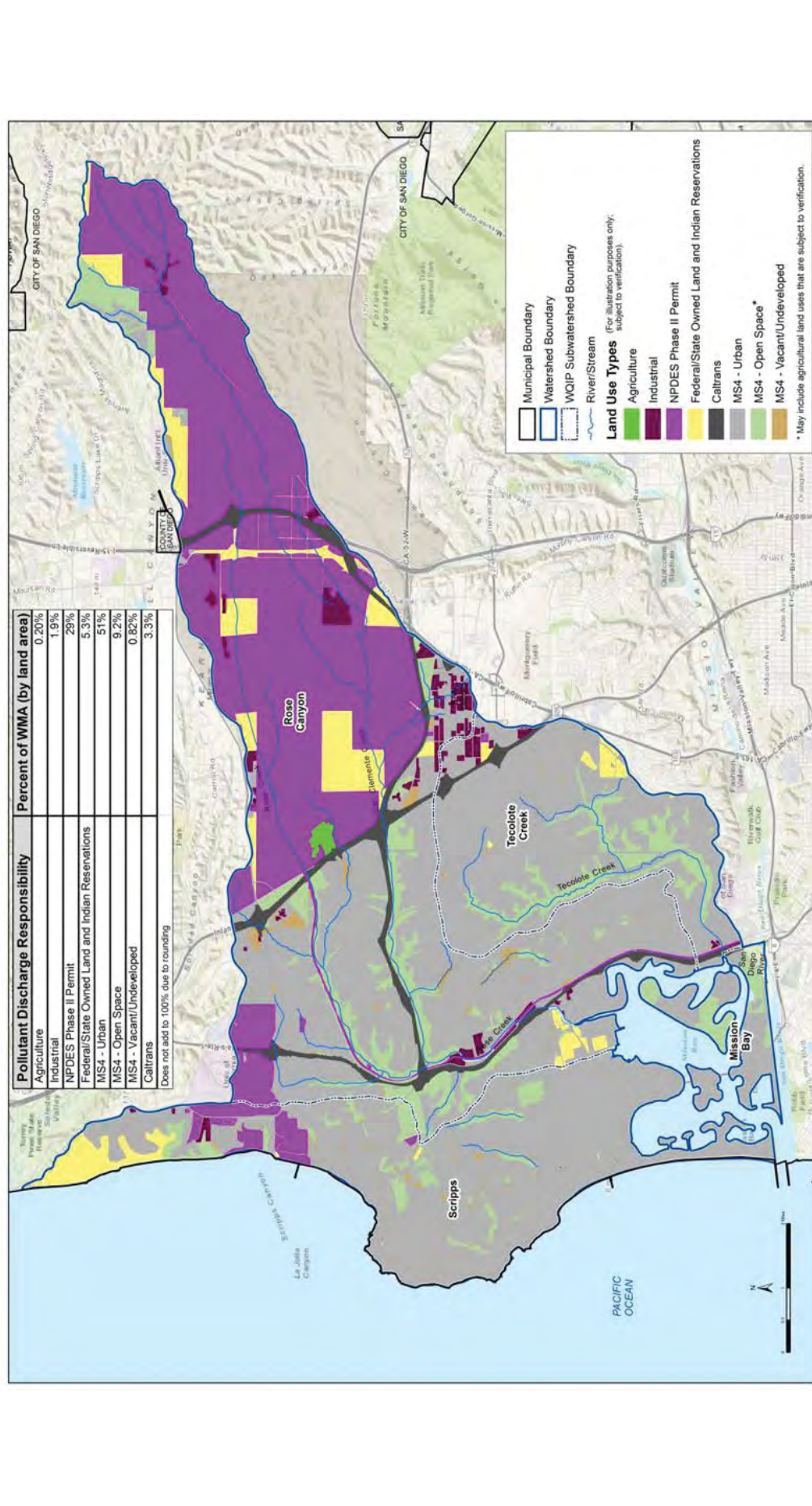


Figure 1-1
Mission Bay WMA Pollutant Discharge
Responsibilities

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1.2 Regulatory Background

In 1972, the CWA amended the Federal Water Pollution Control Act, providing the mechanism for regulating discharges to waters of the United States through the NPDES permit program. The CWA requires appropriate NPDES permits for specific types of discharges (e.g., municipal and industrial storm water) to surface waters of the United States. Individual states may administer the federal law through their own legislation, in addition to regulating other types of discharges (e.g., discharges to land and irrigated agriculture).

California passed the Porter-Cologne Water Quality Control Act (Porter-Cologne) to control water pollution in 1969 (prior to the CWA), and has since amended it to comply with and implement the CWA. Porter-Cologne gave the State Board and nine Regional Water Quality Control Boards the authority to regulate discharges to waters of the state (which include all waters of the United States) and to issue NPDES permits.

The jurisdictions of the nine Regional Water Quality Control Boards correspond to nine large watershed areas across the state, which are referred to as basins. These basins are delineated using topographical maps surveyed by the United States Geological Survey and are further subdivided into (smaller) watersheds and subwatersheds. The water quality standards, including the beneficial uses and water quality objectives, for each basin are detailed in the Water Quality Control Plan (Basin Plan) for each region. For the San Diego region (Region 9), the Basin Plan was adopted in 1994 and has been amended several times since. The Mission Bay WMA is one of ten watersheds (otherwise referred to as WMAs) within the San Diego Basin and is regulated by the Regional Board using its authority under Porter-Cologne in conjunction with the water quality standards described in the Basin Plan.

For approximately 20 years after the CWA's passage, NPDES permits were primarily issued to wastewater and industrial facilities (such as publicly owned treatment works [POTWs], paper mills, and power plants) that discharged waste to natural surface waters as part of their operations. These regulations substantially improved surface water quality throughout the country. However, many waterbodies still suffer from suboptimal water quality, and their benefits (termed "beneficial uses" in the CWA) were not always attained.

The pathways by which pollutants can enter waters of the state are not limited to wastewater discharging from a pipe. In the early 1990s, the California Regional Water Quality Control Boards began to issue NPDES permits to municipalities and other agencies that discharge water via a storm drain system, identified as an MS4. The MS4s, which are systems of conveyances that may include the storm drains and flood control structures associated with land development, are primarily owned and operated by municipalities. MS4s are distinguished from combined sewers, which direct storm drain flows to a wastewater treatment plant; in contrast, MS4s convey water flowing from streets, buildings, and other land areas into surface waters, both directly and indirectly. MS4s may convey both storm water and authorized non-storm water discharges.

The initial (“Phase I”) MS4 Permits, typically issued for a five-year term, focused on actions to be taken by Copermittees. These actions included regulation of residential and commercial activities, new and existing development, and other construction activities; facility inspections; water quality monitoring; and programs to detect and eliminate illegal discharges.

The Phase I MS4 Permits also established the following regulatory mechanisms:

- ❖ **Receiving water limitations** prohibit discharges from MS4s that cause or contribute to the violation of water quality standards or water quality objectives.
- ❖ **Effluent limitations** are based either on technology, by requiring pollutants to be reduced to the maximum extent practicable (MEP), or on water quality, by specifying the maximum concentration of pollutants in MS4 storm water discharges.
- ❖ **Discharge prohibitions** specify what may and may not be legally discharged to a state waterbody in a manner causing, or threatening to cause, a condition of pollution, contamination, or nuisance.

Monitoring programs required by the Phase I MS4 Permits were effective in characterizing the receiving waters in urban areas and the pollutants typically found in MS4 discharges. Furthermore, the permit programs developed and implemented numerous BMPs, ranging from street sweeping to public education and outreach to true source control (e.g., eliminating copper from automotive brake pads through state legislation). However, despite the implementation of program activities meeting the MEP standard, impairments of beneficial uses remain. Because these impairments exist, the Regional Board is required to review existing policies and to develop new policies, such as TMDLs. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards, and an allocation of that load among the various sources of the pollutant.

The Regional Board worked closely with the Copermittees and interested parties during development of the most recent version of the MS4 Permit to institute a new scientifically based approach to water quality management. The new approach is based on water quality outcomes, rather than on fulfillment of prescriptive activities. While maintaining each jurisdiction’s authority and accountability, monitoring is conducted to answer specific questions and provide the basis for implementation actions in the Mission Bay WMA.

1.3 Water Quality Improvement Plan Process

During development of the Water Quality Improvement Plan, the Responsible Agencies solicited data, information, and recommendations through a public participation process, as mandated by Provision F.1.a of the MS4 Permit. The public participation process included public workshops (described in Sections 2 and 3 of this document) and the creation of a Water Quality Improvement Consultation Committee (Consultation

Committee), which provided recommendations during the development of the Water Quality Improvement Plan. The Consultation Committee included the following required representatives:

- ❖ A representative of the Regional Board
- ❖ A representative of the environmental community (i.e., a non-governmental organization) associated with a waterbody within the Mission Bay WMA
- ❖ A representative of the development community familiar with the opportunities and constraints for implementing structural BMPs, retrofitting projects, and stream, channel, or habitat rehabilitation projects in the Mission Bay WMA

In addition to the three required Consultation Committee members, the Responsible Agencies chose seven members at large, based on interest forms received after the first public workshop.

The Consultation Committee reviews drafts of keys sections of the Water Quality Improvement Plan, and meets periodically during the two-year development process to discuss the following topics:

- ❖ Priorities, potential strategies, and sources of pollutants and stressors (November 2013 [completed])
- ❖ Numeric goals, strategies, and schedules (July 2014 [completed] and October 2014 [completed])
- ❖ Final Water Quality Improvement Plan (June 2015, 30-day comment period)

1.4 Water Quality Improvement Plan Goal and Approach

As stated in the MS4 Permit, “the goal of the Water Quality Improvement Plans is to further the CWA’s objective to protect, preserve, enhance, and restore the water quality and designated beneficial uses of waters of the state.”

Since the inception of MS4 Permits more than 20 years ago, the Responsible Agencies have directed substantial resources to improve water quality in the Mission Bay WMA through the City’s Watershed Urban Runoff Management Program (WURMP) and Jurisdictional Urban Runoff Management Program (JURMP), and Caltrans’ Storm Water Management Plan. The Water Quality Improvement Plan represents the next phase in watershed management and enhancement following many years of monitoring and program implementation. Additionally, this Water Quality Improvement Plan serves as the comprehensive planning document for the proposed management program that will be implemented within the Mission Bay WMA. As the comprehensive planning document, this Water Quality Improvement Plan incorporates and replaces all previously submitted comprehensive planning documents for this WMA, including the Bacteria TMDL Comprehensive Load Reduction Plan (CLRP).

This Water Quality Improvement Plan is intended to be a living document and proposes an iterative and adaptive management process to meet the MS4 Permit goals. The overall process is shown in Figure 1-2 and described in this section.



Figure 1-2
Water Quality Condition Improvement Plan Process

The initial step in developing this Water Quality Improvement Plan was a review of known receiving water impairments and the water quality data that had been collected during prior MS4 Permit cycles, along with other available data and public input. This process identified a set of receiving water conditions within the Mission Bay WMA (Section 2.1).

For each identified receiving water condition, available data from upstream MS4 discharges were reviewed to determine whether there was evidence that the MS4 discharges may be a source of pollutants to the receiving water condition (Section 2.2). When evidence of a potential linkage was found, the receiving water condition became a “priority water quality condition” (Section 2.3). A subset of these priority water quality conditions was selected to represent the highest priority water quality conditions (Section 2.4).

The CWA regulatory process and the MS4 Permit monitoring programs performed to date have generally been successful in identifying the highest priorities in the Mission Bay WMA. Selection of the highest priority water quality conditions is based on the methodology developed by the Responsible Agencies (Appendix A) and these conditions reflect some of the most challenging water quality issues to address in the WMA. The strategies identified in this Water Quality Improvement Plan to address these issues are expected to simultaneously address many of the other priorities in the WMA. The highest priority water quality conditions identified in this plan were subject to review and input from the Regional Board; environmental, business, and development organizations; and the public.

Current water quality issues identified by the Responsible Agencies include a list of impaired waterbodies with designations that have been approved by the USEPA per CWA Section 303(d) (303(d) or 303(d) list or listing). Goals and schedules for addressing these issues have been developed and included in the Basin Plan as TMDLs for certain 303(d) listings or as General Ocean Plan Exceptions for areas of special biological significance (ASBS).

With the highest priority water quality conditions established, the next step was to identify the potential sources of the pollutants and stressors contributing to the highest

priority water quality conditions (Section 3). Concurrently, potential strategies to address the highest priority water quality conditions were identified. The potential strategies ranged from activities such as street sweeping, public outreach, and construction of water quality treatment structures to the development of standards and regulatory initiatives. The potential strategies were selected from existing plans, public feedback, and suggestions from the Consultation Committee.

Given the potential strategies, interim and the final Water Quality Improvement Plan numeric goals have been developed using the latest research and currently available technology (Section 4). These interim goals provide a schedule for measuring progress toward final numeric goals. Final numeric goals are intended to protect and restore beneficial uses when achieved. According to the MS4 Permit (Provision B.3), “the water quality improvement goals and strategies must address the highest priority water quality conditions by effectively prohibiting non-storm water discharges to the MS4, reducing pollutants in storm water discharges from the MS4 to the MEP, and protecting the water quality standards of receiving waters.” Numeric goals and schedules have been developed to track improvements related to the highest priority water quality conditions detailed in this Water Quality Improvement Plan, while prioritizing strategies that can address multiple pollutants simultaneously.

In coordination with the Regional Board and other interested parties, the Responsible Agencies have developed a list of recommended strategies with implementation schedules and the estimated dates for achievement of interim and final numeric goals. The list of recommended strategies was developed by evaluating the potential strategies developed under the previous step for their estimated ability to ultimately achieve the numeric goals, while providing a multi-pollutant benefit. The Responsible Agencies have prioritized the list of recommended strategies by incorporating a comprehensive approach to all pollutants and conditions. The end goal is to optimize the improvement to water quality in relation to the overall costs of implementation and assessment. The Responsible Agencies are committed to contributing to improved water quality in the Mission Bay WMA by reducing the discharge of pollutants from their MS4s through implementation of the recommended strategies identified in this Water Quality Improvement Plan. Lastly, the City of San Diego estimated the fiscal impact of implementing the jurisdictional strategies required to meet the goals identified and conducted an alternatives analysis to estimate the load contribution and associated BMP implementation implications for MS4s and Non-MS4 entities in the Mission Bay WMA.

To evaluate progress toward improving water quality and meeting scheduled goals, a question-based program to monitor and assess water quality improvement has been developed (Section 5). The program will be implemented on a watershed basis so that the Responsible Agencies can efficiently combine their resources.

This Water Quality Improvement Plan includes an iterative and adaptive management process for Responsible Agencies to re-evaluate conditions and improve strategies and assessments (Section 6). The process will draw from the data collected as part of the

Monitoring and Assessment Program and the JRMP to create a water quality improvement program that is dynamic and proactive.

1.5 The Mission Bay WMA

The Mission Bay WMA drains a highly urbanized area of approximately 64 square miles, almost entirely west of Interstate 15 in coastal San Diego County. The WMA is entirely within the jurisdiction of the City of San Diego; however, several major corridors maintained by Caltrans are also in the WMA. The land areas of the jurisdictions are provided in Table 1-2.

Table 1-2
Jurisdictional Land Area Sizes for the Mission Bay WMA

Responsible Agencies	Land Area (Acres)
City of San Diego	39,650
Caltrans	1,378

To develop the Water Quality Improvement Plan, the Mission Bay WMA was separated into four main subwatersheds to make receiving water the focus when selecting priority water quality conditions and implementing the jurisdictional runoff management program. These subwatersheds, which are delineated by the major hydrologic boundaries in the WMA, are Rose Canyon, Tecolote Creek, Mission Bay, and Scripps. A subwatershed map is provided in Appendix B. These subwatersheds aid organization and help give geographical context to the conditions and strategies. However, the locations of the receiving waters were not a factor in determining the priority water quality conditions.

Rose Creek, Tecolote Creek, and Cudahy Creek are the WMA's main tributaries to Mission Bay. San Clemente Creek and Cudahy Creek are tributaries to Rose Creek, and are considered part of the Rose Canyon subwatershed. San Clement Creek flows to the southwest, parallel to Rose Creek, before joining Rose Creek near the interchange of Interstate 5 and State Route 52.

The Mission Bay subwatershed comprises Vacation Isle and Fiesta Island areas, which are smaller, separate drainage areas within Mission Bay.

The Scripps subwatershed is unique in that it has two separate drainage ways. The "Crown Point" area and the eastern portion of the Mission Beach community drain into Mission Bay. The remaining portion of the Scripps subwatershed drains into the Pacific Ocean and two current ASBS, which encompass a large portion of the La Jolla Shores marine environment.

Many of the natural vegetative communities in the Mission Bay WMA have been altered by land development. However, concentrated native chaparral scrub habitats are found in the headwaters of the Rose Canyon subwatershed (Appendix B).

Land use information was obtained from the land layer of the geographical information system (GIS) of the San Diego Association of Governments (SANDAG, 2009), which contains over 80 different land use classifications. These land use classifications were aggregated into nine general land use classifications. A breakdown of the land uses in the Mission Bay WMA is provided in Table 1-3. While a large portion of the WMA is highly urbanized (Appendix B), open space and recreation is the single largest land use type (31 percent), followed by residential land use (28 percent).

Table 1-3
Mission Bay WMA Land Uses

Land Use	Area (Acres)	Percent of Total (%)
Open Space/Parks	12,582	30.67
Residential	11,463	27.94
Freeway/Road/Transportation	6,610	16.11
Office/Institutional	4,686	11.42
Vacant/Undeveloped	2,794	6.81
Industrial	1,448	3.53
Commercial	1,294	3.15
Agriculture	80	0.19
Water	72	0.18

The map illustrating the impervious areas of the Mission Bay WMA is provided in Appendix B. Impervious cover in this map is any surface in the landscape that cannot effectively absorb or infiltrate rainfall. Impervious areas include driveways, roads, parking lots, rooftops, and sidewalks. The amount of impervious cover reflects the amount of urbanization in a WMA. Increased impervious cover adds to the rainfall runoff potential in the WMA, with implications for water quality and flood control. Soils on this map are depicted as pervious; however, some local soil types may exhibit such low infiltration rates that they may be nearly impermeable.

1.6 Water Quality Improvement Plan Organization

The organization of this Water Quality Improvement Plan follows the requirements of the MS4 Permit. The Water Quality Improvement Plan sections and the corresponding MS4 Permit provisions are organized as follows:

Section 1, Introduction – This section provides the purpose of the Water Quality Improvement Plan and summarizes the spatial context of the WMA encompassed by the Water Quality Improvement Plan.

Section 2, Priority Water Quality Conditions – This section steps through the process of selecting the priority water quality conditions, including assessing receiving water conditions (Provision B.2.a), assessing the impacts of the MS4 discharges (Provision B.2.b), identifying the priority water quality conditions (Provision B.2.c(1)), and identifying the highest priority water quality conditions (Provision B.2.c(2)).

Section 3, MS4 Sources of Pollutants and/or Stressors – This section describes known and suspected sources of pollutants or other stressors that cause or contribute to the highest priority water quality conditions, describes the prioritization process of the sources or stressors, and summarizes the priority sources or stressors by jurisdiction (Provision B.2.d).

Section 4, Water Quality Goals, Strategies, and Schedules – For the highest priority water quality conditions, this section details the WMA interim and final numeric goals and the schedule for measuring progress toward achieving these goals (Provision B.3.a(1)). These goals are used to develop the jurisdictional specific water quality improvement strategies (Provision B.3.b(1)) and the schedules for jurisdictional specific water quality improvement strategies (Provisions B.3.a(2) and B.3.b(3)).

Section 5, Water Quality Improvement Monitoring and Assessment Program – This section summarizes the integrated Monitoring and Assessment Program (Provision B.4).

Section 6, Iterative Approach and Adaptive Management Process – This section describes the methodology to re-evaluate the priority water quality conditions (Provision B.5.a); adapt the goals, strategies, and schedules (Provision B.5.b); and adapt the Monitoring and Assessment Program (Provision B.5.c). It also describes the processes to modify the Water Quality Improvement Plan (Provision B.6.b) and the JRMP (Provision F.2.a) following re-evaluation.

2 Priority Water Quality Conditions

Local agencies have long worked in partnership to protect and improve water quality throughout the Mission Bay Watershed Management Area. Over the years there have been substantial improvements to water quality in the streams and other tributaries leading to Mission Bay and ultimately the Pacific Ocean. Even so, there are segments of waterbodies in the Mission Bay Watershed Management Area that continue to suffer from impairments to water quality.



Working collaboratively with the Regional Board and the public, the agencies with jurisdictional responsibilities in the Mission Bay WMA identified a total of 16 priority water quality conditions associated with discharges from storm drain systems within this area. This identification effort is the first step required for the new Water Quality Improvement Plan process (described in Section 1 and illustrated in the graphic above). The plan developed for the Mission Bay WMA employs a scientific process of pollutant source identification and management.

Section 2 Highlights

- ❖ Describes the process to determine priority water quality conditions and identify highest priority water quality conditions
- ❖ Identifies the priority water quality conditions:
 - Rose Canyon – 10 priority water quality conditions (2 selected on the basis of monitoring data)
 - Tecolote Creek – 4 priority water quality conditions
 - Scripps – 2 priority water quality conditions
- ❖ Identifies the highest priority water quality conditions:
 - Tecolote Creek subwatershed
 - Impairment of contact recreation of Tecolote Creek from indicator bacteria during wet and dry weather
 - Scripps subwatershed
 - Impairment of contact recreation of Pacific Shoreline at multiple locations from indicator bacteria during both wet and dry weather
 - Impairment of the La Jolla Area of Special Biological Significance (ASBS 29) from sediment during wet weather

The impairment of contact recreation in Tecolote Creek from bacteria was determined to be one of the highest priority water quality conditions in the Tecolote Creek subwatershed during wet and dry weather. Another highest priority water quality condition related to bacteria is the impairment of contact recreation along the Pacific Shoreline at multiple locations in the Scripps subwatershed during both wet and dry weather. The final highest priority water quality condition is impairment of the Area of Special Biological Significance just off the coast in La Jolla from sediment transported during wet weather.

Discharges that are not conveyed by the MS4 are regulated separately. However, the Responsible Agencies are responsible for discharges originating from these Non-MS4 lands outside of their regulatory control (i.e., industrial, agricultural, Phase II, state, federal, and Indian reservation lands) if those pollutants are ultimately discharged from the MS4 of a Responsible Agency. Non-MS4 discharges also have an impact on water quality in the Mission Bay WMA. Therefore, Responsible Agencies will seek opportunities for collaboration and improved communication with non-municipal sources and the appropriate regulatory agencies to ensure that these discharges are appropriately regulated before they enter the Responsible Agencies' storm drain systems.

A water quality condition may be defined as an impairment of a receiving water beneficial use. Priority water quality conditions are defined in this Water Quality Improvement Plan as receiving water conditions that have evidence of being caused or contributed to by MS4 discharges, and may be "pollutants, stressors, and/or receiving water conditions that are the highest threat to receiving water quality or that most adversely affect the quality of receiving waters" (Provision B.2.c).

The priority water quality condition identification process began by assessing the receiving water conditions (Provision B.2.a) and the impacts from MS4 sources (Provision B.2.b). Combining these assessments resulted in a list of priority water quality conditions. During these assessments, data gaps were discovered. Data gaps are defined in this Water Quality Improvement Plan as areas where there is a lack of information needed to assess the receiving water conditions or impacts from MS4 sources. Data gaps are addressed in Sections 5 and 6 of this Water Quality Improvement Plan (Monitoring and Assessment Program and the Iterative Approach and Adaptive Management Process).

The highest priority water quality conditions were then selected by the Responsible Agencies from the list of priority water quality conditions using the process detailed below and summarized in Appendix A.

Figure 2-1 summarizes the selection sequence used to identify the priority and highest priority water quality conditions.



Figure 2-1
Mission Bay WMA Priority and Highest Priority Water Quality Condition Selection Process

2.1 Step 1: Determine Receiving Water Conditions

As defined by the USEPA, a receiving water is any body of water (for example, a creek, river, lake, or estuary) into which surface water, treated waste, or untreated wastewater is discharged (USEPA, 2012a).

Receiving water conditions are identified based on the following considerations listed in Provision B.2.a of the MS4 Permit:

- (1) Receiving waters listed as impaired on the 2010 303(d) list of impaired waters
- (2) TMDLs adopted and/or under development by the Regional Board

- (3) Receiving waters recognized as sensitive or highly valued by the Copermittees, including estuaries designated under the National Estuary Program under CWA Section 320, wetlands defined by the State or U.S. Fish and Wildlife Service's National Wetlands Inventory as wetlands, waters having the beneficial use designation of Preservation of Biological Habitats of Special Significance (BIOL), and receiving waters identified as ASBS
- (4) The receiving water limitations of Provision A.2 of the MS4 Permit
- (5) Known historical versus current biological, physical, and chemical water quality conditions
- (6) Available, relevant, and appropriately collected and analyzed biological, physical, and chemical receiving water monitoring data, including, but not limited to, data describing:
 - Chemical constituents
 - Water quality parameters (i.e., pH, temperature, conductivity, etc.)
 - Toxicity identification evaluations for both receiving water column and sediment
 - Trash impacts
 - Bioassessments
 - Physical habitat
- (7) Available evidence of erosional impacts on receiving waters due to accelerated flows (i.e., hydromodification)
- (8) Available evidence of adverse impacts on the biological, physical, and chemical integrity of receiving waters
- (9) The potential improvements in the overall condition of the WMA that can be achieved

The following subsections detail how Considerations 1 through 9 are incorporated into the assessment.

2.1.1 The 2010 303(d) List and Beneficial Uses (Consideration 1)

2010 303(d) Listings

The 303(d) list is named after the section number of the CWA that established the requirements to create a list of impaired waterbody segments. An impaired waterbody is a waterbody with “chronic or recurring monitoring violations” of “applicable numeric and/or narrative water quality criteria” (USEPA, 2012a). Under CWA Section 303(d), states, territories, and authorized tribes are required to develop lists of impaired waters (303(d) list) and submit for USEPA approval every two years. The Regional Board is tasked with developing the 303(d) list in the San Diego region. The 303(d) list was updated in 2010 and identifies these impaired waterbodies by specifying:

- ❖ The particular waterbody that is impaired (in the Mission Bay WMA, the specific waterbody can range in scale from an ephemeral stream to portions of the Pacific Ocean Shoreline)
- ❖ If known, the pollutant causing the impairment (e.g., bacteria or sediment)
- ❖ The beneficial use(s) being impaired
- ❖ The potential pollutant source(s)

The Mission Bay WMA has several 2010 303(d) listed waterbodies, which are mapped in Figure 2-2. The names of the listed waterbodies are provided in Table 2-1.

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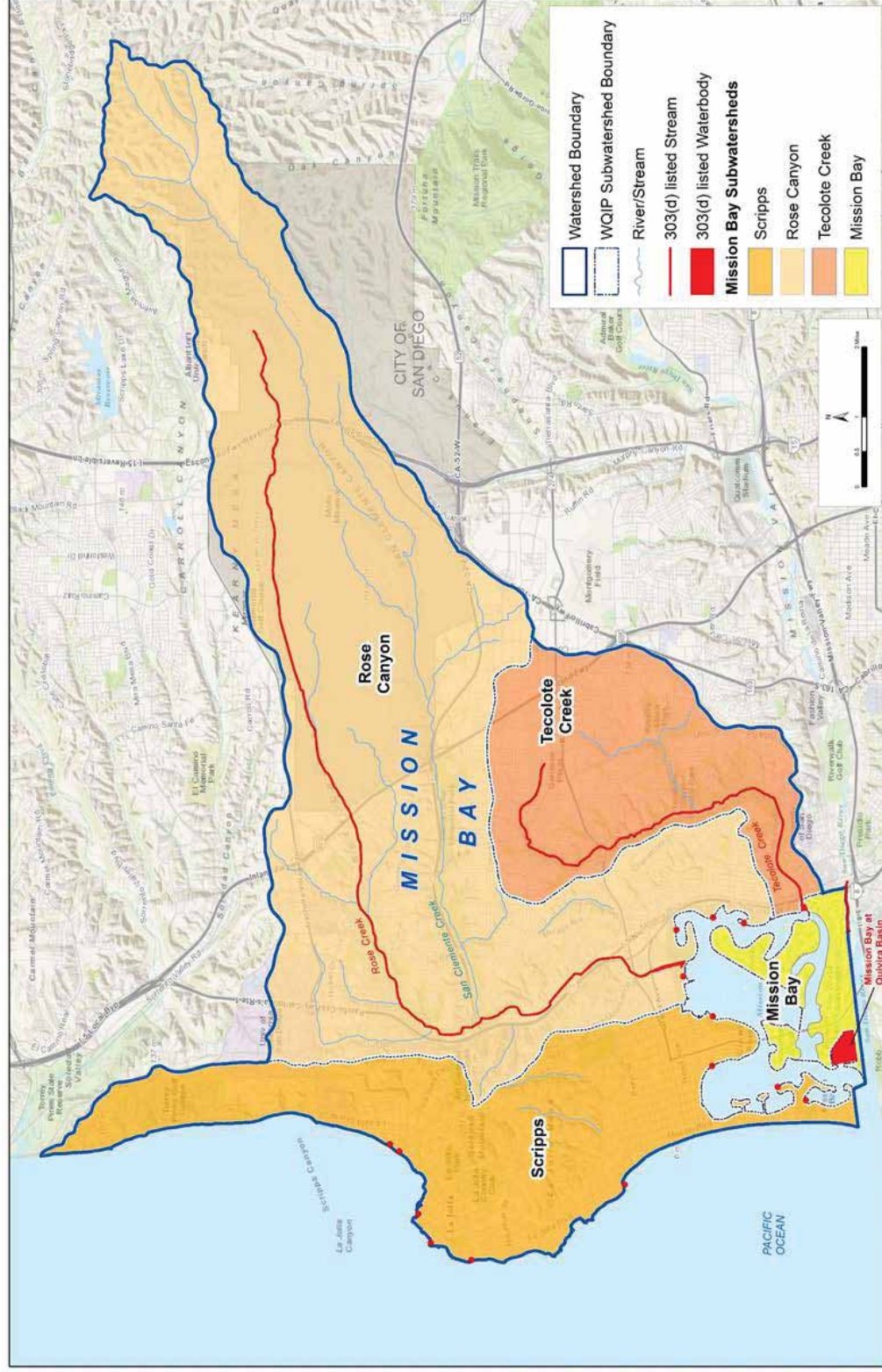


Figure 2-2
Mission Bay WMA
2010 303(d) Listed Waterbodies

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Beneficial Uses

The beneficial uses of a waterbody are designated in the Basin Plan and are defined as “the uses of a waterbody necessary for the survival or well-being of man, plants, and wildlife” (Regional Board, 1994). The development and the adoption of the Basin Plan is the responsibility of the Regional Board. The beneficial uses listed as impaired on 303(d) list of impaired waterbodies within the Mission Bay WMA are described and highlighted in Appendix C. The majority (72 percent) of beneficial uses in Mission Bay WMA are not impaired or have not been assessed by the Regional Board. Of those waterbodies that are listed in Appendix C as having impairments, most beneficial uses are being attained. For more information on the beneficial uses in the Mission Bay WMA, refer to the Basin Plan (http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/).

Beneficial uses may be impaired by various pollutants and stressors, which may be biological (e.g., indicator bacteria), physical (e.g., sedimentation), or chemical (e.g., metals) in nature. Pollutants that may impair beneficial uses in the Mission Bay WMA include the following:

Bifenthrin and permethrin are pyrethroid pesticides that are highly toxic to aquatic organisms and are currently regulated as restricted-use pesticides (California Department of Pesticide Regulation [DPR], 1999; USEPA, 2006).

Indicator bacteria are surrogates used to measure the potential presence of harmful bacteria, fecal material, and associated fecal pathogens. The common indicator bacteria types include total coliform, fecal coliform, *Escherichia coli*, and *Enterococcus*. Indicator bacteria may include non-fecal bacteria or bacteria that are non-fecal in origin (Regional Board, 1994; Southern California Coastal Water Research Project [SCCWRP], 2012).

Metals (cadmium, copper, lead, and zinc) can cause adverse effects on biological species at even slightly elevated levels. Metals can adsorb on to particulate matter and dissolved copper can be directly taken up by algae, bacteria, plants, and benthic organisms (Regional Board, 2007). However, some metals are essential micronutrients for human health. Inadequate copper intake has been linked to heightened cholesterol and increased risk of cardiovascular disease (National Institutes of Health [NIH], 2014). Zinc deficiency can lead to growth retardation, appetite loss, and reduced immune function (NIH, 2013a).

Potential eutrophication conditions exist when excessive amounts of nutrients (commonly nitrogen and phosphorus) are present within an aquatic environment. Nutrients can accelerate the growth of algae and phytoplankton, which can reduce dissolved oxygen content and harm aquatic organisms (World Resources Institute [WRI], 2013). These conditions can imbalance the aquatic system, harming fish, wildlife, and human health.

Sedimentation is the excessive buildup of sediment within downstream waterbodies resulting from high flow events.

Selenium occurs naturally in sulfide ores and volcanic deposits, and can be found in receiving waters through the interaction with groundwater. It can also be related to the irrigation of soil, discharges from coal-fired power plants, mining activities, and petroleum refineries (USEPA, 2014). Acute and chronic exposure can lead to adverse health effects on human circulatory and nervous systems (USEPA, 2014). However, selenium is an essential micronutrient for human health and selenium deficiency may play a role in cancer, cardiovascular disease, cognitive decline, and thyroid disease (NIH, 2013b).

The Index of Biological Integrity (IBI) is a comprehensive method to evaluate the health of the benthic macroinvertebrate community on a scale of 0 to 100, with 100 being very good condition and 0 being very poor condition. This information can be used to assess the health of the stream and is commonly used with bioassessment (State Board, 2013a). The IBI score is not a pollutant or stressor itself, but is a measure of the biological condition of a waterbody. It is used as a surrogate for anthropogenic impacts on receiving water health.

Toxicity, as defined by the Basin Plan, is the adverse response of organisms to chemicals or physical agents. Toxic substances or concentrations thereof produce harmful physiological responses in humans, plants, animals, or other aquatic life (Regional Board, 1994). Toxicity is measured in terms of the lethality (acute) or reproductive impacts (chronic) of the sample on live organisms.

Total dissolved solids (TDS) consist of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, magnesium, sodium, iron, manganese, and other substances. TDS can affect water based in the cells of aquatic organisms. High TDS concentrations can change soil permeability, thereby affecting vegetation (Regional Board, 1994).

Turbidity is a measure of the clarity of water, which is attributed to the amount of suspended particles. Increased turbidity can reduce light penetration, which can reduce photosynthesis and adversely affect aquatic life. High levels of turbidity may also impair drinking water uses (Regional Board, 1994).

2.1.2 Applicable TMDLs, Special Biological Habitats, and Receiving Water Limitations (Considerations 2, 3, and 4)

Mission Bay WMA TMDLS

TMDLs identify the total pollutant loading that receiving waters can receive and still meet water quality standards. The Regional Board is required to develop TMDLs or follow an alternative regulatory process to address 303(d) listed impairments. One TMDL (the Bacteria TMDL) has been adopted in the Mission Bay WMA. The impaired 2010 303(d) listed waterbodies in the Mission Bay WMA, the assessed length or area of

the impairment in the waterbody, and the pollutant listed as causing the impairment are summarized in Table 2-1. The locations of these waterbodies are mapped in Figure 2-2.

The Bacteria TMDL was developed by the Regional Board for impaired beaches and creeks on the 2002 303(d) list to attain and maintain fecal indicator bacteria (FIB) water quality standards. Figure 2-2 presents the 303(d) listed impaired segment for FIB in the Mission Bay WMA. Most beaches were listed as impaired for total coliform or indicator bacteria on the 2002 303(d) list. The Bacteria TMDL included three FIB (total coliform, fecal coliform, and *Enterococcus*) in its approach to address the contact recreational water quality standards. Separate dry weather and wet weather TMDLs were calculated for each FIB. The San Diego Regional Board recognized that exceedances of the water quality objectives (WQOs) for the Contact Water Recreation (REC-1) beneficial use may be partially due to natural sources and so developed the wet weather TMDLs to include an allowable exceedance frequency on the basis of a reference system antidegradation approach (RSAA). The reference system antidegradation approach was included to ensure that bacterial water quality is at least as good as that of a natural (i.e., reference) system. The RSAA is based on data collected at Leo Carrillo Beach, a reference watershed in northern Los Angeles County. The Responsible Agencies have been assigned a waste load allocation (WLA) and will be responsible for reducing their bacterial load and demonstrating that their discharges are not causing exceedances of the numeric WQOs and allowable exceedance frequencies in the receiving water.

According to the TMDL, MS4 discharges are “anthropogenic in nature and the most significant controllable source of bacteria” (Regional Board, 2010). Each MS4 was assigned an individual WLA for bacteria. The TMDL applied a conservative approach by selecting the most stringent numeric targets. The MS4 Permit defines interim and final water quality based effluent limitations (WQBELs) as the basis for compliance, as provided in Attachment E.6 of the MS4 Permit, and describes various ways to achieve compliance. The WQBELs include receiving water limits for the listed segment and effluent limitations for MS4 outfalls or discharges. The receiving water limits are a combination of numeric targets for bacteria density and allowable exceedance frequencies.

The Bacteria TMDL includes Tecolote Creek and 13 segments of the Pacific Ocean Shoreline in the Scripps subwatershed, but was based on the 2002 303(d) list (Regional Board, 2010). Nine of the Pacific Ocean Shoreline segments were subsequently delisted in 2010 (see Note 1 in Table 2-1). Furthermore, the 2010 CWA 303(d) list includes two Pacific Ocean Shoreline segments (La Jolla Cove and Pacific Beach at Pacific Beach Point) that were not included in the Bacteria TMDL or the 2002 303(d) list. The Bacteria TMDL includes the 13 Pacific Ocean Shoreline segments from 2002, prior to the delisting of 9 segments, and does not include the 2 additional segments on the 2010 list. All Pacific Ocean Shoreline segments in Scripps subwatershed that are either listed in the Bacteria TMDL or included on the 2010 303(d) list for bacteria impairments are shown on Figure 2-3.

The delisted Pacific Ocean Shoreline segments were originally included in the TMDL, and then delisted in 2006 or 2008. Although these sites are currently meeting water quality standards, monitoring is required to verify that the delisted sites continue to meet water quality standards and they will be incorporated into Water Quality Improvement Plan as part of the iterative approach in case exceedances occur. If exceedances do occur at delisted sites, the monitoring data will be evaluated, sources will be investigated, and the Responsible Agencies will potentially apply source control strategies to address their potential inputs by the end of the compliance period.

Table 2-1
2010 303(d) or TMDL Listed Waterbodies in the Mission Bay WMA

Waterbody Name	Assessed Length/Area	Pollutant or Stressor	TMDL Approved by OAL
Pacific Ocean Shoreline, Casa Beach (Children's Pool) ¹	0.03 mile	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011
Pacific Ocean Shoreline, La Jolla Cove ²	0.03 mile	Total coliform	To be developed
Pacific Ocean Shoreline, La Jolla Shores Beach at Avenida de la Playa ¹	0.03 mile	Total coliform	April 2011
Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro ³	NA	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011
Pacific Ocean Shoreline, La Jolla Shores Beach at El Paseo Grande ³	0.03 mile ⁴	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011
Pacific Ocean Shoreline, Pacific Beach at Grand Avenue ³	0.03 mile ⁴	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011
Pacific Ocean Shoreline, Pacific Beach at Pacific Beach Point ²	0.03 mile	<i>Enterococcus</i> , total coliform, fecal coliform	To be developed
Pacific Ocean Shoreline, South Casa Beach at Coast Boulevard ³	0.03 mile ⁴	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011
Pacific Ocean Shoreline, Tourmaline Surf Park ³	0.03 mile ⁴	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011

Table 2-1 (continued)
2010 303(d) or TMDL Listed Waterbodies in the Mission Bay WMA

Waterbody Name	Assessed Length/Area	Pollutant or Stressor	TMDL Approved by OAL
Pacific Ocean Shoreline, Vallecitos Court ¹	0.03 mile	Total coliform	April 2011
Pacific Ocean Shoreline, Windansea Beach at Bonair Street ³	0.03 mile ⁴	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011
Pacific Ocean Shoreline, Windansea Beach at Palomar Avenue ³	NA	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011
Pacific Ocean Shoreline, Windansea Beach at Playa del Norte ³	0.03 mile ⁴	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011
Pacific Ocean Shoreline, Windansea Beach at Vista de la Playa ³	0.03 mile ⁴	<i>Enterococcus</i> , total coliform, fecal coliform	April 2011
Pacific Ocean Shoreline, Whispering Sands Beach at Ravina Street ¹	0.03 mile	Total coliform	April 2011
Mission Bay Shoreline, Bahia Point	0.14 mile	<i>Enterococcus</i> , total coliform, fecal coliform	To be developed
Mission Bay Shoreline, Bonita Cove	0.09 mile	<i>Enterococcus</i> , total coliform, fecal coliform	To be developed
Mission Bay Shoreline, Fanuel Park	0.12 mile	<i>Enterococcus</i> , total coliform	To be developed
Mission Bay, mouth of Rose Creek	9.2 acres	Eutrophic, lead	To be developed
Mission Bay Shoreline, Campland	0.08 mile	<i>Enterococcus</i> , total coliform, fecal coliform	To be developed

Table 2-1 (continued)
2010 303(d) or TMDL Listed Waterbodies in the Mission Bay WMA

Waterbody Name	Assessed Length/Area	Pollutant or Stressor	TMDL Approved by OAL
Mission Bay Shoreline, De Anza Cove	0.06 mile	<i>Enterococcus</i> , total coliform, fecal coliform	To be developed
Mission Bay Shoreline, Leisure Lagoon	0.12 mile	<i>Enterococcus</i> , total coliform	To be developed
Mission Bay Shoreline, North Crown Point	0.12 mile	<i>Enterococcus</i> , total coliform	To be developed
Mission Bay Shoreline, Visitors Center	0.10 mile	<i>Enterococcus</i> , total coliform, fecal coliform	To be developed
Rose Creek	13 miles	Selenium, toxicity	To be developed
Mission Bay, mouth of Tecolote Creek	3.1 acres	Eutrophic, lead	To be developed
Tecolote Creek	6.6 miles	Indicator bacteria	April 2011
		Cadmium, copper, lead, nitrogen, phosphorus, selenium, toxicity, turbidity, zinc	To be developed
Mission Bay, Quivira Basin	65 acres	Copper	To be developed
Mission Bay Shoreline, Tecolote Shores	0.04 mile	<i>Enterococcus</i> , total coliform	To be developed

1. Segment is currently listed in 2010 303(d) list and included in the Bacteria TMDL.
2. Segment was added to the 303(d) list in 2010, but is not currently listed in the Bacteria TMDL or the 2002 303(d) list.
3. Segment is not currently listed on the 2010 303(d) List, but is listed in the Bacteria TMDL.
4. Segment length is provided in the 2010 303(d) list.

NA = Segment lengths were not available; OAL = California Office of Administrative Law
See Figure 2-2 for a map of the 303(d) listed waterbodies.

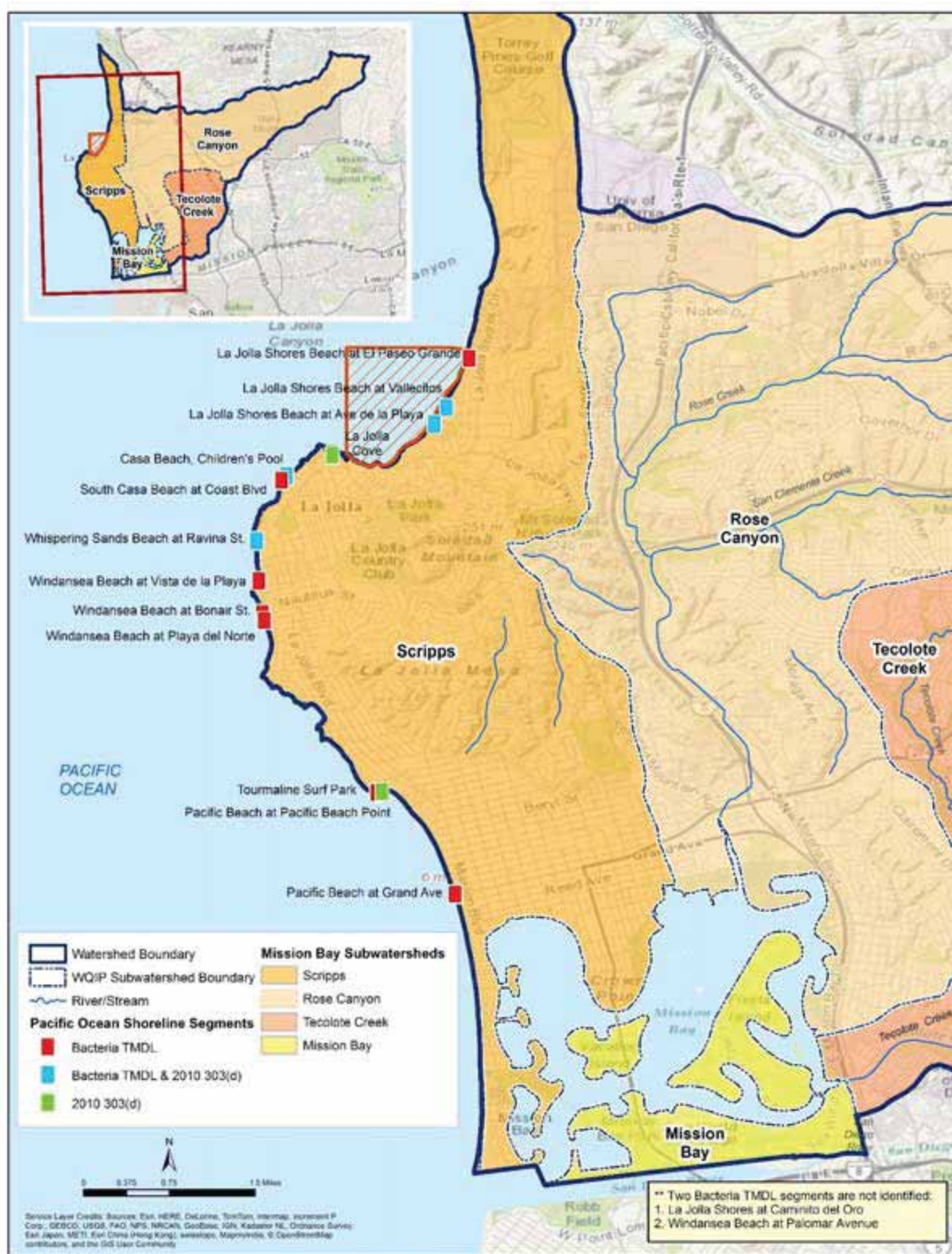


Figure 2-3
Scripps Subwatershed Pacific Shoreline Listed Segments

Special Biological Habitats

Biological Habitats of Special Significance are waterbodies designated with the BIOL beneficial use. In the Mission Bay WMA, the following waterbody is of special significance:

- ❖ Pacific Ocean Shoreline at the La Jolla ASBS (ASBS 29)

ASBS 29 is one of 34 ASBS throughout California designated by the State Board. ASBS are areas that are basic building blocks for a sustainable, resilient coastal environment and support an unusual variety of aquatic life (State Board, 2014b). Dischargers to an ASBS are regulated under the Ocean Plan by either a specific NPDES permit or the *General Exception to the California Ocean Plan for Areas of Special Biological Significance Waste Discharge Prohibition for Storm Water and Nonpoint Source Discharges, with Special Protections* (Resolution 2012-0012) (ASBS General Exception). Dischargers are required to monitor receiving waters and outfall discharges to ensure that natural water quality is not being altered.

Figure 2-4 shows the location of ASBS 29. The following shoreline segments are listed in the Bacteria TMDL and are located in the ASBS sub-drainage area:

- ❖ Pacific Ocean Shoreline, La Jolla Shores Beach at El Paseo Grande
- ❖ Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro
- ❖ Pacific Ocean Shoreline, La Jolla Shores Beach at Avenida de la Playa
- ❖ Pacific Ocean Shoreline, La Jolla Shores Beach at Vallecitos

Receiving Water Limitations

Under the receiving water limitations provision of the MS4 Permit (Provision A.2), discharges from MS4s must not cause or contribute to the violation of water quality standards in any receiving waters. Water quality standards are defined in various regulations, including the Basin Plan. Waterbodies that do not meet water quality standards are identified on the 2010 303(d) list (see Table 2-1).

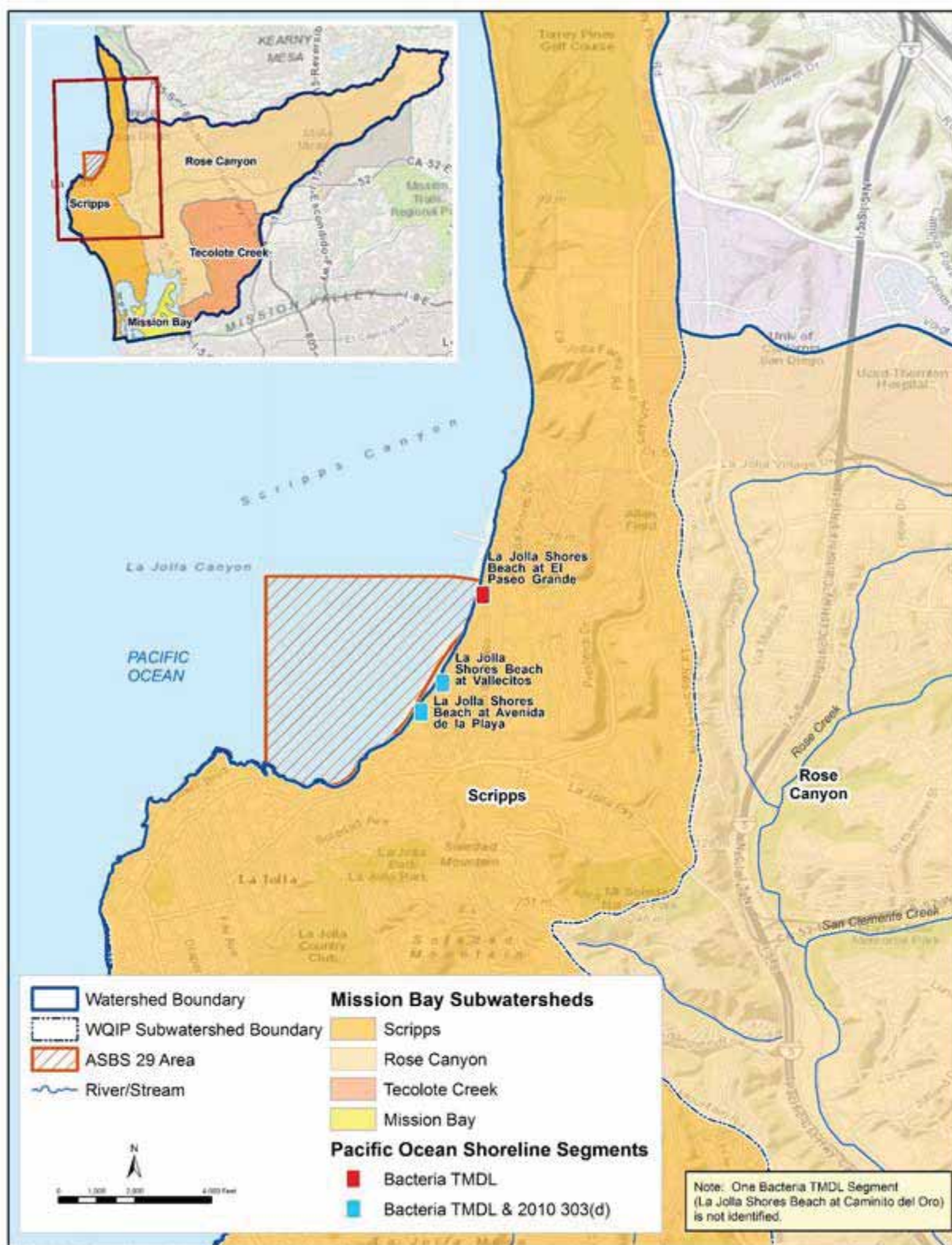


Figure 2-4
ASBS 29 in the Scripps Subwatershed

2.1.3 Data Sources Used To Assess Receiving Water Conditions (Considerations 5 and 6)

The Copermittees participated in the MS4 Permit Regional Monitoring Program under the two previous MS4 Permits. This monitoring program used a triad approach to evaluate receiving water chemistry, toxicity, and benthic community data. It was designed to meet the requirements of the previous MS4 Permits. Monitoring plans were submitted to the Regional Board to document sampling and analytical methodology and data quality requirements consistent with USEPA regulations and guidance and with regional standard operating procedures (SOPs), such as the Surface Water Ambient Monitoring Program (SWAMP) and the SCCWRP, as appropriate.

Since 2005, several primary documents containing biological, physical, and chemical receiving water monitoring data have been developed to document the information collected under the MS4 Permit monitoring program. High priority and medium priority pollutants and stressors were identified by following the WMA Assessment Methodology developed by the Copermittees in 2010. Waterbodies for which monitoring data indicate a failure to meet standards or are 303(d) listed have been identified as receiving water conditions. Data generated from these monitoring programs provided the basis for the assessments and conclusions of the Long-Term Effectiveness Assessment (LTEA) and the WURMP Annual Reports. These primary data sources were used to identify or assess receiving water conditions for this Water Quality Improvement Plan, as described below.

Primary Source 1: Long-Term Effectiveness Assessment

The comprehensive LTEA was released by the San Diego Copermittees in 2011 as a precursor to the 2012 Report of Waste Discharge (San Diego County Municipal Copermittees, 2011). It presents and summarizes data for each WMA between 2005 and 2010, and considers historical trends. In addition to NPDES and MS4 outfall monitoring program data collected by the Copermittees directly, the LTEA includes third-party data from agencies and non-governmental organizations. Examples of third parties are the Southern California Stormwater Monitoring Coalition (SMC) (for additional dry weather receiving water quality data) and Coastkeeper (for water quality data and observational condition assessments).

Primary Sources 2 and 3: Fiscal Year 2011 and Fiscal Year 2012 Watershed Urban Runoff Management Program Annual Reports

The two most recent Annual Reports (FYs 2011 and 2012) produced under the WURMP (City of San Diego, 2013c) were consulted as primary data sources. These Annual Reports include monitoring and inspection data and activities conducted under the WURMP. The reports assess pollutants for the annual receiving water and outfall data collected since the publication of the 2011 LTEA.

Primary Sources 4 and 5: Comprehensive Load Reduction Plans for Tecolote Creek and Scripps Subwatersheds

The Phase I and Phase II CLRPs for the Scripps (City of San Diego, 2012a; 2013a) and Tecolote Creek (City of San Diego, 2012b; 2013b) subwatersheds provide additional primary documents for the Mission Bay WMA. The Bacteria TMDL required the development of CLRPs to provide a blueprint for how the Responsible Agencies would achieve the pollutant load reduction requirements mandated in the Bacteria TMDL, and to incorporate strategies for other pollutants of concern in the subwatersheds. The CLRPs provided objectives and strategies for the other 2010 303(d) listed pollutants and ASBS priorities. For the La Jolla ASBS, the Scripps CLRP specifically highlighted the priority pollutants that had been identified through years of monitoring and in previous regulatory documents (e.g., the La Jolla Shores Coastal Watershed Management Plan).

Secondary Data Sources

Numerous secondary data sources augment the primary data sources described above and are listed in Appendix D.1. These additional data sources were categorized as observational, plan-based, and quality-assured, as follows:

- ❖ Observational data include unplanned visual record(s) of a condition or source, or of evidence of a condition or source from a single sample or measurement.
- ❖ Plan-based data include a structured monitoring plan and sampling based on standard clean practices; however, these data may not have associated data quality and control requirements.
- ❖ Quality-assured data include quality assurance protocols and described procedures to collect representative samples and certification that quality control has been performed.

An important secondary data source is the City of San Diego Strategic Plan for Watershed Activity Implementation (Strategic Plan) (City of San Diego, 2007). The Strategic Plan identifies priority water quality problems based on an assessment of the 2005 Baseline LTEA, monitoring data from the City's annual storm water monitoring reports, and additional water quality data. The priorities identified in the Strategic Plan are:

- ❖ Bacteria
- ❖ Heavy metals
- ❖ Nutrients
- ❖ Sediments
- ❖ Benthic alterations
- ❖ Toxicity

Since the Strategic Plan was completed in 2007, the updated 2011 LTEA and the 2011 and 2012 WURMP Annual Reports represent more recent assessments of the data available for the Mission Bay WMA. The priorities identified by the Strategic Plan are similar to those of the LTEA and 2011 and 2012 WURMP reports.

The LTEA and WURMP reports provide current and historical monitoring data for three receiving water monitoring stations (shown in Figure 2-5), with the data reported and evaluated independently for wet weather and dry weather. During the previous two MS4 Permit cycles, the stations were operated and maintained by the Copermittees, per the requirements of the previous MS4 Permit monitoring program. Monitoring included rapid stream bioassessments, toxicity analysis, flow monitoring, trash surveys, and analytical analysis of samples. One of the stations (in the Tecolote Creek subwatershed) has been monitored since 2002; the other two stations (in the Tecolote Creek and Rose Canyon subwatersheds) have been monitored since 2008. Additionally, portions of the Scripps subwatershed have been monitored as part of the Ocean Outfalls Monitoring Program under the previous MS4 Permit. The La Jolla ASBS has been monitored since 2005, including monitoring under the draft and final requirements of the ASBS General Exception. Table 2-2 provides additional details on the NPDES receiving water monitoring stations.

The Mission Bay subwatershed does not have a designated NPDES receiving water monitoring location. This was identified as a data gap in the development of this Water Quality Improvement Plan because Mission Bay lacks a consistent historical monitoring record. Various water quality and bay sediment quality studies have been performed in the bay as follows:

- ❖ Sediments were monitored during the 2003–2005 Ambient Bay and Lagoon Monitoring Program (San Diego County Municipal Copermittees, 2007). The results of this study indicate that sediment chemistry, toxicity, and biological indicators improved over the three years of the study.
- ❖ In 2004, the Mission Bay Water and Sediment Project was completed, with the goal of developing baseline water quality data for Mission Bay. This study did not designate high priority and medium priority pollutants and stressors, but noted when chemical concentrations in water and sediment were associated with toxicity or were above the appropriate water quality criteria. The project found elevated levels of phosphate, particularly associated with wet weather events in the eastern side of the bay. Toxicity related to copper, lead, zinc, and pesticides (4'4'-DDE and dieldrin, specifically) was also observed (University of San Diego [USD], 2004).

- ❖ Mission Bay was part of the Regional Harbor Monitoring Program (RHMP), developed and implemented by the Port of San Diego, the City of San Diego, the City of Oceanside, and the County of Orange. The RHMP is intended to evaluate the general water quality and condition of aquatic life in the four harbors within the Regional Board's jurisdiction. The 2008 RHMP monitoring stations are provided in Figure 2-5. As with the 2004 Mission Bay Water and Sediment Project, the RHMP did not designate high priority and medium priority pollutants and stressors, but noted when chemical concentrations in water and sediment were above the appropriate water quality criteria. Because this RHMP is the most recent study published, the data are being used to represent the receiving water condition in the Mission Bay subwatershed (Port of San Diego et al., 2008, 2010).

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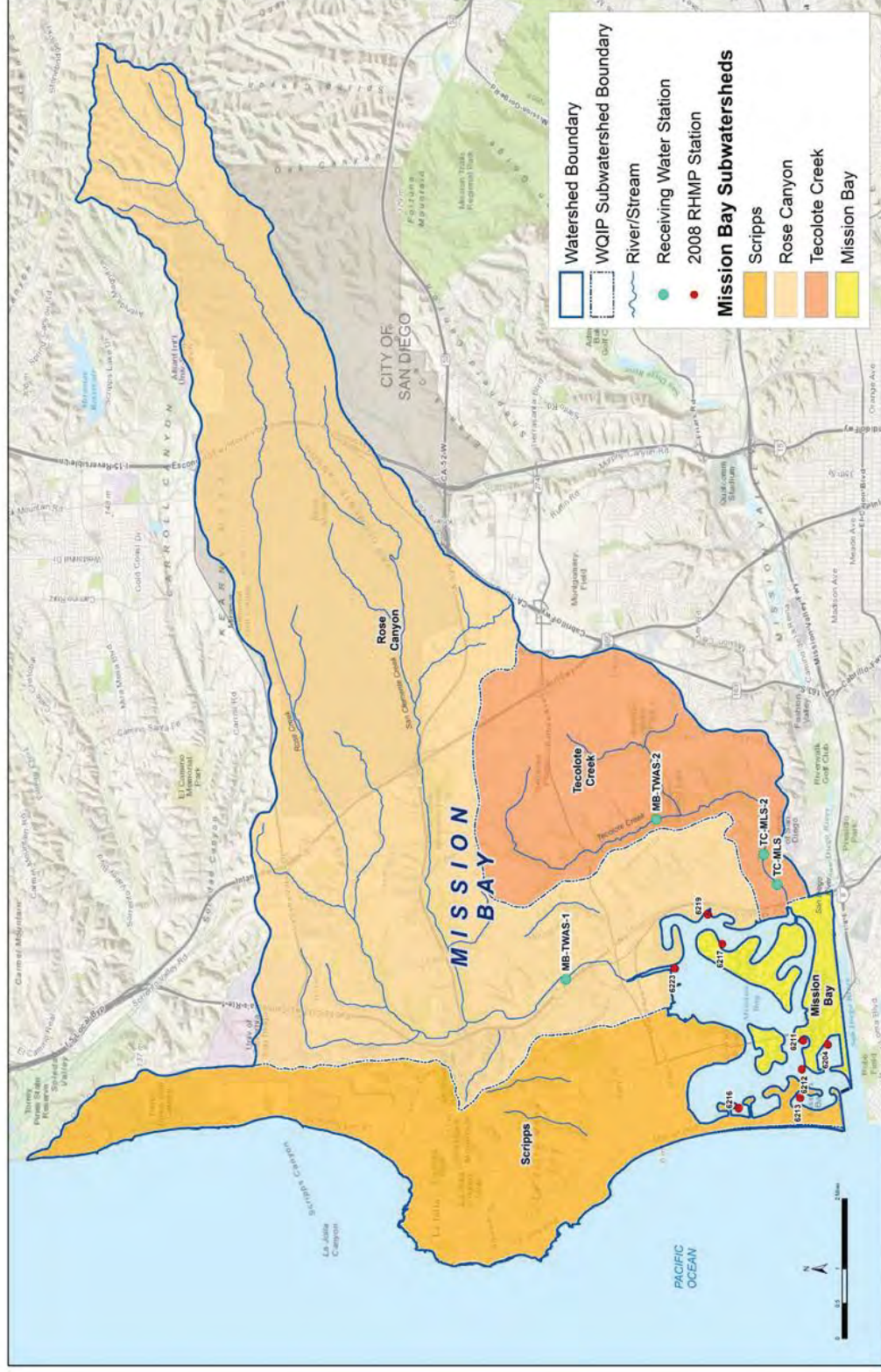


Figure 2-5
NPDES and RHMP Monitoring
Stations

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Table 2-2
NPDES Monitoring Stations in the Mission Bay WMA

Subwatershed	Station Name	Waterbody	Latitude	Longitude
Rose Canyon	MB-TWAS1	Rose Creek	32.81677	-117.22272
Tecolote	MB-TWAS2	Tecolote Creek	32.79799	-117.18956
Tecolote	TC-MLS ¹	Tecolote Creek	32.77294	-117.20308

1. Due to the presence of a dry weather diversion above TC-MLS, MLS monitoring is performed at site TC-MLS2 (32.77565, -117.19651) during dry weather

MLS = mass loading station; TWAS = temporary watershed assessment station

Data from these three NPDES monitoring stations were considered to represent the receiving water quality of the subwatershed in which they were collected. However, water quality monitoring data are typically highly variable both temporally and spatially, and water quality at any specific point in a subwatershed may vary considerably from that of the samples collected at these stations. Medium priority or high priority pollutants provided in two or more of the regional monitoring reports, including the LTEA, the MS4 Permit Regional Monitoring Program (which includes the SMC program), and recent WURMP Annual Reports, are presented in Table 2-3. This table accounts for historical and current water quality monitoring findings used to inform the determination of the receiving water conditions presented in Section 2.1.7.

Table 2-3
Medium and High Priority Pollutants for Receiving Waters

Subwatershed	Dry Weather Conditions	Wet Weather Conditions
Rose Canyon	Poor Index of Biological Integrity (IBI) ¹ , total dissolved solids (TDS) ¹ , toxicity ¹	Bifenthrin ¹ , fecal coliform ¹ , permethrin ¹ , TDS ¹ , total suspended solids (TSS) ¹ , turbidity ¹
Tecolote Creek	<i>Enterococcus</i> ¹ , poor IBI ¹ , total phosphorus ¹ , toxicity ¹	Bifenthrin ¹ , fecal coliform ¹ , TSS ¹ , turbidity ¹
Mission Bay	Total arsenic ² , total chlordane ² , total and dissolved copper ² , total dichloro-diphenyl-trichloroethane (DDT) ² , total mercury ² , total zinc ²	No receiving water data are available
Scripps	No receiving water data are available	Copper ³ , fecal coliform ³ , total coliform ³ , sediment ³

1. As identified in both the LTEA and recent WURMP Annual Reports.

2. As identified for both water and sediment in the RHMP 2008 Summary Reports.

3. As identified in the *La Jolla Shores Coastal Watershed Management Plan*, which is specific to the ASBS. No data are available to support medium or high priorities for the remainder of the Scripps shoreline.

2.1.4 Evidence of Erosional Impacts (Consideration 7)

Attachment A of the LTEA identified hydromodification and scouring of stream banks as well as total suspended solids (TSS) and turbidity transported via storm flows as potential causes of low to poor benthic community structure, as measured by IBI scores derived from bioassessment monitoring. This information is considered evidence of erosional impacts in the Mission Bay WMA. The MS4 Permit Regional Monitoring Program was not designed to identify specific areas of erosion or hydromodification. More information is needed to characterize the spatial extent of these impacts and potential sources.

The Hydromodification Management Plan (HMP) (County of San Diego, 2011) outlines a monitoring program to assess the effectiveness of hydromodification management facilities. Monitoring activities are ongoing and include inflow and outflow monitoring from BMPs, baseline cross-sectional monitoring, and flow-based sediment monitoring. Monitoring data generated by the HMP monitoring program will be considered in future iterations of the Water Quality Improvement Plan.

The City of San Diego is participating in a regional effort to develop the Watershed Management Area Analysis (WMAA), as provided by the MS4 Permit. The purpose of developing the WMAA at the regional level is to ensure consistency among the Copermittees and between WMA. The WMAA will develop WMA-specific requirements for structural BMPs and identify a list of candidate projects related to hydromodification, stream restoration, and structural BMPs. The WMAA is being conducted simultaneously with the development of the Water Quality Improvement Plan. The results of the WMAA have been incorporated into Section 4 of the Water Quality Improvement Plan and are submitted as this submittal.

2.1.5 Evidence of Adverse Impacts (Consideration 8)

The data sources used in Section 2.1.3 (Considerations 5 and 6) were supplemented with the information gathered during the public workshop and public data call to evaluate overall evidence of adverse impacts on the receiving waters. Examples of potential receiving water conditions were presented to the public in a workshop on September 7, 2013, together with the potential impacts of MS4 discharges described in Section 2.2. Public input was received during and after the workshop along with a call for data. The public was asked to respond with final data by September 13, 2013.

Data provided by the public consisted of observational data, information from regional non-governmental organizations, email communications from members of the public, and additional reports provided by the Responsible Agencies. The data provided information on the evidence of pollutants and stressors at several locations. The data generally supported the initial list of receiving water conditions. These data sources are summarized in Appendix D. Unless specified, the receiving water conditions generally apply to the Mission Bay WMA as a whole.

A list of the receiving water conditions provided by the public is as follows:

- ❖ Freshwater discharges
- ❖ Nutrients
- ❖ Sediment (Rose and San Clemente Creeks)
- ❖ Velocity (hydromodification)
- ❖ Trash (e.g., plastic bags, diapers)
- ❖ Human waste from transient encampments
- ❖ Bacteria
- ❖ Non-native vegetation and species
- ❖ Toxicity
- ❖ Flame retardants
- ❖ Metals
- ❖ Ash
- ❖ Sedimentation

2.1.6 Potential Improvements in the Overall Condition of the WMA That Can Be Achieved (Consideration 9)

The potential improvements in the overall condition of the WMA are discussed in Section 2.3. For the purposes of the Water Quality Improvement Plan, the potential improvements in the receiving waters and overall WMA are directly related to the potential improvements in the quality of the MS4 discharges; therefore, these considerations were combined in the evaluation of the priority conditions.

2.1.7 Receiving Water Conditions

An initial list of receiving water conditions was developed on the basis of the evaluation of the 2010 303(d) list, associated TMDLs, waterbodies with special biological significance, the priority pollutants or stressors identified from current and historical receiving water monitoring data, and public input. The criteria and data used to assess the receiving water conditions are detailed in Appendix E.

A receiving water condition was defined using the following four factors:

- (1) The beneficial use(s) that may be associated with the water quality impairment as determined by the 303(d) listing
- (2) The pollutant or stressor causing the impairment

- (3) The spatial extent of the impairment, based on the 2010 303(d) listing or the area near the NPDES monitoring location
- (4) The temporal extents of the impairment (i.e., wet or dry weather)

Receiving water conditions based on the evaluation of the 2010 303(d) list were assigned both dry and wet weather temporal extents. In some instances, this was not the case and only one temporal extent (i.e., dry weather only) is defined. This decision was based on best professional judgment.

When additional data become available that may change the assessment of the receiving water conditions, the data will be incorporated per the iterative and adaptive management processes described in Section 6. The list of receiving water conditions identified in the Mission Bay WMA and the determining factor(s) for each condition are summarized in Appendix F. Beneficial uses identified as impaired are defined in Appendix C.

2.2 Step 2: Determine Potential Receiving Water Impacts from MS4 Discharges

Receiving water conditions may be caused by a wide variety of pollutants and stressors, which may or may not result from human activity or urban development. The primary focus of the MS4 Permit is to regulate discharges from MS4 outfalls into receiving waterbodies. Priority water quality conditions in the WMA are defined as receiving water conditions that are impacted by MS4 discharges. Step 1 of the process to identify water quality conditions identified the receiving water conditions in the WMA. Step 2 was to assess whether MS4 discharges may cause or contribute to receiving water conditions.

The potential impacts on receiving waters from MS4 discharges were identified on the basis of the following considerations (MS4 Permit Provision B.2.b):

- (1) The discharge prohibitions of Provision A.1 and effluent limitations of Provision A.3
- (2) Available, relevant, and appropriately collected and analyzed storm water and non-storm water monitoring data from the Copermittees' MS4 outfalls
- (3) Locations of each Copermittee's MS4 outfalls that discharge to receiving waters
- (4) Locations of MS4 outfalls that are known to persistently discharge non-storm water to receiving waters and likely causing or contributing to impacts on receiving water beneficial uses
- (5) Locations of MS4 outfalls that are known to discharge pollutants in storm water, causing or contributing to impacts on receiving water beneficial uses

- (6) Potential improvements in the quality of discharges from the MS4 that can be achieved

The following subsections detail how Considerations 1 through 6 are incorporated into the assessment.

2.2.1 Discharge Prohibitions (Consideration 1)

MS4 Permit Provisions A.1 and A.3 prohibit discharges from MS4s that cause or contribute to a receiving water condition, and effectively prohibit all discharges of non-storm water into an MS4. Storm water discharges from an MS4 must be free of pollutants to the MEP and all discharges must comply with applicable WQBELs defined in the MS4 Permit. As described below, potential impacts from MS4 discharges were identified by assessing samples from MS4 outfalls that exceeded water quality standards or that persistently discharged non-storm water related to receiving water conditions identified in the previous section.

2.2.2 Available MS4 Monitoring Data (Consideration 2)

The LTEA and the WURMP Annual Reports described in Section 2.1 were the primary sources of monitoring data for MS4 outfalls in the Mission Bay WMA. The secondary sources listed in Appendix D.1 were also considered. The WURMP Annual Reports did not contain non-storm water MS4 outfall monitoring data, so the LTEA was the primary source of dry weather outfall data for assessing MS4 impacts.

The water quality results from one or more MS4 outfalls were compiled in the LTEA and WURMP Annual Reports and were considered representative of the MS4 within the subwatershed area related to the receiving water stations. The MS4 outfall data were used to characterize MS4 water quality in general areas of the WMA. The available MS4 outfall data were considered representative of the potential for MS4 discharges to cause or contribute to a receiving water condition on a subwatershed scale. However, data for direct MS4 discharges to a specific receiving water are not typically available.

Monitoring data were compiled from these documents and are summarized at the end of this section. The complete compilation is provided in Appendix D. In Section 2.3, these data were correlated with the receiving water conditions to determine priority water quality conditions.

The constituents identified as high or medium priority pollutants in the LTEA and recent WURMP Annual Reports are summarized in Table 2-4. Priorities are those identified in both the LTEA and recent WURMP Annual Reports.

Table 2-4
Medium Priority and High Priority Pollutants for Outfalls

Subwatershed	Dry Weather Conditions	Wet Weather Conditions
Rose Canyon	<i>Enterococcus</i> , fecal coliform, total nitrogen, total phosphorus, total dissolved solids (TDS)	Total suspended solids (TSS), fecal coliform
Tecolote Creek	pH, <i>Enterococcus</i> , fecal coliform, total nitrogen, total phosphorus	Fecal coliform
Mission Bay	No MS4 monitoring are data available	No MS4 monitoring data are available
Scripps	Shoreline: <i>Enterococcus</i> , fecal coliform, total nitrogen, total phosphorus ASBS: No MS4 monitoring data are available	Shoreline: No MS4 monitoring data are available ASBS: Indicator bacteria, copper, TSS

The current regional MS4 outfall monitoring program was designed to monitor the high priority constituents of concern on the basis of priorities at the time of the program plan development. This monitoring program design could not always directly link the MS4 outfall data to the quality of downstream receiving waters because of a limited data set available to correlate MS4 impacts on receiving water conditions. This limited data availability is identified as a data gap. Additionally, the constituents monitored under the MS4 outfall monitoring program include general physical characteristics and inorganic non-metals, organics, dissolved and total metals, and bacteriological parameters. As a result, some receiving water conditions lack supporting MS4 impact evidence because of the limited constituent list monitored under the MS4 outfall monitoring program. It is at the discretion of the Responsible Agencies to determine whether a receiving water condition merits additional monitoring to assess MS4 impacts.

2.2.3 Location of MS4 Outfalls (Considerations 3, 4, and 5)

The Responsible Agencies maintain maps of the conveyance systems within their jurisdictions. The locations and density of the outfalls may be a general indicator of MS4 sources in the WMA. Based on available data, Figure 2-4 illustrates the MS4 within the Mission Bay WMA and identifies major MS4 outfalls that discharge to receiving waters. The Responsible Agencies have updated their current inventories to only contain outfalls that meet the definition of a major MS4 outfall per the MS4 Permit.

The Responsible Agencies have reviewed their updated major MS4 outfall inventories to determine which of these outfalls have persistent discharges of non-storm water on the basis of the requirements of the MS4 Permit. This review involved visiting major outfalls during dry weather and recording observations including whether there was flow or ponding at each site. When determining whether a site had persistent flow, the Responsible Agencies referred to the most recent three monitoring visits in their flow databases. If a site had flow and/or ponding during the most recent three visits, it was determined to be persistent. If one of the visits had dry conditions, the site was considered transient. If all three visits were dry, it was considered a dry site. Dry weather field screening will continue during subsequent monitoring years according to the schedule provided in Section 5.1.3. The persistent flow outfall inventory will be updated accordingly.

The MS4 Permit defines persistent flow as “...*the presence of flowing, pooled, or ponded water more than 72 hours after a measureable rainfall event of 0.10 inch or greater during three consecutive monitoring and/or inspection events. All other flowing, pooled, or ponded water is considered transient.*”

The Responsible Agencies have provided a preliminary list of major MS4 outfalls that may have persistent flow based on their Fall 2014 inventory. These outfalls are summarized in Appendix D.3.

The City is responsible for 19 outfalls in the Mission Bay WMA that may persistently discharge non-storm water. Caltrans has not identified any persistent non-storm water discharges in the WMA.

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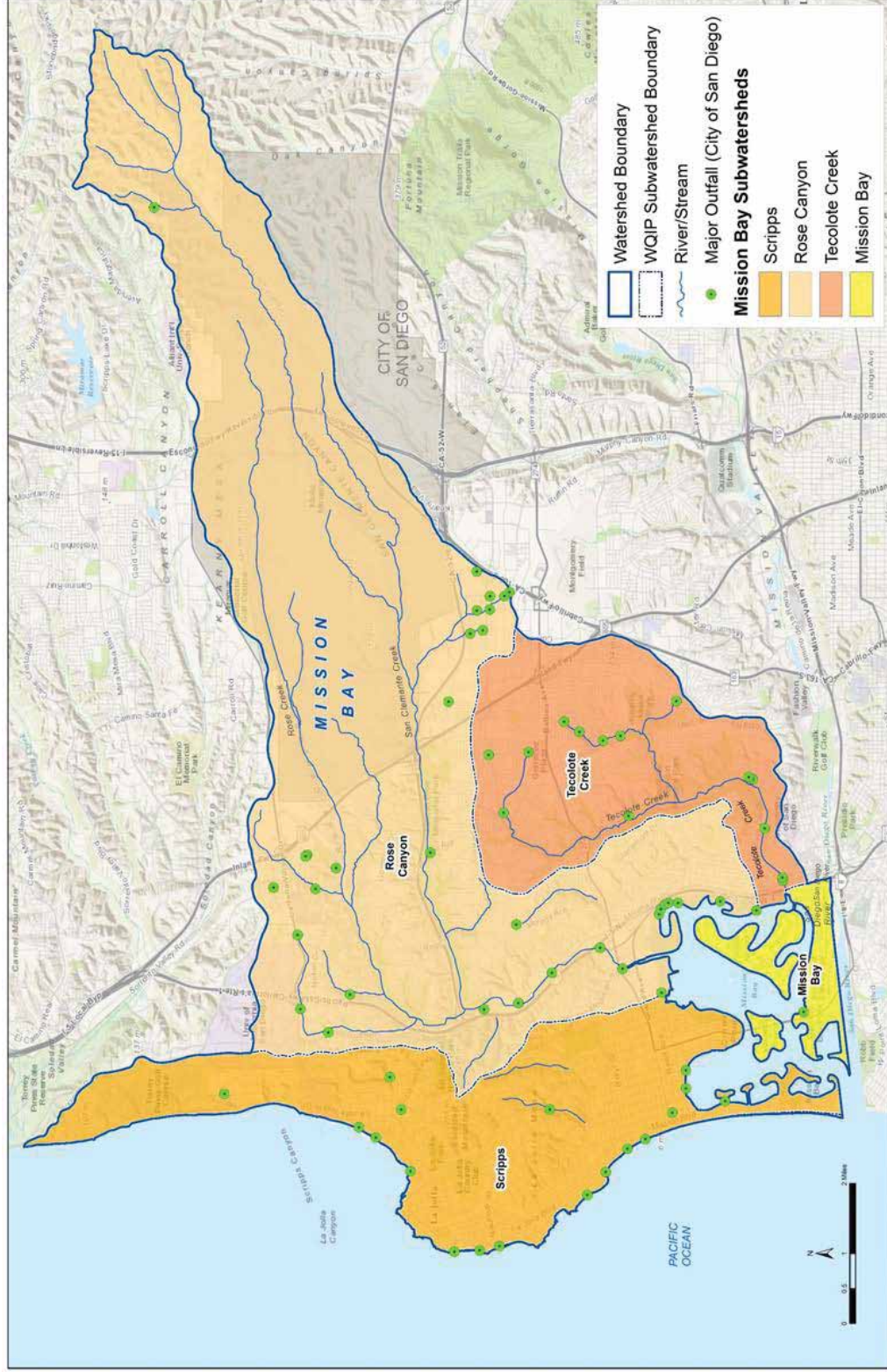


Figure 2-6
Mission Bay WMA Major
MS4 Outfalls

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2.2.4 Potential Improvements in the MS4 Discharges That Can Be Achieved (Consideration 6)

Existing water quality regulations, such as TMDLs and the ASBS General Exception, have mandated water quality goals and schedules. Based on the resources available, the Responsible Agencies have diligently planned, developed, and implemented BMP programs throughout the WMA to meet the requirements of these regulations, as well as the MS4 Permit requirements. For example, extensive resources and activities have been identified for the City of San Diego during the development of CLRPs for the Scripps and Tecolote Creek subwatersheds. The potential improvements in the quality of MS4 discharges are directly linked to the potential for improvements in the receiving waters for the purposes of the Water Quality Improvement Plan, and provide an opportunity to build on previous and planned efforts. Therefore potential improvements are integral to, and included in, the evaluation of the potential priority water quality conditions provided in Section 2.3.1.

2.2.5 Potential Receiving Water Impacts from MS4 Discharges

An initial list of potential impacts from MS4 discharges on receiving water conditions was developed from the evaluation of MS4 outfall monitoring data and the MS4 maps. Impacts from MS4 discharges were identified when one or both of the following criteria were met:

- ❖ MS4 outfalls exhibit current or historical monitoring results that exceed water quality standards related to the receiving water condition, based on the subwatershed analysis allowed by the data presented in the LTEA or WURMP Annual Report.
- ❖ The MS4 or urban runoff was named as a source or potential source in the 2010 303(d) list of impaired waterbodies or in a TMDL.

The final list of potential impacts from MS4 discharges in the Mission Bay WMA is provided in Appendix F. The temporal extent of the MS4 impact is estimated on the basis of the monitoring data or best professional judgment, because the 303(d) list does not provide temporal extent. When additional data that may change the assessment of the potential impacts from MS4 discharges become available, the data will be incorporated per the iterative and adaptive management processes described in Section 6.

2.3 Step 3: Determine Priority Water Quality Conditions

The information gathered to identify receiving water conditions (Section 2.1, MS4 Permit Provision B.2.a) and impacts from MS4 discharges (Section 2.2, MS4 Permit Provision B.2.b) was assessed to “develop a list of priority water quality conditions as pollutants, stressors, or receiving water conditions that are the highest threat to receiving water quality or that most adversely affect the quality of receiving waters” (MS4 Permit Provision B.2.c(1)).

Priority water quality conditions are defined as receiving water conditions for which there is evidence that MS4 discharges may cause or contribute to the condition. They are selected on the basis of the analysis of (1) the receiving water conditions, and (2) an assessment of the MS4 discharges.

An initial list of priority water quality conditions was developed by comparing receiving water conditions with evidence of MS4 contributions. Characterizing the receiving water quality and identifying the potential impacts caused by MS4 discharges to receiving waters in the WMA was necessary to identify the impacts to receiving waters associated with MS4 discharges that were of the most concern to the Responsible Agencies. This initial list was created in compliance with Provisions B.2.c(1)(a)-(e). The initial list was then compared with the public input that was provided during the September 7, 2013, workshop and the public data call. The priorities identified in previous monitoring reports and/or planning documents were also considered. Finally, the overall potential for improvement of the MS4 discharges to affect conditions within the overall WMA was considered. The final list of priority water quality conditions is included in Appendix F.

2.3.1 Potential Improvements in MS4 Discharges and the Overall WMA

Regional reference studies led by Copermittees are underway to better understand the potential improvements in the Mission Bay WMA on the basis of reference receiving water conditions in the San Diego region. Reference receiving water conditions are determined by assessing the water quality in areas with minimal human impact. These conditions will provide important background for understanding and characterization of the health of receiving waters impacted by human activities (SCCWRP, 2010). Copermittees have committed funds to study bacteria and other stressors throughout the San Diego region in the natural environment under both wet and dry weather conditions to better inform solutions and regulations.

Given current regulations, the Bacteria TMDL, the ASBS General Exception and Special Protections, monitoring data, and public input, inputs into ASBS 29 and bacteria are the primary concerns in the WMA receiving waters that are well documented. ASBS 29 has been monitored by the City since 2004 and the final approval of the ASBS General Exception in 2012 has guided the development of the ASBS Compliance Plan (Appendix G). Additionally, since the Bacteria TMDL was adopted in 2011, the Responsible Agencies have been developing strategies and programs to address bacteria and to maintain REC-1 and Non-Contact Water Recreation (REC-2) beneficial uses throughout the Mission Bay WMA. As part of the development of the CLRPs for the Scripps and Tecolote Creek subwatersheds, extensive resources and activities have been identified to improve water quality in the City of San Diego alone. The WMA strategies to be included in Section 4 target bacteria and ASBS stressors, and provide secondary benefits to water quality by potentially reducing other pollutants and stressors. Most of the strategies that will be implemented through this Water Quality Improvement Plan are expected to address multiple receiving water conditions.

The Responsible Agencies are responsible for controlling their MS4 discharges and the impact of these discharges on the receiving waters. The potential improvement in MS4 discharge quality and how it will impact the health of the overall WMA is often unclear. In addition to the MS4 discharges, many factors, such as discharges outside the Responsible Agencies' jurisdiction, natural conditions, or climatic conditions such as drought, influence the receiving water quality. The previous MS4 Permit monitoring program design began to link the MS4 outfall data to the quality of downstream receiving waters and generated a limited data set that can begin to correlate MS4 impacts to receiving water conditions. However, the contributions from MS4 discharges are not well known for certain priority conditions and therefore the potential for improvement is unknown. These limitations were considered to be data gaps for these priority water quality conditions and are described in Section 2.3.3.

2.3.2 Priority Water Quality Conditions

The identified priority water quality conditions for each subwatershed are summarized in Appendix F. The following information is included for each priority water quality condition per the MS4 Permit:

- (1) The beneficial use impairment(s) associated with the priority water quality condition
- (2) The pollutant or stressor causing the beneficial use impairment, if known
- (3) The temporal extent of the priority water quality condition (dry and/or wet weather)
- (4) The geographical extent of the priority water quality condition within the WMA, if known
- (5) Lines of evidence leading to identification as a priority water quality condition, including evidence of MS4 discharges that may cause or contribute to the condition
- (6) An assessment of the adequacy of the monitoring data to characterize the factors causing or contributing to the priority water quality condition, including consideration of spatial and temporal variation

The impaired beneficial use, potential stressor, temporal extent of the priority water quality condition, lines of evidence clarifying the selection as a priority water quality condition (i.e., determining factors), and data gaps were determined during the assessment of the receiving water conditions and the MS4 impacts. Data gaps are discussed in more detail in Section 2.3.3. The geographical extent of the priority water quality conditions is based on the extent of the associated 303(d) listing or the location of the associated NPDES monitoring location. For each priority water quality condition, the associated Responsible Agencies were determined through an analysis of the geographical extent and jurisdictional boundaries.

2.3.3 Priority Water Quality Condition Data Gaps and Considerations

From a review of the priority water quality conditions presented in Appendix F, some of monitoring data associated with a number of conditions are not adequate to represent the spatial and temporal variations of the conditions (Appendix F Table F-2). There may be other considerations that should be taken into account when analyzing the data gaps. The priority water quality conditions with data gaps and considerations, where applicable, are briefly discussed below:

- ❖ Impairment of REC-1 and Shellfish Harvesting (SHELL) in the Rose Canyon subwatershed:
 - There are no receiving water monitoring sites located in Mission Bay; the receiving water monitoring site is located in Rose Creek.
 - MS4 outfall monitoring locations are limited around the 303(d) listed waterbodies along the Mission Bay Shoreline. Therefore, it is unknown whether MS4 discharges cause or contribute to the receiving water condition.

Consideration

- The RHMP monitoring program did not find exceedances of water quality criteria for total coliform, fecal coliform, and *Enterococcus*.
- ❖ Impairment of the Marine Habitat (MAR) in Rose Canyon subwatershed:
 - There are no receiving water monitoring sites located at the mouth of Rose Creek in Mission Bay; the receiving water monitoring site is located upstream in the Rose Creek.
 - The 303(d) list includes the MS4 as a source of lead. Because the MS4 outfall monitoring program did not consistently monitor for lead, a full characterization of the MS4 impact on lead concentrations in MS4 discharges was not possible. Additionally, when lead was detected in MS4 discharges, concentrations did not exceed the water quality criteria. It is unknown whether MS4 discharges cause or contribute to the receiving water condition.
 - The physical and biological contributions to a nutrient impairment have not been characterized to allow for an analysis of impact of the MS4 discharges on the impairment.
- ❖ Impairment of Warm Freshwater Habitat (WARM) in Rose Canyon subwatershed:
 - The MS4 impact on the receiving water impairment due to toxicity is unclear. It is unknown whether MS4 discharges cause or contribute to the receiving water condition.

- The physical and biological contributions to receiving water toxicity have not been characterized.
- Direct discharges to the impairment have not been characterized.
- ❖ Impairment of REC-1 in the Tecolote Creek subwatershed:
 - There are no receiving water monitoring sites located in Mission Bay; the receiving water monitoring site is located in Tecolote Creek.
 - MS4 outfall monitoring locations are limited around the 303(d) listed waterbodies along the Mission Bay Shoreline. Therefore, it is unknown whether MS4 discharges cause or contribute to the receiving water condition.

Consideration

- The RHMP monitoring program did not find exceedances of water quality criteria for *Enterococcus*.
- ❖ Impairment of REC-2 in Tecolote Creek subwatershed:
 - The physical and biological contributions to a nutrient impairment have not been characterized to allow for an analysis of the impact of the MS4 discharges on the impairment.
 - Turbidity is not measured in MS4 samples, but TSS is measured. TSS concentrations did not exceed water quality standards during the most recent round of sampling. It is unknown whether MS4 discharges cause or contribute to the receiving water condition.
- ❖ Impairment of REC-1 and SHELL in the Scripps subwatershed:
 - There are no receiving water monitoring sites located near the 303(d) listed waterbodies (Mission Bay and Pacific Ocean).
 - MS4 outfall monitoring locations are limited around the 303(d) listed waterbodies along the Mission Bay and Pacific Ocean Shoreline. Therefore, it is unknown whether MS4 discharges cause or contribute to the receiving water condition.

Consideration

- The RHMP monitoring program did not find exceedances of water quality criteria for total coliform, fecal coliform, and *Enterococcus*.

2.4 Step 4: Determine Highest Priority Water Quality Conditions

Once the list of priority water quality conditions was developed, “a subset of the water quality conditions (pursuant to Provision B.2.c(1))” were identified as the highest priorities. The MS4 Permit provides the Copermitees with the discretion to justify the highest priority water quality conditions for program development and implementation on the basis of a number of factors, including the potential to improve watershed health, available resources, and best professional judgment. The methodology used to select the priority and highest priority water quality conditions is described in Appendix A. According to the methodology, the highest priority water quality conditions are priority water quality conditions that are either (1) associated with a TMDL, ASBS requirements, or other water quality regulations, or (2) have been elevated to highest priority on the basis of an evaluation of four additional selection criteria. These four additional selection criteria are described later in this section. Each priority water quality condition identified in Appendix F was screened against these criteria and the results are summarized below.

Three highest priority water quality conditions in the Mission Bay WMA were identified on the basis of a review of TMDLs, ASBS requirements, and other water quality regulations, and are summarized in Table 2-5. Two of the highest priority conditions are associated with the Bacteria TMDL, which includes the research conducted and the programs implemented to reduce the contribution of MS4 discharges to bacteria impairments. The bacteria impairment has the greatest potential for near-term improvement in water quality that can be achieved by controlling discharges from the MS4. Over the past five years, tremendous effort has been invested by the Responsible Agencies to develop and plan BMPs to control bacteria.

Additionally, since 2004, the ASBS General Exception has guided studies within ASBS 29 that have identified potential stressors impacting the BIOL beneficial use of the ASBS. The City’s Phase II CLRP for Scripps (City of San Diego, 2013a) determined copper to be the critical pollutant (stressor) requiring the largest load reduction (i.e., requires the greatest implementation of BMPs to meet the water quality target). However, the Phase II CLRP also noted that when the City’s ASBS Site-Specific Dilution and Dispersion Model (dilutor factor) (City of San Diego, 2013d) is applied to the ASBS water quality objectives, the critical stressor in the ASBS changes from copper to sediment. As such, the strategies described in the Phase II CLRP (to be considered for this plan) would focus on and reduce indicator bacteria and sediment along with all other priority water quality conditions for all four subwatersheds identified in Appendix F, including copper.

Table 2-5
Highest Priority Water Quality Conditions in the Mission Bay WMA

Highest Priority Condition	Potential Stressor	Temporal Extent		Subwatershed
		Wet	Dry	
Impairment of REC-1 in Tecolote Creek	Indicator Bacteria	✓	✓	Tecolote Creek
Impairment of ASBS 29	Sediment ¹	✓	–	Scripps
Potential Impairment of REC-1 at the Pacific Ocean Shoreline ²	Indicator Bacteria	✓	✓	Scripps

1. Application of the City's ASBS Site-Specific Dilution and Dispersion Model changes the highest priority water quality condition for the ASBS 29 from copper to sediment.
2. Applies to the following Pacific Ocean Shoreline locations only: Casa Beach at Children's Pool, La Jolla Shores Beach at Avenida de la Playa, La Jolla Shores Beach at Caminito del Oro, La Jolla Shores Beach at El Paseo Grande, Pacific Beach at Grand Avenue, South Casa Beach at Coast Boulevard, Tourmaline Surf Park, Vallecitos Court, Windansea Beach at Bonair Street, Windansea Beach at Palomar Avenue, Windansea Beach at Vista de la Playa, and Whispering Sands Beach at Ravina Street

Based on the review of the WMA regulatory drivers, no highest priority water quality conditions have been identified for the Rose Canyon or Mission Bay subwatersheds because priority water quality conditions for those waterbodies did not meet the criteria in the priority and highest priority water quality conditions selection methodology outlined in Appendix A. Furthermore, runoff from the Responsible Agencies is not the only source for the receiving water conditions in Rose Canyon. Specifically, the responsibility for managing storm water quality on some lands in the upper watershed areas of Rose Canyon is not under the jurisdiction of the Responsible Agencies and is outside the scope of the City's MS4 Permit and Caltrans' NPDES permit, as shown in Figure 1-1. Therefore, unless wet weather pollutant discharges from these lands enter the Responsible Agencies' storm drain systems, they are outside the scope and mandates of the Water Quality Improvement Plan development effort.

Priority water quality conditions not associated with regulatory drivers were further considered for elevation to a highest priority on the basis of four additional factors:

- (1) The supporting data set is sufficient to adequately characterize the degree to which the priority water quality condition changes seasonally, and over geographic area, to support its consideration as a highest priority water quality condition.
- (2) Storm water/non-storm water runoff is a predominant source for the priority water quality condition.

- (3) The priority water quality condition is controllable by the Responsible Agencies.
- (4) The priority water quality condition would not be addressed by strategies identified for other highest priority water quality conditions in this Water Quality Improvement Plan.

Each of these additional factors must be confirmed to determine whether the priority water quality condition should be elevated to a highest priority water quality condition. Appendix F summarizes the evaluation of the priority water quality conditions not associated with a regulatory driver. This analysis determined that all but two of the priority water quality conditions will be addressed by strategies applicable to the highest priority water quality conditions, and therefore provides justification for not elevating these conditions to highest priority. Furthermore, for some priority water quality conditions there is a lack of data to adequately characterize the condition and to definitively state that storm water or non-storm water runoff is the predominant cause of the condition. These data gaps were discussed in Section 2.3.3, and again justify not elevating these conditions to highest priority. When additional data become available to assess these priority water quality conditions, the data will be incorporated per the iterative and adaptive management processes described in Section 6, and the conditions may be reevaluated for potential elevation to highest priority. This Water Quality Improvement Plan is designed to concentrate efforts on the highest priority water quality conditions, while simultaneously developing programs to address the other priority water quality conditions.

3 MS4 Sources of Pollutants and/or Stressors

The previous section of this Water Quality Improvement Plan described the process for selecting the highest priority water quality conditions in the Mission Bay Watershed Management Area. Those highest priority water quality conditions include:

❖ Tecolote Creek subwatershed:

- Limitation of contact recreational uses of Tecolote Creek due to the presence of bacteria indicating impairments during wet and dry weather

❖ Scripps subwatershed:

- Impairment of ASBS 29 from sediment during wet weather
- Limitation of contact recreational uses of the Pacific Ocean Shoreline at the following locations due to the presence of bacteria indicating impairments during wet and dry weather:
 - Casa Beach (Children's Pool)
 - La Jolla Shores Beach at Avenida de la Playa
 - La Jolla Shores Beach at Caminito del Oro
 - La Jolla Shores Beach at El Paseo Grande
 - Pacific Beach at Grand Avenue
 - South Casa Beach at Coast Boulevard
 - Tourmaline Surf Park
 - Vallecitos Court
 - Windansea Beach at Bonair Street

Section 3 Highlights

- ❖ Categorization and prioritization of sources of bacteria and sediment
 - ❖ High Priority Sources for the City of San Diego:
 - Bacteria – Golf Courses/Parks, POTWs, Residential Areas, Sanitary Sewer Overflows, and Waste Disposal
 - Sediment – Agriculture, Construction, Home and Garden Care, Hydromodification, Land Use Alteration, Landscaping, Nurseries/Greenhouses, Mobile Landscaping, Parks and Recreation, and Residential Areas
- Windansea Beach at Palomar Avenue
 - Windansea Beach at Playa del Norte
 - Windansea Beach at Vista de la Playa
 - Whispering Sands Beach at Ravina Street

As shown in the graphic below, the second step of the Water Quality Improvement Plan (“Sources”) is to identify and prioritize sources and stressors in the Mission Bay WMA (Provision B.2.d). Source identification and prioritization in this Water Quality Improvement Plan are based upon the source assessments previously conducted as a part of the 2011 LTEA and refined by the 2012 WURMP Annual Report. Bacteria has 5 high priority sources and sediment has 10 high priority sources that have been previously identified. The goal of the source analysis is to identify and prioritize sources on the basis of the MS4 Permit requirements. It is not required or intended to be an independent source characterization.



Figure 3-1 outlines the process for identifying MS4 sources potentially contributing to the highest priority water quality conditions (Step 1) and the method for prioritizing the sources (Step 2). Data gaps identified as part of the source identification are highlighted to guide future analysis. As more source information is gathered, the source identification process may be refined as described in the iterative and adaptive management processes in Section 6, and source priorities may vary by Responsible Agency.

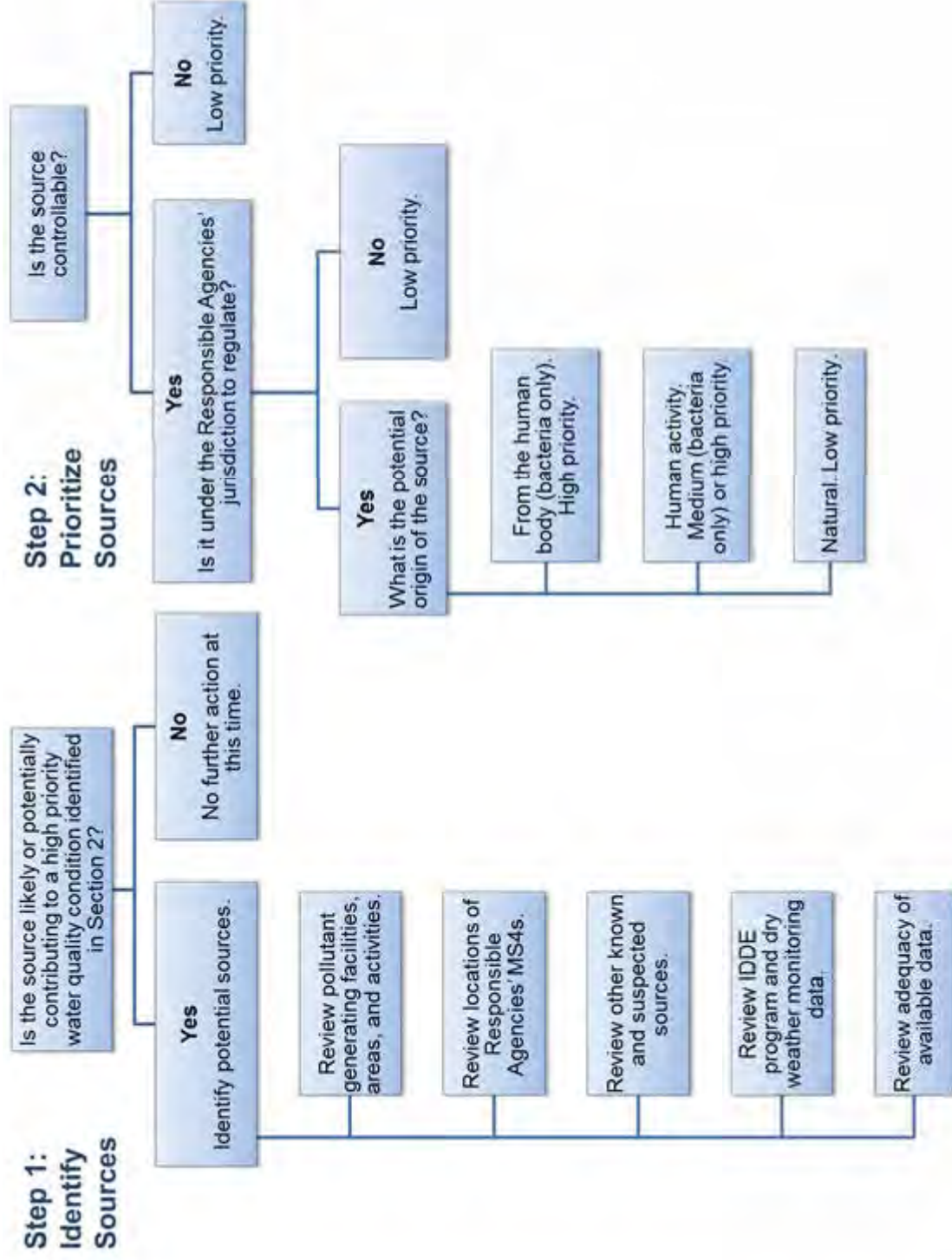


Figure 3-1
Highest Priority Water Quality Conditions Source Identification Process
Page | 3-3

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3.1 Step 1: Identification of Bacteria and Sediment Sources

Per the MS4 Permit (Provision B.2.d), sources of bacteria and sediment were identified on the basis of the following five considerations:

- (1) Pollutant-generating facilities, areas, and activities within the WMA
- (2) Locations of the Responsible Agencies' MS4s
- (3) Other known or suspected sources of non-storm water or pollutants in storm water discharges to receiving waters
- (4) Available data from the Responsible Agencies' monitoring and IDDE
- (5) Adequacy of available data

Seven primary resources provided the information for these considerations:

- (1) 2011 LTEA as described in Section 2
- (2) 2010–2011 WURMP Annual Report as described in Section 2
- (3) 2011–2012 WURMP Annual Report as described in Section 2
- (4) Maps of the MS4 system maintained by each Responsible Agency
- (5) JURMP Annual Reports submitted by the Responsible Agencies, which contain agency-specific monitoring data and IDDE data, including the identification of outfalls that persistently flow during dry weather (City of San Diego, 2012c)
- (6) Bacterial Conceptual Models and Literature Review that were developed by the San Diego County Municipal Copermittees in 2012 and are included as an appendix to the Tecolote Creek Watershed CLRP (City of San Diego, 2012b) and duplicated as Appendix H in this Water Quality Improvement Plan
- (7) Stakeholder input

Additional data sources were used to augment the primary sources and a complete list is provided in Appendix D.1. These include the Bacteria TMDL (Regional Board, 2010) and the 2010 303(d) list, as well as the Phase I and Phase II CLRPs for Scripps (City of San Diego, 2012a; 2013a) and Tecolote Creek (City of San Diego, 2012b; 2013b) subwatersheds.

3.1.1 Pollutant-Generating Facilities, Areas, and Activities in the WMA

The LTEA evaluated the known facilities, areas, and activities that generate bacteria and sediment in the San Diego region, which are defined as follows:

- ❖ A **facility** is a type of existing development, such as a commercial or industrial business, a parking structure, a municipal airfield, a landfill, or an automotive repair shop. An MS4 is considered to be a facility.

- ❖ An **area** is a communal area such as the trash dumpsters in a commercial strip mall, open space, a wildlife preserve, a parking lot, or a residential neighborhood.
- ❖ **Activities** include practices such as irrigation, portable toilet cleaning, storage of pet wastes, and vehicle washing (Regional Board, 2013).

To identify sources, the LTEA evaluated the available wet and dry weather receiving water and outfall monitoring data and IDDE program results, as well as the adequacy of the data. The 2011 LTEA began with sources identified in the previous MS4 Permit (R9-2007-001) and updated the list on the basis of the most recent inventory. The sources were scored using a matrix that accounted for the number of pollutant-generating activities associated with each source (in categories of 0, 1-4, and >4 activities) and the potential for wet weather discharge from each source (from 1 = no discharge potential to 5 = high discharge potential). These scores were then converted into the following qualitative loading potentials:

- ❖ **None (N)** includes sources with no identified pollutant-generating activities and low discharge potential.
- ❖ **Unknown (UK)** includes sources with one or more identified pollutant-generating activities, but very low discharge potential.
- ❖ **Unlikely (UL)** includes sources with no pollutant-generating activities, but high discharge potential, or sources with moderate discharge potential and one or more pollutant-generating activities.
- ❖ **Likely (L)** includes sources with high discharge potential and identified pollutant-generating activities.

Beginning with the sources identified in the 2007 MS4 Permit and updating the list with the most recent research, the 2011 LTEA evaluated a total of 37 facilities, areas, and activities (sources) and identified a number of likely sources of bacteria and sediment. The WURMP Annual Reports identify the likely sources from the LTEA that are found within the Mission Bay WMA. In addition, the reports identify the quantity of each of the sources that are in the WMA. These sources, land use categories, and quantities are summarized in Table 3-1. Sources classified as having an unknown loading potential in the 2011 LTEA are included in the assessment of the adequacy of available data (Section 3.1.6).

Table 3-1
Likely Sources of Bacteria and Sediment Identified in WURMP Annual Reports

Source Type	Category	Total Number of Sources in WMA ¹	Highest Priority Water Quality Conditions	
			Bacteria	Sediment
Agriculture	Other	2 (80 acres)	–	✓
Animal Facilities	Commercial	77	✓	–
Construction	Construction	NA	–	✓
Eating/Drinking Establishments	Commercial	1281	✓	–
Golf Courses/Parks	Municipal	14	✓	✓
Home and Garden Care	Residential	11,463 acres	✓	✓
Hydromodification	Construction	NA	–	✓
Landscaping	Commercial	32	✓	✓
Land Use Alteration	Construction	NA	–	✓
Mobile Eating/Drinking Establishments	Commercial	2	✓	–
Mobile Landscaping	Commercial	205	✓	✓
Nurseries/Greenhouses	Commercial	7	–	✓
Publicly Owned Treatment Works (POTWs)	Municipal	1	✓	–
Waste Disposal	Municipal	3	✓	–

1. Sources are quantified by facility counts or acreage. Facility counts help define the sources during dry weather and land uses help defines sources during wet weather.

NA = not available. The number of sources is either variable, as with construction, or is not currently assessed by the jurisdiction because of the difficulty in obtaining an accurate count.

“✓” = Source applies to highest priority water quality condition.

“–” = Source does not apply to highest priority water quality condition.

The WURMP also identified sanitary sewer overflows and bacteria regrowth in the MS4 as potential sources of bacteria, and land use alteration and hydromodification as potential sources of sediment.

3.1.2 Other Known and Suspected Sources

Sources other than those within the Responsible Agencies' jurisdictions and under their regulatory authority may also contribute to the bacteria and sediment impairments within the Mission Bay WMA. Discharges from these sources are often conveyed to receiving waters by the Responsible Agencies' MS4s. The principal sources outside the Responsible Agencies' jurisdictions, which are described below, are:

- ❖ Phase II MS4 outfalls
- ❖ Other permitted discharges
- ❖ Other potential point sources
- ❖ Other non-point sources

Phase II MS4 Outfalls

Phase II MS4s are smaller agencies (relative to municipalities) or areas that are regulated under the State's Phase II MS4 General Permit (State Board Order No. 2013-0001-DWQ) (State Board, 2013b). They are outside the authority of the Responsible Agencies and, within the San Diego region, can include, but are not limited to, correctional, transit, educational, and federal facilities. Phase II MS4 permittees are responsible only for the runoff from their facilities and activities, whereas the Responsible Agencies are responsible for receiving runoff from other sources. Phase II MS4s may contribute to the impairment of beneficial uses in the Mission Bay WMA. Some Phase II MS4s have been named in the Bacteria TMDL (Regional Board, 2010).

The following Phase IIs are located in the Mission Bay WMA:

- ❖ University of California (UC), San Diego
- ❖ Veterans Administration (VA) San Diego Healthcare System
- ❖ North County Transit District (NCTD)
- ❖ Marine Corps Air Station Miramar

Contributions from Phase II MS4s are a suspected source of bacteria and sediment in both storm water and dry weather non-storm water discharges. The Responsible Agencies will collaborate with the Regional Board and Phase II MS4s when possible to collect data to quantify the Phase II MS4s' contribution to the bacteria and sediment impairments.

Other Permitted Discharges

Other permitted discharges, such as discharges covered under the State's Construction General Permit (Order No. 2012-0006-DWQ) (State Board, 2012a) and the Industrial General Permit (Order No. 2014-0057-DWQ) (State Board, 2014a), may also contribute to the highest priority water quality conditions. Industrial waste treatment facilities, for

example, can contribute sediment by increasing erosion and aerial deposition of sediment during land disturbance activities. That sediment may also contain and transport bacteria, which are commonly found in industrial waste. Agricultural discharges, which are generally covered under a conditional discharge waiver from the Regional Board, are discussed below as an example of non-point source discharges. Such discharges may be conveyed to receiving waters by the Responsible Agencies' MS4s.

In addition to the MS4 Permit, four other types of storm water permits are present within the Mission Bay WMA, as presented in Table 3-2.

Table 3-2
Storm Water Discharge Permits

Permit Type	Number of Permits¹
Municipal Storm Water	2
Industrial Storm Water	6 ²
Construction Storm Water	15 ²
Caltrans Storm Water	1
Other Individual NPDES Discharges	4
Total	28

Sources: State Board, 2011a; State Board, 2011b.

1. Number of permits in Tecolote and Scripps subwatersheds only.
2. Number of individual permittees filing under statewide general permit.

Waste management sites (e.g., landfills and waste transfer stations) and construction sites have also been identified as significant point sources of bacteria in the San Diego region (Regional Board, 2010). They are also likely contributors of sediment (City of San Diego, 2013c). Although there are three municipal landfills in the Mission Bay WMA, none were identified as a likely source of bacteria or sediment in the 2012 WURMP Annual Report. Miramar Landfill, operated by the City, is located adjacent to San Clemente Creek in the Rose Canyon subwatershed (California Department of Resources Recycling and Recovery [CalRecycle], 2013). The Responsible Agencies will collaborate with the Regional Board and other permitted dischargers when possible to collect data to quantify their contribution to the bacteria and sediment impairments.

Other Point Sources

A point source is a discrete conveyance, such as a pipe or ditch, that may discharge pollutants from a specific area or facility. Private outfalls are point sources that may discharge bacteria and/or sediment to the MS4 or receiving waters; however, no private outfalls have been identified by the Responsible Agencies in the Mission Bay WMA. Industrial sites with individual NPDES permits may also be considered point sources.

Other Non-Point Sources

Non-point sources typically flow over land and discharge to receiving waters over a broad or non-discrete area, as opposed to a point location. Potential non-point source discharges include agriculture, wildlife, sewage infrastructure, transient encampments, and other natural sources (City of San Diego, 2009; City of San Diego, 2012a; Regional Board, 2013).

During wet weather, storm water runoff may carry bacteria and sediment from agricultural lands to the MS4. Per the Bacteria TMDL, bacteria carried by agricultural discharges that enter the MS4 conveyance system are considered to be controllable by the MS4s. Agricultural sites operate under a conditional discharge waiver from the Regional Board (Resolution No. R9-2007-0104), meaning that they are exempt from the discharge requirements of the current MS4 Permit. This waiver expired in 2014, and a new Agricultural Order is expected to go into effect in 2015. A draft tentative order detailing waste discharge requirements for commercial agricultural and nursery operations was released by the Regional Board on January 17, 2014. Responsible Agencies will look for opportunities to collaborate with the Regional Board and agricultural dischargers when possible and appropriate.

The Bacteria TMDL identifies wildlife areas, which include open space land uses and are sometimes not under the jurisdiction of Responsible Agencies, as sources of bacteria. The wildlife areas partially account for bacteria contributions from wild animals and decaying plant sources.

The Bacterial Conceptual Models and Literature Review (City of San Diego, 2012a) identifies transient encampments as a bacteria source that can directly discharge bacteria from human origins to receiving waters. Transient encampments are temporarily located in both municipal and open space land uses. The issues raised by transient encampments are socio-economic by nature. Addressing the sources of homelessness requires coordination with law enforcement, social services, and the legal community. Sources related to sewage infrastructure (such as sewer collection systems, sanitary sewer overflows, illicit discharges to the sewer system, and septic tanks) have also been identified by the Responsible Agencies as potential sources of bacteria. Additionally, during dry periods, bacteria can regrow within the MS4 and create biofilms (City of San Diego, 2012a). These sources may be found within the Mission Bay WMA and are considered under the jurisdiction of the Responsible Agencies.

During dry weather, bacteria may enter the MS4 or receiving waters through groundwater infiltration or irrigation runoff into municipal drainage channels (County of Los Angeles, 2010). Also, groundwater may contribute to the bacteria in the MS4 and receiving waters (Regional Board, 2010).

The Tecolote Creek CLRP identifies aerial deposition (i.e., sediment blown and redeposited by wind) as both a natural source and a source influenced by human activity for sediment in the San Diego region (City of San Diego, 2012b).

3.1.3 Locations of the Responsible Agencies' MS4s

The MS4 maps discussed in Section 2 were reviewed as part of the source identification process. The Rose Canyon subwatershed has the largest number of major MS4 outfalls in the Mission Bay WMA. The Tecolote Creek and Scripps subwatersheds have roughly half the number of major MS4 outfalls compared with the Rose Canyon subwatershed. The Mission Bay subwatershed has only one major MS4 outfall.

3.1.4 IDDE Program and Dry Weather Monitoring Data

In addition to the evaluation in the LTEA, data from the illicit discharge detection and elimination program and receiving water monitoring programs were reviewed to determine whether known or suspected sources of bacteria and sediment may be controllable by the Responsible Agencies' MS4s. Dry weather field screening, inspections, and complaint responses have been shown to be effective means of detecting and eliminating illicit discharges (San Diego County Municipal Copermittees, 2011).

Dry Weather Field Screening and Persistent Flow

Dry weather field screening data collected as part of the MS4 Permit's transitional monitoring program were also considered on the basis of dry weather persistent flows, where available. Flow during dry weather may result from permitted, allowed, or illegal discharges. Dry weather flow provides a mechanism to transport bacteria from facilities, areas, or activities to receiving waters. Per MS4 Permit Provision D.2.a(2)(b)(iv),

"Persistent flow is defined as the presence of flowing, pooled, or ponded water more than 72 hours after a measureable rainfall event of 0.1 inch or greater during three consecutive monitoring and/or inspection events. All other flowing, pooled, or ponded water is considered transient."

Based on a review of the MS4 outfall map in Section 2, the Responsible Agencies have identified a total of 18 major MS4 outfalls in the Scripps subwatershed, 37 major MS4 outfalls in the Rose Canyon subwatershed, 14 major MS4 outfalls in the Tecolote Creek subwatershed, and 1 major MS4 outfall in the Mission Bay subwatershed. The City has identified 19 major MS4 outfalls in the Mission Bay WMA that may persistently discharge non-storm water. These outfalls are presented in Appendix D.3. Caltrans has not identified any persistent non-storm water discharges in the WMA.

Facility Inspections

Facility inspections complement the IDDE program and include informing the public about storm water and dry weather runoff. Inspections also detect potential dry weather flows discharging from facilities. Inspections may confirm whether specific types of facilities are significant sources. Although information is available on facility inspections based on the previous permit JURMP annual reporting requirements, the JURMP data assessment did not provide detailed information linking facility inspections to sources of bacteria and sediment. Section 5 (Monitoring and Assessment) and Section 6 (Iterative Approach) describe how JRMP report requirements will be used to answer water quality-related questions.

Storm Water Complaints

The City of San Diego has implemented regional and jurisdictional storm water telephone hotlines since the issuance of Order R9-2001-01 in 2001. Members of the public may call in complaints to the Regional Hotline, which is maintained by the County of San Diego. The County contacts the appropriate jurisdiction to follow up on complaints received by the Regional Hotline and websites. In addition, the City responds to complaints received by its own hotlines. Complaints received via the hotlines have helped the City identify and eliminate illicit discharges, particularly during dry weather (San Diego County Municipal Copermittees, 2011).

As with facility inspections, storm water complaints were reported annually on the basis of the previous permit JURMP annual reporting requirements, but the JURMP data assessment did not provide detailed information linking storm water complaints and IDDE investigations to sources. Section 5 (Monitoring and Assessment) and Section 6 (Iterative Approach) describe how JURMP report requirements will be used to better report the water quality-related data associated with storm water complaints and their related follow-up IDDE investigations.

3.1.5 Summary of Bacteria and Sediment Sources

Bacteria and sediment sources were identified on the basis of the available resources and the considerations required by the MS4 Permit, as described above.

The Bacteria TMDL states that sources of bacteria may be the same in wet and dry weather. However, while the wet and dry weather sources of bacteria may be the same, the transport mechanisms are different. During wet weather, bacteria are discharged to the MS4 and then to the receiving waters via storm water runoff, which occurs over a general area and can be well represented by land use. During dry weather, discharges are conveyed by means of non-storm water runoff, which includes illicit discharges, irrigation runoff, groundwater infiltration, and permitted discharges. These discharges are associated with specific facilities, areas, or activities. The different wet and dry weather transport mechanisms require different strategies to address the impairment and are discussed in Section 4. Wet and dry weather sources were also categorized by land use using the Responsible Agencies' inventories of facilities and land uses to help develop the goals, strategies, and schedules described in Section 4.

The TMDL for Sedimentation in Los Peñasquitos Lagoon (Resolution No. R9-2012-0033) does not apply to the Mission Bay WMA. However, it provided information on the potential sources of sediment in the San Diego region. For example, it states that sources of sediment are more significant in wet weather.

Table 3-3 presents facilities, areas, and activities identified by the Responsible Agencies as known or suspected sources of bacteria and sediment, and the typical land uses that were associated with the sources as part of the identification process.

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**Table 3-3
Identified Pollutant-Generating Facilities, Areas, and Activities**

Known or Suspected Source	Land Uses								
	Construction	Commercial	Industrial	Municipal	Residential	Parks and Recreational Areas	Open Space	Landfills	Other ¹
BACTERIA									
Facility									
Golf Courses/Parks	–	✓	–	✓	–	✓	–	–	–
Publicly Owned Treatment Works (POTWs)	–	–	–	✓	–	–	–	–	✓
Waste Disposal	–	✓	–	✓	–	–	–	✓	✓
Animal Facilities	–	✓	–	✓	–	–	–	–	✓
Eating and Drinking Establishments	–	✓	–	✓	–	✓	–	–	✓
Mobile Eating/Drinking Establishments	–	✓	–	–	–	–	–	–	–
Nurseries, and Greenhouses	–	✓	✓	✓	–	✓	–	–	✓
Area									
Residential Areas	–	–	–	–	✓	–	–	–	–
Activity									
Mobile Landscaping	–	✓	–	✓	✓	✓	–	–	–
Home and Garden Care	–	–	–	–	✓	–	–	–	–
Landscaping	–	✓	–	✓	✓	✓	–	–	–
Non-WURMP Identified Sources ²									
Agriculture	–	–	–	✓	✓	–	–	–	✓
Bacteria Regrowth and Biofilms	–	–	–	✓	–	–	–	–	✓
Transient Encampments	–	–	–	–	–	–	–	–	✓

Table 3-3 (continued)
Identified Pollutant-Generating Facilities, Areas, and Activities

Known or Suspected Source	Land Uses							
	Construction	Commercial	Industrial	Municipal	Residential	Parks and Recreational Areas	Open Space	Landfills Other ¹
Open Space Areas	–	–	–	–	–	–	✓	–
Sanitary Sewer Overflows	–	–	✓	✓	✓	✓	–	–
Wildlife	–	–	–	✓	–	✓	✓	✓
SEDIMENT								
Facility								
Nurseries and Greenhouses	–	✓	✓	✓	–	✓	–	✓
Parks and Recreation (including Golf Courses and Cemeteries)	–	✓	–	✓	–	✓	–	–
Area								
Agriculture	–	–	–	✓	✓	–	–	✓
Residential Areas	–	–	–	–	✓	–	–	–
Activity								
Construction	✓	–	–	–	–	–	–	–
Hydromodification	✓	–	–	✓	–	✓	✓	–
Home and Garden Care	–	–	–	–	✓	–	–	–
Landscaping	–	✓	–	✓	✓	✓	–	–
Land Use Alteration	✓	–	–	–	–	–	–	–
Mobile Landscaping	–	✓	–	✓	✓	✓	–	–

Table 3-3 (continued)
Identified Pollutant-Generating Facilities, Areas, and Activities

Known or Suspected Source	Land Uses						
	Construction	Commercial	Industrial	Municipal	Residential	Parks and Recreational Areas	Open Space
Non-WURMP Identified Sources²							
Atmospheric Deposition	✓	✓	✓	✓	✓	✓	✓
Ocean Sediment Contribution	–	–	–	–	–	✓	–
Open Space Areas	–	–	–	–	–	–	✓
						Landfills	Other ¹

1. Other sources are those sources outside of the Responsible Agencies' jurisdictions and regulatory authorities. See Section 3.1.2.
 2. Non-WURMP identified sources have been categorized separately because this information comes from secondary sources that have not gone through the same regulatory review process as have the WURMP identified sources.
- “✓” = Land use applies to source.
“–” = Land use does not apply to source.

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3.1.6 Adequacy of Available Data

The Copermittees' monitoring and inspections programs, along with the MS4 inventory, provide sufficient data to categorize the known or suspected sources of bacteria and sediment within the Mission Bay WMA. However, additional potential sources have been identified during the source identification that cannot be directly linked to bacteria and sediment MS4 contributions on the basis of the data available. The contributions of these potential sources to bacteria and sediment concentrations in the MS4 are unknown. Table 3-4 presents potential sources that require additional data to determine whether they are likely contributors to impairments within the Mission Bay WMA.

Table 3-4
Potential Bacteria and Sediment Sources with Data Gaps

Pollutant/ Stressor	Potential Source Where Magnitude of Impact Is Unknown	Potential Origin of the Source	Source of Data
Bacteria	Land surface erosion	Human activity and natural	CLRP
	Industrial activities	Human body and human activity	CLRP
	Municipal activities	Human body and human activity	CLRP
	Fertilizers (residential and agricultural)	Human activity	CLRP
	Reclaimed water use	Human activity	CLRP
Sediment	Land surface erosion	Human activity and natural	CLRP
	Vehicle washing	Human activity	CLRP
	Pavement erosion	Human activity	CLRP
	Sewer leaks, sanitary sewer overflows, illicit discharges, and septic systems	Human body and human activity	CLRP

CLRP = Scripps Watershed Comprehensive Load Reduction Plan (City of San Diego, 2012a) and/or Tecolote Watershed Comprehensive Load Reduction Plan (City of San Diego, 2012b)

Additionally, the following sources require further study to determine whether they may be contributing to the impairment of beneficial uses in the Mission Bay WMA:

- ❖ Phase II MS4 contribution of bacteria and sediment as detailed in Section 3.1.2
- ❖ Non-point source contribution of bacteria and sediment as detailed in Section 3.1.2

- ❖ Locations and discharge characteristics of private outfalls and industrial point sources
- ❖ Persistently flowing dry weather outfalls identified from the Responsible Agencies' transitional monitoring program (in progress)

3.2 Step 2: Prioritization of Bacteria and Sediment Sources

Based on the findings of Section 3.1, sources were prioritized according to two factors: (1) the ability of the Responsible Agencies to control the source, and (2) the level of human influence.

To determine whether a potential source is controllable, the following factors were considered: (1) the locations of the MS4s and potential contributing land uses during wet weather, (2) known outlets with persistent dry weather flow, and (3) jurisdictional authority.

The relative level of human influence was evaluated on the basis of the origin of the bacteria and/or sediment along with the relationship to urban development and human activity. For bacteria, the levels of FIB in a waterbody can be related to recreational health risks. For example, a non-human-impacted waterbody with high FIB densities can pose less risk for water recreation than a human-impacted waterbody with low FIB densities (Soller et al., 2010; Schoen and Ashbolt, 2010). For sediment, the amount of erosion is often dependent on soil type, but also the amount of human activity. Highly erodible sediment near the coast may naturally erode but the rate of erosion will increase with human activity. The prioritization of the known and suspected sources is described in the following subsections.

3.2.1 Source Controllability

Sources were ranked on the basis of the ability of the Responsible Agency to control the associated discharges. Controllable sources are controllable activities by humans, although in some instances (e.g., agricultural activities), Responsible Agencies have limited jurisdictional authority to regulate them. Most point sources were considered controllable, whereas many non-point sources were not. Controllable sources are those sources that are anthropogenic (i.e., influenced by humans) in origin (Regional Board, 2010).

The Bacteria TMDL provides a definition of controllable sources. This definition was also applied to sediment sources for consistency in the WMA. These controllable sources of stressors include:

- ❖ Discharges from municipal land uses
- ❖ Discharges from Caltrans
- ❖ Discharges from agricultural land uses that flow into the Responsible Agencies' MS4

Sources of stressors that are not controllable according to the Bacteria TMDL include:

- ❖ Discharges from open space and undeveloped land
- ❖ Wildlife (except secondary wildlife)
- ❖ Bacteria bound in soil and humic material
- ❖ Other natural sources not influenced by human activity

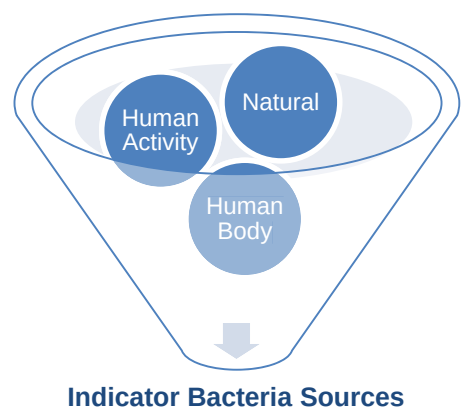
Sources that are outside the Responsible Agencies' jurisdictional boundaries, non-point sources that are not considered controllable, and sources over which the Responsible Agencies do not have regulatory authority were considered to be non-controllable.

Based on this definition, sources in the Mission Bay WMA were categorized as follows:

- ❖ Controllable:
 - Discharges from a municipal land use, Caltrans, or an agricultural land use
 - Identified land uses associated with the facility, area, or activity within the Responsible Agencies' jurisdictions
- ❖ Not controllable:
 - Discharges not from a municipal land use, Caltrans, or an agricultural land use
 - No identified land uses associated with the facility, area, or activity within the Responsible Agencies' jurisdictions

3.2.2 Level of Human Influence and Source Prioritization

Sources for bacteria and sediment were prioritized on the basis of the level of human influence. The Bacterial Conceptual Models and Literature Review, in Appendix H, was developed for the San Diego County Municipal Copermittees' 2011-2012 Urban Runoff Monitoring Final Report and was described in the Tecolote Creek CLRP (City of San Diego, 2012b). It provides a methodology to characterize the sources of bacteria (*Enterococcus*, fecal coliform, and total coliform) by the level of human influence. Sediment source prioritization utilized the same methodology as that for bacteria, excluding sources from the human body that are not applicable.



The three categories of source origin are the human body, human activity, and natural:

- ❖ Human body: Bacteria carried or shed by humans (e.g., bather shedding and sewage)
- ❖ Human activity: Sources from non-human anthropogenic origins (the source is not from the human body, but may be increased by human influence or activities such as pet waste and secondary wildlife generation for bacteria, or land disturbing activities from construction for sediment)
- ❖ Natural: Sources from non-human non-anthropogenic origins (not increased by human influence), such as natural sources, including wildlife and natural plant decay for bacteria and naturally occurring erosion for sediment

Sources were ranked on the basis of the category of the stressor origin. Bacteria sources from the human body were given the highest priority, followed by sources associated with human activity, and finally by sources known or suspected to be natural in origin. For sediment, sources associated with human activity were assigned a high priority and sources identified with a potential natural origin were assigned a low priority.

For the Mission Bay WMA, the final stressor prioritization was determined as follows:

- ❖ High:
 - Bacteria:
 - Source is controllable, and
 - Human body is identified as a potential origin.
 - Sediment:
 - Source is controllable, and
 - Human activity is identified as a potential origin.
- ❖ Medium (bacteria only):
 - Source is controllable, and
 - Human activity is identified as a potential origin.
- ❖ Low (bacteria and sediment):
 - Source is not controllable, or
 - Source is controllable and natural is identified as a potential origin.

Table 3-5 prioritizes the identified known and suspected sources of bacteria and sediment in the Mission Bay WMA.

**Table 3-5
Prioritized Sources**

Known or Suspected Source	Controllability Based on Copermittee Jurisdiction	Potential Origin of the Source
<i>BACTERIA</i>		
<i>Facility—High</i>		
Golf Courses/Parks	Controllable	Human body and human activity
Publicly Owned Treatment Works (POTWs)	Controllable	Human body and human activity
Waste Disposal	Controllable	Human body and human activity
<i>Facility—Medium</i>		
Animal Facilities	Controllable	Human activity
Eating and Drinking Establishments	Controllable	Human activity
Mobile Eating/Drinking Establishments	Controllable	Human activity
Nurseries, and Greenhouses	Controllable	Human activity
<i>Area—High</i>		
Residential Areas	Controllable	Human body and human activity
<i>Area—Medium</i>		
Agriculture	Controllable ¹	Human activity
<i>Area—Low</i>		
Open Space Areas	Not controllable	Natural
Transient Encampments	Not controllable ²	Human body and human activity
<i>Activity—High</i>		
Sanitary Sewer Overflows	Controllable	Human body and human activity

**Table 3-5 (continued)
Prioritized Sources**

Known or Suspected Source	Controllability Based on Copermittee Jurisdiction	Potential Origin of the Source
Activity—Medium		
Mobile Landscaping	Controllable	Human activity
Home and Garden Care	Controllable	Human activity
Landscaping	Controllable	Human activity
Wildlife (Secondary) ³	Controllable	Human activity
Activity—Low		
Bacteria Regrowth and Biofilms	Controllable ⁴	Natural
Wildlife	Not controllable	Natural
SEDIMENT		
Facility—High		
Nurseries, and Greenhouses	Controllable	Human activity
Parks & Recreation (including Golf Courses & Cemeteries)	Controllable	Human activity
Area—High		
Agriculture	Controllable ¹	Human activity
Residential Areas	Controllable	Human activity
Area—Low		
Open Space Areas	Not controllable	Natural
Activity—High		
Construction	Controllable	Human activity
Hydromodification	Controllable	Human activity and natural
Home and Garden Care	Controllable	Human activity
Landscaping	Controllable	Human activity
Land Use Alteration	Controllable	Human activity
Mobile Landscaping	Controllable	Human activity

**Table 3-5 (continued)
Prioritized Sources**

Known or Suspected Source	Controllability Based on Copermittee Jurisdiction	Potential Origin of the Source
<i>Activity—Low</i>		
Atmospheric Deposition	Not controllable	Human activity and natural
Ocean Sediment Contribution	Not controllable	Natural

1. Per the Bacteria TMDL, discharges from agricultural lands are controllable.
2. Transient encampments are temporarily located in both municipal and open space land uses. The issues raised by transient encampments are socio-economic by nature. Addressing the sources of homelessness requires coordination with law enforcement, social services, and the legal community. Therefore, it has been designated as an uncontrollable source.
3. Secondary wildlife includes vermin and other wildlife species associated with human presence and habitation.
4. Bacteria regrowth is a natural phenomenon that is hard to track or predict. The regrowth of bacteria in pipes is influenced by multiple factors, some that are under the direct control of the MS4s and some that are not.

3.3 Summary of Priority Sources for City of San Diego

The JURMP Annual Report for the City of San Diego was reviewed to determine whether priority sources could be found in the Mission Bay WMA (City of San Diego, 2012c). Land use information provided in the JURMP Annual Report was used to determine whether agriculture and residential sources were found in the jurisdiction. Because Caltrans is not subject to the MS4 Permit, it has not developed a JURMP Annual Report that presents the priority sources. Therefore, only sources for the City are provided in this section. Priority sources for the City are summarized in Tables 3-6 and 3-7.

Table 3-6
Summary of Priority Indicator Bacteria Sources

Source Type	City of San Diego
<i>High Priority</i>	
Golf Courses/Parks	✓
Publicly Owned Treatment Works (POTWs)	✓
Residential Areas	✓
Sanitary Sewer Overflows	✓
Waste Disposal	✓
<i>Medium Priority</i>	
Agriculture	✓
Animal Facilities	✓
Eating/Drinking Establishments	✓
Home and Garden Care	✓
Landscaping	✓
Mobile Eating/Drinking Establishments	✓
Mobile Landscaping	✓
Nurseries/Greenhouses	✓
Wildlife (Secondary) ^{1,2}	✓
<i>Low Priority</i>	
Transient Encampments	NA ³
Bacteria Regrowth and Biofilms	✓
Open Space Areas	✓
Wildlife ¹	✓

1. This includes wildlife assumed to be present in the City of San Diego's jurisdiction.

2. Secondary wildlife includes vermin and other wildlife species associated with human presence and habitation.

3. NA= Not available; the number of transient encampments is not currently assessed by jurisdiction because of the challenges in obtaining an accurate count of encampments, which (by definition) are temporary. A point-in-time count is prepared annually by the Regional Task Force on the Homeless, and can be found on their website (<http://www.rtfhsd.org/>).

Table 3-7
Summary of Priority Sediment Sources

Source Type	City of San Diego
<i>High Priority</i>	
Agriculture	✓
Construction	✓
Home and Garden Care	✓
Hydromodification	✓
Land Use Alteration	✓
Landscaping	✓
Nurseries/Greenhouses	✓
Mobile Landscaping	✓
Parks & Recreation (Including Golf Courses and Cemeteries)	✓
Residential Areas	✓
<i>Low Priority</i>	
Atmospheric Deposition	✓
Ocean Sediment Contribution	✓
Open Space Areas	✓

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4 Water Quality Goals, Strategies, and Schedules

Section 2 established three highest priority water quality conditions in the Mission Bay WMA. The highest priority water quality condition in the Tecolote Creek subwatershed is the potential impairment of contact recreation beneficial uses in Tecolote Creek caused by indicator bacteria during both wet and dry weather. Within the Scripps subwatershed, two highest priority water quality conditions have been selected: (1) the potential impairment of ASBS 29 caused by sediment during wet weather, and (2) potential impairment of 13 segments of the Pacific Ocean Shoreline for contact recreation caused by indicator bacteria during wet and dry weather. Four of those 13 segments are also located in the ASBS.

Section 3 identified and prioritized sources and stressors potentially contributing to the impairments in the Mission Bay WMA. Golf courses and parks, POTWs, residential areas, sanitary sewer overflows, and waste disposal are the highest priority sources likely to be contributing to the bacteria impairment. Agriculture, construction, home and garden care, hydromodification, land use alteration, landscaping, parks and recreation, residential areas, and nurseries and greenhouses are the highest priority sources likely to be contributing to the sediment impairment.

Section 4 Highlights

- ❖ Goals for the highest priority water quality conditions (Section 4.1).
- ❖ Details on the planned strategies:
 - A description of the nonstructural and structural strategies to be implemented to achieve the goals (Section 4.2). Collaborative strategies will also be highlighted (Section 4.2.5).
 - Each Responsible Agency's strategies, with an implementation schedule (Appendix J).
 - The basis for strategy selection and prioritization, along with implementation assumptions used to estimate strategy effectiveness within the compliance analysis (Appendix K).
- ❖ Specifics of the compliance analysis modeling results (Section 4.3):
 - A percent load reduction for each BMP category to demonstrate that final goals will be met by implementing the strategies (Section 4.3.1).
 - The schedule for implementation to demonstrate that interim and final goals will be achieved by implementing the strategies (Section 4.3.2).
 - Detailed modeling results, including anticipated load reductions by each strategy type, subwatershed, jurisdiction, and pollutant (Appendix K).

As shown in the graphic below, the third step of Water Quality Improvement Plan development process is to identify the goals, strategies, and implementation schedules for the Mission Bay WMA to address sources and stressors that are contributing to the bacteria and sediment impairments (Provision B.3).



The following sections presents the goals (Section 4.1) and strategies (Section 4.2) selected by the Responsible Agencies to address the highest priority water quality conditions in the Mission Bay WMA. A compliance analysis using a watershed model was completed to demonstrate the anticipated progress toward achieving these goals through the proposed strategies and their implementation schedules (Section 4.3). The modeling results are summarized in Section 4.3.

Although this section identifies and details the goals, strategies, and schedules targeting the highest priority water quality conditions in the Tecolote Creek and Scripps subwatersheds, many strategies selected are applied across the Responsible Agencies' jurisdictions and will also benefit conditions in the Rose Canyon and Mission Bay subwatersheds. The City of San Diego's (City) JRMP is implemented across the City's jurisdiction, and thus across the WMA. Therefore, most of the strategies identified in this Water Quality Improvement Plan are or will be implemented throughout the WMA.

4.1 Goals

Numeric goals are developed in this section to support Water Quality Improvement Plan implementation, and will be used to measure progress toward addressing the highest priority water quality conditions. Numeric goals may take a variety of forms, but are quantifiable so that progress toward and achievement of the goals are measurable. Each highest priority water quality condition may include multiple criteria or indicators. In accordance with the MS4 Permit and applicable regulatory drivers, final goals and reasonable interim goals have been developed. An interim goal is required for each five-year period from Water Quality Improvement Plan approval to the anticipated final goal compliance date (including an interim goal for this permit term).

Within the Mission Bay WMA, the Bacteria TMDL dictates the bacteria goals for both wet and dry weather in the Tecolote Creek and Scripps subwatersheds to address and attain REC-1 beneficial uses. MS4 Bacteria TMDL targets may be met in the receiving water (at the Bacteria TMDL listed segment), in MS4s discharges, by determining that the MS4 is not causing or contributing to receiving water exceedances, by demonstrating that exceedances are due to loads from natural sources, or by implementing an approved Water Quality Improvement Plan that used a watershed model or other watershed analytical tools to identify BMPs required to achieve compliance with the final receiving water or effluent goals. The percent load reduction

by jurisdiction is also the metric produced by the compliance analysis, which used a watershed model to demonstrate that selected strategies will meet interim and final goals.

In addition to the Bacteria TMDL-listed segments of beach in the Scripps subwatershed, a portion of the subwatershed drains into the La Jolla ASBS 29 and is subject to regulation under the Ocean Plan and the ASBS General Exception and Special Protections. The City's Phase II CLRP for the Scripps subwatershed (City of San Diego, 2013a) determined copper to be the critical pollutant (stressor) requiring the largest load reduction. This means that it requires the greatest implementation of BMPs to meet the water quality target. However, the Phase II CLRP also noted that when the City's ASBS Site-Specific Dilution and Dispersion Model (dilutor factor) (City of San Diego, 2013d) is applied to the ASBS water quality objectives, the critical stressor in the ASBS changes from copper to sediment. For the purposes of Water Quality Improvement Plan development, the dilution factor was applied and, therefore, sediment during wet weather is the highest priority water quality condition within the ASBS drainage areas.

Compliance with the Special Protections is measured by comparing monitoring results with the 85th percentile threshold of reference water quality, which is currently being developed. The primary regulatory driver, identified by the largest required load reduction, is used for planning purposes to determine the strategies needed to comply with the most stringent interim and final goals for each of the small coastal drainages that make up the Scripps subwatershed. Most of the ASBS area is regulated by the Bacteria TMDL. Only one drainage area is solely regulated by the ASBS Special Protections and not the Bacteria TMDL. The remaining areas in the Scripps subwatershed are not identified in the Bacteria TMDL and are outside of the ASBS and are therefore not considered in the highest priority water quality condition. Implementing strategies to attain the most stringent goal is anticipated to result in attainment of all goals. Monitoring and assessment may determine whether modifications to the strategies are necessary if the Water Quality Improvement Plan interim goals are not being achieved.

Ultimately, protection of the receiving water is the desired outcome. As discussed in Section 1, discharges from sources other than the Phase I MS4s are outside of the jurisdiction and regulatory responsibility of this Water Quality Improvement Plan and may contribute to exceedances of receiving water or subwatershed goals. Therefore, multiple compliance pathways are included in the Water Quality Improvement Plan numeric goals that mirror the Bacteria TMDL compliance pathways. The final and interim numeric goals for the Mission Bay WMA were derived from WQBELs identified in the Bacteria TMDL and incorporated into the MS4 Permit. Appendix I presents the Bacteria TMDL numeric targets and Ocean Plan effluent limitations and provides the basis for the Water Quality Improvement Plan numeric goals. The Bacteria TMDL allows for final exceedances of water quality objectives during wet weather to account for natural sources of bacteria and these are reflected in the allowable exceedance frequency goals.

Performance-based goals are included to measure short-term jurisdictional progress toward achieving goals, given that sustained water quality improvement is typically demonstrated over a longer timeframe. Performance measures are intended to measure an outcome from a strategy or suite of strategies, and provide an interim link to demonstrate reasonable incremental progress in the quality of MS4 discharges and receiving waters by FY18. The strategies or suite of strategies presented have been selected because they are measurable and provide a direct benefit in the short term. Section 4.2 and the associated appendices present the full suite of strategies that will be considered for implementation. Section 4.3 presents the anticipated schedule for implementation and the associated load reduction benefit estimated through implementation of the suite of strategies.

Section 4.1.1 presents the interim and final Water Quality Improvement Plan numeric goals for the Tecolote Creek subwatershed. Section 4.1.2 presents the interim and final numeric goals for the Scripps subwatershed.

4.1.1 Tecolote Creek Subwatershed

The highest priority water quality condition in the Tecolote Creek subwatershed was identified within Tecolote Creek; therefore, numeric goals have been identified within the creek at the creek mouth. Bacteria TMDL modeling and Water Quality Improvement Plan BMP optimization used a downstream location within the creek (creek mouth) to quantify exceedance frequencies and subwatershed load reductions required to protect REC-1 beneficial uses. An iterative approach will be used as needed to assess sources and strategies upstream. Note that a low-flow diversion is located within Tecolote Creek, upstream of the confluence with the Mission Bay Shoreline that diverts dry weather flows from entering Mission Bay. The diversion at 4674 Tecolote Road does not divert all dry weather flows from Tecolote Creek, only those from that outfall. As with all low-flow diversions, it is checked and maintained at least once per month.

The City of San Diego and Caltrans developed goals both collaboratively and individually to best address the sources and stressors within the Mission Bay WMA and individual jurisdictions. An individualized approach provides flexibility in selecting interim goals on the basis of jurisdiction-specific strategies and schedules, and provides the framework for a more accurate assessment of progress toward achieving goals within each jurisdiction. Performance-based goals are included, in addition to goals based on TMDL targets, to measure the short-term jurisdictional progress toward achieving goals given that demonstrating sustained water quality improvement requires monitoring over time.

The Water Quality Improvement Plan interim and final goals for the City of San Diego for wet and dry weather are presented in Table 4-1 and Table 4-2, respectively. The final and interim numeric goals for the Tecolote Creek subwatershed were derived from TMDL targets identified in the Bacteria TMDL and incorporated into the MS4 Permit for freshwater creeks. As discussed in Appendix I, multiple compliance pathways are provided for the Bacteria TMDL. Water Quality Improvement Plan interim goals have been identified for each five-year assessment period and include Bacteria TMDL targets. Where Bacteria TMDL targets are not required, interim goals were estimated considering the planning and implementation efforts described above and in the strategies and schedules discussion (Sections 4.2 and 4.3). Performance-based goals were selected to measure short-term jurisdictional progress toward achieving goals during the current permit cycle.

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**Table 4-1
Tecolote Creek Subwatershed Wet Weather Goals for the City of San Diego**

Compliance Pathways		Baseline	Goals by Assessment Period and Fiscal Year					
			Current Permit Term (FY14 – FY18)	FY 16-20	FY 21-25	FY 26-30	FY 31-36	
			FY18	FY19	FY24 ¹	FY29	FY31 ¹	
Receiving Water % Days Exceeding WQO	Fecal coliform	75% Days Exceeding WQO (2002 TMDL Model)	See performance measures	75% ²	49%	36%	22%	
	Enterococcus	81% Days Exceeding WQO (2002 TMDL Model)		81% ²	51%	37%	22%	
OR								
MS4 Discharges % Days Exceeding WQO	Fecal coliform	Historical MS4 wet weather data will be used to identify the baseline in the first Water Quality Improvement Plan Annual Report	See performance measures	22%	22%	22%	22%	
	Enterococcus			22%	22%	22%	22%	
	Total coliform ³			22%	22%	22%	22%	
OR								
MS4 Discharges % Load Reduction	Fecal coliform	0% Load Reduction (2002 TMDL Model)	See performance measures	4.0%	9.0%	12.0%	17.9%	
	Enterococcus			3.0%	6.0%	8.0%	11.8%	
	Total coliform ³			2.0%	5.0%	7.0%	10.0%	
OR								
MS4 Discharges Implement Accepted Water Quality Improvement Plan	Metric for compliance analysis is MS4 discharge % load reduction (above). Interim compliance is implementation of strategies and schedule (presented in Appendix J) based on analysis results. Final compliance is implementation of BMPs based on analysis results and demonstration of compliance with any of the compliance pathways through monitoring and assessment. See Section 4.3.2 and Appendix K for compliance analysis results.							

**Table 4-1 (continued)
Tecolote Creek Subwatershed Wet Weather Goals for the City of San Diego**

Compliance Pathways	Baseline	Goals by Assessment Period and Fiscal Year					
		Current Permit Term (FY14 – FY18)	FY 16-20	FY 21-25	FY 26-30	FY 31-36	
		FY18	FY19	FY24 ¹	FY29	FY31 ¹	
OR							
MS4 Discharges # of Direct or Indirect MS4 Discharges to Receiving Water	Discharges	Number of flowing major MS4 outfalls during wet weather monitoring (Section 5 of this Water Quality Improvement Plan)	0	0	0	0	
OR							
% Exceedances of Final Receiving Water WQOs Due to Natural Sources ⁴	Fecal coliform	Unknown at this time. A detailed source study that differentiates between human and non-human sources would be needed to establish the baseline.	100%	100%	100%	100%	
	<i>Enterococcus</i>		100%	100%	100%	100%	

Table 4-1 (continued)
Tecolote Creek Subwatershed Wet Weather Goals for the City of San Diego

Compliance Pathways	Baseline	Goals by Assessment Period and Fiscal Year	
		Current Permit Term (FY14 - FY18)	
PERFORMANCE MEASURES			
Suite of Strategies to Measure Performance During First Permit Term	Baseline	FY18	
Develop a green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality during wet and dry weather	0 acres treated in 2002, the year used as baseline in the Bacteria TMDL	84.6 acres of drainage area treated through construction of 2 green infrastructure BMPs ⁵	

1. Denotes TMDL interim and final target.

2. Denotes existing wet weather frequency as modeled in the Bacteria TMDL. With limited baseline monitoring data available, this goal reflects a reasonable estimate considering the difficulty in demonstrating progress within the receiving water during wet weather in a short amount of time. Furthermore, development and redevelopment of the urban environment has occurred since the Bacteria TMDL baseline loads were calculated in 2001. As such, this goal demonstrates that progress has been made by the Responsible Agencies by maintaining the existing wet weather exceedance frequency.

3. Total coliform effluent limitations only apply to MS4 outfalls that discharge to the Tecolote Creek mouth.

4. Demonstration of exceedances of final receiving water limitations due to natural sources includes demonstration that pollutant loads from MS4s are not causing or contributing to exceedances.

5. The 84.6 acres of drainage area treated are associated with 2 green infrastructure projects that will be completed by FY18: (1) permeable pavement at Mt. Abernathy Road and Camber Drive draining 19.6 acres, and (2) permeable pavement at Bannock and Genesee Avenues draining 65 acres.

% = percent; FY = fiscal year; WQO = Water Quality Objective

All numeric goals are cumulative from the baseline assessment for each fiscal year.

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Table 4-2
Tecolote Creek Subwatershed Dry Weather Numeric Goals for the City of San Diego

Compliance Pathways		Baseline	Assessment Period and Fiscal Year		
			Current Permit Term (FY14-FY18)	FY 16-20	FY 21-25
			FY18	FY19 ¹	FY21 ¹
Receiving Water % Days Exceeding WQO	Fecal coliform	100% Days Exceeding WQO (2002 ²)	See performance measures	50%	0%
	<i>Enterococcus</i>	100% Days Exceeding WQO (2002 ²)		50%	0%
OR					
MS4 Discharges % Days Exceeding WQO	Fecal coliform	Historical MS4 dry weather data will be used to identify the baseline in the first Water Quality Improvement Plan Annual Report	See performance measures	0%	0%
	<i>Enterococcus</i>			0%	0%
	Total coliform ³			0%	0%
OR					
MS4 Discharges % Load Reduction	Fecal coliform	0% Load Reduction (2002 TMDL Model)	See performance measures	49.5%	98.4%
	<i>Enterococcus</i>			50.0%	99.9%
	Total coliform ³			50.0%	99.6%
OR					
MS4 Discharges Implement Accepted Water Quality Improvement Plan		Metric for compliance analysis is MS4 discharge % load reduction (above). Interim compliance is implementation of strategies and schedule (presented in Appendix J) based on analysis results. Final compliance is implementation of BMPs based on analysis results and demonstration of compliance with any of the compliance pathways through monitoring and assessment. See Section 4.3.2 and Appendix K for compliance analysis results.			

**Table 4-2 (continued)
Tecolote Creek Subwatershed Dry Weather Numeric Goals for the City of San Diego**

Compliance Pathways	Baseline	Assessment Period and Fiscal Year		
		Current Permit Term (FY14-FY18)	FY 16-20	FY 21-25
		FY18	FY19 ¹	FY21 ¹
OR				
# of Direct or Indirect MS4 Discharges to Receiving Water	Discharges	Number of persistently flowing major MS4 outfalls provided in Section 5.1 of the Monitoring and Assessment Program of this Water Quality Improvement Plan	See performance measures	0
OR				
% of Exceedances of Final Receiving Water WQOs Due to Natural Sources ⁴	Fecal coliform	Unknown at this time. A detailed source study that differentiates between human and non-human sources would be needed to establish the baseline.	100%	100%
	<i>Enterococcus</i>		100%	100%

**Table 4-2 (continued)
Tecolote Creek Subwatershed Dry Weather Numeric Goals for the City of San Diego**

Compliance Pathways	Baseline	Assessment Period and Fiscal Year	
		Current Permit Term (FY14-FY18)	
PERFORMANCE MEASURES			
Suite of Strategies to Measure Performance During First Permit Term	Baseline	FY18	
Develop a green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality during wet and dry weather	0 acres treated in 2002, the year used as baseline in the Bacteria TMDL	84.6 acres of drainage area treated through construction of 2 green infrastructure BMPs ⁵	
Implement runoff reduction programs such as targeted education and outreach efforts, enhanced inspections, additional rebate programs ⁶ , and increased enforcement	Historical dry weather monitoring data will be used to establish a baseline in the first Water Quality Improvement Plan Annual Report	10% reduction in prohibited ⁷ dry weather flow from baseline measured at persistently flowing outfalls in the WMA	

1. Denotes TMDL interim and final target.
 2. The existing exceedance frequency was calculated on the basis of available monitoring data between 1996 and 2002 per MS4 Permit requirements and presented in more detail in Appendix I.
 3. Total coliform effluent limitations only apply to MS4 outfalls that discharge to the Tecolote Creek mouth.
 4. Demonstration of exceedances of final receiving water limitations due to natural sources includes demonstration that pollutant loads from MS4s are not causing or contributing to exceedances.
 5. The 84.6 acres of drainage area treated are associated with 2 green infrastructure projects that will be completed by FY18: (1) permeable pavement at Mt. Abernathy Road and Camber Drive draining 19.6 acres, and (2) permeable pavement at Bannock and Genesee Avenues draining 65 acres.
 6. City of San Diego rebates include grass replacement, rainwater harvesting, downspout disconnect, and micro-irrigation.
 7. Does not include allowable discharges as defined in Provision A and Provision E.2.a of the MS4 Permit.
- % = percent; FY = fiscal year; WQO = Water Quality Objective
- All numeric goals are cumulative from the baseline assessment for each fiscal year.

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Caltrans is not permitted within the MS4 Permit; however, Caltrans is subject to similar requirements through its MS4 Permit (State Board, 2012b). Caltrans has voluntarily contributed to the Water Quality Improvement Plan effort to provide a consistent and subwatershed-wide approach to meeting applicable TMDL requirements. The baseline strategies are continuously implemented and augmented as resources become available.

Attachment IV to the Caltrans MS4 Permit outlines a methodology for prioritizing stream segments included in TMDLs to which Caltrans is subject. The permit establishes BMP implementation requirements, evaluated in terms of compliance units. Caltrans is expected to achieve 1,650 compliance units per year through the implementation of retrofit BMPs, cooperative implementation, and post-construction treatment beyond permit requirements.

Impaired reaches throughout the state will be prioritized on the basis of several factors, including, but not limited to, percent reduction needed, Caltrans drainage area contributing to the reach, and proximity to receiving waters. Reaches with metals TMDLs will likely be prioritized. This prioritization list is currently under negotiation between Caltrans Headquarters and the State Water Resources Control Board.

Caltrans' jurisdiction areas include roadways, land adjacent to roadways, and facilities; Caltrans' jurisdictional strategies specifically focus on BMP implementation to reduce known pollutants within these areas. Caltrans' strategies vary from those of other Responsible Agencies (in both type and name) to best address freeway characterization discharges from its right-of-way. Strategies include programs developed by Caltrans Headquarters for statewide execution and District 11 implementation. Caltrans' implementation of strategies within the WMA is dependent on legislative approval.

For Bacteria TMDLs, Caltrans is expected to eliminate dry weather flows by implementing control measures to ensure effective prohibition (Provision B.2 of the MS4 Permit). For wet weather flows, Caltrans is expected to implement control measures/BMPs to prevent discharge of bacteria from the right-of-way, including source control and preemptive activities such as street sweeping, cleanup of illegal dumping, and public education on littering. Implementation of these controls is per the TMDL prioritization list currently under development.

Caltrans' Water Quality Improvement Plan interim and final goals for wet weather are presented in Table 4-3. Caltrans Water Quality Improvement Plan interim and final goals for dry weather are presented in Table 4-4.

Table 4-3
Tecolote Creek Subwatershed Wet Weather Goals for Caltrans

Goals	Unit of Measure	Assessment Metric
MS4 Discharges	Cooperative Implementation Agreement	Achievement of compliance units by contributing funds to a cooperative implementation
OR		
MS4 Discharges	Implementation of Nonstructural BMPs	Continued implementation of wet weather nonstructural BMP activities within the watershed
OR		
MS4 Discharges	Implementation of Structural BMPs	Continued implementation of wet weather structural BMP activities for proposed projects within the watershed

Table 4-4
Tecolote Creek Subwatershed Dry Weather Goals for Caltrans

Goals	Unit of Measure	Assessment Metric
MS4 Discharges	Reduction in Dry Weather Flow	Elimination of dry weather flows by implementing control measure to ensure effective prohibition
OR		
MS4 Discharges	Implementation of Dry Weather BMPs	Implementation of drought-tolerant landscaping and conversion to smart irrigation controllers within the WMA

4.1.2 Scripps Subwatershed

4.1.2.1 Scripps Subwatershed Goals

The goals for the Scripps subwatershed were based on the applicable regulatory driver for each segment or drainage area. Five sub-basins discharge to the ASBS. Of those five sub-basins, four also discharge to a Bacteria TMDL-listed shoreline segment. As presented in Appendix I, the load reduction required to meet the Bacteria TMDL is an order of magnitude larger than that required for sediment under the ASBS Special Protections. Therefore, for the four sub-basins regulated by both the Bacteria TMDL and the ASBS Special Protections, implementing strategies that target bacteria load reductions is expected to meet and exceed the reductions necessary for sediment. The drainage areas that are subject to the Bacteria TMDL and/or the ASBS Special Protections are presented in Table 4-5 and Figure 4-1.

Table 4-5
Scripps Subwatershed Drainage Areas

Shoreline Segment or Area	Regulatory Driver
La Jolla Shores Beach at El Paseo Grande	TMDL & ASBS
La Jolla Shores Beach at Caminito del Oro	TMDL & ASBS
La Jolla Shores Beach at Vallecitos	TMDL & ASBS
La Jolla Shores Beach at Avenida de la Playa	TMDL & ASBS
La Jolla Shores at Princess St	ASBS
Casa Beach, Children's Pool	TMDL
South Casa Beach at Coast Boulevard	TMDL
Whispering Sands Beach at Ravina Street	TMDL
Windansea Beach at Vista de la Playa	TMDL
Windansea Beach at Bonair Street	TMDL
Windansea Beach at Playa del Norte	TMDL
Windansea Beach at Palomar Avenue	TMDL
Tourmaline Surf Park	TMDL
Pacific Beach at Grand Avenue	TMDL

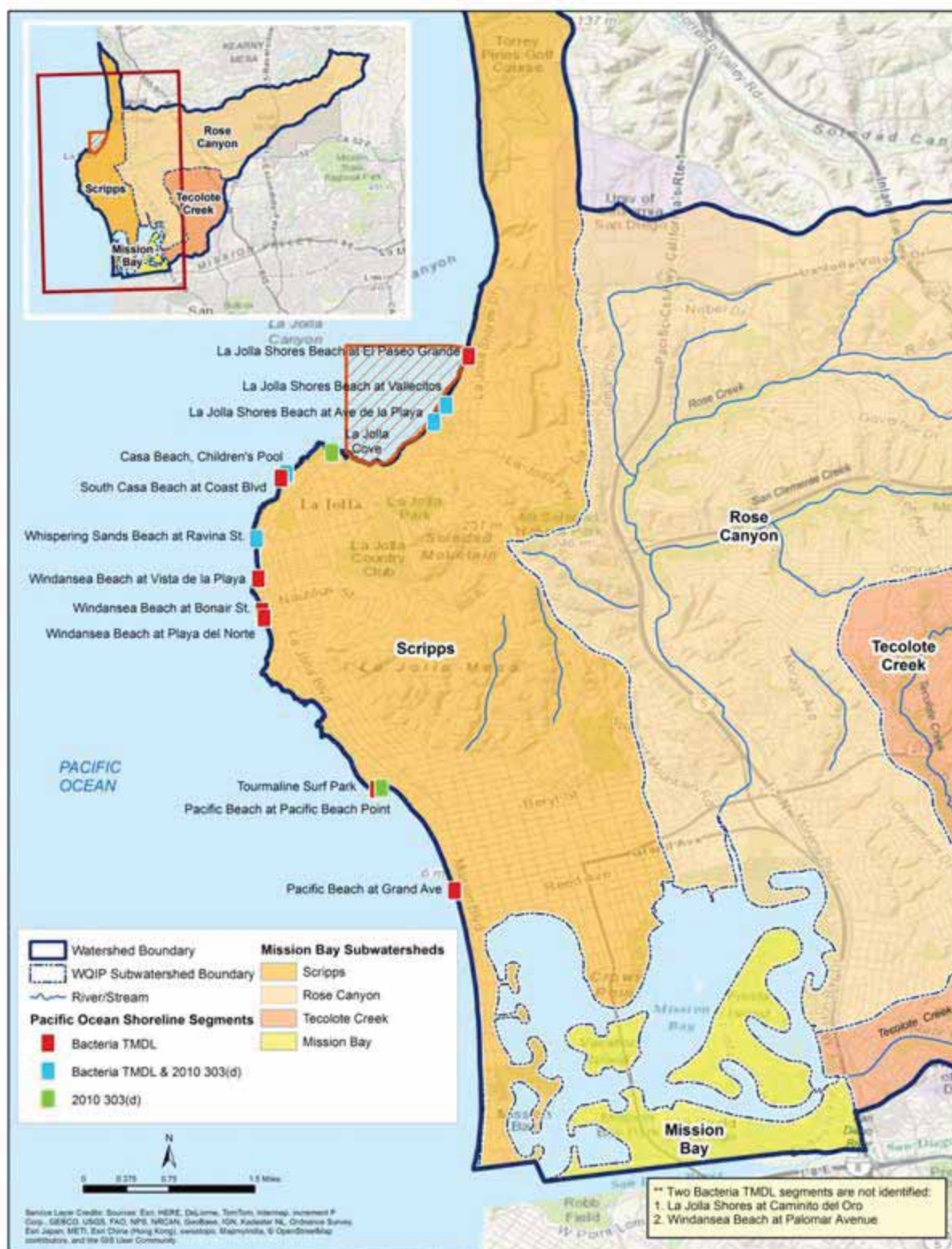


Figure 4-1
Scripps Subwatershed Bacteria TMDL-Listed Segments and ASBS Designation

The final and interim numeric goals for wet and dry weather are presented in Table 4-6 and Table 4-7, respectively. Multiple compliance pathways are provided. The receiving water goals (percent days exceeding a WQO) were translated into load reductions from the Mission Bay WMA and are two of the TMDL compliance pathways. In addition, actions providing that the Responsible Agencies are not causing or contributing to a receiving water exceedance (no direct or indirect discharge from the MS4, or exceedances within the receiving water that attributable to natural sources) are also pathways toward meeting compliance. Compliance can also be met by developing and implementing an accepted Water Quality Implementation Plan that incorporates BMPs required to meet receiving water or effluent goals using a watershed model or other watershed analytical tools to demonstrate compliance.

Water Quality Improvement Plan interim goals have been identified for each five-year assessment period and include Bacteria TMDL targets. Where Bacteria TMDL targets are not required, interim goals were estimated considering the planning and implementation efforts described above and in the strategies and schedules discussion (Sections 4.2 and 4.3). Performance-based goals were selected to measure short-term jurisdictional progress toward achieving goals during the current permit cycle.

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Table 4-6
Wet Weather Numeric Goals for the Scripps Subwatershed

Compliance Pathways		Applicable Drainages ¹	Baseline	Goals by Assessment Period and Fiscal Year				
				Current Permit Term (FY14 – FY18)	FY 16-20	FY 21-25	FY 26-30	FY 31-36
				FY18	FY19	FY24 ²	FY29	FY31 ²
Receiving Water % Days Exceeding WQO	Fecal coliform	TMDL	52% Days Exceeding WQO (2002 TMDL Model)	See performance measures	52% ³	37%	30%	22%
	Enterococcus				52% ³	37%	30%	22%
	Total coliform				52% ³	37%	30%	22%
OR								
MS4 Discharges % Days Exceeding WQO	Fecal coliform	TMDL	Historical MS4 wet weather data will be used to identify the baseline in the first Water Quality Improvement Plan Annual Report.	See performance measures	22%	22%	22%	22%
	Enterococcus				22%	22%	22%	22%
	Total coliform				22%	22%	22%	22%
OR								
MS4 Discharges % Load Reduction	Fecal coliform	TMDL	0% Load Reduction (2002 TMDL Model)	See performance measures	3.5%	5.0%	7.0%	10.0%
	Enterococcus	TMDL			2.0%	3.0%	5.0%	6.6%
	Total coliform	TMDL			2.0%	2.5%	4.0%	5.1%
	Sediment	ASBS			0.3%	0.3%	0.8%	0.6%
OR								
MS4 Discharges Implement Accepted Water Quality Improvement Plan		TMDL, ASBS	Metric for compliance analysis is MS4 discharge % load reduction (above). Interim compliance is implementation of strategies and schedule (presented in Appendix J) based on analysis results. Final compliance is implementation of BMPs based on analysis results and demonstration of compliance with any of the compliance pathways through monitoring and assessment. See Section 4.3.2 and Appendix K for compliance analysis results.					

Table 4-6 (continued)
Wet Weather Numeric Goals for the Scripps Subwatershed

Compliance Pathways	Applicable Drainages ¹	Baseline	Goals by Assessment Period and Fiscal Year					
			Current Permit Term (FY14 – FY18)	FY 16-20	FY 21-25	FY 26-30	FY 31-36	
			FY18	FY19	FY24 ²	FY29	FY31 ²	
OR								
MS4 Discharges # of Direct or Indirect MS4 Discharges to Receiving Water	Discharges	TMDL, ASBS	Number of flowing major MS4 outfalls during wet weather monitoring (Section 5 of this Water Quality Improvement Plan)	See performance measures	0	0	0	0
OR								
% Exceedances of Final Receiving Water WQOs Due to Natural Sources ⁴	Fecal coliform	TMDL, ASBS	Unknown at this time. A detailed source study that differentiates between human and non-human sources would be needed to establish the baseline.	100%	100%	100%	100%	100%
	<i>Enterococcus</i>			100%	100%	100%	100%	100%
	Total coliform			100%	100%	100%	100%	100%

**Table 4-6 (continued)
Wet Weather Numeric Goals for the Scripps Subwatershed**

Compliance Pathways	Baseline	Goals by Assessment Period and Fiscal Year
		Current Permit Term (FY14 – FY18)
PERFORMANCE MEASURES		
Suite of Strategies to Measure Performance During First Permit Term	Baseline	FY18
Develop a green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality during wet and dry weather	0 acres treated in 2002, the year used as baseline in the Bacteria TMDL	8.9 acres of drainage area treated through construction of 1 green infrastructure BMP ⁵

1. Denotes the regulatory driver triggering compliance within drainage areas. See Table 4-5 and Figure 4-1 to identify the applicable drainage areas.
 2. Denotes TMDL interim and final target.
 3. Denotes existing wet weather frequency as modeled in the Bacteria TMDL. With limited baseline monitoring data available, this goal reflects a reasonable estimate considering the difficulty in demonstrating progress within the receiving water during wet weather in a short amount of time. Furthermore, development and redevelopment of the urban environment has occurred since the Bacteria TMDL baseline loads were calculated in 2001. As such, this goal demonstrates that progress has been made by the Responsible Agencies by maintaining the existing wet weather exceedance frequency.
 4. Demonstration of exceedances of final receiving water limitations due to natural sources includes demonstration that pollutant loads from MS4s are not causing or contributing to exceedances.
 5. The 8.9 acres of drainage area treated are associated with 1 green infrastructure project that will be completed by FY18: (1) permeable pavement and bioretention at Kellogg Park draining 8.9 acres.
- All numeric goals are cumulative from the baseline assessment for each fiscal year.

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Table 4-7
Dry Weather Numeric Goals for the Scripps Subwatershed

Compliance Pathways		Baseline	Assessment Period and Fiscal Year		
			Current Permit Term (FY14-FY18)	FY 16-20	FY 21-25
Receiving Water % Days Exceeding WQO	Fecal coliform	15% Days Exceeding WQO (2002 ²)	FY18	FY19 ¹	FY21 ¹
	Enterococcus	13% Days Exceeding WQO (2002 ²)	See performance measures	7%	0%
	Total coliform	6% Days Exceeding WQO (2002 ²)		6%	0%
	OR				
MS4 Discharges % Days Exceeding WQO	Fecal coliform	Historical MS4 dry weather data will be used to identify the baseline in the first Water Quality Improvement Plan Annual Report	See performance measures	0%	0%
	Enterococcus			0%	0%
	Total coliform			0%	0%
OR					
MS4 Discharges % Load Reduction	Fecal coliform	0% Load Reduction (2002 TMDL Model)	See performance measures	49.5%	99.0%
	Enterococcus			50.0%	99.9%
	Total coliform			50.0%	99.8%
OR					
MS4 Discharges Implement Accepted Water Quality Improvement Plan		Metric for compliance analysis is MS4 discharge % load reduction (above). Interim compliance is implementation of strategies and schedule (presented in Appendix J) based on analysis results. Final compliance is implementation of BMPs based on analysis results and demonstration of compliance with any of the compliance pathways through monitoring and assessment. See Section 4.3.2 and Appendix K for compliance analysis results.			

Table 4-7 (continued)
Dry Weather Numeric Goals for the Scripps Subwatershed

Compliance Pathways	Baseline	Assessment Period and Fiscal Year		
		Current Permit Term (FY14-FY18)	FY 16-20	FY 21-25
		FY18	FY19 ¹	FY21 ¹
OR				
# of Direct or Indirect MS4 Discharges to Receiving Water	Discharges	Number of persistently flowing major MS4 outfalls provided in Section 5.1 of the Monitoring and Assessment Program of this Water Quality Improvement Plan	0	0
OR				
% of Exceedances of Final Receiving Water WQOs Due to Natural Sources ³	Fecal coliform	Unknown at this time. A detailed source study that differentiates between human and non-human sources would be needed to establish the baseline.	100%	100%
	<i>Enterococcus</i>		100%	100%
	Total coliform		100%	100%

**Table 4-7 (continued)
Dry Weather Numeric Goals for the Scripps Subwatershed**

Compliance Pathways	Baseline	Assessment Period and Fiscal Year	
		Current Permit Term (FY14-FY18)	
PERFORMANCE MEASURES			
Suite of Strategies to Measure Performance During First Permit Term	Baseline	FY18	
Develop a green infrastructure policy, attain City Council approval, and construct green infrastructure BMPs to improve water quality during wet and dry weather	0 acres treated in 2002, the year used as baseline in the Bacteria TMDL	8.9 acres of drainage area treated through construction of 1 green infrastructure BMP ⁴	
Implement runoff reduction programs such as targeted education and outreach efforts, enhanced inspections, additional rebate programs ⁵ , and increased enforcement	Historical dry weather monitoring data will be used to establish a baseline in the first Water Quality Improvement Plan Annual Report	10% reduction in prohibited ⁶ dry weather flow from baseline measured at persistently flowing outfalls in the WMA	

1. Denotes TMDL interim and final target.
 2. The existing exceedance frequency was calculated based on available monitoring data between 1996 and 2002 per MS4 Permit requirements and presented in more detail in Appendix 1.
 3. Demonstration of exceedances of final receiving water limitations due to natural sources includes demonstration that pollutant loads from MS4s are not causing or contributing to exceedances.
 4. The 8.9 acres of drainage area treated are associated with 1 green infrastructure project that will be completed by FY18: (1) permeable pavement and bioretention at Kellogg Park draining 8.9 acres.
 5. City of San Diego rebates include grass replacement, rainwater harvesting, downspout disconnect, and micro-irrigation.
 6. Does not include allowable discharges as defined in Provision A and Provision E.2.a of the MS4 Permit.
- All numeric goals are cumulative from the baseline assessment for each fiscal year.

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As stated in Section 4.1, compliance with Water Quality Improvement Plan goals is met by achieving any one of the goals presented in the goal tables during an assessment period. One of the compliance pathways is implementing a Water Quality Improvement Plan that demonstrates that the selected strategies will meet the goals. Within the Mission Bay WMA, a compliance analysis using a watershed model was conducted to identify the strategies required to be implemented to meet interim and final goals. Modeling described in the following sections demonstrates that the jurisdictional strategies presented in Section 4.2 will meet the jurisdictional goals, expressed as a load reduction from the jurisdiction's MS4.

For efficiency, the modeling analysis to assess the load reduction and BMP optimization considered the entire subwatershed, including the ASBS drainage area (not including the southern area that drains to Mission Bay). The final jurisdiction goal, 9.6 percent load reduction of fecal coliform, was used as the target for BMP implementation across the subwatershed. Strategy implementation may occur City-wide or within targeted drainage areas of the Scripps subwatershed, but amounts were quantified cumulatively across the subwatershed to provide assurance that implementation would meet the goals. This approach also provides additional assurance shoreline goals will be met, as dispersion along the shoreline between the very small coastal drainages may affect water quality. The receiving water goals will be assessed only at the Bacteria TMDL segments.

4.2 Strategies

The Responsible Agencies were tasked with identifying water quality improvement strategies that may be implemented to address the highest priority water quality conditions. The strategies were selected on the basis of their ability to effectively and efficiently eliminate non-storm water discharges to the MS4, reduce pollutants in storm water discharges from the MS4 to the MEP, and achieve the interim and final numeric goals identified in Section 4.1. A compliance analysis was completed using a watershed simulation and BMP optimization model developed for the Tecolote and Scripps subwatersheds to quantify load reductions to support evaluation of TMDL compliance and select the most cost-effective BMP strategy for implementation. The compliance analysis modeled the outcome of applying a set of strategies to the watershed in the most cost-effective order, and demonstrated that implementation of the strategies would result in achievement of interim and final goals.

A brief description of the strategy selection process is provided in Section 4.2.1. A general discussion of nonstructural strategies, such as MS4 maintenance and street sweeping, administrative policies, enforcement of municipal ordinances, education and outreach programs, rebate and incentive programs, and collaboration with WMA partners, is presented in Section 4.2.2. Structural strategies are those strategies that can improve water quality by removing pollutants through physical means such as filtration and infiltration and are introduced in Section 4.2.3. A description of selected nonstructural and structural strategies selected by each Responsible Agency to target the highest priority water quality conditions by jurisdiction is presented in Section 4.2.4.

A comprehensive list of strategies, including the method for implementing each strategy, the cost, and Mission Bay WMA partners included in the effort, is presented in Appendix J. Strategies implemented on a WMA scale or through collaboration with WMA partners are discussed in more detail in Section 4.2.5. The modeling results, or outcome of the implementation of the strategies selected in terms of percent load reduction, are presented in Appendix K. Section 4.3 presents a summary of the compliance analysis results to demonstrate the anticipated progress toward achieving the interim and final goals.

4.2.1 Strategy Selection

A list of potential strategies (nonstructural and structural) was developed by the Responsible Agencies on the basis of JRMP activities and enhancements to JRMP activities, and augmented by public input and discussion with the Mission Bay WMA Consultation Committee (Mission Bay WMA Responsible Agencies, 2014). This list was used as a guide by each Responsible Agency to identify strategies appropriate for its jurisdiction.

Strategy selection considered the following:

- ❖ Emphasis was given to strategies that target highest priority water quality conditions and those that provide multiple benefits.
- ❖ The Responsible Agencies considered the triple bottom line, evaluating the environmental, economic, and social components of the strategies.
- ❖ Strategies that improve and promote cooperation and collaboration between the Responsible Agencies and other governmental agencies (WMA groups, Caltrans, water districts, school districts) and other entities, such as private or non-profit organizations, were also prioritized. Responsible Agencies are continually collaborating with internal jurisdictional departments, and these collaborating entities are presented in the jurisdictional strategies table, as well.

The City of San Diego and Caltrans evaluated their existing programs, the potential for incorporating enhancements and new administrative programs, and the types of structural BMPs that may be considered, if warranted and appropriate for the jurisdiction. The City of San Diego evaluated all aspects of its JRMP, which provided the necessary background for existing nonstructural solutions and selected areas where enhanced or restructured activities may provide a greater benefit to water quality. Similarly, Caltrans evaluated the programs and practices required within its statewide Storm Water Management Plan (SWMP) Annual Report and District 11 Work Plan to identify existing nonstructural strategies and potential enhancements.

Efficiency in pollutant reduction is based partly on identifying the known and suspected areas or sources likely to be contributing to the highest priority water quality conditions and targeting those sources. To assist in the geographical identification of sources, watershed modeling and GIS tools were used to estimate the relative bacteria loading within the Mission Bay WMA, land ownership and availability of public land for implementation, and physical watershed characteristics such as slope and soil types for BMP selection. Appendix K provides additional information on strategy selection, including a description of the prioritization of drainage areas within Tecolote Creek and Scripps subwatersheds by bacteria loading, implementation assumptions used to estimate strategy effectiveness within the simulation models, and results of the modeling efforts, such as anticipated load reductions by strategy, subwatershed, jurisdiction, and pollutant.

4.2.2 Nonstructural Strategy Descriptions

Nonstructural strategies are defined as those actions and activities that are intended to reduce storm water pollution and that do not involve construction or implementation of a physical structure to filter and treat storm water. These strategies are also considered nonstructural by the nature of their programmatic implementation. MS4 maintenance and street sweeping, administrative policies, creation and enforcement of municipal ordinances, education and outreach programs, rebate and other incentive programs, and cooperation and collaboration with other WMA or regional partners are examples of nonstructural strategies. Jurisdictions across the region have implemented these types of programs for many years, either in response to MS4 Permit requirements or in response to jurisdiction- or WMA-specific needs (Regional Board, 2013).

The combination of existing efforts and new or enhanced efforts determines the final, expected load reduction (Figure 4-2). Fundamentally, strategies were chosen on the basis of their expected effectiveness in reducing pollutant sources and targeting pollutant-generating activities (PGAs) of concern in the Mission Bay WMA, and their suitability for and potential for implementation by the Responsible Agencies.

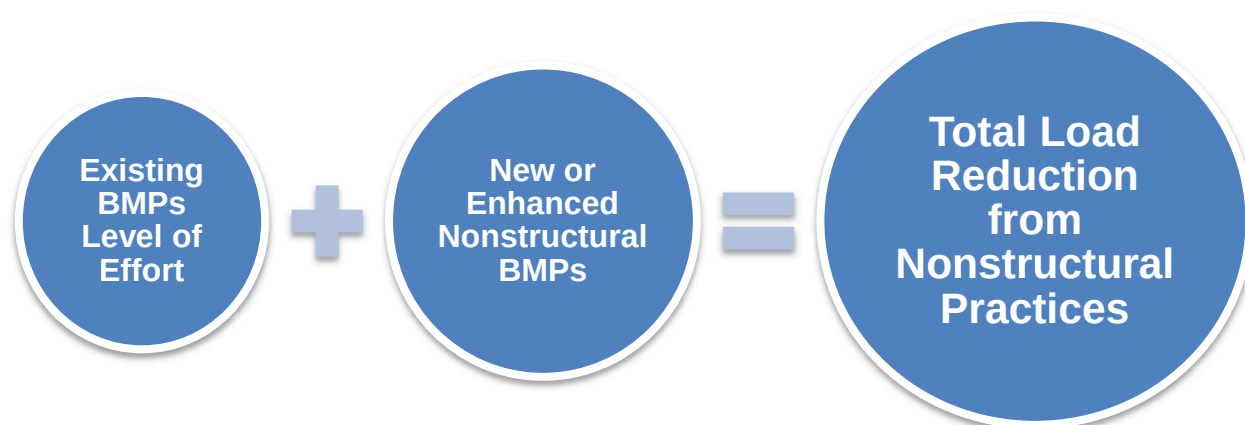


Figure 4-2
Determining Total Load Reduction from Nonstructural Strategies

The list of nonstructural strategies for each Responsible Agency is based on the following:

- ❖ Existing programs or actions that the Responsible Agencies are already implementing or must implement based on MS4 Permit requirements
- ❖ Opportunities for enhancing and refining existing programs or actions
- ❖ Identification of new actions or initiatives that are effective or potentially effective in other areas or programs

It is challenging to accurately quantify most nonstructural BMP benefits in terms of pollutant load reductions because quantification generally requires extensive survey and monitoring information. In addition, nonstructural strategies may target pollutants, land uses, or populations, resulting in different load reductions, depending on the implementation technique. Nevertheless, the modeling completed and discussed further in Appendix K estimates the effectiveness of current and future levels of implementation of select nonstructural strategies, building on the previous CLRP I and II efforts and using best available information. Nonstructural strategies that cannot be effectively modeled to determine their quantifiable benefits are referred to as non-modeled nonstructural strategies (Section 4.2.2.1). The nonstructural strategies with sufficient supporting data to estimate associated load reductions through modeling are discussed in Section 4.2.2.2.

4.2.2.1 Non-Modeled Nonstructural Strategies

Most nonstructural strategies implemented by the City of San Diego are part of the City's JRMP. The MS4 Permit requires Responsible Agencies to control the contribution of pollutants to the MS4 and the discharges from the MS4 within their jurisdictions through JRMPs (MS4 Permit Provision E). The MS4 Permit requires the jurisdictions to identify the strategies being implemented by JRMP Provisions E.2 through E.7 as part of the Water Quality Improvement Plan for the highest priority water quality conditions. Caltrans is not included under the MS4 Permit; however, Caltrans is subject to similar requirements through its MS4 Permit (State Board, 2012b). Caltrans' strategies vary from those of the City (in both type and name) to best address typical discharges from its jurisdictions. Caltrans has voluntarily contributed to the Water Quality Improvement Plan effort to provide a consistent and subwatershed-wide approach to meeting applicable Bacteria TMDL requirements, as resources are available. Additional information on Caltrans' required programs is provided in its MS4 Permit (State Board, 2012b).

Nonstructural strategies may be broad, overarching administrative programs or activities targeting specific sources. The MS4 Permit provides guidelines for Responsible Agency implementation of each program; however, the programs are implemented differently depending on the unique characteristics of each jurisdiction. In implementing the Water Quality Improvement Plan, the Responsible Agencies will implement strategies within their JRMPs with a specialized approach to best achieve the numeric goals and meet permit requirements within their jurisdictions. Because the MS4 Permit provides flexibility in selecting strategies, jurisdictions may prioritize different strategies within their JRMPs, to more effectively achieve pollutant reductions.

For those nonstructural strategies where sufficient data existed to support modeling of effectiveness, load reductions were quantified. Those strategies are described in Section 4.2.2.2. The effectiveness of most nonstructural strategies, e.g., those non-modeled nonstructural strategies covered in this section, are difficult to quantify through modeling; however, the relative benefit associated with water chemistry, physical, and biological improvements for each of these non-modeled nonstructural strategies is shown in Table 4-9.

Table 4-8 describes the JRMP strategy categories. The relative benefit associated with water chemistry, physical, and biological improvements achieved by strategy implementation is presented in Table 4-9. The assumptions represent best professional judgment based on literature reviews, practical experience, and stakeholder input. The strategy benefits outlined in Table 4-9 are dependent on site characteristics, implementation, and the target pollutant of the program or strategy. Although the benefits are variable, estimates of the relative pollutant reduction benefits are provided for comparative evaluation. A compilation of references used to estimate the overall, relative benefit is included in Appendix L. Table 4-9 identifies the primary benefits (●), the secondary benefits (◐), and the potential benefits that the strategy does not address (○). Estimated benefits assume typical design, land use, and geography, but can be modified to target pollutants or site-specific needs. For additional information on JRMP implementation, see each Responsible Agency's JRMP document (to be submitted in June 2015).

Table 4-8
Categories of JRMP Nonstructural Strategies

Strategy Category	Strategy Description
Development Planning	Uses Responsible Agencies' land use and planning authority to require implementation of BMPs to address effects from new development and redevelopment.
Construction Management	Addresses pollutant generation from construction activities associated with new development or redevelopment.
Existing Development	Addresses pollutant generation from existing development, including commercial, industrial, municipal, and residential land uses. Includes stream, channel, and habitat restoration and retrofitting in areas of existing development.
Illicit Discharge, Detection, and Elimination (IDDE) Program	Actively detects and eliminates illicit discharges and improper disposal of wastes into the MS4.
Public Education and Participation	Promotes and encourages behaviors to reduce pollutant discharges. Describes opportunities for public participation in water quality improvement planning.
Enforcement Response Plan	Describes escalating enforcement measures for each JRMP component.

**Table 4-9
JRMP Nonstructural Strategy Benefits**

STRATEGY	Average Water Chemistry Benefit ¹									Physical and Biological Benefit			
	Bacteria ²	Metals	Organics	Sediment ²	Pesticides	Nutrients	Oil and Grease	Dissolved Solids	Trash	Flow Rate	Volume Reduction	Habitat/ Wildlife	Aquatic Life
Development Planning													
All Development Projects	Benefit varies by source control or low-impact development (LID) BMP type: Refer to Table 4-11 for a discussion of structural benefits.												
Priority Development Projects (PDPs)	●	●	●	●	●	●	●	●	●	●	●	●	●
Construction Management	○	○	○	●	○	○	●	○	●	●	●	○	●
Existing Development													
Commercial, Industrial, Municipal, and Residential Minimum BMP Requirements and Facility and Area Inspections	●	●	●	●	●	●	●	●	●	●	●	●	●
MS4 Infrastructure Maintenance (including Catch Basin Cleaning)	●	○	○	●	●	●	○	○	○	○	○	○	●
Roads, Streets, and Parking Lots Maintenance (including Street Sweeping)	●	●	●	●	○	●	○	●	●	○	○	○	●

Table 4-9 (continued)
JRMP Nonstructural Strategy Benefits

STRATEGY	Average Water Chemistry Benefit ¹									Physical and Biological Benefit			
	Bacteria ²	Metals	Organics	Sediment ²	Pesticides	Nutrients	Oil and Grease	Dissolved Solids	Trash	Flow Rate	Volume Reduction	Habitat/ Wildlife	Aquatic Life
Pesticide, Herbicides, and Fertilizer Program	○	○	●	○	●	●	○	○	○	○	○	◐	●
Retrofit and Rehabilitation in Areas of Existing Development	<i>Varies by development area; potential benefit for all conditions.</i>												
IDDE Program	<i>Benefit varies; potential benefit for all conditions.</i>												
Public Education and Participation	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐
Enforcement Response Plan	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐

1. For references for the water chemistry benefits for each strategy, refer to Appendix L.

2. Orange-shaded cells indicate highest priority water quality condition for the Mission Bay WMA.

Responsible Agencies have also identified additional strategies that fall outside of a JRMP category. These additional strategies are not required by MS4 Permit Provision E, but the Responsible Agency has identified them as potentially effective in addressing priority water quality conditions within its jurisdiction. They may not be appropriate or effective within all jurisdictions.

The effectiveness of non-modeled, nonstructural strategies is difficult to quantify. Therefore, assigning a load reduction to each strategy or a suite of strategies is difficult. For the BMPs that are not represented in the model, a conservative load reduction of 10 percent is allocated. A 10 percent load reduction for nonstructural activities was estimated by averaging the range of measured and anticipated pollutant removal from the list of City of San Diego nonstructural strategies. Strategies were categorized as “high” percent removal, those with greater City control (operation and maintenance of MS4 infrastructure), or “low” percent removal, those requiring public behavior changes. The range of pollutant load reduction was as low as approximately 2 percent and as high as 72 percent. The overall average percent removal for all constituents and all activities is 10.1 percent. The average bacteria removal from the list of strategies was 11.7 percent (HDR, 2014).

4.2.2.2 Modeled Nonstructural Strategies

While the effectiveness of most nonstructural strategies is difficult to quantify, the pollutant and flow reduction benefits from rain barrels, downspout disconnections, and irrigation runoff reduction practices were estimated using quantitative methods, as described in Appendix K. The general effectiveness of each strategy was identified. The implementation assumptions, such as the number of rain barrels implemented per year, were then modeled independently of other nonstructural strategies because of their quantifiable properties. Appendix K describes the modeling process for the nonstructural strategies for each Responsible Agency. Because Caltrans’ jurisdiction primarily consists of roadways, rain barrels and other incentive programs are not applicable.

Table 4-10
Modeled Nonstructural Strategies

Modeled Nonstructural Strategy¹	Strategy Description	Example Photograph
Rain Barrels Incentive Program	Capturing storm water from rooftops in residential rain barrels is a simple method to reduce demand on the potable water system and help prevent pollution by reducing the amount of runoff entering municipal storm drain systems. Retained runoff can be reused for irrigation, or when reuse is not possible, the retained flows can be slowly released after a period of storage. Any released flows can be routed through landscaped areas, in which runoff load reduction can be attained through the processes of infiltration and evapotranspiration, or to bioretention BMPs as part of a treatment train. Through its residential BMP rebate program, the City of San Diego offers residential customers a cash-back rebate of \$1.00 for every gallon of rain barrel storage capacity up to 400 gallons. Other rebate programs offered by regional water agencies and promoted by Responsible Agencies are also available.	
Downspout Disconnection Incentive Program	Implementing a downspout disconnection incentive program can promote load reductions by routing runoff over pervious surfaces, such as landscaped or grassed areas, rather than directly connected areas such as rooftops, where runoff flows onto sidewalks. Downspout disconnections provide a similar watershed impact as rain barrels and downspout disconnections are modeled similarly.	

Table 4-10 (continued)
Modeled Nonstructural Strategies

Modeled Nonstructural Strategy¹	Strategy Description	Example Photograph
Irrigation Runoff Reduction and Grass Replacement	This nonstructural BMP, which doubles as a water conservation initiative, incorporates good landscaping practices to limit irrigation runoff. Grass Replacement transforms areas with grasses that require regular irrigation to other, native pervious cover that does not require regular irrigation. The irrigation efficiency program sets the goal of eliminating irrigation overspray practices over the course of the 20-year implementation period.	

1. Assumptions about the modeling process and the extent of implementation are in Appendix K.

4.2.3 Structural Strategy Descriptions

Structural strategies can be used strategically throughout the contributing watershed to improve water quality by removing pollutants through a variety of chemical, physical, and biological processes, including filtration and infiltration. The effectiveness and feasibility of implementing different types of BMPs should be carefully considered in regard to the BMP impact and cost to implement and maintain. Long-term structural BMP effectiveness is often dependent on the successful construction and routine maintenance of each BMP. Note that there are many areas in the Mission Bay WMA that contain low-infiltrating soils types. These factors were acknowledged by the Responsible Agencies through consideration of non-infiltrating BMP systems in these areas such as detention ponds, wetlands, and bioretention and permeable pavement with underdrains, as well as through consideration of channel restoration projects or source control strategies. Before implementing structural strategies, Responsible Agencies will consult with appropriate resource agencies (e.g., California Coastal Commission, California Department of Fish and Wildlife, Fish and Wildlife Service, National Marine Fisheries Service, etc.) and will obtain required permits as necessary. Further, Responsible Agencies will identify and apply “lessons learned” during project development and post-development monitoring. Feasibility of maintenance and inspection will be incorporated in the design and site selection stages to ensure that structural BMPs meet engineered specifications and can be maintained for the life of the BMP without difficulty.

Similar to nonstructural strategies, structural strategies (BMPs) were chosen on the basis of their expected effectiveness in reducing pollutant sources and targeting PGAs of concern in the Mission Bay WMA and their suitability and potential for implementation by the Responsible Agencies.

Potential structural strategies were broken into three categories based on scale and overall function: (1) green infrastructure, (2) multiuse treatment areas, and (3) water quality improvement BMPs (Figure 4-3). These categories and their respective levels of implementation in the Mission Bay WMA are discussed in detail in the following sections.

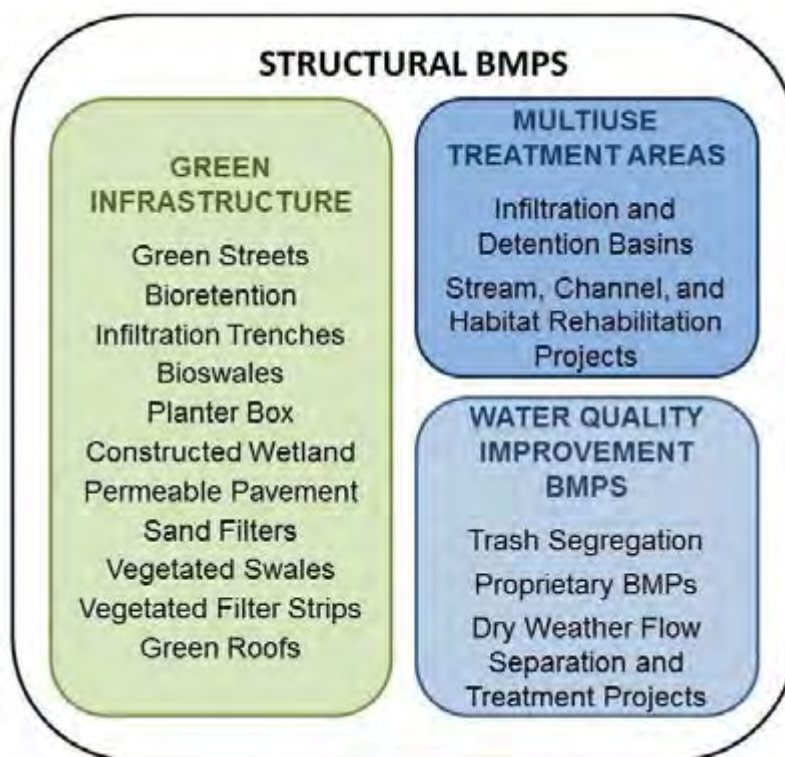


Figure 4-3
Summary of Structural Strategy Categories

Modeling was used to estimate the effectiveness of already-implemented structural BMPs and future levels of implementation of select structural BMPs, building on the previous CLRP I and II efforts and using best available information. Modeling assumptions and results are further detailed in Appendix K.

Table 4-11 provides the relative benefit to water quality improvement by structural BMP type. Although the benefits are variable, estimates of the relative pollutant reduction benefits are provided for comparative reference. As for the nonstructural benefits, these estimates are based on best professional judgment from literature reviews, practical experience, and stakeholder input. The site characteristics, BMP implementation, and pollutant of concern all influence the BMP benefits. Routine maintenance of these

structural strategies also significantly impacts their benefits. A compilation of references used to estimate the overall, relative benefit is included in Appendix L. Table 4-11 identifies the primary benefits (●), the secondary benefits (◐), and the potential benefits that the strategy does not address (○). Estimated benefits assume typical design, land use, and geography, but can be modified to target pollutants or site-specific needs.

Table 4-11
Structural Strategies Benefits

STRUCTURAL STRATEGY	Water Chemistry Benefit ¹									Physical and Biological Benefit			
	Bacteria ²	Metals	Organics	Sediment ²	Pesticides	Nutrients	Oil and Grease	Dissolved Solids	Trash	Flow Rate	Volume Reduction	Habitat/ Wildlife	Aquatic Life
Green Infrastructure													
<i>Green Infrastructure Outside the Right-of-Way</i>													
Bioretention	●	●	●	●	●	◐	●	◐	●	●	●	○	◐
Infiltration Trenches	●	●	●	●	●	●	●	●	●	●	●	○	●
Bioswales	●	●	●	●	●	◐	●	◐	●	●	●	○	◐
Planter Boxes	●	●	●	●	●	◐	●	◐	●	◐	◐	○	◐
Permeable Pavement	◐	●	◐	●	●	◐	◐	◐	◐	●	●	○	◐
Constructed Wetlands	●	●	◐	●	●	●	◐	◐	●	●	◐	●	◐
Sand Filters	●	●	●	●	●	◐	●	○	●	◐	◐	○	◐
Vegetated Swales	◐	◐	◐	●	◐	◐	◐	○	●	◐	◐	○	◐
Vegetated Filter Strips	◐	◐	◐	●	◐	◐	◐	○	●	◐	◐	○	◐
Green Roofs	◐	◐	○	●	○	○	○	○	○	●	◐	○	◐
Green Streets													
Green Streets	●	●	●	●	●	◐	●	◐	●	●	●	○	◐

Table 4-11 (continued)
Structural Strategies Benefits

STRUCTURAL STRATEGY	Water Chemistry Benefit ¹									Physical and Biological Benefit			
	Bacteria ²	Metals	Organics	Sediment ²	Pesticides	Nutrients	Oil and Grease	Dissolved Solids	Trash	Flow Rate	Volume Reduction	Habitat/ Wildlife	Aquatic Life
Multiuse Treatment Areas													
Infiltration and Detention Basins	●	●	●	●	●	●	●	●	●	●	●	○	●
Stream, Channel, and Habitat Rehabilitation Projects	Varies by project												
Water Quality Improvement BMPs													
Trash Segregation, Proprietary BMPs, and Dry Weather Flow Separation and Treatment Projects	Varies by project												

1. References for the water chemistry benefits for each strategy are in Appendix L.
2. Orange-shaded cells indicate the highest priority water quality condition for the Mission Bay WMA.

4.2.3.1 Green Infrastructure

A critical consideration in selecting and evaluating structural BMPs is scale. A critical consideration in selecting and evaluating structural BMPs is scale. Green infrastructure refers to structural BMPs that are built within the landscape at the site scale, which often requires retrofit of site designs to accommodate the rerouting and positioning of BMPs onsite. Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provide habitat, flood protection, and cleaner water, and may also benefit the environment through cleaner air. At the scale of a neighborhood or site, green infrastructure includes storm water management systems such as bioretention areas, permeable pavements, and green roofs that use natural processes to soak up, store, and treat water.

Green infrastructure typically incorporates multiple BMPs using the natural features of the site in conjunction with the goal of the site development. Multiple BMPs can be incorporated into the site development to complement and enhance the proposed layout, while also providing water quality treatment and runoff volume reduction. Green infrastructure practices provide control and treatment of storm water runoff on or near locations where the runoff initiates. The most common and effective green infrastructure BMPs implemented by the Responsible Agencies are listed in Table 4-12. Rain barrels are covered programmatically as a nonstructural strategy, but are also commonly incorporated as multi-benefit components of green infrastructure systems.

Table 4-12
Common Green Infrastructure Strategies

Green Infrastructure BMP	BMP Description	Example Photograph
Bioretention	Shallow vegetated features constructed in green spaces alongside roads, sidewalks, and other paved surfaces. Bioretention includes an engineered soil media designed to encourage pollutant treatment and water storage.	
Infiltration Trenches	Narrow, linear BMPs that have functions similar to those of bioretention areas with variable surface materials, including rock or decorative stone, designed to allow storm water to infiltrate into subsurface soils.	

Table 4-12 (continued)
Common Green Infrastructure Strategies

Green Infrastructure BMP	BMP Description	Example Photograph
Bioswales	Shallow, open channels designed to reduce runoff volume through infiltration and pollutant removal by filtering water through vegetation within the channel and infiltration into bioretention soil media. Bioswales can serve as a storm water conveyance, but the primary objective is water quality enhancement (often referred to as linear bioretention).	
Planter Box	Fully contained system containing soil media and vegetation that functions similarly to a small biofiltration BMP, but includes an impermeable liner and underdrain.	
Constructed Wetland	Engineered, shallow marsh system designed to control and treat storm water runoff. Particle-bound pollutants are removed through settling and other pollutants are removed through biogeochemical activity.	
Permeable Pavement	Material that allows streets, parking lots, sidewalks, and other impervious covers to retain their natural infiltration capacity while maintaining the structural and functional features of the materials they replace. Roads such as highways can include permeable friction course (PFC) overlays that provide water quality benefits when traditional permeable pavement is not suitable.	

Table 4-12 (continued)
Common Green Infrastructure Strategies

Green Infrastructure BMP	BMP Description	Example Photograph
Sand Filters	Treatment systems that remove particulates and solids from storm water runoff by facilitating physical filtration.	
Vegetated Swales	Shallow, open channels that are designed primarily for storm water conveyance. Pollutants such as trash and debris are removed by physically straining/filtering water through vegetation in the channel.	
Vegetated Filter Strips	Bands of dense, permanent vegetation with a uniform slope, designed to provide pretreatment of runoff generated from impervious areas before it flows into another BMP as part of a treatment train.	
Green Roofs	Roofing systems that layer a soil/vegetative cover over a waterproofing membrane and can reduce runoff through interception and evapotranspiration.	

Green infrastructure can provide water quality and community benefits at the site scale outside of the right-of-way or within the public street right-of-way (green streets). The following subsections discuss implementation of green infrastructure in these two settings.

Green Infrastructure Outside the Right-of-Way

Any single BMP or a combination of the BMPs listed in Table 4-12 can be applied at the site scale to capture and treat storm water runoff at the source. These potential small-scale projects are important to the WMA as a whole when incorporated near the top of the watershed because collectively they can provide an effective means toward pollutant load reduction, while also attenuating peak flow, reducing discharge volume, and providing aesthetic value and improved habitat quality. These potential small-scale BMPs can be implemented on public parcels by municipalities or incorporated into Priority Development Projects (PDPs) and redevelopment activities on private parcels. Examples of potential existing development retrofits for green infrastructure BMPs outside the right-of-way include converting parking lot medians into planter boxes and asphalt into permeable pavements.

A large portion of the impervious areas on most parcels, regardless of land use type, consists of a combination of parking lots and roof tops. Those areas can often be treated using a system of green infrastructure implemented in landscape areas and replacing hardscape with comparable permeable materials (see examples in Figure 4-4 and Figure 4-5). Other options for treatment to be considered for areas outside the right-of-way are green roofs, infiltration trenches, sand filters, vegetated filter strips, and vegetated swales.



Figure 4-4
Bioretention Areas in Parking Lots and Adjacent to Buildings Provide Multiple Benefits by Treating Runoff While Also Serving as Landscape Features and Habitat



Figure 4-5
Permeable Pavement Functions as a Parking and Driving Surface While Capturing and Treating Storm Water

Green Infrastructure in the Right-of-Way (Green Streets)

Green streets can consist of multiple BMP types implemented in a linear fashion within the road right-of-way. Placing BMPs within the right-of-way provides an additional opportunity to treat urban storm water runoff, attenuate peak flow, and reduce discharge volume while improving community pride, land value, and habitat quality. Given that green streets are in the right-of-way, they have no land acquisition costs and are more conveniently accessed for maintenance activities. Green streets also provide the added benefit of treating runoff from both the roadway and contributing parcel.

The most common approaches for green streets include bioretention areas located between the edge of the pavement and the edge of the right-of-way and permeable pavement installed in parking lanes. The configuration of the street, particularly the presence of curb and gutter, locations of underground utilities, road classifications, and sidewalk, parking, and right-of-way widths, often dictates the configuration of green streets. Options are presented below for streets with and without curb and gutter.

Streets With Curb and Gutter

Curb and gutter is often used to provide a clear delineation between the travel lanes and the parkway area of the right-of-way. With this configuration, storm water is often treated through permeable pavement in the parking lanes and bioretention areas in the space between the back of the curb and the sidewalk. Figure 4-6 provides examples of green infrastructure in the parking area and parkway within the right-of-way.



Figure 4-6
Examples of Bioretention and Permeable Pavement in the Right-of-Way
With Curb and Gutter

Streets Without Curb and Gutter

Streets without curb and gutter provide direct connection for diffused runoff to be treated within the right-of-way. Often, without the delineation provided by curb and gutter, the right-of-way at the edge of the travel lane can become compacted and eventually cause erosion concerns. Implementing green street concepts can provide an opportunity to stabilize those areas using permeable pavers, as shown in Figure 4-7, or bioretention areas.



Figure 4-7
Permeable Pavers in the Right-of-Way Without Curb and Gutter

Example Green Infrastructure Project Within the Right-of-Way

The Bannock Avenue Green Street Retrofit Project, which is currently nearing completion, implements several surface and subsurface low-impact development (LID) BMP components to manage flows from a 20-acre drainage area. The plans include installing bioretention areas, treatment planters, and pervious pavement systems within the City's rights-of-way to treat the 85th percentile storm for the drainage area, reducing bacteria, heavy metal, nutrient, pesticide, and sediment loadings to Tecolote Creek (Figure 4-8).



Figure 4-8
Bannock Avenue During Construction

The project's initial design analysis included innovative use of the System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN) model to optimize BMP combinations within the right-of-way, for both pollutant removal and cost benefits. Existing pervious areas between the edge of the sidewalk and edge of the curb were classified on the basis of current neighborhood use, such as areas altered by homeowners with plantings, or areas with mature trees. This allowed the City to optimize the design on the basis of neighborhood preferences and concerns and to understand how the project would affect day-to-day use of the area's streets and landscapes. Several new BMPs will provide traffic-calming benefits, supporting implementation of the City's recently updated Street Design Manual. Maintenance practices were also discussed in the design analysis to be considered in the final design (Figure 4-9).



Figure 4-9
Rendering of Completed
Bannock Avenue Green Street

Ongoing community outreach is central to the Bannock Avenue project. Many workshops have been held in the neighborhood for communication and feedback, and City staff members are working to identify key post-construction management and resident use issues. A strong BMP monitoring component has been built into the project to evaluate conditions and effectiveness, which will provide the City with valuable feedback to serve as a template to guide future BMP design guidelines and implementation of green streets and BMPs in the rights-of-way.

Implementation in the Mission Bay WMA

The pollutant and flow reduction benefits attributed to the implementation of potential green infrastructure BMPs in the Mission Bay WMA were estimated using quantitative methods and are summarized in Appendix K. These benefits were then applied to the areas that the City of San Diego identified for potential green infrastructure opportunities (some of which have already been constructed recently) throughout the Mission Bay WMA to meet numeric targets. The resulting total level of implementation of potential green infrastructure BMPs is outlined in Section 4.2.4 and further discussed in Section 4.3.

4.2.3.2 Multiuse Treatment Areas

Large structural treatment control BMPs, referred to as multiuse treatment areas, are regional facilities that receive flows from neighborhoods or larger areas. They often serve dual purposes for flood control and groundwater recharge. These BMPs are often located in public spaces and can be co-located within parks or green spaces to provide excellent ecosystem services and aesthetic value to stakeholders. Bioretention areas can enhance biodiversity and beautify the urban environment with native vegetation. Large-scale facilities, such as infiltration basins or dry extended detention basins, can provide dual use as athletic fields or open spaces.

The following components can be incorporated into multiuse treatment areas to promote multiuse benefits:

- ❖ Simple signage or information kiosks can be used to raise public awareness of storm water issues, educate the public, and provide a guide for native plant and wildlife identification.
- ❖ Volunteer groups can be organized to perform basic maintenance such as trash removal as an opportunity to raise public awareness.
- ❖ Public-private partnerships can be pursued where property owners are supportive of water quality improvement measures and parcels are identified for ideal multiuse treatment area locations.
- ❖ Larger BMPs can be equipped with pedestrian cross-paths or benches for wildlife viewing.
- ❖ Sculptures and other art can be installed within the BMP and outlet structures and cisterns can incorporate aesthetically pleasing colors, murals, or facades.
- ❖ Vegetation with canopy cover can provide shade, localized cooling, and noise dissipation.
- ❖ Bird and butterfly feeders can be used to attract wildlife to the BMPs.
- ❖ Ornamental plants can be cultivated along the perimeter and in the bed of vegetated BMPs (invasive plants should be avoided).

Infiltration and Detention Basins

Large multiuse BMPs considered in the Water Quality Improvement Plan will focus on surface BMPs (on public parcels) that provide treatment through the detention and infiltration of runoff. Examples include infiltration basins and dry extended detention basins. These BMPs are designed to hold runoff for an extended period of time to allow water to evaporate into the atmosphere, infiltrate into native soils, or be transpired by vegetation, while accommodating for overflow and bypass during large storm events. These BMPs are well suited to public spaces such as active (soccer fields) and passive (parks) recreation areas and raise public awareness of storm water management.

Example Multiuse Treatment Area Project

The Tecolote Canyon Park catchment is located in the southwestern portion of the Tecolote Creek subwatershed. It is bordered by State Route 52 on the north, Interstate 5 on the west, and Interstate 805 on the east, and culminates at the Tecolote Canyon Park. The 6,032-acre drainage area is predominantly single-family residential. Pending a geotechnical investigation by a licensed geotechnical engineer, an infiltration or detention basin would be appropriate to treat the drainage area.

Based on regional monitoring in residential areas and the characteristics of the drainage area, there is an expectation that nutrients, TSS, and bacteria will be prevalent in storm water runoff. Relative to similarly sized drainage areas, it is anticipated that there will be higher levels of (1) nutrients, due to expected fertilization of the Sam Snead All American Golf Course, (2) TSS, due to a significant amount of open space, and (3) bacteria, due to the dense housing configuration and potential for pet waste.

Locating a BMP in the park would provide an educational opportunity for children and adults through signage. If detention were to be implemented, there would be an opportunity to use the stored water for irrigation. Figure 4-10 shows the open space where an infiltration or detention basin could be implemented. Figure 4-11 shows an example of a park designed to function as a multiuse treatment area.



Figure 4-10
Example of an Athletic Field Designed to Function as an Infiltration Basin



Figure 4-11
Existing Ball Fields at Tecolote Canyon Park Could Be Converted to Infiltration or Detention Basins, Maintaining Their Function as a Community Amenity

Stream, Channel, and Habitat Rehabilitation Projects

Natural streams, channels, and habitats serve hydrologic and ecological functions that can be compromised when these natural systems are degraded or altered. For instance, increased runoff volumes and velocities can cause stream bank erosion of

streams or channels, which can result in large quantities of sediment and sediment-binding pollutants entering the drainage system. Degraded coastal habitats such as salt marshes, lagoons, and wetlands can disrupt biological productivity, which can lead to unhealthy or poor ecosystems.

Rehabilitation projects aim to improve stream or channel conditions or restore habitats through engineered enhancements. Stream or channel rehabilitation projects stabilize stream banks or enhance stream settings to achieve water quality benefits. Stream or channel rehabilitation projects can include grading; construction of check structures, drop structures, and channel bed and bank protection measures; vegetation planting to protect channel areas; and modified channel cross-sections to promote hydrologic connectivity. Habitat rehabilitation projects try to improve biological productivity or ecosystem functionality through the restoration of natural hydrologic processes, natural vegetation, and other baseline physical characteristics. In addition to water quality and habitat improvements, other benefits of rehabilitation projects include restoration of benthic macroinvertebrates and terrestrial wildlife, which are indirect measures of water quality. Rehabilitation projects can also include educational opportunities which can lead to greater public understanding of water quality.

Implementation in Mission Bay WMA

The pollutant and flow reduction benefits attributed to the implementation of potential multiuse treatment areas (specifically infiltration and detention basins) in the Mission Bay WMA were estimated using quantitative methods and are summarized in Appendix K. These benefits were then applied to the areas that the City of San Diego identified for potential multiuse treatment area opportunities throughout the Mission Bay WMA to meet numeric targets. The resulting total level of implementation of multiuse treatment areas is outlined in Section 4.2.4 and Section 4.3.

4.2.3.3 Water Quality Improvement BMPs

The Responsible Agencies will implement green infrastructure as permitted and when feasible, but site constraints preclude use of green infrastructure in some areas. In such cases, water quality improvement BMPs may be required to protect water resources. Water quality improvement BMPs include trash segregation, proprietary BMPs, and dry weather flow separation and treatment projects. Maintenance of these BMPs is covered separately under nonstructural strategies as part of each Responsible Agency's MS4 infrastructure maintenance programs, where applicable.

Trash segregation includes inlet devices, such as trash guards or trash racks, which are installed to capture trash and debris before conveyance into receiving waters. Proprietary BMPs are prefabricated commercial products such as hydrodynamic separators or catch basin filter inserts that typically provide storm water treatment in space-limited areas, often using patented and innovative technologies.

Proprietary BMPs typically use settling, filtration, absorptive/adsorptive materials, vortex separation, and sometimes vegetative components to remove pollutants from runoff.

Dry weather flow separation and treatment projects are those identified and planned for by each respective Responsible Agency to target non-storm water dry season flows and divert these flows for treatment onsite or to sanitary sewer systems and ultimately wastewater treatment plants.

Implementation in Mission Bay WMA

Because of the relative scale of their pollutant-reduction benefits and the lack of published supporting data, trash segregation and proprietary BMPs were not modeled. However, the level of implementation of these BMPs is outlined in Section 4.2.4 and Section 4.3.

The pollutant and flow reduction benefits attributed to the implementation of dry weather diversions in the Mission Bay WMA were included in the model, as summarized in Appendix K. The total number of dry weather diversions is outlined in Section 4.2.4 and Section 4.3.

4.2.4 Jurisdictional Strategy Selection by Responsible Agency

Strategy selection within the Mission Bay WMA is discussed in Section 4.2.1 and Appendices J and K. Sections 4.2.4.1 and 4.2.4.2 provide examples of recommended strategies for each Responsible Agency, and jurisdiction-specific selection methodologies, if different from watershed-wide selection methodologies. The recommended strategies are those that are intended to specifically target the highest priority water quality conditions to achieve the numeric goals identified in Section 4.1. These strategies are a subset of each Responsible Agency's JRMP. A complete list of strategies and schedules by Responsible Agency, including the implementation approach, implementation year, and level of effort required, is presented in Appendix J.

As presented in Sections 4.2.2 and 4.2.3, most nonstructural and structural strategies address multiple pollutants. For example, maintenance activities for catch basins and roads primarily target sediment, metals, and trash. In addition, bacteria and organics can also be removed. Green infrastructure strategies such as bioretention and bioswales primarily target bacteria, sediment, and metals; however, they can provide dissolved solids and organics reductions as well. Permeable pavement primarily targets sediment, oil and grease, and metals, but can provide secondary benefits toward bacteria and organics reductions as well.

4.2.4.1 City of San Diego Example Strategies

The City has identified administrative policies, urban development management programs, and innovative pilot projects as strategies to achieve its goals, and is investing in research for site locations for green infrastructure and other treatment BMPs throughout its jurisdiction in multiple WMAs. Furthermore, the City is currently developing a framework to evaluate other potential benefits that the recommended strategies may provide beyond those associated with water quality. These other benefits may be financial, environmental, or societal. Other benefits refer to additional outcomes of a strategy beyond water quality improvements. Other benefits can include reduced air pollution, increased water conservation, aesthetics-induced property value increases, and increased business investments. The recommended strategies will be scored on the basis of the number of other benefits they provide, and may guide future updates to the Water Quality Improvement Plan (Appendix M).

The following strategies are examples of those selected by the City and planned for implementation. A complete list of strategies planned for implementation and a description of the strategy selection process is provided in Appendix J. The City's projected funding needs to implement the strategies are presented here and in Appendix J. These strategies will be implemented by the City of San Diego; they are not intended to be implemented by private entities (e.g., development, business, industry, etc.); however, some of the City's strategies, such as development planning, may have implications for private entities. In the Mission Bay WMA, an analysis using a watershed model was conducted to identify the strategies required to be implemented to meet interim and final goals. The strategies and implementation schedules identified in Appendix J demonstrate that numeric goals will be met on the basis of that analysis. The adaptive management process provides the framework to evaluate progress toward meeting the goals and allows for modification of strategies, if necessary. If strategies are modified, the analysis will be updated as needed to provide assurance that numeric goals will be met. The strategies and schedules are subject to change and are contingent upon annual budget approvals and funding availability. They will be modified through the adaptive management process as needed.

The City will address wet weather discharges of bacteria, sediment, and other pollutants through activities on public land across its jurisdiction in the Mission Bay WMA. During dry weather, implementation will focus on the reduction of irrigation runoff. The following example strategies provide multiple benefits by addressing bacteria and sediment, as well as other water quality pollutants such as trash.

Development Planning – Development and Implementation of a Green Infrastructure Policy and Program.

In FY16, the City will begin development of a policy that will require inclusion of green infrastructure features on all suitable City projects, including non-SUSMP (Standard Urban Storm Water Mitigation Plan) projects. This policy will be coordinated with ongoing efforts to update City design manuals and LID design standards for public LID BMPs. To guide implementation of the new policy, a green infrastructure program will

be initiated in parallel. The program will begin with research and recommendations for ideal methods for green infrastructure project siting and prioritization within the City. By FY18, the City will complete construction of green infrastructure and/or green streets projects as detailed in the City's corresponding structural strategies (see Appendix J for Green Infrastructure strategies and schedules).

Construction Management – Explore Enhanced Inspections for Construction Sites

In FY16, the City plans to establish standards and guidelines for storm water construction phase requirements. These standards and guidelines will include inspections at appropriate frequencies and will identify enforcements that can take place. Inspections and enforcements will be specifically focused in sediment TMDL WMAs, such as the Los Peñasquitos WMA, and ASBS in the Mission Bay WMA.

Existing Development – Enhanced Property-Based Inspection Program

In FY16, the City plans to administer a program that will require implementation of minimum BMPs for existing development (commercial, industrial, municipal, and residential) that are specific to the facility, area types, and PGAs. This program would increase the number of discharges identified, as compared with the number of discharges identified in standard inspections. This program would also include the inspection of existing development at appropriate frequencies and methods, such as property-based inspections in lieu of traditional individual business inspections. The City conducted an extensive multi-year pilot study of its business inspection program and found that more discharges could be found and abated by inspecting large properties rather than individual businesses.

Existing Development – Increased Enforcement

The City intends to enhance enforcement responses by increasing the number of Code Compliance staff. Between FY16 and FY19, the City is planning to gradually hire additional Code Compliance Officers and support staff to increase compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management, and existing development as detailed in the City's Enforcement Response Plan. This effort will target increased enforcement of irrigation runoff and water-using mobile businesses.

Existing Development – Residential and Commercial Rebate Programs Targeting Water Quality

The City plans to continue and expand its landscape-based rebate program to target water quality impacts from residential and commercial areas in FY16 and beyond. Expansion of this program will occur by providing for additional rebates and/or through distribution of promotional and information material and brochures to community groups, libraries, and recreation centers. Educational material would emphasize watershed stewardship and encourage the implementation of designated BMPs through rebates for rain barrels, grass replacement, downspout disconnection, and micro-irrigation.

Existing Development – Erosion Control and Slope Stabilization

In FY16, the City plans to increase identification and enforcement of actionable erosion and slope stabilization issues on private and municipal property and require stabilization and repair. This strategy would be performed through an inventory and assessment of eroding areas and their risk to surface waters followed by the development of a schedule for ongoing inspection and stabilization.

Increased Public Education and Participation

The City conducts an extensive public education and outreach program through its Think Blue program. Examples include the following:

- ❖ The City will continue and expand several of its current outreach programs. Outreach programs would be widely implemented but targeted to home owners associations (HOAs), business owners associations (BOAs), maintenance districts, various community groups through organized community trash cleanup events, and water-using mobile businesses.
- ❖ Workshops will be held, community events will be organized, and informational material and brochures will be disbursed to reach community members and advise them of incentives, regulations, and training, and provide general information they need for implementation of good watershed stewardship practices or BMPs.

Structural Strategies – Green Infrastructure

Green infrastructure projects in the Scripps and Tecolote Creek subwatersheds in the Mission Bay WMA include a green lot in Kellogg Park (FY14) in the Scripps subwatershed, and green streets on Mt. Abernathy Avenue and Camber Drive (FY14) and Bannock Avenue (FY16) in the Tecolote Creek subwatershed. A multiuse treatment area in the Mission Bay WMA currently includes an infiltration system on the Torrey Pines Golf Course (in place) in the Scripps subwatershed. (Refer to Appendix K for information on BMP configurations and drainage area assumptions.) To meet load reduction targets, additional green infrastructure BMPs (in the form of bioretention and permeable pavement) and multiuse treatment areas are needed in the Tecolote Creek subwatershed. Potential multiuse treatment area project sites have been identified in previous site optimization and prioritization efforts in the Tecolote Creek subwatershed. The operation and maintenance of new dry weather flow diversions (FY14–FY15) is also anticipated to start in FY16 in the Scripps subwatershed. Refer to Appendix K for information on BMP footprints, drainage areas treated, and additional green infrastructure details.

Cost of Service Study

The City plans to conduct a Cost of Service Study starting in FY15. This study will examine the full cost of flood control and storm water strategies needed to comply with storm water regulations for the City. The City of San Diego's Watershed Asset Management Plan will be used as the basis for the study.

City of San Diego Estimated Cost of Strategy Implementation

The City's Storm Water Division leads the City's efforts to protect and improve water quality and reduce flood risk. These activities include but are not limited to: public education, employee training, water quality monitoring, source identification, code enforcement, watershed management, and BMP development/implementation within the City's jurisdictional boundaries. The Storm Water Division is also tasked with providing the most efficient storm drain system operation and maintenance services including inspection, maintenance, and repair of storm drain systems in the public right of way and drainage easements. The complete list of strategies undertaken by the Storm Water Division is presented in this section.

The City has developed projected funding needs that will be used to submit annual budget requests to secure the resources necessary to comply with the Municipal Permit. These funding needs include four general categories:

- (1) Storm Water Division funding needs to implement day-to-day operational JRMP activities as required by Provision E in the Municipal Permit;
- (2) Storm Water Division funding needs for flood risk management programs associated with the JRMP, such as infrastructure repair and replacement;
- (3) Storm Water Division funding needs for activities managed by the Storm Water Division to meet the goals identified in the Water Quality Improvement Plan; and
- (4) Funding needs for City departments and divisions other than the Storm Water Division to implement day-to-day operational JRMP activities, as required by the Municipal Permit. Examples of JRMP activities include administration, training, and BMP implementation.

The City's Storm Water Division funding needs (which represent the first three categories above) are presented below as "City of San Diego" funding needs, but do not include funding needs for other City departments and divisions to implement required JRMP activities (category four above) because the recommended strategies included in this plan only apply to the City's Storm Water Division. For more information about the funding needs for non-Storm Water Division departments and divisions, please refer to the fiscal analysis in the City's Jurisdictional Runoff Management Plan (Section 10). Table 4-13 presents the projected funding needs to implement the Mission Bay WMA Water Quality Improvement Plan through FY40. The compliance period for Mission Bay is through FY31, when the final goals are expected to be met. To maintain comparability among Water Quality Improvement Plan projected funding needs for different WMAs (the City is in six WMAs with different compliance schedules), ongoing operation and maintenance costs after the compliance period (between FY32 and FY40 for Mission Bay) are included in Table 4-13. However, the majority of the funding will be needed within the first 15 years to meet the numeric goals. Twenty five year funding needs (FY16 - FY40) for the Mission Bay WMA are presented for JRMP activities, flood risk management programs, and Water Quality Improvement Plan activities by funding source: the City's General Fund (GF) or Capital Improvement Projects (CIP) funds. The

General Fund is generally used for nonstructural strategies, design support, and operations and maintenance (O&M) of structural projects. CIP funding is used during the design and construction phase of structural projects. The source of the funding needs is the Storm Water Division's 2015 Watershed Asset Management Plan (WAMP) Cost Update, which will be made available on the Storm Water Division's website ([http://www.sandiego.gov/stormwater/plans reports/](http://www.sandiego.gov/stormwater/plans%20reports/)) in July 2015.

Table 4-13
City of San Diego Projected Fiscal Year Funding Needs by Funding Source and Category for Mission Bay WMA (FY16-40)¹

General Fund	
Water Quality Improvement Plan	\$12,494,279
JRMP	\$66,860,733
Flood Risk Management	\$144,714,554
Sub Total General Fund:	\$224,069,566
CIP	
Water Quality Improvement Plan	\$26,114,687
JRMP	\$0
Flood Risk Management	\$41,273,491
Sub Total CIP:	\$67,388,178
Total	
25 FY Mission Bay WMA Total Need:	\$291,457,744

1. Does not include funding needs for other City of San Diego Departments or Divisions to implement JRMP required activities.

Figure 4-12 illustrates the projected fiscal year annual funding needs over the 25-year compliance period for the Storm Water Division to implement its JRMP activities, flood risk management programs, and Water Quality Improvement Plan activities in the Mission Bay WMA. Figure 4-13 shows the projected fiscal year GF and CIP funding needs for each of these years. Figures 4-14 and 4-15 show the projected fiscal year GF and CIP funding needs, respectively, by category for each of these years.

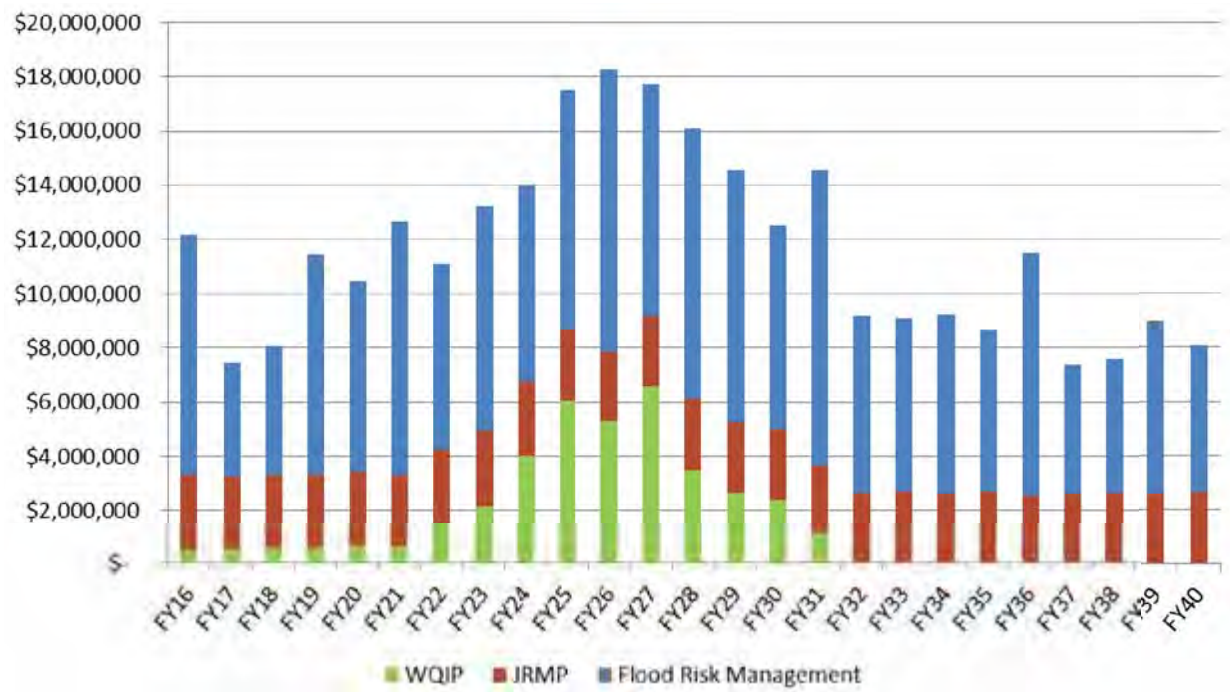
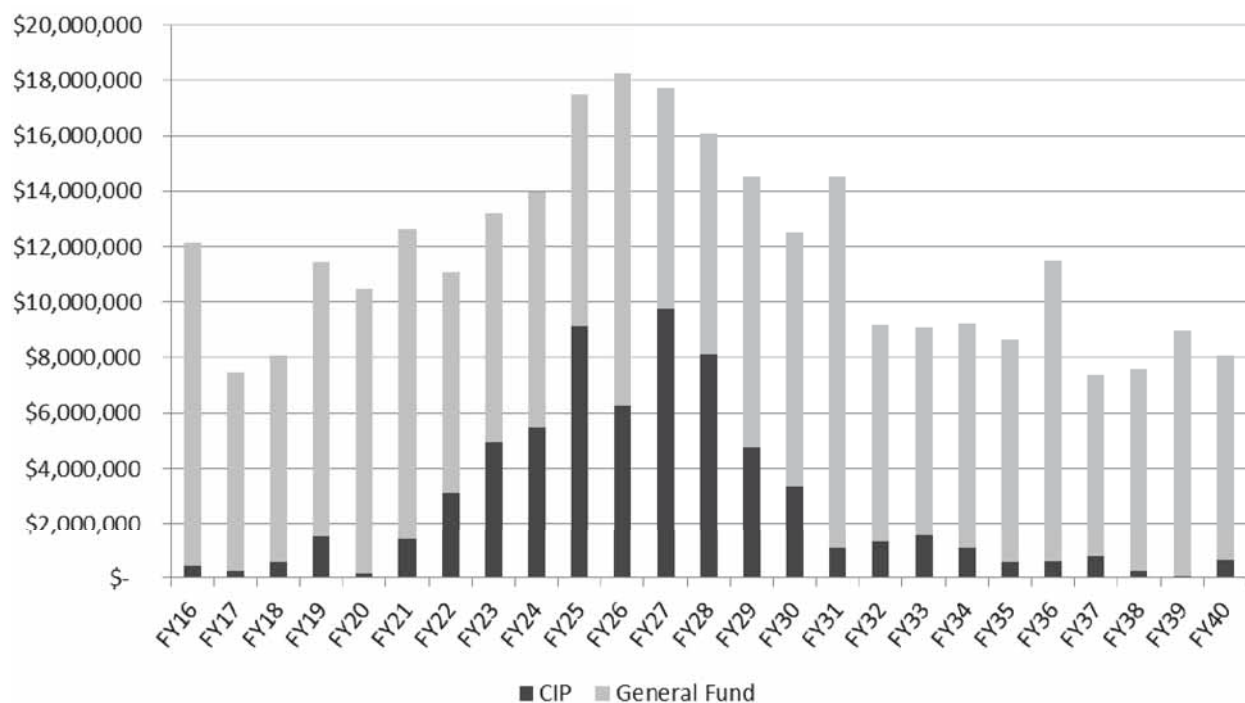


Figure 4-12
City of San Diego Projected Fiscal Year Annual Funding Needs by Category for the Mission Bay WMA



CIP = Capital Improvement Projects

Figure 4-13
City of San Diego Projected Fiscal Year Annual Funding Needs by Funding Source for the Mission Bay WMA

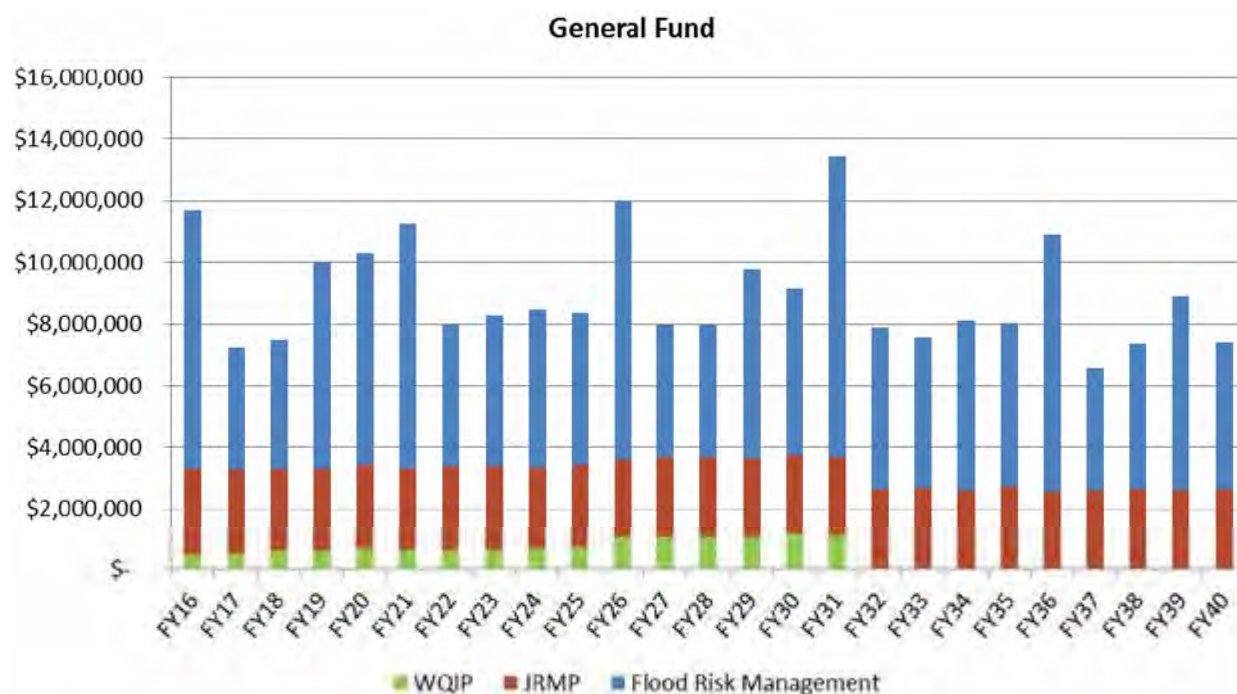


Figure 4-14
City of San Diego Projected Fiscal Year Annual General Fund Needs for the Mission Bay WMA

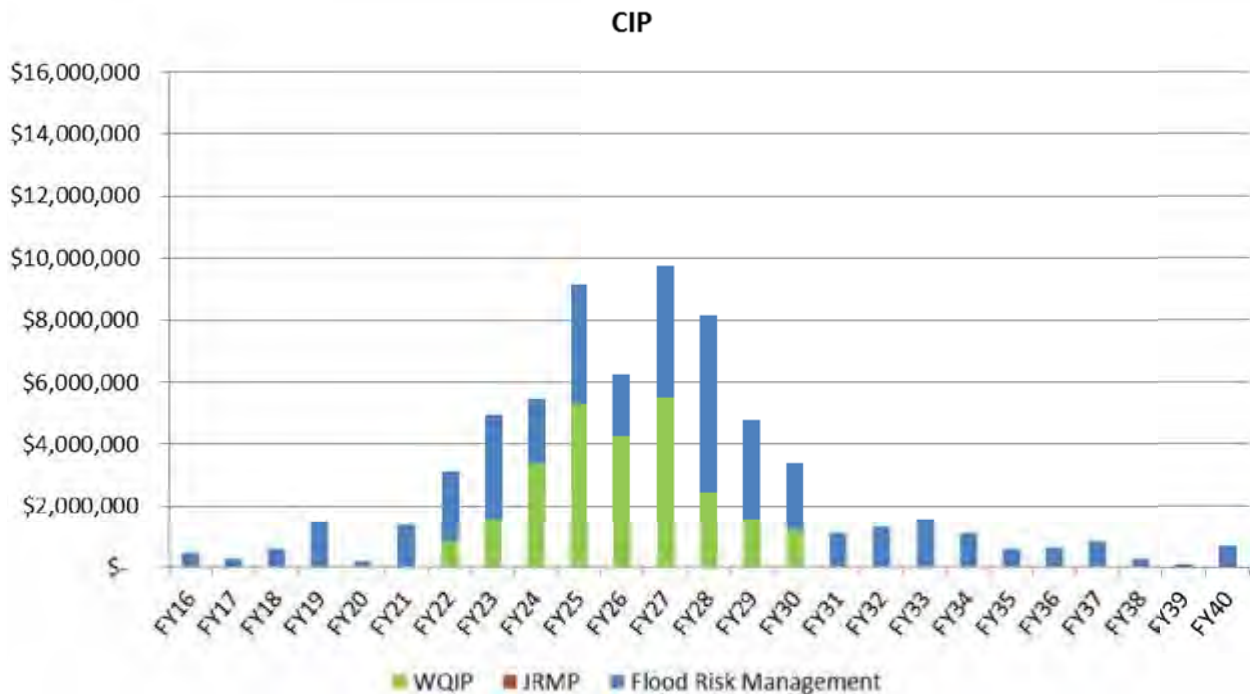


Figure 4-15
City of San Diego Projected Fiscal Year Annual CIP Funding Needs for the Mission Bay WMA

4.2.4.2 Caltrans Strategies

Caltrans' jurisdiction areas include roadways, land adjacent to roadways, and facilities; Caltrans' jurisdictional strategies specifically focus on BMP implementation to reduce known pollutants within these areas. Caltrans is not permitted within the MS4 Permit; however, Caltrans is subject to TMDL requirements through its MS4 Permit (State Board, 2012b). Caltrans' strategies vary from those of other Responsible Agencies (in both type and name) to best address typical discharges from its jurisdictions. Strategies include programs being implemented by Caltrans Headquarters for statewide execution and District 11 for local implementation. Caltrans' implementation of strategies within the WMA is dependent on state funding. A complete list of strategies and their anticipated implementation schedules are provided in Appendix J. The strategies and schedules are subject to change and are contingent upon annual budget approvals and funding availability. They will be modified through the adaptive management process as needed.

4.2.5 Collaborative WMA Strategies

In addition to implementing strategies on a jurisdictional basis, Responsible Agencies may collaboratively implement projects within the WMA that improve water quality. The WMA strategies in the Mission Bay WMA include watershed-wide efforts to encourage water conservation, which targets dry weather goals through the reduction of irrigation and irrigation runoff.

4.2.5.1 Collaborative Approach to Irrigation Reduction

Responsible Agencies of the Mission Bay WMA are collaborating with water agencies to encourage implementation of water conservation efforts. In a Mediterranean climate such as that in southern California, water conservation efforts ensure a reliable water supply while keeping the region naturally beautiful. Water conservation that attempts to reduce irrigation and minimize storm water runoff can also improve water quality of receiving waterbodies. The Metropolitan Water District of Southern California (MWD) and San Diego County Water Authority (SDCWA) are the primary water providers in southern California who lead regional and multijurisdictional programs that incentivize water conservation efforts.

MWD's SoCal Water\$mart Program and SDCWA's WaterSmart Program support conservation efforts by offering incentives in the form of rebates for rain barrels, rotating sprinkler nozzles, weather-based irrigation controllers, soil moisture sensor systems, and turf replacement (MWD, 2014; SDCWA, 2014). The San Diego County Water Authority's WaterSmart program also offers landscape training classes and plant fairs to educate and engage the community in water conservation efforts. Several Responsible Agencies and local municipal water districts promote and express interest in collaborating with MWD and SDCWA to support their water conservation incentive programs (Table 4-14). Funding and resources to support these region-wide water conservation efforts for each Responsible Agency are presented in Table 4-14. There is also potential to collaborate with retail water suppliers who have more direct contact with water users and who can more effectively monitor water consumption to identify possible sources of system leaks and over-irrigation.

Table 4-14
Responsible Agency Collaboration With Regional and WMA
Water Conservation Programs

Responsible Agency	Responsible Agency Departmental Agency	Metropolitan Water District (MWD)	San Diego County Water Authority (SDCWA)	Other	Funding
City of San Diego	Transportation and Storm Water Department (T&SW); Public Utilities Department (PUD)	✓	–	–	Residential BMP Rebate program is intended to promote rebates for rain barrels, irrigation controls (grass replacement), and downspout disconnections. The program budget is approximately \$425K annually.

4.2.5.2 Offsite Alternative Compliance Option (WMAA)

The MS4 Permit allows for the implementation of offsite alternative compliance methods in lieu of meeting structural BMP design standards and/or hydromodification management criteria on the project site. To implement an alternative compliance program, a jurisdiction must first complete an optional WMAA as detailed in MS4 Permit Provision B.3.b(4). The San Diego County Copermittees have collectively funded and provided guidance for development of a regional WMAA. Findings of the draft regional WMAA, specific to the Mission Bay WMA, are provided in Appendix N. The WMAA characterizes important processes of the watershed through creation of GIS layers that include the following information:

- ❖ A description of dominant hydrologic processes, such as areas where infiltration or overland flow likely dominates
- ❖ A description of existing streams in the watershed, including bed material and composition, and whether they are perennial or intermittent
- ❖ Current and anticipated future land uses
- ❖ Potential coarse sediment yield areas
- ❖ Locations of existing flood control structures and channel structures, such as stream armoring, constrictions, grade control structures, and hydromodification or flood management basins

Information from the WMAA can be used for the following purposes:

- ❖ To identify candidate projects that could potentially be used as offsite alternative compliance options in lieu of satisfying full onsite retention, biofiltration, and hydromodification runoff requirements
- ❖ To identify and/or prioritize areas where it is appropriate to allow certain exemptions from onsite hydromodification management BMPs

Alternative compliance methods can be implemented at the subwatershed scale (e.g., multiuse treatment area BMPs) or as green infrastructure BMPs (e.g., green streets). Regardless of scale, offsite alternative compliance BMPs mitigate for pollutants not reliably retained on the project site or hydromodification impacts not reliably mitigated onsite per requirements detailed in MS4 Permit Provisions E.3.c(1) and E.3.c(2). Note that onsite treatment control BMPs will still be required, although such BMPs would not be required to meet the onsite retention requirements. In addition to meeting site-specific structural BMP and hydromodification management requirements, alternative compliance methods can provide enhanced benefits for the WMA.

In addition to allowing for offsite alternative compliance program development, the WMAA findings can also assist in determining the feasibility of candidate projects for offsite alternative compliance implementation (MS4 Permit Provision B.3.b(4)(b)). The Responsible Agencies compiled a list of candidate projects that consider the numeric goals of the Mission Bay WMA as well as projects previously identified in JRMPs and other regulatory documents. Candidate project lists currently available are provided in Appendix N. The Water Quality Improvement Plan will be updated to include the final candidate project list, as that list is made available.

The WMAA document was developed as part of a regional Copermittee effort and followed criteria set forth in the MS4 Permit. The effort included a call for data and information to be included in the analysis. Data included in the document are intended for guidance purposes. Where more site-specific information is available, then the more detailed information should be used.

The WMAA also provides an assessment of applicable exemptions to hydromodification management requirements, in addition to the MS4 Permit's allowed exemptions regarding direct discharges to exempt receiving waters including the Pacific Ocean and Mission Bay (or direct discharges to underground storm drains or concrete-lined channels directly discharging to the Pacific Ocean or Mission Bay). For the Mission Bay WMA, no additional potential exemptions are recommended with regard to exempt river reaches, stabilized conveyances, highly impervious watersheds, or tidally influenced lagoons.

4.2.5.3 Collaboration with the Regional Board

The Responsible Agencies will work with the Regional Board to identify solutions and address sources of potential water quality impairments within the Mission Bay WMA.

Descriptions of the current priorities are provided below and will be updated as implementation, monitoring, and assessment continues.

Enforcement of Non-MS4 Dischargers

As discussed in Section 1, the MS4 Permit requires the Responsible Agencies to control pollutants originating from Non-MS4 or non-municipal lands if those pollutants ultimately discharge into the MS4. Therefore, the Responsible Agencies recognize the need to collaborate with and improve communication between non-municipal entities within the WMA and the appropriate regulatory agencies to ensure that discharges are appropriately regulated before entering the MS4, and to improve water quality throughout the Mission Bay WMA.

The Responsible Agencies will work with the Regional Board to identify and address Non-Phase I MS4 sources of potential water quality impairment within the WMA. These sources may include working with Phase II MS4 dischargers, school districts, nurseries and agricultural dischargers, non-compliant or non-filing industrial dischargers, or non-compliant construction dischargers, as the need arises. In addition, the Regional Board should work with the MS4s to identify potential updates to TMDLs, the MS4 Permit, and other responsible parties' NPDES permits, as appropriate, to more accurately and fairly assign load responsibilities among all the responsible parties in the watershed. Additional collaborations between the Responsible Agencies and the Regional Board are detailed in Section 4.2.5.4, and Section 4.4 discusses the alternative analysis to identify MS4 and Non-MS4 responsibilities.

Bacteria TMDL Updates

A number of Pacific Ocean Shoreline segments in the Scripps subwatershed were removed from the 303(d) list for REC-1 impairment in 2010. However, calculation of the Bacteria TMDL had already begun and the segments remained in the TMDL through TMDL adoption in 2011. The Pacific Ocean Shoreline segments were then incorporated into the TMDL requirements within the MS4 Permit in 2013. The Responsible Agencies will pursue removal of the beach segments from the Bacteria TMDL and Attachment E of the MS4 Permit.

In February 2010, the Regional Board adopted Resolution No. R9-2010-0001, *Resolution Amending the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Revised Total Maximum Daily Loads for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek)*, referred to as the Bacteria TMDL. As part of the Bacteria TMDL Implementation Plan, the Regional Board included a planned milestone to consider revisions to the Bacteria TMDL on the basis of new technical information provided by the dischargers or other entities within five years after the effective date of the Bacteria TMDL (April 4, 2016). The Counties of San Diego and Orange and the City of San Diego are coordinating with the Regional Board to assess the scope of a third-party TMDL reopener process.

4.2.5.4 Refinement of Water Quality Regulations

A goal for Responsible Agencies is to protect human health and improve water quality in an effective and efficient manner. To achieve this goal, the Water Quality Improvement Plan will be used as a tool to plan and estimate the costs of the BMPs needed to protect human health and improve water quality for the highest priority water quality conditions in the Mission Bay WMA. The MS4 Permit clearly states that the “Copermittees need only comply with permit conditions relating from discharges from the MS4s for which they are operators.” This objective is reflected in the discussion presented in Section 1.1 and Figure 1-1. However, it is worth noting that the MS4 Permit assigns Bacteria TMDL discharge responsibility entirely to the Copermittees. As such, the Responsible Agencies will collaborate with the Regional Board to refine the accuracy of regulations to ensure that Non-MS4 dischargers are regulated appropriately. The Water Quality Improvement Plan provides an opportunity to present a scenario where discharges associated with areas within the Copermittees’ jurisdictions covered by other NPDES permits or regulatory procedures, or owned by federal or state agencies or Indian tribes, are removed from the Copermittees’ responsibility. In short, the goal of this exercise is to begin a dialog with the Regional Board that may lead to the following outcomes:

- (1) Removal of Non-MS4 discharges and the associated BMPs needed to treat those discharges from the Responsible Agencies’ burden.
- (2) Amendment of current TMDLs and the MS4 Permit to correctly assign responsibilities for Non-MS4 discharges to the appropriate entities.
- (3) Strengthening of Non-MS4 NPDES permits that are directly tied to the requirements of existing and future TMDLs. For example, the City of San Diego and USEPA Region 9 are currently collaborating on a modeling study to evaluate the relative pollutant loads from various commercial, industrial, institutional, and MS4 Phase II sources and the costs to reduce loads from each source. Results of this analysis will inform the USEPA of the ability of the MS4 Permit to address these sources, potentially resulting in new specific requirements for the Industrial General Permit and General Phase II Permit to address TMDL discharges.

Note that the Copermittees would continue to implement programs to inspect, enforce, and oversee some of these dischargers because the MS4 Permit requires that “each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharge to apply for and obtain a separate NPDES permit.”

Other NPDES Permits

There are several active NPDES permits for dischargers within the Mission Bay WMA that are not addressed by the MS4 Permit, including:

- ❖ NPDES No. CAS000003 – Statewide Storm Water Permit, Waste Discharge Requirements for State of California Department of Transportation (Caltrans Permit)

- ❖ NPDES NO. CAS000002 – General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (General Construction Permit)
- ❖ NPDES General Permit No. CAS000001 – Waste Discharge Requirements for Dischargers of Storm Water Associated with Industrial Activities Excluding Construction Activities (Industrial General Permit)
- ❖ NPDES General Permit No. CAS000004 – Waste Discharge Requirements for Storm Water Discharges from Small MS4s (General Phase II Permit)

Caltrans is voluntarily participating in the Water Quality Improvement Plan, and is proposing BMPs within its jurisdiction to meet jurisdictional numeric goals. The General Construction Permit is difficult to assess because areas are never constant, and oversight of these areas by both the Copermittees and the Regional Board is addressed through separate processes. However, areas addressed by the Industrial General Permit and the General Phase II Permit are clear and their responsibilities can be considered in the Water Quality Improvement Plan. The Industrial General Permit states that “discharges addressed by this General Permit are considered to be point source discharges, and therefore must comply with effluent limitations that are consistent with the assumptions and requirements of any available waste load allocation for the discharge prepared by the state and approved by USEPA.” Similarly, the General Phase II Permit states that “discharges from Small MS4s are point source discharges subject to TMDLs,” and further states that “this Order requires Permittees to comply with all applicable TMDLs.” With TMDL pollutants representing the highest priority water quality conditions, it is logical to assume that the Industrial General Permit and General Phase II Permit are independently responsible for meeting associated wasteload allocations, and therefore can be separated from the Copermittees’ responsibility in the Water Quality Improvement Plan.

In addition to these NPDES permits, the Regional Board allows a Conditional Waiver of Discharges from Agricultural and Nursery Operations (Ag Waiver) that applies to discharges of storm water runoff and irrigation return water. Ag Waiver enrollment is accomplished in one of three ways. Operations can (1) join an established Monitoring Group; (2) submit a Notice of Intent (NOI) and form a new Monitoring Group; or (3) enroll as an individual by submitting a NOI. However, there is a lack of data available to identify those areas in the Mission Bay WMA covered by the Ag Waiver.

Land owned by federal and state agencies or Indian tribes can also be considered in terms of removing responsibility of the Copermittees in the Water Quality Improvement Plan. Copermittees do not have authority to require BMPs to be placed within these lands, nor do they have authority to regulate discharges from these lands.

As a result of these considerations, the following land use categories were assessed for potential removal from the responsibility of the Copermittees within the Water Quality Improvement Plan:

- ❖ Industrial Areas
- ❖ General Phase II Permittees
- ❖ Agricultural Areas
- ❖ Federal, State, and Indian Lands

An Alternative Scenario was developed to estimate the load contribution and associated BMP implementation implications for MS4s and Non-MS4 entities in the Mission Bay WMA. The results of this analysis are summarized in Section 4.4 and provide important context for collaborative discussions with the Regional Board and Non-MS4 entities in the future. The following sections describe how the land areas for the four categories listed above were selected for the alternative scenario

Industrial Areas

The Industrial General Permit addresses a range of industrial facilities and operations; however, the inclusion of specific industry owners within the permit is contingent on their registration within the permit. To date, the Industrial General Permit addresses only a limited number of registrants, as identified in California's Stormwater Multiple Application and Report Tracking System (SMARTS). Industrial permit locations were geocoded on the basis of address information provided in SMARTS (if available) and the associated parcels were identified on the basis of SANDAG parcel ownership GIS data.

An additional consideration for assessing the impact of industrial areas on pollutant loadings, particularly those not currently registered in the Industrial General Permit, is the use of land use GIS to establish industrial areas. Assessment of industrial land use can provide an indication of the impact that additional registrants in the Industrial General Permit can have on reducing the responsibility of the Copermittees, should those areas be fully registered in the permit. Currently, the USEPA is providing similar analyses of the impact of industrial land uses (as well as commercial and institutional areas) in watersheds in the San Diego and Los Angeles Regions to evaluate the effectiveness of the NPDES program to regulate these areas. The intent of this study is to inform future discussions regarding revisions of the Industrial General Permit, including increased registration of all applicable industrial dischargers and stricter requirements to directly address TMDL requirements and other water quality impairments. Further analysis of industrial areas in the Water Quality Improvement Plan will provide additional assessment of the balance between responsibilities of the Copermittees and the role of all industrial areas in the Industrial General Permit should full registration of industrial areas take place.

General Phase II Permit

Several small MS4s that are regulated under the Phase II General Permit are located within the Mission Bay WMA. Similar to the Industrial General Permits, further analysis is necessary to identify Phase II permit responsibilities to facilitate meeting the Water Quality Improvement Plan numeric goals. Existing Phase II Permits were spatially identified on the basis of information gathered from permit documentation on the Regional Board's website. In addition, it is understood that some school districts and other facilities that qualify will be incorporated into the General Phase II Permit program in the near future. These potential Phase II Permits were not spatially located, but could be included in future analyses.

Agriculture

Without specific information regarding agricultural areas enrolled in the Ag Waiver, SANDAG land use data were used to identify agricultural lands within the Mission Bay WMA to help estimate the contribution from these areas.

Federal, State, and Indian Land

Multiple areas in the Mission Bay WMA are owned by federal or state governments, or by Indian tribes. These lands were identified on the basis of SANDAG parcel ownership GIS data to help estimate the contribution from these areas.

4.3 Implementation Schedule to Meet Final Goals

Responsible Agencies must identify reasonable schedules that demonstrate progress toward achieving the interim and final numeric goals presented in Section 4.1. Compliance analysis results presented in Appendix K and summarized in Section 4.3.1 dictated the schedule for implementation, which is presented graphically in Section 4.3.2. This Water Quality Improvement Plan incorporates the 20-year Bacteria TMDL compliance schedule to attain wet weather goals and the 10-year Bacteria TMDL compliance schedule to attain dry weather goals. Strategy development and planning included an assessment of relative cost-effectiveness of each strategy and was one of the key drivers in phasing strategy implementation. Nonstructural BMPs are effective in reducing pollutant loads before they enter the storm drain and are generally cost-effective and require a shorter planning period. Therefore, most nonstructural strategies are planned for implementation before or upon approval of the Water Quality Improvement Plan. Structural BMPs can be cost-effective when greater load reductions are needed and treatment must occur after the pollutants enter the storm drain system, particularly when benefits other than water quality improvements are considered. However, planning for structural BMPs requires more time to secure resources, design BMPs, and obtain permits. Most of the potential structural BMPs are planned for later in the compliance period to allow more time to ensure that the implementation is necessary to meet numeric goals and that BMPs have been designed to achieve the load reductions required, and that alternatives to construction have been evaluated.

4.3.1 Jurisdictional Implementation (Compliance Analysis)

A summary of the implementation year and duration of each jurisdictional strategy is presented in Appendix J within each jurisdictional strategy table. If a jurisdictional strategy is not initiated upon approval of the Water Quality Improvement Plan, the expected implementation year is provided. The implementation description within the strategy table for optional strategies provides the circumstances for implementation and the resources needed. Optional strategies are those strategies that may be triggered in the future to achieve the interim and final numeric goals. The schedules and resources required to implement the WMA strategies are presented in Section 4.2.5, and within each jurisdictional strategy for those jurisdictions participating in the WMA strategy. This section describes the selection of the schedule for implementation, the benefits expected from the strategies, and the dates that the final and interim goals will be met by the Responsible Agency.

Jurisdictional schedules demonstrate how phased implementation of the nonstructural and structural strategies by jurisdiction, listed in Section 4.2.4, achieves Bacteria TMDL wet weather numeric goal compliance over 20 years and dry weather numeric goal compliance over 10 years. To demonstrate this progress and to select and schedule the most cost-effective strategies, the following steps were taken (graphically depicted in Figure 4-14):

- (1) The combination of programmatic nonstructural strategies that could not be explicitly modeled were assumed to result in a combined pollutant load reduction of 10 percent, as described further in Appendix K. These are the most cost-effective strategies and were, accordingly, scheduled first.
- (2) Pollutant reduction benefits realized by nonstructural strategies that could be explicitly represented in the model were then quantified. These strategies were scheduled along with the non-modeled nonstructural strategies (item 1 above).
- (3) Potential structural strategies were then individually evaluated by category for the most cost-effective solution toward Bacteria TMDL numeric goal compliance. Because multiuse treatment areas are the most cost-effective strategy toward pollutant load reduction (Figure 4-16), this category of structural strategies was maximized and scheduled first.
- (4) The remaining pollutant load reduction required to meet the final numeric goal was then assigned to potential green infrastructure BMPs, which, accordingly, follow next in the jurisdictional schedules.

The resulting jurisdictional schedules are outlined for the City of San Diego in Section 4.3.1.1.



Figure 4-16
Conceptual Diagram Illustrating BMP Implementation (not to scale)

4.3.1.1 City of San Diego

The City of San Diego currently plans to implement the strategies outlined in Section 4.2 per the schedule provided in Appendix J. A combination of nonstructural strategies, multiuse treatment areas, and green infrastructure may be used to meet the interim and final numeric goals. Implementation of most of the nonstructural strategies is planned to occur prior to or upon approval of the Water Quality Improvement Plan.

In the Tecolote Creek subwatershed, most of the nonstructural strategies will be implemented by FY18. Two green infrastructure projects were implemented (2013 and 2014) and are currently being maintained. Additional implementation of multiuse treatment is planned for 20 acres between FY25 and FY29, with an assumed two years of planning and design and two years of construction for each project, after which long-term maintenance will begin.

In the Scripps subwatershed, implementation of the non-modeled and modeled nonstructural strategies will begin prior to FY16, are anticipated to achieve the maximum level of implementation in FY18, and will continue to be implemented throughout the full 20-year compliance period for the Bacteria TMDL. Given load reduction provided by the non-modeled, nonstructural strategies, the subwatershed goals will be met by employing of these BMPs. As an added benefit, one multiuse treatment area project and one green infrastructure project were implemented (2012 and 2008, respectively) in the Scripps subwatershed. These BMPs are currently being maintained as summarized in Appendix J.

In Mission Bay WMA, a compliance analysis using a watershed model was conducted to identify the strategies required to be implemented to meet interim and final goals. BMP optimization models were used to simulate associated pollutant reductions over the entire compliance period. A summary of the level of effort anticipated for each modeled strategy, the associated load reductions predicted for the highest priority water quality condition, and the predicted benefit to other water quality parameters for wet and dry weather conditions are presented in Table 4-15 and Table 4-16 for the Tecolote Creek and Scripps subwatersheds, respectively. The adaptive management process provides the framework to evaluate progress toward meeting the goals and allows for modification of strategies. As strategies are modified, the compliance analysis will be updated as needed to provide assurance that numeric goals will be met.

The dry weather results present the percent bacteria load reduction through implementation of two primary strategy types: (1) non-modeled nonstructural strategies, and (2) irrigation runoff reduction strategies. Irrigation reduction strategies include the implementation of grass replacement projects, micro-irrigation system conversions, weather-based irrigation controllers, education and outreach, and enforcement of regulations that prohibit runoff. Modeling simulations of 25 percent irrigation reduction and elimination of overspray have demonstrated a 99 percent bacteria load reduction for the City of San Diego within the Tecolote and Scripps subwatersheds. Complete elimination of dry weather runoff is the goal; however, there is also an anticipated load reduction from treatment of dry weather flows through structural BMPs as they are built. Infiltration and detention basins built to treat wet weather flows can also be designed to infiltrate or detain dry weather runoff, thus providing multi-season benefits. If monitoring and assessment demonstrate that compliance is not occurring, the City of San Diego will adapt its programs and assess the incorporation of optional strategies or amendments to ongoing strategies.

Table 4-15
Water Quality Improvement Plan Wet and Dry Weather Reductions for the
City of San Diego in the Tecolote Creek Subwatershed

Strategy and Level of Implementation ¹	City of San Diego Reduction - Tecolote Creek Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enterococcus	Total Coliform
Wet Weather										
Nonstructural, Non-Modeled ³	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Rain Barrel Installations	0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	<0.01%	<0.01%	0.01%	0.01%
Downspout Disconnect	0.12%	0.04%	0.02%	0.04%	0.04%	0.07%	0.04%	0.04%	0.02%	0.02%
Irrigation Reduction ⁴	<0.1%	1.6%	1.5%	0.3%	0.6%	0.1%	0.6%	1.6%	<0.1%	<0.1%
Multiuse Treatment Areas	4.2%	1.1%	0.4%	0.5%	0.5%	0.5%	2.1%	1.1%	5.0%	4.1%
Green Infrastructure	3.6%	2.0%	1.8%	1.1%	1.6%	1.7%	2.0%	2.7%	2.8%	0.8%
Total	17.9%	14.7%	13.7%	12.0%	12.8%	12.4%	14.8%	15.4%	17.8%	14.9%
	Goal= 17.9%								Goal= 11.8%	Goal= 10.0%

Table 4-15 (continued)
Water Quality Improvement Plan Wet and Dry Weather Reductions for the
City of San Diego in the Tecolote Creek Subwatershed

Strategy and Level of Implementation ¹	City of San Diego Reduction – Tecolote Creek Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enterococcus	Total Coliform
Dry Weather										
Nonstructural, Non-Modeled ³	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Irrigation Reduction ⁴	99%	32%	25%	25%	25%	25%	25%	25%	99%	99%
Total	100% ⁵								100% ⁵	100% ⁵
	Goal= 98.4%	42%	35%	35%	35%	35%	35%	35%	Goal= 99.9%	Goal= 99.6%

Orange-shaded cells indicate highest priority water quality conditions for the WMA.

1. Note that these numbers are planning-level calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the numeric goals outlined above at each respective project site. Reported BMP sizes include projects that have already been implemented.
2. Limiting impairment for highest priority water quality condition.
3. Nonstructural load reductions include both the modeled and non-modeled load reductions. Non-modeled load reductions are assumed to be 10% for all pollutants (HDR, 2014) and modeled load reductions vary by strategy and pollutant.
4. Irrigation reduction strategies include the implementation of grass replacement projects, micro-irrigation system conversions, weather-based irrigation controllers, education and outreach, and enforcement of regulations that prohibit runoff. These are the primary dry weather strategies; as structural strategies such as multiuse treatment areas are implemented, additional load reductions may be achieved.
5. Mechanistic, process-based assumptions were not applied to non-modeled nonstructural BMPs, resulting in the cumulative dry weather load reductions exceeding 100% (this implies that the combination of strategies will be more than sufficient to achieve dry weather load reduction goals).

Table 4-16
Water Quality Improvement Plan Wet and Dry Weather Reductions for the
City of San Diego in the Scripps Subwatershed

Strategy and Level of Implementation ¹	City of San Diego Reduction – Scripps Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment ²	Total Cu	Total Pb	Total Zn	Total N	Total P	Enterococcus	Total Coliform
Wet Weather										
Nonstructural, Non-Modeled ³	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Rain Barrel Installations	0.01%	<0.01%	0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%	0.01%	0.01%
Downspout Disconnect	0.13%	0.04%	0.03%	0.05%	0.05%	0.08%	0.04%	0.04%	0.02%	0.02%
Irrigation Reduction ⁴	<0.1%	2.4%	1.4%	0.4%	0.6%	0.1%	1.0%	2.5%	<0.1%	<0.1%
Multiuse Treatment Areas	0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.03%	0.02%
Green Infrastructure	0.4%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.3%	0.1%
Total	10.6%	12.5%	11.6%	10.6%	10.7%	10.3%	11.1%	12.6%	10.4%	10.1%
	Goal/= 10.0%		Goal/= 0.6%						Goal = 6.6%	Goal = 5.1%

Table 4-16 (continued)
Water Quality Improvement Plan Wet and Dry Weather Reductions for the
City of San Diego in the Scripps Subwatershed

Strategy and Level of Implementation ¹	City of San Diego Reduction – Scripps Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment ²	Total Cu	Total Pb	Total Zn	Total N	Total P	Enterococcus	Total Coliform
Dry Weather										
Nonstructural, Non-Modeled ³	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Irrigation Reduction ⁴	99%	34%	25%	25%	25%	25%	24%	24%	99%	99%
Total	100% ⁵								100% ⁵	100% ⁵
	Goal= 99.0%	44%	35%	35%	35%	35%	34%	34%	Goal = 99.9%	Goal = 99.8%

Orange-shaded cells indicate highest priority water quality conditions for the WMA.

1. Note that these numbers are planning-level and calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the numeric goals outlined above at each respective project site.

2. Limiting impairment for highest priority water quality condition.

3. Nonstructural load reductions include both the modeled and non-modeled load reductions. Non-modeled load reductions are assumed to be 10% for all pollutants (HDR, 2014) and modeled load reductions vary by strategy and pollutant.

4. Irrigation reduction strategies include the implementation of grass replacement projects, micro-irrigation system conversions, weather-based irrigation controllers, education and outreach, and enforcement of regulations that prohibit runoff. These are the primary dry weather strategies; as structural strategies such as multiuse treatment areas are implemented, additional load reductions may be achieved.

5. Mechanistic, process-based assumptions were not applied to non-modeled nonstructural BMPs, resulting in the cumulative dry weather load reductions exceeding 100% (this implies that the combination of strategies will be more than sufficient to achieve dry weather load reduction goals).

4.3.1.2 Caltrans

Caltrans will voluntarily implement the strategies outlined in Section 4.2, as resources are available, per the schedule provided in Appendix J within the Tecolote Creek subwatershed. Attachment IV to the Caltrans MS4 Permit outlines a methodology for prioritizing stream segments included in TMDLs to which Caltrans is subject. The permit establishes BMP implementation requirements evaluated in terms of compliance units, rather than load reduction targets. Caltrans is expected to achieve 1,650 compliance units per year through the implementation of retrofit BMPs, cooperative implementation, and post-construction treatment beyond permit requirements.

For Bacteria TMDLs, Caltrans is expected to eliminate dry weather flows by implementing control measures to ensure effective prohibition (Provision B.2 of the MS4 Permit). For wet weather flows, Caltrans is expected to implement control measures/BMPs to prevent discharge of bacteria from the right-of-way; this can be source control and preemptive activities such as street sweeping, cleanup of illegal dumping, and public education on littering. Implementation of these controls is per the TMDL prioritization list currently under development.

4.3.2 Progress Toward Achieving Numeric Goals

The City of San Diego currently plans to implement the strategies outlined in Section 4.2 per the schedule provided in Appendix J to achieve the subwatershed load reductions presented in Section 4.3.1. Implementation phasing is necessary to properly plan, assess, and adapt strategies that will be the most efficient and effective in addressing the highest priority water quality conditions. Caltrans is also within the Mission Bay WMA, but is covered under a separate MS4 permit; although not required to meet load reduction goals, Caltrans will continue to voluntarily collaborate with the watershed planning process to ensure a consistent approach in meeting Bacteria TMDL targets.

The City of San Diego has already demonstrated progress toward meeting the numeric goals by implementing a number of nonstructural and green infrastructure projects within the Mission Bay WMA. The City's expected progress toward meeting interim and final numeric goals is presented for wet weather in Figure 4-17 and Figure 4-18, and for dry weather in Figure 4-19 and Figure 4-20 in the Tecolote Creek and Scripps subwatersheds, respectively. As strategies are implemented over time (x-axis), the anticipated load reduction increases (y-axis).

Modeling results demonstrate that the wet and dry weather goals in the Tecolote Creek subwatershed and the Scripps subwatershed will be met by implementing the City of San Diego's suite of planned strategies. Compliance with Water Quality Improvement Plan goals is met by achieving one of the compliance pathways for each highest priority water quality conditions during each assessment period (Section 4.1). The Responsible Agencies within the Mission Bay WMA will implement monitoring and adaptive management, coordinate with WMA stakeholders, and continue to pursue the necessary sustainable, effective, and efficient strategies to address the highest priority water quality conditions.

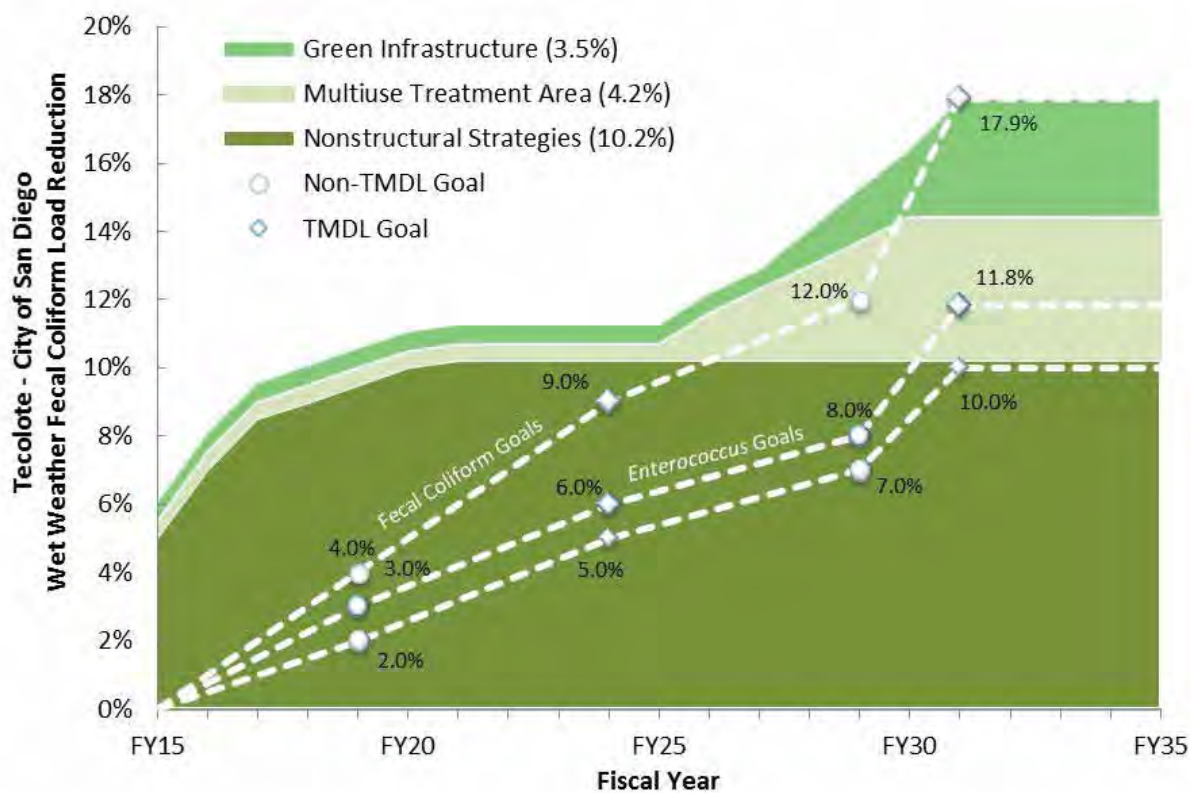


Figure 4-17
City of San Diego Wet Weather Compliance Schedule for the
Tecolote Creek Subwatershed

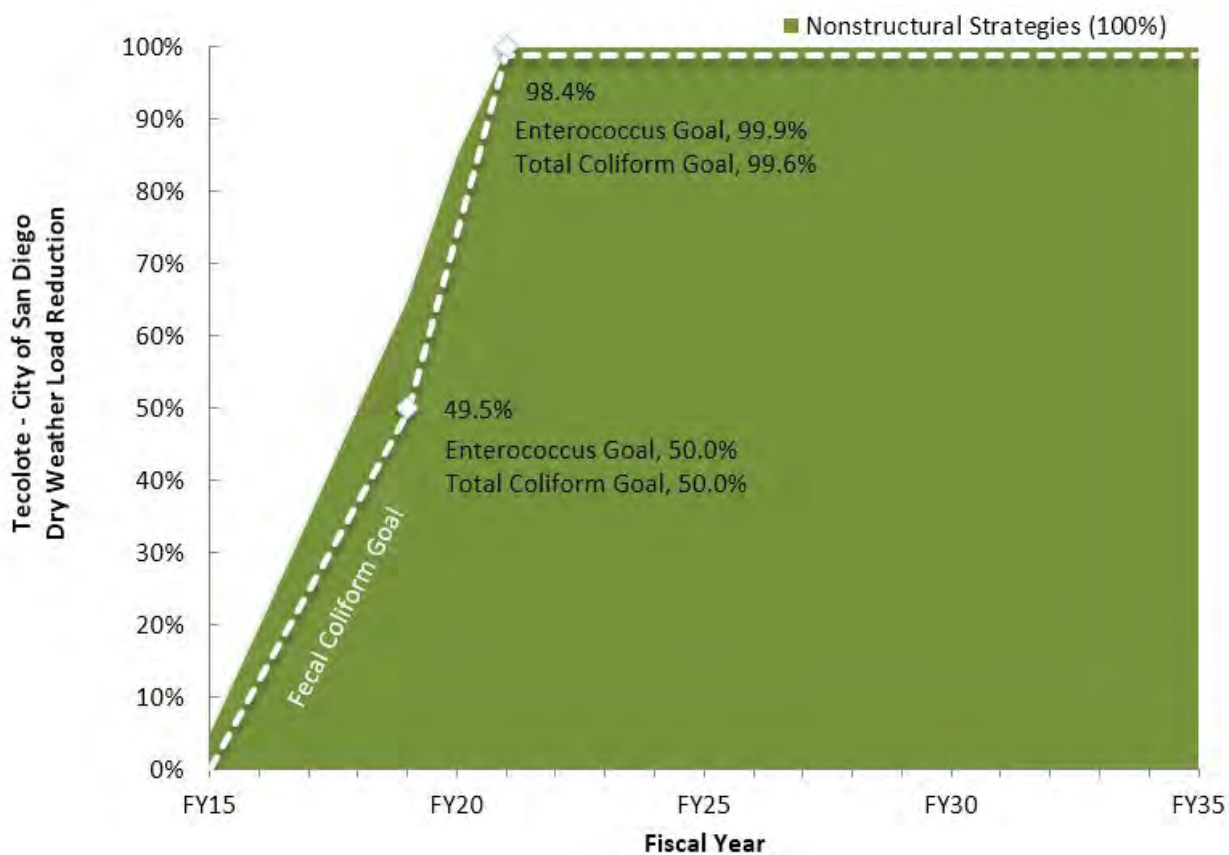


Figure 4-18
City of San Diego Dry Weather Compliance Schedule for the
Tecolote Creek Subwatershed

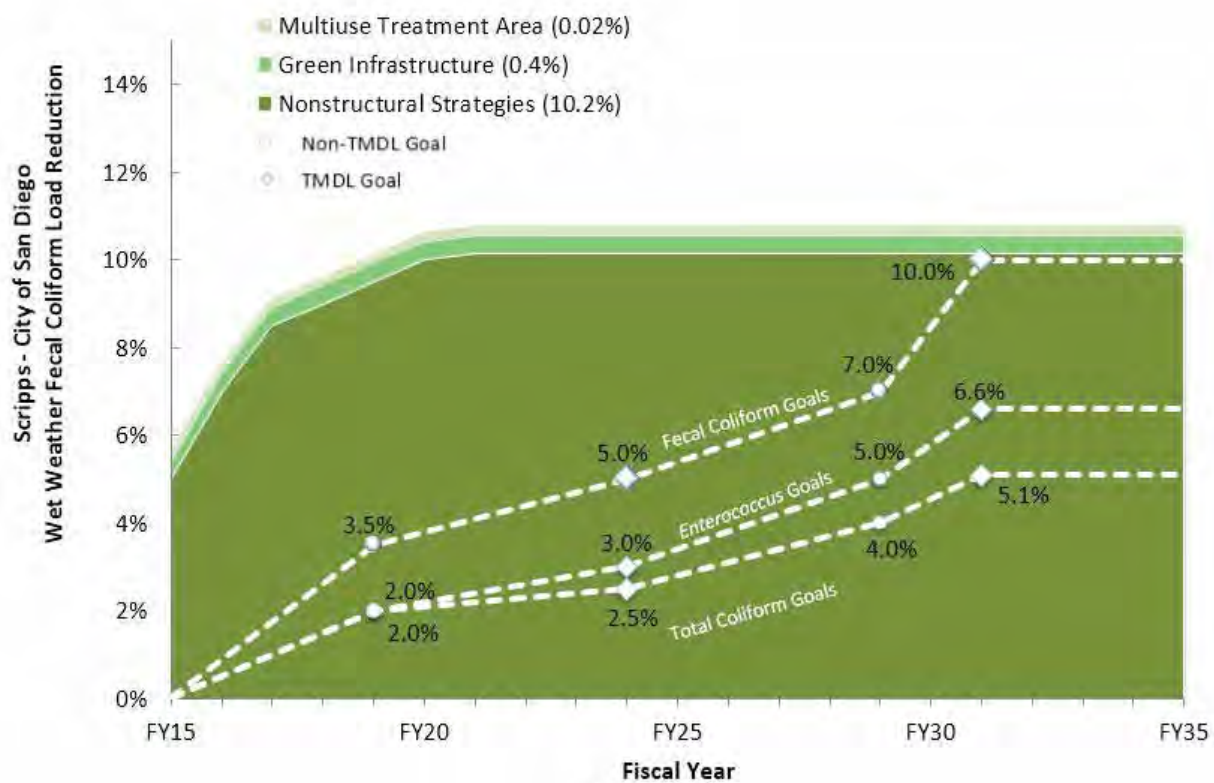


Figure 4-19
City of San Diego Wet Weather Compliance Schedule for the
Scripps Subwatershed

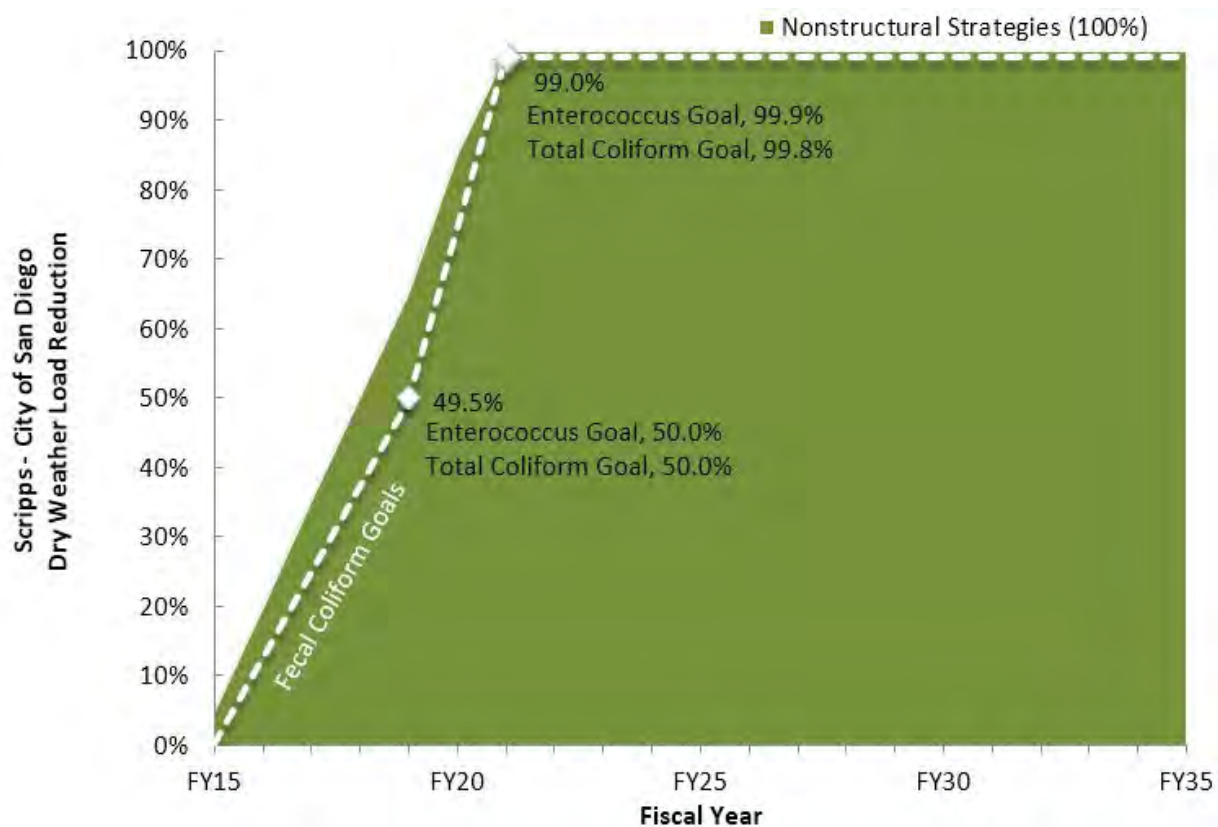


Figure 4-20
City of San Diego Dry Weather Compliance Schedule for the
Scripps Subwatershed

4.4 Alternative BMP Implementation Scenario for Refinement of Water Quality Regulations

As discussed in Section 1 and Section 4.2.5.4, the pollutant loads from Non-MS4s can be differentiated from loads from MS4s to more accurately and fairly assess load reduction responsibilities within the watershed. Load reduction responsibilities are assigned to responsible dischargers in a TMDL and are enforceable when adopted in a NPDES Permit. The Bacteria TMDL (R9-2010-0001) only assigns load reduction responsibility to the MS4s within the Mission Bay WMA, although Non-MS4 areas are present within the WMA and contribute to bacteria loads. It is worth noting that pollutant loads from Non-MS4 areas may discharge directly to a receiving water body or enter a MS4 before ultimately discharging to a receiving water body.

Given these inconsistencies and the lack of clarity on how responsible dischargers are identified in the TMDL, the primary scenario included in this Water Quality Improvement Plan currently does not differentiate between MS4 loads and Non-MS4 loads. To separate Non-MS4 loads from MS4 loads, a preliminary alternative modeling analysis was performed and is presented in this section. The purpose of this analysis is to foster future discussions about accurate and fair apportionment of pollutant reduction responsibilities in the watershed to ensure that Non-MS4 discharges are regulated before they enter a MS4 to improve water quality throughout the WMA. It is important to note that under the Alternative Scenario the MS4s would continue to implement programs to inspect and provide oversight of industrial discharges and detect illicit discharges, as discussed in Section 4.2.5.4. This analysis was conducted for only one subwatershed within the Mission Bay WMA, Tecolote Creek, because compliance with the Bacteria TMDL requires significant wet weather load reduction strategies in the Tecolote Creek subwatershed. Scripps was not included in the analysis because structural strategies are not required in the subwatershed.

The first step of the analysis was to update the watershed model to remove areas associated with the following Non-MS4s: registered industrial permits, Phase II permits, federal and state lands (and Indian lands, if present), and agricultural lands. Federal, state, and Indian lands, and agricultural lands, were removed because these areas are also subject to separate regulatory requirements. Land areas involving pollutant loading from construction activities and groundwater extraction were not considered because of the limited timeframe associated with construction permits and groundwater extraction impacts were assumed to be negligible. The second step was to optimize the proposed structural strategies in the remaining MS4 areas to achieve the required MS4 load reductions to meet the Water Quality Improvement Plan numeric goals while maintaining cost efficiencies.

The overall subwatershed load reduction goal would be met through reductions by both the MS4s and Non-MS4s achieving the same percent load reduction, thereby maintaining equity among all dischargers. Estimated load reductions were based on the relative loading from each responsible discharger in the watershed. Additional details and the data and assumptions used in the analysis are provided in Appendix O.

Table 4-17 summarizes the current Water Quality Improvement Plan load reduction requirements (primary scenario) and the alternative scenario results which separate MS4 and Non-MS4 loads for the Tecolote Creek subwatershed. The Alternative Scenario allows cost efficiencies to be achieved while still meeting the subwatershed's overall load reduction goal. Although the MS4 load reduction difference between the primary and alternative scenarios is small, the total cost savings to the MS4s are significant. This is due to structural BMP optimization within MS4 areas and a greater proportion of the required load reduction being addressed by nonstructural programs which are less costly. Note that BMP optimization refers to the modeling analysis that was conducted to identify the "optimal" structural BMP opportunities (considering BMP size, type, and location in the subwatershed) that would achieve the load reduction with the lowest cost. BMP optimization was conducted for both scenarios; however, additional cost savings are provided in the alternative scenario because only MS4 areas are considered. Results of this analysis are shown for the City of San Diego in Table 4-18, as an example.

Table 4-17
Summary of Primary and Alternative Scenario Results

Primary Scenario (MS4 + Non-MS4 Areas Combined)		Alternative Scenario (Separate MS4 and Non-MS4 Areas)			
		MS4 Allocation		Non-MS4 Allocation	
Fecal Coliform Load Reduction		Fecal Coliform Load Reduction		Fecal Coliform Load Reduction	
%	10 ⁹ MPN/mL	%	10 ⁹ MPN/mL	%	10 ⁹ MPN/mL
18%	92,496	18%	90,268	18%	2,228

MPN/mL = most probable number per milliliter

Table 4-18
Example Cost and Load Reduction Summary for the City of San Diego

Cost Comparison between Primary and Alternative Scenario	Primary Scenario (MS4 + Non-MS4 Areas Combined ¹ ; \$Million)	Alternative Scenario (MS4 Only ² ; \$Million)	Cost Savings from Primary Scenario (\$Million)
	\$31	\$30	\$1 (3.2%)
MS4 Load Reduction Summary for Alternative Scenario	MS4 Existing Load for Fecal Coliform (# x 10 ⁹)	Load Reduction Target for Fecal Coliform (%)	Load Reduction Target for Fecal Coliform (# x 10 ⁹)
	504,290	18%	90,268

1. MS4 treats loads from other regulated sources
2. MS4 treats loads within its jurisdiction

The MS4s assert that the Regional Board is ultimately responsible for regulating storm water discharges from Non-MS4s to more accurately and fairly assign pollutant reduction responsibilities in the watershed. The MS4s support this regulatory approach as an effective tool for improving water quality, and are committed to participating in efforts to incorporate Non-MS4s into current water quality regulations. To that end, the MS4s will continue to refine and update the alternative scenario analysis, and will engage stakeholders in a dialogue about how all the responsible parties within the watershed can work together to achieve the numeric goals in the Water Quality Improvement Plan. For example, the current list of Industrial General Permit (IGP) non-filers could be added to the analysis to more accurately estimate load reduction responsibilities for industrial dischargers within the WMA.

In addition, the Regional Board should work with the MS4s to identify potential updates to TMDLs, the MS4 Permit, and other responsible parties' NPDES permits, as appropriate, to more accurately and fairly assign load responsibilities among all the responsible parties in the watershed. The MS4s will provide the Regional Board with additional analysis and information necessary to facilitate future determinations by the Regional Board on load reduction responsibilities within the WMA. The Water Quality Improvement Plan may be revised in a future update to remove the Non-MS4 loads.

5 Water Quality Improvement Plan Monitoring and Assessment Program

This section of the Water Quality Improvement Plan describes the development of the Monitoring and Assessment Program for the Mission Bay WMA. The Monitoring Program includes three major components: (1) the receiving water monitoring program measures the long-term health of the watershed; (2) the MS4 outfall monitoring program investigates the elimination of dry weather flows from MS4 outfalls and the condition of the water quality of the flows that exit the MS4 outfalls during rain events; and (3) special studies take a further look into the highest priority water quality conditions presented in Section 2. The Assessment Program includes an annual analysis of the monitoring data and an integrated analysis that combines all analyses previously performed at the end of the MS4 Permit term.

Section 5 Highlights

- ❖ Presents the Monitoring and Assessment Program for the Mission Bay WMA Water Quality Improvement Plan
- ❖ Monitoring Program includes the following components:
 - Receiving Water Monitoring
 - Includes 49 total locations for 1 to 5 years of monitoring per location
 - Measures long-term health and attainment of beneficial uses
 - MS4 Outfall Monitoring
 - Includes 10 total locations
 - Dry weather: Includes inspections and inventory development with the goal of eliminating non-storm flow
 - Wet weather: Investigates whether there is a change in flow volumes and/or an improvement in discharge quality
 - Special Studies
- ❖ Assessment Program includes:
 - Annual assessments, including a review of the receiving water, MS4 outfall, and special studies data
 - A permit term assessment, combining all previous assessments into an integrated assessment

As shown in the graphic below, the fourth step of the Water Quality Improvement Plan (Monitoring & Assessment) is the development of an integrated Monitoring and Assessment Program for the Mission Bay WMA (Provision B.4, Provision D, Provision E, Provision F, and Attachment E). The Monitoring and Assessment Program moves into the second phase of the Water Quality Improvement Plan process.



The first three steps of the Water Quality Improvement Plan drive the City's program planning and budgeting processes:

- (1) Determining the priority water quality conditions
- (2) Identifying the sources
- (3) Defining goals, strategies, and schedules in relation to the highest priority water quality conditions

The last three steps of the Water Quality Improvement Plan are designed to evaluate the progress in addressing the priority water quality conditions through monitoring and assessment, updating the Water Quality Improvement Plan where needed (Adaptive Management Process, Section 6 of the Water Quality Improvement Plan), and reporting the findings of the assessments along with any necessary changes. Annual Reporting is described under both Section 5 and Section 6 of this Water Quality Improvement Plan, as it draws on both the Monitoring and Assessment Program and the Adaptive Management Process. The Water Quality Improvement Plan Monitoring and Assessment Program applies only to the City because Caltrans' monitoring requirements are regulated under their own MS4 Permit.

Based on the requirements of the MS4 Permit and Water Quality Improvement Plan process, the City has developed an integrated Monitoring and Assessment Program for the Mission Bay WMA that:

- (1) Assesses the progress toward achieving the numeric goals and schedules provided in Section 4
- (2) Measures the progress toward addressing the highest priority water quality conditions established in Section 2
- (3) Evaluates the City's overall efforts to implement the Water Quality Improvement Plan

The Monitoring and Assessment Program incorporates requirements of Provision B and Provision D of the MS4 Permit along with the specific monitoring and assessment requirements for the Bacteria TMDL listed in Attachment E of the MS4 Permit. Table 5-1 presents an overview of planned monitoring activities for the Mission Bay WMA, including key monitoring elements and an implementation schedule by program. The program is designed to characterize the pollutant levels associated with the highest priority water quality conditions in the discharges from the MS4

Water Quality Improvement Plan Monitoring includes sampling and analysis, inspection, and data collection at beaches, creeks, estuaries, and storm drain outfalls to observe conditions, improve understanding, and inform the management within the WMA to improve water quality conditions.

outfalls, identify sources of the highest priority water quality condition pollutants, and assess the effectiveness of strategies designed to address the highest priority water quality conditions. Additionally, these programs will generate data to track priority water quality conditions and general health and condition within the WMA. As stated in Provision D of the MS4 Permit:

“The purpose of this provision is for the Copermittees to monitor and assess the impact on the conditions of receiving waters caused by discharges from the Copermittees’ MS4s under wet weather and dry weather conditions. The goal of the Monitoring and Assessment Program is to inform the Copermittees about the nexus between the health of receiving waters and the water quality condition of the discharges from their MS4s. This goal will be accomplished through monitoring and assessing the conditions of the receiving waters, discharges from the MS4s, pollutant sources and/or stressors, and effectiveness of the water quality improvement strategies implemented as part of the Water Quality Improvement Plans.”

Translated into the Water Quality Improvement Plan process, the Monitoring and Assessment Program will provide the tools necessary to evaluate the main components presented in Sections 2 through 4 of the Water Quality Improvement Plan. In particular, the assessment focuses on the compliance pathways in Section 4. To do this, Section 5 is divided into two main components, Monitoring and Assessment. Figure 5-1 summarizes the main components of the Mission Bay WMA Monitoring and Assessment Program.

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Table 5-1
Water Quality Improvement Plan Monitoring

MS4 Permit Monitoring Programs			Monitoring Elements	Permit Schedule ¹					
				2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	
Monitoring to Assess Goals and Schedules		Dry/Wet	Varies by goal and jurisdiction	—	—	●	●	●	
Receiving Water Monitoring	Long-Term Receiving Water		Dry	Conventionals ² , FIB, nutrients, metals, pesticides, toxicity (chronic), possible TIE/TREs, visual observations, field measurements	● ³	—	—	—	—
				Hydromodification (channel conditions, discharge points, habitat integrity, evidence and estimate of erosion and habitat impacts)	● ³	—	—	—	—
				Bioassessment (BMI taxonomy, algae taxonomy, physical habitat characteristics)	● ³	—	—	—	—
			Wet	Conventionals ² , FIB, nutrients, metals, pesticides, toxicity (chronic), field measurements	● ³	—	—	—	—
	Regional Monitoring	Bight	Dry	Chemistry, toxicity, benthic infauna	●	—	—	—	● ⁴

Table 5-1 (continued)
Water Quality Improvement Plan Monitoring

MS4 Permit Monitoring Programs				Monitoring Elements	Permit Schedule ¹				
					2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Receiving Water Monitoring (continued)	Regional Monitoring (continued)	SMC	Dry	Bioassessment	●	●	●	●	●
		2011 Hydromodification Monitoring Program (HMP)	Wet	Channel assessments; flow monitoring; sediment transport monitoring	●	●	●	—	—
		AB 411 ⁵	Dry	FIB	●	●	●	●	●
	Sediment Quality Monitoring	Sediment Quality Monitoring	Dry	Chemistry, toxicity, benthic infauna	● ⁶	● ³	—	—	—
	TMDL Monitoring	Bacteria TMDL for Tecolote Creek and the Pacific Ocean Shoreline	Dry	FIB, visual observations, optional field measurements	●	●	●	●	●
			Wet	FIB, visual observations, optional field measurements	●	●	●	●	●
	ASBS Monitoring	ASBS	Wet (pre/during/post storm)	Conventionals ² , nutrients, metals, organics, toxicity	●	●	—	●	●
					—	—	●	●	●

Table 5-1 (continued)
Water Quality Improvement Plan Monitoring

MS4 Permit Monitoring Programs ¹			Monitoring Elements ¹	Permit Schedule ¹				
				2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
MS4 Monitoring	MS4 Field Screening	Dry	Visual: flow condition, presence and assessment of trash in and around the station, IC/IDs, descriptions	● ³	● ³	●	●	●
	MS4 Outfall	Dry	Field parameters, conventionals ² , nutrients, metals, FIB	–	–	●	●	●
		Wet	Field parameters, conventionals ² , nutrients, metals, FIB	● ³	● ³	●	●	●
Special Studies	San Diego Regional Reference Streams	Dry	Field parameters, conventionals ² , FIB, instantaneous flow	2012-2014	● ⁷	–	–	–
			Streams only: nutrients, metals, bioassessment (including physical habitat and chlorophyll a)	2012-2014	–	–	–	–
		Wet	Field parameters, conventionals ² , FIB	2012-2014	●	–	–	–
			Streams only: nutrients, metals, toxicity, flow, and precipitation (duration of storm)	2012-2014	●	–	–	–

Table 5-1 (continued)
Water Quality Improvement Plan Monitoring

MS4 Permit Monitoring Programs ¹			Monitoring Elements ¹	Permit Schedule ¹				
				2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Special Studies (continued)	Tecolote Creek Quantitative Microbial Risk Assessment Study (QMRA)	Dry	Scat survey, illicit discharge survey, visual observations, field parameters, conventionals ² , nutrients, FIB, MST markers, pathogens	●	●	TBD ⁸	TBD ⁸	TBD ⁸
		Wet	Field parameters, MST markers, pathogens, FIB	●	●	TBD ⁸	TBD ⁸	TBD ⁸
	Bannock Avenue BMP Effectiveness Study	Wet	Field parameters, FIB, conventionals ² , nutrients, metals.	–	–	●	–	–
	Stream Gauge Study	Dry/Wet	Temperature, water level, conductivity (location-dependent)	–	●	●	–	–

1. The MS4 Permit was adopted on May 8, 2013; the MS4 Permit became effective on June 27, 2013. Note the implementation of the programs will depend on the approval date of the Water Quality Improvement Plan and the fiscal year of implementation may be modified.
2. Definition of conventionals (conventional parameters) based on SWMP guidelines.
3. Completed under the Transitional Monitoring Program according to MS4 Permit Provisions D.1.a and D.2.a.
4. The 2018 Southern California Bight Regional Monitoring will occur during the summer of 2018 or 2019.
5. The AB 411 program is not required by the MS4 Permit. Responsible Agencies are using the data to track beach water quality conditions related to the Highest Priority Water Quality Condition for the WMA.
6. Sediment Quality Monitoring was completed under the Regional Harbor Monitoring Program of the 2013 Southern California Bight Regional Monitoring Program.
7. Dry weather monitoring at reference streams was completed in spring 2014. Dry weather monitoring at reference beaches began in Fall 2014
8. QMRA is in a source abatement phase as of February 2015. The future schedule of QMRA will be determined by effectiveness of source abatement.

BMI = benthic macroinvertebrates; IC/ID = Illicit connection/illicit discharge;
MST = microbial source tracking; TIE = toxicity identification evaluation;
TRE = Toxicity Reduction Evaluation



Figure 5-1
Monitoring and Assessment Program Components for the Mission Bay WMA

5.1 Water Quality Improvement Plan Monitoring Program

The Water Quality Improvement Plan Monitoring Program has three major components:

- ❖ Receiving water monitoring
- ❖ MS4 outfall discharge monitoring
- ❖ Special studies

Those three components, together with other information gathered from jurisdictional sources, are used to assess progress toward achieving short-term goals and schedules, as described in Section 5.1.1 below.

A summary of the Water Quality Improvement Plan Monitoring Program (including detailed information required to complete the monitoring tasks) is in Appendix P. The associated monitoring plans for each of the various elements described in Sections 5.1.1 through 5.1.4 will be available on the Project Clean Water Website, <http://www.projectcleanwater.org/index.php>, by June 2015. The methods and procedures described in these plans may be modified on the basis of site-specific environmental conditions and updated analytical methodologies.

- ❖ Wet weather is defined as >0.1 inch of rainfall within a 24-hour period and the following 72 hours after the end of rainfall.
- ❖ Dry weather is defined as all other days where rainfall is <0.1 inch of rainfall within a given 24-hour period.

5.1.1 Monitoring to Assess Progress Toward Achieving Goals and Schedules

This section summarizes monitoring designed to assess progress toward achieving goals related to the highest priority water quality conditions, which are bacteria and sediment for the Mission Bay WMA, as described in Chapter 2 of the Water Quality Improvement Plan. As outlined in Chapter 4 of the Water Quality Improvement Plan, bacteria goals are based on the multiple compliance pathways set forth for the Bacteria TMDL in Attachment E.6 of the MS4 Permit. Compliance with the TMDL may be demonstrated via one of the compliance pathways identified in the MS4 Permit. The proposed compliance dates for both the TMDL's interim goals and final goals are set outside of this Permit cycle. Table 5-2 presents the interim and final TMDL goals and monitoring that may be used to track progress toward achieving the goals.

The City has established jurisdictional goals for bacteria and sediment, the highest priority water quality conditions, during this MS4 Permit term to demonstrate progress toward compliance with the TMDL requirements. Caltrans has established jurisdictional goals for bacteria in the Tecolote Creek subwatershed. Generally, the Responsible Agencies have identified near-term goals to address potential bacteria and sediment sources and/or to reduce anthropogenic dry weather flow in MS4 outfalls. Data collection or monitoring elements that go beyond the prescribed Permit activities are tailored to measure progress toward meeting each goal. These elements, which are

further detailed in the following subsections, may include visual surveys, inspections, sampling and analysis, or field measurements, and development of new outreach and source control programs related to bacteria reduction.

Table 5-2
Monitoring Related to Bacteria TMDL Interim and Final Goals¹

Compliance Pathway		TMDL Goal	Monitoring Elements
1 OR	Receiving Water Conditions	Meet allowable exceedance frequency of the interim or final Receiving Water Limitations (RWLs) in the receiving water	Bacteria data collected at compliance points as described in Section 5.1.2, TMDL Monitoring Program
2 OR	MS4 Outfall Discharges ²	Meet allowable exceedance frequency in MS4 outfall discharges	Bacteria and flow data collected at outfalls as described in as described in Section 5.1.3, MS4 Outfall Monitoring Program
3 OR	MS4 Outfall Discharges ²	Pollutant load reductions for discharges from the Responsible Agencies' MS4 outfalls greater than or equal to the final load reductions	Bacteria, sediment, and flow data collected at outfalls as described in as described in Section 5.1.3, MS4 Outfall Monitoring Program
4 OR	MS4 Outfall Discharges ²	No direct or indirect discharge from the Responsible Agencies' MS4 outfalls to the receiving water ³	Visual observation of flow from outfalls to receiving waters as described in Section 5.1.3, MS4 Outfall Monitoring Program
5 OR	Receiving Water Conditions ²	Exceedances of the final receiving water limitations in the receiving waters due to loads from natural sources	Data from Sections 5.1.1, 5.1.2, 5.1.4, and Jurisdictional Runoff Management Programs.
6	Water Quality Improvement Plan	Implementation of Water Quality Improvement Plan and use of adaptive management (Interim Goal)	Data from Jurisdictional Runoff Management Programs
		OR	
		Implementation of Water Quality Improvement Plan and use of adaptive management (Final Goal)	Data from monitoring and Jurisdictional Runoff Management Programs

1. The Responsible Agencies propose to meet the TMDL interim goals by 2019 for dry weather and 2024 for wet weather.
2. Monitoring for this compliance pathway will also provide data for the City of San Diego to assess compliance with sediment goals in the ASBS.
3. Does not include allowable discharges as defined in MS4 Permit Provision A and Provision E.2.a.

Wet Weather Monitoring Related to Performance Measures

Responsible Agencies have established wet weather goals for the 2013-2018 Permit term. Tables 5-3 and 5-4 summarize the data that will be collected to assess these goals by jurisdiction.

Table 5-3
Wet Weather Monitoring Related to Jurisdictional Goals in
Tecolote Creek Subwatershed

Jurisdiction	Performance Metrics	Assessment Metric	Monitoring Elements
City of San Diego	Develop a green infrastructure policy, attain City Council approval, and construct 2 green infrastructure BMPs ¹ to improve water quality from 84.6 acres of drainage area	Acres of drainage area treated by construction of 2 green infrastructure BMPs	Detail the completion of BMPs, including acres treated

1. The 84.6 acres of drainage area treated are associated with 2 green infrastructure projects that will be completed by FY18: (1) permeable pavement at Mt. Abernathy Road and Camber Drive draining 19.6 acres, and (2) permeable pavement at Bannock and Genesee Avenues draining 65 acres.

Table 5-4
Wet Weather Monitoring Related to Jurisdictional Goals in
Scripps Subwatershed

Jurisdiction	First Permit Term Numeric Goals 2013-2018	Assessment Metric	Monitoring Elements
City of San Diego	Develop a green infrastructure policy, attain City Council approval, and construct 1 green infrastructure BMP ¹ to improve water quality from 8.9 acres of drainage area	Acres of drainage area treated by construction of 1 green infrastructure BMP	Detail the completion of BMP, including acres treated

1. The 8.9 acres of drainage area treated are associated with 1 green infrastructure project that will be completed by FY18: (1) permeable pavement and bioretention at Kellogg Park draining 8.9 acres.

Dry Weather Monitoring Related to Performance Measures

The Responsible Agencies have established dry weather goals for the 2013-2018 MS4 Permit term. Tables 5-5 and 5-6 summarize the data that will be collected to assess these goals.

**Table 5-5
Dry Weather Monitoring Related to Jurisdictional Goals in
Tecolote Creek Subwatershed**

Jurisdiction	Performance Metrics	Assessment Metric	Monitoring Elements
City of San Diego	Develop a green infrastructure policy, attain City Council approval, and construct 2 green infrastructure BMPs ¹ to improve water quality from 84.6 acres of drainage area	Acres of drainage area treated by construction of 2 green infrastructure BMPs	Detail the completion of BMPs, including acres treated
	Reduce by 10% the prohibited ² dry weather flow from baseline measured at persistently flowing outfalls during dry weather	Percent reduction in prohibited ² dry weather flow	Collect flow measurements at persistently flowing outfalls

1. The 84.6 acres of drainage area treated are associated with 2 green infrastructure projects that will be completed by FY18: (1) permeable pavement at Mt. Abernathy Road and Camber Drive draining 19.6 acres, and (2) permeable pavement at Bannock and Genesee Avenues draining 65 acres.
2. Does not include allowable discharges as defined in Provision A and Provision E.2.a of the MS4 Permit.

Table 5-6
Dry Weather Monitoring Related to Jurisdictional Goals in
Scripps Subwatershed

Jurisdiction	Performance Metrics	Assessment Metric	Monitoring Elements
City of San Diego	Develop a green infrastructure policy, attain City Council approval, and construct 1 green infrastructure BMP ¹ to improve water quality from 8.9 acres of drainage area	Acres of drainage area treated by construction of 1 green infrastructure BMP	Detail the completion of BMP, including acres treated
	Reduce by 10% the prohibited ² dry weather flow from baseline measured at persistently flowing outfalls during dry weather	Percent reduction in prohibited ² dry weather flow	Collect flow measurements at persistently flowing outfalls

1. The 8.9 acres of drainage area treated are associated with 1 green infrastructure project that will be completed by FY18: (1) permeable pavement and bioretention at Kellogg Park draining 8.9 acres.
2. Does not include allowable discharges as defined in Provision A and Provision E.2.a of the MS4 Permit.

5.1.1 Receiving Water Monitoring

The purpose of the receiving water monitoring program is to characterize trends in the chemical, physical, and biological conditions of a receiving water to determine whether beneficial uses are protected, maintained, or enhanced. This program is designed to meet the requirements set forth in Provision D.1 of the MS4 Permit. Long-term monitoring occurs during both wet and dry conditions for water quality and physical and biological integrity, along with sediment quality monitoring and participation in regional monitoring. The MS4 Permit also stipulates how TMDL monitoring requirements are to be incorporated into the receiving water monitoring program, as described in Attachment E of the MS4 Permit. Receiving water monitoring comprises the following programs:

- ❖ Long-term receiving water monitoring
- ❖ Regional monitoring participation
- ❖ Sediment quality monitoring
- ❖ TMDL monitoring
- ❖ ASBS monitoring

Long-Term Receiving Water Monitoring

Long-term receiving water monitoring will track the overall health of the receiving waters and is designed to answer the following questions:

- ❖ Are conditions in the receiving water protective, or likely protective, of beneficial uses?
- ❖ What are the extent and magnitude of the current or potential receiving water problems?
- ❖ Are the conditions in the receiving water getting better or worse?

Dry and wet weather monitoring will continue at the historical mass loading station (TC-MLS) located on the lower reach of Tecolote Creek. Copermittees have monitored TC-MLS since 2001 to meet the requirements of previous MS4 Permits. The MLS is depicted on Figure 5-2. This site will be monitored three times during wet weather and three times during dry weather per permit cycle. This monitoring program is designed to monitor the highest priority water quality conditions in the receiving water, along with a comprehensive list of constituents based on the 303(d) list impairments, CLRP, non-storm water action levels (NALs) or storm water action levels (SALs), and Table D-3 of the MS4 Permit. During both dry and wet weather, water samples will be analyzed for conventional constituents, nutrients, metals, pesticides, bacteria, field parameters, and toxicity, when applicable. Toxicity identification evaluations (TIEs), if necessary, will be conducted in compliance with Provisions D.1.c(4)(f) and D.1.d(4) of the MS4 Permit and used to determine the causative agent(s) of toxicity. Once per term during dry weather, a bioassessment will be conducted to evaluate chemical, physical, and biological data, and hydromodification monitoring will be conducted to record the stream conditions and habitat integrity and impacts.

The 2013 and 2014 Transitional Monitoring Programs satisfied long-term receiving water monitoring requirements, including dry and wet weather water quality sampling, bioassessments, and hydromodification monitoring for this Permit term. These data can be used to re-evaluate priorities via the iterative approach as described in Section 6. For details of this monitoring program, refer to Appendix P. The methods and procedures provided in Appendix P may be modified on the basis of site-specific environmental conditions and updated analytical methodologies.

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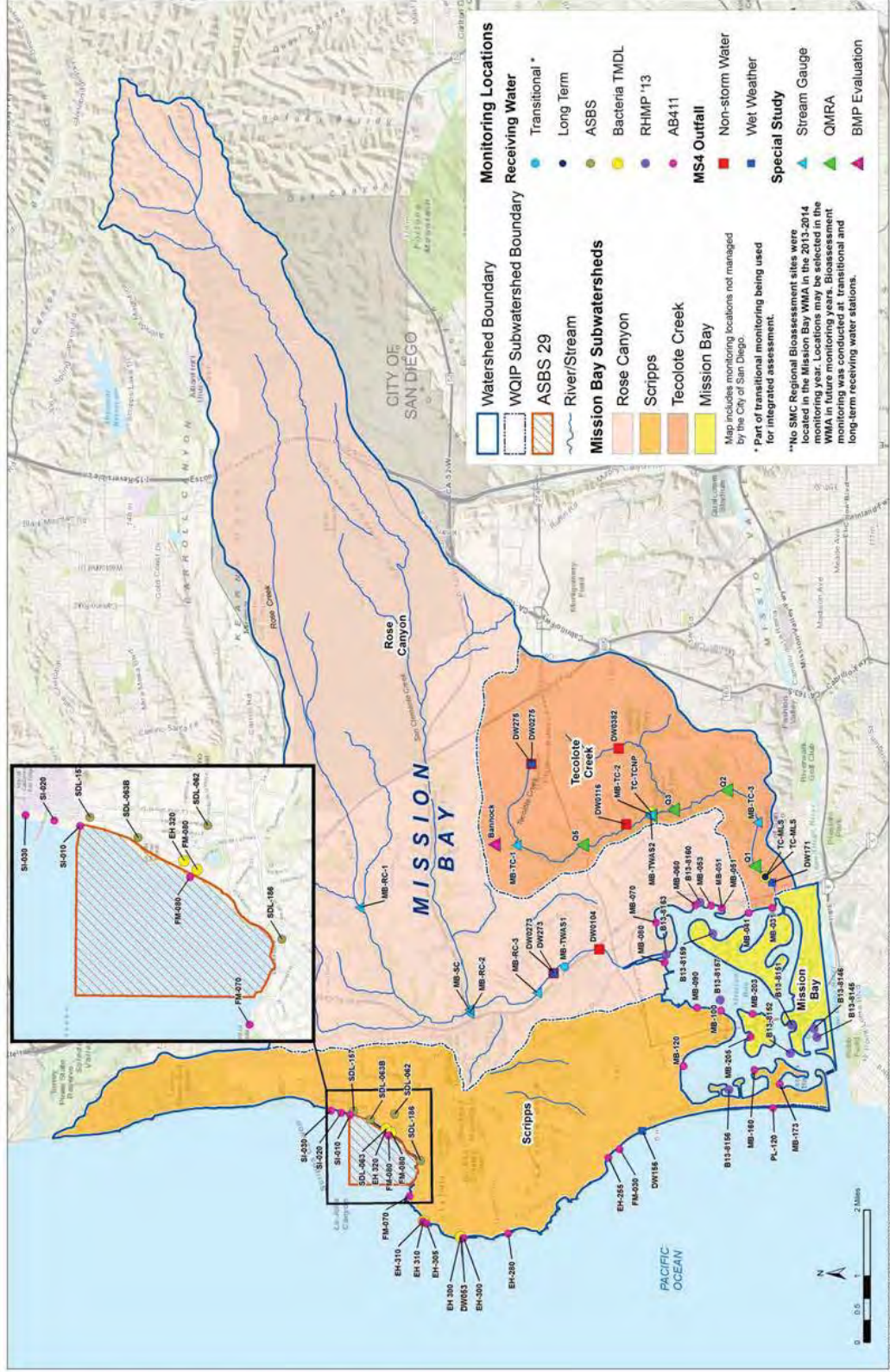


Figure 5-2
 MAP Monitoring Locations for the
 Mission Bay WMA

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Regional Monitoring Participation

Regional monitoring includes separate studies that will evaluate various aspects of receiving water health on a regional scale. The data may be used by the City to answer the following questions:

- ❖ Are conditions in the receiving water protective, or likely protective, of beneficial uses?
- ❖ What are the extent and magnitude of the current or potential receiving water problems?

The City participated in the following regional programs:

- ❖ Bight

The Bight regional monitoring program is a multi-agency collaborative effort developed to assess the ecological condition of the Southern California Bight from a regional perspective. The core monitoring program consists of sediment chemistry, sediment toxicity, benthic infauna, demersal fish, and epibenthic invertebrates. The goals of past Bight programs were to answer three primary questions:

- What are the extent and magnitude of direct impact from sediment contaminants?
- How does the extent and magnitude of the environmental impact vary by habitat?
- What is the trend in extent and magnitude of direct impacts from sediment contaminants?
- The RHMP was conducted under the region-wide Bight '13 monitoring program managed by SCCWRP to characterize the sediment quality. The RHMP was developed by the Port of San Diego, the City of San Diego, the City of Oceanside, and the County of Orange (RHMP Agencies) in response to a July 24, 2003, request by the Regional Board under §13225 of the California Water Code. The RHMP is a comprehensive effort to survey the general water and sediment quality and condition of aquatic life and to determine whether beneficial uses are being protected and attained in Dana Point Harbor, Oceanside Harbor, Mission Bay, and San Diego Bay. The program is composed of a core monitoring program supplemented by focused special studies warranted by the chemical, biological, and toxicological results of this core monitoring.

- ❖ SMC Regional Monitoring

Since 2001, the City has partnered with regulated storm water municipalities in southern California, the Regional Boards of Southern California, and the SCCWRP to form the Southern California SMC. The goals of the SMC are to

standardize monitoring, improve understanding of storm water mechanics, and identify receiving water impacts from storm water (SCCWRP, 2002). According to its 2014 Research Agenda, the SMC has identified 21 projects for the next 5-year term and is in the process of prioritizing its efforts on the basis of need and available funding (SMC, 2014a). The City will continue participation in the SMC Regional Freshwater Stream Bioassessment Monitoring Program (SMC Regional Bioassessment Program) that began as a five-year program in 2008–2013 and will be implemented for another five years (2015–2019).

The 2009–2013 SMC Regional Bioassessment Program was designed to address the following monitoring questions (SMC, 2014b):

- What is the extent of impact in streams of southern California?
- What are the stressors that impact southern California streams?
- Is the extent of stream impacts changing over time?

A final monitoring report was prepared on the basis of 2009–2013 results to identify lessons learned, data gaps, and recommendations to guide the design of the 2015–2019 program. In 2015, a new five-year SMC program will extend the initial survey to answer key management questions about the impacts of storm water on stream conditions. The program will have an added emphasis on detecting trends, including non-perennial streams and sampling sediment chemistry and toxicity.

The non-perennial stream monitoring was initiated in April 2014, with site revisits in May and June 2014. Sampling included benthic macroinvertebrates (BMI), algae, physical habitat, and California Rapid Assessment Method (CRAM). The trend site monitoring was conducted during the standard index period (i.e., from mid-May through July). Sampling for trend site monitoring included all of the parameters and constituents of the original SMC Regional Bioassessment Program (San Diego County Municipal Copermittees, 2014). The bioassessment monitoring was conducted at a total of 64 bioassessment stations; 30 stations were compliance stations; 28 stations were randomly placed SMC stations; and 6 stations were San Diego County reference stations (San Diego County Municipal Copermittees, 2014).

❖ Hydromodification Regional Monitoring Program

Copermittees have developed a regional HMP to address impacts on beneficial uses and stream habitat from increased erosive force potentially caused by an increase in runoff discharge rates and duration from all Priority Development Projects (County of San Diego, 2011). The HMP was initially developed to meet the requirements of the 2007 MS4 Permit. The Monitoring Plan is defined in Chapter 8 of the HMP, and was updated by the San Diego County Regional Copermittees and accepted by the Regional Board in February 2014. The HMP requires monitoring with a final report due to the Regional Board in December 2016. Monitoring consists of channel sediment transport assessments, and

continuous flow monitoring of pre-project, post-project, and reference conditions per MS4 Permit Provisions D.1.a and D.1.c(6). Additional monitoring is required per MS4 Permit Provision D.1.a(2).

❖ San Diego County Beach Water Quality (AB 411) Monitoring

San Diego County Department of Environmental Health (DEH) implements the Beach and Bay Water Quality Monitoring Program to support the statewide program funded by the Beach Safety Act (California Assembly Bill [AB] 411). This program is commonly referred to as AB 411 monitoring. The purpose of this monitoring program is to advise the public of potential health risks that could occur with water contact recreation at local beaches. DEH will post a health advisory notice or close a beach when FIB results are above REC-1 water quality standards. There are 26 AB 411 beach-monitoring stations in the Mission Bay WMA. All of these stations are monitored at least once weekly during dry weather (April 1 through October 31) and nine stations are monitored at least once weekly during the wet season (November 1 through March 30). The AB 411 monitoring program is not required by the MS4 Permit. RAs are using the AB 411 data to track beach water quality conditions related to the highest priority water quality condition for the WMA.

Sediment Quality Monitoring

Sediment quality monitoring is designed to assess compliance with receiving water limits applicable to MS4 discharges to enclosed bays and estuaries in accordance with the State Water Board's Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality (Sediment Control Plan). Part I of the State Board's Sediment Quality Control Plan provides sediment quality objectives for enclosed bays and estuaries and does not apply to ocean waters or inland surface waters (State Board, 2009). Sediment quality monitoring will be performed in compliance with Permit Provision D.1.e(2), which requires preparation of a Sediment Quality Monitoring Plan that satisfies the requirements of the Sediment Control Plan. As described in the Sediment Control Plan, assessment of receiving water quality with respect to the California Sediment Quality Objectives (SQOs) involves use of a multiple-line-of-evidence approach.

The data generated will be used to answer the following question:

- ❖ What is the condition of sediments in enclosed bays or estuaries with respect to the statewide sediment quality objectives?

The Sediment Quality Monitoring Plan and Quality Assurance Project Plan describe detailed proposed monitoring procedures and analytical methods that are illustrative and may change on the basis of site environmental conditions. As indicated in Table 5-1, sediment quality monitoring of the Mission Bay was conducted in the summers of 2013 and 2014.

The participating agencies propose to conduct one round of sediment sampling each Permit term. The second required round of sampling will be satisfied by conducting additional follow up sampling in the vicinity of potentially impacted sites identified in the first round. Sediment quality monitoring will employ the following general approach to meet the requirements of the Permit:

- (1) Conduct initial monitoring within each qualifying water body per the requirements of the state's Sediment Control Plan. These data will be used to assess the degree of potential impact at each site using the California SQO multiple-line-of-evidence approach in accordance with the assessment criteria specified in Sediment Control Plan Section V. These scores are derived using multiple metrics from three key lines of evidence: (1) sediment chemistry data, (2) toxicity data, and (3) benthic community data. Sites are then categorized as un-impacted, likely un-impacted, possibly impacted, likely impacted, or clearly impacted.
- (2) Confirm and characterize pollutant-related impacts for any sites that are considered possibly impacted, likely impacted, or clearly impacted, following an integration of all lines of evidence. In accordance with Sediment Control Plan criteria, the data assessment in this phase is required to determine whether the score(s) indicate potential impacts due to toxic pollutants (e.g., freshwater-related contaminant sources from the MS4), or non-toxic pollutants (e.g., physical habitat, freshwater inundation, legacy contaminants, or other potential factors). This phase would be considered the first phase of the stressor/source identification (SSID) investigation based on existing data. The requirements of this phase are dependent on the site characteristics as follows:
 - a. Monitoring Locations deemed to be possibly, likely, or clearly impacted based on initial monitoring for which the impact or impairment is determined to likely not be caused or contributed to by MS4 discharges will be monitored once more in the current Permit term. Follow-up monitoring is required to verify the findings from the first round of monitoring.
 - i. If results from the follow-up monitoring are consistent (possibly impacted), or un-impacted, no additional follow-up will be required during the current Permit term.
 - ii. If the second round of sampling reclassifies the station as likely or clearly impacted, an additional follow-up investigation may be needed or suspended pending future routine SQO monitoring. In this circumstance, results of the analytical assessments will be discussed with the Regional Board staff to determine whether/where any SSID studies should be undertaken, and to identify major elements of the approach for any identified studies. Prior to additional investigation, a site-specific Sediment Assessment Work Plan would be prepared that would outline specific steps and methodologies to be taken.

- b. Stations deemed by assessment to be likely or clearly impacted by MS4 discharges will require additional follow-up investigation and this is deemed the first phase of SSID. A site-specific Sediment Assessment Work Plan will be prepared that will outline specific steps and methodologies to be taken. Per the Sediment Control Plan, SSID comprises three steps: (1) confirmation and characterization of pollutant impacts, (2) pollutant identification, and (3) source identification and management actions.
- (3) In the annual Sediment Monitoring Report, describe the planned follow-up monitoring, including any planned SSID studies, and revisions to the Sediment Monitoring Plan, accordingly.

According to MS4 Permit Provision D.1.e(2), sediment monitoring is required to assess compliance with sediment quality receiving water limits applicable to MS4 discharges to enclosed bays and estuaries. Therefore, of the RHMP sites monitored, the freshwater-influenced sites are considered most applicable to evaluate or be representative of MS4 discharges. A total of 9 sediment sampling sites were monitored in Mission Bay as part of the RHMP. Of those, two were designated as freshwater-influenced locations: one at the base of Rose Creek and one at the base of Cudahy Creek (Table 5-7). Note, however, that a number of additional sites were classified under other categories that were located in areas that also receive freshwater influence. Several other locations in the marinas and elsewhere are close enough to storm drain inputs to have considerable influence from freshwater as well during large storm events.

Table 5-7
Freshwater-Influenced RHMP'13 Site IDs and Locations

RHMP Waterbody	Number of Sites	Site ID	Sediment Sampling	
			Latitude	Longitude
Mission Bay	2	B13-8163	32.78720	-117.20868
		B13-8160	32.79458	-117.21997

During the transitional (pre-Water Quality Improvement Plan) monitoring phase, the RHMP, in coordination with the Bight '13 program, may satisfy all or a portion of the requirements of the state's Sediment Control Plan (adopted in 2009) for monitoring of sediments in Mission Bay. The analysis is in progress and is focused on the most recent Bight '13/RHMP 2013 freshwater-influenced monitoring stations. Additional sediment monitoring data from Southern California Bight Monitoring Bight '08/RHMP efforts in 2008 are also available for these locations. The Bight '08/RHMP 2008 will be used in conjunction with the Bight '13/RHMP 2013 data to assess consistency both temporally and spatially for the same freshwater-influenced areas, when possible. The Mission Bay Responsible Agencies will determine if additional monitoring locations are needed to represent other areas influenced by freshwater in Mission Bay pending the completion

of the RHMP assessment and reporting (i.e., Tecolote Creek is a major source of freshwater and sediments to Mission Bay, but has not been monitored directly as a part of the regional Bight '08/Bight '13 or RHMP monitoring efforts).

Final analysis of the data collected for RHMP in 2013 are currently underway, and not currently available for decision-making purposes. A draft RHMP report containing these results is due to be submitted to the RHMP agencies in the summer of 2015, this report will most likely satisfy the requirements for the Sediment Monitoring Program. The Sediment Monitoring Plan is considered to be the template and will be modified based on the completed RHMP assessment and reporting. Modifications will include specifications for monitoring stations and schedule of implementation. The schedule of implementation shown in the Sediment Monitoring Plan reflects the pending data and will be amended upon completion of the RHMP analytical assessments described above to reflect any planned follow-up monitoring.

During the transitional (pre-Water Quality Improvement Plan) monitoring phase, the Southern California Regional Bight '13 Monitoring Program (Bight '13) satisfied the initial monitoring requirements of the state's Sediment Control Plan.

TMDL Monitoring

TMDL provisions, schedules, and monitoring requirements are provided in Attachment E of the MS4 Permit. The purpose of TMDL monitoring programs is to track progress toward achieving compliance with interim and final numeric targets.

The Bacteria TMDL is the only applicable TMDL in the Mission Bay WMA. Compliance monitoring is designed to meet the receiving water monitoring requirements of the Bacteria TMDL. Compliance monitoring, including wet and dry weather sampling, will be conducted each year at the compliance monitoring locations. The data generated will be used to address the following questions:

- ❖ Are TMDL numeric targets for bacteria indicators being met at the compliance monitoring locations?
- ❖ Are bacteria levels improving at the compliance monitoring locations?

Dry weather monitoring will be conducted weekly during the recreation season (April 1 through October 31) to be consistent with AB 411 monitoring frequencies, and monthly (at a minimum) during the wet season per the MS4 Permit requirements. Samples are to be collected on dry weather days, after an antecedent dry period of 72 hours with less than 0.2 inch of rainfall. Wet weather monitoring will be conducted at the compliance monitoring locations for up to three storm events during each wet season (October 1 through April 30). Storms resulting in greater than 0.2 inch of precipitation will be targeted for analysis. FIB are the target constituents for multiple segments within the Mission Bay WMA, as indicated by the MS4 Permit. Grab samples at beach locations will be collected in a manner consistent with requirements of the AB 411 program and will be analyzed for total coliform, fecal coliform, and *Enterococcus*. Grab

samples at creek locations will be analyzed for fecal coliform, *Escherichia coli*, and *Enterococcus*. For details of this monitoring program, refer to Appendix P. The methods and procedures described in Appendix P may be modified on the basis of site-specific environmental conditions and updated analytical methodologies.

Bacteria TMDL compliance monitoring has been conducted in the receiving water since Fall 2012.

Areas of Special Biological Significance Monitoring

ASBS monitoring is used to assess the maintenance and protection of natural water quality conditions in areas of special biological significance that support an unusual variety of aquatic life, and often host unique individual species. Sampling includes up to five outfall monitoring locations and one receiving water monitoring location at the end of Avenida de la Playa. One to three wet weather events are monitored per year and include both grab samples in the receiving water and flow-weighted composite samples at the outfall locations. The program also includes additional flow monitoring to continue to calibrate a hydraulic model of the Avenida de la Playa subwatershed.

5.1.2 MS4 Outfall Monitoring

The purpose of the MS4 outfall monitoring program is to evaluate the potential contribution from MS4 discharges to the receiving water quality. This program is designed to meet requirements set forth in Provision D.2 of the MS4 Permit. The MS4 outfall monitoring program has both dry and wet weather monitoring components. The outfall monitoring seeks to answer the question:

- ❖ Do non-storm water or storm water discharges from the MS4 contribute to receiving water quality problems?

This program is composed of the following two components:

- ❖ Dry Weather
 - Field screening
 - MS4 outfall dry weather monitoring
- ❖ Wet Weather
 - MS4 outfall wet weather monitoring

Table 5-8 provides the number of major outfalls to be monitored under each component of the MS4 Outfall Monitoring Program by the City. The number of major outfalls monitored per year as shown in Table 5-8 are subject to change on the basis of new information, updates to the City's MS4 outfall inventories, changes in transient or persistent flow classifications, and/or changes or updates to the priority water quality conditions over the life of the Water Quality Improvement Plan. Detailed proposed monitoring methods and procedures will be presented in the MS4 Outfall Monitoring Plan (the plan will be available on the Project Clean Water website,

<http://www.projectcleanwater.org/index.php>, by June 2015). These methods and procedures may be modified on the basis of site-specific environmental conditions and updated analytical methodologies.

Table 5-8
Number of Major MS4 Outfalls

Jurisdiction	Number of Major Outfalls Per Year		
	Field Screening ^{1,2}	Dry Weather Monitoring	Wet Weather Monitoring
City of San Diego	71 (71)	5	5

1. Total number of major outfalls within the City's jurisdiction in the WMA is provided in parentheses.
2. For Copermittees with portions of their jurisdictions in more than one WMA and more than 500 major MS4 outfalls in its jurisdiction, at least 500 major outfalls must be inspected once per year.

MS4 Outfall Dry Weather Monitoring

The purpose of the MS4 Outfall Dry Weather Monitoring Program is to evaluate the potential contribution from MS4 discharges to the receiving water quality during dry conditions and to effectively eliminate non-storm water discharges. The dry weather MS4 outfall monitoring component has two phases. For the first phase, each Copermittee will perform a field screening of a certain number of outfalls on the basis of the total number of outfalls in its jurisdiction. Using this outfall review, the Copermittees will prioritize the persistently flowing outfalls on the basis of their potential to impact receiving water quality. For the second phase, the highest priority dry weather MS4 outfalls will then be monitored, using more in-depth methods than those used in the field screening program.

Dry Weather Field Screening

Field screening is visual monitoring of all MS4 outfalls to identify and eliminate sources of persistently flowing non-storm water discharges. Dry weather MS4 outfall discharge field screening is designed to answer the following questions:

- ❖ Which non-storm water discharges are transient and which are persistent?
- ❖ Which discharges should be investigated as potential illicit connection/illicit discharges?

The frequency of field screening is determined on a jurisdictional basis and is dependent on the number of major outfalls. Provision D.2.b(1) of the MS4 Permit outlines three categories as the basis for frequency, as described below:

- ❖ 0-125 major outfalls, 80% of major outfalls 2 times per year
- ❖ 125-500 major outfalls, all major outfalls 1 time per year
- ❖ 500+ major outfalls, at least 500 major outfalls 1 time per year

Field screening activities will be conducted during dry weather with an antecedent dry period of at least 72 hours with less than 0.1 inch of rainfall. Field observations will include flow condition (pooled, ponded, flowing, or no flow), estimate of flow, characteristics of flow and water, likely source(s), presence of trash, or evidence or signs of illicit connections or illegal dumping. Follow-up investigations will be employed on the basis of jurisdictional IC/ID programs.

Prioritization of Non-Storm Water Persistently Flowing Outfalls

The City ranked its major outfalls on the basis of their highest priority water quality conditions, PGAs, and specific site considerations. The City considered the following factors to prioritize persistently flowing outfalls:

- ❖ Potential to contribute to a highest or priority water quality condition
- ❖ Historical monitoring or inspection data
- ❖ Controllability
- ❖ Surrounding land uses/potential sources
- ❖ Flow rate

Highest Priority MS4 Outfall Dry Weather Monitoring

The purpose of this program is to determine which major persistent-flow MS4 outfalls impact receiving water quality during dry weather. MS4 outfall dry weather monitoring is designed to answer the following questions:

- ❖ Do dry weather discharge concentrations at MS4 outfalls meet MS4 Permit action levels?
- ❖ What is the relative contribution of MS4 outfalls to priority water quality conditions during dry weather?
- ❖ What are the sources of persistent non-storm water flows?

The City will monitor a minimum of five major MS4 outfalls during dry weather. Each outfall will be monitored semi-annually during dry weather conditions. During each event, field observations will be recorded, and, when measureable flow is present, in-situ field measurements and analytical data will be collected. Analytical constituents will include constituents contributing to the highest priority conditions, 303(d) list impairments, TMDLs, NALs, and Table D-7 of the MS4 Permit as described in the MS4 Outfall Monitoring Plan (the Plan will be available on the Project Clean Water Website, <http://www.projectcleanwater.org/index.php>, by June 2015). When historical data demonstrated or justified that analysis of a constituent is not necessary for a particular waterbody or outfall, then it has been removed and its removal notated in the analytical table provided in the Water Quality Improvement Plan Annual Report. The methods and procedures described in the MS4 Outfall Monitoring Plan may be modified on the basis of site-specific environmental conditions and updated analytical methodologies.

Based on the data collected at the MS4 outfalls per jurisdiction as shown in Table 5-8, monitoring at these outfalls may be reprioritized to eliminate monitoring entirely or to reduce it to field screening activities only to address higher priority non-storm water persistent flows. Reprioritization of outfalls may occur if one of the following conditions is met:

- ❖ Non-storm water discharges have been effectively eliminated for three consecutive monitoring events; or
- ❖ Source(s) of the persistent flows have been identified as not an illicit or a source of pollutants; or
- ❖ Pollutants in the persistent flow do not exceed NALs; or
- ❖ The threat to water quality has been reduced by the Participating Agency.

Wet Weather MS4 Outfall Monitoring

The purpose of this program is to identify pollutants in storm water discharges from the MS4s, guide pollutant source identification efforts, and track progress in achieving the goals set forth in Section 4. The City's five monitoring locations for the wet weather MS4 outfall discharge monitoring component are chosen to be representative of the residential, commercial, industrial, and mixed-use land uses within the Mission Bay WMA. These five locations will be monitored during one storm event annually. Wet weather MS4 outfall discharge monitoring is designed to answer the following questions:

- ❖ Do wet weather discharge concentrations at MS4 outfalls meet MS4 Permit action levels?
- ❖ What is the relative contribution of MS4 outfalls to priority water quality conditions during wet weather?
- ❖ How do representative MS4 outfalls discharge concentrations, loads, and flows change over time?

The MS4 Permit (Provision D.2.c) requires that a minimum of five outfalls will be monitored once per year during a storm event with greater than 0.1 inch of rainfall. During each event, observational and hydrologic data will be recorded, including duration of the storm, rainfall estimates, and estimated or measured flow rates and volumes. Grab samples will be collected to analyze for pH, temperature, specific conductivity, dissolved oxygen, turbidity, hardness, and indicator bacteria. When feasible, a composite sample must be collected and analyzed for constituents contributing to the highest priority conditions, 303(d) list impairments, TMDLs, and SALs, as described in the MS4 Outfall Monitoring Plan (the plan will be available on the Project Clean Water Website, <http://www.projectcleanwater.org/index.php>, by June 2015). The methods and procedures described in the MS4 Outfall Monitoring Plan may be modified on the basis of site-specific environmental conditions and updated analytical methodologies. If historical data demonstrate or justify that analysis of a

constituent is not necessary for a particular waterbody or outfall, then it will be removed and its removal noted in the Water Quality Improvement Plan Annual Report.

The 2013 Transitional Monitoring Programs began implementation of the wet weather MS4 outfall monitoring requirements at the five Mission Bay WMA outfall monitoring locations. Some of the locations selected for the Water Quality Improvement Plan Monitoring Program are different the Transitional Monitoring Program monitoring locations.

5.1.3 Special Studies

Special studies have been selected to further investigate the highest priority water quality conditions set forth in Section 2 to meet requirements set forth in Provision D.3 of the MS4 Permit. The special studies will include a regional special study and a special study specific to the Mission Bay WMA.

San Diego Regional Reference Streams and Beaches Studies

The regional special studies selected for the Mission Bay WMA is the San Diego Regional Reference Streams and Beaches Studies currently being conducted by the San Diego and Orange County Copermittees. The studies will develop numeric targets that account for “natural sources” to establish the concentrations or loads from streams in a minimally disturbed by anthropogenic activities or “reference” condition. The Reference Stream Study also collected nutrients, metals, and toxicity data as secondary constituents, with a goal of collecting the data necessary to derive reasonable and accurate numeric targets for bacteria, nutrients, and heavy metals on the basis of a reference approach. This studies will provide a scientific basis for evaluating bacteria compliance levels in the Bacteria TMDL. The results of these studies will be used to support the forthcoming reopener of the recently adopted Bacteria TMDL and to support numeric targets in future TMDLs for bacteria, nutrients, and metals.

The San Diego Regional Stream Reference Study will address the following questions (SCCWRP, 2013):

- ❖ How does the WQO exceedance frequency vary between summer dry weather, winter dry weather, and wet weather?
- ❖ How does the WQO exceedance frequency vary by hydrologic factors, including:
 - Size of storm (wet weather only)?
 - Discharge flow rate and volume (wet and dry weather)?
 - Beginning versus end of storm season (wet weather only)?
- ❖ How does the WQO exceedance frequency vary by input factors such as:
 - Size of catchment?
 - Geology?

- ❖ How does the WQO exceedance frequency vary by biotic and abiotic factors, including:
 - Algal cover and/or biofilms?
 - Water quality (temperature, pH, conductivity, dissolved oxygen, total suspended solids concentration)?

The San Diego Regional Reference Beaches Study will address the following questions (SCCWRP, 2013) in beaches minimally influenced by anthropogenic activities:

- ❖ How does the WQO exceedance frequency vary between summer dry weather, winter dry weather, and wet weather?
- ❖ How does the WQO exceedance frequency vary by hydrologic factors, including:
 - Discharge flow rate (wet and dry weather)?
 - Status of estuary mouth (open/closed; dry weather only)?
- ❖ What are the wet and dry weather exceedance frequencies of fecal indicator bacteria in estuaries?

For the stream study, a total of 6 locations were selected for wet weather monitoring and up to 10 locations were selected for dry weather monitoring in the San Diego region. Sites were selected to represent 95 percent undeveloped land uses (reference conditions), two major geologic settings, and the target catchment sizes. Wet weather sampling frequency at the six locations consists of three targeted events throughout the wet season (October 1 through April 31). Dry weather sampling frequency consists of weekly sampling for up to 40 weeks at flowing locations during winter and summer dry weather periods. Dry weather sampling occurs if there has been no measurable rainfall for at least 72 hours.

Water samples will be analyzed for a combination of conventional constituents, nutrients, metals, fecal indicator bacteria, microbial source testing, and algae. Of these constituents, *Enterococcus*, *E. coli*, fecal coliform, total coliform, *Bacteroides*, and *in-situ* parameters are of primary importance; all other analytes are considered secondary. During dry weather sampling, reference stream sites will be assessed for algal percent cover, algal biomass, ash-free biomass, and factors that control the growth of algae (stream bankfull dimensions, canopy cover, and pebble count). Flow discharge rates were estimated for seven reference streams using recorded continuous water level data during both wet and dry weather conditions and measured velocity and flow during sampled wet weather events.

Tecolote Creek Quantitative Microbial Risk Assessment

The special study selected to represent the Mission Bay WMA is the Tecolote Creek Quantitative Microbial Risk Assessment Study (QMRA) that is currently being conducted in response to the Bacteria TMDL (the plan will be available on the Project Clean Water Website, <http://www.projectcleanwater.org/index.php>, by June 2015). The

study is designed to characterize the predominance of non-human sources in the watershed, quantify the potential risks associated with water contact recreation (e.g., swimming), and, if appropriate, calculate WQOs to reflect the watershed's site-specific conditions. The QMRA is a tool to aid in the development of site-specific WQOs for watersheds and conditions not well represented by the "default" WQOs (i.e., watersheds or conditions that are not dominated by treated sewage sources).

The QMRA study was developed with the following questions in mind:

- ❖ Are the bacteria sources to Tecolote Creek predominantly non-human, as concluded by previous studies?
- ❖ Which waterborne pathogens of concern are present in the Tecolote Creek watershed, and at what concentrations are they expected to occur at REC-1 or REC-2 sites?
- ❖ What is the risk of gastrointestinal illness (GI) from water contact recreation in Tecolote Creek due to the pathogens of concern?
- ❖ What site-specific WQOs would reflect those GI risks and protect water contact beneficial uses?
- ❖ Which best management practices are expected to be most cost-effective in reducing GI risks in coastal watersheds?
- ❖ Which "lessons learned" from the QMRA study could be used to develop and guide other risk assessment and management activities in the San Diego region?

Five sites were selected for wet and dry weather monitoring, with three wet weather and seven dry weather events targeted each year. Because the program is adaptive, the number of sampled events may vary. During wet weather events, receiving water composite and pollutograph grab samples will be collected throughout the hydrograph at one site. Grab samples during peak hydrograph conditions will be collected at the other four sites. Dry weather sampling will consist of one grab sample collected from each monitoring location, following an antecedent dry period of at least seven days. Samples will be analyzed for field parameters, FIB, microbial source tracking (MST), and reference pathogens.

5.1.4 Other Special Studies

The City has planned projects and studies to fill data gaps, further investigate priority and highest priority water quality conditions, or evaluate MS4 discharges and potential impacts. These projects exceed the monitoring requirements of the MS4 Permit. These studies will be implemented on the basis of available resources.

Stream Gauge Study

Many water bodies in the San Diego region have not been subject to regular flow monitoring. Knowledge of water level is essential for programs, including TMDL implementation, bio-objectives, and bioassessment. The stream gauge study attempts to fill in some of the gaps in the information regarding the level of flow at seven stream locations in Mission Bay WMA. Monitoring will answer the questions:

- ❖ What is the level of flow in local streams?
- ❖ Which streams are perennial and which are ephemeral?

The study, which began in spring of 2014 and will continue until spring 2015, includes installation of datalogger units. Dataloggers will gather water level, temperature, and conductivity data at 5-minute intervals. There are three locations in Rose Creek, one location in San Clemente Creek, and three locations in Tecolote Creek.

Bannock Avenue Neighborhood Enhancements and Bacteria Treatment for Tecolote Creek Watershed Protection – BMP Effectiveness Assessment

The Bannock Avenue Neighborhood Enhancements employ LID BMPs to reduce indicator bacteria loads in storm water runoff. One goal of the project is to help the City meet requirements of the Bacteria TMDL in Tecolote Creek. A BMP effectiveness assessment is being employed to answer the following question:

- ❖ Can LID BMPs effectively reduce storm water runoff pollutant contributions entering the storm drain system in the Tecolote Creek watershed?

Sampling will occur at 10 inlet/outlet monitoring locations, corresponding to 5 BMP configuration monitoring sites, as well as 1 drainage area outfall monitoring location. Five storm events will be targeted. Time-weighted composite samples and flow-weighted composite samples will be collected at the inlet/outlet and drainage area outfall sites, respectively. Pollutograph samples will also be collected, as required by protocol. Analyses will include field parameters, conventional parameters, nutrients, metals, and indicator bacteria.

5.1.5 Remaining Data Gaps

The data gaps discussed in Section 2 were compared with each of the monitoring program components described in the previous subsections. Most of the data gaps will be addressed by the Monitoring and Assessment Program. The long-term monitoring locations include a larger suite of pollutants than previously monitored on the basis of the new MS4 Permit requirements and provide more detail on hydromodification. In addition, because the MS4 outfall monitoring locations for dry and wet weather are prioritized on the basis of the priority water quality conditions identified in Section 2, over time there will be more MS4 data near the waterbodies included in the priority water quality conditions. It is expected to take a few years of monitoring to potentially

assess the MS4 contribution to the priority water quality conditions because of the typical high variability of constituent concentrations in storm water. MS4 monitoring locations may also need to change because it is unlikely that MS4 locations will be monitored near each priority water quality condition during one monitoring season.

Some data gaps can be filled by working collaboratively with other agencies to access the data that they collect. For example, the County of San Diego County DEH collects data on bacteria counts at local beaches along the Pacific Shoreline. The City can work with DEH to obtain these data and use them to assess the receiving water impacts of total coliform, fecal coliform and *Enterococcus* on Pacific Shoreline segments during the summer months that are currently not being monitored by the City.

Some data gaps remain because the present state of science does not allow for the full characterization of the cause of the priority water quality condition. The impairment caused by nutrients is affected by the physical and biological conditions of the receiving water. The link between these factors and concentration of nutrients in the priority water quality condition waterbodies will not be determined as part of this iteration of the Monitoring and Assessment Program. Similarly, for receiving waters impaired by toxicity, factors other than runoff from the MS4 contribute to toxicity levels. The Monitoring and Assessment Program currently does not include analyses of Non-MS4 contributions to toxicity in receiving water. For pollutants such nutrients, groundwater may be a contributing source, as noted throughout the San Diego Region (City of San Diego, 2011).

5.1.6 Regional Clearinghouse

The Responsible Agencies will use existing data-sharing templates to facilitate compilation of watershed-wide data sets for assessment and reporting purposes. To support reporting under previous Permit cycles, regional data-sharing templates were developed for receiving water monitoring, MS4 outfall monitoring, field screening, and illicit connection/illicit discharge (IC/ID) reporting. The Responsible Agencies will make the following data and documentation available to the public on the Project Clean Water website:

- ❖ Mission Bay WMA Water Quality Improvement Plan and all updated versions with date of update
- ❖ Annual Reports for the WMA
- ❖ JRMP documents for each Responsible Agency within the WMA and all updated versions with date of update
- ❖ BMP Design Manual for each Responsible Agency within the WMA and all updated versions with date of update
- ❖ Reports from special studies conducted in the WMA
- ❖ Monitoring data uploaded to the California Environmental Data Exchange Network (CEDEN) with links to the uploaded data

- ❖ Available GIS data, layers, and/or shape files used to develop the maps to support the Water Quality Improvement Plan, Annual Reports, and Jurisdictional Runoff Management Programs

5.2 Water Quality Improvement Plan Assessment Program

The assessment portion of the Monitoring and Assessment Program will evaluate the data collected under the monitoring programs described in Section 5.1, as well as the information collected as part of the JRMP. The data collected from these two programs will be used to assess progress toward achieving the Water Quality Improvement Plan numeric goals and schedules and to measure the progress toward addressing the highest priority water quality conditions.

This section summarizes the requirements of the four primary assessments listed in Figure 5-1. Depending on permit requirements, some assessments will be reported annually, as part of the Water Quality Improvement Plan Annual Report, while others will be included in the Report of Waste Discharge that the City must submit prior to the issuance of the next MS4 Permit. The timeframe for each of the assessments is as follows:

- ❖ Annual Reporting
 - Receiving Water Assessment
 - MS4 Outfall Discharge Assessment
 - Special Studies Assessment
- ❖ MS4 Permit Reporting (Report of Waste Discharge at end of MS4 Permit Cycle)
 - Integrated Assessment

Project Clean Water is a web-based portal for San Diego County watersheds. It is used as a centralized point of access to share educational materials, water quality information, and MS4 Permit-required reports with the public.

www.projectcleanwater.org

The Monitoring and Assessment Program will be evaluated and adapted in the context of the Annual Reporting and the Report of Waste Discharge. The re-evaluation will consider data gaps and the results of all monitoring program elements. Required elements of the Water Quality Improvement Plan Annual Report are provided in Table 5-9.

Modifications may be made to the Monitoring and Assessment Program, but the core elements required by the MS4 Permit and described in Section 5.1 must be maintained. This limits the amount of adaptation that is possible. Potential changes could be to change the frequency of sampling, add a new analyte of concern, or move a monitoring location.

Table 5-9
Annual Reporting Components

Assessment and Documentation	Detailed Data and Information
Summary of data collected, findings, interpretations, and conclusions from the assessments required per MS4 Permit Provisions F.3.b(3)(a)-(c)	❖ Receiving Water Assessments per Provision D.4.a. ❖ Sediment Quality Assessments per Provision D.1.e(2) ❖ TMDL Assessments per Provision E.6 ❖ MS4 Outfall Discharger Assessments D.4.b ❖ IDDE relevant information and findings per Provision E.2 ❖ Special studies: findings and progress per Provision D.4.c ❖ Re-evaluation of the priority water quality conditions, numeric goals, strategies, schedules, and/or monitoring and assessment, as needed per Provision D.4.d¹
Progress of implementing the Water Quality Improvement Plan per MS4 Permit Provision F.3.b(3)(d)	❖ Progress toward interim and final numeric goals for the highest priority water quality conditions for the watershed ❖ Status of water quality improvement strategies by each Responsible Agency ❖ Proposed modifications to water quality improvement strategies and supporting rationale ❖ Water quality improvement strategies planned for implementation during the next reporting period ❖ Proposed modifications to Water Quality Improvement Plan and/or each Copermittee's jurisdictional runoff management program document ❖ Previous modifications or updates incorporated into the Water Quality Improvement Plan and/or each Copermittee's jurisdictional runoff management program document

Table 5-9 (continued)
Annual Reporting Components

Assessment and Documentation	Detailed Data and Information
A completed Jurisdictional Runoff Management Program Annual Report Form for each Copermittee in the WMA, certified by a Principal Executive Officer, Ranking Elected Official, or Duly Authorized Representative per Provision F.3.b(3)(e)	❖ City of San Diego
Any data or documentation utilized in developing the Water Quality Improvement Plan Annual Report for each Responsible Agency, upon request by the Regional Board. Monitoring data must be uploaded to CEDEN and available for access on the Regional Clearinghouse per Provision F.3.b(3)(f)	❖ Receiving water and data collected per Provision D. 1 ❖ MS4 outfall discharge monitoring data collected per Provision D.2 ❖ Special Study data ❖ IC/ID investigation data

1. This re-evaluation is not required annually; at minimum, it must be completed as part of the Report of Waste Discharge.

5.2.1 Integrated Assessment

The integrated assessment builds on the receiving water assessment, MS4 outfall discharge assessment, and special studies assessment described in Sections 5.2.2 through 5.2.4. Additionally, the integrated assessment will evaluate the data collected as part of the transitional monitoring program implemented after the approval of the 2013 MS4 Permit and before the implementation of the monitoring program detailed in Section 5.1 Transitional monitoring components from the 2007 MS4 Permit consisted of:

- ❖ Continuation of the receiving water monitoring programs performed under the previous MS4 Permits (including monitoring at the two temporary watershed assessment station (TWAS) locations in Rose Creek and Tecolote Creek)
- ❖ Continuation of the Hydromodification Management Plans monitoring program
- ❖ Continued participation in regional receiving water monitoring programs
- ❖ Implementation of the Bacteria TMDL CLRPs
- ❖ Continuation of the dry weather MS4 outfall field screening program
- ❖ Continuation of wet weather MS4 outfall discharge monitoring

The City will integrate the data collected as part of the Monitoring and Assessment Program with information collected during the implementation of the JRMP. The integrated assessment will evaluate the main components of the Water Quality Improvement Plan and will follow the assessment process outlined in the MS4 Permit, as summarized in Table 5-10. The priority water quality conditions will be re-evaluated using the receiving water and MS4 outfall discharge assessments on the basis of the methodology presented in Appendix A. The compliance pathways that comprise the goals and schedules presented in Section 4 will be reviewed on the basis of the results of the receiving water and MS4 outfall discharge assessments, along with data collected as part of the JRMP. This evaluation will characterize progress in achieving the compliance goals. Finally, water quality monitoring data and maintenance/observational data related to BMP effectiveness will be used to assess the strategies implemented by the City. Table 5-10 summarizes the assessment program components.

The integrated assessment for all three Water Quality Improvement Plan components will be performed during the development of the Report of Waste Discharge. Strategies will be evaluated in the Water Quality Improvement Plan Annual Report on the basis of the data collected as part of the JRMP and any new relevant BMP effectiveness data collected by the City.

Table 5-10
Integrated Assessment Components

Water Quality Improvement Plan Components	MS4 Permit Assessment Methodology	Evaluation Assessment
Priority Water Quality Conditions	<u>Re-assess receiving water, priority, and highest priority conditions.</u> (1) Re-evaluate the receiving water conditions per methodology and any new methodology provided in Appendix A. (2) Re-evaluate the impacts of MS4 discharges on receiving waters per methodology provided in Appendix A. (3) Identify beneficial uses in receiving waters that must be protected per Receiving Water Assessment (Section 5.2.2). <u>Re-evaluate MS4 sources and stressors based on potentially new priority and highest priority conditions.</u> (4) Re-evaluate the identification of MS4 sources and/or stressors performed in Section 3.	❖ Receiving Water Assessments ❖ MS4 Outfall Discharge Assessments
Goals and Schedules (Compliance Pathways)	<u>Evaluate effectiveness of goals.</u> (1) Evaluate the progress toward achieving interim and final numeric goals for protecting impacted beneficial uses in receiving waters.	❖ Receiving Water Assessments ❖ MS4 Outfall Discharge Assessments ❖ JRMP Assessments

Table 5-10 (continued)
Integrated Assessment Components

Water Quality Improvement Plan Components	MS4 Permit Assessment Methodology	Evaluation Assessment
Strategies	<u>Evaluate effectiveness of strategies and actions.</u> (1) Identify the non-storm water and storm water pollutant loads from the MS4 outfalls on the basis of the MS4 Outfall Discharge Assessment (Section 5.2.3). (2) Identify the non-storm water and storm water pollutant load reductions, or other improvements that are necessary to attain the interim and final numeric goals. (3) Identify the non-storm water and storm water pollutant load reductions, or other improvements, that are necessary to demonstrate that non-storm water and storm water discharges are not causing or contributing to exceedances of receiving water limitations. (4) Evaluate the progress of the strategies toward achieving interim and final numeric goals for protecting beneficial uses in receiving waters.	❖ MS4 Outfall Discharge Assessments ❖ Special Studies Assessments for BMP Effectiveness ❖ JRMP Assessments

Performance-Based Goals Assessment

Of particular interest for the integrated assessment to be performed during this MS4 Permit cycle is a review of the performance-based goals presented in Section 4. These goals will be reviewed during the development the Report of Waste Discharge. Section 6.3.2 summarizes the jurisdictional goals put forth by the City and the measures that will be used to assess the goals.

5.2.2 Receiving Water Assessments

The assessment of receiving waters involves evaluating the physical, chemical, and biological conditions of the receiving waters and the condition of the sediment. The City must assess the status and trends of receiving water quality conditions in coastal waters, enclosed bays, harbors, estuaries, and streams in the Mission Bay WMA. This assessment includes evaluation of both dry weather and wet weather conditions. The receiving water assessment may be presented in the Water Quality Improvement Plan Annual Report or will be in the Report of Waste Discharge and will:

- ❖ Assess whether the conditions of the receiving waters are meeting the numeric goals established in Section 4.
- ❖ Identify the most critical beneficial uses that must be protected to ensure the overall health of the receiving water.
- ❖ Evaluate whether those critical beneficial uses are being protected.
- ❖ Identify short-term and/or long-term improvements or degradation of those critical beneficial uses.
- ❖ Consider whether the strategies established in the Water Quality Improvement Plan contribute toward progress in achieving the interim and final numeric goals of the Water Quality Improvement Plan.
- ❖ Identify gaps in the monitoring data needed to assess the provisions above.

Additionally, the Water Quality Improvement Plan Annual Report will incorporate a Sediment Monitoring Report in accordance with the schedule included in the Sediment Monitoring Plan. The Sediment Monitoring Report will contain the following information:

- ❖ **Analysis.** Evaluation, interpretation, and tabulation of the water and sediment monitoring data
- ❖ **Sample Location Map.** Identification of the locations, types, and number of samples on a site map
- ❖ **California Environmental Data Exchange Network.** A statement certifying that the monitoring data and results have been uploaded into CEDEN

A human health risk assessment may be conducted on the basis of the Sediment Monitoring Report conclusions and at the direction of the Regional Board. This assessment will determine whether the human health objective contained in the Receiving Water Limitations has been attained at each monitoring location.

5.2.3 MS4 Outfall Discharge Assessments

The MS4 outfall discharge assessments include evaluating both the dry weather monitoring associated with the IDDE program and the wet weather monitoring data collected by the City. Details of these two separate assessments are provided below. The City will assess its MS4 programs individually and will compile the reports as part of the Mission Bay WMA Water Quality Improvement Plan Annual Report. The key elements of the MS4 Outfall Discharge Assessments are summarized in Table 5-11.

Table 5-11
Key Elements of the MS4 Discharge Assessments

Dry Weather Outfall Assessment	Illicit Discharge	Wet Weather Outfall Assessment
❖ Identify sources of non-storm water discharges on the basis of field screening data or IDDE activities ❖ Rank and prioritize non-storm water discharges ❖ Identify sources contributing to numeric action limit exceedances ❖ Estimate volumes and loads of non-storm water discharges ❖ Evaluate non-storm water discharge monitoring locations ❖ Evaluate the effectiveness of the water quality improvement strategies	❖ All IC/ID investigations ❖ IC/IDs eliminated within the jurisdiction	❖ Estimate volumes and loads of storm water discharges ❖ Evaluate temporal trends ❖ Evaluate storm water discharge monitoring locations and frequency ❖ Evaluate Water Quality Improvement Plan analysis ❖ Evaluate the effectiveness of water quality improvement strategies

Dry Weather Outfall Assessments and Illicit Discharges

The City must assess and report the progress of its IDDE program (required pursuant to MS4 Permit Provision E.2) toward effectively prohibiting non-storm water and illicit discharges into the MS4s within its jurisdiction, including the following elements:

❖ Identify sources of non-storm water discharges.

Based on the dry weather MS4 outfall discharge field screening monitoring described in Appendix P, the City must assess and report as follows (Provision D.4.b(1)(b)):

- Identify the known and suspected controllable sources (e.g., facilities, areas, land uses, and pollutant-generating activities) of transient and persistent flows within the City's jurisdiction in the Mission Bay WMA.
- Identify sources of transient and persistent flows within the City's jurisdiction in the Mission Bay WMA that have been reduced or eliminated.
- Identify modifications of the field screening monitoring locations and frequencies for the MS4 outfalls in the City's inventory necessary to identify and eliminate sources of persistent flow non-storm water discharges (Provision D.2.b).

The JRMP Annual Report will be used to guide this assessment in the Water Quality Improvement Plan Annual Report. Known and suspected sources will be identified during the implementation of JRMP activities. These activities include the facility inspections that complement the IDDE program and information gathered by the storm water hotline or other public complaints. The JRMP Annual Report now consists of a one-page form that summarizes the JRMP activities in Attachment D of the MS4 Permit, along with supporting information. Section IV of the JRMP Annual Report Form summarizes the findings of the IDDE Program. The back-up that may be provided along with the form may include the following information to help identify sources:

- Subwatershed of the source or complaint
- Potential receiving water of the source or complaint
- Potential pollutant or pollutant category that could be contributed by the source or complaint

❖ Rank and prioritize non-storm water discharges.

Based on the data collected and applicable numeric action levels as described in Section 2 and detailed in Appendix P, the City must rank the MS4 outfalls in its jurisdictions according to the potential threat to receiving water quality and produce a prioritized list of persistently flowing major MS4 outfalls. The Water Quality Improvement Plan will be updated as described in Section 6 on the basis of these findings and with the goal of implementing (in the order of the ranked

priority list) targeted programmatic actions and source investigations to eliminate persistent non-storm water discharges and/or pollutant loads.

❖ **Identify sources contributing to numeric action level exceedances.**

For the highest priority major MS4 outfalls with persistent flows that exceed numeric action levels, the City must identify the known and suspected sources within its jurisdiction in the Mission Bay WMA that may cause or contribute to the numeric action level exceedances.

❖ **Estimate volumes and loads of non-storm water discharges.**

Annually, the City must (1) analyze the data collected as part of the Non-Storm Water Persistent Flow MS4 Outfall Discharge Monitoring Program from the highest priority major MS4 outfalls and (2) use a model or another method to calculate or estimate the non-storm water volumes and pollutant loads collectively discharged from all the major MS4s outfalls in its jurisdiction that have persistent dry weather flows during the monitoring year. These calculations or estimates must include:

- The percent contribution from each known source for each MS4 outfall
- The annual non-storm water volumes and pollutant loads collectively discharged from the City's major MS4 outfalls to receiving waters within the City's jurisdiction
- The annual volumes and pollutant loads for sources of non-storm water not subject to the City's legal authority that are discharged from the City's major MS4 outfalls to downstream receiving waters

❖ **Evaluate non-storm water discharge monitoring locations.**

Based on an evaluation of the data collected from the highest priority non-storm water persistent flow MS4 outfall monitoring locations, the outfall monitoring locations may be reviewed and the list reprioritized according to one or more of the following criteria (Provision D.2.b(2)(b)(ii)):

- The non-storm water discharges have been effectively eliminated (i.e., there is no flowing, pooled, or ponded water) for three consecutive dry weather monitoring events.
- The sources of the persistent flows have been identified as a category of non-storm water discharges that do not require an NPDES permit and do not have to be addressed as an illicit discharge because they were not identified as sources of pollutants (i.e., the constituents in the non-storm water discharge do not exceed numeric action levels) and the persistent flow can be reprioritized to a lower priority.

- The constituents in the persistent flow non-storm water discharge do not exceed numeric action levels.
- The source(s) of the persistent flows has (have) been identified as a non-storm water discharge authorized by a separate NPDES permit.

Where these criteria have not been met but the threat to water quality has been reduced by the City, the highest priority persistent flow MS4 outfall monitoring stations may be reprioritized accordingly for continued dry weather MS4 outfall discharge field screening monitoring as part of the dry weather MS4 outfall discharge field screening program.

The City must document removal or reprioritization of the highest priority persistent flow MS4 outfall monitoring stations identified under the non-storm water persistent flow MS4 outfall discharge monitoring program in the Water Quality Improvement Plan Annual Report. When the City removes a persistent flow MS4 outfall monitoring station, it will be replaced with the next highest prioritized major MS4 outfall designated by that jurisdiction in the Mission Bay WMA. If there are no remaining qualifying major MS4 outfalls within the jurisdiction, the number of major MS4 outfalls monitored will be reduced.

❖ **Evaluate the effectiveness of the water quality improvement strategies.**

As part of the Report of Waste Discharge, the City will review the data collected as part of the Dry Weather MS4 Outfall Discharge Monitoring Program and findings from annual dry weather MS4 discharge monitoring assessments described above (Provisions D.4.b(1)(c)(v)[a]-[c] and Provision D.4.b(1)(c)(vi)). The evaluation will incorporate the following:

- Identification of reductions and progress in achieving reductions in non-storm water and illicit discharges to the City's MS4s in the Mission Bay WMA
- Assessment of the effectiveness of the water quality improvement strategies being implemented by the City within the Mission Bay WMA toward reducing or eliminating non-storm water and pollutant loads discharging from the MS4s to receiving waters, and, if possible, estimation of the non-storm water volume and/or pollutant load reductions attributable to specific water quality strategies
- Identification of modifications necessary to increase the effectiveness of the water quality improvement strategies implemented by the City toward reducing or eliminating non-storm water and pollutant loads discharging from the MS4s to receiving waters within its jurisdiction
- Identification of data gaps in the monitoring data necessary to assess the provisions above

Wet Weather Outfall Assessments and Illicit Discharges

The City must assess and report the progress of the water quality improvement strategies implemented as part of the Water Quality Improvement Plan and the JRMP toward reducing pollutants in storm water discharges from the MS4s. This is designated as the Wet Weather MS4 Outfall Discharge Monitoring Program. The assessment of this program will:

❖ Estimate volumes and loads of storm water discharges.

As part of the Water Quality Improvement Plan Annual Report, the City must analyze the monitoring data collected as part of the Wet Weather MS4 Outfall Discharge Monitoring Program. This includes using a watershed model or another method to calculate or estimate the following for each monitoring year:

- The average storm water runoff coefficient for each land use type within the Mission Bay WMA
- For storm events with measurable rainfall greater than 0.1 inch, the volume of storm water and pollutant loads discharged from the monitored MS4 outfalls to receiving waters within the Mission Bay WMA
- The total flow volume and pollutant loadings discharged from the City's jurisdiction within the Mission Bay WMA over the course of the wet season, extrapolated from the data produced from the monitored MS4 outfalls
- For storm event with measurable rainfall greater than 0.1 inch, the percent contribution of storm water volumes and pollutant loads discharged from land use type within (1) each hydrologic subarea with a major MS4 outfall to receiving waters or (2) each major MS4 outfall to receiving waters

❖ Evaluate temporal trends.

To evaluate all the data collected as part of the Wet Weather MS4 Outfall Discharge Monitoring Program, the City must:

- Incorporate new outfall monitoring data into time series plots for each long-term monitoring constituent for the Mission Bay WMA.
- Analyze statistical trends on the cumulative long-term wet weather MS4 outfall discharge water quality data set.

❖ **Evaluate storm water discharge monitoring locations and frequency.**

The City may identify modifications to the wet weather MS4 outfall discharge monitoring locations and frequencies necessary to identify pollutants in storm water discharges from the MS4s in the WMA (Provision D.2.c(1)). The two methods available per the MS4 Permit to modify the Wet Weather MS4 Discharge Outfall Program are the following:

- The City may adjust the wet weather MS4 outfall discharge monitoring locations in the Mission Bay WMA, as needed, to (1) identify pollutants in storm water discharges from MS4s, (2) guide pollutant source identification, and (3) determine compliance with the WQBELs associated with the Bacteria TMDL in Attachment E of the MS4 Permit. The number of stations should be at least equivalent to the number of stations required under the MS4 Permit (Provision D.2.a(3)(a)). Additional outfall monitoring locations (above the minimum per jurisdiction) may be required to demonstrate compliance with the WQBELs associated with the Bacteria TMDL and the Draft Sediment TMDL.
- The City may adjust the analytical monitoring required for the Mission Bay WMA if historical data or other supporting information demonstrate or justify that analysis of a constituent is not necessary.

❖ **Evaluate Water Quality Improvement Plan analysis.**

The City will evaluate the Water Quality Improvement Plan analysis on the basis of the wet weather MS4 outfall monitoring data collected and the applicable storm water action levels (Provision C.2). This evaluation will include analyzing and comparing the monitoring data used to develop the Water Quality Improvement Plan, particularly the strategies presented in Section 4. Additionally, the City will evaluate whether those analyses should be updated as a component of the adaptive management described in Section 6.

❖ **Evaluate effectiveness of water quality improvement strategies.**

As part of the Report of Waste Discharge, the city will review the data collected pursuant to Wet Weather MS4 Outfall Discharge Monitoring Program and findings from the annual wet weather MS4 discharge monitoring assessments described above (Provisions D.4.b(2)(c)(i)-(ii)). The evaluation will:

- Identify progress in achieving reductions in pollutant concentrations and/or pollutant loads from different land uses or drainage areas discharging from the City's MS4s in the Mission Bay WMA.

- Assess the effectiveness of water quality improvement strategies being implemented by the City within the Mission Bay WMA toward reducing pollutants in storm water discharges from the MS4s to receiving waters within the WMA to the maximum extent practicable (if possible, include an estimate of the pollutant load reductions attributable to specific water quality strategies implemented by the City).
- Identify modifications necessary to increase the effectiveness of the water quality improvement strategies implemented by the City in the Mission Bay WMA toward reducing pollutants in storm water discharges from the MS4s to receiving waters in the WMA to the maximum extent practicable.
- Identify data gaps in the monitoring data necessary to assess the above provisions.

5.2.4 Special Studies Assessments

As part of the Water Quality Improvement Plan Annual Report, the City will evaluate the results and findings from the special studies described in Appendix P. They will use the resulting data to (1) assess their relevance to the City's characterization of receiving water conditions, (2) understand sources of pollutants and/or stressors, and (3) control and reduce the discharges of pollutants from the MS4 outfalls to receiving waters. As with the other monitoring programs, the results of the special studies assessment may warrant modifications of or updates to the Water Quality Improvement Plan.

The Mission Bay WMA special studies will attempt to answer questions concerning the natural "reference" concentration of bacteria and other pollutants in the region and to quantify specifically the natural sources of bacteria in Tecolote Creek. The special studies will help guide the implementation of the strategies for the highest priority water quality conditions.

Future special studies related to BMP effectiveness that are implemented by the City in the Mission Bay WMA will be included in this assessment. The City may elect to report the results of BMP effectiveness studies that are being performed in other WMAs if they relate to the highest priority water quality conditions and results are expected to be transferrable to strategies planned for the Mission Bay WMA.

5.2.5 Regional Monitoring Report

The regional monitoring and reporting requirement from Provision F.3.c of the MS4 Permit requires integration of all data on a regional scale to recommend modifications to the implementation or assessment of the Water Quality Improvement Plan and jurisdictional runoff management programs. The report must assess the following:

- ❖ The beneficial uses of the receiving waters within the San Diego Region that are supported and not adversely affected by the Responsible Agencies' MS4 discharges.
- ❖ The beneficial uses of the receiving waters within the San Diego Region that are adversely affected by the Responsible Agencies' MS4 discharges.
- ❖ The progress toward protecting beneficial uses of the receiving waters within the San Diego Region from Responsible Agencies' MS4 discharges.
- ❖ Pollutants or conditions of emerging concern that may impact beneficial uses of the receiving waters within the San Diego region.

6 Iterative Approach and Adaptive Management Process

The iterative approach that facilitates the adaptive management process for the Mission Bay WMA is presented in this section. The iterative approach re-evaluates the water quality conditions and priorities, goals, and strategies on the basis of the requirements of the MS4 Permit. The adaptive management process details how the Water Quality Improvement Plan (including the Monitoring and Assessment Plan) will be revised when new priorities and/or highest priorities are added, how goals will be adjusted or new goals are added, and how strategies will be modified to meet the latest goals.

As shown in the graphic below, the fifth step of the Water Quality Improvement Plan (adaptive management process) is to develop the iterative approach that facilitates the adaptive management process for the Mission Bay WMA (per MS4 Permit Provisions A.4, B.5, D.4.d, and F.2.c). The sixth step of the Water Quality Improvement Plan (annual reporting) is to compile and analyze the information collected as part of the MS4 Permit implementation. Annual reporting is described in both Sections 5 and 6 of this Water Quality Improvement Plan, as it draws on both the Monitoring and Assessment Program and the adaptive management process.

The MS4 Permit describes various triggers that may require program adaptation, including exceedances of water quality standards in receiving waters, new information, Regional Board recommendations, and public participation.

Section 6 Highlights

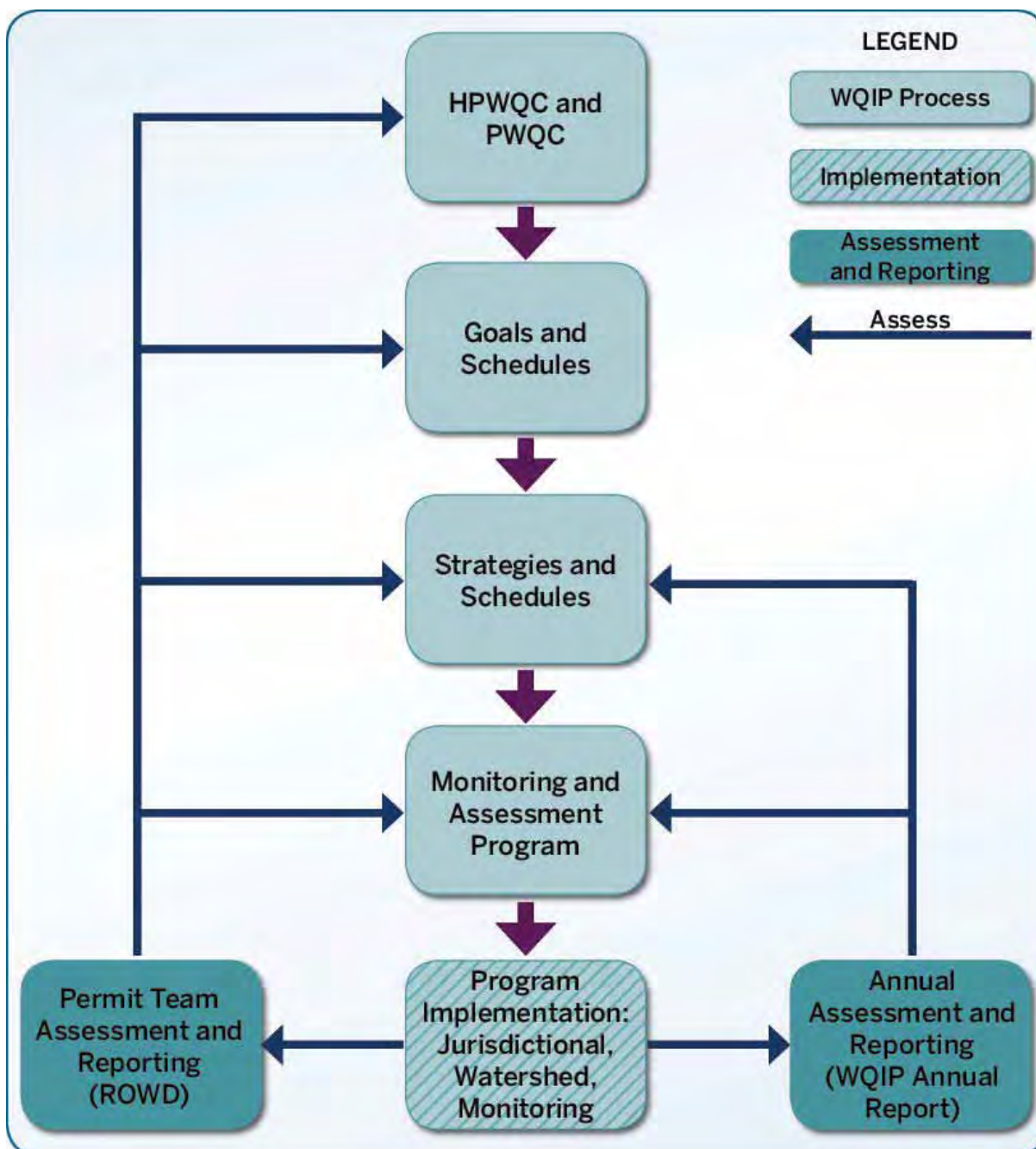
- ❖ Presents the iterative approach to facilitate the adaptive management process for the Mission Bay WMA
- ❖ Iterative approach re-evaluates the following on the basis of the requirements of the MS4 Permit:
 - Conditions and priorities
 - Goals
 - Strategies
- ❖ Adaptive management process explains how the Water Quality Improvement Plan will be revised when:
 - New priorities and/or highest priorities are developed
 - Goals are adjusted or new goals are added
 - Strategies are modified to meet the latest goals



The results of effectiveness assessments of JRMP programs and strategies may also trigger adaptations of the Water Quality Improvement Plan. Each trigger will result in specific adaptive management processes or actions within timeframes specified in the MS4 Permit. The timing of the adaptive management requirements is typically either annually or at the end of the MS4 Permit term. Other adaptations, especially those driven by TMDLs, will likely occur outside of the MS4 Permit term.

The adaptive management process provides the framework to evaluate progress toward meeting the requirements in the compliance pathways of the Bacteria TMDL and ASBS that are reflected in the goals presented in Section 4. The adaptive management process will be used in conjunction with the data collected as part of the Monitoring and Assessment Program to evaluate whether modifications to goals, schedules, and/or strategies are necessary to achieve compliance with the interim and final TMDL compliance options provided in Attachment E of the MS4 Permit. Figure 6-1 provides an overview of the adaptive management process.

MS4 Permit requirements, annual assessments and adaptation, and Report of Waste Discharge assessments and adaptations, including triggers and resulting actions, are described in Sections 6.1 through 6.3.



HPWQC= Highest Priority Water Quality Condition; PWQC = Priority Water Quality Condition;
ROWD = Report of Waste Discharge; WQIP = Water Quality Improvement Plan

Figure 6-1
Water Quality Improvement Plan Assessment and Adaptive Management Process

6.1 MS4 Permit Requirements: Iterative Approach and Adaptive Management

The MS4 Permit includes the requirements for adaptive management in multiple provisions. Provisions A.4, B.5, D.4.d, and F.2.c each contain requirements related to adaptive management, as summarized below:

- ❖ Provision A.4 requires the Water Quality Improvement Plan to be designed and adapted to ultimately comply with the discharge prohibitions (Provisions A.1.a and A.1.c) and receiving water limitations (Provision A.2.a) specified in the MS4 Permit. The provision addresses the adaptive management process that may be triggered when exceedances of water quality standards persist in receiving waters.
- ❖ Provision B.5 contains specific considerations that must be included in the adaptive management process, whether performed as part of the Water Quality Improvement Plan Annual Report or as part of the Report of Waste Discharge. This includes the re-evaluation of priority water quality conditions; adaptation of goals, strategies, and schedules; and adaptation of the Monitoring and Assessment Program.
- ❖ Provision D.4.d contains the processes for the assessments and adaptive management that must occur in preparation of the Report of Waste Discharge.
- ❖ Provision F.2.c describes the requirements for updates to the Water Quality Improvement Plan that could result from implementation of the adaptive management requirements.

The following sections elaborate on the adaptive management processes, including the frequencies of adaptation required by the MS4 Permit (annual versus MS4 Permit term), triggers, and resulting actions

Figure 6-2 provides a tentative timeline for the adaptive management process.

The first Water Quality Improvement Plan Annual Report is scheduled to be submitted by the Responsible Agencies in January 2017. This will include an abbreviated monitoring and JRMP implementation period, because the Monitoring and Assessment Program and JRMP will not be effective until after the approval of the Water Quality Improvement Plan. The timeline below assumes that the Water Quality Improvement Plan will be approved by the Regional Board during fall 2015, with the earliest implementation potentially beginning in October 2015.

The second Annual Report for the current MS4 Permit cycle will be submitted in January 2018. This submittal would be after the submittal of the Report of Waste Discharge that is due to the Regional Board in December 2017.

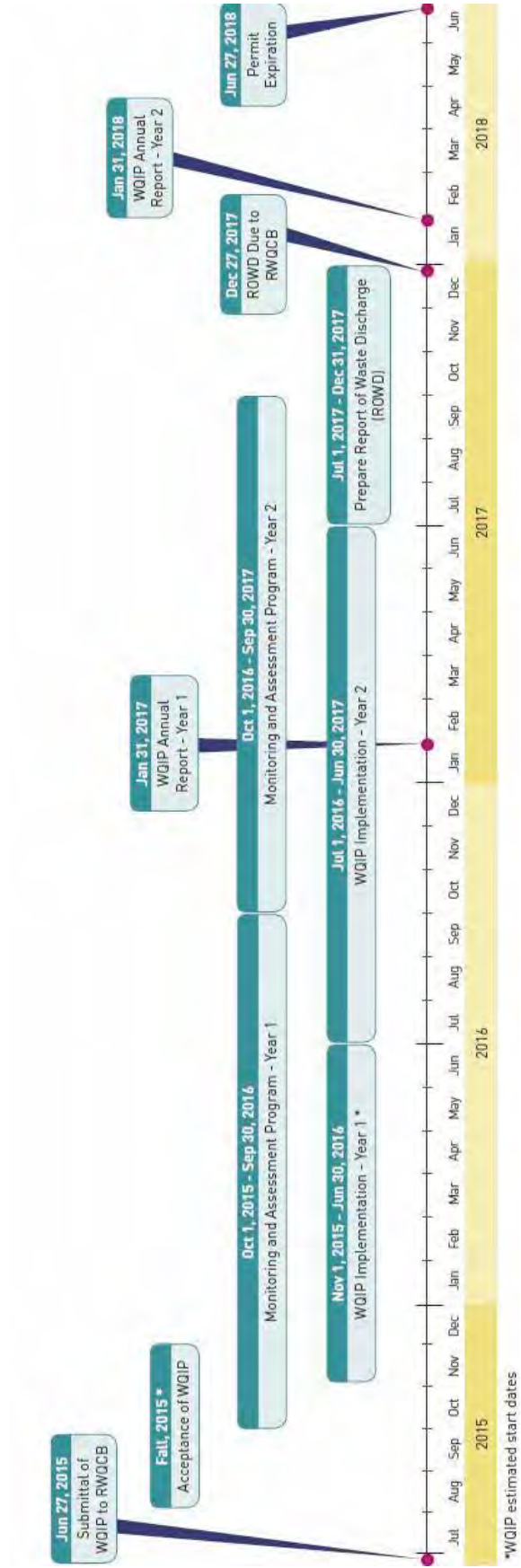


Figure 6-2
Water Quality
Improvement Plan Assessment
and Reporting Timeline

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6.2 Annual Assessments and Adaptive Management

The MS4 Permit contains two conditions that may trigger adaptation annually:

- (1) Exceedance of water quality standards in receiving waters, and
- (2) New information

In either case, modifications may be appropriate for the water quality goals, strategies, schedules, and/or Monitoring and Assessment Program. The priority water quality conditions may be modified as needed during the MS4 Permit term, but would likely be modified only as a result of assessments conducted for the Report of Waste Discharge. A summary of the triggers that must be assessed annually and the corresponding adaptive management processes is presented in Table 6-1.

Table 6-1
Adaptive Management on an Annual Basis (Annual Report)

Plan Element	Trigger ¹	Adaptive Management Process Considerations
Water Quality Strategies and Schedules	Persistent Exceedances Not Addressed (A.4.a(2))	<i>Provision A.4.a(2), Integrated Assessment Considerations (Summarized in Figure 6-3)²</i> ❖ Water quality standard exceedances for pollutants that are addressed by the Water Quality Improvement Plan; continuing implementation of the accepted plan and updating as necessary; ❖ If MS4 discharges are causing or contributing to a new exceedance of an applicable water quality standard for pollutants that are not addressed by the Water Quality Improvement Plan, updating of the plan as part of the Water Quality Improvement Plan Annual Report (unless directed by the Regional Board to update it earlier ❖ Following Regional Board approval of modifications to the Water Quality Improvement Plan, update of the JRMP accordingly by the City
	New Information (B.5.b)	<i>Provision B.5.b, Iterative Approach and Adaptive Management Considerations</i> ❖ Modifications to the priority water quality conditions based on Provision B.5.a ❖ Progress toward achieving numeric goals for the highest priority water quality conditions

Table 6-1 (continued)
Adaptive Management on an Annual Basis (Annual Report)

Plan Element	Trigger¹	Adaptive Management Process Considerations
Water Quality Strategies and Schedules (continued)	New Information (B.5.b) (continued)	❖ Progress in meeting established schedules ❖ New policies or regulations that may affect goals ❖ Reductions of non-storm water discharges ❖ Reductions of pollutants in storm water discharges from MS4s to the MEP ❖ New information resulting from the re-evaluation of impacts from MS4 discharges and/or pollutants and stressors ❖ Efficiency in implementing the Water Quality Improvement Plan ❖ Recommendations of the Regional Board ❖ Recommendations received through a public participation process
Monitoring and Assessment Program	Persistent Exceedances Not Addressed (A.4.a(2))	<i>Provision A.4.a(2), Integrated Assessment Considerations (Summarized in Figure 6-3)²</i> ❖ Following the process as described in Figure 6-3, which might include revising the monitoring program to fill data gaps with modifications such as moving monitoring locations, adding additional sample collection, or changing type of sample collected.
Monitoring and Assessment Program	New Information (B.5.c)	<i>Provision B.5.c, Iterative Approach and Adaptive Management Considerations</i> ❖ Re-evaluation based on new information such as modified priority water quality conditions, goals, strategies, or schedules ❖ New information that might include new regulations ❖ Inclusion in the Monitoring and Assessment Program of the monitoring required by the MS4 Permit

1. Following approval of a TMDL with wasteload allocations by the OAL and the USEPA, Responsible Agencies must initiate an update of the Water Quality Improvement Plan within six months.
2. This procedure does not have to be repeated for continuing or recurring exceedances of the same water quality standard(s) once scheduled strategies are implemented unless Responsible Agencies are directed to do so by the Regional Board.

6.2.1 Receiving Water Assessments

Evaluation of receiving water and MS4 outfall discharge data will be performed annually as part of the Water Quality Improvement Plan Annual Report (MS4 Permit Provision F.3.b(3)(a)) is described in Section 5. More comprehensive evaluations of receiving water data will be performed for the Transitional Monitoring and Assessment Program Report and for the Report of Waste Discharge (Provision D.4.a(1)). These evaluations will summarize receiving water data collected within the Mission Bay WMA and provide information with the potential to trigger the adaptive management process to achieve compliance with MS4 Permit discharge prohibitions and receiving water limitations as prescribed in Provision A.

Provision A.4 describes adaptive management procedures that the Responsible Agencies must implement “if exceedance(s) of water quality standards persist in receiving waters.” Thus, the trigger for the adaptive management process under this provision is indication of exceedances of water quality standards that persist in receiving waters. If the adaptive management process is triggered under this provision, the process will assess two key questions:

- ❖ Is the MS4 a source of a pollutant causing the exceedances to persist in the receiving waters?
- ❖ Are the exceedances addressed by the Water Quality Improvement Plan?

If the MS4 is determined to be a source of pollutants causing the receiving water exceedance(s) and the receiving water exceedances are addressed under the Water Quality Improvement Plan, the Responsible Agencies will continue implementing the Water Quality Improvement Plan. If the MS4 is determined to be a source of pollutants causing the receiving water exceedance(s) and the receiving water exceedances are not addressed, the Responsible Agencies will update the plan to address the exceedances as described in Provision A.4.a(2) and submit the updates with the Water Quality Improvement Plan Annual Report. The updates will include, as applicable:

- ❖ A description of strategies that are currently being implemented, are effective, and will continue
- ❖ A description of strategies that will be implemented to reduce or eliminate pollutants or conditions that are a source of the receiving water exceedances
- ❖ Updates to the implementation schedules for existing, revised, or additional strategies
- ❖ Updates to the Monitoring and Assessment Program to track progress toward achieving compliance with Provisions A.1.a, A.1.c and A.2.a

The adaptive management process as required under Provision A.4 is illustrated in Figure 6-3.

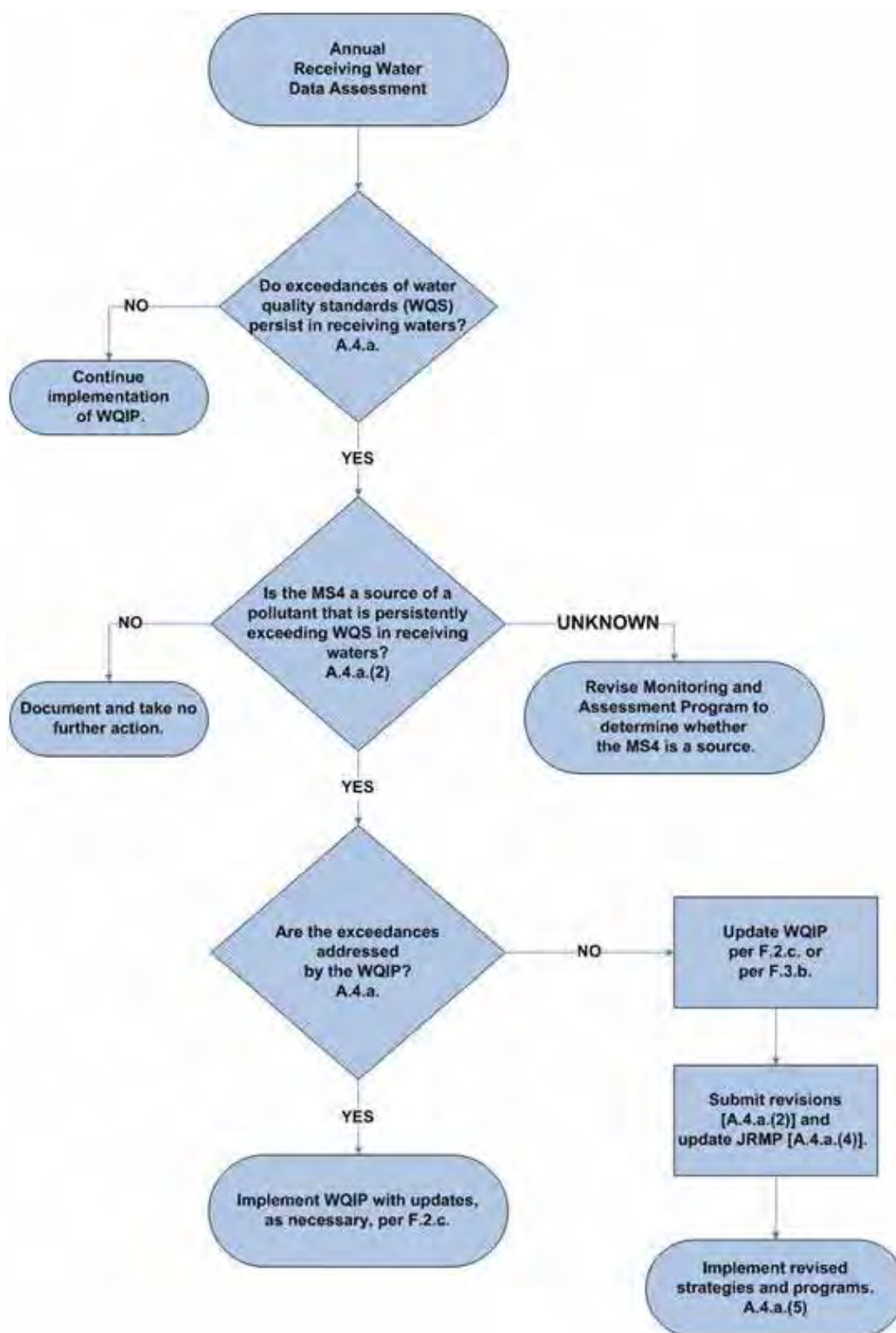


Figure 6-3
Receiving Water Exceedance Process (Provision A.4)

6.2.2 Annual Evaluation of New Information

The adaptive management process may also be triggered as new information becomes available (Provision B.5.b). Where appropriate, modifications may be made to goals, strategies, schedules, and/or the Monitoring and Assessment Program and reported in the Water Quality Improvement Plan Annual Report. Types of new information that may trigger the adaptive management process as part of the annual assessment process are discussed below, including the potential trigger(s) for modification(s), and the resulting adaptive management process to be used.

Regulatory Drivers

Where new regulations or policies are adopted that impact Mission Bay WMA planning and implementation processes in the near term, modifications to the Water Quality Improvement Plan goals, strategies, schedules, and/or Monitoring and Assessment Plan may be warranted, and (in some cases) required. For example, an update to the Water Quality Improvement Plan will be initiated no later than six months following approval of a TMDL Basin Plan Amendment by the California Office of Administrative Law (OAL) and the USEPA. The trigger applies to TMDLs containing WLAs assigned to Responsible Agencies within the WMA during the term of the MS4 Permit (Provision F.2.c(2)). Other examples of regulatory drivers that may trigger modifications to the Water Quality Improvement Plan include new state policies (e.g., those related to trash, toxicity, biological objectives, and bacteria) and changes resulting from modifications to existing MS4 Permit requirements (e.g., as a result of a re-opener).

Special Study Results

As part of the Monitoring and Assessment Program, the Responsible Agencies are performing special studies related to the highest priority water quality conditions for the Mission Bay WMA. The special studies are designed to provide information related to sources of the highest priority water quality condition within the Mission Bay WMA, will be implemented during the MS4 Permit term, and are typically performed over multiple years. As relevant data, conclusions, and lessons learned become available from these studies, the Water Quality Improvement Plan may be modified. The study results may impact the goals, strategies, schedules, and the monitoring and assessment plans. Additionally, lessons learned and study results from outside the Mission Bay WMA, especially those related to sediment and bacteria impairments, may also be incorporated into the Water Quality Improvement Plan.

Program Effectiveness Assessments

Strategies developed within the Water Quality Improvement Plan will be incorporated into individual Responsible Agency programs through implementation of the JRMP or the SWMP, as applicable. Each Responsible Agency is implementing programs that are focused on addressing the highest priority water quality conditions within the Mission Bay WMA. While implementation of these programs has been ongoing in many cases, refinements to the programs provide additional focus on the particular water quality issues identified in the Water Quality Improvement Plan. Over time, Responsible Agencies will use various assessment methods to determine which program refinements are effective and which are not. In some cases, the program effectiveness assessment results may provide useful information leading to adaption of elements of the Water Quality Improvement Plan. As new information is applicable, it may be used to modify goals, strategies, schedules, and the Monitoring and Assessment Program.

Regional Board Recommendations

Adaptation of the Water Quality Improvement Plan may also be required on the basis of recommendations from the Regional Board. Recommendations may be from the public participation process, the Consultation Committee, review of submitted reports, or other Regional Board interests.

6.3 MS4 Permit Term Assessments and Adaptive Management

The MS4 Permit also contains specific assessments to be performed during the preparation of the Report of Waste Discharge. The assessments are longer term, occurring only once during the MS4 Permit cycle. Because the updates to the Water Quality Improvement Plan are required to undergo a full public participation process per Provision F.2.c, including reconvening the Consultation Committee, modifications will consider input from the public and the Regional Board. Adaptation of Water Quality Improvement Plan elements will also consider new regulations or policies as appropriate. In the Report of Waste Discharge preparation, all elements of the Water Quality Improvement Plan are eligible for modifications through the required adaptive management processes. Elements that will be evaluated include the water quality conditions (i.e., priorities), goals and accompanying schedules, strategies and accompanying schedules, and the Monitoring and Assessment Program. Table 6-2 summarizes the triggers and adaptive management processes that are required as part of the Report of Waste Discharge.

Table 6-2
Adaptive Management on a Permit Term Basis (Report of Waste Discharge)

Plan Element	Adaptive Management Process Considerations
Priority Water Quality Conditions (B.5.a, D.4.d(1))	<i>Provision B.5.a, Iterative Approach and Adaptive Management Considerations</i> ❖ Achievement of the outcome of improved water quality through the implementation of strategies identified in the Water Quality Improvement Plan ❖ New information developed in the re-assessment of receiving water conditions, impacts from MS4 discharges, and subsequent re-evaluation of priorities ❖ Spatial and temporal accuracy of monitoring data ❖ Availability of new information and data from sources outside the JRMP programs that inform the effectiveness of implementation strategies and actions ❖ Recommendations of the Regional Board ❖ Recommendations received through a public participation process
	<i>Provision D.4.d(1), Integrated Assessment Considerations</i> ❖ Re-evaluation of the receiving water conditions and the impacts of MS4 discharges on receiving waters per the process developed in Section 2 of the Water Quality Improvement Plan and included in Appendix A, including the identification of beneficial uses in receiving waters that are protected per the Monitoring and Assessment Program ❖ Re-evaluation of the identification of MS4 sources and/or stressors that correspond to elevation of a new highest priority
Water Quality Goals and Schedules (B.5.b, D.4.d(1))	<i>Provision B.5.b, Iterative Approach and Adaptive Management Considerations</i> ❖ Modifications to the priority water quality conditions based on Provision B.5.a ❖ Progress toward achieving numeric goals for the highest priority water quality conditions ❖ Progress in meeting established schedules ❖ New policies or regulations that may affect goals ❖ Reductions of non-storm water discharges

Table 6-2 (continued)
Adaptive Management on a Permit Term Basis (Report of Waste Discharge)

Plan Element	Adaptive Management Process Considerations
Water Quality Goals and Schedules (B.5.b, D.4.d(1)) (continued)	❖ Reductions of pollutants in storm water discharges from MS4s to the MEP ❖ New information resulting from re-evaluating impacts from MS4 discharges and/or pollutants and stressors ❖ Efficiency in implementing the Water Quality Improvement Plan ❖ Recommendations of the Regional Board ❖ Recommendations received through a public participation process
	<i>Provision D.4.d(1), Integrated Assessment Considerations</i> ❖ Evaluation of the progress toward achieving interim and final numeric goals for protecting impacted beneficial uses in receiving waters
	<i>Provision D.4.d(2), Integrated Assessment Considerations</i> ❖ Identification of the non-storm water and storm water pollutant loads from the MS4 outfalls per Provision D.4.b ❖ Identification of the non-storm water and storm water pollutant load reductions, or other improvements that are necessary to attain the interim and final numeric goals ❖ Identification of the non-storm water and storm water pollutant load reductions, or other improvements, that are necessary to demonstrate that non-storm water and storm water discharges are not causing or contributing to exceedances of receiving water limitations ❖ Evaluation of the progress of the strategies toward achieving interim and final numeric goals for protecting beneficial uses in receiving waters
Monitoring and Assessment Program (B.5.c)	<i>Provision B.5.c, Iterative Approach and Adaptive Management Considerations</i> ❖ Review of Monitoring and Assessment Programs based on the requirements in Provision D ❖ Adjustment of the monitoring program to determine whether discharges from the MS4 are causing/contributing to exceedances in the receiving water when new exceedances persist; identification and addressing of data gaps via re-assessment of monitoring locations and frequencies; adjustment of the monitoring program to address results of special studies

6.3.1 Priority Water Quality Conditions

The process for selecting the highest priority water quality conditions is documented in Section 2 of this Water Quality Improvement Plan. Given the relatively short duration of the remainder of this MS4 Permit term after expected approval of the Water Quality Improvement Plan, the priority water quality conditions selected during the development of the Water Quality Improvement Plan will remain for the duration of the current term. They will be modified only on the basis of new information assessed as part of the Report of Waste Discharge. Data collected during the MS4 Permit term will be used to update the analysis of the priority water quality conditions based on the methodology described in Appendix A and implemented in Section 2.

6.3.2 Progress toward Achieving Goals

As part of the preparation of the Report of Waste Discharge, the Responsible Agencies will evaluate the progress toward achieving the interim and final numeric goals established in Section 4.1. The Water Quality Improvement Plan interim goals identified for the current permit term are provided in Tables 6-3 through 6-4, along with the related assessment metric for each.

Table 6-3
City of San Diego Tecolote Creek Subwatershed Jurisdictional Goals, FY14–FY18

Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year	Assessment Method
		Current Permit Term (FY14–FY18)	
Wet Weather Performance Measures			
Performance Metrics		FY18	
MS4 Discharges Bacteria and Sediment Reduction	Green Infrastructure Policy	Construct 2 green infrastructure BMPs to treat 84.6 acres of drainage area	Summarize the completed projects that capture and treat drainage from 84.6 acres in the January 2018 Water Quality Improvement Plan Annual Report

Table 6-3 (continued)
City of San Diego Tecolote Creek Subwatershed Jurisdictional Goals, FY14–FY18

Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year	Assessment Method
		Current Permit Term (FY14–FY18)	
Dry Weather Performance Measures			
Performance Metrics		FY18	
MS4 Discharges Dry Weather Flow, Bacteria, and Sediment Reduction	Green Infrastructure Policy	Construct 2 green infrastructure BMPs to treat 84.6 acres of drainage area	Summarize the completed projects that capture and treat drainage from 84.6 acres in the January 2018 Water Quality Improvement Plan Annual Report
MS4 Discharges Reduce Pollutants in Dry Weather Discharges	Dry Weather Flow Reduction from Baseline	Achieve a 10% reduction in prohibited ¹ dry weather flow from baseline measured at persistently flowing outfalls in the WMA	Summarize the prohibited ¹ dry weather flow reduction observed through MS4 outfall monitoring program in the Mission Bay WMA in the January 2018 Water Quality Improvement Plan Annual Report

1. Does not include allowable discharges as defined in Provision A and Provision E.2.a of the MS4 Permit.

Table 6-4
City of San Diego Scripps Subwatershed Jurisdictional Goals, FY14–FY18

Numeric Goal	Unit of Measure	Assessment Period and Fiscal Year	Assessment Method
		Current Permit Term (FY14–FY18)	
Wet Weather Performance Measures			
Performance Metrics		FY18	
MS4 Discharges Bacteria and Sediment Reduction	Green Infrastructure Policy	Construct 1 green infrastructure BMP to treat 8.9 acres of drainage area	Summarize the completed projects that capture and treat drainage from 8.9 acres in the January 2018 Water Quality Improvement Plan Annual Report
Dry Weather Performance Measures			
Performance Metrics		FY18	
MS4 Discharges Dry Weather Flow, Bacteria, and Sediment Reduction	Green Infrastructure Policy	Construct 1 green infrastructure BMP to treat 8.9 acres of drainage area	Summarize the completed projects that capture and treat drainage from 8.9 acres in the January 2018 Water Quality Improvement Plan Annual Report
MS4 Discharges Reduce Pollutants in Dry Weather Discharges	Dry Weather Flow Reduction from Baseline	Achieve a 10% reduction in prohibited ¹ dry weather flow from baseline measured at persistently flowing outfalls in the WMA	Summarize the prohibited ¹ dry weather flow reduction observed through MS4 outfall monitoring program in the Mission Bay WMA in the January 2018 Water Quality Improvement Plan Annual Report

1. Does not include allowable discharges as defined in Provision A and Provision E.2.a of the MS4 Permit.

The goals and compliance pathways will be assessed using data collected per the Monitoring and Assessment Program and JRMP, along with the schedules developed in conjunction with each goal. Depending on the results of the assessment, it may be appropriate to adjust either or both of the numeric goals and/or the schedules associated with each goal. The exception is when the interim and/or final numeric goals and schedules are based on approved Bacteria TMDL compliance schedules; in this case, interim schedules may be modified. However, numeric targets (interim and final) and final schedules cannot be modified without changes to the Bacteria TMDL.

6.3.3 Strategies and Schedules

The strategies and implementation schedules developed to address the highest priority water quality conditions in the Mission Bay WMA will be re-evaluated as part of the preparation of the Report of Waste Discharge. Ultimately, the effectiveness of the strategies will be based on the progress toward achieving the interim and final numeric goals. However, an evaluation of strategies based on the achievement of the interim and final numeric goals may take many years of implementation and monitoring to assess. To supplement the “goal-based” assessments, water quality and programmatic data collected over the MS4 Permit term will be incorporated into the assessment and adaptive management process to modify strategies and implementation schedules as appropriate.

Water Quality Data Evaluation of Strategies

Receiving water data will be assessed as described in Section 5.2.2. The assessment will indicate progress toward goals and protection of beneficial uses. These data may be used to evaluate the collective effectiveness of the Water Quality Improvement Plan strategies. This information will provide a “big picture” assessment of the success of the strategies over the long term.

MS4 outfall data and special studies results may provide information that is more directly linked to the implementation of individual strategies. Where possible, this information will be used to modify, eliminate, and/or develop new strategies to address the highest priority water quality conditions in the Mission Bay WMA. Where appropriate, these assessments will include a comparison of the data with the NALs and SALs, as required by Provision C of the MS4 Permit. These data will provide the foundation for the MS4 outfall discharge assessments described in Section 5.2.3, which will examine the results of the Responsible Agencies’ IDDE and MS4 outfall discharge monitoring programs. Where strategies can be linked to measurable or demonstrable reductions (or increases) of non-storm water discharges or of pollutants in storm water, appropriate modifications will be made.

Program Assessments

Where available, the results of program effectiveness assessments performed on the jurisdictional or WMA scale may also drive the adaptation of specific strategies. The level of information will vary by jurisdiction and by program, because these types of assessments are not explicitly required under the MS4 Permit. However, in many cases, the jurisdictions are performing programmatic assessments to ensure the most effective use of limited resources. These assessments have the potential to provide information to determine the effectiveness of specific strategies that is more relevant than water quality data collected at outfalls or in receiving waters, and the assessments may be a key driver in adapting strategies. In some cases, modifications to strategies may also be the result of internal jurisdictional opportunities or constraints, such as increases or decreases in available funding or staffing.

6.3.4 Monitoring and Assessment Program

As part of the Report of Waste Discharge, the Responsible Agencies will consider modifications to the Monitoring and Assessment Program, consistent with the requirements in Provision D.4.d(3). During the MS4 Permit term, modifications must be consistent with the requirements of Provisions D.1, D.3, and D.3 (receiving water, MS4 outfall, and special study monitoring requirements, respectively), which limit the amount of adaptation that is possible. However, recommendations in the Report of Waste Discharge provide an opportunity to propose more meaningful modifications to the Monitoring and Assessment Program. Examples of potential modifications include adjustments to:

- ❖ Determine whether discharges from the MS4 are linked to exceedances in the receiving water
- ❖ Address data gaps via re-assessment of monitoring locations and frequencies
- ❖ Address results of special studies

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APPENDIX A

Priority and Highest Priority Water Quality Condition Selection Methodology

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APPENDIX A – Methodology for Selecting Priority and Highest Priority Water Quality Conditions

The methodology to select the priority and highest priority water quality conditions follows four steps.

Step 1: Determine Receiving Water Conditions (Permit B.2.a). The goal of the receiving water assessment is to determine the receiving water conditions in the watershed. Some receiving water conditions may be selected as priority water quality conditions if there is sufficient data showing that the MS4 is causing and contributing to the receiving water condition or if it is suspected that the MS4 may be causing and contributing but there is a gap in the data.

- a. Information and data to evaluate receiving waters conditions includes:
 - i. TMDLs;
 - ii. 303(d) listings to determine impaired beneficial uses;
 - iii. Sources that are provided as part of the 303(d) listing. (This is important if the 303(d) listing has called out the MS4 as a source);
 - iv. RW limits for appropriate segments;
 - v. Historic and current data from the LTEA and WURMP. (Associate a NPDES monitoring location with each watershed when available. The priorities listed by these documents exceed water quality benchmarks.); and
 - vi. 3rd party data submitted in response to public data call.
- b. Determine a receiving water condition based on the following criteria:
 - i. TMDLs in the watershed applied upstream where appropriate;
 - ii. All 303(d) listings;
 - iii. All additional receiving water conditions identified by reviewing historic and current monitoring data; and
 - iv. 3rd party data submitted in response to public data call.

Step 2: Determine Potential Receiving Water Impacts from MS4 Discharges (Permit B.2.b). Review MS4 Monitoring Data to determine potential receiving water impacts associated with MS4 discharges by assessing the following:

- a. Outfall monitoring data provided in the WURMP and LTEA. (It is important to note that often only one MS4 wet weather outfall location is associated with each NPDES monitoring location, meaning that the analysis is done at the subwatershed level and not in the receiving water);
- b. WQBELs where appropriate;
- c. The 303(d) listing identifies the MS4 as a source; and
- d. 3rd party data submitted in response to public data call.

Step 3: Determine Priority Water Quality Conditions (Permit B.2.c.(1)). The goal of this step is to select the priority water quality conditions by analyzing the receiving water conditions based on the potential for the MS4 to cause and contribute to the condition. Priority water quality conditions may be identified based on the following criteria:

- a. MS4 subwatershed outfall data compared to the receiving water condition. If the subwatershed level outfall data shows that MS4 is causing and contributing to the receiving water condition then it may be considered a priority water quality condition;
- b. If there is no outfall monitoring data associated with the receiving water condition, the 303(d) listing will be referenced to determine if the MS4 is included as a source. If the MS4 is listed as a source, this receiving water condition may be considered a priority water quality condition with a data gap; and
- c. Consider 3rd party input submitted in response to public data call.

Step 4: Determine Highest Priority Water Quality Condition(s) (Permit B.2.c.(2)).

The MS4 Permit requires the Copermittees to identify the highest priority water quality conditions to be addressed by the Water Quality Improvement Plan, and provide a rationale for selecting a subset of the priority water quality conditions identified in Step 3. Because the MS4 Permit requires the development and identification of numeric goals, strategies, and schedules for the highest priority water quality conditions, a scientifically-based screening analysis of priority water quality conditions was applied. Conditions already subject to an approved TMDL, ASBS or other water quality regulation will be elevated to highest priority water quality condition.

The Responsible Agencies will identify priority water quality conditions not subject to an approved water quality regulation as a highest priority based on the following factors:

- a. The supporting data set is sufficient to adequately characterize the degree to which the priority water quality condition changes seasonally, and over geographic area, to support its consideration as a highest priority water quality condition.
- b. Storm water/ non-storm water runoff is a predominant source for the priority water quality condition.
- c. The priority water quality condition is controllable by the Responsible Agencies.
- d. The priority water quality condition would not be addressed by strategies identified for other highest priority water quality conditions in this Water Quality Improvement Plan.

APPENDIX B

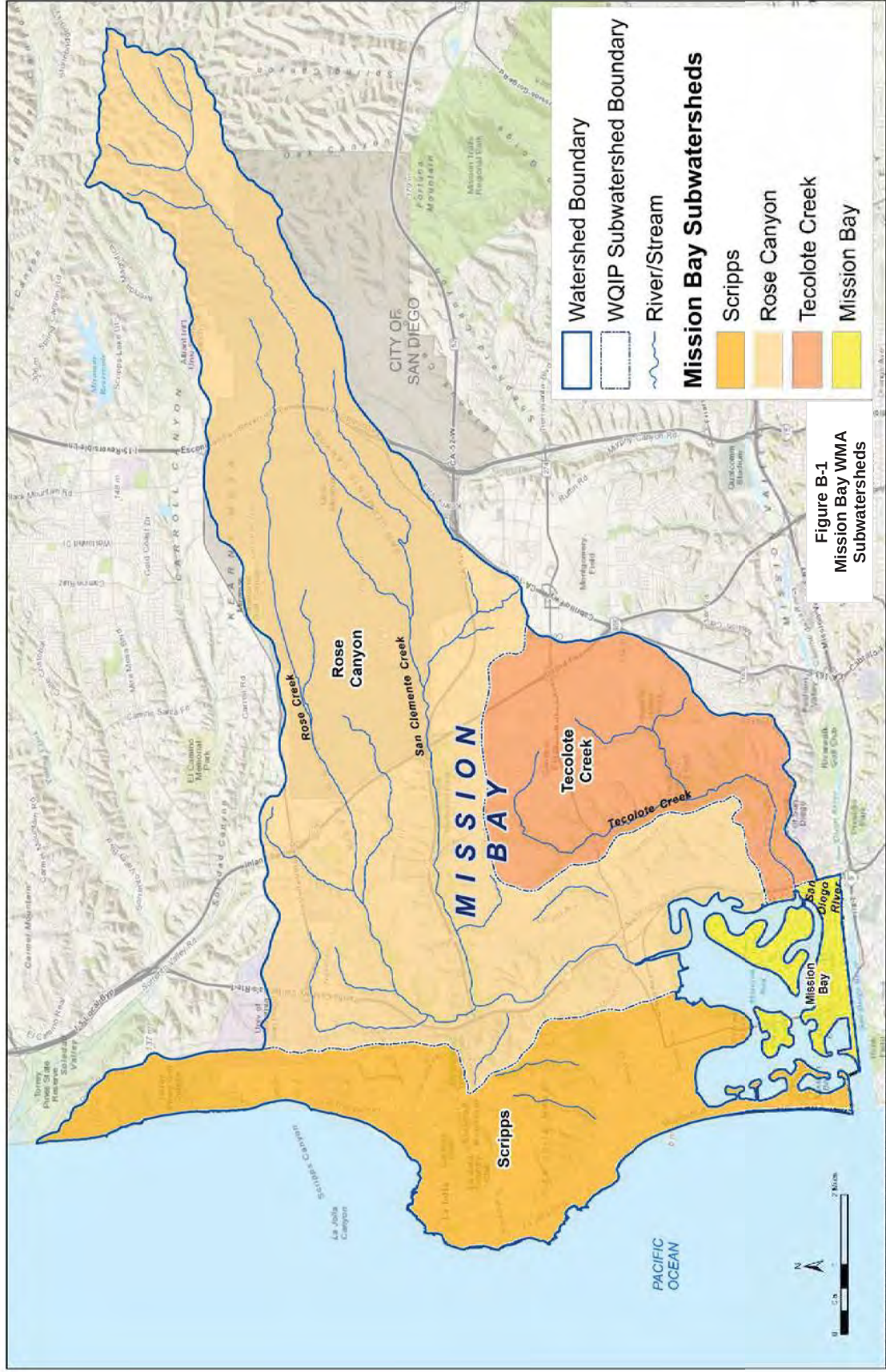
Mission Bay WMA Maps

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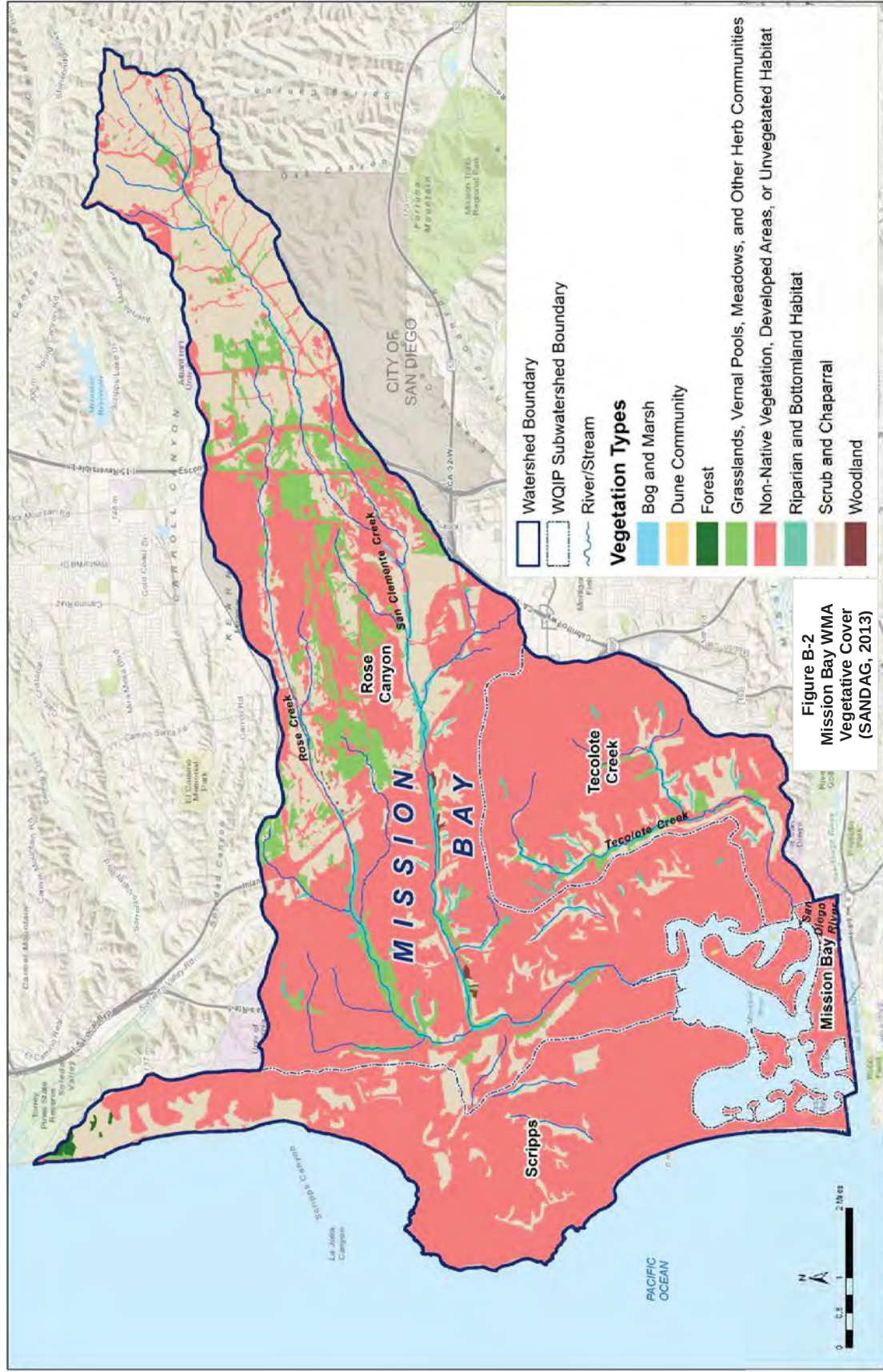
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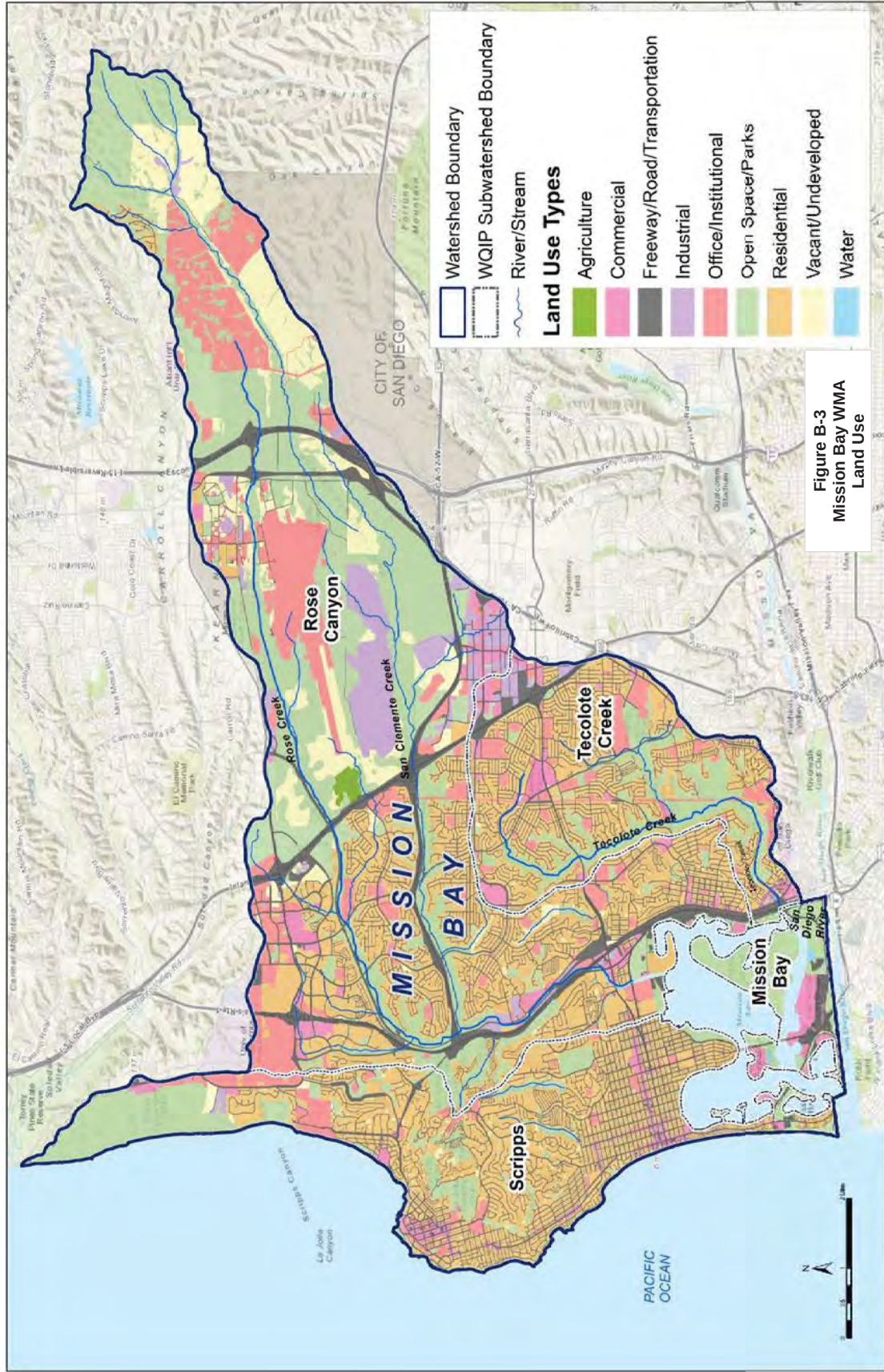
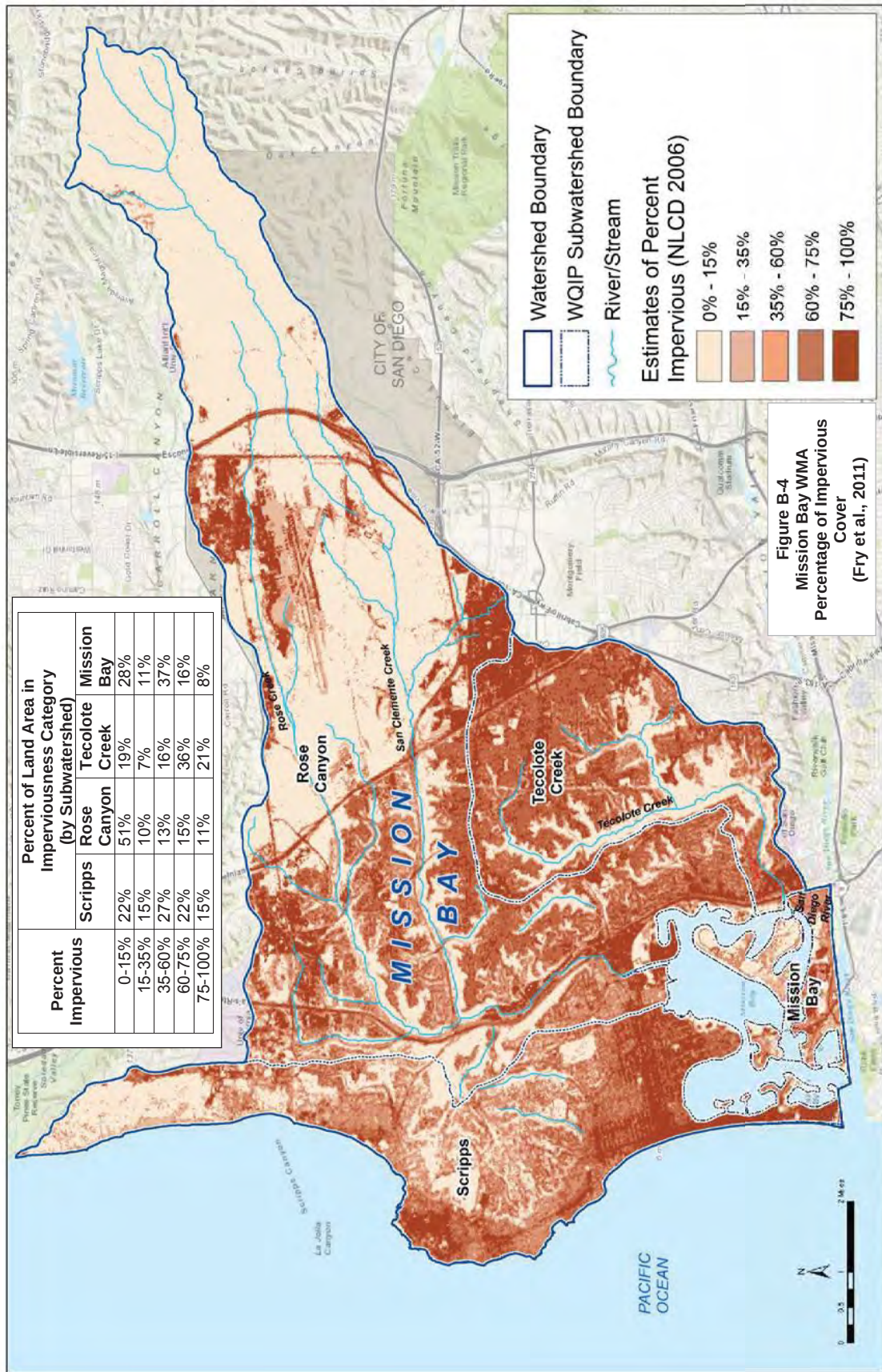


Figure B-3
Mission Bay WMA
Land Use

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APPENDIX C

Beneficial Uses of 303(d) Listed Waterbodies in the Mission Bay WMA

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Table C-1 presents the beneficial use designations of the 303(d) listed waterbodies in the Mission Bay WMA. Beneficial uses specifically identified as impaired by the 2010 303(d) list are shaded blue. This table does not present waterbodies that were not identified as impaired on the 303(d) list. Approximately 72% of the beneficial uses in the Mission Bay WMA are not impaired or have not been assessed. Of those waterbodies that are listed as having impairments, most beneficial uses are attained.

Table C-1
Beneficial Uses of the 2010 303(d) Listed Waterbodies in the Mission Bay WMA

303(d) Listed Waterbody Name	Beneficial Use															
	M U N	I N D	R E C 1	R E C 2	B I O L	W A R M	W I L D	R A R E	S P W N	N A V	C O M M	E S T	M A R	A Q U A	M I G R	S H E L L
Rose Creek (906.40)	+	○	●	●		●	●									
Tecolote Creek (906.50)	+		○	●		●	●									
Mission Bay at Quivira Basin (906.7)		●	●	●			●	●	●		●	●	● ¹		●	●
Mission Bay Shoreline, at Leisure Lagoon (906.4)		●	●	●			●	●	●		●	●	●		●	●
Mission Bay Shoreline, at North Crown Point (906.3)		●	●	●			●	●	●		●	●	●		●	●
Mission Bay (mouth of Rose Creek only) (906.4)		●	●	●			●	●	●		●	●	●		●	●
Mission Bay Shoreline, at Visitors Center (906.4)		●	●	●			●	●	●		●	●	●		●	●
Mission Bay Shoreline, at Bahia Point (906.3)		●	●	●			●	●	●		●	●	●		●	●
Mission Bay Shoreline, at Bonita Cove (906.3)		●	●	●			●	●	●		●	●	●		●	●
Mission Bay Shoreline, at Campland (906.4)		●	●	●			●	●	●		●	●	●		●	●

continued on next page

303(d) Listed Waterbody Name	Beneficial Use															
	MUN	IND	REC 1	REC 2	BIOLOGICAL	WATER QUALITY	WILDLIFE	RARE	SPAWN	NAV	COMM	EST	MAR	AQUA	MIGR	SHELL
Mission Bay Shoreline, at De Anza Cove (906.4)		●	●	●			●	●	●		●	●	●		●	●
Mission Bay Shoreline, at Fanuel Park (906.3)		●	●	●			●	●	●		●	●	●		●	●
Mission Bay (mouth of Tecolote Creek) (906.5)		●	●	●			●	●	●		●	●	●		●	●
Mission Bay Shoreline, at Tecolote Shores (906.5)		●	●	●			●	●	●		●	●	●		●	●
Pacific Ocean Shoreline, Casa Beach (Children's Pool) (906.3)		●	●	●	●		●	●	●	●	●		●	●	●	●
Pacific Ocean Shoreline, La Jolla Cove (906.3)		●	●	●	●		●	●	●	●	●		●	●	●	●
Pacific Ocean Shoreline, La Jolla Shores Beach at Avenida de La Playa (906.3)		●	●	●	●		●	●	●	●	●		●	●	●	●
Pacific Ocean Shoreline, Pacific Beach at Pacific Beach Point (906.3)		●	●	●	●		●	●	●	●	●		●	●	●	●
Pacific Ocean Shoreline, Vallecitos Court (906.3)		●	●	●	●		●	●	●	●	●		●	●	●	●
Pacific Ocean Shoreline, Whispering Sands Beach at Ravina Street (906.3)		●	●	●	●		●	●	●	●	●		●	●	●	●

Beneficial use is impaired based on the 2010 303(d) list

○ Potential beneficial use

● Existing beneficial use

+ Excepted from MUN

1. Marine Habitat in Mission Bay at Quivira Basin is designated as an “impaired aquatic life” use in the 303(d) list. It is designated a “beneficial use” in the Basin Plan, and is referred to herein for consistency.

The definitions of beneficial uses that are impaired based on the 303(d) list in the Mission WMA are defined in the Basin Plan as follows:

- ❖ **Estuarine Habitat (EST)** includes uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).
- ❖ **Industrial Service Supply (IND)** includes uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.
- ❖ **Marine Habitat (MAR)** includes uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).
- ❖ **Contact Water Recreation (REC-1)** includes uses 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.
- ❖ **Non-Contact Water Recreation (REC-2)** includes the uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
- ❖ **Shellfish Harvesting (SHELL)** includes uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sport purposes.
- ❖ **Warm Freshwater Habitat (WARM)** includes uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.

The beneficial uses in the Mission Bay WMA which are not listed as impaired are defined in the Basin Plan as follows:

- ❖ **Aquaculture (AQUA)** includes the uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

- ❖ **Preservation of Biological Habitats of Special Significance (BIOL)** includes uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or ASBS, where the preservation or enhancement of natural resources requires special protection.
- ❖ **Commercial and Sport Fishing (COMM)** includes the uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.
- ❖ **Migration of Aquatic Organisms (MIGR)** includes uses of water that support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.
- ❖ **Municipal and Domestic Supply (MUN)** includes uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
- ❖ **Navigation (NAV)** includes uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.
- ❖ **Rare, Threatened, or Endangered Species (RARE)** includes uses of water that support habitats necessary, at least in part, for the survival and successful maintenance or plant or animal species established under state or federal law as rare, threatened, or endangered.
- ❖ **Spawning, Reproduction, and/or Early Development (SPWN)** includes uses of water that support high quality habitats suitable for reproduction, early development and sustenance of marine fish and/or cold freshwater fish.
- ❖ **Wildlife Habitat (WILD)** includes uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

APPENDIX D

Additional Data Sources

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APPENDIX D.1

Primary and Secondary Data Sources

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Primary and Secondary Data Sources

Primary References

2011 Long-Term Effectiveness Assessment. San Diego Stormwater Copermittees Urban Runoff Management Programs. Final Report
2011-2012 San Diego County Copermittee Receiving Waters and Urban Runoff Monitoring Report
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2008 City of San Diego JURMP (Including FY11 and FY12 Annual Report)
Mission Bay & La Jolla WURMP (Including FY11 and FY12 Annual Report)
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Tecolote CLRP Phase I & II

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Appendix D.2

Third Party Data Sources Summary

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Document:

City of San Diego JURMP 2012

Locations within watershed:

No data

Conditions:

Analytical screening analyte exceedances highest for *Enterococcus*, Total Coliform, then Fecal Coliform. Field screening analytes with exceedances highest for Turbidity

Sources:

No data

Strategies:

Outlined in detail in Mission Bay and La Jolla WURMP 2012. Includes monitoring, trash removal, retrofits/enhancements, low flow diversions, and outreach, among other things.

Document:

San Diego Coastkeeper Water Quality Monitoring and Data Summary 2011-2013

Locations within watershed:

Rose Creek, Tecolote Creek, San Clemente Canyon

Conditions:

Tecolote Creek has significant bacteria issues. Recommend that bacteria and over-irrigation be considered priority pollution conditions for the watershed.

Sources:

No data

Strategies:

No data

Document:

City of San Diego Storm Water Program Rose Creek Watershed Opportunities Project Report from San Diego Earth Works, 2005

Locations within watershed:

Rose Creek

Conditions:

Sporadic elevated constituent levels in storm drains during dry weather. Ammonia and pH exceeded trigger levels. One *Enterococcus* exceedance. No pesticides detected.

Sources:

No data

Strategies:

No data

Document:

Rose Creek Watershed Opportunities Assessment. Hydrologic Modifications Technical Memorandum from San Diego Earth Works

Locations within watershed:

Rose Creek

Conditions:

Hydrologic modification

Sources:

Slope failure due to rainfall, use of iceplant as erosion control measure

Strategies:

No data

Document:

Rose Creek Watershed Opportunities Assessment. Biological Resources Technical Memorandum from San Diego Earth Works

Locations within watershed:

Rose Creek

Conditions:

Erosion, wildlife killed by cars, habitat degradation

Sources:

High numbers of trails, urbanization, runoff

Strategies:

Habitat restoration through repair of erosion areas, reclamation of disturbed lands, trail consolidation.

Document:

Rose Creek Watershed Opportunities Assessment. Recreational Elements

Locations within watershed:

Rose Creek

Conditions:

No data

Sources:

No data

Strategies:

No data

Document:

Rose Creek Watershed Wetland, Riparian, and Water Quality Restoration Opportunities Analysis from San Diego Earth Works, 2012

Locations within watershed:

Rose Creek

Conditions:

No data – general watershed assessment only

Sources:

No data

Strategies:

No data

Document:

Rose Creek Opportunities Assessment from Rose Creek Watershed Alliance

Locations within watershed:

Rose Creek

Conditions:

No data: general watershed assessment only

Sources:

No data

Strategies:

Provides recommendations to enhance the natural, cultural, public safety, and recreation attributes of the Rose Creek Watershed.

Document:

Email From Marian Bear Park Recreation Council, public input form all referencing Marian Bear Memorial Park Natural Resource Master Plan, 1994

Locations within watershed:

San Clemente Creek, Marian Bear Memorial Park

Conditions:

Erosion, Sediments in San Clemente Creek

Sources:

Canyon walls, slopes, banks

Strategies:

- Water quality monitoring slated to commence in near future at time of publication
 - Vegetation of eroding areas
-

Document:

Photos and video submitted by Debby Knight showing storm flow in 2010

Locations within watershed:

Rose Creek, exact location unknown

Conditions:

Hydromodification

Sources:

No data

Strategies:

No data

Document:

Regional Harbor Monitoring Plan 2008 Final Report and 3 Year Summary Report

Locations within watershed:

Mission Bay

Conditions:

During dry weather, concentration above water quality criteria for both water and sediment including total arsenic, total and dissolved copper, total zinc, total mercury, total DDT, and total chlordanes.

Sources:

No data

Strategies:

No data

Document:

City of San Diego Strategic Plan for Watershed Activity Implementation, input from Consultation Committee

Locations within watershed:

Tecolote Watershed and Miramar Watershed

Conditions:

In Tecolote Watershed, the priority conditions were identified as:

- Bacteria

- Heavy Metals
- Nutrients
- Sediments
- Benthic Alterations
- Toxicity

In Miramar Watershed, the priority conditions were identified as:

- Bacteria
- Heavy Metals
- Nutrients
- Sediments
- Toxicity

Sources:

Potential Sources in Tecolote Watershed include:

- Eating and Drinking Establishments
- Residential Areas and Activities
- Commercial Landscaping
- Animal Related Facilities
- Golf Courses, Parks, and Recreational Activities
- Municipal Facilities and Activities
- Auto Related Facilities
- Roads, Streets, Highways, and Parking Facilities
- Pest Control Facilities
- Construction Activities

Potential Sources in Miramar Watershed include:

- Eating and Drinking Establishments
- Residential Areas and Activities
- Commercial Landscaping
- Animal Related Facilities
- Golf Courses, Parks, and Recreational Activities
- Industrial Facilities
- Municipal Facilities and Activities
- Auto Related Facilities
- Roads, Streets, Highways, and Parking Facilities
- Pest Control Facilities
- Construction Activities

Strategies:

No data (Strategies identified through 2011 only)

Document:

Mission Bay Water and Sediment Testing Project Final Report, input from Consultation Committee

Locations within watershed:

Six sites within Mission Bay:

- Tecolote Creek Inlet
- Cudahy Creek Inlet

- Rose Creek Inlet
- Fiesta Bay
- Sail Bay
- Ventura Point (near the mouth of the Bay)

Conditions:

- Elevated levels of phosphate, particularly observed in the Back Bay in concert with rain events
- Exceedances of ERL values for copper, lead, zinc, 4'4'-DDE, and dieldrin

Sources:

- Input from creeks, street runoff, and historical nutrients in Bay

Strategies:

No data

Document:

Download SWAMP data from CEDEN website using the following search parameters – San Diego County and SWAMP RWB 9 Monitoring

<http://ceden.waterboards.ca.gov/AdvancedQueryTool>

Locations within watershed:

See red highlighted waterbodies in the table on Page C-11.

Conditions:

SWAMP monitoring data available from CEDEN for Region 9 was reviewed to determine if the data provide additional priority water quality conditions. Many of the programs included 1 -4 sampling events and measured a range of parameters. A majority of the monitoring occurred before the 2005 and 2011 LTEAs that incorporated the most recent regional monitoring data for the region. No additional conditions were selected based on a review of the data.

Sources:

No Data

Strategies:

No Data

Project Name from CEDEN	Years	Station Name(s)	Temporal	No. of Sampling Events	Matrix	Summary of General Analyses
Statewide Project Urban Pyrethroid Status Monitoring		Peñasquitos Creek @ Springbrook	dry weather	1	sediment	TOC, % fines, moisture, and pyrethroids
RWB9 Status Sampling 2008	2008	Campo Creek 1, Ironside Creek, Los Peñasquitos Creek 6, Rose Canyon Creek 4	dry weather	1	water, benthic	field measurements, comments noted, velocity, algae, and conventional chemistry
RWB9 Rotational BA Monitoring 2005	2005	Santa Ysabel Creek ~2mi E Hwy 79	dry weather	1	physical	field measurements, velocity, and slope profile
RWB9 Rotational Monitoring 2002	2002	Los Peñasquitos Creek 6, Poway Creek 2, Rose Canyon Creek 4 , Soledad Canyon Creek 2, and Soledad Canyon Creek 4	dry weather	1-4	water, sediment	field measurements, conventional chemistry, metals, herbicides, pesticides, and velocity. % fines
RWB9 Rotational Monitoring 2003	2003	Green Valley Creek 2, San Dieguito River 9, Santa Ysabel Creek 1	dry weather	2-4	water, sediment	Field measurements, conventional chemistry, metals, herbicides, pesticides, and velocity. % fines
San Diego Regional Board Fire Study	2005, 2007, 2008, 2009	Black Mountain Creek Upstream of Santa Ysabel Creek, Boden Canyon Creek (BOD), Boden Canyon Creek ~0.5 mile upstream of Santa Ysabel Creek, Chicarita Creek downstream of Evening Creek Road, Green Valley Creek 2, Kit Carson Creek Sunset Drive crossing	dry weather	1-3	water	field measurements and velocity
Statewide Perennial Streams Assessment 2008	2008	Encinitas Creek, Arroyo Trabuco 57, Santa Ysabel Creek	dry weather	1	water, benthic	field measurements, comments noted, velocity, algae, and conventional chemistry

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Project Name from CEDEN	Years	Station Name(s)	Temporal	No. of Sampling Events	Matrix	Summary of General Analyses
MAP Wadeable Streams 2004	2004	Santa Ysabel Creek below Witch Creek	dry weather	2	water	field measurements and velocity
Statewide Ref Condition Management Plan 2009	2009	Noble Canyon Creek ~0.8mi above Pine Valley Cr.	dry weather	1	water, benthic	field measurements, conventional chemistry, algae and velocity
Statewide Ref Condition Management Plan 2010	2010	Cedar Creek 2, Japacha Creek above Hwy 79, Spring Canyon Creek ~2.3mi above Hwy 74	dry weather	1	water, benthic	field measurements, conventional chemistry, algae and velocity
Statewide Ref Condition Management Plan 2008	2008	Arroyo Trabuco	dry weather	1	water, benthic	field measurements, conventional chemistry, algae and velocity
Statewide Ref Condition Management Plan 2011	2011	Cold Spring Canyon above Devil Cyn Creek, Devils Canyon Creek above San Mateo Cyn. Creek, Juaquapin Creek above Sweetwater River, Kitchen Creek at Kitchen Creek Road, Troy Canyon Creek (TCC2), Wilson Creek 3	dry weather	1	water, benthic	field measurements, conventional chemistry, algae and velocity
Statewide Ref Condition Mgmt Plan Index Study 2009	2009	Noble Canyon Creek ~0.8mi above Pine Valley Cr.	dry weather	2	water, benthic	field measurements, conventional chemistry, algae and velocity
Statewide Ref Condition Mgmt Plan Index Study 2010	2010	Cedar Creek 2	dry weather	4	water, benthic	field measurements, conventional chemistry, algae and velocity
Statewide Stream Pollution Trends Study 2008	2008, 2009, 2010	Agua Hedionda Creek 6, Escondido Creek at Camino del Norte, Forrester Creek 2, Los Peñasquitos Creek 6, San Diego River at Ward Road, San Dieguito River 9, San Juan Creek 9, Santa Margarita at Basilone Rd, Soledad Canyon Creek 4, Tijuana River at Hollister Rd	dry weather	1	sediment	Organics, PCBs, Pyrethroids, Pesticides, Semi-volatile Organic Carbons, metals

APPENDIX D.3
Persistent Flow Outfall Summary

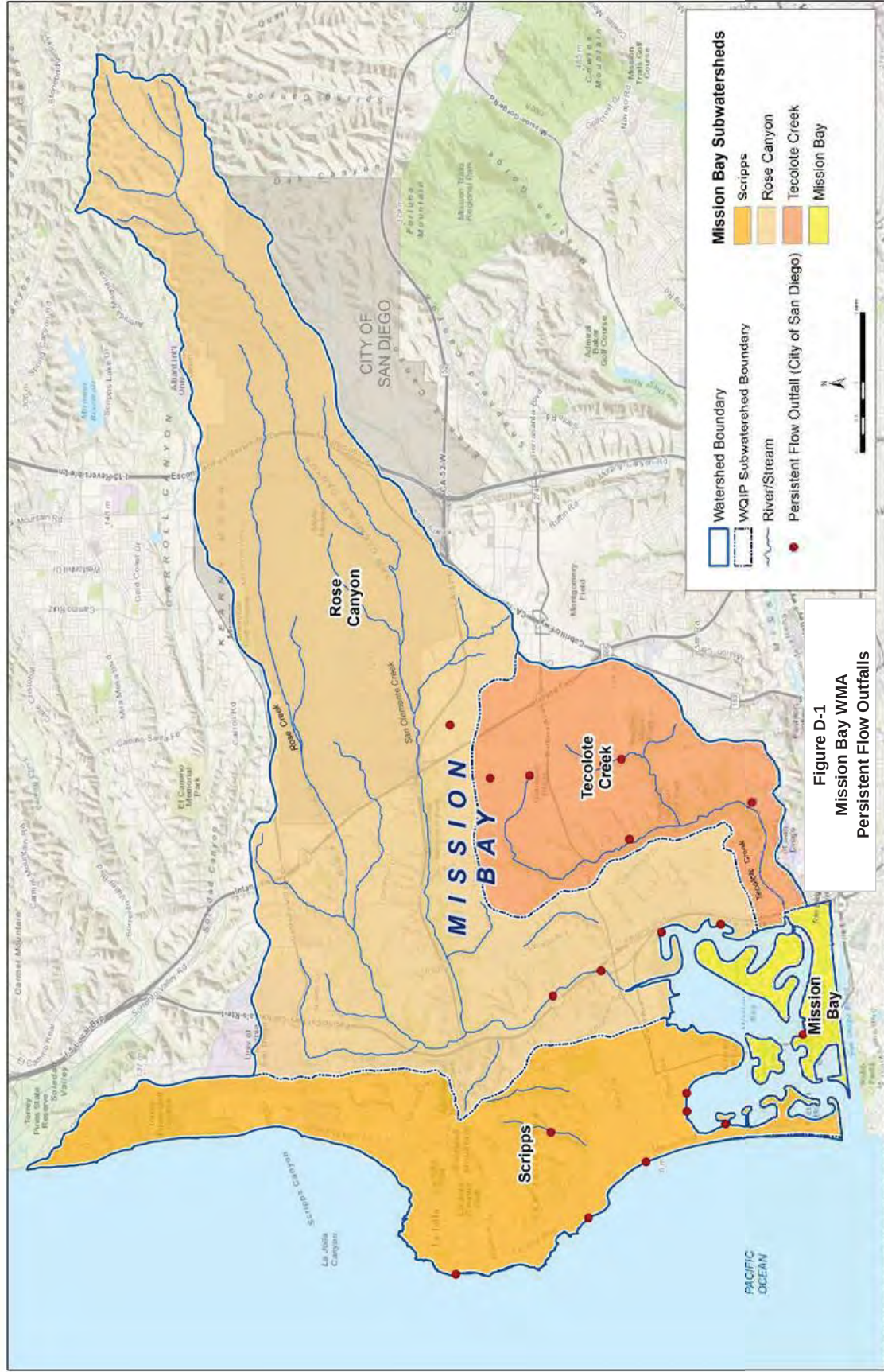
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Potential Persistent Flow Outfalls¹

Jurisdiction ²	Subwatershed	Site ID	Latitude	Longitude	Land Use
City of San Diego ³	Mission Bay	DW0166	32.76707	-117.23218	Commercial/Roads
	Rose Canyon	DW0066	32.84057	-117.16789	Parks/Open Space
		DW0104	32.80919	-117.21887	Residential
		DW0273	32.81917	-117.22407	Residential
		DW0398	32.79662	-117.21088	Residential
		DW0400	32.784350	-117.209246	Roads
	Scripps	DW0053	32.83938	-117.28185	Residential/Parks
		DW0152	32.81183	-117.27011	Residential
		DW0156	32.79984	-117.25853	Residential
		DW0158	32.791417	-117.248014	Residential
		DW0159	32.791438	-117.244266	Residential
		DW0162	32.78333	-117.25066	Residential
		DW0580	32.81963	-117.25239	Residential
	Tecolote Creek	DW0107	32.80861	-117.17597	Residential
		DW0116	32.80332	-117.19156	Residential
		DW0176	32.77755	-117.18396	Residential/Commercial
		DW0275	32.82403	-117.17834	Residential
		DW0382	32.80500	-117.17497	Residential
		DW0392	32.83228	-117.17893	Residential/Commercial

1. This list of persistent flow outfalls is current based on 2014 dry weather monitoring data.
2. No outfalls with persistent dry weather flow have been identified in Caltrans jurisdiction.
3. Identified land uses for the City of San Diego include all land uses comprising more than 30% of upstream drainage area.

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APPENDIX D.4

Public Input from Water Quality Improvement Plan Workshop

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Public Input Form

Conditions

- Landfill (source)
- Freshwater
- Purple pipes – runoff and intermittent stream discharges
- Nutrients
- Over-irrigation
- Trolley conditions (future impacts)
- Sediment in Rose Canyon
- Sediment in San Clemente Creek
- Velocity – Hydro Mod
- Trash, feces from homeless encampments
- Bacteria
- Plastic trash bags
- Beach trash visitors/tourists – Plastic bags, diapers
- Mission Bay/Ocean currents and tides carry trash from other areas to Mission beach.
- Non-native plants and wildlife
- Rose Canyon – Freeway and rail traffic
- Toxicity in all areas due to emergent pollutants such as hormones and caffeine
- Wild fires – Flame retardants, metals, ash, and sedimentation

Sources

- Airplane exhaust – aerial deposition into Mission Beach
- Tires
- Rail transit – Degreasers and dust
- Dumping dog waste in canyon – (Requested better education)
- Parking lots – Retrofits, new developments, reflective coating
- Soap from car washing
- Development in UTC – Wetlands filled in and exported mitigation to other areas



- Pave everything, put pipe at the top of the canyon, causes sedimentation and erosion of the canyon
- Schools, particularly high schools have a lot of waste, trash, etc. in the parking lots and fields
- Boats, particularly two-stroke engines, in Mission Bay – Trash and chemicals from boats
- Nesting of birds is affected by trash and plastics, nests are built with trash
- Wind is N/W and currents
- Boats dumping holding tanks (lifeguards and coast guard are supposed to monitor)
- Homeless encampments
- Trash from day use in scenic areas because there are no trash cans
- Illegal dumping in Rose Creek
- Seagulls distribute trash throughout Bay due to open trash receptacles

Strategies

- Trash cans where people use open spaces
- Comprehensive strategies for encampment issues
- Native plants/pervious surfaces
- Demonstration projects
- Low water usage gardens in the watershed such as rainwater harvesting/smart water/pervious surfaces
- Partner with colleges, check out innovation center
- Port-a-Potties along entire trail, not just one spot
- Development review boards should include strategies for managing water
- Construction/building permits (Phase II) should include water management
- Education to city/local planning boards
- Public signs, too small and not adequate, pack-in/pack-out signs
- Ban car washing in streets or driveways
- Make street sweeping schedule public, more parking restrictions
- Require wetland mitigation in the watershed
- No more outlet pipes at the tops of canyons
- Treat storm water the same way as sewage
- Prevent purple pipe from going into storm drain/creeks



- Dog parks – ticket people without bags or flashlights at night
- Support restoration of wetlands in NE corner of Mission Bay
- Reverse flow valves don't work/berm ponds for fresh water. Sewer interceptor system doesn't work
- Ban plastic bags and bottles
- Repair storm drains, one size does not fit all
- Chemical pollutant responses such as acid neutralizing
- Swales – Are they effective? Enforcement of effectiveness to developers and Caltrans
- Operation and maintenance issues of structural BMPs
- Caltrans – Swales in I-5 widening project
- Allow community groups to have access to dumpsters when they do clean ups so they bags are not left exposed until they are picked up. Better facilitation of these clean ups, such as through ILACSD
- Landscaping to prevent runoff, restoring natural contours of the land
- Private property right on the creek
- TJ Estuary has bought properties in the flood plain to prevent these issues
- Don't allow certain uses in sensitive areas
- Train planning groups (such as CEQA training)
- Don't favor some areas of the watershed over others when it comes to directing resources for water quality improvements



Water Quality Improvement Plan Workshop
Mission Bay & La Jolla Watershed
September 7, 2013
9:00 a.m. – 11:00 a.m.

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APPENDIX E

Receiving Water Condition and Urban Runoff Assessment

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Appendix E –Receiving Water Condition and Urban Runoff Assessment

Appendices E.1 and E.2 present an assessment of receiving water conditions and the impact of urban discharges in Mission Bay WMA during wet and dry weather, respectively. The list of receiving water conditions was developed on the basis of the 2010 303(d) list, applicable TMDLs, waterbodies with special biological significance, public input, and the priority pollutants or stressors identified from current and historical receiving water monitoring data. MS4 monitoring data compiled from the LTEA and WURMP Annual Reports, as well as any applicable TMDL WQBELs, are also evaluated in relation to the receiving water conditions to determine if a priority water quality condition existed.

The tables in Appendices E.1 and E.2 are presented by WQIP Subwatershed and 303(d) listed waterbody. In order to mirror the process used by the Responsible Agencies to assess the potential receiving water conditions for each waterbody, the data are presented in the order they were evaluated. The following is an illustration of how the reader might follow the process used to assess receiving water conditions in an example waterbody (Example Waterbody A):

- ❖ **303(d) Listings (Page E-5, reading left to right)** identifies the WQIP subwatershed, applicable TMDLs, and 303(d) listed waterbody (Example Waterbody A), and then presents the associated pollutants, impaired beneficial uses, and potential sources of impairment for Example Waterbody A as identified under the 2010 303(d) list.
- ❖ **Receiving Water Assessment and Conditions (Page E-6, reading left to right)**
 - **Receiving Water Assessment** identifies the WQIP subwatershed, applicable TMDLs, and 303(d) listed waterbody (Example Waterbody A), and then presents public input submitted in response to the public data call and NPDES receiving water monitoring station data for Example Waterbody A. The receiving water priorities identified were noted as exceeding water quality benchmarks in the 2005-2010 LTEA, FY 11 & 12 WURMP, or 2008 RHMP (for dry weather assessment only).
 - **Receiving Water Conditions** summarizes the receiving water conditions identified through the 303(d) listings and receiving water assessment, and states the applicable lines of evidence.
- ❖ **Urban Runoff Monitoring Assessment (Page E-7, reading left to right)** identifies the WQIP subwatershed and 303(d) listed waterbody (Example Waterbody A), and then presents the priority pollutants at the MS4 outfall, based on the Urban Runoff Monitoring Program and identified in the 2005-2010 LTEA and FY 11&12 WURMP Annual Reports, for Example Waterbody A. as well as the applicable WQBELs where appropriate.

Page E-8 then restarts the assessment with an evaluation of 303(d) listings for the next waterbody.

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APPENDIX E.1

Wet Weather Receiving Water Condition Assessment

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WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Mission Bay	NA	Mission Bay at Quivira Basin	Copper	Estuarine Habitat, Marine Habitat	Unknown
Rose Canyon	NA	Mission Bay Shoreline, at Campland	<i>Enterococcus</i>	Water Contact Recreation	Unknown
			Fecal Coliform	Water Contact Recreation	Unknown
			Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment				Receiving Water Conditions	
			Public Input	NPDES Receiving Water			Receiving Water Conditions	Line(s) of Evidence
				Applicable Receiving Water Station(s)	2005-2010 LTEA	FY11 & 12 WURMP		
Mission Bay	NA	Mission Bay at Quivira Basin	Freshwater Discharges, Nutrients, Sediment (Rose Canyon and San Clemente Creek, Velocity (Hydromodification)), Trash, Feces, Bacteria, Non-native Vegetation and Invasive Species, Toxicity, Flame Retardants, Metals, Ash, Sedimentation	NA	NA	NA	Impairment of MAR and EST due to copper in Quivira Basin during wet weather.	303(d)
Rose Canyon	NA	Mission Bay Shoreline, at Campland	Same as above	MB-TWAS 1	Turbidity, Bifenthrin, BOD, TSS, Permethylrin, Fecal Coliform, TDS	Turbidity, Bifenthrin, TSS, Permethylrin, Very Poor IB1, Fecal Coliform, TDS	Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Mission Bay Shoreline at Campland during wet weather.	303(d)
							Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Campland during wet weather.	303(d)

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	
			2005-2010 LTEA	FY 11 & 12 WURMP	WQBELS
Mission Bay	NA	Mission Bay at Quivira Basin	NA	NA	NA
Rose Canyon	NA	Mission Bay Shoreline, at Campland	TSS, Fecal Coliform	NA	NA

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Rose Canyon	NA	Mission Bay Shoreline, at De Anza Cove	<i>Enterococcus</i>	Water Contact Recreation	Unknown
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Source Unknown
		Mission Bay Shoreline, at Leisure Lagoon	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Unknown Non-Point Source
		Mission Bay Shoreline, at North Crown Point	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment				Receiving Water Conditions	
			Public Input	NPDES Receiving Water			Receiving Water Conditions	Line(s) of Evidence
				Applicable Receiving Water Station(s)	2005-2010 LTEA	FY11 & 12 WURMP		
Rose Canyon	NA	Mission Bay Shoreline, at De Anza Cove	Same as above	MB-TWAS 1	Turbidity, Bifenthrin, BOD, TSS, Permethylin, Fecal Coliform, TDS	Turbidity, Bifenthrin, TSS, Permethylin, Very Poor IBI, Fecal Coliform, TDS	Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Mission Bay Shoreline at De Anza Cove during wet weather.	303(d)
							Impairment of SHELL due to total coliform of the Mission Bay Shoreline at De Anza Cove during wet weather.	303(d)
		Mission Bay Shoreline, at Leisure Lagoon					Impairment of REC-1 due to <i>Enterococcus</i> of the Mission Bay Shoreline at Leisure Lagoon during wet weather.	303(d)
							Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Leisure Lagoon during wet weather.	303(d)
		Mission Bay Shoreline, at North Crown Point					Impairment of REC-1 due to <i>Enterococcus</i> of the Mission Bay Shoreline at North Crown Point during wet weather.	303(d)
							Impairment of SHELL due to total coliform of the Mission Bay Shoreline at North Crown Point during wet weather.	303(d)

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	
			2005-2010 LTEA	FY 11 & 12 WURMP	WQBELS
Rose Canyon	NA	Mission Bay Shoreline, at De Anza Cove	TSS, Fecal Coliform	NA	NA
		Mission Bay Shoreline, at Leisure Lagoon			
		Mission Bay Shoreline, at North Crown Point			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Rose Canyon	NA	Mission Bay (Mouth of Rose Creek)	Eutrophic	Marine Habitat	Landfills, Nurseries, Point Source, Highway/Road/Bridge Runoff, Non-point Source, Urban Runoff/Storm Sewers
			Lead	Marine Habitat	Highway/Road/Bridge Runoff, Landfills, Urban Runoff/Storm Sewers, Non-point Source, Point Source
		Mission Bay Shoreline, at Visitors Center	<i>Enterococcus</i>	Water Contact Recreation	Unknown
			Fecal Coliform	Water Contact Recreation	Point Source/Non-point Source
		Rose Creek	Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers
			NA	NA	NA

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment				Receiving Water Conditions	
			Public Input	NPDES Receiving Water			Receiving Water Conditions	Line(s) of Evidence
				Applicable Receiving Water Station(s)	2005-2010 LTEA	FY11 & 12 WURMP		
Rose Canyon	NA	Mission Bay (Mouth of Rose Creek)	Same as above	MB-TWAS 1	Turbidity, Bifenthrin, BOD, TSS, Permethylrin, Fecal Coliform, TDS	Turbidity, Bifenthrin, TSS, Permethylrin, Very Poor IBI, Fecal Coliform, TDS	Potential eutrophic conditions not included because impacts to MAR during wet weather are unknown. Potential eutrophic conditions will be listed as contributing to impairment of MAR during dry weather.	
							Impairment of MAR due to lead in Mission Bay at the Mouth of Rose Creek during wet weather.	303(d)
		Mission Bay Shoreline, at Visitors Center					Impairment of REC-1 due to <i>Enterococcus</i> and total and fecal coliform of the Mission Bay Shoreline at the Visitors Center during wet weather.	303(d)
		Rose Creek					Impairment of SHELL due to total coliform of the Mission Bay Shoreline at the Visitors Center during wet weather.	303(d)
							Elevated TDS near NPDES monitoring locations in Rose Creek during wet weather.	RW monitoring data (historic & current)

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELS
			2005-2010 LTEA	FY 11 & 12 WURMP	
Rose Canyon	NA	Mission Bay (Mouth of Rose Creek)	TSS, Fecal Coliform	NA	NA
		Mission Bay Shoreline, at Visitors Center			
		Rose Creek			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Rose Canyon	NA	Rose Creek	NA	NA	NA
			Selenium	Warm Freshwater Habitat	Natural Sources
			Toxicity	Warm Freshwater Habitat	Urban Runoff/Storm Sewers

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment				Receiving Water Conditions	
			Public Input	NPDES Receiving Water			Receiving Water Conditions	Line(s) of Evidence
				Applicable Receiving Water Station(s)	2005-2010 LTEA	FY11 & 12 WURMP		
Rose Canyon	NA	Rose Creek	Same as above	MB-TWAS 1	Turbidity, Bifenthrin, BOD, TSS, Permethrin, Fecal Coliform, TDS	Turbidity, Bifenthrin, TSS, Permethrin, Very Poor IBI, Fecal Coliform, TDS	Elevated turbidity near NPDES monitoring locations in Rose Creek during wet weather.	RW monitoring data (historic & current)
							Elevated TSS near NPDES monitoring locations in Rose Creek during wet weather.	RW monitoring data (historic & current)
							Elevated bifenthrin and permethrin near NPDES monitoring locations in Rose Creek during wet weather.	RW monitoring data (historic & current)
							Impairment of WARM due to selenium in Rose Creek during wet weather.	303(d)
							Impairment of WARM due to toxicity in Rose Creek during wet weather.	303(d)

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	
			2005-2010 LTEA	FY 11 & 12 WURMP	WQBELS
Rose Canyon	NA	Rose Creek	TSS, Fecal Coliform	NA	NA

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	ASBS 29 - La Jolla Shores ASBS	Fecal Coliform	ASBS	NA
			Total Coliform	ASBS	NA
			Copper	ASBS	NA
			Sediment	ASBS	NA
		Mission Bay Shoreline, at Bahia Point	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Unknown
		Mission Bay Shoreline, at Bonita Cove	<i>Enterococcus</i>	Water Contact Recreation	Unknown
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Unknown

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment			Receiving Water Conditions						
			Public Input	NPDES Receiving Water		Receiving Water Conditions	Line(s) of Evidence					
				Applicable Receiving Water Station(s)	2005-2010 LTEA			FY11 & 12 WURMP				
Scripps	Bacteria TMDL & La Jolla Shores ASBS	ASBS 29 - La Jolla Shores ASBS	Same as above	Numerous years of monitoring conducted in the ASBS 29 drainage area and ASBS 29 starting in 2005. This data was used to develop the La Jolla Shores Coastal Watershed Management Plan, Scripps CLRP, and other compliance related documents. Priorities taken from the La Jolla Shores Coastal Watershed Management Plan. No direct NPDES monitoring locations.	NA	NA	Reduction of fecal coliform loads to those specified in the Scripps CLRP during wet weather.	Scripps Phase II CLRP Table 2-8				
							Reduction of total coliform loads to those specified in the Scripps CLRP during wet weather.	Scripps Phase II CLRP Table 2-8				
		Mission Bay Shoreline, at Bahia Point					Reduction of copper loads to those specified in the Scripps CLRP during wet weather.	Scripps Phase II CLRP Table 2-8				
							Reduction of sediment loads to those specified in the Scripps CLRP during wet weather.	Scripps Phase II CLRP Table 2-8				
		Mission Bay Shoreline, at Bahia Point					Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Mission Bay Shoreline at Bonita Cove during wet weather.	303(d)				
							Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Bahia Point during wet weather.	303(d)				
Mission Bay Shoreline, at Bonita Cove					Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Mission Bay Shoreline at the Bonita Cove during wet weather.	303(d)						
					Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Bonita Cove during wet weather.	303(d)						

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELS
			2005-2010 LTEA	FY 11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	ASBS 29 - La Jolla Shores ASBS	Indicator Bacteria, Copper, TSS (ASBS outfall monitoring data 2010-2013)	NA	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9- 2013-0001; Attachment E.6)
		Mission Bay Shoreline, at Bahia Point	NA	NA	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9- 2013-0001; Attachment E.6)
		Mission Bay Shoreline, at Bonita Cove			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Mission Bay Shoreline, at Fanual Park	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Source Unknown
		Pacific Ocean Shoreline, Avenida de La Playa	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
		Pacific Ocean Shoreline, Avenida de La Playa	Total Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
				Shellfish Harvesting	Urban Runoff/Storm Sewers
		Pacific Ocean Shoreline, Children's Pool	<i>Enterococcus</i>	Water Contact Recreation	Natural Sources/Other Urban Runoff
			Fecal Coliform	Water Contact Recreation	Natural Sources/Unknown
			Total Coliform	Water Contact Recreation	Natural Sources/Other Urban Runoff/Unknown

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment				Receiving Water Conditions	
			Public Input	NPDES Receiving Water			Receiving Water Conditions	Line(s) of Evidence
				Applicable Receiving Water Station(s)	2005-2010 LTEA	FY11 & 12 WURMP		
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Mission Bay Shoreline, at Fanual Park	Same as above	NA	NA	NA	Impairment of REC-1 due to <i>Enterococcus</i> of the Mission Bay Shoreline at Fanual Park during wet weather.	303(d)
		Pacific Ocean Shoreline, Avenida de La Playa					Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Fanual Park during wet weather.	303(d)
		Pacific Ocean Shoreline, Avenida de La Playa					Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Pacific Ocean Shoreline at Avenida de la Playa during wet weather.	Bacteria TMDL
		Pacific Ocean Shoreline, Avenida de La Playa					Impairment of REC-1 due to total coliform of the Pacific Ocean Shoreline at Avenida de la Playa during wet weather.	Bacteria TMDL
		Pacific Ocean Shoreline, Children's Pool					Impairment of SHELL due to total coliform of the Pacific Ocean Shoreline at Avenida de la Playa during wet weather.	303(d)
		Pacific Ocean Shoreline, Children's Pool					Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Pacific Ocean Shoreline at Children's Pool during wet weather.	303(d) and Bacteria TMDL
							Impairment of REC-1 due to total coliform of the Pacific Ocean Shoreline at Children's Pool during wet weather.	Bacteria TMDL

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	
			2005-2010 LTEA	FY 11 & 12 WURMP	WQBELS
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Mission Bay Shoreline, at Fanual Park	NA	NA	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9- 2013-0001; Attachment E.6)
		Pacific Ocean Shoreline, Avenida de La Playa			
		Pacific Ocean Shoreline, Avenida de La Playa			
		Pacific Ocean Shoreline, Children's Pool			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Children's Pool	Total Coliform	Shellfish Harvesting	Natural Sources/Other Urban Runoff/Unknown
		Pacific Ocean Shoreline, La Jolla Cove	Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers and Other Unknown Source
		Pacific Ocean Shoreline, Pacific Beach Point	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
		Pacific Ocean Shoreline, Pacific Beach Point	Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
		Pacific Ocean Shoreline, Pacific Beach Point	Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers and Other Unknown Source
		Pacific Ocean Shoreline, Ravina	Total Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
		Pacific Ocean Shoreline, Vallecitos Court	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
			Total Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment			Receiving Water Conditions			
			Public Input	NPDES Receiving Water		Receiving Water Conditions	Line(s) of Evidence		
				Applicable Receiving Water Station(s)	2005-2010 LTEA			FY11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Children's Pool	Same as above	NA	NA	Impairment of SHELL due to total coliform of the Pacific Ocean Shoreline at Children's Pool during wet weather.	303(d)		
		Pacific Ocean Shoreline, La Jolla Cove					Impairment of SHELL due to total coliform of the Pacific Ocean Shoreline at La Jolla Cove during wet weather.	303(d)	
		Pacific Ocean Shoreline, Pacific Beach Point					Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Pacific Ocean Shoreline at Pacific Beach Point during wet weather.	303(d)	
		Pacific Ocean Shoreline, Pacific Beach Point					Impairment of SHELL due to total coliform of the Pacific Ocean Shoreline at Pacific Beach Point during wet weather.	303(d)	
		Pacific Ocean Shoreline, Ravina					Impairment of REC-1 due to total coliform of the Pacific Ocean Shoreline at Ravina during wet weather.	303(d) and Bacteria TMDL	
		Pacific Ocean Shoreline, Vallecitos Court					Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Pacific Ocean Shoreline at Vallecitos Court during wet weather.	Bacteria TMDL	
							Impairment of REC-1 due to total coliform of the Pacific Ocean Shoreline at Vallecitos Court during wet weather.	Bacteria TMDL	

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELS
			2005-2010 LTEA	FY 11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Children's Pool	NA	NA	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9- 2013-0001; Attachment E.6)
		Pacific Ocean Shoreline, La Jolla Cove			
		Pacific Ocean Shoreline, Pacific Beach Point			
		Pacific Ocean Shoreline, Pacific Beach Point			
		Pacific Ocean Shoreline, Ravina			
		Pacific Ocean Shoreline, Vallecitos Court			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Vallecitos Court	Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers and Other Unknown Source
		Pacific Ocean Shoreline, La Jolla Shores Beach at el Paseo Grande	NA	NA	NA
		Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro			
		Pacific Ocean Shoreline, South Casa Beach at Coast Blvd.			
		Pacific Ocean Shoreline, Windansea Beach at Vista de la Playa			
		Pacific Ocean Shoreline, Windansea Beach at Bonair Street			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment				Receiving Water Conditions	
			Public Input	NPDES Receiving Water			Receiving Water Conditions	Line(s) of Evidence
				Applicable Receiving Water Station(s)	2005-2010 LTEA	FY11 & 12 WURMP		
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Vallecitos Court	Same as above	NA	NA	NA	Impairment of SHELL due to total coliform of the Pacific Ocean Shoreline at Vallecitos Court during wet weather.	303(d)
		Pacific Ocean Shoreline, La Jolla Shores Beach at el Paseo Grande					Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform during wet weather	Bacteria TMDL
		Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro					Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform during wet weather	Bacteria TMDL
		Pacific Ocean Shoreline, South Casa Beach at Coast Blvd.					Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform during wet weather	Bacteria TMDL
		Pacific Ocean Shoreline, Windansea Beach at Vista de la Playa					Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform during wet weather	Bacteria TMDL
		Pacific Ocean Shoreline, Windansea Beach at Bonair Street					Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform during wet weather	Bacteria TMDL

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELS
			2005-2010 LTEA	FY 11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Vallecitos Court			Enterococcus, Fecal Coliform, Total Coliform (Order No. R9-2013-0001; Attachment E.6)
		Pacific Ocean Shoreline, La Jolla Shores Beach at el Paseo Grande			
		Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro	NA	NA	
		Pacific Ocean Shoreline, South Casa Beach at Coast Blvd.			NA
		Pacific Ocean Shoreline, Windansea Beach at Vista de la Playa			
		Pacific Ocean Shoreline, Windansea Beach at Bonair Street			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Windansea Beach at Playa del Norte	NA	NA	NA
		Pacific Ocean Shoreline, Windansea Beach at Palomar Ave.			
		Pacific Ocean Shoreline, Pacific Beach at Grand Ave.			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment				Receiving Water Conditions	
			Public Input	NPDES Receiving Water			Receiving Water Conditions	Line(s) of Evidence
				Applicable Receiving Water Station(s)	2005-2010 LTEA	FY11 & 12 WURMP		
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Windansea Beach at Playa del Norte	Same as above	NA	NA	NA	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform during wet weather	Bacteria TMDL
		Pacific Ocean Shoreline, Windansea Beach at Palomar Ave.					Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform during wet weather	Bacteria TMDL
		Pacific Ocean Shoreline, Pacific Beach at Grand Ave.					Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform during wet weather	Bacteria TMDL

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	
			2005-2010 LTEA	FY 11 & 12 WURMP	WQBELS
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Windansea Beach at Playa del Norte	NA	NA	NA
		Pacific Ocean Shoreline, Windansea Beach at Palomar Ave.			
		Pacific Ocean Shoreline, Pacific Beach at Grand Ave.			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Tecolote Creek	Bacteria TMDL	Tecolote Creek	Indicator Bacteria	Water Contact Recreation	Point Source/Non-point Source
			Cadmium	Warm Freshwater Habitat	Point Source/Non-point Source
			Copper	Warm Freshwater Habitat	Point Source/Non-point Source
			Lead	Warm Freshwater Habitat	Point Source/Non-point Source
			Zinc	Warm Freshwater Habitat	Point Source/Non-point Source
			Phosphorus	Non-contact Recreation	Unknown
			Toxicity	Warm Freshwater Habitat	Point Source/Non-point Source

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment				Receiving Water Conditions	
			Public Input	NPDES Receiving Water			Receiving Water Conditions	Line(s) of Evidence
				Applicable Receiving Water Station(s)	2005-2010 LTEA	FY11 & 12 WURMP		
Tecolote Creek	Bacteria TMDL	Tecolote Creek	Same as above	TC-MLS, MB-TWAS-2	Turbidity, Fecal Bifenthrin, Coliform, TSS, BOD, Malathion, Permethrin, Toxicity (<i>C. dubia</i> acute survival, <i>C. dubia</i> chronic survival, <i>C. dubia</i> reproduction)	TSS, Turbidity, Bifenthrin, Permethrin, COD, Very Poor IBI, Fecal Coliform, Toxicity (<i>S. capricornutum</i> growth)	Impairment of REC-1 due to indicator bacteria in Tecolote Creek during wet weather.	303(d), Bacteria TMDL and RW monitoring data (historic & current)
							Impairment of WARM due to cadmium, copper, lead, and zinc in Tecolote Creek during wet weather.	303(d)
							Phosphorous not included because impacts to REC-2 during wet weather are unknown. Phosphorus will be listed as contributing to impairment of REC-2 during dry weather.	
							Impairment of WARM due to toxicity in Tecolote Creek during wet weather.	303(d) and RW monitoring data (historic & current)

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	
			2005-2010 LTEA	FY 11 & 12 WURMP	WQBELS
Tecolote Creek	Bacteria TMDL	Tecolote Creek	Fecal Coliform	NA	Enterococcus, Fecal Coliform (Order No. R9- 2013-0001; Attachment E.6)

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listing(s)		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Tecolote Creek	Bacteria TMDL	Tecolote Creek	Turbidity	Non-contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
			NA	NA	NA
		Mission Bay (Mouth of Tecolote Creek)	Eutrophic	Estuarine Habitat	Point Source/Non-point Source
			Lead	Industrial Service Supply	Point Source/Non-point Source
		Mission Bay Shoreline, at Tecolote Shores	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff and Other Unknown Source
			Total Coliform	Shellfish Harvesting	Unknown

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Receiving Water Assessment				Receiving Water Conditions	
			Public Input	NPDES Receiving Water			Receiving Water Conditions	Line(s) of Evidence
				Applicable Receiving Water Station(s)	2005-2010 LTEA	FY11 & 12 WURMP		
Tecolote Creek	Bacteria TMDL	Tecolote Creek	Same as above	TC-MLS; MB-TWAS-2	Turbidity, Bifenthrin, Fecal Coliform, TSS, BOD, Malathion, Permethrin, Toxicity (<i>C. dubia</i> acute survival, <i>C. dubia</i> chronic survival, <i>C. dubia</i> reproduction)	TSS, Turbidity, Bifenthrin, Permethrin, COD, Very Poor IBI, Fecal Coliform, Toxicity (<i>S. capricornutum</i> growth)	Impairment of REC-2 due to turbidity in Tecolote Creek during wet weather.	303(d) and RW monitoring data (historic & current)
							Elevated bifenthrin and permethrin near NPDES monitoring locations in Tecolote Creek during wet weather.	RW monitoring data (historic & current)
		Mission Bay (Mouth of Tecolote Creek)					Eutrophic conditions not included because impacts to EST during wet weather are unknown. Eutrophic conditions will be listed as contributing to impairment of EST during dry weather.	
		Mission Bay Shoreline, at Tecolote Shores					Impairment of IND due to lead in Mission Bay at the Mouth of Tecolote Creek during wet weather.	303(d)
							Impairment of REC-1 due to <i>Enterococcus</i> of the Mission Bay Shoreline at Tecolote Shores during wet weather.	303(d)
							Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Tecolote Shores during wet weather.	303(d)

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	
			2005-2010 LTEA	FY 11 & 12 WURMP	WQBELS
Tecolote Creek	Bacteria TMDL	Tecolote Creek			<i>Enterococcus</i> , Fecal Coliform (Order No. R9- 2013-0001; Attachment E.6)
		Mission Bay (Mouth of Tecolote Creek)	Fecal Coliform	NA	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9- 2013-0001; Attachment E.6)
		Mission Bay Shoreline, at Tecolote Shores			

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APPENDIX E.2

Dry Weather Receiving Water Condition Assessment

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WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Mission Bay	NA	Mission Bay at Quivira Basin	Copper	Estuarine Habitat, Marine Habitat	Unknown
			NA	NA	NA

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment						RHMP Monitoring Data	Receiving Water Conditions	
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program			Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Mission Bay	NA	Mission Bay at Quivira Basin	Freshwater discharges, nutrients, sediment (Rose Canyon and San Clemente Creek, Velocity (Hydromodification)), Trash, Feces, Bacteria, non-native vegetation and invasive species, toxicity, flame retardants, metals, ash, sedimentation	NA		NA	NA		Freshwater Influenced Areas: Elevated total arsenic, total copper, total zinc, and total DDT in sediments; <u>Marinas</u> : Elevated dissolved copper and total copper in surface waters; Elevated total arsenic, total copper, total mercury, total zinc, and total DDT in sediments; <u>Shallow Areas</u> : Elevated total arsenic, total copper, total zinc, total DDT, and total chlordanes in sediments ; Elevated total copper in surface waters	Impairment of MAR and EST due to copper in Quivira Basin during dry weather.	303(d)
		NA							Elevated total arsenic, total copper, and total DDTs in sediments of freshwater influenced areas	Historical RHMP Monitoring Data	

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Mission Bay	NA	Mission Bay at Quivira Basin	NA	NA	NA
		NA			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Mission Bay	NA	NA	NA	NA	NA

Receiving Water Assessment												Receiving Water Conditions	
WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence		
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP					
Mission Bay	NA	NA	Same as above	NA	NA	NA	NA	NA	<u>Freshwater</u> Elevated total arsenic, total copper, total zinc, and total DDT in sediments; <u>Marinas</u> : Elevated dissolved copper and total copper in surface waters; Elevated total arsenic, total copper, total mercury, total zinc, and total DDTs in sediments of marina areas Elevated total copper in surface waters and sediments of marina areas	Elevated dissolved copper in surface waters of marina areas	Historical RHMP Monitoring Data		
										Elevated total arsenic, total copper, total zinc, total DDTs, and total chlordanes in sediments of shallow areas	Historical RHMP Monitoring Data		
										Elevated total copper in surface waters and sediments of shallow areas	Historical RHMP Monitoring Data		

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Mission Bay	NA	NA	NA	NA	NA

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Rose Canyon	NA	Mission Bay Shoreline, at Campland	<i>Enterococcus</i>	Water Contact Recreation	Unknown
			Fecal Coliform	Water Contact Recreation	Unknown
			Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers
		Mission Bay Shoreline, at De Anza Cove	<i>Enterococcus</i>	Water Contact Recreation	Unknown
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Source Unknown

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment						Receiving Water Conditions		
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Rose Canyon	NA	Mission Bay Shoreline, at Campland	Same as above	MB-TWAS 1	Toxicity (C. dubia acute survival, C. dubia chronic survival, C. dubia reproduction, S. capricornutum acute), Poor IBI, O/E, CRAM, TDS	Toxicity (C. dubia reproduction, S. capricornutum growth, C. dubia chronic survival) , Very Poor IBI sample**, TDS, DO and Enterococcus (Coastkeeper)	Chloride, Sulfate, Bifenthrin, Very Poor IBI, O/E, Total N, Total P, TDS **Based on two stations**	NA	NA	Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Mission Bay Shoreline at Campland during dry weather.	303(d)
										Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Campland during dry weather.	303(d)
		Mission Bay Shoreline, at De Anza Cove								Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Mission Bay Shoreline at De Anza Cove during dry weather.	303(d)
										Impairment of SHELL due to total coliform of the Mission Bay Shoreline at De Anza Cove during dry weather.	303(d)

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Rose Canyon	NA	Mission Bay Shoreline, at Campland	Enterococcus, Fecal Coliform, Total N, Total P, TDS	Enterococcus, Fecal Coliform, Total N, Total P, TDS	NA
		Mission Bay Shoreline, at De Anza Cove			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Rose Canyon	NA	Mission Bay Shoreline, at Leisure Lagoon	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Unknown Non-point Source
		Mission Bay Shoreline, at North Crown Point	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Public Input	Applicable Receiving Water Station(s)	Receiving Water Assessment				RHMP Monitoring Data	Receiving Water Conditions	
					NPDES Receiving Water		SMC Program				
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP		Receiving Water Conditions	Line(s) of Evidence
Rose Canyon	NA	Mission Bay Shoreline, at Leisure Lagoon	Same as above	MB-TWAS 1	Toxicity (C. dubia acute survival, C. dubia chronic survival, C. dubia reproduction, S. capricornutum acute), Poor IBI, O/E, CRAM, TDS	Toxicity (C. dubia reproduction, S. capricornutum growth, C. dubia chronic survival), Very Poor IBI ***Based on one sample***; TDS, DO and Enterococcus (Coastkeeper)	Chloride, Sulfate, Bifenthrin, Very Poor IBI, O/E, Total N, Total P, TDS ***Based on two stations****	NA	Impairment of REC-1 due to the Mission Bay Shoreline at Leisure Lagoon during dry weather.	303(d)	
											Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Leisure Lagoon during dry weather.
		Mission Bay Shoreline, at North Crown Point							Impairment of REC-1 due to the Mission Bay Shoreline at North Crown Point during dry weather.	303(d)	
									Impairment of SHELL due to total coliform of the Mission Bay Shoreline at North Crown Point during dry weather.	303(d)	

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Rose Canyon	NA	Mission Bay Shoreline, at Leisure Lagoon	Enterococcus, Fecal Coliform, Total N, Total P, TDS	Enterococcus, Fecal Coliform, Total N, Total P, TDS	NA
		Mission Bay Shoreline, at North Crown Point			

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Rose Canyon	NA	Mission Bay (Mouth of Rose Creek)	Eutrophic	Marine Habitat	Landfills, Nurseries, Point Source, Highway/Road/Bridge Runoff, Non-point Source, Urban Runoff/Storm Sewers
			Lead	Marine Habitat	Highway/Road/Bridge Runoff, Landfills, Urban Runoff/Storm Sewers, Non-point Source, Point Source
		Mission Bay Shoreline, at Visitors Center	<i>Enterococcus</i>	Water Contact Recreation	Unknown
			Fecal Coliform	Water Contact Recreation	Point Source/Non-point Source
			Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment					Receiving Water Conditions			
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data		
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Rose Canyon	NA	Mission Bay (Mouth of Rose Creek)	Same as above	MB-TWAS 1	Toxicity (C. dubia acute survival, C. dubia chronic survival, C. dubia reproduction, S. capricornutum acute), Poor IBI, O/E, CRAM, TDS	Toxicity (C. dubia reproduction, S. capricornutum growth, C. dubia chronic survival), Very Poor IBI ***Based on one sample***; TDS, DO and Enterococcus (Coastkeeper)	Chloride, Sulfate, Bifenthrin, Very Poor IBI, O/E, Total N, Total P, TDS ***Based on two stations****	NA	NA	Impairment of MAR due to potential eutrophic conditions in Mission Bay at the Mouth of Rose Creek during dry weather.	303(d)
										Impairment of MAR due to lead in Mission Bay at the Mouth of Rose Creek during dry weather.	303(d)
		Mission Bay Shoreline, at Visitors Center			Impairment of REC-1 due to Enterococcus and fecal coliform of the Mission Bay Shoreline at the Visitors Center during dry weather.					303(d)	
					Impairment of SHELL due to total coliform of the Mission Bay Shoreline at the Visitors Center during dry weather.					303(d)	

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Rose Canyon	NA	Mission Bay (Mouth of Rose Creek)	Enterococcus, Fecal Coliform, Total N, Total P, TDS	Enterococcus, Fecal Coliform, Total N, Total P, TDS	NA
		Mission Bay Shoreline, at Visitors Center			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Rose Canyon	NA	Rose Creek	NA	NA	NA
			Selenium	Warm Freshwater Habitat	Natural Sources
			Toxicity	Warm Freshwater Habitat	Urban Runoff/Storm Sewers
			Dry Weather Flows	ASBS	NA
Scripps	Bacteria TMDL & La Jolla Shores ASBS	ASBS 29 - La Jolla Shores ASBS			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Public Input	Applicable Receiving Water Station(s)	Receiving Water Assessment				Receiving Water Conditions		
					NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Rose Canyon	NA	Rose Creek	Same as above	MB-TWAS 1	Toxicity (C. dubia acute survival, C. dubia chronic survival, C. dubia reproduction, S. capricornutum acute), Poor IBI, O/E, CRAM, TDS	Toxicity (C. dubia reproduction, S. capricornutum growth, C. dubia chronic survival), Very Poor IBI ***Based on one sample***; TDS, DO and Enterococcus (Coastkeeper)	Chloride, Sulfate, Bifenthrin, Very Poor IBI, O/E, Total N, Total P, TDS ***Based on two stations****	NA	Very Poor IBI scores near NPDES monitoring locations in Rose Creek during dry weather.	RW monitoring data (historic & current)	
									Elevated TDS near NPDES monitoring locations in Rose Creek during dry weather.	RW monitoring data (historic & current)	
									Impairment of WARM due to selenium in Rose Creek during dry weather.	303(d) and RW monitoring data (historic & current)	
									Impairment of WARM due to toxicity in Rose Creek during dry weather.	303(d) and RW monitoring data (historic & current)	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	ASBS 29 - La Jolla Shores ASBS	Same as above	NA	NA	NA	NA	NA	No dry weather runoff into ASBS 29.	2012 Ocean Plan Special Exceptions for ASBS	

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Rose Canyon	NA	Rose Creek	<i>Enterococcus</i> , Fecal Coliform, Total N, Total P, TDS	<i>Enterococcus</i> , Fecal Coliform, Total N, Total P, TDS	NA
Scripps	Bacteria TMDL & La Jolla Shores ASBS	ASBS 29 - La Jolla Shores ASBS	The City of San Diego has installed low flow diversions throughout the watershed draining to ASBS 29. No MS4 data is available since dry weather flow has been eliminated.		

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Mission Bay Shoreline, at Bahia Point	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Unknown
		Mission Bay Shoreline, at Bonita Cove	<i>Enterococcus</i>	Water Contact Recreation	Unknown
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Unknown

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment						Receiving Water Conditions		
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Mission Bay Shoreline, at Bahia Point	Same as above	NA	NA	NA	NA	NA	Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Mission Bay Shoreline at Bahia Point during dry weather.	303(d)	
									Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Bahia Point during dry weather.		303(d)
		Mission Bay Shoreline, at Bonita Cove							Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Mission Bay Shoreline at Bonita Cove during dry weather.	303(d)	
									Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Bonita Cove during dry weather.		303(d)

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Mission Bay Shoreline, at Bahia Point	NA	NA	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9-2013-0001; Attachment E.6)
		Mission Bay Shoreline, at Bonita Cove			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Mission Bay Shoreline, at Fanuel Park	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Source Unknown
			<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers
		Pacific Ocean Shoreline, Avenida de La Playa	Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers
			Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment						Receiving Water Conditions		
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Mission Bay Shoreline, at Fanuel Park	Same as above	NA		NA	NA	NA	NA	Impairment of REC-1 due to <i>Enterococcus</i> of the Mission Bay Shoreline at Fanuel Park during dry weather.	303(d)
										Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Fanuel Park during dry weather.	303(d)
		Pacific Ocean Shoreline, Avenida de La Playa								Impairment of REC-1 due to <i>Enterococcus</i> , fecal and total coliform of the Pacific Ocean Shoreline at Avenida de La Playa during dry weather.	Bacteria TMDL
										Impairment of SHELL due to total coliform of the Pacific Ocean Shoreline at Avenida de La Playa during dry weather.	303(d)

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Mission Bay Shoreline, at Fanuel Park	NA	NA	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9-2013-0001; Attachment E.6)
		Pacific Ocean Shoreline, Avenida de La Playa			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Children's Pool	<i>Enterococcus</i>	Water Contact Recreation	Natural Sources/Other Urban Runoff
			Fecal Coliform	Water Contact Recreation	Natural Sources/Unknown
			Total Coliform	Water Contact Recreation	Natural Sources/Other Urban Runoff/Unknown
			Total Coliform	Shellfish Harvesting	Natural Sources/Other Urban Runoff/Unknown
		Pacific Ocean Shoreline, La Jolla Cove	Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers and Other Unknown Source
			Total Coliform		

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment						Receiving Water Conditions		
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Children's Pool	Same as above	NA	NA	NA	NA	NA	Impairment of REC-1 due to <i>Enterococcus</i> and total and fecal coliform of the Pacific Ocean Shoreline at Children's Pool during dry weather.	303(d) and Bacteria TMDL	
		Pacific Ocean Shoreline, La Jolla Cove							Impairment of SHELL due to total coliform of the Pacific Ocean at Children's Pool during dry weather.	303(d)	

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Children's Pool	NA	Total N, Total P, Fecal Coliform, <i>Enterococcus</i> (2012 Annual Monitoring Report Targeted Dry Weather Program)	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9-2013-0001; Attachment E.6)
		Pacific Ocean Shoreline, La Jolla Cove			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Pacific Beach Point	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
			Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers and Other Unknown Source
		Pacific Ocean Shoreline, Ravina	Total Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
		Pacific Ocean Shoreline, Vallecitos Court	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
			Fecal Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment						Receiving Water Conditions		
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Pacific Beach Point	Same as above	NA	NA	NA	NA	NA	Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Pacific Ocean Shoreline at Pacific Beach Point during dry weather.	303(d)	
		Pacific Ocean Shoreline, Ravina							Impairment of SHELL due to total coliform of the Pacific Ocean at Pacific Beach Point during dry weather.	303(d)	
									Impairment of REC-1 due to total coliform of the Pacific Ocean at Ravina during dry weather.	303(d) and Bacteria TMDL	
		Pacific Ocean Shoreline, Vallecitos Court							Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform of the Pacific Ocean at Vallecitos Court during dry weather.	Bacteria TMDL	

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Pacific Beach Point	NA	Total N, Total P, Fecal Coliform, <i>Enterococcus</i> (2012 Annual Monitoring Report Targeted Dry Weather Program)	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9-2013-0001; Attachment E.6)
		Pacific Ocean Shoreline, Ravina			
		Pacific Ocean Shoreline, Vallecitos Court			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Vallecitos Court	Total Coliform	Water Contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
			Total Coliform	Shellfish Harvesting	Urban Runoff/Storm Sewers and Other Unknown Source
		Pacific Ocean Shoreline, La Jolla Shores Beach at el Paseo Grande	NA	NA	NA
		Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment						Receiving Water Conditions		
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Vallecitos Court	Same as above	NA	NA	NA	NA	NA	Impairment of REC-1 due to total coliform of the Pacific Ocean at Vallecitos Court during dry weather.	Bacteria TMDL	
		Pacific Ocean Shoreline, La Jolla Shores Beach at el Paseo Grande								Impairment of REC-1 due to <i>Enterococcus</i> , and total and fecal coliform during dry weather	Bacteria TMDL
		Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro									

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Vallecitos Court	NA	Total N, Total P, Fecal Coliform, <i>Enterococcus</i> (2012 Annual Monitoring Report Targeted Dry Weather Program)	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9-2013-0001; Attachment E.6)
		Pacific Ocean Shoreline, La Jolla Shores Beach at el Paseo Grande		NA	NA
		Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro		NA	NA

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, South Casa Beach at Coast Blvd.	NA	NA	NA
		Pacific Ocean Shoreline, Windansea Beach at Vista de la Playa			
		Pacific Ocean Shoreline, Windansea Beach at Bonair Street			
		Pacific Ocean Shoreline, Windansea Beach at Playa del Norte			
		Pacific Ocean Shoreline, Windansea Beach at Palomar Ave.			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment						Receiving Water Conditions			
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence	
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP				
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, South Casa Beach at Coast Blvd.	Same as above	NA	NA	NA	NA	NA	Impairment of REC-1 due to <i>Enterococcus</i> , and total and fecal coliform during dry weather	Bacteria TMDL		
		Pacific Ocean Shoreline, Windansea Beach at Vista de la Playa									Impairment of REC-1 due to <i>Enterococcus</i> , and total and fecal coliform during dry weather	Bacteria TMDL
		Pacific Ocean Shoreline, Windansea Beach at Bonair Street								Impairment of REC-1 due to <i>Enterococcus</i> , and total and fecal coliform during dry weather		
		Pacific Ocean Shoreline, Windansea Beach at Playa del Norte										Impairment of REC-1 due to <i>Enterococcus</i> , and total and fecal coliform during dry weather
		Pacific Ocean Shoreline, Windansea Beach at Palomar Ave.								Impairment of REC-1 due to <i>Enterococcus</i> , and total and fecal coliform during dry weather		

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	
			2005-2010 LTEA	FY 11 & 12 WURMP	WQBELs
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, South Casa Beach at Coast Blvd.			
		Pacific Ocean Shoreline, Windansea Beach at Vista de la Playa			
		Pacific Ocean Shoreline, Windansea Beach at Bonair Street	NA	NA	NA
		Pacific Ocean Shoreline, Windansea Beach at Playa del Norte			
		Pacific Ocean Shoreline, Windansea Beach at Palomar Ave.			

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Pacific Beach at Grand Ave.	NA	NA	NA
Tecolote Creek	Bacteria TMDL	Tecolote Creek	<i>Enterococcus</i>	Water Contact Recreation	Point Source/Non-point Source
			Total Coliform		
			Fecal Coliform		
			Cadmium	Warm Freshwater Habitat	Point Source/Non-point Source
			Copper		
			Lead		
			Zinc	Non-contact Recreation	Unknown
			Phosphorus		

Receiving Water Assessment												Receiving Water Conditions	
WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence		
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP					
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Pacific Beach at Grand Ave.	Same as above	NA	NA	NA	NA	NA	NA	Impairment of REC-1 due to <i>Enterococcus</i> , and total and fecal coliform during dry weather	Bacteria TMDL		
Tecolote Creek	Bacteria TMDL	Tecolote Creek	Same as above	TC-MLS, MB-TWAS-2	Selenium, Toxicity (<i>S. capricornutum</i> acute, <i>C. dubia</i> reproduction and chronic survival, <i>C. dubia</i> acute survival), Poor IBI, O/E, CRAM, Total P, Benthic Algae, <i>Enterococcus</i> , Fecal Coliform	Toxicity (<i>C. dubia</i> chronic survival and reproduction), Very Poor IBI, CRAM, Total N ***Based on one station at TWAS, and on one sample in TC-MLS****	Toxicity (<i>C. dubia</i> reproduction, <i>S. capricornutum</i> growth, <i>C. dubia</i> reproduction), Very Poor IBI, <i>Enterococcus</i>	Toxicity (<i>C. dubia</i> reproduction), Very Poor IBI, Total P	NA	Impairment of REC-1 due to <i>Enterococcus</i> , total coliform, and fecal coliform in Tecolote Creek during dry weather.	303(d), Bacteria TMDL, and RW monitoring data (historic & current)		
										Impairment of WARM due to cadmium, copper, lead, and zinc in Tecolote Creek during dry weather.	303(d)		
										Impairment of REC-2 due to potential eutrophic conditions (phosphorus) in Tecolote Creek during dry weather.	303(d) (Phosphorus) and RW monitoring data (current)		

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Scripps	Bacteria TMDL & La Jolla Shores ASBS	Pacific Ocean Shoreline, Pacific Beach at Grand Ave.	NA	NA	NA
Tecolote Creek	Bacteria TMDL	Tecolote Creek	pH, <i>Enterococcus</i> , Fecal Coliform, Total N, Total P	<i>Enterococcus</i> , Fecal Coliform, Total N, Total P	<i>Enterococcus</i> , Fecal Coliform (Order No. R9-2013-0001; Attachment E.6)

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Tecolote Creek	Bacteria TMDL	Tecolote Creek	Toxicity	Warm Freshwater Habitat	Point Source/Non-point Source
			Turbidity	Non-contact Recreation	Urban Runoff/Storm Sewers and Other Unknown Source
			NA	NA	NA
		Mission Bay (Mouth of Tecolote Creek)	Eutrophic	Estuarine Habitat	Point Source/Non-point Source

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment					Receiving Water Conditions			
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Tecolote Creek	Bacteria TMDL	Tecolote Creek	Same as above	TC-MLS, MB-TWAS-2	Selenium, Toxicity (S. capricornutum acute, C. dubia reproduction and chronic survival, C. dubia acute survival), Poor IBI, O/E, CRAM, Total P, Benthic Algae, Enterococcus, Fecal Coliform	Toxicity (C. dubia reproduction, S. capricornutum growth, C. dubia reproduction), Very Poor IBI, Enterococcus	Toxicity (C. dubia chronic survival and reproduction), Very Poor IBI, CRAM, Total N ***Based on one station at TWAS, and on one sample in TC-MLS****	Toxicity (C. dubia reproduction), Very Poor IBI, Total P	NA	Impairment of WARM due to toxicity in Tecolote Creek during dry weather.	303(d) and RW monitoring data (historic & current)
										Impairment of REC-2 due to turbidity in Tecolote Creek during dry weather.	303(d) and RW monitoring data (historic & current)
										Very poor IBI scores near NPDES monitoring locations in Tecolote creek during dry weather.	RW monitoring data (historic & current)
		Mission Bay (Mouth of Tecolote Creek)								Impairment of EST due to eutrophic conditions in Mission Bay at the Mouth of Tecolote Creek during dry weather.	303(d)

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Tecolote Creek	Bacteria TMDL	Tecolote Creek	pH, <i>Enterococcus</i> , Fecal Coliform, Total N, Total P	<i>Enterococcus</i> , Fecal Coliform, Total N, Total P	<i>Enterococcus</i> , Fecal Coliform (Order No. R9-2013-0001; Attachment E.6)
		Mission Bay (Mouth of Tecolote Creek)	pH, <i>Enterococcus</i> , Fecal Coliform, Total N, Total P	<i>Enterococcus</i> , Fecal Coliform, Total N, Total P	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9-2013-0001; Attachment E.6)

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	303(d) Listings		
			Pollutant(s)	Impaired Beneficial Use(s)	Potential Source(s)
Tecolote Creek	Bacteria TMDL	Mission Bay (Mouth of Tecolote Creek)	Lead	Industrial Service Supply	Point Source/Non-point Source
		Mission Bay Shoreline, at Tecolote Shores	<i>Enterococcus</i>	Water Contact Recreation	Urban Runoff and Other Unknown Source
			Total Coliform	Shellfish Harvesting	Unknown

WQIP Subwatershed	TMDL/ ASBS	303(d) Listed Waterbody	Receiving Water Assessment					Receiving Water Conditions			
			Public Input	Applicable Receiving Water Station(s)	NPDES Receiving Water		SMC Program		RHMP Monitoring Data	Receiving Water Conditions	Line(s) of Evidence
					2005-2010 LTEA	FY 11 & 12 WURMP	2005-2010 LTEA	FY 11 & 12 WURMP			
Tecolote Creek	Bacteria TMDL	Mission Bay (Mouth of Tecolote Creek)	Same as above	TC-MLS, MB-TWAS-2	Selenium, Toxicity (<i>S. capricornutum</i> acute, <i>C. dubia</i> reproduction and chronic survival, <i>C. dubia</i> acute survival), Poor IBI, O/E, CRAM, Total P, Benthic Algae, Enterococcus, Fecal Coliform	Toxicity (<i>C. dubia</i> chronic survival and reproduction), Very Poor IBI, CRAM, Total N ***Based on one station at TWAS, and on one sample in TC-MLS****	Toxicity(<i>C. dubia</i> reproduction), Very Poor IBI, Total P	NA	Impairment of IND due to lead in Mission Bay at the mouth of Tecolote Creek during dry weather.	303(d)	
		Impairment of REC-1 due to <i>Enterococcus</i> of the Mission Bay Shoreline at Tecolote Shores during dry weather.							303(d)		
		Impairment of SHELL due to total coliform of the Mission Bay Shoreline at Tecolote Shores during dry weather.									

WQIP Subwatershed	TMDL/ASBS	303(d) Listed Waterbody	Urban Runoff Monitoring Assessment		
			MS4 Outfall and Dry Weather Monitoring Program	TMDL	WQBELs
			2005-2010 LTEA	FY 11 & 12 WURMP	
Tecolote Creek	Bacteria TMDL	Mission Bay (Mouth of Tecolote Creek)	pH, <i>Enterococcus</i> , Fecal Coliform, Total N, Total P	<i>Enterococcus</i> , Fecal Coliform, Total N, Total P	<i>Enterococcus</i> , Fecal Coliform, Total Coliform (Order No. R9-2013-0001; Attachment E.6)
		Mission Bay Shoreline, at Tecolote Shores			

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APPENDIX F

Receiving Water Conditions, Potential Impacts of MS4 Discharges, and Priority Water Quality Conditions in the Mission Bay WMA

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This appendix contains details of the analysis of receiving water conditions (Section 2.1), impacts from MS4 discharges (Section 2.2), and the factors that were evaluated to develop the final list of priority water quality conditions and high priority water quality conditions. The information is presented in three tables, which are described below.

It should be noted that the Mission Bay subwatershed does not have any priority water quality conditions because the receiving water conditions did not have evidence of MS4 impacts.

Table F-1: Receiving Water Conditions and Potential Impacts of MS4 Discharges in the Mission Bay WMA

Table F-1 presents all identified receiving water conditions in the Mission Bay WMA and the potential impacts of the MS4 discharges. These conditions were identified as described in Sections 2.1 and 2.2 based on the considerations detailed in the table. These include:

- Available receiving water data (current or historic) or regulatory drivers that support the condition. A check mark in the table indicates that samples have exceeded water quality objectives or the 2010 303(d) list or a TMDL identifies the waterbody as impaired. Where possible, the data were divided by temporal extent (wet- or dry-weather).
- Available current or historic MS4 monitoring data indicating that the MS4 potentially causes or contributes to the condition. A check mark indicates that samples collected from the MS4 during wet- or dry-weather have exceeded water quality objectives. MS4 data from the subwatershed was typically used for this consideration; data for MS4 discharges directly to the receiving water body in question are rarely available.
- Identification of the MS4 as a source of the condition in the 2010 303(d) list or a TMDL.
- The factors that led to the determination that the condition exists and was therefore included in the table.

Table F-2: Priority Water Quality Conditions in the Mission Bay WMA Subwatersheds

Table F-2 presents the following information for each priority water quality condition per the MS4 Permit (Provision B.2.b):

- The beneficial use impairment(s) associated with the priority water quality condition;
- The pollutant or stressor causing the beneficial use impairment, if known;
- The temporal extent of the priority water quality condition (dry and/or wet weather);

- The geographical extent of the priority water quality condition within the WMA, if known (based on the extent of the associated 303(d) listing or the location of the associated NPDES monitoring location);
- Lines of evidence leading to identification as a priority water quality condition, including evidence of MS4 discharges that may cause or contribute to the condition; and
- An assessment of the adequacy of the monitoring data to characterize the factors causing or contributing to the priority water quality condition, including consideration of spatial and temporal variation.

The table also lists the Responsible Agencies that potentially contribute to the condition. The contents of this table were determined by the assessment of the receiving water conditions and the MS4 impacts (presented in Table F-1).

Table F-3: Evaluation of Priority Water Quality Conditions in the Mission Bay WMA

As described in Section 2.3, priority water quality conditions that were identified based on the methodology presented in Appendix A. The remaining priority water quality conditions were evaluated based on several factors to determine if they warranted elevation to high priority water quality conditions for this iteration of the Water Quality Improvement Plan. Table F-3 summarizes this evaluation. The priority water quality condition must meet all of the following criteria to be considered a high priority water quality condition:

- Supporting data are sufficient to characterize the receiving water condition. To be sufficient, multiple samples collected under quality controlled monitoring must have exceeded water quality objectives.
- Storm water or non-stormwater runoff is a predominant source. Samples or observations collected under quality controlled monitoring programs must indicate that MS4 discharges are a predominant source of the receiving water condition.
- Controllable by Responsible Agencies. The pollutant or stressor must be within the authority of the Responsible Agency to control. To be considered controllable, there must be a clear link between the MS4 contribution and the receiving water condition, and the potential strategies to address the condition must be applicable to the geographic extent of the condition.
- Cannot be addressed by strategies identified for other high priority water quality conditions. The condition was not elevated to a high priority water quality condition if strategies identified for other high priority water quality conditions are expected to address the condition

Table F-1
Receiving Water Conditions and Potential Impacts of MS4 Discharges in the Mission Bay WMA

Subwatershed	Waterbody	Condition	Receiving Water Data or Regulatory Drivers Support Consideration as a Receiving Water Condition		Determining Factor(s) For Receiving Water Data	MS4 Monitoring Data Indicates Potential MS4 Impact ¹		MS4 Listed As Source on 303(d) or TMDL	Elevated to Priority Water Quality Condition?
			Wet	Dry		Wet	Dry		
Rose Canyon	Mission Bay Shoreline, at Campland	Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	Wet, Dry	Yes
	Mission Bay Shoreline, at De Anza Cove	Impairment of REC-1 due to <i>Enterococcus</i>	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Impairment of REC-1 due fecal coliform	✓	✓	2010 303(d)	–	–	Wet, Dry	Yes
	Mission Bay Shoreline, at Leisure Lagoon	Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Impairment of REC-1 due to <i>Enterococcus</i>	✓	✓	2010 303(d) and public input	–	✓	Wet, Dry	Yes
	Mission Bay Shoreline, at North Crown Point	Impairment SHELL due to total coliform	✓	✓	2010 303(d) and public input	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Impairment of REC-1 due to <i>Enterococcus</i>	✓	✓	2010 303(d) and public input	✓	✓ ²	Wet, Dry	Yes
	Mission Bay (Mouth of Rose Creek)	Impairment of MAR due to potential eutrophic ³ conditions (no pollutant specified)	– ³	✓	2010 303(d) and public input	–	–	Wet, Dry	Yes
		Impairment of MAR due to lead	✓	✓	2010 303(d) and public input	–	–	Wet, Dry	Yes
	Mission Bay Shoreline, at Visitor's Center	Impairment of REC-1 due to fecal coliform	✓	✓	2010 303(d) and public input	✓	✓ ²	–	Yes
		Impairment of REC-1 due to <i>Enterococcus</i>	✓	✓	2010 303(d) and public input	–	✓ ²	–	Yes
	Mission Bay Shoreline, at Visitor's Center	Impairment of SHELL due to total coliform	✓	✓	2010 303(d) and public input	–	–	Wet, Dry	Yes
		Impairment of WARM due to toxicity	✓	✓	2010 303(d) and public input	–	–	Wet, Dry	Yes
	Rose Creek	Impairment of WARM due to selenium	✓	✓	2010 303(d) and public input	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Very poor IBI scores near NPDES monitoring locations in Rose Creek	–	✓	Current and historical receiving water monitoring data	–	–	–	No; Very poor IBI scores cannot be identified as a priority water quality condition because the full impact of all environmental contributions including the MS4 have not been characterized.
Continued on next page	Rose Creek	Elevated TDS near NPDES monitoring locations in Rose Creek	✓	✓	Current and historical receiving water monitoring data	–	✓	–	Yes
		Elevated turbidity near NPDES monitoring locations in Rose Creek	✓	–	Current and historical receiving water monitoring data, public input	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Elevated TSS near NPDES monitoring locations in Rose Creek	✓	–	Current and historical receiving water monitoring data, public input	✓	–	–	Yes

Subwatershed	Waterbody	Condition	Receiving Water Data or Regulatory Drivers Support Consideration as a Receiving Water Condition		Determining Factor(s) For Receiving Water Data	MS4 Monitoring Data Indicates Potential MS4 Impact ¹		MS4 Listed As Source on 303(d) or TMDL	Elevated to Priority Water Quality Condition?
			Wet	Dry		Wet	Dry		
Rose Canyon	Rose Creek	Elevated bifenthrin and permethrin levels near NPDES monitoring locations in Rose Creek	✓	–	Current and historical receiving water monitoring data	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
Tecolote Creek	Tecolote Creek	Impairment of REC-1 due to indicator bacteria (total coliform, <i>Enterococcus</i> , and fecal coliform)	✓	✓	2010 303(d) Bacteria TMDL, current and historical receiving water monitoring data, and public input	✓	✓	Wet, Dry	Yes
Tecolote Creek	Tecolote Creek	Impairment of WARM due to cadmium, copper, lead, and zinc	✓	✓	2010 303(d) and public input	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Impairment of REC-2 due to potential eutrophic conditions ³ (phosphorus)	– ³	✓	2010 303(d) and current and historical receiving water monitoring data, public input	–	✓	–	Yes
		Impairment of WARM due to toxicity	✓	✓	2010 303(d) current and historical receiving water monitoring data, public input	–	–	–	No; Toxicity cannot be identified as a priority water quality condition because the full impact of all environmental contributions including the MS4 have not been characterized.
		Impairment of REC-2 due to turbidity	✓	✓	2010 303(d) and current and historical receiving water monitoring data	–	–	Wet, Dry	Yes
		Very poor IBI scores near NPDES monitoring locations	–	✓	Current and historical receiving water monitoring data	–	–	–	No; Very poor IBI scores cannot be identified as a priority water quality condition because the full impact of all environmental contributions including the MS4 have not been characterized.
Mission Bay	Mission Bay (Mouth of Tecolote Creek)	Elevated bifenthrin and permethrin levels near NPDES monitoring locations in Tecolote Creek	✓	–	Current and historical receiving water monitoring data	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Impairment of EST from eutrophic conditions ³ (no pollutant specified)	– ³	✓	2010 303(d)	–	–	–	No; No MS4 data, and based on best professional judgment MS4 impacts on eutrophic conditions are not quantifiable.
		Impairment of IND from lead	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
Mission Bay	Mission Bay Shoreline, at Tecolote Shores	Impairment of REC-1 due to <i>Enterococcus</i>	✓	✓	2010 303(d)	✓	✓ ³	Wet, Dry	Yes
		Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Impairment of MAR and EST due to copper	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
Mission Bay	Quivira Basin Mission Bay (Freshwater Influenced Areas)	Elevated total arsenic, total copper, total zinc, and total DDTs in sediments	–	✓	Historical RHMP monitoring data	–	–	–	No; no MS4 data to justify designation as priority water quality condition.

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Subwatershed	Waterbody	Condition	Receiving Water Data or Regulatory Drivers Support Consideration as a Receiving Water Condition		Determining Factor(s) For Receiving Water Data	MS4 Monitoring Data Indicates Potential MS4 Impact ¹		MS4 Listed As Source on 303(d) or TMDL	Elevated to Priority Water Quality Condition?
			Wet	Dry		Wet	Dry		
Mission Bay	Mission Bay (Marinas)	Elevated dissolved copper in surface waters	–	✓	Historical RHMP monitoring data	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Elevated total arsenic, total mercury, total zinc, and total DDTs in sediments	–	✓	Historical RHMP monitoring data	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Elevated total copper in surface waters and sediments	–	✓	Historical RHMP monitoring data	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
	Mission Bay (Shallow Areas)	Elevated total arsenic, total zinc, total DDTs, and total chlordanes in sediments	–	✓	Historical RHMP monitoring data	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Elevated total copper in surface waters and sediments	–	✓	Historical RHMP monitoring data	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
Scripps	La Jolla Shores/ ASBS 29	No dry weather runoff into La Jolla Shores ASBS 29	–	✓	Scripps Phase II CLRP Table 2-8	–	– ⁴	–	No; no MS4 data to justify designation as priority water quality condition.
		Reduction of fecal coliform loads to those specified in the Scripps CLRP	✓	–	Scripps Phase II CLRP Table 2-8	✓	–	–	Yes
		Reduction of total coliform loads to those specified in the Scripps CLRP	✓	–	Scripps Phase II CLRP Table 2-8	✓	–	–	Yes
		Reduction of copper loads to those specified in the Scripps CLRP	✓	–	Scripps Phase II CLRP Table 2-8	✓	–	–	Yes
		Reduction of sediment loads to those specified in the Scripps CLRP	✓	–	Scripps Phase II CLRP Table 2-8	✓	–	–	Yes
	Mission Bay Shoreline, at Bahia Point	Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform	✓	✓	2010 303(d)	–	–	Wet, Dry ²	Yes
		Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
	Mission Bay Shoreline, at Bonita Cove	Impairment of REC-1 due to <i>Enterococcus</i>	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
		Impairment of REC-1 due to fecal coliform	✓	✓	2010 303(d)	–	–	Wet, Dry	Yes
		Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
	Mission Bay Shoreline, at Fanuel Park	Impairment of REC-1 due to <i>Enterococcus</i>	✓	✓	2010 303(d)	–	–	Wet, Dry	Yes
		Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	–	No; no MS4 data to justify designation as priority water quality condition.
	Pacific Ocean Shoreline, Casa Beach (Children's Pool)	Impairment of REC-1 due to <i>Enterococcus</i>	✓	✓	2010 303(d) and Bacteria TMDL ⁵	–	✓ ²	Wet, Dry ²	Yes
		Impairment of REC-1 due to fecal coliform	✓	✓	2010 303(d) and Bacteria TMDL ⁵	–	✓ ²	–	Yes
		Impairment of REC-1 due to total coliform	✓	✓	Bacteria TMDL ⁵	–	–	Wet, Dry ²	Yes
		Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	Wet, Dry ²	Yes

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Subwatershed	Waterbody	Condition	Receiving Water Data or Regulatory Drivers Support Consideration as a Receiving Water Condition		Determining Factor(s) For Receiving Water Data	MS4 Monitoring Data Indicates Potential MS4 Impact ¹		MS4 Listed As Source on 303(d) or TMDL	Elevated to Priority Water Quality Condition?
			Wet	Dry		Wet	Dry		
Scripps	Pacific Ocean Shoreline, La Jolla Cove	Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	Wet, Dry	Yes
	Pacific Ocean Shoreline, La Jolla Shores Beach at Avenida de la Playa ⁶	Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform	✓	✓	Bacteria TMDL ⁵	–	–	Wet, Dry	Yes
		Impairment of REC-1 due to total coliform	✓	✓	Bacteria TMDL ⁵	–	–	Wet, Dry	Yes
	Pacific Ocean Shoreline, La Jolla Shores Beach at Avenida de la Playa ⁶	Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	Wet, Dry	Yes
	Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform	✓	✓	Bacteria TMDL ^{5,8}	–	–	– ⁷	Yes
	Pacific Ocean Shoreline, La Jolla Shores Beach at El Paseo Grande	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform	✓	✓	Bacteria TMDL ^{5,8}	–	–	– ⁷	Yes
	Pacific Ocean Shoreline, Pacific Beach at Grand Ave	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform	✓	✓	Bacteria TMDL ^{5,8}	–	–	– ⁷	Yes
	Pacific Ocean Shoreline, Pacific Beach at Pacific Beach Point	Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform	✓	✓	2010 303(d)	–	✓	Wet, Dry	Yes
		Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	Wet, Dry	Yes
	Pacific Ocean Shoreline, South Casa Beach at Coast Boulevard	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform	✓	✓	Bacteria TMDL ^{5,8}	–	–	– ⁷	Yes
	Pacific Ocean Shoreline, Tourmaline Surf Park	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform	✓	✓	Bacteria TMDL ^{5,8}	–	–	– ⁷	Yes
	Pacific Ocean Shoreline, Vallecitos Court	Impairment of SHELL due to total coliform	✓	✓	2010 303(d)	–	–	Wet, Dry ^{2,9}	Yes
		Impairment of REC-1 due to total coliform, <i>Enterococcus</i> and fecal coliform	✓	✓	Bacteria TMDL ⁵	–	–	Wet, Dry	Yes
	Pacific Ocean Shoreline, Windansea Beach at Bonair Street	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform	✓	✓	Bacteria TMDL ^{5,8}	–	–	– ⁷	Yes

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Subwatershed	Waterbody	Condition	Receiving Water Data or Regulatory Drivers Support Consideration as a Receiving Water Condition		Determining Factor(s) For Receiving Water Data	MS4 Monitoring Data Indicates Potential MS4 Impact ¹		MS4 Listed As Source on 303(d) or TMDL	Elevated to Priority Water Quality Condition?
			Wet	Dry		Wet	Dry		
Scripps	Pacific Ocean Shoreline, Windansea Beach at Palomar Avenue	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform	✓	✓	Bacteria TMDL ^{5,6}	–	–	– ⁷	Yes
	Pacific Ocean Shoreline, Windansea Beach at Playa del Norte	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform	✓	✓	Bacteria TMDL ^{5,6}	–	–	– ⁷	Yes
	Pacific Ocean Shoreline, Windansea Beach at Vista de la Playa	Impairment of REC-1 due to total coliform, <i>Enterococcus</i> , and fecal coliform	✓	✓	Bacteria TMDL ^{5,6}	–	–	– ⁷	Yes
	Pacific Ocean Shoreline at Whispering Sands Beach at Ravina Street ⁶	Impairment of REC-1 due to total coliform	✓	✓	2010 303(d) and Bacteria TMDL ⁵	–	–	Wet, Dry	Yes
		Impairment of REC-1 due to <i>Enterococcus</i> and fecal coliform	✓	✓	Bacteria TMDL ⁵	–	–	Wet, Dry	Yes

1. Monitoring results show that the water quality standard exceedances were exceeded in the MS4 monitoring data

2. Dry weather diversions have been installed upstream.

3. Only listed as a dry weather condition based on best professional judgement that wet weather impacts are not quantifiable

4. The City of San Diego has installed low-flow diversions throughout the watershed draining to ASBS 29. No MS4 data are available since dry weather flow has been eliminated.

5. Although, these segments were originally 303(d) listed as impaired by total coliform, the TMDL applied numeric targets for three indicator bacteria (total coliform, *Enterococcus*, and fecal coliform).

6. These Bacteria TMDL shoreline segments are located within the ASBS 29 sub-drainage area.

7. These segments were delisted from the 2010 303(d) list because monitoring data showed that the segments did not exceed water quality standards.

8. Segment not currently listed on the 2010 CWA 303(d) List but is listed in the Bacteria TMDL.

9. Only the REC-1 beneficial use is impaired by the MS4 per the bacteria TMDL.

✓ = Criteria are met, – = Criteria are not met

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Table F-2
Priority Water Quality Conditions in the Mission Bay WMA Subwatersheds

Priority Water Quality Condition (1)	Potential Stressor(s) (2)	Temporal Extent (3)	Geographical Extent (4)	Determining Factors (5)	Data Gaps (6)		Potentially Responsible Agencies	
					RW ¹	MS4 ²	CT	SD
Rose Canyon Subwatershed								
Impairment of SHELL of Mission Bay Shoreline at Campland	Total coliform	Wet, Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	–	✓
Impairment of REC-1 of Mission Bay Shoreline at De Anza	Fecal coliform	Wet ³	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	–	✓
Impairment of REC-1 at Mission Bay Shoreline at Leisure Lagoon	Enterococcus	Wet, Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources; current and historical dry weather receiving water monitoring data located upstream in Rose Creek; current and historical subwatershed level outfall monitoring data	Y	Y	–	✓
Impairment of REC-1 at Mission Bay Shoreline at North Crown Point	Enterococcus	Wet ³	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources; current and historical dry weather receiving water monitoring data located upstream in Rose Creek; historical subwatershed level outfall data for wet weather	Y	Y	–	✓

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Priority Water Quality Condition (1)	Potential Stressor(s) (2)	Temporal Extent (3)	Geographical Extent (4)	Determining Factors (5)	Data Gaps (6)		Potentially Responsible Agencies	
					RW ¹	MS4 ²	CT	SD
Rose Canyon Subwatershed								
Impairment of SHELL at Mission Bay Shoreline at North Crown Point	Total coliform	Wet ³	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources; current and historical dry weather receiving water monitoring data located upstream in Rose Creek; historical subwatershed level outfall data for wet weather	Y	Y	-	✓
Impairment of MAR of Mission Bay at Mouth of Rose Creek	Potential eutrophic conditions (no pollutant specified)	Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources; current and historical dry weather subwatershed level outfall monitoring data	Y	Y	-	✓
Impairment of MAR of Mission Bay at Mouth of Rose Creek	Lead	Wet, Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	✓	✓
Impairment of REC-1 of Mission Bay Shoreline at Visitor's Center	Enterococcus	Wet ³	2010 303(d) listed segment	Historical wet weather subwatershed level outfall data	Y	Y	-	✓
	Fecal coliform			Historical wet weather subwatershed level outfall data; current and historical dry weather subwatershed level outfall monitoring				
Impairment of SHELL of Mission Bay Shoreline at Visitor's Center	T total coliform	Wet ³	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	-	✓

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Priority Water Quality Condition (1)	Potential Stressor(s) (2)	Temporal Extent (3)	Geographical Extent (4)	Determining Factors (5)	Data Gaps (6)		Potentially Responsible Agencies	
					RW ¹	MS4 ²	CT	SD
Rose Canyon Subwatershed								
Impairment of WARM in Rose Creek	Toxicity	Wet, Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	✓	✓
	TDS	Dry	Rose Creek near NPDES monitoring location	Current and historical receiving water monitoring data; current and historical subwatershed level outfall monitoring data	N	Y	–	✓
	TSS	Wet		Current and historical receiving water monitoring data; subwatershed level historical outfall monitoring data	N	Y	✓	✓
Tecolote Creek Subwatershed								
Impairment of REC-1 of Tecolote Creek	Indicator bacteria (total coliform, Enterococcus, and fecal coliform)	Wet, Dry	2010 303(d) listed segment	Bacteria TMDL; current and historical receiving water; subwatershed level current and historical outfall monitoring data	N	N	–	✓
Impairment of REC-2 of Tecolote Creek	Potential eutrophic conditions (Phosphorous)	Dry	2010 303(d) listed segment	Current and historical receiving water monitoring data; subwatershed level current and historical outfall monitoring data	N	Y	–	✓
	Turbidity	Wet, Dry		Current and historical receiving water monitoring data; Urban runoff/storm sewers 2010 303(d) listed as sources	N	Y	–	✓

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Priority Water Quality Condition (1)	Potential Stressor(s) (2)	Temporal Extent (3)	Geographical Extent (4)	Determining Factors (5)	Data Gaps (6)		Potentially Responsible Agencies	
Tecolote Creek Subwatershed								
Impairment of REC-1 of Mission Bay Shoreline at Tecolote Shores	Enterococcus	Wet ³	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	–	✓
Scripps Subwatershed								
Impairment of Area of Special Biological Significance (ASBS)	Fecal coliform	Wet	La Jolla Shores ASBS, MS4-A SBS 29	Scripps Phase II CLRP Table 2-8	N	N	–	✓
	Total coliform							
	Copper							
	Sediment							
Impairment of REC-1 of Mission Bay Shoreline at Bahia Point	Enterococcus	Wet ³	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources.	Y	Y	–	✓
	Fecal coliform							
Impairment of REC-1 of Mission Bay Shoreline at Bonita Cove	Fecal coliform	Wet, Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources.	Y	Y	–	✓
Impairment of REC-1 of Mission Bay Shoreline at Fanuel Park	Enterococcus	Wet, Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	–	✓

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Priority Water Quality Condition (1)	Potential Stressor(s) (2)	Temporal Extent (3)	Geographical Extent (4)	Determining Factors (5)	Data Gaps (6)		Potentially Responsible Agencies	
<i>Scripps Subwatershed</i>								
Impairment of REC-1 of Pacific Ocean Shoreline, Casa Beach (Children's Pool)	Enterococcus and fecal coliform	Wet ³	2010 303(d) listed segment	Bacteria TMDL; Natural sources/other urban runoff 2010 303(d) listed as sources	N	N	-	✓
	Total coliform	Wet ³		Bacteria TMDL	Y	Y	-	✓
Impairment of SHELL of Pacific Ocean Shoreline, Casa Beach (Children's Pool)	Total coliform	Wet ³	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	-	✓
Impairment of SHELL of Pacific Ocean Shoreline, La Jolla Cove	Total coliform	Wet, Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	-	✓
Impairment of REC-1 of Pacific Ocean Shoreline, La Jolla Shores Beach at Avenida de la Playa ⁴	Enterococcus, fecal coliform, and total coliform	Wet, Dry	2010 303(d) listed segment	Bacteria TMDL	N	N	-	✓

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Priority Water Quality Condition (1)	Potential Stressor(s) (2)	Temporal Extent (3)	Geographical Extent (4)	Determining Factors (5)	Data Gaps (6)		Potentially Responsible Agencies	
					RW ¹	MS4 ²	CT	SD
Scripps Subwatershed								
Impairment of SHELL of Pacific Ocean Shoreline, La Jolla Shores Beach at Avenida de la Playa ⁴	Total coliform	Wet, Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	–	✓
Impairment of REC-1 of Pacific Ocean Shoreline, La Jolla Shores Beach at Caminito del Oro	Total coliform, <i>Enterococcus</i> , and fecal coliform	Wet, Dry	2002 303(d) listed segment	Bacteria TMDL ⁵	Y ⁶		–	✓
Impairment of REC-1 of Pacific Ocean Shoreline, La Jolla Shores Beach at El Paseo Grande	Total coliform, <i>Enterococcus</i> , and fecal coliform	Wet, Dry	2002 303(d) listed segment	Bacteria TMDL ⁵	Y ⁶		–	✓
Impairment of REC-1 of Pacific Ocean Shoreline, Pacific Beach at Grand Avenue	Total coliform, <i>Enterococcus</i> , and fecal coliform	Wet, Dry	2002 303(d) listed segment	Bacteria TMDL ⁵	Y ⁶		–	✓

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Priority Water Quality Condition (1)	Potential Stressor(s) (2)	Temporal Extent (3)	Geographical Extent (4)	Determining Factors (5)	Data Gaps (6)		Potentially Responsible Agencies	
					RW ¹	MS4 ²	CT	SD
Scripps Subwatershed								
Impairment of REC-1 of Pacific Ocean Shoreline, Pacific Beach at Pacific Beach Point	Enterococcus, fecal coliform	Wet, Dry	2010 303(d) listed segment	Current dry weather outfall monitoring; Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	–	✓
Impairment of SHELL of Pacific Ocean Shoreline, Pacific Beach at Pacific Beach Point	Total coliform	Wet, Dry	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources				
Impairment of REC-1 of Pacific Ocean Shoreline, South Casa Beach at Coast Boulevard	Total coliform, Enterococcus, and fecal coliform	Wet, Dry	2002 303(d) listed segment	Bacteria TMDL ⁵	Y ⁶	Y ⁶	–	✓
Impairment of REC-1 of Pacific Ocean Shoreline, Tourmaline Surf Park	Total coliform, Enterococcus, and fecal coliform	Wet, Dry	2002 303(d) listed segment	Bacteria TMDL ⁵	Y ⁶	Y ⁶	–	✓

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Priority Water Quality Condition (1)	Potential Stressor(s) (2)	Temporal Extent (3)	Geographical Extent (4)	Determining Factors (5)	Data Gaps (6)		Potentially Responsible Agencies	
Scripps Subwatershed								
Impairment of REC-1 of Pacific Ocean Shoreline, Vallecitos Court	Enterococcus, fecal coliform, and total coliform	Wet ³	2010 303(d) listed segment	Bacteria TMDL	N	N	–	✓
Impairment of SHELL of Pacific Ocean Shoreline at La Jolla Shores Beach at Vallecitos	Total coliform	Wet ³	2010 303(d) listed segment	Urban runoff/storm sewers 2010 303(d) listed as sources	Y	Y	–	✓
Impairment of REC-1 of Pacific Ocean Shoreline at Windansea Beach at Bonair Street	Enterococcus, fecal coliform, and total coliform	Wet, Dry	2002 303(d) listed segment	Bacteria TMDL ⁵	Y ⁶	Y ⁶	–	✓
Impairment of REC-1 of Pacific Ocean Shoreline at Windansea Beach at Palomar Ave	Enterococcus, fecal coliform, and total coliform	Wet, Dry	2002 303(d) listed segment	Bacteria TMDL ⁵	Y ⁶	Y ⁶	–	✓

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Priority Water Quality Condition (1)	Potential Stressor(s) (2)	Temporal Extent (3)	Geographical Extent (4)	Determining Factors (5)	Data Gaps (6)		Potentially Responsible Agencies	
					RW ¹	MS4 ²	CT	SD
Scripps Subwatershed								
Impairment of REC-1 of Pacific Ocean Shoreline at Windansea Beach at Playa del Norte	Enterococcus, fecal coliform, and total coliform	Wet, Dry	2002 303(d) listed segment	Bacteria TMDL ⁵	Y ⁶	Y ⁶	–	✓
Impairment of REC-1 of Pacific Ocean Shoreline at Windansea Beach at Vista de la Playa	Enterococcus, fecal coliform, and total coliform	Wet, Dry	2002 303(d) listed segment	Bacteria TMDL ⁵	Y ⁶	Y ⁶	–	✓
Impairment of REC-1 of Pacific Ocean Shoreline at Whispering Sands Beach at Ravina Street ⁴	Enterococcus, fecal coliform, and total coliform	Wet, Dry	2010 303(d) listed segment	Bacteria TMDL	N	N	–	✓

1. Are there gaps in the RW data used to characterize the priority water quality condition? (Y = yes; N = no)
2. Are there gaps in the MS4 data used to characterize the geographical contribution of the MS4 to priority water quality condition? (Y = yes; N = no)
3. Dry weather diversions have been installed upstream.
4. These Bacteria TMDL shoreline segments are located within the ASBS 29 sub-drainage area
5. Segment currently not listed on the 2010 CWA 303(d) List but is listed in the Bacteria TMDL.
6. These segments are meeting water quality standards in the receiving waters and therefore, the MS4 is not contributing to a priority water quality condition. These segments are a priority because they are listed in the Bacteria TMDL.

CT = California Department of Transportation (Caltrans); SD = City of San Diego

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Table F-3
Evaluation of Priority Water Quality Conditions in the Mission Bay WMA

Sub-watershed	Priority Water Quality Condition	Potential Stressor(s)	(a) Supporting Data Is Sufficient to Characterize the Receiving Water Conditions	(b) Storm Water/Non-Storm Water Runoff Predominant Source	(c) Controllable by Responsible Agencies ¹	(d) Cannot Be Addressed by Identified Strategies
Rose Canyon	Impairment of SHELL of Mission Bay Shoreline at Campland	Total coliform	–	–	–	–
	Impairment of REC-1 of Mission Bay Shoreline at De Anza Cove	Fecal coliform	–	–	–	–
	Impairment of REC-1 at Mission Bay Shoreline at Leisure Lagoon	<i>Enterococcus</i>	–	–	–	–
	Impairment of REC-1 at Mission Bay Shoreline at North Crown Point	<i>Enterococcus</i>	–	–	–	–
	Impairment of SHELL at Mission Bay Shoreline at North Crown Point	Total coliform	–	–	–	–
	Impairment of MAR of Mission Bay at Mouth of Rose Creek	Potential eutrophic conditions (no pollutant specified)	–	–	–	–
		Lead	–	–	–	–

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Sub-watershed	Priority Water Quality Condition	Potential Stressor(s)	(a) Supporting Data Is Sufficient to Characterize the Receiving Water Conditions	(b) Storm Water/Non-Storm Water Runoff Predominant Source	(c) Controllable by Responsible Agencies ¹	(d) Cannot Be Addressed by Identified Strategies
Rose Canyon	Impairment of REC-1 of Mission Bay Shoreline at Visitor's Center	Enterococcus	–	–	–	–
		Fecal coliform	–	–	–	–
	Impairment of SHELL of Mission Bay Shoreline at Visitor's Center	Total coliform	–	–	–	–
		Toxicity	✓	–	–	✓
		TSS	✓	–	–	–
Tecolote Creek	Impairment of WARM in Rose Creek	TDS	✓	✓	–	✓
		Potential Eutrophic Conditions (Phosphorus)	✓	–	–	–
		Turbidity	–	–	–	–
	Impairment of REC-1 of Mission Bay Shoreline at Tecolote Shores	Enterococcus	–	–	–	–
		Copper	✓	✓	✓	–
Scripps	Impairment of REC-1 of Mission Bay Shoreline at Bahia Point	Enterococcus	–	–	–	–
		Fecal coliform	–	–	–	–

Continued on next page

Sub-watershed	Priority Water Quality Condition	Potential Stressor(s)	(a) Supporting Data Is Sufficient to Characterize the Receiving Water Conditions	(b) Storm Water/Non-Storm Water Runoff Predominant Source	(c) Controllable by Responsible Agencies ¹	(d) Cannot Be Addressed by Identified Strategies
Scripps	Impairment of REC-1 of Mission Bay Shoreline at Bonita Cove	Fecal coliform	–	–	–	–
	Impairment of REC-1 of Mission Bay Shoreline at Fanuel Park	<i>Enterococcus</i>	–	–	–	–
	Impairment of SHELL of Pacific Ocean Shoreline, Casa Beach (Children's Pool)	Total coliform	–	–	–	–
	Impairment of SHELL of Pacific Ocean Shoreline, La Jolla Cove	Total coliform	–	–	–	–
	Impairment of SHELL of Pacific Ocean Shoreline, La Jolla Shores Beach at Avenida de la Playa	Total coliform	–	–	–	–
	Impairment of REC-1 of Pacific Ocean Shoreline, Pacific Beach at Pacific Beach Point	<i>Enterococcus</i> , fecal coliform	–	–	–	–

Continued on next page

Sub-watershed	Priority Water Quality Condition	Potential Stressor(s)	(a) Supporting Data Is Sufficient to Characterize the Receiving Water Conditions	(b) Storm Water/Non-Storm Water Runoff Predominant Source	(c) Controllable by Responsible Agencies ¹	(d) Cannot Be Addressed by Identified Strategies
Scripps	Impairment of SHELL of Pacific Ocean Shoreline, Pacific Beach at Pacific Beach Point	Total coliform	–	–	–	–
	Impairment of SHELL of Pacific Ocean Shoreline, Vallecitos Court	Total coliform	–	–	–	–

"✓" – The criterion is met for the priority water quality condition.

"–" – The criterion is not met for the priority water quality condition.

1. The priority water quality condition is considered controllable if two criteria are met: (1) There is a clear link between the MS4 contribution and the receiving water conditions, and (2) The potential strategies that apply to the potential stressor are applicable for the drainage area of the receiving water condition.

APPENDIX G

ASBS Compliance Plan

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**FINAL COMPLIANCE PLAN
LA JOLLA AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE**

**Submitted to:
San Diego Regional Water Quality Control Board**



**Submitted by:
City of San Diego**

**Prepared by:
AMEC Environment & Infrastructure, Inc.
San Diego, California**

September 20, 2014

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ACRONYMS AND ABBREVIATIONS

ASBS	area of special biological significance
ASBS 29	La Jolla ASBS
ASBS 31	San Diego—Scripps ASBS
Bacteria TMDL	<i>Revised Total Maximum Daily Loads for Indicator Bacteria</i> (SDRWQCB, 2010)
Bight '08	<i>Southern California Bight 2008 Regional Monitoring Survey</i> (SCCWRP, 2003)
Bight '13	<i>Southern California Bight 2013 Regional Monitoring Survey</i> (SCCWRP, 2013)
BMP	best management practice
City	City of San Diego
CLRP	comprehensive load reduction plan
CSDM	coastal storm drain monitoring
FY	(City) fiscal year
General Exception	Resolution Number 2012-0012 (SWRCB, 2012b), a general exception to the Ocean Plan
HA	hydrologic area
HOA	homeowners' association
IC	illegal connection
ID	illicit discharge
JURMP	jurisdictional urban runoff management program
La Jolla ASBS Dilution Study	La Jolla ASBS Site-Specific Dilution and Dispersion Model (City, 2013c)
La Jolla Watershed	La Jolla Shores Coastal Watershed
LID	low-impact development
MLS	mass loading station
MS4	municipal separate storm sewer system
new NPDES MS4 Permit	Order Number R9-2013-0001 (SDRWQCB, 2013b)
NPDES	National Pollutant Discharge Elimination System
Ocean Plan	Water Quality Control Plan for Ocean Waters of California (SWRCB, 2012e)
PFEIR	Program Final Environmental Impact Report (SWRCB, 2012a)
PGA	pollutant-generating activities
previous NPDES MS4 Permit	Order Number R9-2007-0001 (SDRWQCB, 2007)

ACRONYMS AND ABBREVIATIONS (Continued)

Project SWELL	Project Stewardship: Water Education for Lifelong Leadership
RWQCB	(California) Regional Water Quality Control Board
SCCWRP	Southern California Coastal Water Research Project
Scripps Watershed	Scripps Hydrologic Area (HA 906.30)
SDRWQCB	California Regional Water Quality Control Board San Diego Region
SIO	Scripps Institution of Oceanography
SMC	Storm Water Monitoring Coalition
SUSMP	standard urban storm water mitigation plan
SWMP	storm water management plan
SWPPP	storm water pollution prevention plan
SWRCB	(California) State Water Resources Control Board
TCBMP	treatment control best management practice
TWAS	temporary watershed assessment station
UC IPM	University of California (Agriculture and Natural Resources Statewide) Integrated Pest Management Program
UCSD	University of California San Diego
USEPA	United States Environmental Protection Agency
WQIP	water quality improvement plan
WQO	water quality objective
WURMP	watershed urban runoff management program

1.0 INTRODUCTION AND BACKGROUND

This compliance plan applies to the La Jolla Area of Special Biological Significance (La Jolla ASBS; also ASBS 29) and how it is impacted by storm water discharges and associated potential contaminants. Specifically, the plan describes the approach of the City of San Diego (City) to comply with the requirements of Resolution Number 2012-0012¹ of the State Water Resources Control Board (SWRCB), *Approving Exceptions to the California Ocean Plan for Selected Discharges into Areas of Special Biological Significance, Including Special Protections for Beneficial Uses, and Certifying a Program Environmental Impact Report* (2012b) (General Exception).

Based on data collected in ASBS 29, the La Jolla ASBS Site-Specific Dilution and Dispersion Model (La Jolla ASBS Dilution Study) (City, 2013c) (discussed in Section 3.2) and analysis provided in the Scripps Watershed Comprehensive Load Reduction Plan (CLRP) (City, 2013d) (discussed in Section 4.0), the City's current implementation of non-structural and structural best management practices (BMPs) complies with the General Exception requirement to protect natural water quality during wet and dry weather conditions. Low-flow diversions currently installed at nine locations are intended to eliminate non-storm water discharges to the ASBS during dry weather. Furthermore, the City's implementation of BMPs is in accordance with the schedule required in the General Exception (discussed in Section 5.1). The City plans to continue to maintain and implement existing BMPs and to continue monitoring in the ASBS per the General Exception to protect and assess maintenance of natural water quality.

The following sections describe the regulatory framework for this La Jolla ASBS Compliance Plan.

1.1 Storm Water Regulation

The Clean Water Act (CWA) was adopted in 1972 and prohibits point sources of discharges, such as storm water, into waters of the United States (U.S.) unless the discharge complies with the National Pollutant Discharge Elimination System (NPDES) program. The U.S. Environmental Protection Agency (USEPA) authorizes the SWRCB to administer the NPDES program under CWA Section 402. Similarly, the SWRCB authorizes the Regional Water Quality Control Boards (RWQCBs) to issue NPDES permits for storm water discharges.

Storm water runoff is commonly transported through municipal separate storm sewer system (MS4s), which typically discharge water (and any potential pollutants) directly into streams, bays, and/or an ocean. The San Diego RWQCB (SDRWQCB) adopted a revised NPDES MS4 Permit (SDRWQCB, 2013b) that regulates MS4 discharges from municipalities such as the City. Therefore, based on Section I.A.2.d of the General Exception, this Compliance Plan is subject to approval from the Executive Officer of the SDRWQCB.

¹ Resolution 2012-0012 was subsequently revised by Resolution 2012-0031 (SWRCB, 2012d). The only change was a correction of the compliance timeframe from four years to six years.

The new NPDES MS4 Permit requires the City to conduct multiple activities, including:

- Identify major outfalls and pollutant loadings;
- Detect and eliminate all non-storm water discharges to the MS4, except as specifically and legally exempted;
- Prevent and reduce pollutants in runoff from industrial, commercial, and residential areas by implementing best management practices (BMPs);
- Control storm water discharges from new development and redevelopment;
- Inspect industrial, commercial, and construction activities;
- Provide pertinent education about and promote public reporting of pollution; and
- Monitor discharges and impacts on receiving waters.

In 1974, the SWRCB designated 34 regions along the coast of California as ASBS under Resolution Number 74-28 (SWRCB, 1974). These ASBS are “areas designated by the SWRCB as ocean areas requiring protection of species or biological communities to the extent that alteration of natural water quality is undesirable” (SWRCB, 2012b).

Section 13170.2 of the California Water Code requires the SWRCB to prepare and adopt a *Water Quality Control Plan for Ocean Waters of California* (last revised, 2012e) (Ocean Plan). The Ocean Plan establishes water quality objectives (WQOs) that are the basis of regulating point source and non-point source waste discharges into coastal waters. The Ocean Plan prohibits all discharges to an ASBS and requires discharge points to be located far enough away from an ASBS to maintain natural water quality conditions; however, the SWRCB can issue permits that exempt certain discharges to an ASBS.

In March 2012, the SWRCB adopted the General Exception (SWRCB, 2012b), which exempts certain listed dischargers. The conditions in the General Exception are designed to protect beneficial uses of the receiving water, yet allow continuation of essential public services, such as flood control, slope stabilization, erosion prevention, maintenance of the natural hydrologic relationship between terrestrial and marine ecosystems, public health and safety, public recreation and coastal access, commercial and recreational fishing, navigation, and essential military operations (national security) (SWRCB, 2012b).

The General Exception designates the City as the sole discharger to ASBS 29. The General Exception authorizes the City to discharge into ASBS 29, provided that it:

- Complies with the NPDES MS4 Permit; and
- Includes an ASBS Compliance Plan in the Mission Bay Watershed Management Area (WMA) Water Quality Improvement Plan (WQIP)²; the Mission Bay WMA includes the La Jolla ASBS.

² The new NPDES MS4 Permit (Order Number R9-2013-0001) (SDRWQCB, 2013b) requires the City to develop a WQIP, which is equivalent to a storm water management plan (SWMP) or storm water pollution prevention plan (SWPPP).

1.2 Document Organization

1.2.1 General Compliance

In general, the ASBS Compliance Plan:

- Addresses the prohibition of non-storm water runoff and the requirement to maintain natural water quality for storm water discharges to ASBS 29, according to Section I.A.2 of the General Exception;
- Serves as the ASBS Pollution Prevention Plan required for non-point source discharges, according to Section I.B.2 of the General Exception;
- Describes the City's strategy to comply with the General Exception; and
- Will be updated according to Sections I.A.2.h and I.B.2.c of the General Exception.

1.2.2 Specific Compliance

Specifically, this ASBS Compliance Plan:

- Describes the measures by which non-authorized, non-storm water runoff has been eliminated by the City, and how these measures will be maintained, monitored, and documented;
- Includes minimum frequencies for inspection of MS4s;
- Addresses storm water discharges and, in particular, describes how pollutant reductions in storm water runoff are achieved by implementing BMPs;
- Addresses erosion control and the reduction and/or prevention of anthropogenic sedimentation in the ASBS; and
- Describes the City's non-structural and structural BMPs currently employed and its plan to continue implementation in the future, including a schedule for the City's WQIP.

1.2.3 General Exception Requirements

The requirements for this ASBS Compliance Plan per the General Exception are addressed in sections of this report, as noted below:

Section 1—Introduction: Describes California discharge regulations, ASBS-specific requirements, compliance actions, and the organization of this ASBS Compliance Plan.

Section 2—Discharges to the La Jolla ASBS: Describes the ASBS 29 drainage area, identifies discharges to ASBS 29, and specifically addresses the prohibition of non-storm water runoff and the requirement to maintain natural water quality for storm water discharges to an ASBS; describes measures by which all non-authorized, non-storm water runoff has been eliminated, states how these measures will be maintained over time, and states how these measures are monitored and documented; and identifies storm water runoff and pollutant sources from the City's parks and recreation facilities and areas of erosion potential. (Addresses Sections I.A.2.a, Section I.A.2.e, I.B.2.b, and II of the General Exception.)

Section 3—Prioritization of Discharges: Identifies municipal and industrial storm water discharges, prioritizes them based on risk to water quality, and incorporates data from storm water runoff and ocean receiving water monitoring. (Addresses Section I.A.2.a of the General Exception.)

Section 4—Implemented BMPs: Describes existing nonstructural BMPs, including an education and outreach program; and describes existing structural BMPs and their role. Describes the planned continuation of currently implemented non-structural and structural BMPs, and the role of BMPs in maintaining natural water quality. (Addresses Sections I.A.2.b, I.A.2.c, I.A.2.d, I.A.2.e, I.A.2.f, I.A.2.g, I.B.2.b, and II of the General Exception.)

Section 5—Compliance and Implementation Schedule: Provides the compliance schedule and the BMP implementation schedule; mandates submitting a report if receiving water monitoring indicates that discharges are altering natural conditions; and describes the procedures for revising the ASBS Compliance Plan to maintain compliance with the General Exception. (Addresses Sections I.A.2.g, I.A.2.h, I.A.3, I.B.2.c, and I.B.3 of the General Exception.)

Section 6—References: Presents the documents referenced in the development of this ASBS Compliance Plan.

2.0 Discharges to the La Jolla Area of Special Biological Significance

2.1 La Jolla Watershed

ASBS 29 is located off the northern coast of the Scripps Hydrologic Area (HA) (HA 906.30; also Scripps Watershed) in the La Jolla Shores Coastal Watershed (La Jolla Watershed). The ASBS 29 drainage area is approximately 1,600 acres and extends from the Pacific Ocean shoreline to an elevation of approximately 243 meters (800 feet) at Mount Soledad. Drainage into the ASBS flows from MS4 storm water outfalls, overland sheet flow (directly from non-MS4 discharges), and natural drainage features (La Jolla Shores Watershed Management Group, 2008). The primary land use is residential with some commercial and institutional (i.e., the University of California San Diego Scripps Institute of Oceanography [UCSD-SIO] campus) areas.

The MS4 storm water outfalls are point sources of storm water runoff into receiving water bodies, regulated by the NPDES MS4 Permit. The location and density of these outfalls generally indicate the significance of storm-water-based sources in the drainage area. The degree of urbanization and the imperviousness of a drainage area dictate the amount of storm water that is conveyed directly to the MS4 and into receiving waters. Contributing land use activities include, but are not limited to, landscaping, car washing, pet waste, and vehicle wear (City, 2012c).

2.2 Dry Weather Flows

Non-storm water discharges are prohibited under the General Exception. The only discharges allowed are those that are essential for emergency response purposes, structural stability, slope stability, or those that occur naturally. Landscape irrigation in the La Jolla Watershed is a high-water-use activity. Over-irrigation often results in dry weather urban runoff that transports pollutants from impervious surfaces (such as roadways and parking lots) and discharges them into the ASBS. The primary pollutants from urban runoff are sediment, bacteria, nutrients, and metals.

The City's BMPs to reduce or eliminate non-storm water discharges include constructing low-flow diversions, education and outreach targeted on reducing irrigation runoff, incentivizing smart gardening and water conservation measures (such as rebates to incentivize grass removal), and promoting rain barrels and downspout disconnections. The City also investigates illegal connections and illicit discharges (IC/ID) in response to flows that exceed the water quality criteria during routine dry weather monitoring.

The City's programs to eliminate non-storm water discharges and reduce or control pollutant sources that drain into the ASBS are discussed further in Section 4.

2.3 Storm Water Discharges (Wet Weather Flows)

Under the General Exception, the only permitted point source discharges of storm water are those authorized by the General Exception or by an NPDES permit issued by the SWRCB or SDRWQCB. Per the General Exception, the only allowed discharges to the ASBS are those from existing storm water outfalls and those discharges must comply with all of the applicable terms, prohibitions, and special conditions in the General Exception.

Because of urbanization, steep slopes and a highly developed storm drain network in the upper reaches of its drainage system, the La Jolla Watershed responds quickly to rainfall events when fast-moving storm water surges downstream. Most of the runoff from the ASBS 29 drainage area is conveyed through a network of storm drains before it is discharged at several locations along the shoreline into the ASBS. Most of the runoff enters the City's NPDES-permitted MS4 through curb inlets in public streets or through catch basins at the lower (western) ends of open space and undeveloped areas. Runoff is then discharged into the ASBS via outfalls along the shoreline. The Avenida de la Playa and El Paseo Grande storm drains are the largest of these outfalls; together, they drain more than 50 percent of the ASBS 29 drainage area to the Pacific Ocean.

Sheet flow is minimal and is limited to the western end of Avenida de la Playa, the bluffs of the Devil's Slide area, and small portions of the boardwalk. Although no streams flow directly into the ASBS, natural drainage features discharge some urban runoff from cliffs or directly onto beaches (La Jolla Shores Watershed Management Group, 2008). Other discharges to the ASBS originate from private homes that discharge directly to the ocean via pipes, outfalls and weep holes embedded in the sea walls.

Figure 2-1 shows the locations of storm water outfalls to the ASBS and the City's MS4 in the La Jolla Watershed.



**Figure 2-1: La Jolla Shores Coastal Watershed
 and ASBS 29 with MS4 Outfall Locations**

2.4 Parks and Recreation Facilities Discharges

The General Exception requires the City to address storm water runoff from parks and recreation facilities and to identify all pollutant sources (including sediment sources) that may cause waste to enter storm water runoff. Over-watering landscaped areas increases the potential for fertilizer, herbicides and pesticides to be conveyed into the City's MS4. Parking lots in parks and recreation facilities are potential sources of heavy metals, oil and sediment. In addition, pet waste that is not properly disposed of in parks is a major source of pathogenic bacteria and other parasites. As a result, storm water pollutant mitigation measures must address parks and recreation facilities and their associated potential pollutant sources.

To meet the requirements of the General Exception, the City has implemented a number of non-structural and structural BMPs throughout the La Jolla Watershed, including BMPs at City Park and Recreation Department facilities (Section 4). The BMPs are effective at controlling soil erosion, preventing pesticide discharges, limiting trash, and reducing runoff from parking areas (discussed further in Section 4). The City plans to continue maintaining and implementing these BMPs to protect natural water quality.

The City's Park and Recreation Department oversees nearly 40,000 acres of developed and undeveloped open space and more than 340 parks (City, 2013c). Five of these parks are in the ASBS 29 drainage area (Figure 2-2) and are briefly described below.

- **Kellogg Park and La Jolla Shores Beach Park** (at 2112 Vallecitos and 8200 Camino del Oro, respectively, and totaling 13.42 acres) are, given their proximity and overlapping public use, discussed herein as one large park. Kellogg Park is a long, grassy area that parallels La Jolla Shores Beach Park; the two are separated by a palm-tree-lined, concrete boardwalk. Amenities include a children's playground, picnic tables, grills, restrooms, showers, and a free parking lot. La Jolla Shores is adjacent to the San Diego La Jolla Underwater Park Ecological Reserve.
- **Cliffridge Park** (10.90 acres at 8311 Cliffridge Avenue) is located amidst a residential neighborhood, the La Jolla YMCA and Torrey Pines Elementary School. To the west is a natural hillside that descends to Torrey Pines Road. The park features athletic fields, including four baseball diamonds, one tee-ball field, and two lined soccer fields within the baseball outfields. Other amenities are a food concession stand, picnic tables and restrooms.
- **Laureate Mini Park** is a small (0.81-acre) neighborhood park at the intersection of Avenida de la Playa and El Paseo del Ocaso. Mini parks generally are open spaces with 0.5 to 1.5 acres of play area and serve a neighborhood.
- **La Jolla Athletic Area (Allen Field)** (6.41 acres on Torrey Pines Road, south of Expedition Way) is a grass athletic field, primarily dedicated to soccer fields used by the La Jolla Youth Soccer League. This park is leased to La Jolla Youth, Inc., which is responsible for park maintenance. An office building in the park is the soccer league's offices and clubhouse; three portable toilets are located behind the building.

Potential sources of pollutants are identified and discussed in subsequent sections.



Figure 2-2: Park and Recreation Facilities Within ASBS Drainage Area

2.4.1 La Jolla Shores Small Vessel Boat Launch

La Jolla Shores has the only drive-on beach access to the ocean within City limits. It is located on the 2000 Block of Avenida de la Playa, four blocks west of La Jolla Shores Drive and approximately 300 yards south of the lifeguard station. Access consists of a break (of about 35 feet) in the seawall that permits vehicles to drive onto the beach to unload and load small vessels close to the surf. Discharges of storm water from impervious surfaces on the land side of the sea wall consist of sheet flow to the beach.

This is an unimproved boat launch (sand launch for small vessels and personal watercraft only); vehicles are allowed to drive on the sand only in a very limited area and no faster than 5 miles per hour. There is no ramp structure at this location and trailered boats cannot be launched by backing into water as at traditional boat launch ramps. Given these conditions this area was determined to not be considered as a waterfront and marine operations area as defined in Section III of the General Exception.

2.4.2 Trash Receptacles

The City provides numerous trash receptacles to properly manage trash and reduce the amount of trash that could enter the ASBS.

An overview of the trash receptacles at the parks in the ASBS drainage area is presented below

- Kellogg Park and La Jolla Shores Beach Park have 91 waste receptacles:
 - Eight solar-powered trash compactors (which are emptied as needed);
 - Thirty-six covered trash cans (in the park), 24 around the southern grassy area and 12 in the northern grassy area and picnic areas, all of which are emptied daily;
 - Forty-one uncovered trash cans (placed on the beach sand), which are emptied daily in the summer (Memorial Day through Labor Day) and three times a week during the rest of the year; and
 - Six covered dumpsters (at the northeastern end of the Kellogg Park parking lot).
- Cliffridge Park has 18 waste receptacles:
 - Nine covered trash cans (six around the picnic tables and three dispersed in other high-use areas, all of which are emptied daily);
 - Eight uncovered trash cans (two around the picnic tables and six dispersed in other high-use areas, all of which are emptied daily); and
 - One covered dumpster.
- Laureate Mini Park has two trash cans on the sidewalk adjacent to the park that are maintained by the City.

- Allen Field has 10 waste receptacles, maintained by La Jolla Youth, Inc.:
 - Nine covered trash cans (in its three soccer fields); and
 - One covered dumpster.

2.4.3 Roadways and Parking Lots

Impervious surfaces in urban landscapes increase runoff volume and contribute pollutants. Roadways and parking lots collect pollutants from tailpipe emissions and brake linings that are associated with a number of pollutants, including copper, lead, zinc, and polycyclic aromatic hydrocarbons (City, 2010b).

Parking lots and roadways associated with the parks in the ASBS watershed are:

- Kellogg Park and La Jolla Shores Beach Park—a parking lot that is available to the public from 4:00 a.m. to 10:00 p.m. (City, 2013c);
- Cliffridge Park—a small City-maintained parking area, with additional public parking on the neighboring City streets and no City-maintained roads;
- Laureate Mini Park—no parking lots, with City street parking available; and
- Allen Field—a small one-way parking lot accessible from Torrey Pines Road with parking on the adjacent grass and dirt areas.

At Kellogg Park the City has implemented the Kellogg Park Green Lot Retrofit Project (discussed in Section 4.2) to allow infiltration of urban runoff by replacing conventional asphalt in the parking lot with porous pavement. This pavement addresses potential water quality problems by reducing and treating runoff flows and discharges to the ASBS via infiltration and retention.

2.4.4 Picnic Areas

Picnic areas are often sources of litter. Waste generated from recreational picnic area use (such as carelessly discarded trash, paper wrappers and plastic bottles) has the potential to enter the storm drain system and ASBS.

Picnic facilities are available at City parks, as follows:

- At Kellogg Park and La Jolla Shores Beach Park there are 19 picnic tables and 7 barbecue grills in the north end of the park. The picnic areas are well maintained and have covered trash cans and hot coal receptacles. Other amenities include 37 benches along the boardwalk facing the beach, seven fire pits on the beach, two restroom facilities, four sinks, nine showers, and three water fountains.
- Cliffridge Park has five picnic tables and three benches. There is a food concession area on the north end of the park with four tables, along with covered trash cans. A fifth table is in the grassy area and has a covered trash can at each end of the table (see Figure 2-3).

Laureate Mini Park has no picnic facilities.

- Allen Field has no picnic facilities, but it has five benches and one three-tiered set of bleachers for spectators.



Figure 2-3: Picnic Area at Cliffridge Park

2.4.5 Soil Erosion

Park areas have the potential to deliver sediment into the storm drain system and/or ASBS. Unpaved areas, non-vegetated areas and parking lots are potential sources of non-point sediment.

Potential soil erosion and sediment delivery from park and recreation facilities in the ASBS drainage area are as follows:

- Kellogg Park has a low potential to contribute sediment to the ASBS because it consists of two well-established grassy areas, a concrete boardwalk and walkways, a developed parking lot, and a sand playground. In addition, the City's Kellogg Park Green Lot Retrofit Project allows infiltration of urban runoff and reduces sediment from being discharged to the ASBS from the parking lot.

- Cliffridge Park has a low potential to contribute sediment as most of the park is grass sports fields and its landscaped areas are generally within curbing or are vegetated and mulched.
- Laureate Mini Park has a contiguous grassy area without exposed soil; therefore, the potential for soil erosion is very low.
- Allen Field has a low potential to contribute sediment to the ASBS because most of it is well-established grass fields. However, the adjacent parking lot is a potential sediment source because street dirt accumulates on roads and parking lots and has the potential to run off in response to precipitation.

2.5 Erosion Potential and Control

The General Exception identifies sediment as a targeted pollutant. The most likely source of sediment in the ASBS 29 is erosion of canyon and open space areas within the drainage area. Development around open space areas has increased storm water flow volumes and velocities and has led to higher rates of erosion. Sediment in storm water runoff may result from land-disturbing activities at residences, such as landscaping, construction, and exposed non-vegetated soils. Other potential sources of sediment are urban and residential land uses, transportation uses (such as roads, highways, and parking lots), and coastal bluffs. Of these potential sources, construction activities would likely generate the largest sediment load. Road grit and finer particles not collected through street sweeping also contribute sediment to storm water runoff.

La Jolla is underlain primarily by sedimentary rock and has occasional outcrops of plutonic and metamorphic rocks. Small surficial landslides associated with expansible clay deposits of the Friars and Delmar Formations in the area are abundant. The shoreline along the ASBS is approximately 1.6 miles long. The northern 1.0 mile consists of fine sandy beaches; the southern 0.6 mile is composed of rocky boulders or ledges at the base of the cliffs, with one pebble beach in the Devil's Slide area. This area is bisected by a strand of the active Rose Canyon fault system. The northern three-fourths of the shoreline faces westward; the southernmost one-fourth faces northward (SWRCB, 1979).

The City's Development Services Department has conducted a seismic safety study (City, 2008) that contains a series of maps that identify likely geological hazards throughout the City. Based on these maps, Figure 2-4 shows unstable coastal bluffs, known landslide areas and areas with slide-prone geology in the La Jolla Watershed. BMPs currently implemented and planned to be continued to address the erosion control requirements of the General Exception are discussed in Section 4.

2.5.1 Construction Activities

Runoff from construction sites can transport pollutants including sediment, debris and chemicals to the storm drain system or directly to a river, lake or coastal water. Polluted storm water runoff can harm aquatic wildlife. Sedimentation can destroy aquatic habitat and high volumes of runoff can cause stream bank erosion. Debris can clog waterways and potentially reach the ocean where it can kill marine wildlife and impact habitat (USEPA, 2013).

2.5.2 Coastal Bluffs and Open Space Areas

Natural open spaces, ravines and canyons can generate sediment from erosion. As shown in Figure 2-4, unstable coastal bluffs, which have the potential to deliver sediment to the ASBS, form much of the shoreline. At the bluff tops are private homes, other structures and open space. Portions of undeveloped hillsides and bluffs further up in the La Jolla Watershed are exposed to wind and rain erosion, potentially contributing to sediment transported to the ASBS via roadways and the MS4.

Areas such as Pottery Canyon and La Jolla Heights Open Space have been designated as open space within La Jolla. Areas such as the slopes of Mount Soledad and Pottery Canyon are being preserved to protect the environmentally sensitive resources of La Jolla, including its coastal bluffs, steep hillside slopes, canyons, native plant life, and wildlife habitat linkages.

Because the beach is narrow and lacks a wide sand buffer, the bluffs along the shoreline are subjected to erosion from wave action, particularly during the winter.

Sediment, road grit and finer particles that accumulate on streets and parking lots from erosion, residential landscaping and atmospheric deposition are minimized through street sweeping. The City's Street Sweeping Program is discussed in more detail in Section 4.

Areas of open space designated as parks and recreation facilities under the management of the City, such as Cliffridge Park, are discussed in Section 2.4.

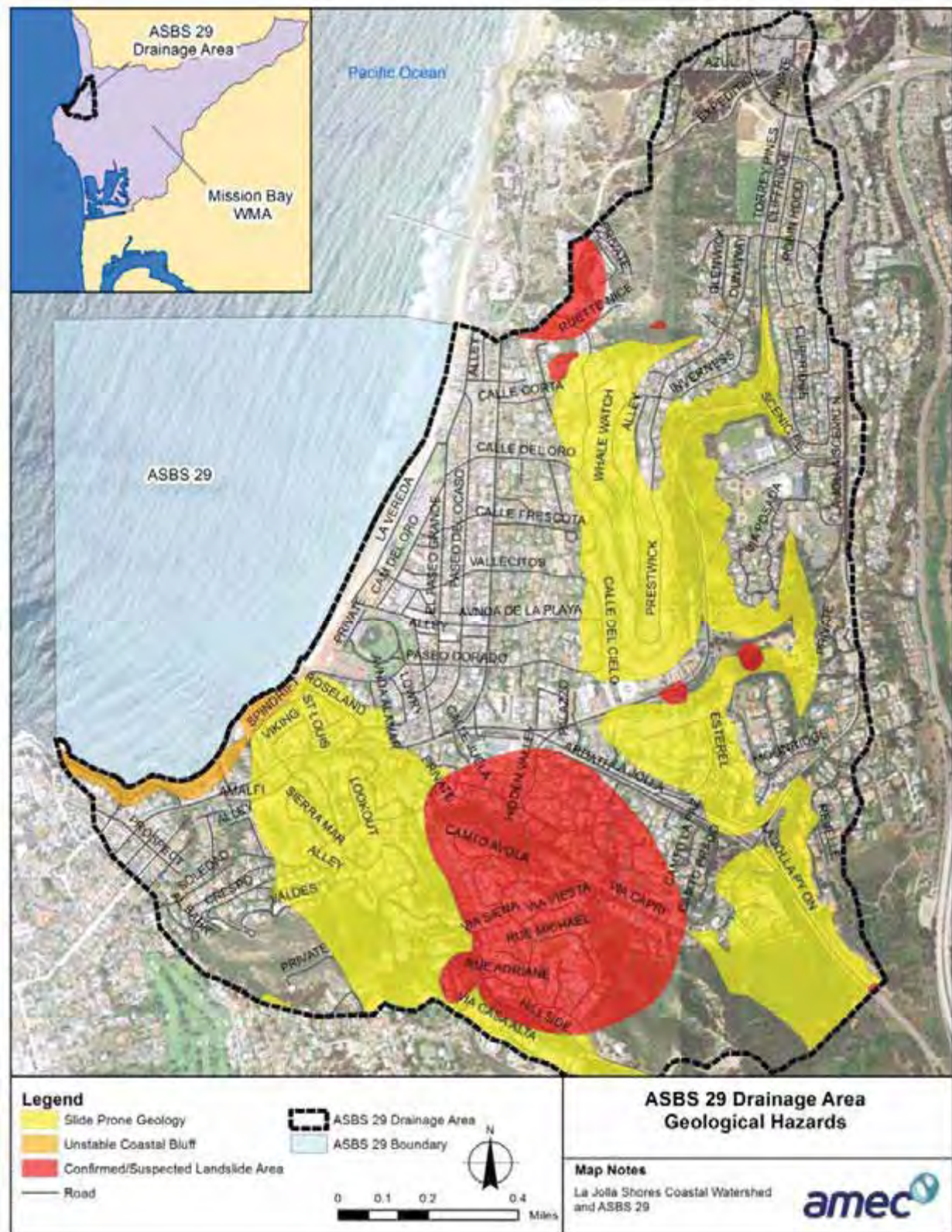


Figure 2-4: ASBS 29 Drainage Area Erosion Potential Map

3.0 Priority Discharges

The General Exception requires the ASBS Compliance Plan to include a map indicating the priority of discharges. High-priority discharges are those that pose the greatest threat to water quality and that have been identified as potentially requiring the installation of structural BMPs.

The City evaluated the discharges within ASBS 29 to determine the high-priority discharges based on the following factors:

- Available monitoring data;
- The La Jolla ASBS Dilution Study;
- Appendix 5 of the SWRCB Program Final Environmental Impact Report (PFEIR) (SWRCB, 2012a);
- Size of outfall or discharge;
- Drainage area size and land use; and
- Practicality and safety of structural BMP placement and monitoring (e.g., bluff access limitations).

Based on these factors, three high-priority discharges have been identified within ASBS 29 (see Table 3-1) and are detailed in the following subsections.

3.1 Historical and Current Monitoring

The City has participated extensively in monitoring storm water runoff and receiving waters in order to:

- Provide a means of evaluating the environmental risks of storm water discharges by identifying types and amounts of pollutants present;
- Determine the relative potential for storm water discharges to affect water quality;
- Identify potential sources of pollutants;
- Eliminate or control identified sources through management actions; and
- Assess the effectiveness of permit conditions and storm water management plans.

Monitoring through these programs, although not always regulation-driven, assesses the effectiveness of measures implemented to protect the water quality and ASBS beneficial uses.

3.1.1 Regulatory Monitoring Programs

Water quality monitoring conducted under several regulatory monitoring programs includes:

- Coastal Storm Drain Monitoring (CSDM) Program,
- Storm Water Monitoring Coalition (SMC) Regional Bioassessment,

- Dry Weather Monitoring Program under the Jurisdictional Urban Runoff Management Program (JURMP),
- Mass Loading Station (MLS) and Temporary Watershed Assessment Stations (TWAS) Ambient and Storm Monitoring Program ,
- AB 411 Beach Sanitation Posting, and
- Revised Total Maximum Daily Loads for Indicator Bacteria, Project 1–Twenty Beaches and Creeks in the San Diego Region (Bacteria TMDL) (SDRWQCB, 2010).

The results of these programs are presented in the *San Diego County Co-permittees Annual Urban Runoff Monitoring Report* and the *2005–2010 San Diego Storm Water Co-permittees Long-Term Effectiveness Assessment Report* (San Diego County Co-permittees, 2011).

No MLS or TWAS sites are in the Scripps Watershed, which limits water quality analysis to a review of the special studies in the La Jolla Watershed area (which are often associated with ASBS compliance and characterization).

3.1.2 La Jolla Shores Coastal Watershed Management Plan

The La Jolla Shores Coastal Watershed Management Plan was developed by the La Jolla Shores Watershed Management Group under Proposition 84 grant funding. Development of this plan included initial water quality monitoring of outfall discharges and receiving water conditions during storm events within the La Jolla Watershed and ASBS 29 (La Jolla Shores Watershed Management Group, 2008).

3.1.3 Core Discharge Monitoring Program

To comply with the Core Discharge Monitoring Program aspect of the General Exception, the City (because it discharges to the ASBS) is required to monitor storm water at its outfalls that are at least 18 inches in diameter and discharge to the ASBS. Five storm drains in the City's jurisdiction that drain to ASBS 29 have been voluntarily monitored by the City for multiple wet weather seasons prior to and in accordance with the monitoring requirements of the General Exception. The City's voluntary and required monitoring in ASBS 29 has created a multi-year data set, particularly with respect to its largest outfall at Avenida de la Playa. Under the new NPDES MS4 Permit, the CSDM and Dry Weather Monitoring programs will be discontinued. However, the City will continue to monitor in accordance with Section IV of the General Exception.

3.1.4 Bight '08 and '13 ASBS Regional Monitoring Programs

The City has participated in two ASBS regional monitoring programs: The 2008 and 2013 Southern California Bight Regional Monitoring Programs (Bight '08 and Bight '13, respectively). These programs comprise a region-wide comprehensive assessment of receiving water conditions by assessing reference locations and locations influenced by urban runoff for water quality during storm events; bioaccumulation of potential pollutants, rocky intertidal habitat surveys, and a variety of focused special studies.

Preliminary draft results for receiving water monitoring under the Bight '13 ASBS Regional Monitoring Program were released by SCCWRP on August 21, 2014 (SCCWRP, 2014). These program results include storm water monitoring results from reference site and receiving water sites, as well as the findings from the rocky intertidal habitat surveys, bioaccumulation sampling and plume studies. Water quality data collected from reference sites were used to determine the 85th percentile benchmark. By definition of the 85th percentile, the reference sites have an exceedance rate of 15 percent; the exceedance rate in the La Jolla ASBS (12 percent) was less than that. Results from the Bight '08 ASBS Regional Monitoring Program also showed an exceedance rate less than 15 percent (5 percent). These analytical results indicate that the condition of water quality in the La Jolla ASBS is consistent with that of reference conditions, which represent natural water quality, and demonstrates consistency across program years. These findings also support those of the La Jolla ASBS Dilution Study, which indicated a high level of dilution in the receiving water. The collective results of water chemistry data, toxicity data, and biological assessments during this study showed consistency with natural water quality conditions in reference sites. This suggests that the City's current management measures (i.e., BMPs) are achieving the targeted receiving water quality conditions.

Although a few constituents showed inconsistent and minor exceedances of the 85th percentile, these exceedances did not persist across monitored storms. Toxicity was not observed in the receiving water mixing zone, except for a sub-lethal response observed for kelp growth in a single sample.

The biological surveys that were part of the Bight '13 program indicate that reference and receiving water quality conditions were similar. The rocky intertidal habitat survey concluded that there was no discernible difference in species richness and community composition for mobile and sessile species among selected discharge and reference ASBS in southern California, including the Devil's Slide area in the southern portion of the La Jolla ASBS. Bioaccumulation monitoring results as a part of the Bight 13 Program also found median concentrations of a suite of trace metals and organic compounds to be similar among selected discharge and reference ASBS in southern California, including Scripps Reef (the site representing the La Jolla ASBS for this particular assessment).

The goal of the General Exception (and of the ASBS program as a whole) is to protect natural water quality to support the sensitive and valued native biological communities in these special areas. The results from the overall Bight '13 program and, in particular, the biological components of the latest rocky intertidal habitat survey show that natural water quality conditions are being maintained in the La Jolla ASBS. The few exceedances in the analytical samples are anticipated to be managed by the City's existing BMPs in the watershed, which it plans to continue. Despite any observed minor and transient exceedances of individual constituents in the receiving water during storm events, multiple supporting lines of evidence indicate that the overall health of the biota in the La Jolla ASBS is in good condition and that its natural water quality is being maintained. These conclusions are based on information collected not only during the Bight 13 Program but also through the past several years of compliance monitoring and a variety of other recent ecosystem assessment special studies in the La Jolla ASBS. A more thorough summary of these efforts and the resulting supporting conclusions is currently in preparation and will be available soon for review under a separate report to be submitted to the City.

3.2 La Jolla ASBS Dilution Study

In 2012, the City conducted the La Jolla ASBS Dilution Study to provide a quantitative, site-specific dilution and dispersion model to help determine appropriate dilution factors per guidance provided in the Ocean Plan (2012a) (City, 2013c). The effluents from three permitted outfalls (SDL-186, SDL-062, and SDL-157) within ASBS 29 were studied using the SEDXPORT hydrodynamic modeling system. The model is designed to numerically simulate dry weather and wet weather scenarios. The dilution study incorporated historical site-specific outfall data on water mass boundary properties (bathymetry, salinity, temperature, ocean levels and tides) and ocean forcing functions (waves, currents and winds). This modeling approach has been conducted for UCSD SIO's discharges, reviewed by the Natural Water Quality Committee (SCCWRP, 2010), and accepted by the SDRWQCB in 2008 when it was incorporated into a revision of UCSD SIO's NPDES Permit (SIO, 2008).

Results of the La Jolla ASBS Dilution Study (City, 2013c) indicated that storm water discharges from monitored outfalls into ASBS 29 generated dilution factors ranging from 10^2 in the near shore to 10^7 in the seaward boundary during wet weather. Further resolution of the model at the zone of initial dilution produced a worst-case dilution factor of 15 to 1 for 90 percent of the possible outcomes for the greatest-discharge outfall, SDL-062. The extreme worst case (0.13 percent probability in conditions of high discharge and a calm sea state) generated a 12.6:1 dilution factor for this outfall.

The dilution factor of 12.6:1 has been accepted by the SDRWQCB for the City to incorporate into its Mission Bay WMA WQIP. This factor has been included in pollutant-reduction analyses of outfall discharges to ASBS 29 and the results indicate that currently implemented non-structural BMPs provide the pollutant reductions necessary to protect natural water quality.

3.3 SWRCB Program Final Environmental Impact Report

SWRCB staff issued a PFEIR (SWRCB, 2012a) that evaluated the potential environmental effects of the adoption and implementation of the proposed statewide General Exception to the Ocean Plan waste discharge prohibition. Appendix 5 of the PFEIR includes the results of an assessment of discharges to ASBS conducted by the Southern California Coastal Water Research Project (SCCWRP, 2003) between March 2001 and February 2003. Discharges were documented within 100 meters (328 feet) of the high tide lines. The PFEIR Appendix 5 also includes the water quality threat levels designated for the surveyed discharges.

3.4 Evaluation of Discharges

Three outfalls are designated as high threats to water quality and are potentially subject to additional management measures: SDL062, SDL063 and SDL157 (see Figure 3-1).

Table 3-1: High-Priority Discharges in ASBS 29

Outfall	Latitude	Longitude	Upstream Source	Shape	Diameter/ Width (meters)	Discharges Onto
SDL062	32.8546	-117.2589	Urban watershed	Rectangular	5.00	Beach
SDL063	32.8556	-117.2582	Urban watershed	Rectangular	1.00	Beach
SDL157	32.8628	-117.25485	Urban watershed	Round	1.00	Beach



Figure 3-1: ASBS 29 Storm Drain Prioritization Map

4.0 Implemented Best Management Measures and Practices

To meet the requirements of the General Exception, the City conducted receiving water and outfall discharge monitoring as a participant in the Bight '08 and Bight '13 Regional Monitoring Programs and implemented a number of non-structural and structural BMPs throughout the La Jolla Watershed. The City plans to continue implementation of these BMPs, which control soil erosion, prevent pesticide discharges, enhance public education and outreach, limit trash, and reduce storm water runoff from parking areas.

The combined use of non-structural and structural BMPs makes pollutant reduction more practical and effective. Non-structural BMPs are designed to reduce pollutant loads before they enter the storm drain system. Source reduction strategies, such as addressing the discharge of trash and the disposal of animal waste, often reduce multiple pollutants including nutrients, sediment and bacteria. Structural BMPs, including storm water infiltration systems and low-flow diversions, are designed to reduce pollutant loading by treatment and by reducing runoff volume via capture, retention and infiltration.

City services include activities to maintain and improve City infrastructure and to reduce the amount of pollution that enters the storm drain system. The City has several special projects and pilot studies to assess the most efficient way to prevent pollution at local beaches, bays and creeks. These projects include both non-structural and structural BMPs, such as outreach programs designed to educate and change existing behaviors and attitudes of residents and business operators. Design and construction of low-impact development (LID) and capital improvement projects, such as detention basins and porous (pervious) pavement, provide long-term benefits to the storm drain system. The City also offers inspection services for businesses to determine how best to reduce their impact on the storm drain system.

Table 4-1 summarizes the City's BMPs that are currently implemented in the ASBS 29 drainage area and the benefits of each type of BMP.

4.1 Implemented Non-Structural BMPs

Consistent with the Scripps Watershed CLRP, non-structural BMP reduction strategies are actions and activities to reduce storm water pollution that do not involve construction of a physical component or structure to filter and treat storm water (City, 2012c). Non-structural BMPs also include landscape-based measures, but whose functions are not exclusively limited to storm water filtration or treatment.

This section describes currently implemented non-structural BMPs and/or management activities in the La Jolla Watershed³. Some of these non-structural BMPs have been implemented citywide and are not exclusive to the ASBS 29 drainage area.

The new NPDES MS4 Permit (Order Number R9-2013-0001) (SDRWQCB, 2013) requires the development of WQIPs. The WQIPs are intended to guide responsible parties towards improving water quality in receiving waters by controlling pollutants from MS4 discharges. Future water quality improvement goals, strategies and monitoring and assessment programs will be included in the WQIP for the Mission Bay WMA, which includes ASBS 29.

Table 4-1: Summary of City-Implemented BMPs in ASBS 29 and Potential Benefits

Best Management Practice	Pollutant Reduction & Prevention	Runoff Reduction & Elimination	Runoff Treatment	Erosion Control
<i>Non-Structural BMPs</i>				
Inspections	✓	✓	—	✓
Trash Management	✓	—	—	—
Animal Waste Management	✓	—	—	—
MS4 Cleaning	✓	—	—	—
Street Sweeping	✓	—	—	—
Channel and Slope Stabilization	✓	—	—	✓
Sanitary Sewer Management	✓	✓	—	—
Smart Gardening and Water Conservation	✓	✓	—	✓
Education and Outreach	✓	✓	—	✓
Pesticides and Other Chemical Management	✓	—	—	—
Land Development Code Amendments	✓	✓	✓	✓
Updated Minimum BMPs	✓	✓	✓	✓
<i>Structural BMPs</i>				
Low-Flow Diversions	✓	✓	✓	—
Low-Impact Development (LID)	✓	✓	✓	✓

BMP = best management practice; MS4 = municipal separate storm sewer system

4.1.1 Facility and Construction Site Inspections

Storm water inspections occur under multiple types of permits, including the General Exception, NPDES permits, a statewide Construction General Permit, Phase I and Phase II MS4 Permits, and a statewide Industrial Activities Storm Water Permit.

Inspections of operations or activities within the ASBS 29 drainage area are an effective way to quickly assess potential impacts on water quality and to correct deficiencies and/or change

³ The City described and summarized water quality improvement activities annually in its Watershed Urban Runoff Management Program (WURMP) reports required under the previous NPDES MS4 Permit (Order Number R9-2007-0001) (SDRWQCB, 2007). Details specific to the La Jolla Watershed are in the Mission Bay and La Jolla WURMP (City, 2012a). Water quality improvement activities were also identified in the CLRP for the Scripps HA, which was developed in response to the Bacteria TMDL and submitted to the RWQCB in 2012.

behaviors. These evaluations increase efficiencies in addressing discharges, correcting behaviors and abating sources of targeted pollutants at a variety of residential, commercial, and industrial areas.

In accordance with the General Exception, the City inspects facilities and/or sites in the ASBS 29 drainage area at the following frequencies:

- Municipal facilities: Once prior to and once during the rainy season;
- Construction sites: Weekly during the rainy season;
- Industrial facilities: Monthly during the rainy season;
- Commercial Facilities: Twice during the rainy season; and
- Outfalls greater than or equal to 18 inches in diameter: Once prior to the beginning of rainy season (October 1) and once during the rainy season; outfalls are routinely maintained to remove trash and other anthropogenic debris.

The City has multiple inspection programs that are described in the following subsections.

4.1.1.1 Treatment Control BMP Inspection and Maintenance Verification Program

Treatment control BMPs (TCBMPs) are permanent storm water treatment features that are incorporated into the design of newly developed or redeveloped properties to meet the requirements of the City's Model Standard Urban Storm Water Mitigation Plan (SUSMP) (San Diego Co-permittees, 2002). The City is required by the JURMP to annually verify via inspection that TCBMPs on properties within its jurisdiction are being effectively operated and maintained. Owners and operators of these properties are required to conduct regular maintenance activities per agreements signed with the City and filed with the County of San Diego.

The City's TCBMP program (City, 2013e) has three main components:

- Inventory maintenance
- An annual maintenance verification form
- Periodic TCBMP maintenance site inspections

There are currently 10 private TCBMP projects in the ASBS 29 drainage area that the City inspects to verify proper maintenance; these are described in Section 4.2 (Implemented Structural BMPs).

4.1.1.2 Industrial and Commercial Facilities Inspection Program

The NPDES MS4 Permit (SDRWQCB, 2013) requires the City to inventory and inspect industrial and commercial businesses to prevent illegal discharges to the storm drain system. The City implemented an inspection program to evaluate these sites and sources, inspect businesses, and answer the following management questions:

- What areas and activities should be targeted?

- Does the City's industrial and commercial inventory need to be re-evaluated?
- Can specific pollutant source types within the inventory be feasibly prioritized, based on site-specific characteristics?

The City continuously re-evaluates the inventory to include all businesses required to be on the inventory. Businesses are inspected to verify that the City's minimum BMPs are being implemented and are effective at preventing non-storm water discharges. Inspections assess the staff's knowledge of storm water and BMPs, and evaluate pollutant-generating activities of the businesses. A "pollutant potential" is calculated to help gauge the likelihood of an illegal discharge from every business. Enforcement actions are taken against businesses that have not implemented effective BMPs.

During fiscal year 2014 (FY14), 24 commercial facilities within the ASBS 29 drainage area were inspected (SWRCB, 2012c). (No industrial facilities were in the ASBS 29 drainage area.) Based on assigned codes, five new commercial and two new industrial businesses were added to the ASBS 29 drainage area business inventory during the FY15 update to be confirmed and inspected.

4.1.1.3 Construction Inspections

The City issues construction permits with inherent inspection requirements for private construction in the ASBS 29 drainage area. The City Engineer oversees construction inspection for public capital improvement projects. Repair and replacement of existing public infrastructures is occasionally performed as an operational activity rather than a capital improvement project, and in those cases the operational department performing the work has standard procedures addressing inspection. All construction sites inspected by the City are inspected for construction BMP compliance in accordance with the JURMP, which identifies the frequency and scope of inspections. Additionally, if the construction site exceeds thresholds that make it subject to the Construction General Permit, the City verifies that projects are enrolled.

Per the Construction General Permit, dischargers are required to conduct weekly BMP visual inspection and quarterly non-storm water visual inspections at each drainage area for the presence of unauthorized and authorized non-storm water discharges and their sources. Storm-related inspections for qualifying storm events ($\frac{1}{2}$ inch or more of rainfall) must include visual inspections of BMPs and observations of storm water discharges at all discharge locations prior to the storm, during the storm (every 24 hours), and after the storm. Inspection and potential sampling requirements could increase, based on site risk level, as determined by the site SWPPP.

4.1.1.4 Municipal Facility Inspection Program

The City requires two self-inspections of municipal facilities in the ASBS 29 drainage area each year (once prior to and once during the rainy season). The purpose of these inspections is to determine whether proper BMPs and good housekeeping measures are being implemented to eliminate non-storm water discharges and reduce pollutants in storm water runoff. If deficiencies or ineffective procedures are identified, City staff develops and implements plans for corrective action(s) to address the deficiency. If City staff determine that no corrective action(s) can be

implemented immediately (such as construction of a structural control), the City establishes a schedule for implementing the corrective action(s).

4.1.1.5 Inspections Based on Property and Pollutant-Generating Activities (PGA)

The City has evaluated and recommended changes to its inspection program to focus on land uses, pollutant-generating activities (PGAs) and high-priority areas that are most likely to be contributing to pollutant loading, and areas where the greatest pollutant load reductions are likely to be achieved by inspection and enforcement.

For example, the City has transitioned to property-based inspections, as opposed to tenant-based, as part of its business (industrial and commercial) inspection program in the ASBS 29 drainage area. Property-based inspections are an important inspection strategy because dumpsters, landscaping and parking areas are typically managed by a general property management company or contractor rather than by a specific business. Under the previous inspection program, these common areas were often not covered during an inspection. Adding property-based inspections provides significant opportunities to increase the effectiveness and reach of the City's ongoing conservation strategies related to outreach and education, enforcement and inspection.

The City has incorporated the new property-based inspection protocols into its industrial and commercial inspection program and is currently conducting property-based inspections citywide, including in the ASBS 29 drainage area.

4.1.2 Trash Management

The General Exception prohibits discharging trash to ASBS 29. To comply with this prohibition, the City has multiple measures to address trash discharges. The City promotes recycling of solid waste to reduce the amount entering landfills, which helps the City comply with the California Integrated Waste Management Act of 1989 (Assembly Bill 939), and helps meet the recycling goals established by the City and mandated by the State of California. Routine trash collection services within the ASBS 29 drainage area minimize trash and debris discharges to ASBS 29.

The City maintains the following trash management measures:

- Residential Collection of Refuse—Weekly trash service, including collection, transportation and disposal of residential refuse;
- Recycling—Curbside collection of recyclable materials every-other-week, required as part of the City's Recycling Ordinance (City, 2007);
- Green Material and Yard Waste—Curbside collection of green material and yard waste every other week, which is used to generate compost, wood chips and mulch that are made available to residents;
- Composting—Access by residents to composting resources and education with a voucher program that discounts compost bins for residents;

- Household Hazardous Wastes—Recycling of residential household hazardous wastes at the City’s household hazardous waste transfer facility;
- Environmentally Preferable Purchasing—Use by City departments of products with a lesser effect on human health and the environment, as much as practical;
- The City’s Storm Water Division “Think Blue” Hotline, on which residents may report illegal dumping; and
- Trash clean-up sponsorships, including through community-based organizations (which are detailed in the WURMP activity sheets).

At park and recreation facilities, the City provides numerous trash receptacles to properly manage trash and reduce the amount of trash that could enter ASBS 29. In addition to regularly scheduled trash service (as described in Section 2.4.2), during major holidays or planned events, the City places temporary trash and recycle receptacles on beaches to facilitate proper disposal of the increased volume of trash (San Diego Clean Beach Coalition, 2012).

Additionally, maintained picnic areas reduce the “spillover” caused by visitors taking food, trash and party decorations into more sensitive beach areas. Picnic areas provide designated areas for cooking and are near receptacles for trash and hot coals. Signs encouraging users to keep the picnic areas clean are posted.

4.1.3 Animal Waste Management

Dogs are allowed at City beaches and bay locations within the ASBS 29 drainage area while on a leash. There are two off-leash dog beaches within the City that are not located in the ASBS 29 drainage area. Some general guidelines for dog owners are (City, 2013c):

- Leashed dogs are allowed on beaches from 6:00 p.m. to 9:00 a.m. from April 1 to October 31, and from 4:00 p.m. to 9:00 a.m. from November 1 to March 31.
- Pet owners must be prepared to pick up pet waste in all areas, whether the pet is leashed or unleashed. It is unlawful to allow a dog (or other pet) to defecate on public property without immediately removing the waste and disposing of it properly.

The City also dispenses pet waste bags in some areas frequented by pet owners. During the City’s two-year Pet Waste Bag Dispenser pilot study, the number of pet waste bags dispensed was recorded and the effectiveness of the overall program at reducing pollutants was assessed (City, 2012a). Animal waste management is also a large part of the City’s “Think Blue” campaign, which is discussed in greater detail in Section 4.1.8.

4.1.4 MS4 Cleaning

The City Storm Water Division inspects, maintains and repairs the City’s MS4 including the unblocking of drains, the removal of debris from storm drain structures and channels, the cleaning and repairing of damaged drainpipes, and the sweeping of City streets throughout the City including within the ASBS 29 drainage area (City, 2013e).

The San Diego region's weather pattern is typified by a long dry season from roughly May through October. During this time, materials are expected to accumulate in catch basins without discharging. This dry season is typically followed by a wet weather season, with sporadic but occasionally significant rain events that can transport these materials to the receiving waters.

Catch basin cleaning programs provide direct, additional reduction of pollutants. The City conducted a Catch Basin Cleaning pilot study that characterized the physical dimensions, conditions and functions of catch basins in the City's drainage network (City, 2013d). The City assessed the effectiveness of both manual and Vactor™ (vacuum eductor trucks) cleaning methods in different land use settings, and characterized the sediments removed, accumulation rates and pollutants. Catch basins in four pilot area networks were cleaned four times between December 2011 and March 2012 and one time in September 2012. The study also included the development and implementation of record-keeping protocols for the City and its contracted crews, and thus enabled the City to identify catch basins that consistently accumulate the greatest amount of debris. Using these data, the City identified areas where more frequent catch basin cleanings would reduce clogging and other maintenance issues. This study provided considerations to optimize the City's catch basin cleaning methods to remove the most debris and pollutants for the level of effort (i.e., cost) expended. These optimization techniques may be applied to catch basins in the ASBS 29 if funding becomes available.

4.1.5 Street Sweeping

The City's Street Sweeping Program uses mechanical and enhanced pavement cleaning practices to minimize transport of pollutants, primarily those associated with sediment (e.g., metals) within the ASBS 29 drainage area. Street sweeping also helps prevent pipes and outlet structures in storm water detention facilities from becoming clogged with debris and trash. The City sweeps streets and parks and recreation facilities regularly for general road maintenance.

Results from effectiveness monitoring and operational assessments of the City's sweeping program are documented in several City street sweeping pilot studies: *Targeted Aggressive Street Sweeping Pilot Study Effectiveness Assessment* (City, 2010a), *City of San Diego Street Sweeper Literature Review Final Technical Memorandum* (URS, 2010a), *City of San Diego Targeted Aggressive Street Sweeping Pilot Program Phase III Median Sweeping Study* (URS, 2010b), and *City of San Diego Targeted Aggressive Street Sweeping Pilot Program Phase IV Speed Efficiency Study* (URS, 2011).

Based on City street sweeping pilot studies, improved street and median sweeping technology has been shown to reduce wet weather pollutant loads for bacteria, metals, non-metal toxics, and nutrients (City, 2012c). Increasing the sweeping frequency, increasing the area of impervious cover swept, and upgrading sweeping equipment were found to potentially remove more pollutants.

The City has replaced some of its mechanical broom street sweepers with high-efficiency, regenerative air- and vacuum-assisted sweepers that are expected to improve pollutant load removal. The City has converted some of its routes in the ASBS 29 drainage area from mechanical to vacuum sweeping and begun sweeping selected median areas within the ASBS drainage area.

4.1.6 Sanitary Sewer Management

In 2001, the City initiated a sewer spill reduction program within the ASBS 29 drainage area, which included cleaning all 3,000 miles of the municipal sewerage system by 2004; developing a system-wide cleaning schedule; televising and assessing the condition of more than 1,200 miles of the oldest and most problematic sewer lines in the system; and increasing the number of miles of sewer lines that are replaced or rehabilitated from 15 to 45 miles per year. Between 2000 and 2007, the program reduced the number of spills by 79 percent (City, 2013g). The program's success has also reduced beach closures from sewer spills (City, 2013g) and associated bacteria entering ASBS 29. The City has a sewer overflow tracking and response plan to ensure that all sanitary sewer overflows are identified, responded to, investigated, and reported promptly and effectively.

The City has developed two residential and commercial programs targeted at reducing the introduction of materials that may impede or damage the sewer system:

- Residential Grease Disposal Program—The City provides residents with a cooking oil and grease recycling program at the Miramar Landfill Recycling Center and with educational materials on how to keep grease out of the drain; and
- Food Establishment Wastewater Discharge Program—This program controls the discharge of grease from food establishments into the wastewater collection system and requires a permit to do so; the permitting process requires that the facilities install the appropriate grease-removal equipment to trap cooking grease before it enters the wastewater system.

4.1.7 Smart Gardening and Water Conservation

To reduce runoff entering the MS4, the City provides various resources to promote smart gardening and to educate and inspire residents through exhibits and programs featuring water conservation and the sustainable use of related natural resources. The resources are available to residents and businesses in the ASBS 29 drainage area.

Specifically, these smart gardening and water conservation methods include:

- Vegetated Swales—Biofiltration BMPs reduce runoff velocities, which allows sediment and other pollutants to settle out (SDRWQCB, 2013a); biofiltration also absorbs nutrients and reduces peak runoff velocities;
- Bioretention Systems (Rain Gardens)—These landscaping features are adapted to treat storm water runoff on-site, and are typically applied to small sites; they function as soil- and plant-based filters that remove pollutants through a variety of physical, biological, and chemical treatment processes;
- Revegetation—Ornamental vegetation is replaced with native, drought-resistant vegetation, providing soil cover to reduce erosion, water use, and runoff; and

- **Water Conservation**—Expanded conservation programs aim to conserve water and prevent pollution by reducing the runoff entering the storm drain system; these include residential rainwater harvesting rebates, greywater information, resources for California-friendly landscape plants, residential water survey, and water conservation rebates and incentives, such as turf conversion and rebates for smart-irrigation controllers.

4.1.8 Education and Outreach

The City has multiple approaches to educating its residents, visitors and industry on ways to prevent pollution and protect local waterways within the ASBS 29 drainage area. Following are some elements and examples of how these programs are implemented.

Think Blue—The "Think Blue" outreach program works to educate residents, business owners, and industry leaders about the effects of storm water pollution and steps everyone can take to protect the environment. Think Blue works with community-based organizations and other government agencies to promote storm water pollution prevention. Information on general practices and impacts on water quality are available through guidebooks on the following topics:

– Wash water and irrigation runoff	– Pet waste disposal
– Construction activities	– Integrated pest management
– Trash storage and disposal	– Landscaping (green waste, pesticide use, and erosion prevention)
– Vehicle maintenance	

Project SWELL (Stewardship: Water Education for Lifelong Leadership)—This program is a school-based science curriculum that teaches children (through classroom presentations) about the importance of the region's waterways and how to understand and improve their condition (City, 2013f). It is administered through a partnership of the City, the San Diego Unified School District, and San Diego Coastkeeper (Coastkeeper).

Partnership with Coastkeeper—The City, in a partnership with Coastkeeper and SIO, developed full-color trifold brochures about the La Jolla ASBS with general information on ASBS issues, marine protected areas information, and pollution prevention practices for local businesses and residents. Approximately 2,000 brochures were distributed in 2006 to the community, and the brochure continues to be available to the public. (La Jolla Shores Watershed Management Group, 2008). At the City's Kellogg Park, Coastkeeper worked with The Friends of Kellogg Park to develop ASBS content for a permanent lithocrete (crushed glass in concrete) map installed in the concrete boardwalk. The map is an educational tool for the visitors of La Jolla Shores; provides information on the area's ecological, cultural, and conservation aspects; and easily and accessibly raises ASBS awareness.

Publically Available Data—Historical and current data are available to the public through the Southern California Coastal Ocean Observing System, which maintains a website with user-friendly interfaces and products (such as Google maps) to display coastal data interactively.

Enhance Education and Outreach—Based on results of an effectiveness survey and changing regulatory requirements, the City distributed information about minimum BMPs (including LID descriptions) through the public information processes of the City's Development Services Department, including BMP and LID descriptions. This information is available to anyone seeking development permits or information about development opportunities in the City. The Storm Water Division actively distributes fact sheets about BMP requirements as part of its code compliance and inspection functions, and makes this information available on the Division's Website and, as communication needs are refined, via other outlets.

4.1.8.1 Posted Requirements, Public Signage and Notifications

Signs or other appropriate measures are placed throughout the parks, beaches and visitor centers that inform and educate the public of any applicable requirements of the General Exception and identify the ASBS boundaries.

City of San Diego regulation signs that prohibit alcohol use, glass containers, smoking, littering, disturbing noises, and overnight sleeping, camping, or parking are placed at beaches, cliffs, walkways, park areas, and adjacent parking lots within the ASBS 29 drainage area. These regulation signs also explain restrictions on beach fires and pets.

At Kellogg Park, 22 regulations are posted at the corners of the park that have access to the grassy areas, at picnic areas, at all but one beach entrance (behind Lifeguard Tower 32), and at the small vessel boat launch at the end of Avenida de La Playa. Additionally, "No Littering" and "Clean up After Your Pet" signs are posted at Cliffridge Park. At Allen Field, all organized activities must be coordinated through La Jolla Youth, Inc., which conveys to users, along with signage at the park, the prohibition of litter. Dogs are also prohibited at Allen Field.

4.1.8.2 Posted ASBS Boundaries

A large lithocrete map depicting the coastal waters of the ASBS is featured at Kellogg Park/La Jolla Shores Beach Park, between the playground and the bathrooms, at the southern end. It depicts the intertidal, nearshore, and offshore species of the ASBS, as well as ASBS boundaries, coastal geologic features, and geographic coordinates of the area, all designed for pedestrian access.

Species found in the ASBS are represented on the lithocrete map by their physical features, as shown in Figure 4-1, and are numbered to correspond with photographs on a board near the water fountains at the restroom facilities. This numbering system is also used in the children's play structure to promote further ASBS education.



Figure 4-1: Portion of the Lithocrete Map at La Jolla Shores Beach

Preservation of the marine environment is encouraged through placards within and around the lithocrete map that inform visitors of the locations of the preserves and of the regulation that “nothing may be disturbed or taken without a permit; plant and invertebrate, water quality, archeological and cultural resources protected by law.”

The southern end of Kellogg Park has a children's playground with swings and a play structure on the sand. The structure incorporates aspects of environmental education and stewardship of the ASBS, and also teaches ocean safety through interactive informational displays of the ASBS and local marine life.

At the La Jolla Shores small vessel boat launch (see Section 2), signs provide notice of the La Jolla Underwater Park and Ecological Preserve and the La Jolla State Marine Conservation Area, and specify the state restrictions for the area. The lifeguard station at La Jolla Shores Beach has a large sign on its eastern wall that describes in detail the La Jolla Underwater Park and a map of that shows the ASBS boundaries (Figure 4-2).



Figure 4-2: Sign Posted at La Jolla Shores Beach Lifeguard Station

4.1.9 Management of Pesticides and Other Chemicals

The City's integrated pest management program provides resources and educational information on pest control and proper lawn care to reduce the use of pesticides throughout the City. The City encourages using native plants in landscaping to reduce pesticide, fertilizer and water usage within the ASBS 29 drainage area. The City promotes the following tips to maintain a healthy yard with minimal fertilizers, herbicides, insecticides, or other chemicals:

- When fertilizing, use no more than 3–6 pounds of nitrogen per 1,000 square feet per year;
- Routinely inspect and repair sprinkler heads;
- Aerate lawns annually and remove thatch if it exceeds ½ inch;
- Plant grass species that do well in the area;
- Irrigate deeply and infrequently; and
- Cut only one-third to one-half of grass height at each mowing and keep lawnmower blades sharp.

The City collaborates with the University of California's Agriculture and Natural Resources Statewide Integrated Pest Management Program (UC IPM). This program provides extensive online resources about home and landscape pests, weeds and pesticides. The program also provides online training, events and workshops on pesticide safety. UC IPM offers interactive tools (such as weather models) to help plan and to base pest management decisions on site conditions.

The City also works with the County of San Diego to promote the safe use of pesticides at their parks and recreation facilities and to promote the use of effective biocontrol measures. If pesticides must be used, the City offers these tips to reduce their effects on local waterways (City, 2013a):

- Choose an insecticide based on the targeted pest, preferably the least toxic option;
- Don't apply pesticides indoors to areas that will be washed with water or where food is prepared or stored;
- Determine the right amount of pesticide to purchase and use;
- Don't over-water after applying outdoor pesticides;
- Never let pesticide runoff flow into storm drains;
- Don't apply indoor pesticide into or near floor drains or sinks;
- Use spot treatments whenever possible;
- Don't apply pesticides outdoors when rain is forecast or when it is windy; and
- Don't apply pesticides on paved areas.

4.1.10 Enhanced Implementation of Low-Impact Development Through Land Development Code Amendments

SUSMP and Land Development Code ordinances outline low-impact development (LID) requirements that minimize impervious surfaces and promote infiltration and evaporation of runoff using natural filters, which mimic the natural hydrologic functions. Retained water can also be used for reuse. In some cases, existing City Land Development Codes and policies create barriers to LID. Updating City development codes, in this instance, has been a multiple-year process that began with a pilot study that assessed opportunities to implement LID measures.

The City's Storm Water Division undertook a review of the City's Municipal Code, ordinances and policies to identify opportunities to facilitate using LID storm water management measures. The review identified and prioritized opportunities for storm water LID site planning and design implementation within the ASBS 29 drainage area, and recommended amendments to the City's current policies and codes. Amending these policies and the Land Development Code will enhance LID implementation for both new development and redevelopment by amending zoning, which is expected to better control pollutant sources. The next step is to proceed with the City's discretionary review process to codify the accepted recommended changes.

In FY 14–15, the City gathered input from the following City and stakeholder groups:

- Code Monitoring Team.
- Technical Advisory Committee.
- Community Planners Committee.
- Planning Commission. and
- City Council (final City approval).

Once the City process has been completed, the California Coastal Commission will review the proposed code changes for approval and application within the Coastal Zone, which is anticipated to take 15–18 months.

4.1.11 Land Development Code and Enforcement

This BMP is a catch-all category for updating required minimum BMPs as standards based on the requirements of the new MS4 Permit. The City is currently updating its minimum BMPs and prohibitions for residential, commercial and industrial uses.

4.1.11.1 Construction Activities

The Construction General Permit applies to any construction project in the ASBS 29 drainage area that disturbs one or more acres of soil, or disturbs less than one acre but is part of a larger common plan of development that in total disturbs one or more acres. Such projects are required to obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction and Land Disturbance Activities, Order 2009-0009-DWQ (SWRCB, 2009) (Construction General Permit).. This permit requires developing and implementing a SWPPP that contains a plan to prevent erosion and control sediment delivery to the MS4. The SWPPP must list BMPs that the discharger will use to treat or minimize storm water runoff and specify the placement of those BMPs. These regulations help control sediment discharge from construction activities.

The City's *Storm Water Standards Manual* (City, 2012b) specifies permanent and construction-phase storm water quality requirements for the following project types and phases:

- Private projects processed through the City's Development Services Department, and
- Capital improvement projects processed through the City's Engineering and Capital Projects Department.

The *Storm Water Standards Manual* further guides developers in selecting, designing and incorporating BMPs that help address construction erosion and sediment control.

The JURMP specifies construction-related BMPs that are required for activities associated with operations and maintenance.

4.1.11.2 Coastal Bluffs and Open Space Areas

Development on coastal bluffs is subject to the environmentally sensitive land regulations in the City Municipal Code, which are intended to “assure that development occurs in a manner that protects the overall quality of the resources and the natural and topographic character of the area, encourages a sensitive form of development, retains biodiversity and interconnected habitats, maximizes physical and visual public access to and along the shoreline, and reduces hazards due to flooding in specific areas while minimizing the need for construction of flood control facilities” (City, 2012d). Private property owners in the ASBS 29 drainage area are responsible for assessing their property’s erosion problems and taking appropriate protection.

4.2 Implemented Structural BMPs

This section describes the structural BMPs, including LID measures that are currently in use by the City. To control storm water discharge to the MS4 during a design storm⁴, dischargers must first consider using on-site LID practices to infiltrate, use or evapotranspire storm water runoff.

LID emphasizes conservation and use of on-site natural features to protect water quality. LID can significantly increase the protection of water quality by using engineered, small-scale controls that replicate the pre-development hydrologic regime of watersheds by infiltrating, storing, evaporating, and detaining runoff close to its source. The City developed the *LID Design Manual* (City, 2011) to provide guidance for planning, designing and implementing LID BMPs for street improvement, new public streets and development and redevelopment of city parks and recreation facilities. The Design Manual provides clear guidance to planners, design engineers, plan reviewers, inspectors, and maintenance staff for designing and implementing LID practices and for tailoring design standards and recommendations to the unique climate and geography of the San Diego area, including the ASBS 29 drainage area.

Structural BMPs are built into the development at the site scale, and large-scale structural BMPs receive flows from neighborhoods or regions and often serve the dual purpose of both flood control and groundwater recharge. These BMPs are often in public spaces and can be co-located in parks or green spaces.

Figure 4-3 provides an overview of all implemented structural BMPs in the ASBS 29 drainage area. Structural BMPs are described in Sections 4.2.1 through 4.2.3.

4.2.1 Low-Flow Diversions

In 1997, storm drain outfalls along the coastline were inventoried and prioritized by their potential for human contact with flow from the drain (i.e., flow crossing the beach). Outfalls were labeled by street name location, and those with high or medium contact potential were studied to determine the feasibility and cost of diverting low flows to the wastewater collection system.

⁴ A design storm is a storm event of a specified size that is used to determine the required treatment capability of a BMP based on calculated runoff volumes and peak discharge rates.

Low-flow diversions are structures that redirect dry weather urban runoff into the sanitary sewer system, where the runoff then receives the same treatment as sewer water. The City has installed low-flow storm drain diversion systems in phases to serve the coastlines of the La Jolla, Pacific Beach and Ocean Beach areas. Installation of dry weather flow diversions is a BMP implementation strategy to meet the General Exception's prohibition of dry weather flows and reduces loading of pollutants by capturing and treating runoff.

The City has nine low-flow diversions installed within the ASBS 29 drainage area, as shown in Figure 4-3. The locations of installed low-flow diversions are:

- Corner of Spindrift Avenue and Roseland,
- Avenida de la Playa and Paseo del Ocaso,
- Vallecitos and Camino del Oro,
- Along Camino del Oro near La Jolla Shores Drive,
- 8555½ El Paseo Grande,
- 7920 Princess Street,
- 1624 Torrey Pines Road,
- Corner of Torrey Pines Road and Charlotte, and
- Corner of Camino del Oro and El Paseo.

The City will monitor low-flow diversion measures on the downstream side of the diversion to verify zero flow beyond the diversion and into ASBS 29.

4.2.2 Low Impact Development “Green Lot” Project at Kellogg Park

At Kellogg Park, the City has implemented the Green Lot Retrofit Project to allow infiltration of urban runoff by replacing a portion of the conventional asphalt in the parking lot with porous pavement and other infiltration areas. The northern and southern ends of the parking lot were replaced with porous pavement, and the western perimeter was upgraded with a decomposed granite planter area that runoff can flow into and infiltrate. The parking lot is also planter-bed-landscaped with native, drought-tolerant vegetation. This retrofit project addresses potential water quality problems by reducing and treating runoff flows and discharges to ASBS 29 via infiltration and retention.

4.2.3 Treatment Control Best Management Practices

TCBMPs are permanent storm water treatment features that are incorporated into the design of newly developed or redeveloped properties, and are installed to meet the City's SUSMP requirements. Currently, there are 10 private TCBMP projects in the ASBS 29 drainage area, each with varying numbers and types of BMPs (see Figure 4-3 and Table 4-2). The types of TCBMPs within the ASBS 29 drainage area include vegetated swales, drainage inserts, filtration systems, and infiltrations basins/trenches.

A vegetated swale is a broad, shallow channel with a dense stand of vegetation covering the side slopes and bottom (USEPA, 1999). They are designed to trap particulate pollutants (suspended solids and trace metals), promote infiltration and reduce the flow velocity of storm water runoff (USEPA, 1999). Drainage inserts are manufactured filters or fabric placed in a drop

inlet to remove sediment and debris (CASQA, 2003). Filtration systems treat storm water runoff by using various types of filtration media including sand, vegetation, and/or some other absorptive filtering media. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives storm water runoff. Runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix (CASQA, 2003). An infiltration basin is a shallow impoundment that is designed to infiltrate storm water. Infiltration basins use the natural filtering ability of the soil to remove pollutants in storm water runoff (CASQA, 2003).

Table 4-2: Treatment Control Best Management Practices in ASBS 29 Drainage Area

Project Name	Number of BMPs by Type			
	Drainage Insert	Filtration Systems	Grass/Vegetated Swale	Infiltration Basin or Trench
Arellano Grading/Paul Residence	—	1	—	—
Bondy Residence	3	—	—	—
Chenango Residence	1	—	—	—
Hawley Residence	7	—	—	—
Hazard Residence	—	—	—	1
Liu Residence	1	—	—	—
Mashayekan Residence	1	—	—	—
Rosen Residence	1	—	—	—
Schroeder Residence	1	—	—	—
Spindrift Drive Residence (04)	—	—	1	—

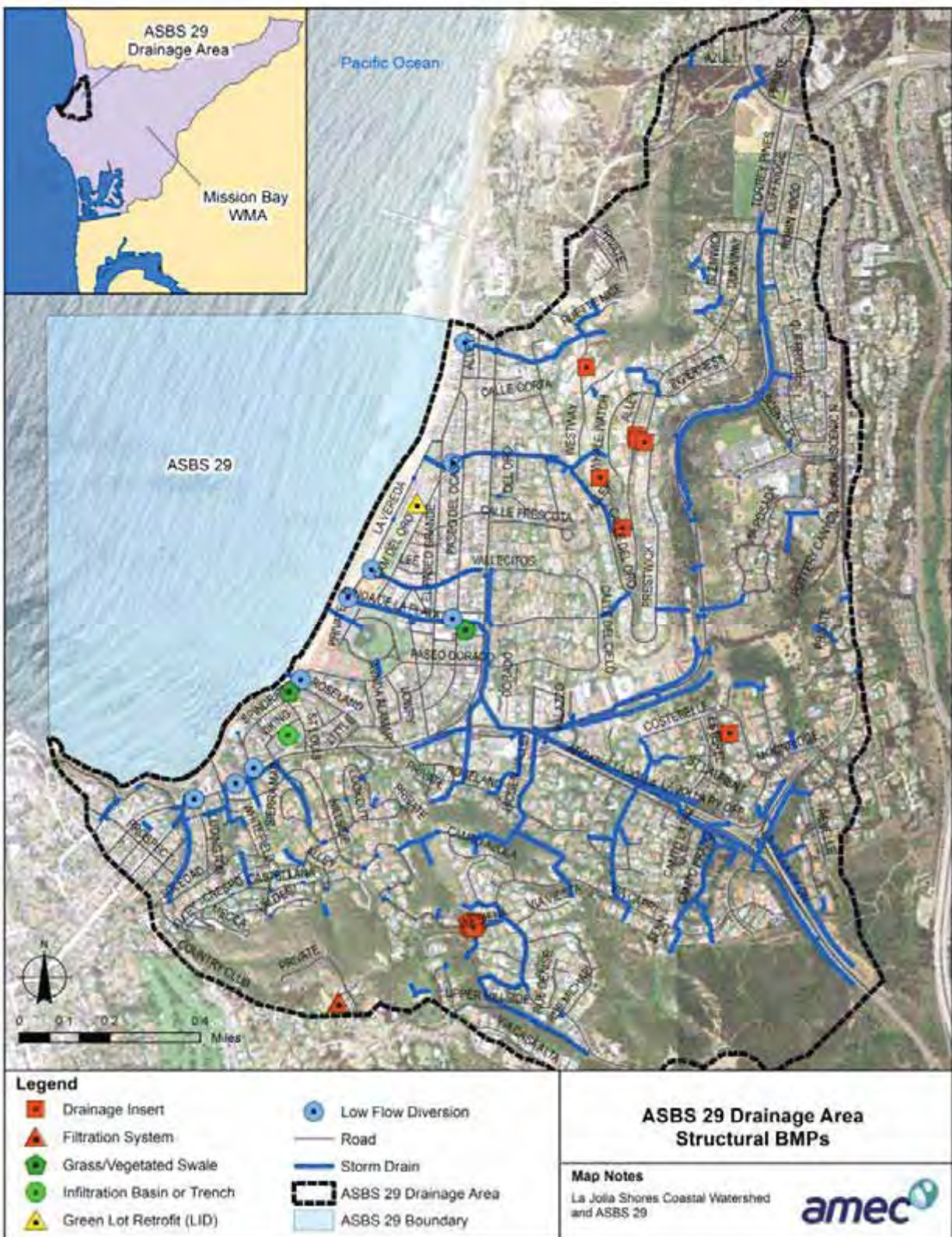


Figure 4-3: Structural Best Management Practices Implemented in ASBS 29

4.3 Planned Continuation of Existing Best Management Practices

The Scripps Watershed CLRP was prepared and submitted to the SDRWQCB in 2012 and updated in 2013 (City, 2013d). The CLRP was developed as an integrated water quality plan that combines multiple permit-based and voluntary strategies and BMPs into a comprehensive approach to compliance with the Bacteria TMDL (SDRWQCB, 2010). The CLRP also integrates considerations for addressing General Exception regulations for the Scripps Watershed (a portion of the Mission Bay WMA) and the adjacent ASBS 29.

The City, as the sole responsible party in the Scripps Watershed (except for UCSD), will use the CLRP to develop watershed implementation programs, evaluate their effectiveness, and make adjustments over the anticipated 20-year implementation period of the Bacteria TMDL. The prioritization process for implementing BMPs carefully considers many factors, including feasibility, cost-effectiveness, social and other impacts, and the potential to reduce pollutant loads. These factors have been considered and analyzed as part of the CLRP development process for each individual management practice. Prioritization allows earlier implementation of the BMPs that have the highest feasibility, highest cost-effectiveness and greatest potential to reduce loads. The forthcoming Mission Bay Watershed WQIP (due in June 2015) will incorporate the CLRP, and will supersede and serve as the CLRP upon its adoption by the SDRWQCB.

Water quality target levels for BMP design in the General Exception are (a) Table B, Instantaneous Maximum Water Quality Objectives in Chapter II of the Ocean Plan, or (b) a 90 percent reduction in pollutant loading during storm events for the City's total discharges.

The Scripps Watershed CLRP made recommendations regarding non-structural and structural BMPs for load reductions in the watershed, a subset of which are applicable to BMP recommendations for the La Jolla Watershed required by the General Exception. However, when the dilution factor of 12.6:1 (see Section 3.2) is incorporated into the CLRP analysis, the results indicate that the necessary pollutant load reductions required by the General Exception are being achieved by the non-structural and structural BMPs currently implemented by the City. Based on these results, no further non-structural or structural BMPs are necessary. However, currently implemented BMPs are planned to continue at their current level. Furthermore, based on the requirement of the General Exception to cease all dry weather discharges, the currently installed low-flow diversions and non-structural BMPs were implemented by the compliance date of September 20, 2013.

5.0 Compliance and BMP Implementation Schedule

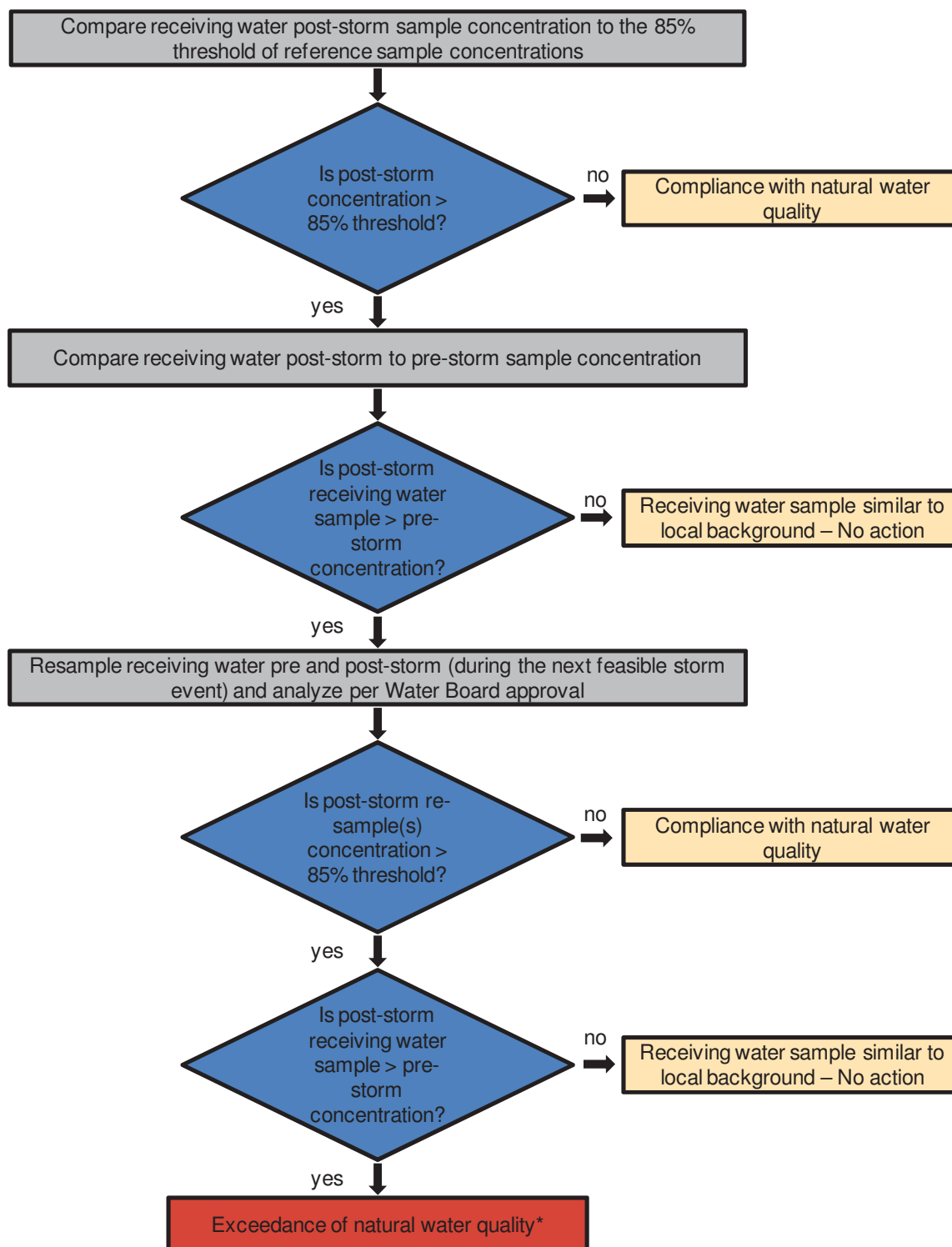
5.1 Compliance and Implementation Schedule

Based on data collected under the Bight '08 and Bight '13 Regional Monitoring Surveys, the *La Jolla ASBS Dilution Study* (discussed in Section 3.2), and analysis provided in the Scripps Watershed CLRP (discussed in Section 4.0), the City's current level of non-structural and structural BMP implementation complies with the General Exception requirement to protect natural water quality. Low-flow diversions currently installed at nine locations are intended to eliminate non-storm water discharges to ASBS 29. The implementation schedule deadlines for the City, in accordance with the General Exception, are as follows:

- **March 20, 2012:**
 - Non-authorized discharges to ASBS 29 were effectively prohibited. **(complete)**
- **September 20, 2013:**
 - The City submitted a Draft ASBS Compliance Plan for ASBS 29 to the SWRCB Executive Director and the SDRWQCB Executive Officer. **(complete)**
 - Non-structural controls were implemented. **(complete)**
- **September 20, 2014:**
 - The City shall submit the Final ASBS Compliance Plan for ASBS 29 with a schedule for structural controls based on the results of monitoring runoff and receiving water. **(on schedule)**
- **March 20, 2018:**
 - Dischargers must comply with the requirement that their discharges into the affected ASBS maintain natural ocean water quality (within the 85th percentile threshold of reference water quality data and pre-storm levels). If results exceed this threshold, see the flowchart in Figure 5-1 for appropriate actions. **(on schedule)**

The City has met the compliance dates for prohibiting non-authorized discharges to ASBS 29 and implementing non-structural controls. To continue compliance with the General Exception, the City plans to maintain and implement existing BMPs as described in Section 4, and to continue monitoring in the ASBS per the General Exception.

According to Section I.A.2 of the General Exception, the Compliance Plan is to be included in the discharger's WQIP (equivalent to a SWMP or SWPPP). The City shall submit the Final WQIP for the Mission Bay WMA on June 27, 2015, which will include this Compliance Plan.



*Note: When an exceedance of natural water quality occurs, the discharger must comply with Section I.A.2.h (for permitted storm water) or Section I.B.2.C (for non-point sources). Note, when sampling data are available, end-of-pipe effluent concentrations will be considered by the Water Boards in making this determination.

Source: General Exception, Attachment 1

Figure 5-1: Flowchart to Determine Compliance with Natural Water Quality

5.2 Required Reporting of Water Quality Exceedances

If the results of receiving water monitoring (described in Section IV.B of the General Exception) indicate that wet weather discharges that include storm water are causing or contributing to an alteration of natural water quality in the ASBS, the City must submit a report to the SDRWQCB within 30 days of receiving the analytical results. (See Figure 5-1 for determining compliance.)

The report must:

- Identify the constituents in storm water that alter natural water quality and the potential sources of those constituents;
- Describe BMPs that are currently being implemented, BMPs that are identified in the ASBS Compliance Plan for future implementation, and any additional BMPs that may be added to the ASBS Compliance Plan to address the alteration of natural water quality; and
- Include a new or modified implementation schedule.

Within 30 days of approval of the report by the SDRWQCB, the City must revise its ASBS Compliance Plan to incorporate any new or modified BMPs that have been or will be implemented, the implementation schedule, and any additional monitoring required. Non-structural BMPs must be implemented within one year of the approval (by the SWRCB or SDRWQCB) of the revised ASBS Compliance Plan. Structural BMPs must be implemented as soon as practicable.

As long as the City has complied with the procedures described above and is implementing the revised ASBS Compliance Plan, the City is not required to repeat the same reporting procedure for continuing or recurring exceedances of natural ocean water quality conditions that are due to the same constituent.

5.3 Modifications of This Compliance Plan

The ASBS Compliance Plan is a dynamic document that may be edited or updated as needed. Any updates, alterations, modifications, or amendments to the document must be submitted to the SDRWQCB for its approval. The plan will be modified when changes occur that directly affect the purpose (Section 1.2), receiving water quality conditions (Section 5.2), or activities of this ASBS Compliance Plan.

This section provides the procedure for notifying the SDRWQCB of any technical changes that the City seeks to make and for seeking a formal modification. This section is not intended to be an exhaustive review of all aspects of modification, but is meant to provide a basis for updating or modifying this plan in a manner that recognizes the plan's objective of protecting natural water quality in ASBS 29. A modification to this document is intended to be an efficient mechanism for notifying the SDRWQCB of a proposed change to the plan set forth in this document and for providing data to support the change.

A proposed modification shall include:

- A narrative justification that describes in detail all changes and the reasons they are necessary; and
- A form that includes, at a minimum, a summary of or an excerpt from the modified (new) text and information, and the previous text and information, with their location(s) in the document.

With the narrative justification, the City shall:

- Submit a cover letter on the agency's letterhead, signed by a City representative;
- Describe the changes;
- Discuss and justify the necessity for the change(s); and
- Identify and explain how the implications of the modification will affect components of the ASBS Compliance Plan.

The City must submit one signed original copy of the modification documents to the SDRWQCB Executive Officer to maintain its compliance status.

5.3.1 Non-Substantive Revisions

Non-substantive revisions are changes that do not affect the purpose of the ASBS Compliance Plan but relate to matters addressed in the requirements of Section 1.A.2 of the General Exception. Examples of such non-substantive changes include, but are not limited to:

- Typographical errors in the ASBS Compliance Plan or underlying documentation; and
- Change in department name, where there is no change in ownership or responsibility.

The City shall give the SDRWQCB notice of such non-substantive changes promptly in writing whenever the need for a non-substantive revision is recognized. An addendum sheet to the document shall summarize all updates to the ASBS Compliance Plan and shall be provided to the SDRWQCB. Although non-substantive revisions do not require approval of the SDRWQCB, it may reply, indicating agreement or disagreement that the change is non-substantive. All non-substantive modifications will be included as part of the modification summary for the next following formal modification.

5.3.2 Alteration of Natural Water Quality and Non-Storm Water Flows

As discussed in Section 5.2, monitoring results that indicate that wet weather MS4 discharges cause or contribute to an alteration of natural water quality shall be reported to the SDRWQCB within 30 days. Within 30 days of approval of the report by the SDRWQCB, the City shall revise its ASBS Compliance Plan, as described in Section 5.3.

If applicable, the revised ASBS Compliance Plan shall describe the measures by which non-storm water discharges will be eliminated and any interim measures that will be employed to reduce non-storm water flows until the final measures have been implemented.

6.0 REFERENCES

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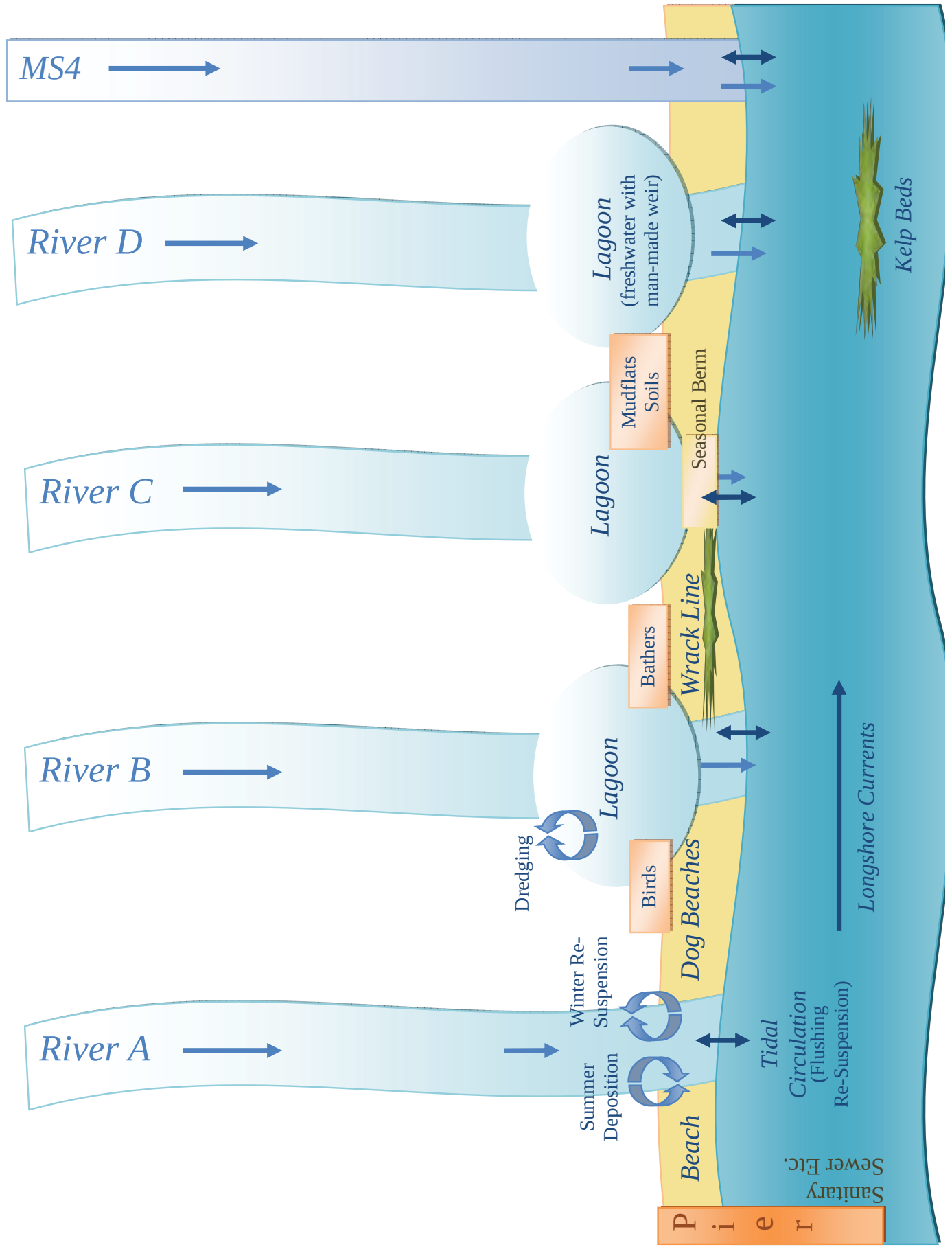
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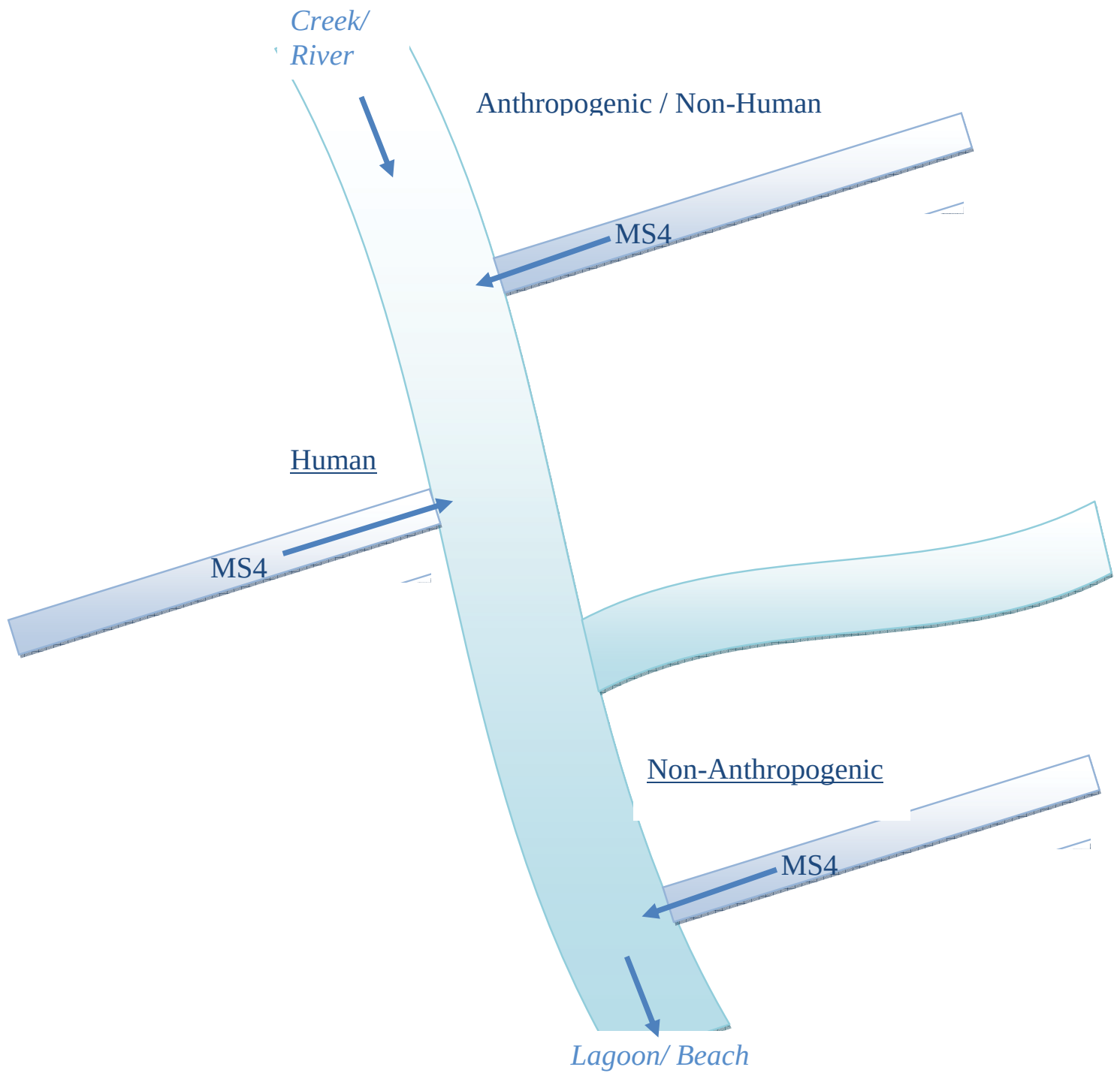
APPENDIX H

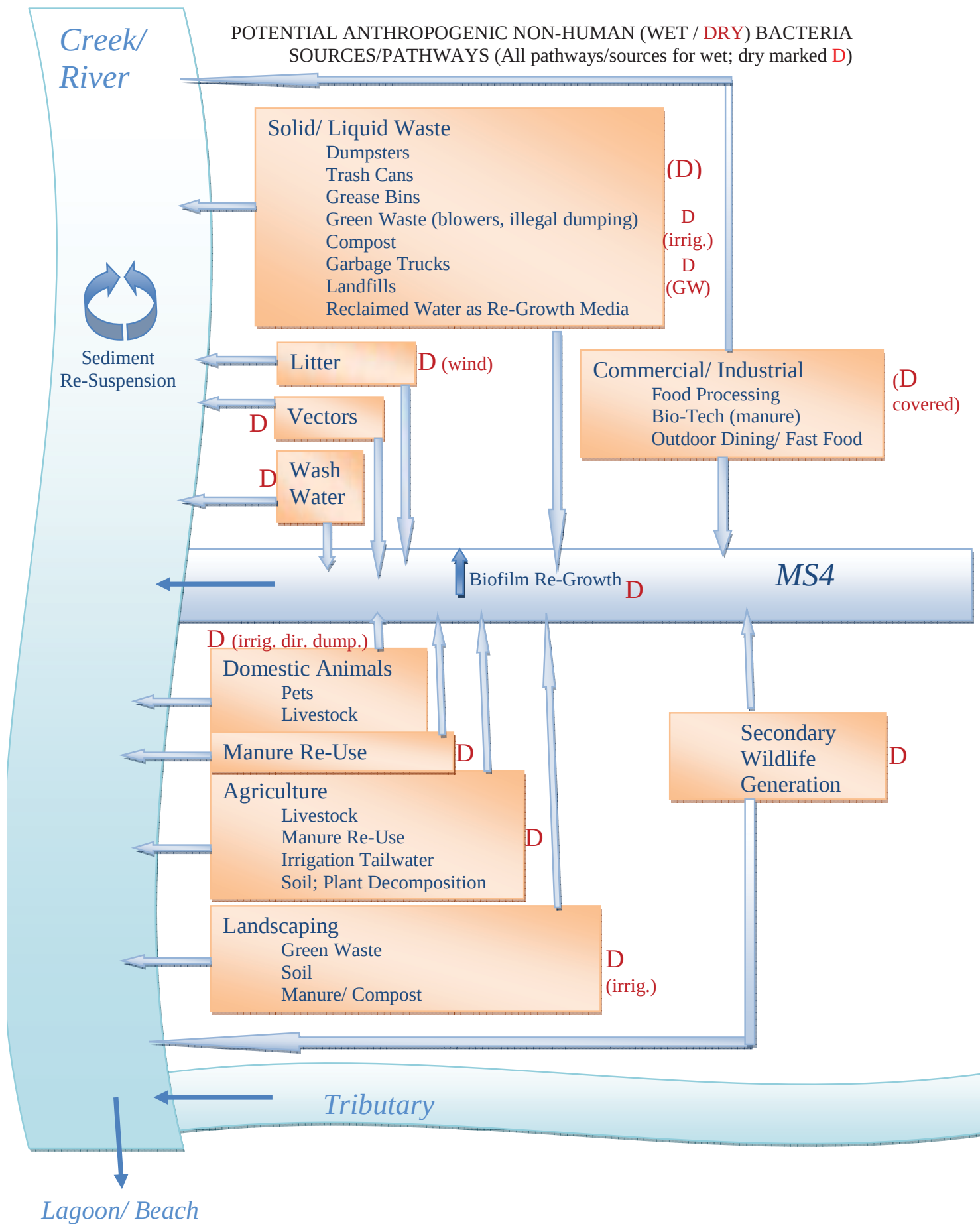
Bacterial Conceptual Models and Literature Review

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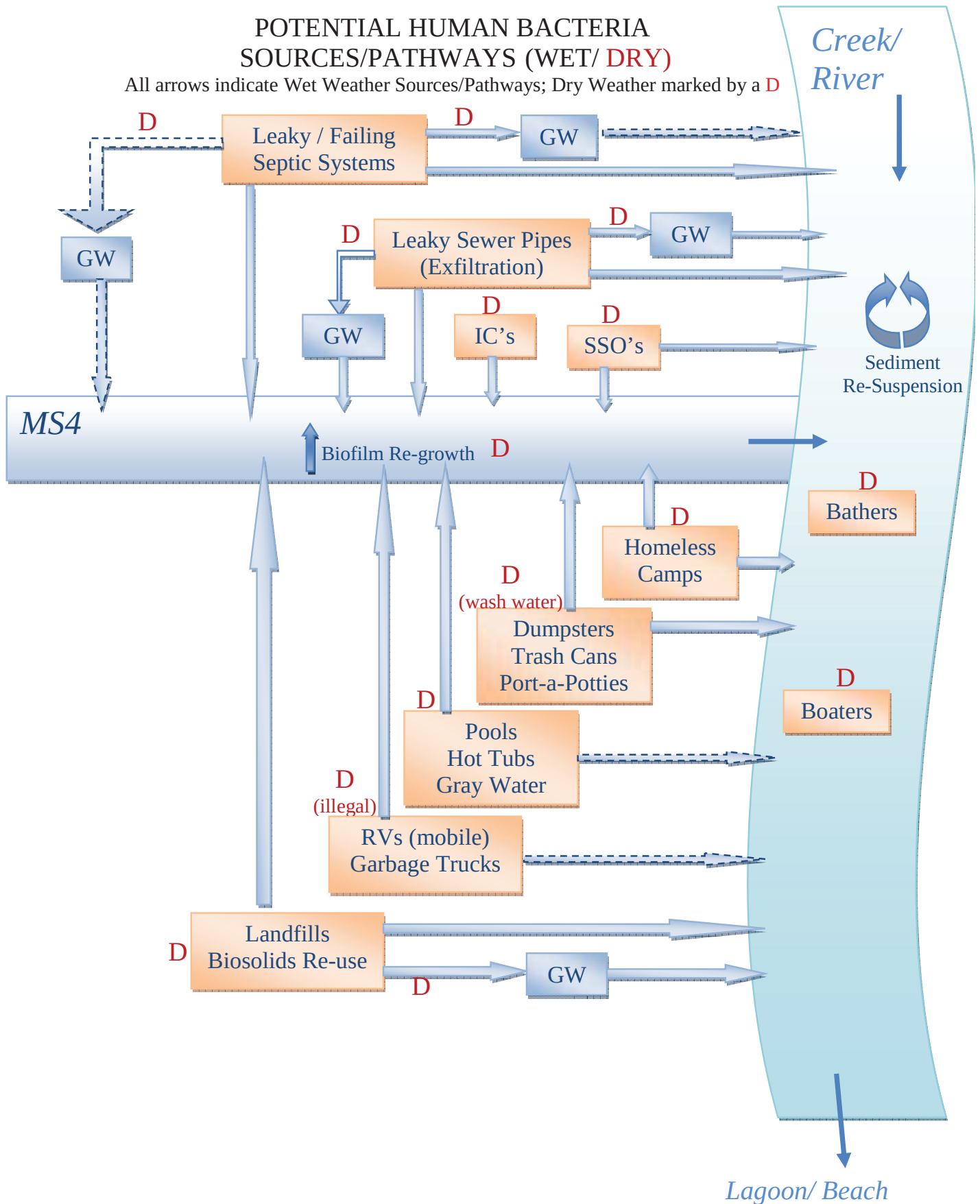
Conceptual Overview of Bacteria Sources



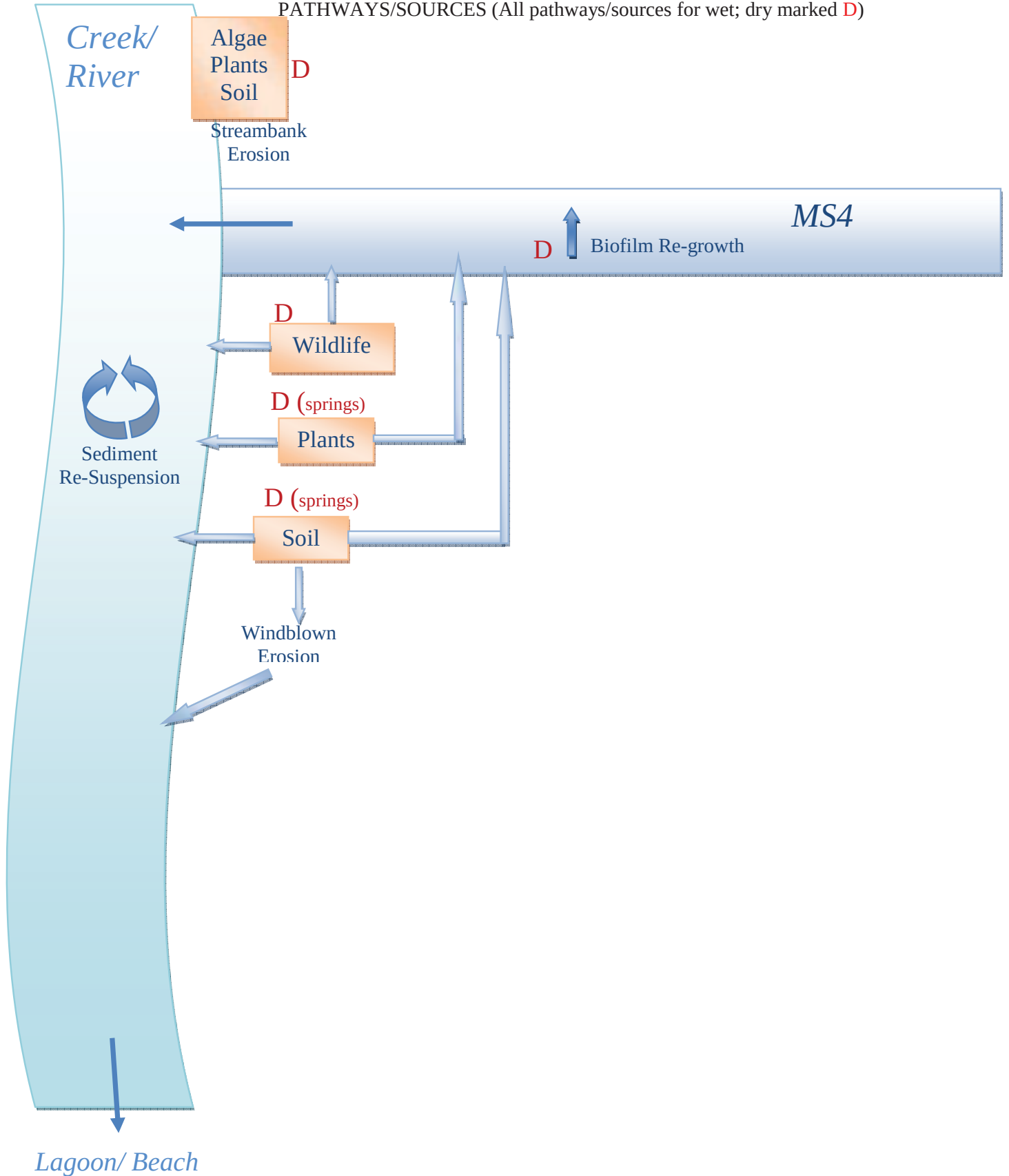


POTENTIAL HUMAN BACTERIA SOURCES/PATHWAYS (WET/ DRY)

All arrows indicate Wet Weather Sources/Pathways; Dry Weather marked by a **D**



POTENTIAL NON-ANTHROPOGENIC WET/ **DRY** BACTERIA
PATHWAYS/SOURCES (All pathways/sources for wet; dry marked **D**)



DRAFT TECHNICAL MEMORANDUM
Summary of Literature Review, Bacteria Source Identification
March 12, 2012

Prepared by: Armand Ruby Consulting in Association with AMEC

This Technical Memorandum summarizes work performed under Task 2, Literature Search and Data Review, for the County of San Diego Bacterial Indicators Source Identification Services Project. The work was overseen by a workgroup of San Diego County Stormwater Copermittee representatives, and included communication with scientists who have expertise in bacteria source tracking and identification. The literature review focused on identifying and summarizing studies that quantify sources and sinks for bacterial constituents in urban watersheds, and was international in scope.

The work products delivered for this task include this technical memorandum, a separate spreadsheet summary of each study/report reviewed, and a compilation of reviewed studies/reports on the AMEC ftp site:

<ftp://ftp.mactec.com/Incoming/Copermittee%20Bact%20Lit%20Review/>

The entries in this memorandum are ordered alphabetically by last name of primary author. Each entry begins with the study number (for cross-referencing back to the spreadsheet matrix), followed by the study title. Web links are provided when available.

A number of studies were found that contained information on indicator bacteria but did not include specific information related to source identification within urban watersheds. These studies are summarized as NSC (Not Source Characterization) studies, beginning on p. 53.

The “Bacteria Source ID Lit Review Matrix” Excel workbook contains the following worksheets:

- The “Source ID Studies Summary Table” worksheet contains summaries of all studies reviewed and found to have useful information on bacteria sources; for each of these studies, any identified sources are indicated as Probably, Potential, Low or Suspected (see “Legend” worksheet for definitions)
- The “# Citations by Source” worksheet contains a tally of the numbers of studies with identified information on each source type
- The “Sources Summary Table” worksheet contains condensed summaries of the studies that have information on each particular source type
- The “Data Summary Table” worksheet contains brief summaries of study data (this is a work in progress)
- The “NSC Studies” worksheet provides summaries of the NSC (Not Source Characterization) studies

56 - Human and bovine adenoviruses for the detection of source-specific fecal pollution in coastal waters in Australia

Warish Ahmed, A. Goonetilleke, and T. Gardner

http://eprints.qut.edu.au/37690/1/Human_and_bovine_adenoviruses_for_the_detection_of_source-specific_fecal_pollution_in_coastal_waters_in_Australia.pdf

Purpose - To enhance the scientific foundation for preemptive public health warnings, examine the relationship between rainfall and beach indicator bacteria concentrations using five years of fecal coliform data taken daily at 20 sites in southern California.

Results - There was a clear relationship between the incidence of rainfall and reduction in beach bacterial water quality in Los Angeles County. Bacterial concentrations remained elevated for five days following a storm, although they generally returned to levels below state water quality standards within three days. The length of the antecedent dry period had a minimal effect on this relationship, probably reflecting a quickly developing equilibrium between the decay of older fecal material and the introduction of new fecal material to the landscape.

Sources:

Probable –Septic (human waste), bovine (domestic animals), animal farms (agriculture),

Potential -

Possible -

31 - Evaluation of Multiple Sewage-Associated Bacteroides PCR Markers for Sewage Pollution Tracking

Warish Ahmed, A. Goonetilleke, D. Powell, and T. Gardner

<http://eprints.qut.edu.au/29217/1/c29217.pdf>

Purpose - The host specificity of the five published sewage-associated Bacteroides markers (i.e., HF183, BacHum, HuBac, BacH and Human-Bac) was evaluated in Southeast Queensland, Australia by testing fecal DNA samples (n = 186) from 11 animal species including human fecal samples collected via influent to a sewage treatment plant (STP).

Results - For the 5 sewage-associated markers tested in this study, the HF183 marker performed better than others. This marker showed 99% specificity to distinguish between the sources of human and animal fecal pollution. The performance of the five markers in terms of specificity was HF183 > BacHum > BacH > Human-Bac > HuBac.

78 - Detection and source identification of faecal pollution in non-sewered catchment by means of molecular markers host-specific

Warish Ahmed, D. Powell, A. Goonetilleke, and T. Gardner

<http://s3.amazonaws.com/publicationslist.org/data/w.ahmed/ref-23/WST%20Article.pdf>

Purpose - To validate the previously published host-specific PCR markers (i.e. HF183, HF134, CF128, BacCan and esp) for the detection of sources of faecal pollution by testing a large number of faecal samples from 13 host groups in Southeast Queensland, Australia.

Results - All 197 faecal samples (100%) from the 13 host groups were positive for general Bacteroides. Of the 42 (i.e. 30 sewage and 12 septic samples) sewage/septic samples tested, all were positive for the human-specific HF183 and HF134 Bacteroides markers. The HF183 marker could not be detected in any faecal samples from animal host groups suggesting that the suitability of this marker to detect human faecal pollution. In contrast, the HF134 marker was detected in 7 (35%) samples from dogs. The presence of this marker in dogs could be due to the transfer of faecal bacteria between human and their companion pets (Dick et al. 2005).

79 - Evaluation of Bacteroides markers for the detection of human faecal pollution

Warish Ahmed, J. Stewart, D. Powell, and T. Gardner

<http://onlinelibrary.wiley.com/doi/10.1111/j.1472-765X.2007.02287.x/pdf>

Purpose - Evaluating the specificity and sensitivity of human-specific HF183 and HF134 Bacteroides markers in various host groups and their utility to detect human faecal pollution in storm water samples collected from non-sewered catchments in Southeast Queensland, Australia.

Results - The specificity and sensitivity of the HF183 and HF134 Bacteroides markers was evaluated by testing 207 faecal samples from 13 host groups, including 52 samples from human sources (via sewage and septic tanks). Polymerase chain reaction analysis of these samples revealed the presence/absence of HF183 and HF134 across these host groups, demonstrating their suitability for distinguishing between human and animal faecal pollution. The HF183 marker was found to be more reliable than that of HF134, which was also found in dogs.

35 - Quantitative PCR assay of sewage-associated Bacteroides markers to assess sewage pollution in an urban lake in Dhaka, Bangladesh

Warish Ahmed, R. Yusuf, I. Hasan, A. Goonetilleke, and T. Gardner

[http://eprints.qut.edu.au/37689/1/Quantitative_PCR_assay_of_sewage-associated_Bacteroides_markers_to_assess_sewage_pollution_in_an_urban_lake_in_Dhaka, Bangladesh.pdf](http://eprints.qut.edu.au/37689/1/Quantitative_PCR_assay_of_sewage-associated_Bacteroides_markers_to_assess_sewage_pollution_in_an_urban_lake_in_Dhaka_Bangladesh.pdf)

Purpose - To assess the magnitude of sewage pollution in an urban lake in Dhaka, Bangladesh by using Quantitative PCR (qPCR) of sewage-associated Bacteroides HF183 markers.

Results – From the 20 water samples tested, 14 (70%) and 7 (35%) were PCR positive for the HF183 and CF128 markers, respectively. The high numbers of enterococci and the HF183 markers indicate sewage pollution.

Sources:

Probable - Slum-like establishments (human waste), MS4 Infrastructure (human waste),

Potential -

Possible – Dogs and cows

139 - Coastal water quality impact of storm water runoff from an urban watershed in Southern California

Jong Ho Ahn, S.B. Grant, C.Q. Surbeck, P.M. DiGiacomo, N.P. Nezlin, and S. Jiang

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/528_B03_WQ_Appendix_I.pdf

Purpose - Assess the coastal water quality impact of storm water runoff from the Santa Ana River, which drains a large urban watershed located in southern California. This is the first wet weather study to examine the linkage between water quality in the surf zone -- where routine monitoring samples are collected and most human exposure occurs -- and water quality offshore of the surf zone.

Results - Storm water runoff from the Santa Ana River negatively impacts coastal water quality, both in the surf zone and offshore. However, the extent of this impact, and its human health significance, is influenced by numerous factors, including prevailing ocean currents, within-plume processing of particles and pathogens, and the timing, magnitude and nature of runoff discharged from river outlets over the course of a storm.

Sources:

Probable - Slum-like establishments (human waste), MS4 Infrastructure (human waste),

Potential -

Possible – Dogs and cows

17 - Lower San Luis Rey River Bacteria Source Identification Study

AMEC, UNC, City of Oceanside, SCCWRP, and USC

Purpose - The goal of the Project was to identify hot spots of fecal indicator bacteria; identify potential sources and prioritize those sources and locations for future bacteria reductions through management measures.

Results - There is evidence of the human-related bacterial sources throughout the river system. Sediment in the river mouth is a contributing source of fecal bacteria to the water column when the river mouth is closed to tidal exchange. The resident gull population was a probable source of fecal bacteria in the river mouth. Additional, monitoring is needed to identify human sources.

Sources:

Probable - Non-specific source (human waste),

Potential–Gulls (secondary wildlife), soil, sediment and sand (seasonal),

Possible - Sewage infrastructure, mobile sources (human waste), domestic animals

43 - Monitoring and Mitigation to Address Fecal Pathogen Pollution along California Coast

Applied Marine Sciences, Inc., University of California Davis, California Department of Fish and Game, and Marine Wildlife Veterinary Care and Research Center

Purpose - The goals of this research program were to use both laboratory and field approaches to investigate issues related to water quality monitoring and mitigation of fecal pathogen pollution along the central California coast.

Results - The universal Bacteroidales marker was detected in all water samples (100%). The human Bacteroidales marker was detected in 37% of samples, while the cow (8%) and dog (6%) bacteroidales markers were detected in less than 10% of samples. Overall, Bacteroidales concentrations ranged from 87-1.3 million gc/mL for universal markers, 45-17,268 gc/mL for human markers, 3-92 gc/mL for cow markers, and 12-575 gc/mL for dog markers.

Sources:

Probable – Non-specific source (human waste),

Potential - Dogs and livestock,

Possible –

68 - Little Sac River Watershed Bacterial Source Tracking Analysis

Dr. Claire Baffaut, Dr. C.A. Carson, and W. Rogers

<https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/3029/LittleSacBacterial.pdf?sequence=1>

Purpose - To identify the sources of bacteria found in the Little Sac River using rep-PCR analyses of fecal material.

Results - The data show that the highest fecal coliform loads come from unknown sources, geese, and human. Data show that sources differ by season but the magnitude of the contamination is not significantly affected by season.

Sources:

Probable – Wastewater treatment plant, Geese (non-specific source)

Potential – Cattle and horses

Possible – Septic (sewage infrastructure)

117 - SOURCES OF POLLUTANTS IN WISCONSIN STORMWATER

R.T. Bannerman, D.W. Owens, R.B. Dodds, and N.J. Hornewer

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.176.2404&rep=rep1&type=pdf>

Purpose - Identification of critical source areas (streets, roads, parking lots, etc.) could reduce the amount of area needing best-management practices in two areas of Madison, WI. Targeting best-management practices to 14% of the residential area and 40% of the industrial area could significantly reduce contaminant loads by up to 75%.

Results - Streets will probably be a critical source area in every land use. The majority of the runoff loads for many contaminants may be from streets in residential and commercial land uses. Parking lots are probably another critical source for commercial and industrial land uses. About 77% of the area in the commercial land use would have to be managed to control at least 75% of the loads for all contaminants except fecal coliform bacteria.

Sources:

Probable – Sewer outfall, Street runoff (residential, commercial and industrial)

Potential – Cattle and horses
Possible – Septic (sewage infrastructure)

82 - Tiered Approach for Identification of a Human Fecal Pollution Source at a Recreational Beach: Case Study at Avalon Bay, Catalina Island, California

Alexandria B. Boehm, J.A. Fuhrman, R.D. Morse, and S.B. Grant

<http://dornsife.usc.edu/labs/fuhrman/Documents/Publications/Tiered%20Approach.pdf>

Purpose - In this study, a three-tiered approach is used to identify human and nonhuman sources of FIB in Avalon Bay, a popular resort community on Catalina Island in southern California.

Results - Most of the FIB contamination along the shoreline of the City of Avalon is due to sources inside the bay and, in particular, from the land side of the beach. During the 24-h survey, the most contaminated shoreline sites exhibited a semi-diurnal FIB pattern in which the concentrations increased during ebbing tides. The multiple instances of positive HF and HV assay results at shoreline stations indicate that human fecal contamination exists in Avalon Bay. The nuisance runoff and bird feces had the highest levels of FIB with TC, EC, and ENT consistently near or above the upper limit of detection for water samples 24 192 MPN/100 mL. With the exception of sample R101, pipe discharges from underneath the pier and wharf and the cooling water boat discharge had relatively low levels of FIB. Sample R101 was taken from a broken pipe carrying gray water underneath the wharf and had TC and EC levels above our detection limit of 24 192 MPN/100 mL and ENT levels of 10 462 MPN/100 mL, which is 100 times higher than the CDHS single-sample standard. City officials repaired this pipe in early October. Subsurface water collected from within the five trenches had sporadically high levels of FIB.

Sources:

Probable – Non-specific source (urban land use; human waste), MS4 Infrastructure (dry weather runoff; human waste), birds (secondary wildlife), reclaimed water (leaking graywater pipe)

Potential –

Possible – Commercial/Industrial (boat cooling water, pier, and wharf discharges from pipes)

153 - Cross-Shelf Transport at Huntington Beach Implications for the Fate of Sewage Discharged through an Offshore Ocean Outfall

Alexandria B. Boehm, B.F. Sanders, and C.D. Winant

<http://www-ccs.ucsd.edu/~cdw/mypubs/109.pdf>

Purpose - Evaluate the potential for internal tides to transport wastewater effluent from the Orange County Sanitation District (OCSd) ocean outfall toward Huntington Beach.

Results - On the basis of these analyses, it remains unclear whether OCSd effluent impairs surf-zone water quality. However, OCSd plume cannot be ruled out as a contributor to poor bathing-water quality at Huntington Beach.

131 - Source Tracking in Lake Darling Watershed

Janice Boekhoff

<http://www.igsb.uiowa.edu/wqm/Publications/Reports/LakeDarlingFinalReport.pdf>

Purpose - Determine the source of fecal contamination in Lake Darling and the surrounding watershed.

Results - *E. coli* bacteria from most of the water samples at Lake Darling have been identified by DNA ribotyping as coming from unknown sources of fecal contamination (75% of the water samples had bacteria from unknown sources using the WHU library). More unknown source classifications than known sources suggested the *E. coli* isolate library was either not large enough or was not representative of all of the sources in the watershed.

Sources:

Probable – Secondary wildlife (cattle and swine), Wildlife (unknown)

Potential –

Possible – Commercial/Industrial (boat cooling water, pier, and wharf discharges from pipes)

83 - Detection of Genetic Markers of Fecal Indicator Bacteria in Lake Michigan and Determination of Their Relationship to Escherichia coli Densities Using Standard Microbiological Methods

Patricia A. Bower, C.O. Scopel, E.T. Jensen, M.M. Depas, and S.L. McLellan

<http://aem.asm.org/content/71/12/8305.full.pdf+html>

Purpose - Lake Michigan surface waters impacted by fecal pollution were assessed to determine the occurrence of genetic markers for *Bacteroides* and *Escherichia coli*.

Results - Human-specific *Bacteroides* spp. were found at three of the nine beach sites tested. Human-specific *Bacteroides* genetic marker is a sensitive measure of sewage contamination. Sanitary sewage overflow samples taken in the suburban part of the watershed showed the presence of cow-specific genetic marker, since the cow-specific primers do not differentiate between types of ruminants, i.e., elk, deer, and cows.

Sources:

Probable – CSO and SSO (Sewage infrastructure; human waste)

Potential – Sanitary sewer infiltration into the storm drain (Sewage infrastructure; human waste), Ruminant (wildlife; non-anthropogenic)

Possible – Sanitary sewer infiltration into the storm drain (Sewage infrastructure; human waste)

27 – Antibiotic Resistance Analysis of Fecal Coliforms to Determine Fecal Pollution Sources in a Mixed-Use Watershed

Brian S. Burnes

<http://www.springerlink.com/content/q3213338g1578x88/fulltext.pdf>

Purpose - Antibiotic resistance analysis was performed on fecal coliform (FC) bacteria from a mixed-use watershed to determine the source, human or nonhuman, of fecal coliform contamination.

Results - Human sources contribute a majority (>50%) of the baseflow FC isolates found in the watershed in urbanized areas. Chicken and livestock sources are responsible for the majority of the baseflow FC isolates found in the rural reaches of the watershed. Stormwater introduces FC isolates from domestic (~16%) and wild (~21%) sources throughout the watershed and varying amounts (up to 60%) from chicken and livestock sources. These results suggest that antibiotic resistance patterns of FC may be used to determine sources of fecal contamination and aid in the direction of water quality improvement.

Sources:

Probable – Urbanized watershed (human waste), cows and chickens (rural watershed)

Potential – Stormwater runoff,

Possible –

13 - Results from a Microbial Source-Tracking Study at Villa Angela Beach, Cleveland, Ohio 2007

Rebecca N. Bushon, E.A. Stelzer, and D.M. Stoeckel

Purpose - The overall goal of the study was to provide NEORSD with source-tracking information to aid in their understanding of elevated bacterial concentrations at Villa Angela Beach in Cleveland Ohio. To understand these elevation concentrations, 13 source samples (influent/effluent to sewage treatment plant, waterfowl feces from beach area, combined sewer overflow, stormwater outfall) and 33 beach-area water and sand samples were analyzed for E coli and 3 Bacteroides DNA markers

Results - Therefore, Btheta does not appear to be a useful human-associated marker for this beach area. In the Lake, human source is not a likely contributor of fecal bacteria, however, the gulls are a probable source. In Euclid Creek, there were strong signals of human sources on two occasions and gulls were not present. The sand did not have human sources present and gull sources were present in low concentrations.

Sources:

Probable -

Potential - Combined sewer overflow, influent/effluent to sewage treatment plant, waterfowl feces from beach area,

Possible -

85 - Population structure, persistence, and seasonality of autochthonous Escherichia coli in temperate, coastal forest soil from a Great Lakes watershed

Muruleedhara N. Byappanahalli, R.L. Whitman, D.A. Shively, M.J. Sadowsky, and S. Ishii

<http://www.glsc.usgs.gov/files/publications/population.pdf>

Purpose - In this study, undisturbed, forest soils within six randomly selected 0.5 m enclosure plots (covered by netting of 2.3 mm mesh size) were monitored from March to October 2003 for *E. coli* in order to describe its numerical and population characteristics.

Results - In this study, soil was found as a potential habitat for the persistent, perhaps resident, *E. coli* populations in temperate conditions. While our studies showed that *E. coli* can occur in temperate forest soils, albeit at low densities, it also had the ability to persist for extended periods in these habitats, suggesting that it is not a transient organism in soil but perhaps part of the natural microflora. Even if this is not the case, its population resiliency suggests that soil-borne *E. coli* should be treated as background concentration in source and impact evaluation investigations.

Sources:

Probable – Soil/Sediment/Sand (non-anthropogenic)

Potential –

Possible – Gull, deer, geese, terns (wrackline; non-anthropogenic)

84 - Ubiquity and Persistence of *Escherichia coli* in a Midwestern Coastal Stream

Muruleedhara Byappanahalli, M. Fowler, D. Shively, and R. Whitman.

<http://aem.asm.org/content/69/8/4549.full.pdf+html>

Purpose - Dunes Creek, a small Lake Michigan coastal stream that drains sandy aquifers and wetlands of Indiana Dunes, has chronically elevated *Escherichia coli* levels along the bathing beach near its outfall. This study sought to understand the sources of chronically elevated *Escherichia coli* levels along the bathing beach near its outfall in Dunes Creek's central branch.

Results - Water samples analyzed during the 1999 and 2000 monitoring seasons clearly demonstrated that *E. coli* concentrations in Dunes Creek were significantly correlated with the park's beach water. Dunes Creek empties directly onto the state park's only swimming beach, indicating that the creek directly impacts bathing water quality. *E. coli* is common within the stream basin, especially in submerged, margin, and wetted bank sediments, with numbers rapidly decreasing landward beyond the banks. The relationship between *E. coli* concentration and stream order suggests that excessive ditching and, consequently, non-point source input via sediment transport are responsible for elevated *E. coli* density in the watershed.

Sources:

Probable – Soil/Sediment/Sand (non-anthropogenic)

Potential –

Possible – Non-specific source (groundwater; non-anthropogenic)

3 - Pismo Beach Fecal Contamination Source Identification Study; Final Report. Aug. 12, 2010

CAL POLY and City of Pismo Beach

http://www.coastalrcd.org/images/cms/files/PismoFinalReport-v1_4%5B1%5D.pdf

Purpose - To identify biological sources of fecal contamination. Primary sources found were bird fecal contamination.

Results - The data collected in this study clearly shows the main source of fecal contamination on the beach is bird droppings near the pier. Nearly 40% of the E. coli strains collected in this study matched bird fecal sources, and E coli strains with a pigeon-specific fingerprint were collected. In addition, measuring the time since a tide last washed the part of the beach being sampled was an excellent predictor of FIB count, indicating that deposition of fecal matter on the beach itself was a predominate contamination mode.

Sources:

Probable - Bathers, dogs, pigeons (secondary wildlife)

Potential - Cows

Possible -

86 - Sourcing faecal pollution from onsite wastewater treatment systems in surface waters using antibiotic resistance analysis

S. Carroll, M. Hargreaves, and A. Goonetilleke

<http://eprints.qut.edu.au/4018/1/4018.pdf>

Purpose - To identify the sources of faecal contamination in investigated surface waters and to determine the significance of onsite wastewater treatment systems (OWTS) as a major contributor to faecal contamination.

Results - Antibiotic resistance patterns (ARP) were established for a library of 717 known Escherichia coli source isolates obtained from human, domesticated animals, livestock and wild sources. The resulting ARP DA indicated that a majority of the faecal contamination in more rural areas was nonhuman; however, the percentage of human isolates increased significantly in urbanized areas using OWTS for wastewater treatment.

Sources:

Probable – Sewage infrastructure (onsite wastewater treatment systems; human waste)

Potential –

Possible –

28 - Faecal pollution source identification in an urbanising catchment using antibiotic resistance profiling, discriminant analysis and partial least squares regression

Steven P. Carroll, L. Dawes, L., M. Hargreaves, and A. Goonetilleke

<http://eprints.qut.edu.au/19108/1/c19108.pdf>

Purpose - Antibiotic Resistance Patterns (ARP) were established for a library of 1005 known E. coli source isolates obtained from human and non-human (domesticated animals, livestock and wild) sources in an urbanising catchment in Queensland State, Australia. Discriminant Analysis (DA) was used to differentiate between the ARP of source isolates and to identify the sources of faecal contamination.

Results - The resulting ARP (Antibiotic Resistance Patterns) DA (Discriminant Analysis) indicated that a majority of the faecal contamination in the rural areas was non-human. However, the percentage of human isolates increased significantly in urbanised areas using onsite systems for wastewater treatment. The PLS regression was able to develop predictive models which indicated a high correlation of human source isolates from the urban area.

Sources:

Probable - Urbanized watershed (human waste), agriculture, other (land use)

Potential –

Possible -

47 - Middle Santa Ana River Bacterial Indicator TMDL Data Analysis Report

CDM and Risk Sciences

Purpose - The primary goal of this study was "to develop an investigative strategy at the highest priority sites, including site-specific or subwatershed-specific activities."

Results – Analysis showed significant differences in the frequency with which molecular markers for humans, dogs, and cattle were detected at the various source evaluation sites. The sites with highest frequency of detection of host-specific markers included the Human marker at Box Springs Channel and Chris Basin; Bovine marker at Anza Drain, Cypress Channel and San Antonio Channel; and Domestic canine marker at Chris Basin, County Line Channel and Day Creek. Where the universal marker was measured, it was quantified at levels much higher than the other measured markers, indicating the presence of many other sources of bacteria, e.g. birds, rodents, small mammals and reptiles. Preliminary review of land use data indicates that bacterial concentrations are positively correlated with degree of urban development and negatively correlated with the proportion of agricultural acreage and open space in the area.

Sources:

Probable – Non-specific source (human waste; 1 of 13 sites), dogs(1 of 13 sites) and cows(3 of 13 sites), commercial/industrial (anthropogenic non-human source), residential, commercial, and industrial (land use)

Potential -

Possible – Agriculture (anthropogenic non-human source), natural land use (non-anthropogenic) natural and agricultural (land use)

127 - Densities of fecal indicator bacteria in tidal waters of the Ballona Wetlands, Los Angeles County, California

John. H. Dorsey

<http://www.freepatentsonline.com/article/Bulletin-Southern-California-Academy-Sciences/151712972.html>

Purpose - Densities of fecal indicator bacteria (FIB) represented by total coliforms, E. coli and enterococci were measured within tidal channels of the Ballona Wetlands (Los Angeles County) to see if the wetlands act as a sink or source for these bacteria and to measure increases in FIB densities during wet weather.

Results - Results suggest that the wetlands may act as a sink in that FIB densities tended to be greater during flood flows into the wetlands, but less in water draining out of the system during ebb flows. However, this condition was not consistently met, especially at stations farthest from the tide gates. These sites could be reflecting increased FIB densities through regrowth within sediments and other unidentified sources.

Sources:

Probable –Storm drains

Potential –

Possible -

181 - Reduction of fecal indicator bacteria (FIB) in the Ballona Wetlands saltwater marsh (Los Angeles County, California, USA) with implications for restoration actions

John H. Dorsey, P.M. Carter, S. Bergquist and R. Sagarin

<http://www.sciencedirect.com/science/article/pii/S004313541000388X/>

Purpose - Determine FIB tidal dynamics within the wetland

Results - The wetlands act as both a source and sink for FIB depending on tidal conditions and exposure to sunlight. Future restoration actions would result in a tradeoff – increased tidal channels offer a greater surface area for FIB inactivation, but also would result in a greater volume of FIB-contaminated re-suspended sediments carried out of the wetlands on stronger ebb flows. As levels of FIB in Ballona Creek and Estuary diminish through recently established regulatory actions, the wetlands could shift into a greater sink for FIB.

119 - FECAL COLIFORM AND STREPTOCOCCUS CONCENTRATIONS IN RUNOFF FROM GRAZED PASTURES IN NORTHWEST ARKANSAS

D. R. Edwards, M.S. Coyne, P.F. Vendrell, T.C. Daniel, P.A. Moore, Jr., and J.F. Murdoch

<http://www.pcwp.tamu.edu/docs/lshs/end->

[notes/Fecal%20Coliform%20and%20Streptococcus%20Concen-0982758667/Fecal%20Coliform%20and%20Streptococcus%20Concentrations%20in%20Runoff%20from%20Grazed%20Pastures%20and%20Northwest%20Arkansas.pdf](http://www.pcwp.tamu.edu/docs/lshs/end-notes/Fecal%20Coliform%20and%20Streptococcus%20Concen-0982758667/Fecal%20Coliform%20and%20Streptococcus%20Concentrations%20in%20Runoff%20from%20Grazed%20Pastures%20and%20Northwest%20Arkansas.pdf)

Purpose - Assess the effects of grazing, time of year, and runoff amounts on FC and FS concentrations and to evaluate whether FC/FS concentration ratios are consistent with earlier values reported as characteristic of animal sources.

Results - In general, FC and FS concentrations were not directly related to either treatment with animal manure or presence of grazing cattle. Ratios of FC to FS concentrations varied widely ranging from almost zero to more than 100. These data confirm earlier findings that FC/FS ratios are not a reliable indicator of the source of FC and FS in the runoff.

147 - FECAL-INDICATOR BACTERIA IN STREAMS ALONG A GRADIENT OF RESIDENTIAL DEVELOPMENT

Steven A. Frenzel and C.S. Couvillion

<http://lshs.tamu.edu/docs/lshs/end-notes/fecal%20indicator%20bacteria%20in%20streams%20along%20a%20gradient%20of%20residential%20development.pdf>

Purpose - In order to adopt EPA water-quality standards for concentrations of *Escherichia coli* (E. coli) or enterococci, and study to determine the effects of urbanization on water quality.

Results - Areas served by sewer systems had significantly higher fecal-indicator bacteria concentrations than did areas served by septic systems. The areas served by sewer systems also had storm drains that discharged directly to the streams, whereas storm sewers were not present in the areas served by septic systems. Fecal-indicator bacteria concentrations were highly variable over a two-day period of stable streamflow, which may have implications for testing of compliance to water-quality standards.

120 - Soil: the environmental source of *Escherichia coli* and Enterococci in Guam's streams

R. Fujioka, C. Sian-Denton, M. Borja, J. Castro, and K. Morpew

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2672.1998.tb05286.x/pdf>

Purpose - Test the hypothesis that faecal bacteria are able to establish themselves in the soil environments of tropical islands by conducting a study in Guam, a tropical pacific island with warmer temperatures and higher humidity than Hawaii (covered in a previous study).

Results - Results obtained in Guam were similar to the results obtained in Hawaii and provided convincing evidence that the faecal bacterial indicators selected by USEPA to establish recreational water quality standards are able to colonize the soil environments of warm, humid tropical islands, current hygienic water quality standards which are based on concentrations of faecal indicator bacteria may not be applicable in tropical islands and perhaps other subtropical and tropical countries in the world. In these countries, stream waters can be expected to contain elevated levels of faecal bacteria.

Sources:

Probable - Rainfall

Potential –

Possible -

91 - Use of composite data sets for source-tracking enterococci in the water column and shoreline interstitial waters on Pensacola Beach, Florida

Fred J. Genthner, J.B. James, D.F. Yates, and S.D. Friedman

<http://64.9.200.77/lists/beachnet/2005-07/pdf00002.pdf>

Purpose - Source identification was performed to better understand risk associated with higher densities of enterococci found in swash zone interstitial water (SZIW) as compared to adjacent bathing water on Pensacola Beach, FL.

Results - This study documents higher densities of enterococci in SZIW than in adjacent bathing waters on Pensacola Beach. Entrapment may partially account for increased bacteria densities, however, biological factors (nutrients, protection from predation) and physical factors (particulate matter, periodic wetting and drying, protection from solar irradiation) may not only allow the enhanced survival of bacteria but may actually provide a growth- promoting environmental niche on the beach.

Sources:

Probable – Seagull (secondary wildlife)

Potential –

Possible – **Non-specific source (human waste)**

46 - Laguna Watershed Study and Water Quality Improvement Feasibility Analysis

Geosyntec and UCSB

Purpose - To evaluate dry weather hydrology, microbiological indicators, bacterial sources and loads, and feasible water quality improvements for the Laguna Channel in Santa Barbara, CA.

Results – Based on the analysis of human-specific *Bacteroides* DNA, it appears that there is significant input of human fecal waste into some Laguna storm drains and into Laguna Channel. An obvious spatial correlation between measured FIB and Human specific *Bacteroides* Marker (HBM) concentrations could not be identified; similar trends between indicator species and HBM concentrations were also not observed.

Sources:

Probable – Non-specific source (human waste),

Potential -

Possible -

148 - Quantitative Detection of Hepatitis A Virus and Enteroviruses Near the United States-Mexico Border and Correlation with Levels of Fecal Indicator Bacteria

Richard M. Gersberg, M.A. Rose, R. Robles-Sikisaka, and A.K. Dhar

<http://publichealth.sdsu.edu/publications/gersberg684.pdf>

Purpose - To measure the levels of Hepatitis A virus (HAV) and enteroviruses in coastal waters, and compare to *E. coli* and enterococci.

Results - HAV and enterovirus were found in 93% of wet weather samples. Inadequate sewage infrastructure in Tijuana, Mexico, also contributes to the high levels found at some sites.

60 - Evaluation of Two Library-Independent Microbial Source Tracking Methods to Identify Sources of Fecal Contamination in French Estuaries

Michele Gourmelon, M.P. Caprais, R. Segura, C. Le Mennec, S. Lozach, J.Y. Piriou, and A. Rince

<http://aem.asm.org/content/73/15/4857.full.pdf+html>

Purpose - The aim of this study was to optimize and validate the two MST techniques (host-specific 16S rRNA gene markers from Bacteroidales and genotyping of F-specific RNA bacteriophages) on human and animal feces, sewage treatment plant (STP) sludge, wastewater samples, and pig liquid manure (PLM; pig slurry) collected in France. Both techniques were then applied to water samples collected at different times from three estuaries

Results - Humans and animals sources are detected as sources of *E. coli* and Enterococci contamination in the estuaries based on host-specific Bacteroidales and F-specific bacteriophages

Sources:

Probable – Septic (human waste), livestock (domestic animals), livestock (agriculture), birds (wildlife), birds (secondary wildlife)

Potential -

Possible -

23 - Generation of Enterococci Bacteria in Saltwater Marsh and its impact on the surf zone water quality

Steven B. Grant, B.F. Sanders, A.B. Boehm, A.J. Redman, J.H. Kim, R.D. Mrše, A.K. Chu, M. Gouldin, C.D. McGee, N.A. Gardiner, B.H. Jones, J. Svejksky, G.V. Leipzig, and A. Brown

<https://www.crops.org/publications/jeq/pdfs/31/4/1300>

Purpose - To characterize the sources and transport of Enterococcus in tidally influenced flood control channels and a saltwater marsh.

Results - We find that enterococci bacteria are present at high concentrations in urban runoff, bird feces, marsh sediments, and on marine vegetation. Surprisingly, urban runoff appears to have relatively little impact on surf zone water quality because of the long time required for this water to travel from its source to the ocean. On the other hand, enterococci bacteria generated in a tidal saltwater marsh located near the beach significantly impacts surf zone water quality.

Sources:

Probable – Marsh (non-anthropogenic; non-specific source), wildlife (marsh avian), marsh sediment, soil/sediment/sand

Potential –

Possible –

92 - Antibiotic Resistance Profiles to Determine Sources of Fecal Contamination in a Rural Virginia Watershed

Alexandria K. Graves, C. Hagedorn, A. Teetor, M. Mahal, A.M. Booth, and R.B. Reneau

<https://www.crops.org/publications/jeq/pdfs/31/4/1300>

Purpose - Antibiotic resistance analysis (ARA) was used to determine if enterococci of human origin were present in a stream (Spout Run) that passes through a rural non-sewered community (Millwood, VA)

Results - A human signature was found in Spout Run as it passed through upper and middle Millwood. No evidence of a human signature was found in Page Brook in an earlier report (Hagedorn et al., 1999), and no evidence of a human signature was found in any of the tributaries that form Spout Run in this study. There are 32 homes in upper Millwood, 21 homes in middle Millwood, and 13 homes in lower Millwood, all on individual septic systems. Repair or replacement of unsatisfactory systems (or installation of a community system) should result in removal of the human signature from Spout Run.

Sources:

Probable – Septic system (sewage infrastructure; human waste), Livestock (domestic animals; anthropogenic non-human sources), wildlife (non-anthropogenic)

Potential –

Possible –

2 - San Diego County Enterococcus Regrowth Study; Draft Final Report, June 11, 2011

John Griffith and D. Ferguson

Purpose - To investigate storm drains as a potential source of Enterococcus bacteria to San Diego's coastal waters during dry weather.

Results –The results of this study suggest that enterococci in these storm drain systems came from predominantly natural sources and include strains that are capable of growing on drain pipe surfaces. The results of the concrete coupon/growth study showed that enterococci were capable of attaching to and growing on concrete coupons. Testing of enterococci extracted from coupons in Cottonwood Creek revealed species and biotypes most closely related to freshwater plants and decomposed algae/vegetation. The majority (77%) of enterococci from the surfaces of coupons, pipe and cobble rock at a La Jolla storm drain were identified as an enterococcal species associated with plants.

A number of natural sources of enterococci were identified at Moonlight State Beach. In this study, up to 70% of creek water isolates were identified as a species commonly found on plants. Multivariate analysis of species and biotypes showed that enterococci in Cottonwood Creek were most similar enterococci found in decomposed algae and vegetation, freshwater plants and seawrack. At least 52% of enterococci in beach water were of a species found in plants, however 34% of isolates were either non-Enterococcus species or unidentifiable, suggesting the possibility of additional sources of enterococci that were not evaluated in this study. Some of the enterococci biotypes in beach water were the same ones found in decomposed algae and vegetation, freshwater plants and seawrack.

The low numbers of birds and predominance of *E. faecalis* in bird stools indicate that birds may not have been a major source of enterococci to creek and beach water, however the dissimilarity in enterococcal populations could also be related to different selection pressures.

All beach and storm drain/creek water samples tested for Bacteroidales indicated very low or non-detectable levels of the human marker, indicating that these samples had little or no evidence of human fecal material.

Sources:

Probable – MS4 Infrastructure (Human waste), avian (secondary wildlife), avian (non-anthropogenic)

Potential – Landscaping (irrigation and lawn clippings),

Possible – Wrackline, Plants (non-anthropogenic), seawrack, beach sand

121 - Escherichia coli and Enterococci at Beaches in the Grand Traverse Bay, Lake Michigan: Sources, Characteristics, and Environmental Pathways

Sheridan K. Haack, L.R. Fogarty, and C. Wright

<http://www.glin.net/lists/beachnet/2007-07/pdf00000.pdf>

Purpose - Overall objectives were to (i) quantify EC and ENT in dominant source materials and recreational waters; (ii) characterize selected source isolates using genomic (EC) or biochemical (ENT) profiling; (iii) identify associations between numbers of these two indicator bacteria groups and ambient conditions; (iv) identify processes that influence spatiotemporal variability of indicator bacteria at these beaches; and (v) evaluate standardized monitoring approaches in light of site-specific knowledge about sources and environmental processes

Results - Bird feces are likely one significant source of bacterial contamination to these beaches. Storm drains and the Boardman River contributed large numbers of EC and ENT to the bay, even during non-runoff conditions.

Sources:

Probable – Seawrack (vegetation and other detritus)

Potential –

Possible –

94 - Determining Sources of Fecal Pollution in a Rural Virginia Watershed with Antibiotic Resistance Patterns in Fecal Streptococci

C. Hagedorn, S.L. Robinson, J.R. Filtz, S.M. Grubbs, T.A. Angier, and R.B. Reneau Jr.

<http://aem.asm.org/content/65/12/5522.full.pdf+html>

Purpose - The objectives of this project were (i) to validate the method of using antibiotic resistance patterns in fecal streptococci and discriminant analysis (DA) to differentiate between human and animal sources and between certain types of animal sources with a larger database of known source isolates from a wider geographical region and (ii) to use this method in a watershed project to identify fecal pollution sources.

Results - The results presented affirm that antibiotic resistance patterns can be used with fecal streptococci to determine sources of fecal pollution in water. Results (detection of no human isolates) had a direct impact on water quality improvement in Page Brook, as local officials were able to focus restoration efforts on the actual sources (e.g., beef cattle) rather than on those that made no contribution to the water pollution.

Sources:

Probable – Cattle (domestic animals; anthropogenic non-human sources)

Potential – Waterfowl, deer unidentified (wildlife; non-anthropogenic)

Possible – Non-specific source (human waste)

69 - Influence of Freshwater Sediment Characteristics on Persistence of Fecal Indicator Bacteria

Laurence Haller, E. Amedegnato, J. Pote, and W. Wildi

<http://www.springerlink.com/content/ju524662v67v4967/fulltext.pdf>

Purpose - To investigate the effect of sediment characteristics such as particle grain size and nutrient and organic matter contents on the survival of fecal indicator bacteria including total coliforms, E. Coli, and Enterococcus.

Results - FIB survival in sediments and possible re-suspension are considerable significance for understanding permanent microbial pollution. Results revealed (1) FIB survived in sediments up to 50 days, (2) higher growth and lower decay rates of FIB in sediments with high levels of organic matter and nutrients and small grain size, (3) longer survival of Enterococcus compared to E. coli and total coliforms.

Sources:

Probable – Wastewater treatment plant (based on other studies), Soil/Sediment/Sand

Potential – Cattle and horses, storm runoff (MS4 Infrastructure; human waste), Agriculture

Possible – Septic (sewage infrastructure), Wastewater treatment plant, storm runoff (MS4 Infrastructure; human waste), Agriculture, Land use

193 - Soil: the environmental source of Escherichia coli and Enterococci in Hawaii's streams

C. M. Hardina, and R. Fukuda

<http://md1.csa.com/partners/viewrecord.php?requester=gs&collection=ENV&recid=9200969&q=&uid=791338866&setcookie=yes>

Purpose - To determine the concentrations and sources of Escherichia coli and enterococci in a typical stream (Manoa) in Hawaii.

Results - Soil is considered the most likely source for the high concentrations of indicator bacteria naturally present in the freshwater streams of Hawaii.

Sources:

Probable – Wastewater treatment plant (based on other studies), Soil/Sediment/Sand

Potential – Cattle and horses, storm runoff (MS4 Infrastructure; human waste), Agriculture, Land use

Possible – Septic (sewage infrastructure), Wastewater treatment plant, storm runoff (MS4 Infrastructure; human waste), Agriculture, Land use

61 - Combining targeted sampling and fluorometry to identify human fecal contamination in a freshwater creek

Peter G. Hartel, K. Rodgers, G.L. Moody, S.N.J. Hemmings, J.A. Fisher, and J.L. McDonald
<http://www.iwaponline.com/jwh/006/0105/0060105.pdf>

Purpose - The aim of this study was to conduct sampling at 2 reaches at Potato Creek, a freshwater creek in Georgia, and 1 tributary during baseflow and stormflow conditions and detect human sources of fecal contamination by using targeted sampling (finding hot spots of fecal contamination within the Creek and/or tributaries and re-sampling these spots) and fluorometry (detection of fluorescing compounds, optical brighteners, & laundry detergents)

Results - Humans, dogs, and cattle are the major suspected sources (not sampled) for fecal contamination in the Potato Creek reaches

Sources:

Probable -

Potential -

Possible – Broken home sewer line, dogs, cows, wildlife (non-anthropogenic),

63 - Drayton Harbor Watershed Microbial Source Tracking Pilot Study Phase 2: California Creek, Dakota Creek and Cain Creek Sub-watersheds

Hirsch Consulting Services

<http://whatcomshellfish.whatcomcounty.org/Drayton/documents/DraytonHarborSanitarySurvey2010.pdf>

Purpose - The objective of this study was to determine whether human or ruminant sources contribute to fecal contamination at selected sampling stations to inform follow-up investigations and corrective actions by Whatcom County and other agencies and to inform the Drayton Harbor Fecal Coliform TMDL Evaluation.

Results - Ruminant and human fecal sources threaten the shellfish harvest.

Sources:

Probable - Non-specific source (human waste), domestic animals,

Potential -

Possible -

67 - Sources and Mechanisms of Delivery of E. coli (bacteria) Pollution to the Lake Huron

Todd Howell

Purpose - To identify the potential sources of fecal pollution to the shoreline.

Results – The long-term fate of the potentially high E. coli loads delivered to the lake at these times is poorly understood. The association of E. coli with particulate material is thought to be a key mechanism by which survival and transport in the lake environment is enhanced.

Sources:

Probable – Agriculture,

Potential – Soil/Sediment/Sand

Possible - **Non-specific source (human waste), agriculture (listed under other with no degree of designation (probable, low, etc.)**

10 - Wrack promotes the persistence of fecal indicator bacteria in marine sands and seawater

Gregory J. Imamura, R.S. Thompson, A.B. Boehm, and J.A. Jay

<http://onlinelibrary.wiley.com/doi/10.1111/j.1574-6941.2011.01082.x/full>

Purpose - Study examined the relationship between beach wrack, FIB, and surrounding water and sediment at marine beaches along the California coast.

Results – FIB concentrations normalized to dry weight were the highest in stranded dry wrack, followed by stranded wet and suspended ‘surf ’wrack. Laboratory microcosms were conducted to examine the effect of wrack on FIB persistence in seawater and sediment. Indigenous enterococci and *Escherichia coli* incubated in a seawater microcosm containing wrack showed increased persistence relative to those incubated in a microcosm without wrack. FIB concentrations in microcosms containing wrack-covered sand were significantly higher than those in uncovered sand after several days. These findings implicate beach wrack as an important FIB reservoir.

Sources:

Probable – Seawrack [1-Dry wrack (highest FIB), 2-wet wrack, 3-surf wrack]

Potential -

Possible -

57 - Presence and Growth of Naturalized *Escherichia Coli* in Temperate Soils from Lake Superior Watersheds

Satoshi Ishii, W.B. Ksoll, R.E. Hicks, and M.J. Sadowsky

<http://aem.asm.org/content/72/1/612.full.pdf+html>

Purpose - The goal of the study to was (i) examine the survival and persistence of *E. coli* populations in three soils in several coastal Lake Superior watersheds (extreme environmental conditions) and to determine if these *E. coli* strains have become naturalized to these soils, (ii) examine the genetic relatedness of soilborne *E. coli* strains from different locations, and (iii) determine if soilborne *E. coli* could actively multiply in the soils examined.

Results - *E. Coli* is able to survive and grow in soil, with growth occurring when temperature and nutrients are higher and able to survive in extreme environments (low temps). Animal feces of surrounding wildlife not shown to be likely source.

Sources:

Probable – Soil/Sediment/Sand

Potential -

Possible - Wildlife

156 - Sources and Persistence of Fecal Coliform Bacteria in a Rural Watershed

Rob C. Jamieson, R. J. Gordon, S. C. Tattrie, and G. W. Stratton

<http://www.cawq.ca/journal/temp/journal/7.pdf#page=32>

Purpose - Quantify the presence of fecal coliform bacteria in the surface waters of a rural watershed and to attempt to determine the primary sources of fecal pollution within rural watersheds.

Results - Fecal coliform levels frequently exceeded recreational water quality guidelines. At the watershed outlet, 94% of the collected samples exceeded the recreational water quality guideline during low flow conditions. Substantial bacterial loading was observed along stream reaches impacted by livestock operations. Bacterial loading was also observed along a stream reach that was not impacted by agricultural activities.

Sources:

Probable – Livestock

Potential -

Possible -

200 - The effect of cattle grazing on indicator bacteria in runoff from a Pacific Northwest watershed

M.D. Jawson, L.F. Elliott, K.E. Saxton, and D.H. Fortier

<http://lshs.tamu.edu/docs/lshs/end->

[notes/the%20effect%20of%20cattle%20grazing%20on%20indicator%20bacteria%20in%20runoff%20from%20a%20pacific%20northwest%20watershed.pdf](http://lshs.tamu.edu/docs/lshs/end-notes/the%20effect%20of%20cattle%20grazing%20on%20indicator%20bacteria%20in%20runoff%20from%20a%20pacific%20northwest%20watershed.pdf)

Purpose - Total coliform (TC), fecal coliform (FC), and fecal streptococcal (FS) numbers were monitored for 3 years to determine the effect of grazing on the presence of these organisms in runoff from a cattle grazed and a non-grazed watershed in the Pacific Northwest

Results - Sampling at several locations within the grazed watershed showed that sources of indicator bacteria were well distributed, and as a result were nonpoint after the initial runoff events. Thus, present FC recommendations developed for point-sources would not apply adequately to grazed land in the Pacific Northwest. Indicator bacteria as presently analyzed would not provide a basis for developing best management practices.

Sources:

Probable – Secondary Wildlife (Cows)

Potential -

Possible –

12 - 2009 Investigation of Spatial and Temporal Distribution of Human-specific Bacteroidales marker in Malibu Creek, Lagoon and Surfrider Beach

Jennifer Jay, R.F. Ambrose, V. Thulsiraj, and S. Estes

Purpose - The goal of the study is to understand the relationship between Fecal indicator bacteria (FIB) and human-specific Bacteroidales (HSB) in coastal wetland. The study examines the spatial & temporal relationship of human-specific Bacteroidales marker (HBM) & FIB in lower Malibu Creek, Lagoon, and Surfrider Beach during wet and dry weather to determine the presence of detectable concentrations of HBM in the lagoon and if concentrations of HBM correlate with FIB

Results - Of the 80 water samples analyzed within the Malibu watershed, five samples were positive for the human-specific HF183 Bacteroidales marker (HBM). The highest percent exceedance of FIB and HBM concentrations were measured during wet weather. During the study, 93.8% of the samples did not have detectable concentrations of HBM. These data do not rule out any particular potential sources of human fecal contamination.

Sources:

Probable -

Potential - storm drains

Possible - Septic systems, Tapia Wastewater Reclamation Facility disinfected discharge, wildlife and birds

98 - Microbial source tracking in a small southern California urban watershed indicates wild animals and growth as the source of fecal bacteria

Sunny C. Jiang, W. Chu B.H. Olson, J. He, S. Choi, J. Zhang, J.Y. Le, and P.B. Gedalanga

<http://www.eng.uci.edu/files/07-1MST.pdf>

Purpose - Apply three MST tools, namely, ARA, human viruses, and E. coli toxin biomarkers to aid in the cleanup of unknown pollution sources in Laguna Niguel. Laguna Niguel is a small urban watershed in southern California that experienced chronic fecal coliform and enterococci contamination, with concentrations on average of 2–4 orders of magnitude greater than State of California established type 2 recreational standards.

Results - Using three independent microbial source tracking methods, the results of this study indicate that human sewage was not a major contributor of fecal bacterial impairment in this small urban watershed. This study showed that rabbit feces contain one of the highest concentrations of Enterococcus spp. per unit weight.

Sources:

Probable – Urban land use (non-specific source), dogs (urban land use), cows and horses (rural open land use),

Potential –

Possible –

76 - Freshwater Beach Total Maximum Daily Load Microbial Source Tracking Study

Dr. Stephen H. Jones

http://des.state.nh.us/organization/divisions/water/wmb/tmdl/documents/sand_dam_appendix_b_beach.pdf

Purpose - The goal of this project was to investigate actual and potential bacterial sources at (3) public beaches. The approach reflects the latest concepts for efficient use of bacterial ribotyping for pollution source identification in New Hampshire, i.e., ribotyping of high priority samples and development of small local source species databases. This targeted approach was designed to optimize identification of the most significant contamination sources at the 3 beaches.

Results - Overall, birds were the most prevalent (37%) source species type, followed by livestock (24%), humans (5%), wild animals (4%) and pets (3%). The most commonly identified source species was geese (17 isolates), followed by cows and mixed avian (7) sheep (6), horses and ducks (3), septage, goat, wastewater effluent and dog (2), with single isolates identified as coming from deer, red foxes, wild turkeys and mixed wildlife.

Sources:

Probable – Livestock, birds (secondary wildlife)

Potential –

Possible – Non-specific source (human waste), pets, wildlife

99 - Tracking Bacterial Pollution Sources in Stormwater Pipes

Dr. Stephen H. Jones

<http://www.unh.edu/users/unh/acad/colsa/marine-program/nhep/resources/pdf/trackingbacterialpollution-unh-03.pdf>

Purpose - Determine the bacteria source species from two of the highest priority storm drain pipes that discharge to Hampton Harbor

Results - Many storm water/runoff studies have attributed fecal contamination to pet wastes. Of the four types of sources identified, pets were the least common, behind birds, humans and wildlife.

Sources:

Probable – Non-specific source (human waste), geese (secondary wildlife), cormorants (wildlife; non-anthropogenic)

Potential –

Possible – Cats and dogs (domestic animals; anthropogenic non-human sources), seagulls and pigeons (secondary wildlife), foxes, raccoons and coyotes (wildlife; non-anthropogenic)

32 - USING MULTIPLE ANTIBIOTIC RESISTANCE AND LAND USE CHARACTERISTICS TO DETERMINE SOURCES OF FECAL COLIFORM BACTERIAL POLLUTION

R. Heath Kelsey, G.I. Scott, D.E. Porter, B. Thompson, and L. Webster

<http://www.springerlink.com/content/p5p4413ku0082707/fulltext.pdf>

Purpose - Multiple Antibiotic Resistance (MAR) analysis and regression modeling techniques were used to identify surface water areas impacted by fecal pollution from human sources, and to determine the effects of land use on fecal pollution in Murrells Inlet, a small, urbanized, high-salinity estuary located between Myrtle Beach and Georgetown, South Carolina.

Results - MAR results suggest that the majority of the fecal pollution detected in the Murrells Inlet estuary may be from non-human sources, including fecal coliforms isolated from areas in close proximity to high densities of active septic tanks.

Sources:

Probable -

Potential -

Possible -

144 - Bacteria Attenuation Modeling and Source Identification in Kranji Catchment and Reservoir

Kathleen B. Kerigan, and J.M. Yeager

<http://censam.mit.edu/publications/yeager.pdf>

Purpose - Determine the bacterial loading of Kranji Catchment and Reservoir and how this will affect planned recreational use of the reservoir.

Results - Farm run-off near the reservoir was the bacterial source of greatest concern. The relatively high concentrations coupled with the short travel time, which diminishes opportunity for attenuation, resulted in high concentrations reaching the reservoir downstream levels.

73 - Draft Calleguas Creek Watershed Quantitative Microbial Source Tracking Study

Beverly Kildare, V. Rajal, S. Tiwari, D. Thompson, B. McSwain, S. Wuertz, D. Bambic, and G. Reide (Report Prepared by UC Davis in Collaboration with Larry Walker Associates)

Wuertz, S., Bambic, D., and Reide, G. (Report Prepared by UC Davis in Collaboration with Larry Walker Associates)

http://www.calleguas.com/ccwmp/DRAFT_CCW_MST_061406.pdf

Purpose - The goal of this microbial source tracking (MST) study was to provide quantitative, host-specific fecal source data and assist in the development of a bacteria TMDL for the Calleguas Creek Watershed (CCW).

Results - Urban areas were found to be sources of human and canine bacteria to Arroyo Simi and Conejo Creek. The Tapo Canyon site, which is upstream of urban influences, exhibited the lowest concentrations and ratios of the mixed-human marker, but the highest concentrations and ratios of the cow/horse marker. Analysis of tertiary-treated wastewater samples indicates that mixed-human Bacteroidales concentrations may be relatively high in discharged effluent. However, such cells are most likely non-viable and thus not associated with water quality objective exceedances.

Sources:

Probable – Non-specific source (human waste), dogs (canine urban land use), cows and horses (rural and open space)

Potential –

Possible –

100 - Non-point source pollution: Determination of replication versus persistence of Escherichia coli in surface water and sediments with correlation of levels to readily measurable environmental parameters

Julie Kinzelman, S.L. McLellan, A.D. Daniels, S. Cashin, A. Singh, S. Gradus, and R. Bagley
<http://www.iwaponline.com/jwh/002/0103/0020103.pdf>

Purpose - Racine, Wisconsin, located on Lake Michigan, experiences frequent recreational water quality advisories in the absence of any identifiable point source of pollution. This research examines the environmental distribution of Escherichia coli in conjunction with the assessment of additional parameters (rainfall, turbidity, wave height, wind direction, wind speed and algal presence) in order to determine the most probable factors that influence E. coli levels in surface waters.

Results - This study indicates that persistence, rather than environmental replication of E. coli, is responsible for the majority of microorganisms recovered from foreshore sands, submerged sands and surface waters at Racine, Wisconsin, beaches along Lake Michigan.

Sources:

Probable – Non-specific source (persistence in surface water; non-anthropogenic),

Soil/Sediment/Sand (persistence)

Potential –

Possible –

135 - Source tracking faecal contamination in an urbanised and a rural waterway in the Nelson-Tasman region, New Zealand

M. Kirs, V.J. Harwood, A.E. Fidler, P.A. Gillespie, W.R. Fyfe, A.D. Blackwood, and C.D. Cornelisen

<http://www.tandfonline.com/doi/pdf/10.1080/00288330.2010.535494>

Purpose - Eight MST markers, including general, ruminant and human-associated Bacteroidales markers, a duck-associated E2 marker, a gull-associated Catellicoccus marimammalium marker and three additional human markers [Enterococcus faecium esp gene, Methanobrevibacter smithii nifH gene, and human polyoma viruses (HPyVs)] were tested for host specificity and sensitivity using an array of animal faecal samples of known origin and wastewater samples.

Results - The validation and application of a suite of end-point PCR assays for MST markers enabled us to identify the presence of faecal contamination from multiple sources, including humans, in a New Zealand urbanised waterway. Outcomes demonstrate that MST markers developed overseas can be utilised in New Zealand context.

150 - PISMO BEACH FECAL CONTAMINATION SOURCE IDENTIFICATION STUDY

Christopher L. Kitts, M.W. Black, M.Y. Moline, A.K. Hamrick, I.C. Robbins, A.A. Schaffner, and N.I. Boutet

http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1325&context=bio_fac

Purpose - Identify the biological sources of fecal contamination as well as the physical and environmental factors that influence the levels of bacteria in the ocean waters at Pismo Beach, California.

Results - The main source of fecal contamination on the beach is bird droppings near the pier. Both wave direction and current direction worked to push high concentrations of FIB away from the pier as the main source of fecal contamination.

Sources:

Probable – Sewage Infrastructure, Domestic animals (dogs, cats and horses), Secondary wildlife (cows, pigeons and gulls)

Potential –

Possible –

101 - Presence and Sources of Fecal Coliform Bacteria in Epilithic Periphyton Communities of Lake Superior

Winfried B. Ksoll, S. Ishii, M.J. Sadowsky, and R.E. Hicks

<http://aem.asm.org/content/73/12/3771.full.pdf+html>

Purpose - (i) determine if fecal coliforms and *E. coli* populations are present and persist in periphyton communities from a harbor and Lake Superior, (ii) identify the most probable sources of *E. coli* found in periphyton, (iii) use laboratory microcosms to examine colonization and survival of *E. coli* in natural periphyton communities, and (iv) estimate the contribution of periphyton borne *E. coli* to overlying waters.

Results - Although many *E. coli* strains isolated from periphyton may have originated from waterfowl and sewage effluent, other strains appeared to be unique to the periphyton studied and may have developed self-sustaining naturalized populations in these communities. *E. coli* cells attached to periphyton, whether they are unique to these periphyton communities or not, can detach and contribute to fecal coliform numbers measured in coastal waters. This confounds the use of fecal coliforms as a reliable indicator of recent fecal contamination of recreational waters.

Sources:

Probable –

Potential – Sewage effluent (wastewater treatment plant; human waste), waterfowl (wildlife; non-anthropogenic), algae (non-anthropogenic)

Possible –

65 - Microbial Source Tracking Study for South Cypress Creek

Thomas B. Lawrence, P.E. (City of Memphis, Division of Public Works)

Purpose - The objective of this project was to be able to determine possible sources of fecal coliform levels found in South Cypress Creek, as well as to be able to try to quantify the impacts. By identifying the sources of the impacts, the City will work to achieve the goal of the Clean Water Act by addressing the specific sources where possible.

Results – Data indicated that there may be both diffuse sources of Avian fecal coliform (such as deposited areas that are washed into the creek at a slow rate), as well as direct discharges into the creek, providing the high numbers. The total human impact was fairly low. Thus, pet contributions may be more related to storm water runoff, rather than would be seen with the other major source types which may be related to direct contact with the creek water. For sources attributed to Wild Animals, the number of isolates was higher than all of the other sources in all fecal result groups, except for the “TNTC” group, where it was second to Avian.

Sources:

Probable – avian (secondary wildlife), wildlife (including birds),

Potential -

Possible - Non-specific source (human waste), domestic animals,

39 - LINKING ON-FARM DAIRY MANAGEMENT PRACTICES TO STORM-FLOW FECAL COLIFORM LOADING FOR CALIFORNIA COASTAL WATERSHEDS

David J. Lewis, E.R. Atwill, M.S. Lennox, L. Hou, B. Karle, and K.W. Tate

http://waterquality.ucanr.org/documents/Dairy_Management_Resources7451.pdf

Purpose - We have conducted a systems approach study of 10 coastal dairies and ranches to document fecal coliform concentration and loading to surface waters at the management decision unit scale. Water quality samples were collected on a storm event basis from loading units that included: manure management systems; gutters; storm drains; pastures; and corrals and lots.

Results – Fecal coliform load from units of concentrated animals and manure are significantly more than units such as pastures while storm flow amounts were significantly less. Fecal coliform concentrations demonstrate high variability both within and between loading units. Fecal coliform concentrations for pastures range from 206 to 2,288,888 cfu/100 ml and for lots from 1,933 to 166,105,000 cfu/100 ml.

Sources:

Probable - Manure Management Systems, Stockpiles, and lots (agriculture),

Potential – MS4 Infrastructure (human waste), pasture (land use)

Possible -

15 - Evaluation of Chemical, Molecular, and Traditional Markers of Fecal Contamination in an Effluent Dominated Urban Stream

R.M. Litton, J.H. Ahn, B. Sercu, P.A. Holden, D.L. Sedlak, and S.B. Grant

<http://pubs.acs.org/doi/abs/10.1021/es101092g>

Purpose - To perform a quantitative sanitary survey of the Middle Santa Ana River, in southern California, utilizing a variety of source tracking tools, including traditional culture-dependent fecal markers, speciation of enterococci isolates, culture-independent fecal markers, and chemical markers of sewage and wastewater

Results - The results support the notion that regrowth of fecal indicator bacteria (FIB) in river sediments may lead to a decoupling between FIB and pathogen concentrations in the water column and thus limit the utility of FIB as an indicator of recreational waterborne illness in inland waters.

Sources:

Probable - in-situ growth in streambed sediments

Potential - effluent stream tributary to Santa Ana River, tributary to RW (Riverside WWTP plant stream tributary to Santa Ana River

Possible - Riverside WWTP & discharge pipe

128 - Snapshot investigation of likely contaminant sources in the Tilligerry Estuary catchment (Zones 5A and 5B)

S.A. Lucas, P.M. Geary, P.J. Coombes, and R.H. Dunstan

http://scholar.googleusercontent.com/scholar?q=cache:F75WyRF5YdUJ:scholar.google.com/&hl=en&num=100&as_sdt=0,5&as_vis=1

Purpose - a) To provide a “snapshot” of water quality in major surface waters draining to the estuary and within the estuary after a particularly wet period. The samples were analysed for nutrients (orthophosphate and nitrate), total coliforms, faecal coliforms, E.Coli, faecal streptococci and faecal sterols and; b) To interpret the most likely sources of faecal contamination from the data obtained as elevated faecal coliform concentrations had been recorded after significant rainfall in the past.

Results - However, the high microbial concentrations observed in major surface drains on the western and eastern side of the estuary also warrant further investigation, however it is clear that the majority of faecal contamination in the estuary is from agricultural land uses. A management program to control and mitigate runoff sources from agricultural lands in the catchment is therefore seen as an integral part of any plan to reduce faecal contamination in Tilligerry estuary.

Sources:

Probable –Human Waste (Non-specific source), Herbivores (Secondary Wildlife)

Potential -

Possible -

62 - Bacteriological methods for distinguishing between human and animal faecal pollution of water: results of fieldwork in Nigeria and Zimbabwe

D. Duncan Mara and J. Oragui

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2536379/pdf/bullwho00087-0144.pdf>

Purpose - Recently, methods have been developed to distinguish between human and animal faecal pollution in temperate climates. The present study assessed the applicability and practicality of these methods in tropical countries.

Results - Ruminant and human fecal sources threaten the shellfish harvest.

Sources:

Probable –domestic animals,

Potential - Non-specific source (human waste), Non-specific source (anthropogenic non-human source),

Possible -

207 - Identifying sources of fecal contamination inexpensively with targeted sampling and bacterial source tracking

J.L. McDonald, P.G. Hartel, L.C. Gentit, C.N. Belcher, K.W. Gates, K. Rodgers, J.A. Fisher, K.A. Smith, and K.A. Payne

http://www.water.rutgers.edu/Source_Tracking/Enterococcus/IdentifyingSourcesofFecalContaminationInexpensivelywithTargetedSamplingandBacterialSource.pdf

Purpose - Our objective was to identify the sources of fecal contamination inexpensively at St. Andrews Park and Sea Island during calm and stormy weather conditions using targeted sampling and two or more BST methods: Enterococcus speciation, the detection of the esp gene, and fluorometry.

Results - Targeted sampling, when combined with two or more of three BST methods--enterococcal speciation, detection of the esp gene, and fluorometry--was able to identify sources of fecal contamination quickly, easily, and inexpensively.

Sources:

Probable – Wildlife (Birds)

Potential -

Possible –Human Waste (Non-specific source), Sewage infrastructure (leaking sewer lines), Unspecified wildlife

26 - Application of Bacteroides fragilis Phage as an Alternative Indicator of Sewage Pollution in Tampa Bay, Florida

Molly R. McLaughlin, and J.B. Rose

<http://www.springerlink.com/content/9221116k3286u5p3/fulltext.pdf>

Purpose - The use of bacteriophages were evaluated in the drainage basins of Tampa Bay

Results – In this study, the phages that infect B. fragilis host RYC2056 (RYC), including phage B56-3, and host ATCC 51477-HSP40 (HSP), including the human specific phage B40-8, were evaluated in the drainage basins of Tampa Bay, 7 samples (n=62), or 11%, tested positive for the presence of phages infecting the host HSP, whereas 28 samples, or 45%, tested positive using the host RYC.

Sources:

Probable – Septic (sewage infrastructure),

Potential -

Possible -

4 - PB Point Bacterial Source Investigation Final Data Report

MEC- Weston and City of San Diego

Purpose - The goal of this study was to use molecular and standard bacterial indicator techniques to assess the host origin of the bacteria found in the receiving waters at PB point.

Results - The results of the PCR analysis are also presented in Table 2. Of the ten receiving water samples collected (not including duplicates), four (75-R on 8/15, 75R on 8/18, 75-L on 8/18 and 75-R on 8/20) were positive for the general PCR marker (GB), suggesting the presence of fecal material. Among the four samples that tested positive for the general marker, two were positive for at least one of the human-specific markers (75-L on 8/18 and 75-R on 8/20), which suggests the presence of bacteria from human origin.

Although the values for the bacterial indicators from all of the storm drain samples were high, only one (not including duplicates) of the five storm drain samples was positive for the general PCR marker (SD-0 on 8/15). None of the storm drain samples were positive for either of the two human markers.

Sources:

Probable –

Potential – Non-specific source (human waste)

Possible -

55 - MISSION BAY - Clean Beaches Initiative Bacterial Source Identification Study

MEC- Weston and City of San Diego

Purpose - The overall goal of this study was to identify the sources of bacterial contamination to Mission Bay.

Results -Results from both MST methods utilized in Phase II confirmed that the large majority of the enteric bacteria in Mission Bay originates from birds and contributions from human sources are insignificant

Sources:

Probable – Avian (secondary wildlife),

Potential –Dogs, over-irrigation, MS4 Infrastructure (delta sediment at storm drain outlet)

Possible - park restrooms and RV pump stations (human waste), boats and homeless(mobile sources), groundwater (non-anthropogenic), marine mammals, bay sediment

105 - Temporal and Spatial Variability of Fecal Indicator Bacteria: Implications for the Application of MST Methodologies to Differentiate Sources of Fecal Contamination

Marirosa Molina

<http://www.environmental-center.com/Files%5C7698%5CArticles%5C5788%5CMolina20600.pdf>

Purpose - Identify and compare the temporal and spatial variability of fecal indicator bacteria from a specific host in manure and water samples and evaluate the implications of such variability on microbial source tracking approaches and applications.

Results - Building an enterococci library is a time-consuming, expensive approach that has the potential to provide a great deal of information when the proper statistical analytical approach (in this case it was cluster analysis) is used to interpret the results. Application of a library-independent approach, such as the Bacteroides markers allows for a much faster and possibly less expensive results, but there remains a lack of thorough temporal, spatial and specificity analyses of the few genetic markers available so far.

Sources:

Probable – Cattle (domestic animals; anthropogenic non-human sources)

Potential –

Possible –

38 - Bacteria Monitoring and Source Tracking in Corpus Christi Bay at Cole and Ropes Parks

Joanna Mott, M. Lindsey, R. Sealy, and A. Smith

<http://www.cbbep.org/publications/virtuallibrary/1010.pdf>

Purpose - In this study water samples from the six Texas Beach Watch stations at Ropes and Cole Parks were analyzed to detect the esp marker as an indicator of human contamination at these locations. Additionally, data on three other human-specific markers--Bacteroidales, Human 2 Polyoma Viruses (HPyVs), and ethanobrevibacter.smithii—from another study, are included in this report for comparison with the esp analysis results.

Results - Human source contamination was detected at Ropes and Cole Park stations under ambient weather conditions as measured by several human-specific markers. The esp gene was detected when levels of enterococci at Ropes Park were higher following rainfall and suggest a human contribution at this location presumably either from storm drain outflow or non-point source run-off. For Ropes and Cole Parks, a broader bacteria source tracking project is recommended to examine not only human, but other sources of contamination.

Sources:

Probable – Non-specific source (human waste),

Potential -

Possible – MS4 Infrastructure (human waste),

72 - Bacteria Source Tracking on the Mission and Aransas Rivers

Joanna Mott, R. Lehman, Ph.D. and A. Smith

Purpose - In this study, bacteria source tracking (BST) was used to evaluate the sources of fecal contamination in the Mission and Aransas River segments and to provide additional data for assessment of sources of contamination into Copano Bay, the water body into which both segments empty.

Results - The majority of unknown source isolates collected from water samples at the five sampling stations along the Mission and Aransas tidal segments were classified as human source. Overall, 63.7-66.9% of unknown source isolate profiles from the composite (ARA+CSU) dataset were classified as treated human sources (originating from treated wastewater effluent). The remaining unknown source isolates were classified as livestock animals and wildlife, with cow, horse and duck contributions accounting for the majority of the animal sources in both the composite dataset and PFGE profiles.

Sources:

Probable – Wastewater treatment plant, cows, horses, ducks

Potential –

Possible – Gulls (secondary wildlife), hogs

41 - Multi-scale landscape factors influencing stream water quality in the state of Oregon

Maliha S. Nash, D.T. Heggem, D. Ebert, T.G. Wade, and R.K. Hall

<http://www.springerlink.com/content/y17u3uh60155w313/fulltext.pdf>

Purpose - This study used the State of Oregon surface water data to determine the likelihood of animal pathogen presence using enterococci and analyzed the spatial distribution and relationship of biotic (enterococci) and biotic (nitrogen and phosphorous) surface water constituents to landscape metrics and others (e.g. human use, percent riparian cover, natural covers, grazing, etc.).

Results – Landscape metrics related to amount of agriculture, wetlands and urban all contributed to increasing nutrients in surface water but at different scales. The probability of having sites with concentrations of enterococci above the threshold was much lower in areas of natural land cover and much higher in areas with higher urban land use within 60 m of stream. A 1% increase in natural land cover was associated with a 12% decrease in the predicted odds of having a site exceeding the threshold. Opposite to natural land cover, a one unit change in each of manmade barren and urban land use led to an increase of the likelihood of exceeding the threshold by 73%, and 11%, respectively. Change in urban land use had a higher influence on the likelihood of a site exceeding the threshold than that of natural land cover.

Sources:

Probable - Urbanized land use

Potential -

Possible – Agriculture

66 - Coastal Nonpoint Source Pollution Monitoring Program

New Jersey Department of Environmental Protection

Purpose - To identify the causes of the degrading water quality in the upper Navesink River. Perform stormwater monitoring to delineate major sources of fecal contamination. Utilize specialized tests, including coliphage and Multiple Antibiotic Resistance (MAR) analyses, to identify the sources of contamination (i.e., human, domestic animal, and wildlife). Once identified, actions can be recommended and taken to eliminate or reduce the impact.

Results – Results for Microbial Source Tracking indicators (F+RNA coliphage and Multiple Antibiotic Resistance) suggest a human source of fecal contamination at sites. Sites were identified as 'hot spots' for further source investigations.

Sources:

Probable - Non-specific source (human waste), wildlife

Potential – Domestic animals,

Possible -

1 - Multi-tiered Approach Using Quantitative Polymerase Chain Reaction for Tracking Source of Fecal Pollution to Santa Monica Bay, Ca, February 2005

Rachel T. Noble, J.F. Griffith, A.D. Blackwood, J.A. Fuhrman, J.B. Gregory, X. Hernandez, X. Liang, A.A. Bera, and K. Schiff

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/2005_06AnnualReport/AR0506_181-194.pdf

Purpose - The objective of this study was to identify the contribution and quantify the loading of fecal contamination to the SMB using a multi-tiered approach. No discussion on what fecal source types (agriculture, birds, dogs) are impacting Santa Monica Bay

Results - Measurements of *Bacteroides* sp. and enterovirus indicated the presence of human fecal contamination throughout the system. *Bacteroides* sp. was present in 33% of mainstem samples. Enterovirus was present in 44% of mainstem samples. The concordance among these measurements was nearly complete; almost every location that detected *Bacteroides* sp. was also positive for enterovirus.

Sources:

Probable - Non-specific Source (human waste)

Potential -

Possible-

108 - Use of Fecal Steroids to Infer the Sources of Fecal Indicator Bacteria in the Lower Santa Ana River Watershed, California: Sewage Is Unlikely a Significant Source

James A. Noblet, D.L. Young, E.Y. Zeng and S. Ensari

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/JournalArticles/444_fecal_steroids.pdf

Purpose - Utilize a suite of fecal steroids, as chemical markers to examine whether sewage was a significant source of FIB within the lower Santa Ana River watershed.

Results - The results implied that sewage was not a significant source of fecal steroids, and therefore perhaps FIB to the study area. Instead, birds may be one possible source of the intermittently high levels of FIB observed in the lower Santa Ana River watershed and the nearby surf zone.

Sources:

Probable –

Potential – Gulls (secondary wildlife; anthropogenic non-human sources)

Possible – Sewage infrastructure (human waste), dogs (domestic animals; anthropogenic non-human sources)

109 - Fecal source tracking by antibiotic resistance analysis on a watershed exhibiting low resistance

Yolanda Olivas, and B.R. Faulkner

<http://www.springerlink.com/content/k02q5v6748702773/fulltext.pdf>

Purpose - To test the efficiency of the antibiotic resistance analysis (ARA) method under low resistance by tracking the fecal sources at Turkey Creek, Oklahoma exhibiting this condition.

Results - The original seasonal and annual DA of the stream sources showed no significant difference between human and livestock input rates in winter, spring and summer ($0.56 \leq P \leq 0.76$). Deer was consistently lower than the other two sources ($0.00 \leq P \leq 0.30$). In fall, the human source predominated over livestock and deer ($P < 0.0001$). Revision of the original DA using the rates of misclassification, decreased classification into the human and deer sources by 6–7% ($0.22 \leq P \leq 0.33$), and increased classification into livestock by 13–14% ($0.04 \leq P \leq 0.06$), showing the significance of the original DA misclassification. In conclusion, the major effect of low antibiotic resistance to this ARA work was a significant level of negative misclassification into the livestock source.

Sources:

Probable – Non-specific source (human waste), livestock (domestic animals; anthropogenic non-human sources)

Potential – Deer (wildlife; non-anthropogenic)

Possible –

143 - Investigation of Faecal Pollution and Occurrence of Antibiotic Resistant Bacteria in the Mooi River System as a Function of a Changed Environment

M.J. Pantshwa, A.M. van der Walt, S.S. Cilliers, and C.C. Bezuidenhout

http://www.ewisa.co.za/literature/files/2008_137.pdf

Purpose - Water quality monitoring and assessments are of paramount importance to identify the river confluence vulnerable to the pollution impacts of urbanization. Investigate some physico-chemical parameters, levels of faecal pollution and occurrence of antibiotic resistant bacteria in the Mooi River system as a function of a changed environment.

Results - Non-human sources contributed greater towards faecal pollution. Urban gradient was recognized in terms of faecal indicator species distribution. Higher levels of antibiotic resistant bacteria were detected in urban sites when compared to lower upstream and elevated downstream levels.

75 - Middle Rio Grande Microbial Source Tracking Assessment Report

Parsons Water & Infrastructure Inc.

Purpose - The objective of this project was to identify specific sources of fecal coliform causing high levels of bacteria in the Middle Rio Grande.

Results - Overall, ribotyping results show, the largest fraction of *E. coli* matched those found in avian sources, followed by canine, human/sewage, rodents, bovine, and equine. The source of approximately 9 percent of the *E. coli* could not be identified. With the exception of rodents, only a few species of wild mammals were identified as sources of fecal coliform found in water: deer or elk, raccoon, coyote, bear, and opossum. It should be noted that an unknown fraction of the canine isolates may be from coyotes and foxes, as many *E. coli* strains are resident both in domestic dogs and wild canines.

Sources:

Probable – Cats, dogs, birds (wildlife)

Potential – Non-specific source (human waste), livestock, rodents (secondary wildlife), Wildlife (deer or elk, raccoon, coyote, bear, and opossum)

Possible –

125 - Bacterial Contamination and Antibiotic Resistance in Fecal Coliforms from Glacial Water Runoff

S.P. Pathak, and K. Gopal

<http://www.springerlink.com/content/fup31h3742514123/fulltext.pdf>

Purpose - Assess the bacteriological contamination in glacial water runoff from the Gangotri glacier and Gangetic river system (Gaumukh to Rishikesh) by enumerating aerobic heterotrophs, coliforms, fecal coliforms and fecal streptococci. Antibiotic resistance among the fecal coliforms, identified as *E. coli*, was also studied.

Results - Contamination of coliform was observed in all samples, while fecal coliform and fecal streptococci were detected in 17 and 18 samples, respectively (Fig. 2). Thus, bacteriological analysis exhibited maximum contamination in most of the water samples from post-Gangotri and Gangetic stations. The observed increase in the proportion of coliforms and fecal coliforms was statistically significant ($p < 0.001$). The counts of fecal streptococci in all study stretches were too low for statistical comparison.

129 - Fecal BMAP Implementation: Identification of Probable Sources in the Butcher Pen Creek Watershed

PBS&J

http://publicfiles.dep.state.fl.us/dear/BMAP/LowerStJohns/Tributaries%20Fecal%20Coliform%20BMAPs/Technical_Reports/ButcherPen/Final%20Draft%20Butcher%20Pen%20WBID%202322%20Tech%20Report%20041008.pdf

Purpose - FDEP has verified 54 tributaries of the Lower St. Johns River—located throughout Duval County and in small portions of Clay and St. Johns Counties—as impaired for fecal coliform, and TMDLs must be developed for these waterbodies. Local stakeholders in the Lower St. Johns Basin, in conjunction with FDEP, are currently working to develop a Basin Management Action Plan (BMAP) to implement the TMDLs for fecal coliform.

Results - Elevated levels of fecal coliforms following rainfall may be an indication that unidentified pollution sources (e.g., leaking wastewater conveyance systems) are being transported by stormwater into Butcher Pen Creek. This evaluation indicates that the probable sources of fecal contamination in the Butcher Pen Creek WBID are human-related. Although Butcher Pen Creek does not have a designated septic tank phase-out area, some areas of the basin have likely had OSTDS failures, as indicated by the existence of septic tank repair permit applications, especially in the northeast corners of the watershed. Therefore, it is likely that there still remain isolated and problematic septic systems that are contaminating the neighboring surface waters.

Sources:

Probable – Sewage infrastructure (SSO events),

Potential – Wastewater discharge

Possible –

34 - Origin and spatial–temporal distribution of faecal bacteria in a bay of Lake Geneva, Switzerland

John Poté, N. Goldscheider, L. Haller, J. Zopfi, F. Khajehnouri, and W. Wildi

http://doc.rero.ch/lm.php?url=1000,43,4,20100511154847-XI/Pot_John_-_Origin_and_spatial-temporal_distribution_of_faecal_bacteria_20100511.pdf

Purpose - To quantify the input flux rates of faecal bacteria from the main contamination sources and to assess their spatial and temporal distribution in the bay, in order to estimate the human health risk related to recreational activities and drinking water use.

Results - The highest FIB concentrations in the near-surface water of the bay consequently occur during floods and mixed lake conditions. Although the thermocline protects the epilimnion from contamination in summer, effluent water may spread in the hypolimnion and reach the drinking-water pumping station 3.8 km further to the west.

Sources:

Probable – Wastewater Treatment Plant

Potential –

Possible –

110 - Classification Tree Method for Bacterial Source Tracking with Antibiotic Resistance Analysis Data

Bertram Price, E.A. Venso, M.F. Frana, J. Greenberg, A. Ware, and L. Currey

<http://aem.asm.org/content/72/5/3468.full.pdf+html>

Purpose - Apply the statistical method known as classification trees to build a model for BST for the Anacostia Watershed in Maryland.

Results - Applying the tree classification model to the 1,565 Anacostia River water isolates yielded the following distribution of sources: 468 (29.9%) pet, 222 (14.2%) human, 437 (27.9%) livestock, and 438 (28.0%) wildlife. These results were determined from analysis of all the water isolates, which represent six monitoring stations with samples collected monthly for 1 year. Therefore, the source distribution presented here does not account for the distribution of high-flow and low-flow periods, which may contribute different sources to the streams. Also, note that bacterial sources can be site specific in a watershed, given the non-conservative nature of bacterial transport. For the purpose of this analysis, all the water isolates from the six monitoring stations were used to estimate the overall watershed relative source contributions. The results based on this averaging method indicate that humans contribute the least bacterial contamination to the Anacostia River. The other sources of bacterial contamination are evenly distributed among pet animals, livestock, and wildlife.

Sources:

Probable – Pets and livestock (domestic animals; anthropogenic non-human sources), wildlife (non-anthropogenic)

Potential – Non-specific sources (human waste)

Possible –

113 - Quantitative microbial faecal source tracking with sampling guided by hydrological catchment dynamics

G. H. Reischer, J.M. Haider, R. Sommer, H. Stadler, K.M. Keiblinger, R. Hornek, W. Zerobin, R.L. Mach, and A.H. Farnleitner

<http://onlinelibrary.wiley.com/doi/10.1111/j.1462-2920.2008.01682.x/pdf>

Purpose - Apply modern quantitative microbial source tracking methods on a large and complex karstic spring catchment in context with hydrology and other water quality parameters over a prolonged period of time in order to comprehensively, qualitatively and quantitatively characterize the pollution sources.

Results - 1) Established and evaluated a new sampling concept with consideration for the whole seasonal hydrological catchment variability and special emphasis on strong pollution events. 2) Demonstrated the ability of quantitative microbial source tracking studies to quantitatively link source-specific marker levels to general faecal pollution indicators in order to estimate the contribution of one source group to total faecal pollution as measured in conventional faecal monitoring.

3) Showed that the thorough investigation of catchment hydrology and pollution dynamics is a prerequisite for successful quantitative microbial source tracking study design.

Sources:

Probable – Ruminant (wildlife; non-anthropogenic)

Potential – Non-specific sources (human waste)

Possible – Soil/Sediment/Sand

133 - Assessment of Sources of Bacterial Contamination At Santa Cruz County Beaches

John Ricker and S. Peters

ftp://ftpdpla.water.ca.gov/users/prop50/10045_SantaCruz/Work%20Plan%20CD%2004/reference%20plans%20and%20background%20information/Sources%20of%20Contamination%20at%20OSCC%20Beaches%202005.pdf

Purpose - Determine the source and health threat of elevated bacteria levels at Santa Cruz County beaches

Results - The most significant source of beach contamination in Santa Cruz County is discharge from the creeks, with a high urban runoff component during both wet and dry weather. 22 point plan to be implemented to improve water quality

Sources:

Probable – Non-specific sources (human waste), Sewage infrastructure (storm drains), Domestic animals (dogs), Secondary wildlife (birds), Wildlife (rats)

Potential –

Possible –

42 - Bacterial Source Tracking Pilot Study DNA Fingerprinting, Human Bacteroidetes ID and Human Enterococci ID

Rogue Valley Council of Governments

Natural Resources Department

Purpose - The purpose of the pilot study was 1) to determine whether bacteria found in local streams is from human or animal sources and 2) to evaluate different BST methodology for future use within the Rogue Valley.

Results - DNA Fingerprinting results show that animal fecal matter is present, but were inconclusive in identifying whether human contamination was present. Many of the analyzed colonies could not be matched to animal or human sources. However, based on the isolates identified, animals are the primary contributor of bacteria to Ashland Creek, Baby Bear, and Griffin Creek (31 of 50).

Sources:

Probable - Domestic animals, wildlife,

Potential -

Possible – Non-specific source (human waste)

7 - Microbiological Water Quality at Reference Beaches in Southern California During Wet Weather

Kenneth Schiff, J. Griffith, and G. Lyon

http://www.sccwrp.org:8060/pub/download/DOCUMENTS/TechnicalReports/448_reference_beach.pdf

Purpose - The contribution of non-human sources of bacteria was quantified at coastal reference beaches in southern California. Provides an overview of sampling methods and analytical results for reference beaches are discussed. Bacteria sources were not identified

Results – Based on the results from this study, natural contributions of nonhuman fecal indicator bacteria were sufficient to generate exceedances of the State of California water quality thresholds during wet weather. Total coliform, E. coli, and enterococcus samples collected during wet weather exceeded water quality thresholds greater than 10 times more frequently during wet weather than during recent dry weather in summer or winter, although the frequency differed by beach. San Onofre State Beach had the greatest concentrations of bacteria and the greatest frequency of water quality threshold exceedances. This may have been the result of several factors that we cannot disentangle. First, San Onofre Creek was the largest watershed we sampled, which may have led to a greater number of nonhuman sources of fecal indicator bacteria upstream. Second, San Onofre Creek had the largest and most mature lagoon of any site sampled, which was located at the beach interface and may have attracted nonhuman fecal sources (i.e. birds). Third, San Onofre Creek was the only discharge where we found human enteric virus. The San Onofre Creek watershed had the greatest fraction of developed land use (3%) of any of the other watershed systems and human activities are known to occur in the lower part of this watershed.

Sources:

Probable – Non-specific source (anthropogenic)

Potential – Non-specific source (human waste)

Possible –

221 - Presence of Bacteroidales as a Predictor of Pathogens in Surface Waters of the Central California Coast

A. Schriewer, W.A. Miller, B.A. Byrne, M.A. Miller, S. Oates, P.A. Conrad, D. Hardin, H.H. Yang, N. Chouicha, A. Melli, D. Jessup, C. Dominik, and S. Wuertz

<http://ukpmc.ac.uk/articles/PMC2935056>

Purpose - Evaluate the value of Bacteroidales genetic markers and fecal indicator bacteria (FIB) to predict the occurrence of waterborne pathogens in ambient waters along the central California coast.

Results - The ability to predict pathogen occurrence in relation to indicator threshold cutoff levels was evaluated using a weighted measure that showed the universal Bacteroidales genetic marker to have a comparable or higher mean predictive potential than standard FIB. This

predictive ability, in addition to the Bacteroidales assays providing information on contributing host fecal sources, supports using Bacteroidales assays in water quality monitoring programs.

77 - Tracking Sources of Fecal Pollution in a South Carolina Watershed by Ribotyping *Escherichia coli*: A Case Study

Troy M. Scott, J. Caren, G.R. Nelson, T.M. Jenkins, and J. Lukasik

<http://sourcemolecular.com/pdfs/scott3.pdf>

Purpose - To describe the effective use of the ribotyping microbial source tracking procedure to determine the source(s) of *Escherichia coli* within a South Carolina watershed.

Results - Prior to investigating potential fecal inputs into this watershed, a significant human source was suspected as the primary input; however, of the 515 *E. coli* isolated from water samples collected during the course of this study, 88% were typed as being of animal fecal origin. Thus, this study was integral in the realization that animals may be a significant source of contamination and that remediation efforts should be redirected to accommodate these findings. Of the 454 animal isolates analyzed, 51 RT profiles were directly matched from a specific animal source. Of these, 22 (43%) were classified as coming from deer feces and 9 (18%) directly matched those generated from dog feces.

Sources:

Probable – Wildlife (deer, raccoons, birds and pelicans),

Potential – Non-specific source (human waste), cats and dogs, gulls (secondary wildlife)

Possible –

19 - Sewage Exfiltration As a Source of Storm Drain Contamination during Dry Weather in Urban Watersheds

Bram Sercu

<http://pubs.acs.org/doi/abs/10.1021/es200981k>

Purpose - To determine whether transmission of sewage is occurring from leaking sanitary sewers directly to leaking separated storm drains, field experiments were performed in three watersheds in Santa Barbara, CA.

Results – Above-background RWT peaks were detected in storm drains in high-risk areas, and multiple locations of sewage contamination were found. Sewage contamination during the field studies was confirmed using the human-specific Bacteroidales HF183 and *Methanobrevibacter smithii* nifH DNA markers. This study is the first to provide direct evidence that leaking sanitary sewers can directly contaminate nearby leaking storm drains with untreated sewage during dry weather and suggests that chronic sanitary sewer leakage contributes to downstream fecal contamination of coastal beaches.

Sources:

Probable -

Potential -

Possible -

6 - Storm Drains are Sources of Human Fecal Pollution during Dry Weather in Three Urban Southern California Watersheds

Bram Sercu, L.C. Van de Werehorst, J. Murray, and P.A. Holden

http://www.santabarbaraca.gov/NR/rdonlyres/C3B1ADAE-37E8-4F89-8F2D-1A24FBAB8D6A/0/Sercuetal_ESnT_2009_v43p2938SI.pdf

Purpose - Dry weather bacteria monitoring in urbanized Santa Barbara, CA watersheds

Results - Of the 80 water samples analyzed within the Malibu watershed, five samples were positive for the human-specific HF183 Bacteroidales marker (HBM). The highest percent exceedance of FIB and HBM concentrations were measured during wet weather. During the study, 93.8% of the samples did not have detectable concentrations of HBM. These data do not rule out any particular potential sources of human fecal contamination.

Sources:

Probable -

Potential - Sewage infrastructure, non-stormwater discharges, MS4 infrastructure (less likely – human waste), MS4 infrastructure (anthropogenic non-human sources)

Possible -

116 - Identification of human fecal pollution sources in a coastal area: a case study at Oostende (Belgium)

Sylvie Seurinck, M. Verdievel, W. Verstraete, and S.D. Siciliano

<http://www.iwaponline.com/jwh/004/0167/0040167.pdf>

Purpose - Identify fecal pollution sources in the North Sea and produce a model required to predict fecal pollution

Results - The canal Gent-Oostende, the Dode Kreek and Gauwelozeekreek, the Voorhaven, and the Montgommerydok contained high levels of the indicator bacteria. The European E. coli standard (5 £ 102/ 100 ml) suggested in the revised draft Bathing Water Directive (Council of the European Communities 2000) was exceeded most of the time at these sites. The human specific Bacteroides marker was detected in almost all water samples from these sites, which indicates that they are regularly contaminated with human fecal pollution. The river Noordede, the Visserijdok and the beach water at 2 sites were only lightly contaminated based on the European E. coli standard. At these sampling sites the human-specific Bacteroides marker was less frequently detected and in lower amounts, except at one locations where high concentrations of 107 human-specific Bacteroides marker per l were recorded at the beginning of the sampling survey and at the end. The detection of indicator organisms and the human specific Bacteroides marker was strongly related to rainfall for this coastal area.

Sources:

Probable – Non-specific sources (human waste)

Potential – Wildlife (non-anthropogenic)

Possible –

11 - Regrowth of Enterococci & Fecal Coliform in Biofilm. Printed in The Journal for Surface Water

John F. Skinner, J. Guzman, and J. Kappeler

Purpose - The goal of the study was to determine the sources of high numbers of enterococci and fecal coliform found in street gutter runoff flowing from residential areas to the Dover Drive storm drain in Newport Beach, Orange County

Results – Bacteria counts in runoff from washing the sidewalk using bacteria-free hose water were 220 enterococci/100 ml and 180 fecal coliform/100 ml. Washoff water from the driveway by manually flooding a residential front lawn was 160 enterococci/100 ml and 9 fecal coliform/100 ml. Runoff from flooding the grass contained 1,250 enterococci/100 ml and 2,000 fecal coliform/100 ml. Water draining directly into the gutter through a hole cut through the curb grew out 70 enterococci/100 ml and 100 fecal coliform/100 ml.

Bacteria-free hose water was introduced into a dry street gutter and tested for enterococci and fecal coliform at 10 meters, 45 meters, and 100 meters downstream when the flow from the hose water reached those locations. There was a progressive rise of both enterococci and fecal coliform bacteria with the increased distance of flow. The levels of fecal indicator bacteria were 26,000 enterococci/100 ml and 14,000 fecal coliform/100 ml when the water reached the 100-meter test site, the last testing station. The source of these high numbers of bacteria is suspected to be coming from regrowth in the street gutters.

The findings of these studies provide evidence that regrowth of both enterococci and fecal coliform bacteria are occurring in biofilm located in residential street gutters and storm drains in Newport Beach.

Sources:

Probable - Street gutter biofilm regrowth (MS4 infrastructure)

Potential – Dog excrement (not tested), lawn irrigation runoff, sidewalk and driveway runoff (Solid/liquid waste), residential washwater, residential lawn runoff

Possible - Residential backyard and side yard patios, roof gutter drains but not tested

49 - F+ RNA Coliphages as Source Tracking Viral Indicators of Fecal Contamination

Dr. Mark D. Sobsey, D.C. Love, and G.L. Lovelace

<http://webmail.ciceet.unh.edu/news/releases/springReports07/pdf/sobsey.pdf>

Purpose - To evaluate and apply novel, cost-effective technologies and methods for the detection, quantification and identification of sources of microbial contaminants and the characterization of those sources as human or nonhuman.

Results - Microbial indicator concentrations in water and shellfish were higher at sites with greater wastewater treatment plant discharges. Of the 9 estuaries in the study, 4 were impacted by point source discharges of waste water treatment plant (WWTP) effluent. Human point source pollution in this study was primarily from waste water treatment plant (WWTP) treated effluent

and possibly raw sewage leaks, while likely human non-point sources included urban runoff, seepage from septic tanks, and boat dumping. Sites with non-human non-point fecal waste contained populations of wildfowl (goose, duck, gull), wild horses, other feral animals, agricultural animals, a dog park and urban pet waste. At 4 estuaries the impacted sites included human point and non-point sources, while the non-impacted sites were pristine sites with wildlife refuges or were geographically separated from human populations. In the Tijuana River Reserve in Southern CA human impacts were documented at all study sites, so in the absence of a truly pristine or non-impacted site, a site with only non-point source runoff from human development was compared to a more contaminated site at the mouth of the Tijuana River containing untreated sewage from Mexico.

Sources:

Probable -

Potential – Sewage infrastructure, Urban runoff (MS4 infrastructure - human waste; suspected to potential)

Possible -

45 - Faecal sterols analysis for the identification of human faecal pollution in a non-sewered catchment.

D. Sullivan, P. Brooks, N. Tindale, S. Chapman, and Ahmed, W.

http://publicationslist.org/data/w.ahmed/ref-14/Daryle_s%20article_%20WST_revised%20version.pdf

Purpose - To identify human faecal pollution in a non-sewered catchment using faecal sterols.

Results - In this study, faecal sterol analysis was used to identify the presence of human sourced faecal pollution or others (non-point sources) in two adjacent creeks of North Maroochy Catchment. It appears that stanols concentrations generally increased with increased catchment runoff. After moderate rainfall, high coprostanols levels found in water samples indicated human faecal pollution and defective septic systems are the most likely sources of pollution. The human signal was traced on one occasion to a defective septic system. In contrast, it appears that during dry weather human faecal pollution is not occurring in the study catchment.

Sources:

Probable – Septic (sewage infrastructure),

Potential –

Possible -

124 - Ecological Control of Fecal Indicator Bacteria in an Urban Stream

Cristiane Q. Surbeck, S.C. Jiang, and S.B. Grant

<http://lshs.tamu.edu/docs/lshs/end-notes/ecological%20control%20of%20fecal%20indicator%20bacteria%20in%20an%20urban%20stream-1429959691/ecological%20control%20of%20fecal%20indicator%20bacteria%20in%20an%20urban%20stream.pdf>

Purpose - Determine the source(s) of elevated FIB concentrations in Cucamonga Creek, a concrete-lined urban stream in southern California. Flow in the creek consists primarily of treated and disinfected wastewater effluent, mixed with relatively smaller but variable flow of runoff from the surrounding urban landscape.

Results - Mass and volume balance calculations indicate that treated wastewater is not a significant source of FIB to Cucamonga Creek. Runoff from the urban landscape appears to be the primary source of FIB loading to Cucamonga Creek during both dry weather and wet weather periods. Observations from the study imply that DOC and FIB concentrations in runoff should co-vary, which is indeed the case both at Cucamonga Creek and in many agricultural and urban streams along the California coast. These results are not consistent with the hypothesis that FIB are static contaminants (like sediments or nutrients) with well-defined and land-use-specific export coefficients, as has been suggested for catchments in the United Kingdom. Rather, our data suggest that nonpoint source FIB impairments in southern California are best viewed as an ecological phenomenon, in which a dynamic balance between FIB sources, nutrient availability, competition with other heterotrophic bacteria, and predator prevalence determines the magnitude and extent of FIB pollution and its human health implications.

Sources:

Probable – Non-specific Source (Human Waste), Domestic animals (dogs), Secondary Wildlife (birds)

Potential –

Possible -

50 - B Street/Broadway Piers, Downtown Anchorage, and Switzer Creek Storm Drain Characterization Study

Tetra Tech, City of San Diego

Purpose - To further characterize the City's storm drain system discharges during both wet and dry weather. This monitoring program evaluated the potential sources of the pollutants-of-concern (POCs) throughout the MS4 system and collected data to calibrate and validate preliminary wet weather runoff modeling efforts for the San Diego Bay TMDLs.

Results - Bacteria concentrations from residential land use site DBR01 are higher than commercial land use site DBC02. The differences in bacteria concentrations across land use sampling sites were compared using t-test or Mann-Whitney Rank Sum test if data do not meet normality test. The results suggested significant difference in concentrations between the two sampling sites for both events and for all three microbiological parameters. Higher concentrations were found at the residential site (DBR01) than the commercial land use site (DBC02).

Sources:

Probable – Residential (Land use)

Potential – Commercial (Land use)

Possible -

53 - Chollas Storm Drain Characterization Study

Tetra Tech, City of San Diego

Purpose - To further characterize the City's storm drain system discharges during both wet and dry weather. This monitoring program evaluated the potential sources of the pollutants-of-concern (POCs) throughout the MS4 system and collected data to calibrate and validate preliminary wet weather runoff modeling efforts for the San Diego Bay TMDLs.

Results - The measured enterococcus and coliform concentrations generally showed large variations. The enterococcus concentrations showed a number of exceedances of the basin action level at a number of sites including several commercial and industrial sites and two residential sites. Fecal coliform concentrations were generally below action levels, with a few industrial and residential sites showing some exceedances. Total coliform concentrations showed a large number of exceedances at seven out of the ten sampling sites. The difference in bacteria concentrations across land use sampling sites was compared based on median concentrations and using the Mann-Whitney Rank Sum test (Table 7-4). The results suggested significant difference in concentrations among the sampling sites for both events and for all three microbiological parameters. Higher concentrations were found at two commercial (CHC07 and CHC12), industrial (CHI08) and two residential sites (CHR03 and CHR04).

Sources:

Probable – Commercial/Industrial (anthropogenic non-human sources; potential to probable), Commercial and industrial (land use)

Potential – Residential (land use)

Possible -

9 - Using Microbial Source Tracking to Support TMDL Development and Implementation

Tetra Tech, Inc. and Herrera Environmental Consultants

Purpose - Provides an overview of Microbial Source Tracking (MST) and how it can be used to support TMDL development and implementation. The document covers potential uses of MST, descriptions of common MST methods, factors for selecting an MST method and designing an MST study, and examples of MST studies used to support TMDL development or implementation.

Results – ID Study: The Bacteroides PCR results generally supported the PFGE results that wildlife was the predominant source of fecal bacteria in the sampled streams. The genetic fingerprinting showed that greater than 10 percent of the total E. coli colonies isolated were from dogs, and cats were almost 20 percent. In addition, there were two days on lower Hauser Creek when Idaho's primary contact water quality criterion for E. coli was exceeded, during which dogs were the source of over 40 percent of the isolates. Horses and cattle each did not exceed 10 percent of the total E. coli isolates; however, horses were greater than 15 percent of the E. coli isolates. Although humans made up 11 percent of the total E. coli colonies isolated on Right Fork Hauser Creek, only one E. coli colony was isolated from water samples collected on days when the water quality criterion was exceeded.

OR: Results indicated widespread contamination from ruminants (non-elk) and, in certain river segments of the Trask, Miami, and Tillamook Rivers and Holden Creek, significant contamination from humans.

NM: Overall, ribotyping results show the largest fraction of *E. coli* matched those found in avian sources, followed by canine, human/sewage, rodents, bovine, and equine. The source of approximately 9 percent of the *E. coli* could not be identified.

VA: MST Results indicate majority of sources derive from wildlife and livestock, followed by humans, and then pets.

NH: Ribotyping identified source species for 76% (19/25) of the *E. coli* isolates in the water samples. The remaining isolates (24%) could not be matched with certainty to patterns in the ribopattern database. Of the identified isolates, geese constituted the largest portion (52%) followed by livestock [sheep (12%) and cows (4%) for a total of 16%] and dogs (8%).

MI: During dry conditions, the human biomarker was present at all sites, except one site. The results were always negative for the human biomarker, giving a strong indication that *E. coli* from human sources was not impacting this site during dry conditions. Positive results for the other sites suggest that there are dry-weather sources of *E. coli* of human origin. These human sources of *E. coli* could include cross-connections between the sanitary and storm sewer systems, illicit discharges to storm sewers, failed on-site sewage disposal systems, and leaking sanitary sewers.

SD: Among the isolates for which the source could be identified, 26% were equine (horse) and 30% were ovine (sheep). Other identified animal sources include porcine (pig), bovine (cow), canine (dog), feline (cat) and human. Based on review of available information and communication with state and local authorities, the primary nonpoint sources of fecal coliform within the Beaver Creek watershed include agricultural runoff, as well as wildlife and human sources. Septic systems are assumed to be the primary human source of bacteria loads to Beaver Creek. The HSPF model was used to determine the contribution of fecal coliform bacteria from identified sources in the Beaver Creek watershed and evaluate the implementation of BMPs to control these sources.

Sources:

Probable – Geese (NH), avian (NM)

Potential – Non-specific source (human waste – NM, OR), sewage infrastructure (MI), illegal connections, domestic animals (NH, ID, NM), agriculture (OR), secondary wildlife (ID)

Possible -

37 - Monitoring Report for Bacterial Source Tracking Segments 0806, 0841, and 0805 of the Trinity River Bacteria TMDL

Texas Institute for Applied Environmental Research (TIAER)

http://repositories1.lib.utexas.edu/bitstream/handle/2152/7038/crwr_onlinereport08-08.pdf?sequence=2

Purpose - This report includes information on study area, characteristics, materials and methods of bacterial source tracking, and results and findings of the source tracking study.

Results – Overall, each of the source contributors showed a definite trend, whether positive or negative, as one moves downstream from Segment 0806, through Segment 0841, and into Segment 0805. The categories did show consistencies in source species. The avian category was consistently dominated by non waterfowl species, while the livestock category's contribution was shared by bovine and horses. Mammalian wildlife was found to be high in rodent species and raccoons, while the pet category was found to be consistently led by dogs.

Sources:

Probable – Non-specific source (human waste – potential to probable)

Potential - Pets and livestock, avian and mammals (wildlife)

Possible -

149 - Assessment of the Origins of Microbiological Contamination of Groundwater at a Rural Watershed in Chile

Mariela Valenzuela, M.A. Mondaca, M. Claret, C. Perez, B. Lagos, and O. Parra

<http://www.scielo.org.mx/pdf/agro/v43n4/v43n4a10.pdf>

Purpose - To improve the state of knowledge on the microbiological quality of groundwater at a rural watershed. Characterize the microbiological quality of the groundwater and to identify sources of contamination.

Results - The main source of fecal contamination is of animal origin, a diffuse one. Concentrations of bacterial indicators have a temporal basis showing variable levels among seasons, with a higher concentration in the rainy one. All 42 wells analyzed contained opportunistic pathogens.

167 - Bacterial pathogens in Hawaiian coastal streams-Associations with fecal indicators, land cover, and water quality

E.J. Viau, K.D. Goodwin, K.M. Yamahara, B.A. Layton, L.M. Sassoubre, S.L. Burns, H.I. Tong, S.H. Wong, and A.B. Boehm

<http://www.sciencedirect.com/science/article/pii/S0043135411001448>

Purpose - To understand the distribution of five bacterial pathogens in O'ahu coastal streams and relate their presence to microbial indicator concentrations, land cover of the surrounding watersheds, and physical-chemical measures of stream water quality.

Results - Results implicate streams as a source of pathogens to coastal waters. Future work is recommended to determine infectious risks of recreational waterborne illness related to O'ahu stream exposures and to mitigate these risks through control of land-based runoff sources.

146 - EFFECTS OF RUNOFF CONTROLS ON THE QUANTITY AND QUALITY OF URBAN RUNOFF AT TWO LOCATIONS IN AUSTIN, TEXAS

Clarence T. Welborn, and J.E. Veenhuis

<http://pubs.usgs.gov/wri/1987/4004/report.pdf>

Purpose - Determine if the rapid urban development in the Austin metropolitan area is causing an increase in the peak discharges from storm runoff and the degradation of the quality in receiving waters.

Results - Loads of most constituents and total densities of bacteria at the mall site were substantially larger in the inflow than in the outflow. The total densities of bacteria at the outflow were less by about 80 percent. Discharge weighted concentration data for Alta Vista indicate that the grass-covered swales and the grass-covered detention area had little or no effects on reducing concentrations or densities of most water-quality constituents.

Sources:

Probable – Residential, Industrial and Commercial Land Use(street, lawn and parking lot runoff)

Potential -

Possible -

14 - Tecolote Creek Microbial Source Tracking Summary Phases I, II, and III

Weston Solutions

Purpose - To investigate the bacterial sources, origins, and loads in the Tecolote Creek watershed and to assess and characterize specific priority activity contributions.

Results – Wet weather bacteria loads from individual land uses indicated that there were no significant differences between different land uses with flows merging and combining throughout drainage areas. There was some indication that higher loads were attributable to transportation corridors, commercial areas, and industrial land uses. Dry weather loads were higher in residential and commercial areas with specific activities identified as including poorly maintained dumpsters leaking high concentrations of indicator bacteria. A key transport mechanism found especially in commercial and industrial areas was over-irrigation. Residential areas were found to be abiding by water conservation recommendations, but this was not seen in commercial and industrial areas.

During dry weather, five positive *Bacteroides* samples were obtained. Each follow-up investigation failed to locate a point source; however, in every instance there was evidence of transient human activity. During wet weather, only 1 sample from a total of 37 samples collected over 9 storms was found to be positive for *Bacteroides*. This sample was collected during the early phase of the storm flows in an area known to be a transient area.

Biofilms on the walls of the MS4 system in particular were found to grow rapidly and contain high numbers of enterococci. Speciation of these enterococci determined that the origins were most likely environmental rather than fecal. Further investigation determined that the storm water, with high numbers of enterococci of fecal origin, was the primary inoculation mechanism but that biofilms matured rapidly into complex communities with a variety of species present. The high flows generated during wet weather were found to cause significant biofilm sloughing. The impact of biofilms on wet weather loads of indicator bacteria into receiving waters would

appear to be significant. Sediments and biofilms within the creek and MS4 system were found to be significant reservoirs.

Sources:

Probable - Biofilm (MS4 Infrastructure), Sediment and biofilms in Tecolote Creek, Sediment and biofilms in MS4 Infrastructure

Potential - MS4 Infrastructure (anthropogenic non-human sources) Land use (residential, commercial, schools, restaurants, nurseries, golf course, livestock & domestic animal, industrial, Open space/Parks/Recreation, transportation corridors)

Possible -

52 - Dry Weather Bacterial Source Identification Study in the Mouth of Chollas Creek

Weston Solutions and the City of San Diego

Purpose - 1. What are the sources and magnitudes of dry weather urban runoff and associated indicator bacteria that influence water quality at the mouth of Chollas Creek?

2. What BMPs may be put in place to reduce or eliminate the influence of dry weather urban runoff at the mouth of Chollas Creek?

Results - During dry weather, there is no hydrologic connection between the mouth of Chollas Creek (the area influenced by tidal action) and the upstream drainage. Thus, bacteria found in the receiving waters of the creek mouth originate from sources that discharge directly to the mouth (i.e., storm drains). The highest bacterial concentrations were associated with the two storm drains near the National Avenue Bridge. Concentrations of indicator bacteria associated with the other identified storm drains were lower, but still contributed to elevated concentrations in the receiving water in the south fork and main stem, respectively. Two sources of flow that contributed to the high bacterial concentrations were identified as (1) over-irrigation of landscaping at the strip mall located at National Avenue and 35th Street and (2) a freshwater slough adjacent to a freeway off ramp that periodically discharges to a storm drain in the south fork of the creek.

Sources:

Probable - Storm drains and scour ponds at storm drain outlet; MS4 infrastructure; human waste), over-irrigation (landscaping)

Potential – Non-specific source (Freshwater slough; non-anthropogenic)

Possible -

54 - Regional Harbor Monitoring Program Pilot Project 2005-08 Summary Final Report

Weston Solutions and the City of San Diego

Purpose - The core monitoring program assesses the conditions found in the harbors based on comparisons to historical reference values for the four harbors and comparisons of contaminant concentrations to known surface water and sediment thresholds using chemistry, bacterial, toxicology, and benthic infaunal community indicators.

Results - Based on the results of the Pilot Project, the following statements can be made: 1) All bacterial concentrations were well below AB 411 levels, 2) The majorities of the marina and

freshwater-influenced strata contained sediments that were not toxic, 3) Benthic infaunal communities in both strata occurred at intermediate levels of disturbance, 4) Toxicity levels in the marina sediments generally were better than harbor-wide historical conditions, 5) Toxicity levels and benthic infaunal communities did not differ between the two strata, and 6) From 2005-2007, no negative short-term trends were evident for any indicator that would be indicative of a degrading condition.

70 - 2009-2010 Coastal Storm Drain Monitoring Annual Report

Weston Solutions, Inc. and County of San Diego Copermittees

Purpose - To determine the impacts that storm drains have on coastal receiving waters.

Results - There were a total of 28 exceedances of the total coliform storm drain action level. Twelve sites had at least one exceedance for total coliform, of which 3 had a total coliform exceedance on multiple dates.

Sources:

Probable – Cats

Potential –Cows, horses, fox, cormorants,

Possible – Non-specific source (human waste), gulls (secondary wildlife), Wildlife (muskrats, raccoons, coyotes, rabbits, turkeys and geese)

74 - MICROBIAL SOURCE TRACKING IN TWO SOUTHERN MAINE WATERSHEDS Report Number: MSG-TR-04-03March 2004Merriland River, Branch Brook and Little River (MBLR) Watershed Report

Kristen Whiting-Grant, F. Dillon, C. Dalton, Dr. M. Dionne, and Dr. S. Jones

Purpose - This study focuses on the Merriland River, Branch Brook and Little River (MBLR) watershed in Wells, Kennebunk and Sanford Maine, where chronic and persistent bacterial contamination from unidentified sources has restricted shellfish harvesting.

Results - Cats were the most frequently identified single source of bacterial contamination (21%); followed by cow (11%); fox (7%); cormorant (5%); human, rabbit, muskrat, horse and gull (all at 3%); turkey (2%); and goose, raccoon, coyote and dog (all at 1%). Also note that ribotypes for 35% of the bacteria samples analyzed by JEL could not be identified, which is to say that no clear matches could be established between ribotypes of known source species and ribotypes from unknown water samples.

Sources:

Probable – Cats

Potential –Cows, horses, fox, cormorants,

Possible – Non-specific source (human waste), gulls (secondary wildlife), Wildlife (muskrats, raccoons, coyotes, rabbits, turkeys and geese)

64 - Microbial Source Tracking in the Dungeness Watershed, Washington

D.L. Woodruff, N.K. Sather, V.I. Cullinan, and S.L. Sargeant

Purpose - To determine the sources of fecal coliform pollution that have been impacting the water quality and shellfish harvesting activities for more than a decade.

Results – The predominant sources of fecal coliform contamination in the Dungeness from all matrix types (e.g. water, sediment, wrack) in the freshwater and marine environments were, in rank order, avian (19.6%), gull (12.5%), waterfowl (9.7%), raccoon (9.2%), unknown (7.3%), human-derived (7.1%), rodent (6.3%) and dog (4.3%). When bird groups were combined, they represented in total about 42% of samples collected and analyzed throughout the study.

Sources:

Probable – Wildlife,

Potential - Non-specific source (human waste), domestic animals,

Possible -

44 - Quantitative Pathogen Detection and MST Combined with modeling of fate and transport of Bacteroidales in San Pablo Bay.

Stefan Wuertz, F. Bombardelli, K. Sirikanchana, A. Schriewer, and Z. Kaveh

Purpose - To develop a decision-making tool in the form of a 3-D model to benefit coastal managers both in terms of pinpointing major sources of fecal pollution and maximizing the usefulness of any monitoring activity.

Results – Monitoring results indicated low-level general and human-derived fecal contamination in the bay, while cow- and dog-derived contamination was not detected, except for one sample which contained dog-specific genetic marker. Human viruses were also below the sample detection limit. The pollution was more likely to come from surrounding urban areas or wastewater treatment facilities than from agricultural farm land or wildlife areas.

Sources:

Probable – Non-specific source (human waste),

Potential -

Possible – Dogs and cows

232 - Indicator organism sources and coastal water quality: a catchment study on the island of Jersey

M.D. Wyer, D. Kay, G.F. Jackson, H.M. Dawson, J. Yeo, and L. Tanguy

<http://www.ncbi.nlm.nih.gov/pubmed/7730205>

Purpose - Compliance monitoring of bathing waters at La Grève de Lecq on the North coast of Jersey revealed a significant deterioration in water quality between 1992 and 1993, as indexed by presumptive coliform, presumptive *Escherichia coli* and streptococci concentrations. During the 1993 bathing season the beach failed to attain the compliance with the EC Guideline criteria for presumptive *E. coli* and streptococci.

Results - A bacteriological survey of the stream catchment draining to the beach revealed that: (i) concentrations of faecal indicator organisms were enhanced at high discharge after rainfall; and (ii) a captive water fowl population, which expanded between 1990 and 1993, was a potential source of faecal pollution.

233 - Beach sands along the California coast are diffuse sources of fecal bacteria to coastal waters

K.M. Yamahara, B.A. Layton, A.E. Santoro, and A.B. Boehm

<http://pubs.acs.org/doi/abs/10.1021/es062822n>

Purpose - The potential for FIB to be transported from the sand to sea was investigated at a single wave-sheltered beach with high densities of ENT in beach sand

Results - We collected samples of exposed and submerged sands as well as water over a 24 h period in order to compare the disappearance or appearance of ENT in sand and the water column. Exposed sands had significantly higher densities of ENT than submerged sands with the highest densities located near the high tide line. Water column ENT densities began low, increased sharply during the first flood tide and slowly decreased over the remainder of the study. During the first flood tide, the number of ENT that entered the water column was nearly equivalent to the number of ENT lost from exposed sands when they were submerged by seawater. The decrease in nearshore ENT concentrations after the initial influx can be explained by ENT die-off and dilution with clean ocean water. While some ENT in the water and sand at LP might be of human origin because they were positive for the *esp* gene, others lacked the *esp* gene and were therefore equivocal with respect to their origin.

58 - High-Throughput and Quantitative Procedure for Determining Sources of Escherichia coli in Waterways by Using Host-Specific DNA Marker Genes

Tao Yan, M.J. Hamilton, and M.J. Sadowsky

<http://aem.asm.org/content/73/3/890.full.pdf+html>

Purpose - The objective of the study was to evaluate a high-throughput, semi-automated, quantitative procedure for determining sources of *E. coli* in waterways by using host-specific DNA marker genes of geese and ducks and robot-assisted high-throughput technology. Although the objective was to evaluate the method, the seasonal goose/duck population as a bacteria source was evaluated at 2 lakes frequented with migratory goose/duck populations and an additional lake that is not frequented by migratory goose

Results - The relative contributions of fecal *E.coli* from the geese/ducks were estimated to be 34% and 51% in Lake Superior and Lake Calhoun, respectively and 0.28% at Lake Hartwell (which has no migratory goose population)

Sources:

Probable – Wildlife (Lake Calhoun, Lake Superior),

Potential -

Possible–Wildlife (Lake Hartwell which has no migratory goose populations)

NSC (Not Source Characterization) Studies

137 - Relationship between rainfall and beach bacterial concentrations on Santa Monica Bay beaches

Drew Ackerman and S. B. Weisberg

http://www.sccwrp.org:8060/pub/download/DOCUMENTS/AnnualReports/2001_02AnnualReport/18_ar37-drew.pdf

Purpose - To enhance the scientific foundation for preemptive public health warnings, examine the relationship between rainfall and beach indicator bacteria concentrations using five years of fecal coliform data taken daily at 20 sites in southern California.

Results - There was a clear relationship between the incidence of rainfall and reduction in beach bacterial water quality in Los Angeles County. Bacterial concentrations remained elevated for five days following a storm, although they generally returned to levels below state water quality standards within three days. The length of the antecedent dry period had a minimal effect on this relationship, probably reflecting a quickly developing equilibrium between the decay of older fecal material and the introduction of new fecal material to the landscape.

175 - Persistence and potential growth of the fecal indicator bacteria, *Escherichia coli* in shoreline sand at Lake Huron

E.W. Alm, J. Burke, and E. Hagan

<http://www.bioone.org/doi/abs/10.3394/0380-1330%282006%2932%5B401:PAPGOT%5D2.0.CO;2>

Purpose - This study was initiated to test the hypothesis that high abundances of the fecal indicator *Escherichia coli* in shoreline sand at freshwater beaches can be explained, at least in part, by the ability of *E. coli* to persist and grow in beach sand.

Results - In controlled laboratory microcosm studies using autoclaved beach sand inoculated with *E. coli* strains previously isolated from ambient beach sand, *E. coli* densities increased from 2 CFU/g to more than 2×10^5 CFU/g sand after 2 days of incubation at 19°C, and remained above 2×10^5 CFU/g for at least 35 days. In field studies utilizing similarly inoculated beach sand in diffusion chambers incubated at a Lake Huron beach, *E. coli* also grew rapidly, reaching high densities (approximately 7.5×10^5 CFU/g), and persisting in a cultivable state at high density for at least 48 days. In comparison, *E. coli* levels in ambient beach sand adjacent to the chambers always had densities <100 CFU/g. Lake Huron beach sand clearly provides nutrients, temperatures, and other conditions needed to support growth of *E. coli*. The growth of *E. coli* in sterile sand diffusion chambers to higher levels than occurs in ambient beach sand may indicate the presence in ambient sand of biological controls on bacterial growth, such as predation or competition.

59 - Host Species-Specific Metabolic Fingerprint Database for Enterococci and *Escherichia coli* and Its Application to Identify Sources of Fecal Contamination in Surface Waters

Warish Ahmed, R. Neller, and M. Katoulli

<http://aem.asm.org/content/71/8/4461.full.pdf+html>

Purpose - To characterize two fecal indicator bacteria, enterococci and *E. coli*, from different host groups (i.e., animal species) to develop a metabolic fingerprint database to identify the source(s) of fecal contamination in a creek in Australia.

Results - Out of 27 water samples: 10% of the biochemical phenotypes (BPT) found for enterococci belonged to human origin, 61% belonged to animals tested. 13% of the BPTs found for *E. coli* belonged to human origin and 54% belonged to animals tested. The remaining BPT found for Enterococci and *E. coli* belonged to BPTs shared between humans and animals or did not match database

Sources:

Probable –Septic (human waste), animal farms (domestic animals), animal farms (agriculture),

Potential -

Possible -

80 - Persistence and Differential Survival of Fecal Indicator Bacteria in Subtropical Waters and Sediments

K.L. Anderson, J.E. Whitlock, and V.J. Harwood

<http://aem.asm.org/content/71/6/3041.full.pdf+html>

Purpose - Fecal coliforms and enterococci are indicator organisms used worldwide to monitor water quality. These bacteria are used in microbial source tracking (MST) studies, which attempt to assess the contribution of various host species to fecal pollution in water. Ideally, all strains of a given indicator organism (IO) would experience equal persistence (maintenance of culturable populations) in water; however, some strains may have comparatively extended persistence outside the host, while others may persist very poorly in environmental waters. Assessment of the relative contribution of host species to fecal pollution would be confounded by differential persistence of strains.

Results - IO persistence according to mesocosm treatment followed the trend: contaminated soil > wastewater > dog feces. *E. coli* ribotyping demonstrated that certain strains were more persistent than others in freshwater mesocosms, and the distribution of ribotypes sampled from mesocosm waters was dissimilar from the distribution in fecal material. These results have implications for the accuracy of MST methods, modeling of microbial populations in water, and efficacy of regulatory standards for protection of water quality. Saltwater had a negative effect on FC persistence, as the decay rates of FC (all inoculum sources combined) in saltwater sediments and water column were greater than those in freshwater. Saltwater also significantly increased enterococcal decay rates compared to freshwater. IO persistence tended to be greater in sediments than in the water column. The average decay rate of FC in sediments of freshwater mesocosms was significantly less than those in the water column, and the difference was nearly significantly at the $\alpha = 0.05$ level in saltwater ($P = 0.083$). Although decay rates of enterococci tended to be greater in the water column than in sediments, the difference was not significant in freshwater or saltwater mesocosms.

176 - Persistence and differential survival of fecal indicator bacteria in subtropical waters and sediments

K.L. Anderson, J.E. Whitlock, and V.J. Harwood

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1151827/>

Purpose - This study utilized mesocosms designed to simulate natural conditions, which were inoculated with fecal material, to test the hypothesis that certain *E. coli* phylotypes exhibit greater persistence than others in aquatic environments.

Results - This study demonstrated a high degree of variability in the response of fecal indicator organisms to stresses in aquatic environments on all levels investigated. Responses to water type (saline versus fresh), location (sediment versus water column), and inoculum type all varied within and between indicator bacterial groups (FC and ENT). The discrepant results emphasize the difficulties encountered in attempting to regulate diverse types of water bodies by one regulatory standard. Also cautionary is the persistence of indicator organisms in sediments, which leads to elevation of their densities and a false indication of recent pollution in the water column after events such as rain storms, construction, or recreational use.

130 - LEVELS OF FECAL INDICATOR BACTERIA AT DOG BEACH AND NEARBY COASTAL BEACHES OF THE CITY OF SAN DIEGO, CA

Amir Baum

http://www.sandiegoriver.org/documents/baum_final_thesis.pdf

Purpose - An analysis of historical County of San Diego microbial marine water quality was conducted to quantitatively compare the levels of fecal indicator bacteria (FIB) levels at Dog Beach, located at the San Diego River Outlet, and nearby coastal beaches. Additionally, this study aimed to determine if relationships existed between daily average river flow/daily precipitation and FIB densities at Dog Beach and nearby coastal beach stations and if significant associations existed between daily precipitation and FIB single sample exceedances.

Results - The study found the strongest association between river flow, precipitation, and TC levels to be at river discharge points during wet months, but no significant association was found during dry weather. The study demonstrated that using a stratified-random sampling design, urban runoff outlets are a primary source of contaminated runoff with 90% of sites near urban runoff outlets failing water quality standards.

81 - Integrated Analysis of Established and Novel Microbial and Chemical Methods for Microbial Source Tracking

Anicet R. Blanch, L. Belanche-Muñoz, X. Bonjoch, J. Ebdon, C. Gantzer, F. Lucena, J. Ottoson, C. Kourtis, A. Iversen, I. Kühn, L. Mocé, M. Muniesa, J. Schwartzbrod, S. Skrabber, G.T.

Papageorgiou, H. Taylor, J. Wallis, and J. Jofre

<http://aem.asm.org/content/72/9/5915.full.pdf+html>

Purpose - The objectives of the present study were (i) to determine the most discriminant tracers showing wide and consistent geographical stability between all locations, (ii) to identify subsets of variables derived from tracers with the highest discriminant capacity, and (iii) to evaluate and

compare statistical or machine learning methods to develop predictive models for source tracking using the minimum number of these variables. In this multilaboratory study, different microbial and chemical indicators were analyzed in order to distinguish human fecal sources from nonhuman fecal sources using wastewaters and slurries from diverse geographical areas within Europe.

Results - Fecal coliforms, enterococci, clostridia, somatic coliphages, and total bifidobacteria were detected in almost all samples (other than a single sample in the case of total bifidobacteria) of both human and animal origin. They were more abundant in the animal samples than in the human samples, but this seems to be due to the higher fecal load of these samples, since relative densities were similar in both groups of samples.

21 - Enterococci Concentrations in Diverse Coastal Environments Exhibit Extreme Variability

A.R. Boehm

<http://pubs.acs.org/doi/abs/10.1021/es071807v>

Purpose - The study examines extreme temporal variations (periods between 1 min and 24 h) in FIB concentrations in diverse marine coastal environments ranging from wave-sheltered to wave-exposed open ocean beaches.

Results - The high frequency variability indicates that regardless of sampling time, a single sample of water tells one little about the true water quality, so multiple samples need to be collected. If it is not feasible to collect multiple samples, then a spatially or temporally composited sample will improve the estimate of the true water quality.

157 - Methicillin-resistant Staphylococcus aureus (MRSA) in municipal wastewater: an uncharted threat?

S. Börjesson, A. Matussek, S. Melin, S. Löfgren, and P.E. Lindgren

<http://www.mendeley.com/research/methicillinresistant-staphylococcus-aureus-mrsa-in-municipal-wastewater-an-uncharted-threat/#page-1>

Purpose - (i) To cultivate methicillin-resistant Staphylococcus aureus (MRSA) from a full-scale wastewater treatment plant (WWTP), (ii) To characterize the indigenous MRSA-flora, (iii) To investigate how the treatment process affects clonal distribution and (iv) to examine the genetic relation between MRSA from wastewater and clinical MRSA.

Results - MRSA could be isolated on all sampling occasions, but only from inlet and activated sludge. The number of isolates and diversity of MRSA were reduced by the treatment process, but there are indications that the process was selected for strains with more extensive antibiotic resistance and PVL+ strains. The wastewater MRSA-flora had a close genetic relationship to clinical isolates, most likely reflecting carriage in the community.

158 - A seasonal study of the mecA gene and Staphylococcus aureus including methicillin-resistant S. aureus in a municipal wastewater treatment plant

S. Börjesson, S. Melin, A. Matussek, and P.E. Lindgren

<http://www.loudounnats.org/pdf/09WRAseasonalstudyofmecASaureusandMRSAinafull-scaleWWTP.pdf>

Purpose - Determine the effect of wastewater treatment processes on mecA gene concentrations, and the prevalence of S. aureus and MRSA over time. To achieve this a municipal wastewater treatment plant was investigated for the mecA gene, S. aureus and MRSA, using real-time PCR assays

Results - Using molecular methods and cultivation, MRSA was for the first time detected in a municipal activated sludge and trickling filter WWTP, but mainly in the early treatment steps, IN, PS and AS. The mecA gene and S. aureus could be detected throughout the year at all sampling sites. The wastewater treatment process reduces mecA gene concentrations, which can partly be explained by removal of biomass.

140 - Particle Associated Microorganisms in Stormwater Runoff

Michael Borst, and A. Selvakumar

<http://www.epa.gov/ORD/NRMRL/pubs/600j03262/600j03262.pdf>

Purpose - Investigate the effects of blending and chemical addition before analysis of the concentration of microorganisms in stormwater runoff play a significant role.

Results - Particle-associated microorganisms play an important, if often unmeasured, portion of the total organism count in stormwater. All organisms, except for E. coli, showed an increase in the measured concentration after blending samples at 22,000 rpm with or without the chemical mixture. Other than fecal streptococci, the organism concentrations decreased with the addition of the Camper's solution in both blended and unblended samples before analyses. There was a statistically significant interaction between the effects of Camper's solution and the effects of blending for all the organisms tested, except for total coliform. Blending did not alter the mean particle size significantly. The results show no correlation between increased total coliform, fecal coliform, and fecal streptococcus concentrations and the mean particle size.

87 - Direct comparison of four bacterial source tracking methods and use of composite data sets

E.A. Casarez, S.D. Pillai, J.B. Mott, M. Vargas, K.E. Dean and G.D. Di Giovanni

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2672.2006.03246.x/pdf>

Purpose - (i) To compare the identification ability of the four BST methods individually and in combination through the use of composite data sets and (ii) to evaluate the use of the developed data sets for the identification of faecal contamination sources in two Central Texas lakes suspected of being impacted by agricultural operations and dairy cattle.

Results - Best matching identification using the composite data set correctly identified 100% of the replicate QC cultures (precision), and had 100% accuracy for E. coli strain and source class

identification of the isolates. Therefore, the four-method composite performed better than any single method.

154 - Removal of bacterial indicators of fecal contamination in urban stormwater using a natural riparian buffer

M.J. Casteel, G. Bartow, S.R. Taylor, and P. Sweetland

http://www.lmtf.org/FoLM/Plans/Water/VistaGrande/Casteetal_10icud_paper.PDF

Purpose - Determine if riparian buffers are able to remove bacterial indicators of fecal contamination and other microbial contaminants from intermittent, high-volume flows such as those encountered during storm events in heavily urbanized areas.

Results - Analysis of lake water showed that levels of *Escherichia coli* and total coliforms increased significantly during storm events, indicating the presence of nonpoint sources of fecal contamination in the area surrounding the lake.

134 - Population structure and persistence of *Escherichia coli* in ditch sediments and water in the Seven Mile Creek Watershed

Ramyavardhanee Chandrasekaran

http://conservancy.umn.edu/bitstream/108879/1/Chandrasekaran_Ramyavardhanee_May2011.pdf

Purpose - Examined the population structure of *E. coli* and determined whether ditch sediments can serve as reservoirs of environmental *E. coli* in the Seven Mile Creek (SMC) watershed, a minor watershed located in south central Minnesota

Results - Further analysis of the count data revealed a strong correlation between *E. coli* concentrations and temperature profile at the SMC. *E. coli* densities in SMC water samples exceeded the permissible Minnesota standard (126 CFU/100 ml) predominantly during summer and fall seasons. In addition to temperature, rainfall also drastically influenced the dynamics and distribution of *E. coli* populations at the SMC. Results suggest that the seasonal variation in *E. coli* counts observed in water and sediments are most likely related to temperature, rainfall, and the patchy distribution of *E. coli* within sampling locations

88 - Relative Decay of Bacteroidales Microbial Source Tracking Markers and Cultivated *Escherichia coli* in Freshwater Microcosms

Linda K. Dick, Erin A. Stelzer, Erin E. Bertke, Denise L. Fong, and Donald M. Stoeckel

<http://aem.asm.org/content/76/10/3255.full.pdf+html>

Purpose - Fecal indicator bacteria (FIB), commonly used to regulate sanitary water quality, cannot discriminate among sources of contamination. The use of alternative quantitative PCR (qPCR) methods for monitoring fecal contamination or microbial source tracking requires an understanding of relationships with cultivate FIB, as contamination ages under various conditions in the environment. In this study, the decay rates of three Bacteroidales 16S rRNA gene markers (AllBac for general contamination and qHF183 and BacHum for human-associated contamination) were compared with the decay rate of cultivated *Escherichia coli* in river water microcosms spiked with human wastewater.

Results - A major finding of this study was that HF marker decay was consistent with, or significantly faster than, that of E. coli under all treatments. This indicates that the HF markers might be useful as conservative estimators of human origin E. coli even as fecal contamination ages in the environment.

118 - Bacteriological Quality of Runoff Water from Pastureland

J.W. Doran, and D.M. Linn

<http://aem.asm.org/content/37/5/985.abstract>

Purpose - Determine the bacteriological characteristics of pasture runoff and to compare them with runoff from an ungrazed area.

Results - We found no relationship between FC and FS counts in rainfall runoff and either rainfall or total runoff for most events. Bacteriological quality of snowmelt runoff. During the 3-year study, there were 10 snowmelt runoff events-two in 1976 and 8 in 1978. The levels of TC in snowmelt runoff from both grazed and ungrazed pasture areas exceeded recommended water quality standards. FC counts, often considered a better index of fecal contamination, were within recommended standards.

89 - Microbial source tracking using host specific FAME profiles of fecal coliforms

Metin Duran, Berat Z. Haznedaroglu, and Daniel H. Zitomer

<http://www.prairieswine.com/pdf/3397.pdf>

Purpose - The objective of this study was to investigate the host-specific differences in fatty acid methyl ester (FAME) profiles of fecal coliforms (FC).

Results - The results presented here provide further evidence that FAME profiles of indicator organisms have statistically significant host specificity and suggest that these differences may be useful in predicting sources of microbial pollution in water environments. However, more research is needed to determine the mechanisms causing the host specificity and to assess the possible temporal and spatial variations in FAME profiles before FAME can be applied in the field.

183 - Quantitative evaluation of enterococci and Bacteroidales released by adults and toddlers in marine water

S.M. Elmir, T. Shibata, H.M. Solo-Gabriele, C.D. Sinigalliano, M.L. Gidley, G. Miller, L.R.W. Plano, J. Kish, K. Withum, and L.E. Fleming

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2761526/>

Purpose - The main objectives of the this study were to measure shedding of enterococci and Bacteroidales using traditional and emerging laboratory methods, and to evaluate shedding from toddlers and adults. The added value of the current study was the evaluation of shedding from toddlers (all prior studies used adult volunteers), and the use of additional methods of fecal indicator bacteria analyses (i.e. enterococci by CS and qPCR, and Bacteroidales by qPCR) as no data are available which directly measure fecal indicator bacteria shedding using these alternate methods.

Results - Human bathers have the potential to release significant amounts of fecal indicator bacteria into the water column via direct shedding off their body and via sand transported by their skin. Direct shedding from the body can include releases from fecally contaminated body areas and skin, and releases from fecally contaminated diapers. In this study, the quantity of enterococci released was a function of bathing cycle, sand exposure, beach sand contamination levels, and microbial flora variations between swimmers.

182 - Quantitative evaluation of bacteria released by bathers in a marine water

S.M Elmir, M.E. Wright, A. Abdelzaher, H.M. Solo-Gabriele, L.E. Fleming, G. Miller, M. Rybolowik, M.T. Peter Shih, S.P. Pillai, J.A. Cooper and E.A. Quay

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2633726/>

Purpose - This study focused on estimating the amounts of enterococci and *S. aureus* shed by bathers directly off their skin and indirectly via sand adhered to skin.

Results - This study demonstrated that bathers shed significant concentrations of enterococci and *S. aureus* into the water column and that *S. aureus* was shed at concentrations at least one order of magnitude greater than enterococci. This study also showed that total enterococci and *S. aureus* released by bathers decreased significantly between bathing episodes, in particular after the first wash cycle. This conclusion agrees with the long standing universal requirement that bathers should shower before entering recreational waters to reduce the microbial load in particular at swimming pools since the water volume is limited. It is concluded from this study that the enterococci contribution from sand adhered to skin, was small relative to the amount shed directly from the skin and represented less than 5% of the total enterococci shed by bathers.

159 - Staphylococcus aureus and fecal indicators in Egyptian coastal waters of Aqaba Gulf, Suez Gulf, and Red Sea

M.A. El-Shenawy

http://www.nodc-egypt.org/contacts_files/vol-31-2/Volume%2031%20%282%29%202005.PDF/9/Text.pdf

Purpose - Study the hygienic status of Egyptian coastal waters of Aqaba Gulf, Suez Gulf and Red Sea. The possibility of using *S.aureus* as supplementary indicator to the conventional bacterial indicators was another goal.

Results - 107 samples (53.5 %) of the 200 total examined samples were found to harbour *S aureus* exceeding the aforementioned guide standards. The present results concluded that addition of *S. aureus* as supplementary indicator to the conventional fecal indications may be useful for judging the marine water quality in Red Sea region.

138 - Sediment Bacterial Indicators in an Urban Shellfishing Subestuary of the Lower Chesapeake Bay

Carl W. Erkenbrecher Jr.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC244041/pdf/aem00190-0106.pdf>

Purpose - Historically, the Lynnhaven, an urban shellfishing estuary of the lower Chesapeake Bay region, has been opened and closed periodically to shellfishing during the past 40 years due to high fecal coliform counts. Document the spatial and temporal distributions and compositions of bacteria in the sediments and overlying waters of an important urban shellfishing area in the lower Chesapeake Bay region, the Lynnhaven Estuary.

Results - Densities of all indicator bacteria were always significantly higher in the sediments than in the overlying subsurface waters. The major problems inherent in this system are nonpoint in their origin. The primary sources of the Lynnhaven's bacterial pollution appeared to be typical of urban and agricultural runoff, although failure of septic tank systems was suspected as a problem in the Lynnhaven's western branch. These results illustrated that sediments in shellfishing areas could serve as a reservoir for high densities of indicator bacteria and that, potentially, pathogens could pose a health hazard.

184 - Enumeration and speciation of enterococci found in marine and intertidal sediments and coastal water in southern California

D.M. Ferguson, D.F. Moore, M.A. Getrich, and M.H. Zhouandai

<http://www.ochealthinfo.com/docs/public/h2o/Enumeration-speciation.pdf>

Purpose - To determine the levels and species distribution of enterococci in intertidal and marine sediments and coastal waters at two beaches frequently in violation of bacterial water standards.

Results - High levels of *Enterococcus* in intertidal sediments indicate retention and possible regrowth in this environment. Significance and Impact of the Study: Re-suspension of enterococci that are persistent in sediments may cause beach water quality failures and calls into question the specificity of this indicator for determining recent faecal contamination.

90 - Comparison of *Bacteroides-Prevotella* 16S rRNA Genetic Markers for Fecal Samples from Different Animal Species

Lisa R. Fogarty and Mary A. Voytek

<http://aem.asm.org/content/71/10/5999.full.pdf+html>

Purpose - The goals of this study were to compare *Bacteroides-Prevotella* populations from nine host species collected at multiple geographical locations and to determine if unique populations could be identified for each host species that could be used to develop markers for fecal source tracking.

Results - Results support the use of molecular techniques to characterize *Bacteroides-Prevotella* populations as a means to improve the ability to track sources of fecal contamination, but also show the need for more development of these methods.

186 - Abundance and characteristics of the recreational water quality indicator bacteria *Escherichia coli* and enterococci in gull faeces

L.R. Fogarty, S.K. Haack, M.J. Wolcott, and R.L. Whitman

<http://cws.msu.edu/documents/FogartyetalJAM2003.pdf>

Purpose - To evaluate the numbers and selected phenotypic and genotypic characteristics of the faecal indicator bacteria *Escherichia coli* and enterococci in gull faeces at representative Great Lakes swimming beaches in the United States.

Results - Gull faeces could be a major contributor of *E. coli* (105–109 CFU g⁻¹) and enterococci (104– 108 CFU g⁻¹) to Great Lakes recreational waters. *E. coli* and enterococci in gull faeces are highly variable with respect to their genotypic and phenotypic characteristics and may exhibit temporal or geographic trends in these features.

162 - A preliminary investigation of fecal indicator bacteria, human pathogens, and source tracking markers in beach water and sand

K.D. Goodwin, L. Matragrano, D. Wanless, C. Sinigalliano, and M.J. LaGier

http://yyy.rsmas.miami.edu/groups/ohh/projects/microbesresearch/GoodwinERK2_4.pdf

Purpose - Data suggesting that fecal indicating bacteria may persist and/or regrow in sand has raised concerns that fecal indicators may become uncoupled from sources of human fecal pollution. To investigate this possibility, wet and dry beach sand, beach water, riverine water, canal water, and raw sewage samples were screened by PCR for certain pathogenic microbes and molecular markers of human fecal pollution.

Results - Overall, this analysis pointed to the need to find better methods of extracting nucleic acids from environmental samples in order to reduce the possibility of false negative results. High quality nucleic acids need to be consistently and efficiently delivered to the detector system if the relationship between fecal indicators and human pathogens and human source tracking markers is to be elucidated.

93 - Comparing Wastewater Chemicals, Indicator Bacteria Concentrations, and Bacterial Pathogen Genes as Fecal Pollution Indicators

Sheridan K. Haack, Joseph W. Duris, Lisa R. Fogarty, Dana W. Kolpin, Michael J. Focazio, Edward T. Furlong, and Michael T. Meyer

<https://www.crops.org/publications/jeq/pdfs/38/1/248>

Purpose - Compare fecal indicator bacteria (FIB) (fecal coliforms, *Escherichia coli* [EC], and enterococci [ENT]) concentrations with a wide array of typical organic wastewater chemicals and selected bacterial genes as indicators of fecal pollution in water samples collected at or near 18 surface water drinking water intakes.

Results - In our study, which examined ambient waters in various land use environments with a wide range of FIB concentrations, fecal pollution was indicated by gene-based and/or chemical-based markers for 14 of the 18 tested samples, with little relation to FIB standards.

95 - Development of Goose- and Duck-Specific DNA Markers To Determine Sources of *Escherichia coli* in Waterways

Matthew J. Hamilton, Tao Yan, and Michael J. Sadowsky

<http://aem.asm.org/content/72/6/4012.full.pdf+html>

Purpose - The development and validation of host source-specific genetic markers for *E. coli* strains originating from Canada geese (*Branta canadensis*).

Results - SSH was successfully used to identify seven DNA markers with high levels of hybridization specificity for *E. coli* strains originating from geese. Combined, the marker DNAs were capable of identifying about 76% of the goose *E. coli* strains examined and 73% of the duck *E. coli* strains examined.

192 - Waterfowl Abundance Does Not Predict the Dominant Avian Source of Beach *Escherichia coli*

D.L. Hansen, S. Ishii, M.J. Sadowsky, and R.E. Hicks

<https://www.soils.org/publications/jeq/abstracts/40/6/1924?access=0&view=pdf>

Purpose - The horizontal, fluorophore enhanced, rep-PCR (HFERP) DNA fingerprinting technique was used to identify potential sources of *Escherichia coli* in water, nearshore sand, and sediment at two beaches in the Duluth-Superior Harbor, near Duluth, MN, and Superior, WI, during May, July, and September 2006.

Results - Waterfowl, including Canada geese, ring-billed gulls, and mallard ducks, were the largest source of *E. coli* that could be identified in water (55–100%), sand (59–100%), and sediment (92–100%) at both beaches. Although ring-billed gulls were more abundant in this harbor, Canada geese were usually the dominant source of waterfowl *E. coli* found at these beaches.

96 - Validation and field testing of library-independent microbial source tracking methods in the Gulf of Mexico

Valerie J. Harwood, Miriam Brownell, Shiao Wang, Joe Lepo, R.D. Ellender, Abidemi Ajidahun, Kristen N. Hellein, Elizabeth Kennedy, Xunyan Ye, and Christopher Flood

<http://www.usm.edu/bst/pdf/Water%20Res%202009.pdf>

Purpose - Standardize and validate MST methods across laboratories in coastal Gulf of Mexico states.

Results - An SOP was developed that allowed simultaneous purification of DNA for viral and bacterial markers, and gave comparable results among three laboratories. The method performance was generally similar whether it was conducted in buffer, fresh water or salt water; however, the human *Bacteroidales* method had a lower limit of detection in buffer and in salt water compared to fresh water.

97 - Fidelity of bacterial source tracking: *Escherichia coli* vs. *Enterococcus* spp. and minimizing assignment of isolates from non-library sources

W.M. Hassan, R.D. Ellender and S.Y. Wang

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2672.2006.03077.x/pdf>

Purpose - Improve the fidelity of library-dependent bacterial source tracking efforts in determining sources of faecal pollution.

Results - The use of enterococci provides higher rates of correct source assignment compared with *E. coli*. The use of similarity thresholds to decide whether to accept source assignments made by computer programmes reduces the rate of mis-assignment of non-library isolates.

197 - Contact with beach sand among beachgoers and risk of illness

C. D. Heaney, E. Sams, S. Wing, S. Marshall, K. Brenner, A.P. Dufour, and T.J. Wade

<http://aje.oxfordjournals.org/content/170/2/164.full.pdf>

Purpose - The purpose of this study is to better understand the illness risk associated with beach sand that can harbor high concentrations of fecal indicator organisms, as well as fecal pathogens.

Results - The results of our study suggest that, among beachgoers participating in a large prospective cohort study at beaches nearby sewage treatment discharges, reported contact with beach sand (defined as either digging in the sand or having one's body buried in the sand) was associated with an elevated risk of enteric illnesses (gastrointestinal illness and diarrhea). Being buried in the sand was more strongly associated with enteric illness than was digging in the sand. We also observed a higher proportion of people who got sand in their mouth among those buried in the sand (40%) compared with those who dug in the sand (20%).

155 - The Impact of Rainfall on Fecal Coliform Bacteria in Bayou Dorcheat (North Louisiana)

Dagne D. Hill, W.E. Owens, and P.B. Tchounwou

www.mdpi.com/1660-4601/3/1/114/pdf

Purpose - Assess the effect of surface runoff amounts and rainfall amount parameters on fecal coliform bacterial densities in Bayou Dorcheat in Louisiana.

Results - Nonpoint source pollution that is carried by surface runoff has a significant effect on bacterial levels in water resources.

199 - Beach sand and sediments are temporal sinks and sources of *Escherichia coli* in Lake Superior

Satoshi Ishii, D.L. Hansen, R.E. Hicks, and M.J. Sadowsky

<http://pubs.acs.org/doi/pdf/10.1021/es0623156>

Purpose - Report on a 2-year investigation of the seasonal variation of *E. coli* concentrations in water, sand, and sediment at the DBC Beach in the Duluth-Superior Harbor of Lake Superior.

Results - Waterfowl in addition to humans can be a significant source of fecal indicator bacteria like *E. coli* at Great Lakes beaches. Although waterfowl have been reported to carry a limited number of pathogenic *E. coli* (36), which was also found our study, they may harbor other potential pathogens such as *Salmonella* and *Campylobacter* (37). The potential health risks associated with waterfowl-borne bacteria found at beaches needs to be investigated in the future.

122 - Fecal bacteria and sex hormones in soil and runoff from cropped watersheds amended with poultry litter

Michael B. Jenkins, D.M. Endale, H.H. Schomberg, and R.R. Sharpe

<http://phoenix.nal.usda.gov/bitstream/10113/15527/1/IND44044786.pdf>

Purpose - Determine if applications of poultry litter to small watersheds would contribute to the load of fecal bacteria and sex hormones to soil and runoff

Results - Under the conditions of drought and conservation tillage, the rates at which we applied poultry litter to the four cropped watersheds appeared to have little or no significant effect on (a) soil community of fecal indicator bacteria, (b) concentrations of estradiol and testosterone in surface soil, and (c) quantities of estradiol and testosterone coming off the watersheds with runoff.

202 - Bacteroidales Diversity in Ring-Billed Gulls (*Larus delawarensis*) Residing at Lake Michigan Beaches

S.N. Jeter, C.M. McDermott, P.A. Bower, J.L. Kinzelman, M. J. Bootsma, G.W. Goetz, and S.L. McLellan

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2655448/pdf/2261-08.pdf>

Purpose - This study investigated the occurrence and diversity of Bacteroidales fecal bacteria in gulls residing in the Great Lakes region.

Results - A total of 467 gull fecal samples from five coastal beaches spanning Lake Michigan's western shore and one inland beach on Lake Winnebago were screened for the presence of Bacteroidales by PCR. There was a low but consistent occurrence of Bacteroidales in the gull populations at these beaches.

151 - The Impact of Annual Average Daily Traffic on Highway Runoff Pollutant Concentrations

Masoud Kayhanian, A. Singh, C. Suverkropp, and S. Borroum

<http://escholarship.org/uc/item/86f8c8n8>

Purpose - Evaluate correlations between annual average daily traffic and storm water runoff pollutant concentrations generated from California Department of Transportation highway sites.

Results - No direct linear correlation was found between highway runoff pollutant mean concentrations and AADT. However, through multiple regression analyses, it was shown that AADT has an influence on most highway runoff constituent concentrations, in conjunction with factors associated with watershed characteristics and pollutant build-up and wash off.

102 - Development of Bacteroides 16S rRNA Gene TaqMan-Based Real-Time PCR Assays for Estimation of Total, Human, and Bovine Fecal Pollution in Water

Alice Layton, Larry McKay, Dan Williams, Victoria Garrett, Randall Gentry, and Gary Saylor

<http://aem.asm.org/content/72/6/4214.full.pdf+html>

Purpose - Design real-time PC assay to target *Bacteroides* species (AllBac) present in human, cattle, and equine feces.

Results - This assay was shown empirically to be proportional to the concentration of human, bovine, and equine feces in water and thus can be used to estimate fecal concentrations without calculating the number of *Bacteroides* cells in the sample. The simplicity of performing these assays by direct PCR of water samples suggests that these assays may be field deployable and thus would aid data collection in watersheds with inherently high spatial and temporal variabilities.

203 - Persistence of fecal indicator bacteria in Santa Monica Bay beach sediments

C.M. Lee, T.Y. Lin, C.C. Lin, G.A. Kohbodi, A. Bhatt, R. Lee, and J.A. Jay

<http://www.sciencedirect.com/science/article/pii/S004313540600220X>

Purpose - This study involved monitoring the fecal indicator bacteria (FIB) levels in water and sediment at three ocean beaches (two exposed and one enclosed) during a storm event, conducting laboratory microcosm experiments with sediment from these beaches, and surveying sediment FIB levels at 13 beaches (some exposed and some enclosed).

Results - Results from microcosm experiments showing similar, dramatic growth of FIB in both overlying water and sediment from all beaches, as well as results from the beach survey, support the hypothesis that the quiescent environment rather than sediment characteristics can explain the elevated sediment FIB levels observed at enclosed beaches. This work has implications for the predictive value of FIB measurements, and points to the importance of the sediment reservoir.

205 - Phylogenetic Diversity and Molecular Detection of Bacteria in Gull Feces

J. Lu, J.W. Santo Domingo, R. Lamendella, T. Edge, and S. Hill

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2446513/>

Purpose - To determine the occurrence of *C. marimammalium* in waterfowl, species-specific 16S rRNA gene PCR and real-time assays were developed and used to test fecal DNA extracts from different bird (n = 13) and mammal (n = 26) species.

Results - To determine the occurrence of *C. marimammalium* in waterfowl, species-specific 16S rRNA gene PCR and real-time assays were developed and used to test fecal DNA extracts from different bird (n = 13) and mammal (n = 26) species.

103 - Genetic Diversity of *Escherichia coli* Isolated from Urban Rivers and Beach Water

Sandra L. McLellan

<http://aem.asm.org/content/70/8/4658.full.pdf+html>

Purpose - Evaluate the genetic profiles of *E. coli* strains found in stormwater, where fecal pollution is derived from multiple uncharacterized host sources, and compare these profiles to known host sources of pollution.

Results - There does not appear to be a proportional relationship between fecal indicator bacteria from a host and what is actually detected in the environment, which will be an important consideration when developing methods for fecal pollution source tracking. Matching of isolates to the entire data set demonstrated that strains from a type of sample (e.g., gull, sewage, stormwater, river water, beach water) were most similar to other strains from the same host or environmental source. These findings may be a function of geographic distribution rather than host source specificity.

126 - Identification and Quantification of Bacterial Pollution At Milwaukee County Beaches

Sandra L. McLellan, and E.T. Jensen

<http://www.gliwi.freshwater.uwm.edu/research/genomics/ecoli/media/Technical%20document%2009-12-05.pdf>

Purpose - Assess the bacterial contaminant load in the waters and sand at beaches within Milwaukee County.

Results - Bacterial water data collected during the summer 2005 beach surveys suggests a positive relationship between rainfall and increased E. coli levels at these particular beach sites. Sewage contamination could potentially reach the beach during combined sewage overflows, or from nearby sewer infrastructure failures.

104 - Evaluation of Repetitive Extragenic Palindromic-PCR for Discrimination of Fecal Escherichia coli from Humans, and Different Domestic and Wild Animals

Bidyut Mohapatra, Klaas Broersma, Rick Nordin and Asit Mazumder

<http://web.uvic.ca/~h2o/publications/Mohapatra%20et%20al.%20MI07pdf.pdf>

Purpose - Investigate the potential of rep-PCR in differentiating e. coli isolates of human, domestic and wild animal origin that might be used as a molecular tool to identify the possible source(s) of fecal pollution of source water.

Results - Rep-PCR DNA fingerprinting results provide evidence about the robustness of this method, and it's simple and cost-effective screening tool to isolate and track non-point sources of fecal contamination.

106 - Evaluation of antibiotic resistance analysis and ribotyping for identification of faecal pollution sources in an urban watershed

D.F. Moore, V.J. Harwood, D.M. Ferguson, J. Lukasik, P. Hannah¹, M. Getrich and M. Brownell

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2672.2005.02612.x/pdf>

Purpose - The accuracy of ribotyping and antibiotic resistance analysis (ARA) for prediction of sources of faecal bacterial pollution in an urban Southern California watershed was determined using blinded proficiency samples. Low rates of correct classification for E. coli proficiency isolates compared with the ARCCs of the libraries indicate that testing of bacteria from samples that are not represented in the library, such as blinded proficiency samples, is necessary to

accurately measure predictive ability. The library-based MST methods used in this study may not be suited for determination of the source(s) of faecal pollution in large, urban watersheds.

Results - None of the methods performed well enough on the proficiency panel to be judged ready for application to environmental samples.

210 - Species distribution and antimicrobial resistance of enterococci isolated from surface and ocean water

D.F. Moore, J.A. Guzman, and C. McGee

<http://www.glin.net/lists/beachnet/2008-05/pdf00000.pdf>

Purpose - The species identification and antimicrobial resistance profiles were determined for enterococci isolated from Southern California surface and ocean waters.

Results - *Enterococcus faecalis*, *E. faecium*, *E. casseliflavus* and *E. mundti* are the most commonly isolated Enterococcus species from urban runoff and receiving waters in Southern California.

107 - A review of technologies for rapid detection of bacteria in recreational waters

Rachel T. Noble and Stephen B. Weisberg

http://www.environmental-expert.com/Files%5C19961%5CArticles%5C6674%5C479_rapid_detection_recreational_waters.pdf

Purpose - Review new methods that have the potential to reduce measurement period for fecal indicator bacteria from more than a day to less than an hour to reduce risk of swimmers to fecal bacteria.

Results - Enzyme substrate methods are most likely to be the first rapid methods adopted for recreational water quality. Enzymatic substrate methods are based on the same capture technology as currently-approved EPA methods, with greater speed attained through enhanced detection technology. As such, the relationship to health risk can be established by demonstrating that the new detection capability produces equivalent results to existing procedures.

214 - Comparison of total coliform, fecal coliform, and enterococcus bacterial indicator response for ocean recreational water quality testing

Rachel T. Noble, D.F. Moore M.K. Leecaster, C.D. McGee, and S.B. Weisberg

<http://www.ochealthinfo.com/docs/public/epi/h2o/Water-Research-Publication-2003.pdf>

Purpose - To compare the relationship between the bacterial indicators, and the effect that changing the standards would have on recreational water regulatory actions, three regional studies were conducted along the southern California shoreline from Santa Barbara to San Diego, California.

Results - Cumulatively, our results suggest that replacement of a TC standard with an EC standard will lead to a five-fold increase in failures during dry weather and a doubling of failures

during wet weather. Replacing a TC standard with one based on all three indicators will lead to an eight-fold increase in failures. Changes in the requirements for water quality testing have strong implications for increases in beach closures and restrictions.

217 - Relationships between sand and water quality at recreational beaches

M.C. Phillips, H.M. Solo-Gabriele, A.M. Piggot, J.S. Klaus and Y. Zhang

<http://www.sciencedirect.com/science/article/pii/S0043135411006269>

Purpose - Enterococci are used to assess the risk of negative human health impacts from recreational waters. Studies have shown sustained populations of enterococci within sediments of beaches but comprehensive surveys of multiple tidal zones on beaches in a regional area and their relationship to beach management decisions are limited.

Results - We sampled three tidal zones on eight South Florida beaches in Miami-Dade and Broward counties and found that enterococci were ubiquitous within South Florida beach sands although their levels varied greatly both among the beaches and between the supratidal, intertidal and subtidal zones.

218 - Shedding of Staphylococcus aureus and methicillin-resistant Staphylococcus aureus from adult and pediatric bathers in marine waters

L.R.W. Plano, A.C. Garza, T. Shibata, S.M. Elmier, J. Kish, C.D. Sinigalliano, M.L. Gidley, G. Miller, K. Withum, L.E. Fleming, and H.M. Solo-Gabriele

<http://www.biomedsearch.com/attachments/00/21/21/10/21211014/1471-2180-11-5.pdf>

Purpose - The primary aim of this study was to evaluate the amount and characteristics of the shedding of methicillin sensitive S. aureus, MSSA and MRSA by human bathers in marine waters.

Results - Twelve of 15 MRSA isolates collected from the water had identical genetic characteristics as the organisms isolated from the participants exposed to that water while the remaining 3 MRSA were without matching nasal isolates from participants. The amount of S. aureus shed per person corresponded to 105 to 106 CFU per person per 15-minute bathing period, with 15 to 20% of this quantity testing positive for MRSA. These findings clearly demonstrate that adults and toddlers shed their colonizing organisms into marine waters and therefore can be sources of potentially pathogenic S. aureus and MRSA in recreational marine waters. Additional research is needed to evaluate recreational beaches and marine waters as potential exposure and transmission pathways for MRSA.

111 - A comparison of ARA and DNA data for microbial source tracking based on source-classification models developed using classification trees

Bertram Price, Elichia Venso, Mark Frana, Joshua Greenberg, and Adam Ware

<http://faculty.salisbury.edu/~mffrana/Cell%20Biol%20Spring%2008/Frana%20paper,%20after.pdf>

Purpose - Determine whether increased reliability, if any, of library-based MST developed with DNA data is sufficient to justify its higher cost, where source predictions are used in TMDL surface water management programs.

Results - While the overall rates of correct classification are higher for the DNA data than for the ARA data, the resulting source predictions for both data indicate similar TMDL surface water bacterial contamination reduction strategies. Questioning the value of DNA data relative to ARA data for MST intended for application in a TMDL program is justified, and the answer may favor ARA data for this application.

112 - Quantitative PCR Method for Sensitive Detection of Ruminant Fecal Pollution in Freshwater and Evaluation of This Method in Alpine Karstic Regions

Georg H. Reischer, David C. Kasper, Ralf Steinborn, Robert L. Mach, and Andreas H. Farnleitner

<http://aem.asm.org/content/72/8/5610.full.pdf+html>

Purpose - Establish a method for the sensitive quantification of ruminant fecal pollution in spring water and groundwater from alpine karstic regions important for public water supplies. Identify a ruminant-specific genetic marker in fecal members of the phylum Bacteroidetes.

Results - The marker could be found at concentrations ranging from not detectable in 4.5 liters (KPAS) to 106 marker equivalents per liter (LKAS2 flood). Strong differences in occurrence were obvious and in accordance with the expected different levels of ruminant fecal.

Preliminary experiments testing the stability of the marker in highly diluted fecal suspensions in spring water at ambient temperatures (4°C) found no strong reduction of detectable marker levels during an incubation period of 2 months.

After additional evaluation, the assay might allow the specific allocation of fecal pollution in alpine water sources, enabling target oriented measures in the catchment area and thus facilitating watershed management. Furthermore, it could also provide additional information for quantitative microbial risk assessment studies as part of water safety plans recommended by the WHO (35), allowing the relative estimation of ruminant fecal input compared to other sources.

164 - Pathogenic fungi: an unacknowledged risk at coastal resorts? New insights on microbiological sand quality in Portugal

R. Sabino, C. Verissimo, M.A. Cunha, B. Wergikoski, F.C. Ferreira, R. Rodrigues, H. Parada, L. Falcão, L. Rosado, C. Pinheiro, E. Paixão, and J. Brandão

<http://www.sciencedirect.com/science/article/pii/S0025326X11001962>

Purpose - Determine the presence of yeasts, pathogenic fungi, dermatophytes, total coliforms, *Escherichia coli* and intestinal enterococci in sand at thirty-three beaches across Portugal.

Results - Results showed that 60.4% of the samples were positive for fungi and that 25.2% were positive for the bacterial parameters. The most frequent fungal species found were *Candida* sp. and *Aspergillus* sp., whereas intestinal enterococci were the most frequently isolated bacteria.

Positive associations were detected among analyzed parameters and country-regions but none among those parameters and sampling period. Regarding threshold values, we propose 15 cfu/g for yeasts, 17 cfu/g for potential pathogenic fungi, 8 cfu/g for dermatophytes. Eighty four cfu/g for coliforms, 250 cfu/g for *E. coli*, and 100 cfu/g for intestinal enterococci.

114 - The use of ribotyping and antibiotic resistance patterns for identification of host sources of *Escherichia coli* strains

M. Samadpour, M.C. Roberts, C. Kitts, W. Mulugeta and D. Alfi

<http://onlinelibrary.wiley.com/doi/10.1111/j.1472-765X.2004.01630.x/pdf>

Purpose - To compare antibiotic resistance and ribotyping patterns ability to identify triplicate isolates sent from a group of 40 *Escherichia coli* taken from seven host sources.

Results - Of the 120 isolates, 22 isolates were resistant to ampicillin, streptomycin, tetracycline and trimethoprim and 98 isolates were susceptible. Antibiotic patterns identified 33 of the triplicates and three of the six groups had isolates from multiple hosts. Ribotyping divided the isolates into 27 ribotype groups with all triplicates grouped into the same ribotype group with one host per group.

219 - The effects of rainfall on *Escherichia coli* and total coliform levels at 15 Lake Superior recreational beaches

R. Sampson, S. Swiatnicki, C. McDermott, and G. Kleinheinz

<http://www.environmental-expert.com/Files%5C6063%5Carticles%5C9235%5C11-12-6.pdf>

Purpose - Fifteen beaches along Lake Superior were monitored over the course of the 2003 and 2004 summer swimming seasons from mid-May through mid-September. Water samples were collected at these 15 beaches less than 24-h after a rainfall event of at least 6 mm. The effect of rainfall on bacterial concentrations along the Wisconsin shores of Lake Superior was investigated.

Results - No relationship between rainfall amount and bacterial concentrations at any of the 15 beaches tested was found. Although other researchers have observed a direct positive relationship between rainfall and *E. coli* levels in beach water, we found no significant relationship for Lake Superior beaches. This is an important finding given the fact that beach closures are often based upon rainfall alone rather than on actual *E. coli* concentration measurements. This study reinforces the fact that the data obtained at one location should not necessarily be extrapolated to beach closure decisions at other locations.

141 - Modeling the dry-weather tidal cycling of fecal indicator bacteria in surface waters of an intertidal wetland

Brett F. Sanders, F. Arega, and M. Sutula

ftp://www.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/2005_06AnnualReport/AR0506_051-66.pdf

Purpose - Utilize a developed model and apply it to predict the dry-weather tidal cycling of FIB in Talbert Marsh, in response to loads from urban runoff, bird feces and resuspended sediments.

Results - Model predictions show that surface water concentrations of TC, EC, and ENT in the wetland are driven by loads from urban runoff and resuspended wetland sediments. The model more accurately predicts TC than EC or ENT. The crucial role that sediments play in the cycling of FIB is highlighted by this study. Sediments function as a reservoir of FIB that may accumulate FIB due to regrowth or settling, or shed FIB when tidal currents or storm flows scour away or even just disturb surficial particles.

115 - Patterns of Antimicrobial Resistance Observed in Escherichia coli Isolates Obtained from Domestic- and Wild-Animal Fecal Samples, Human Septage, and Surface Water

Raida S. Sayah, J.B. Kaneene, Y. Johnson, and R. Miller

<http://aem.asm.org/content/71/3/1394.full.pdf+html>

Purpose - (i) To identify patterns of antimicrobial agent resistance of E. coli strains obtained from human septage, domestic animals, and wildlife living in the Red Cedar watershed in Michigan, and (ii) to compare these antimicrobial agent resistance patterns with those of E. coli strains obtained from surface water in the same watershed.

Results - Antimicrobial agent resistance was detected in all types of samples collected (Table 4). The most frequently encountered form of resistance in all samples was resistance to tetracycline (27.3%), followed by resistance to cephalothin (22.7%), resistance to sulfisoxazole (13.3%), and resistance to streptomycin (13.1%). Animal fecal samples exhibited resistance to all agents tested, while human septage and river water samples showed resistance to three agents and one agent, respectively.

Resistance to cephalothin was present in all types of samples, while tetracycline resistance and streptomycin resistance were found in all types of samples except river water. Resistance to tetracycline was present in both fecal and farm environment samples from all livestock species, while resistance to trimethoprim-sulfamethoxazole was present in both types of samples from only dairy cattle and equids.

142 - Tracking sources of bacterial contamination in stormwater discharges from Mission Bay, California

Kenneth C. Schiff, and P. Kinney

ftp://www.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/1999AnnualReport/07_ar06.pdf

Purpose - Identify whether wet-weather discharges were the predominant source of bacterial contamination to receiving waters.

Results - Seasonal cycles were evident, with the highest levels of total coliform, fecal coliform and enterococcus occurring during the wettest months.

220 - Microbiological Water Quality at Reference Beaches in Southern California During Wet Weather. Technical Report #448

Kenneth C. Schiff, J. Griffith, and G. Lyon

http://www.sccwrp.org:8060/pub/download/DOCUMENTS/TechnicalReports/448_reference_beach.pdf

Purpose - Assess the microbial water quality at reference beaches following wet weather events in southern California.

Results - Based on the results from this study, natural contributions of nonhuman fecal indicator bacteria were sufficient to generate exceedances of the State of California water quality thresholds during wet weather.

145 - Water Quality Indicators and the Risk of Illness in Non-Point Source Impacted Recreational Waters

Kenneth C. Schiff, S.B. Weisberg and J.M. Colford Jr.

<ftp://swrcb2a.waterboards.ca.gov/pub/rwqcb2/TMDL-WEF/5d.pdf>

Purpose - Determine if: 1) water contact increased the risk of illness in the two weeks following exposure to water in Mission Bay? and 2) did the risk of illness increase with increasing levels of microbial indicators of water quality?

Results - Outside of skin rash and diarrhea, there was no statistically increased risk of 12 other symptoms, including highly credible gastrointestinal illness (HCGI). These results contrast with most other recreational bathing studies, most likely because of the lack of human sources of fecal pollution.

165 - Variation of microorganism concentrations in urban stormwater runoff with land use and seasons

A. Selvakumar, and M. Borst

<http://www.iwaponline.com/jwh/004/0109/0040109.pdf>

Purpose - This study investigates if variations in concentrations of microorganisms by at least 1/3-log at the 95% level of confidence are potentially attributable to land use and seasons. Differences less than 1/3-log have little practical importance even if there is statistical significance as the sensitivity of the analyses procedure is less than these.

Results - Statistically significant differences were found between land uses for all microorganisms studied except for *E. coli*. Other than *E. coli*, the microbial concentrations in stormwater runoff consistently vary within and between land uses. Generally, the concentrations in runoff from high-density residential areas are higher than the concentrations in other tested land uses.

222 - Indicator microbes correlate with pathogenic bacteria, yeasts and helminthes in sand at a subtropical recreational beach site

A.H. Shah, A.M. Abdelzaher, M. Phillips, R. Hernandez, H.M. Solo-Gabriele, J. Kish, G. Scorzetti, J.W. Fell, M.R. Diaz, T.M. Scott, J. Lukasik, V.J. Harwood, S. McQuaig, C.D. Sinigalliano, M.L. Gidley, D. Wanless, A. Ager, J. Lui, J.R. Stewart, L.R. Plano, and L.E. Fleming

<http://www.ncbi.nlm.nih.gov/pubmed/21447014>

Purpose - The objectives of this study were to evaluate the presence and distribution of pathogens in various zones of beach sand (subtidal, intertidal and supratidal) and to assess their relationship with environmental parameters and indicator microbes at a non-point source subtropical marine beach.

Results - Results indicate that indicator microbes may predict the presence of some of the pathogens, in particular helminthes, yeasts and the bacterial pathogen *Staphylococcus aureus* including methicillin-resistant forms. Indicator microbes may thus be useful for monitoring beach sand and water quality at non-point source beaches.

132 - Evaluation of conventional and alternative monitoring methods for a recreational marine beach with non-point source of fecal contamination

Tomoyuki Shibata, H.M. Solo-Gabriele, C.D. Sinigalliano, M.L. Gidley, L.R.W. Plano, J.M. Fleisher, J.D. Wang, S.M. Elmir, G. He, M.E. Wright, A.M. Abdelzaher, C. Ortega, D. Wanless, A.C. Garza, J. Kish, T. Scott, J. Hollenbeck, L.C. Backer, and L.E. Fleming

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2966524/>

Purpose - Compare enterococci (ENT) measurements based on the membrane filter, ENT(MF) with alternatives that can provide faster results including alternative enterococci methods (e.g. chromogenic substrate (CS), and quantitative polymerase chain reaction (qPCR)), and results from regression models based upon environmental parameters that can be measured in real-time.

Results - In addition to physico-chemical and hydrometeorological parameters, results also suggested that bacterial indicator levels were affected by the numbers of animals on the beach which may also have seasonal patterns associated with their numbers and fecal inputs. Thus, levels of enterococci at non-point source beaches are affected by a myriad of environmental factors and input loadings which are very difficult to capture within simple regression models.

223 - Adhesion of *Enterococcus faecalis* in the nonculturable state to plankton is the main mechanisms responsible for persistence of this bacterium in both lake and seawater

C. Signoretto, G. Burlacchini, M. del Mar Lleó, C. Pruzzo, M. Zampini, L. Pane, G. Franzini, and P. Canepari

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC525140/>

Purpose - In this study we describe the results of the monitoring of the microbiological quality of both freshwater and marine water by applying an approach consisting of detecting both culturable and nonculturable enterococci which are present in water and adherent to the plankton in order to evaluate to what extent the adhesion to plankton and the VBNC state may represent survival strategies and contribute to the formation of environmental reservoirs of these microorganisms.

Results - We show that molecular methods for the detection of enterococci resulted in a higher number of positive samples than the culture method. The most interesting result of this study was the observation that in Lake Garda *E. faecalis* is almost exclusively found either adhering to plankton or in water, and not both. This result was also confirmed by the results in seawater, although not to such an evident extent.

123 - TRANSPORT OF FECAL BACTERIA FROM POULTRY LITTER AND CATTLE MANURES APPLIED TO PASTURELAND

M.L. Soupir, S. Mostaghimi, E.R. Yagow, C. Hagedorn, and D.H. Vaughan

<http://www.environmental-center.com/Files%5C0%5Carticles%5C9338%5CTransportOfFecalBacteria.pdf>

Purpose - An understanding of the overland transport mechanisms from land applied waste is needed to improve design of best management practices (BMPs) and modeling of nonpoint source (NPS) pollution.

Results - Results of this comparative study clearly indicate that cowpies have a greater potential to contribute high fecal bacteria concentrations into streams than the land application of liquid dairy manure or turkey litter, although bacteria concentrations in runoff from all treatments exceeded Federal standards for primary contact in the United States. The relationship between runoff rates and concentrations of the indicator species was dependent upon the animal waste application, the indicator species and antecedent soil moisture conditions.

152 - Variability of Indicator Bacteria at Different Time Scales in the Upper Hoosic River Watershed

Elena Traister, and S.C. Anisfeld

<http://www.forestry.yale.edu/uploads/publications/Anisfeld-pub03.pdf>

Purpose - Evaluate whether the Upper Hoosic River Basin is meeting water quality criteria for indicator bacteria.

Results - Bacterial levels were higher in more developed watersheds; in summer rather than winter; in storms rather than baseflow; and in the early morning rather than afternoon.

227- Prevalence of yeasts in beach sand at three bathing beaches in South Florida

C. Vogel, A. Rogerson, S. Schatz, H. Laubach, A. Tallman, and J. Fell

<http://www.sciencedirect.com/science/article/pii/S004313540700108X>

Purpose - Determine the abundance and types of yeasts in the wet and dry sand of three recreational beaches in South Florida.

Results - While definitive statements cannot be made, high levels of yeasts may have a deleterious bearing on human health and the presence of such a diverse aggregation of species suggests that yeasts could have a role as indicators of beach health.

224 - Effect of waterfowl (*Anas platyrhynchos*) on indicator bacteria populations in a recreational lake in Madison, Wisconsin

J.H. Standridge, J.J. Delfino, L.B. Kleppe, and R. Butler

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC243530/pdf/aem00202-0205.pdf>

Purpose - Determine the level of effect that waterfowl has on the water quality of a Madison, WI lake.

Results - The most common human health hazard associated with ducks is swimmer's itch, or echinostoma revolutum (12). The duck tapeworm can also occasionally infect humans (4). Ducks have often been implicated as carriers and disseminators of Salmonella (1, 3, 11, 12, 16, 17). The occurrence of these zoonoses indicates that fecal contamination from ducks is a human health hazard and that beach closings based on the presence of high counts of fecal coliform indicator bacteria are warranted. Future surveys aimed at detecting the possible presence of Salmonella in the Vilas Park beach area are indicated.

228 - Estimation of enterococci input from bathers and animals on a recreational beach using camera images

J.D. Wang, H.M. Solo-Gabriele, Am. M. Abdelzher, and L.E. Fleming

<http://www.sciencedirect.com/science/article/pii/S0025326X10001062>

Purpose - Develop a counting methodology to better understand non-point source load impacts. Enterococci inputs to the study beach site (located in Miami, FL) are dominated by non-point sources (including humans and animals).

Results - Enterococci source functions were computed from the observed number of unique individuals for average days of each month of the year, and from average load contributions for humans and for animals. Results indicate that dogs represent the larger source of enterococci relative to humans and birds.

229 - Hand-mouth transfer and potential for exposure to E. coli and F+ coliphage in beach sand, Chicago, Illinois

R.L. Whitman, K. Przybyla-Kelly, D.A. Shively, M.B. Nevers, and M.N. Byappanahalli

<http://www.ncbi.nlm.nih.gov/pubmed/19590129>

Purpose - Examine the transferability of Escherichia coli and F+ coliphage (MS2) from beach sand to hands in order to estimate the potential subsequent health risk.

Results - Using dose-response estimates developed for swimming water, it was determined that the number of individuals per thousand that would develop gastrointestinal symptoms would be 11 if all E. coli on the fingertip were ingested or 33 if all E. coli on the hand were ingested. These results suggest that beach sand may be an important medium for microbial exposure; bacteria transfer is related to initial concentration in the sand; and rinsing may be effective in limiting oral exposure to sand-borne microbes of human concern.

169 - Microbial load from animal feces at a recreational beach

M.E. Wright, H.M. Solo-Gabriele, S. Elmir, and L.E. Fleming

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2771205/pdf/nihms138348.pdf>

Purpose - The goal of this study was to quantify the microbial load (enterococci) contributed by the different animals that frequent a beach site.

Results - The highest enterococci concentrations were observed in dog feces with average levels of 3.9×10^7 CFU/g; the next highest enterococci levels were observed in birds averaging 3.3×10^5 CFU/g. The lowest measured levels of enterococci were observed in material collected from shrimp fecal mounds (2.0 CFU/g). A comparison of the microbial loads showed that 1 dog fecal event was equivalent to 6940 bird fecal events or 3.2×10^8 shrimp fecal mounds. Comparing animal contributions to previously published numbers for human bather shedding indicates that one adult human swimmer contributes approximately the same microbial load as one bird fecal event. Given the abundance of animals observed on the beach, this study suggests that dogs are the largest contributing animal source of enterococci to the beach site.

231 - Microbial load from animal feces at a recreational beach

M.E. Wright, H.M. Solo-Gabriele, S. Elmir, and L.E. Fleming

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2771205/>

Purpose - Quantify the microbial load (enterococci) contributed by the different animals that frequent a beach site.

Results - Results from this study provide evidence that dog feces represent the largest animal source to the study site. Improved management of dog feces at the beach could potentially reduce enterococci inputs to the beach, thereby decreasing the number of advisories for beach sites which are frequented by significant numbers of dogs.

8 - Are microbial indicators and pathogens correlated? A statistical analysis of 40 years of research

J. Wu, S. C. Long, D. Das and S. M. Dorner

<http://www.iwaponline.com/jwh/up/wh2011117.htm>

Purpose - The data were analyzed to assess factors affecting correlations using a logistic regression model considering indicator classes, pathogen classes, water types, pathogen sources, sample size, the number of samples with pathogens, the detection method, year of publication and statistical methods.

136 - Monitoring and Modeling Non-Point Source Contributions of Host-Specific Fecal Contamination in San Pablo Bay

Stefan Wuertz, F.A. Bombardelli, K. Sirikanchana, and D. Wang

<http://escholarship.org/uc/item/8tk0z6p0.pdf>

Purpose - This study employed mathematical and numerical transport models in concert with new molecular techniques to (i) characterize the sources of fecal contamination of water bodies and (ii) quantify the loads and distributions of *Bacteroidales* marker DNA sequences originating from different animal hosts in San Pablo Bay.

Results - Microbial source tracking using fecal *Bacteroidales* is an effective way to monitor fecal pollution of coastal waters. Low levels of the universal genetic marker are ubiquitous throughout

San Pablo Bay. The human marker BacHum-UCD was found in 75% of all samples but no cow- and almost no dog-specific marker was detected.

234 - Growth of enterococci in unaltered, unseeded beach sands subjected to tidal wetting

K.M. Yamahara, S.P. Walters, and A.B. Boehm

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2655449/>

Purpose - To establish if naturally occurring enterococci can replicate in beach sands under environmentally relevant conditions.

Results - The results provide evidence that enterococci may not be an appropriate indicator of enteric disease risk at recreational beaches subject to nonpoint sources of pollution.

170 - A water quality modeling study of non-point sources at recreational marine beaches

X. Zhu, J.D. Wang, H.M. Solo-Gabriele, L.E. Fleming

<http://www.sciencedirect.com/science/article/pii/S0043135411001266>

Purpose - A model study was conducted to understand the influence of non-point sources including bather shedding, animal fecal sources, and near shore sand, as well as the impact of the environmental conditions, on the fate and transport of the indicator microbe, enterococci, at a subtropical recreational marine beach in South Florida.

Results - Enterococci released from beach sand during high tide caused mildly elevated concentration for a short period of time (ten to twenty of CFU/100 ml initially, reduced to 2 CFU/100 ml within 4 h during sunny weather) similar to the average baseline numbers observed at the beach. Bather shedding resulted in minimal impacts (less than 1 CFU/100 ml), even during crowded holiday weekends. In addition, weak current velocity near the beach shoreline was found to cause longer dwelling times for the elevated concentrations of enterococci, while solar deactivation was found to be a strong factor in reducing these microbial concentrations.

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APPENDIX I

Identification of Goals

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APPENDIX I. IDENTIFICATION OF GOALS

Numeric goals have been developed to support Water Quality Improvement Plan implementation and are used to measure progress toward addressing the highest priority water quality conditions. Numeric goals may take a variety of forms, but must be quantifiable so that progress toward and achievement of the goals are measurable. Applicable Total Maximum Daily Load (TMDL) targets are required to be incorporated as Water Quality Improvement Plan goals. Also in accordance with the MS4 Permit and applicable regulatory drivers, final goals and reasonable interim goals for each five-year period from Water Quality Improvement Plan approval to the anticipated final goal compliance date (including an interim goal for this permit term) have been developed.

Within the Mission Bay WMA, the Bacteria TMDL dictates the bacteria goals for each weather condition in Tecolote Creek and Scripps subwatersheds to address and attain REC-I beneficial uses. A TMDL represents the maximum amount of a pollutant of concern that a water body can receive and still attain water quality standards. TMDLs can take a variety of forms, including concentration-based TMDLs, which focus on reducing pollutant sources to achieve a maximum pollutant concentration consistent with existing water quality objectives (WQOs), and load-based TMDLs, which focus on reducing sources to achieve a watershed-specific maximum load that is protective of beneficial uses. The Bacteria TMDL incorporates load-based reductions that were calculated on the basis of watershed modeling results and applicable bacteria WQOs.

In addition to the Bacteria TMDL-listed segments of beach in the Scripps subwatershed, a portion of the subwatershed drains into the La Jolla Area of Special Biological Significance (ASBS 29) and is subject to regulation under the Ocean Plan and the ASBS General Exception and Special Protections. The City's Phase II Comprehensive Load Reduction Plan (CLRP) for Scripps (City, 2013a) determined copper to be the critical pollutant (stressor) requiring the largest load reduction (i.e., requires the greatest implementation of BMPs to meet the water quality target). However, the Phase II CLRP also noted that when the City's ASBS Site-Specific Dilution and Dispersion Model (dilutor factor) (City, 2013e) is applied to the ASBS water quality objectives, the critical stressor in the ASBS changes from copper to sediment. For the purposes of Water Quality Improvement Plan development, the dilution factor was applied and, therefore, sediment during wet weather is the highest priority water quality condition within the ASBS drainage areas (refer to Section 2.4 of this Water Quality Improvement Plan for additional detail).

Compliance with the Special Protections is measured by comparing monitoring results with the 85th percentile threshold of reference water quality, which is currently being investigated. The primary regulatory driver, identified by the largest required load reduction, determines the interim and final goals for each of the small coastal drainages that make up the Scripps subwatershed. The majority of the area is regulated by the Bacteria TMDL. Only one drainage area is solely regulated by the ASBS Special Protections and not the Bacteria TMDL. The remaining areas are not identified in the Bacteria TMDL and are outside of the ASBS and are therefore not considered in the highest priority water quality condition.

This appendix presents Bacteria TMDL and ASBS Special Protections numeric targets, how the targets were derived, and how the targets were translated into Water Quality Improvement Plan numeric goals. Section I.1 presents the interim and final Water Quality Improvement Plan bacteria numeric goals for Scripps and Tecolote subwatersheds. Section H.2 presents the interim and final Water Quality Improvement Plan sediment numeric goals for the ASBS.

I.1 Identification of Bacteria Numeric Goals

The final numeric goals for both Tecolote Creek and Scripps subwatersheds were derived from water quality-based effluent limitations (WQBELs) identified in the Bacteria TMDL and incorporated into the MS4 Permit for freshwater creeks (Tecolote Creek) and beaches (Scripps). Bacteria TMDL WQBELs include receiving water limitations and effluent limitations, presented in multiple formats. The receiving water limitations and effluent limitations are discussed in detail in Section I.1.1 and Section I.1.2, respectively. Attachment E.4 of the Municipal Permit provides the following options to meet numeric goals and to demonstrate final compliance with the Bacteria TMDL:

- (1) There is no direct or indirect discharge from the Responsible Agency's municipal separate storm sewer systems (MS4s) to the receiving water; OR
- (2) There are no exceedances of the final receiving water limitations in the receiving water at, or downstream of, the Responsible Agency's MS4 outfalls; OR
- (3) There are no exceedances of the final effluent limitations at the Responsible Agency's MS4 outfalls; OR
- (4) The pollutant load reductions for discharges from the Responsible Agencies' MS4 outfalls are greater than or equal to the final effluent limitations; OR
- (5) The Responsible Agencies can demonstrate that exceedances of the final receiving water limitations in the receiving water are due to loads from natural sources, AND pollutant loads from the Responsible Agencies' MS4 are not causing or contributing to the exceedances; OR
- (6) The Responsible Agencies develop and implement the Water Quality Improvement Plan as follows:
 - (a) The Responsible Agencies incorporate best management practices (BMPs) to achieve the receiving water limitations and/or the effluent limitations,
 - (b) The Responsible Agencies include an analysis in the Water Quality Improvement Plan, utilizing a watershed model or other watershed analytical tools, to demonstrate that the implementation of the BMPs achieves compliance with the final receiving water and/or effluent limitations,

- (c) The results of the analysis must be accepted by the San Diego Water Board as part of the Water Quality Improvement Plan,
- (d) The Responsible Agencies continue to implement the BMPs, and
- (e) The Responsible Agencies continue to perform the specific monitoring and assessment specified to demonstrate compliance with the receiving water and effluent limitations (RWQCB, 2013a).

1.1.1 Receiving Water Limitations

Bacteria TMDL receiving water limitations are expressed as concentrations and as an allowable exceedance frequency. The limitations vary depending on the weather condition. The Bacteria TMDL identified WQBELs based on precipitation: wet weather (day of 0.2 inches of rainfall or more plus three days) and dry weather (all other days, including those in the winter season). For each condition, receiving water targets were identified based on water quality objectives (WQOs) (WQOs are concentrations of bacteria indicators identified as acceptable levels for recreational contact (REC-1). Total coliform WQOs are identified for saltwater segments only and are not applicable to freshwater streams, therefore receiving Water Quality Improvement Plan goals for Tecolote Creek are only identified for fecal coliform and *Enterococcus*. Table I-1.). The WQOs also vary depending on the type of receiving water; freshwater or saltwater. Tecolote Creek must comply with the freshwater WQOs. The Scripps shoreline must comply with the saltwater WQOs. The TMDL targets are directly incorporated as Water Quality Improvement Plan numeric goals. Table I-1 presents the TMDL receiving water limitations, and thus the Water Quality Improvement Plan numeric goals for Tecolote Creek and the Scripps shoreline, and the final compliance date.

WQOs are concentrations of bacteria indicators identified as acceptable levels for recreational contact (REC-1). Total coliform WQOs are identified for saltwater segments only and are not applicable to freshwater streams, therefore receiving Water Quality Improvement Plan goals for Tecolote Creek are only identified for fecal coliform and *Enterococcus*.

Table I-1
Final Receiving Water Numeric Goals for Mission Bay WMA

Bacteria Indicator	Tecolote Creek WQO (MPN/100mL)	Scripps Shoreline WQO (MPN/100mL)	Allowable Exceedance Frequency ¹ (% Days Exceeding WQOs)	Final Compliance
Wet Weather (Single Sample Maximum) ²				
Fecal coliform	400	400	22%	April 4, 2031
<i>Enterococcus</i>	61	104	22%	
Total coliform	N/A	10,000	22%	
Dry Weather (30-Day Geometric Mean) ³				
Fecal coliform	200	200	0%	April 4, 2021
<i>Enterococcus</i>	33	35	0%	
Total coliform	N/A	1,000	0%	

Note:

1. The 22% allowable exceedance frequency only applies to wet weather days. For dry weather days, the dry weather bacteria densities must be consistent with the single sample maximum REC-1 water quality objects in the Ocean Plan.
2. During wet weather days, only the single sample maximum receiving water limitations are required to be achieved.
3. During dry weather days, the single sample maximum and 30-day geometric mean receiving water limitations are required to be achieved.

% = percent; mL = milliliters; MPN = most probable number; WQO = water quality objective

Wet weather conditions are episodic and short in duration; therefore, single-sample maximum WQOs apply. Geometric mean WQOs apply during dry weather when monitoring results over a longer duration are averaged and assessed. The WQOs do not account for a natural increase in bacteria loads during storm events. To account for background bacteria concentrations during wet weather, the Bacteria TMDL incorporated an allowable exceedance frequency of the WQO based on a reference (mostly undeveloped) watershed.

The Bacteria TMDL specifies a final receiving water limitation allowable exceedance frequency of 22 percent during wet weather periods based on reference conditions, but allows no exceedances during dry weather. Although the number of wet and dry weather days may change from year to year because of variable weather conditions, the percentage of allowable wet weather exceedance days will remain fixed. For example, the number of wet weather days in Water Year 2003 was 42. Therefore, the number of allowable wet weather exceedance days was 9 (22 percent of 42 days, rounded). Final compliance with the dry weather WQOs and TMDL loads is required by Fiscal Year (FY) 2021. Final compliance with the wet weather WQOs and TMDL loads is required by FY 2031.

1.1.2 Effluent Limitations

The Bacteria TMDL provides two expressions of effluent limitations. The first expression is equivalent to the receiving water limitations, but is assessed at MS4 outfalls (Table I-2). The second expression is a mass-based load reduction from the subwatersheds discussed below. Per the Municipal Permit, total coliform WQOs and corresponding exceedance frequencies are applicable to MS4 outfalls that drain to the Tecolote Creek mouth and are therefore included in both expressions of effluent limitations.

Table I-2
Final Effluent Numeric Goals Expressed as an Exceedance Frequency for Mission Bay WMA

Bacteria Indicator	Tecolote Creek (MPN/100mL)	Scripps Shoreline (MPN/100mL)	Allowable Exceedance Frequency ¹ (% Days Exceeding WQOs)	Final Compliance
Wet Weather (Single Sample Maximum) ^{2,3}				
Fecal coliform	400	400	22%	April 4, 2031
<i>Enterococcus</i>	61	104	22%	
Total coliform ⁴	10,000	10,000	22%	
Dry Weather (30-Day Geometric Mean)				
Fecal coliform	200	200	0%	April 4, 2021
<i>Enterococcus</i>	33	35	0%	
Total coliform ⁴	1,000	1,000	0%	

Note:

1. The 22% allowable exceedance frequency only applies to wet weather days. For dry weather days, the dry weather bacteria densities must be consistent with the single sample maximum REC-1 water quality objects in the Ocean Plan for discharges to beaches, and the Basin Plan for discharges to creeks and creek mouths.
2. During wet weather days, only the single sample maximum receiving water limitations are required to be achieved.
3. During dry weather days, the single sample maximum and 30-day geometric mean receiving water limitations are required to be achieved.
4. Total coliform effluent limitations only apply to MS4 outfalls that discharge to the Pacific Ocean Shorelines and creek mouths.

% = percent; mL = milliliters; MPN = most probable number; WQO = water quality objective

The Bacteria TMDL calculated the watershed load reductions that were required to achieve the Bacteria TMDL receiving water limitations. The MS4 Permit incorporated these load reductions for wet and dry weather as effluent limitations. Watershed load reductions were recently recalculated using the watershed models used to develop the Bacteria TMDL for Tecolote Creek and Scripps subwatersheds to better reflect current conditions and improve the accuracy of bacteria load estimates for Water Quality Improvement Plan development. A representative time period was used to calculate the number of allowable exceedance days, since the Water Quality Improvement Plan focuses on implementation planning through an adaptive management framework. Water

Year 2003 represents typical wet and dry weather conditions within the subwatershed, based on an analysis of rainfall data over a 20-year time period. There were 42 wet weather days in Water Year 2003. This representative period provides an appropriate benchmark to use in defining numeric goals and the resulting BMP implementation needs.

As in the Bacteria TMDL, the subwatersheds' loading capacity was calculated by multiplying the WQOs by the average daily modeled flow. Modeled daily loads greater than this threshold were flagged as an exceedance. The allowable exceedance load for wet weather was calculated by summing the top 9 days (22 percent of the 42 wet weather days in the representative year) with the highest modeled daily loads. This load was then subtracted from the modeled wet weather total for the year. The difference between the remaining modeled load and the updated TMDL load represents the load reduction required for wet weather. The percent load reduction is calculated by dividing the exceedance load by the total annual load for the representative year. In Scripps subwatershed, the percent load reduction was quantified for each sub-basin draining to the shoreline and then averaged across the TMDL subbasins. The final load reductions estimated to meet receiving water goals are presented in Table I-3 for Tecolote Creek and Scripps subwatersheds.

Table I-3
Final Numeric Goals Expressed as Percent Load Reduction within
the Mission Bay WMA

Bacteria Indicator	Tecolote Creek Subwatershed Percent Load Reduction	Scripps Subwatershed Percent Load Reduction	Final Compliance
Wet Weather (Single Sample Maximum)			
Fecal coliform	17.9%	10.0% ¹	April 4, 2031
<i>Enterococcus</i>	11.8%	6.6% ¹	
Total coliform	10.0%	5.1% ¹	
Dry Weather (30-day Geometric Mean)			
Fecal coliform	98.4%	99.0% ¹	April 4, 2021
<i>Enterococcus</i>	99.9%	99.9% ¹	
Total coliform	99.6%	99.8% ¹	

Note:

1. Calculated based on the average load reduction required from sub-basins draining to TMDL Pacific Ocean Shoreline segments within the Scripps subwatershed.

% = percent; N/A = not applicable

Although total coliform WQOs are not applicable to freshwater creeks, Attachment E to the MS4 Permit incorporated total coliform effluent limitations to MS4 outfalls that discharge to Pacific Ocean shoreline *and* creek mouths listed in the Bacteria TMDL. Therefore, load reductions were assigned to the Tecolote Creek watershed.

Dry weather WQBELs, expressed as percent subwatershed load reduction, were calculated using the same formula, but without an allowable load using the reference watershed approach applied for dry weather, per the Bacteria TMDL. The TMDL load was calculated in the same manner as for wet weather, and the difference between the remaining modeled load and the TMDL load is the load reduction required for dry weather. The percent load reduction was calculated by dividing the exceedance load by the total annual load for the representative year. Note that dry weather modeling results are typically less reliable because of the episodic nature of irrigation runoff and other water sources during dry periods.

1.1.3 Interim Goals and Existing Conditions

The first five TMDL interim compliance pathways are the same as the final compliance pathways. In addition, two compliance pathways (6 and 7 below) provide interim compliance calculated using a midpoint between existing conditions and final targets. Finally, compliance pathway 8 provides interim compliance with the TMDL if the Responsible Agencies are implementing strategies selected and included in a watershed model or other analytical tool to demonstrate that the interim TMDL compliance requirements will be met. Attachment E.4 of the Municipal Permit provides the following options to meet interim numeric goals and to demonstrate interim compliance with the Bacteria TMDL:

- (1) There is no direct or indirect discharge from the Responsible Agency's municipal separate storm sewer systems (MS4s) to the receiving water; OR
- (2) There are no exceedances of the final receiving water limitations in the receiving water at, or downstream of, the Responsible Agency's MS4 outfalls; OR
- (3) There are no exceedances of the final effluent limitations at the Responsible Agency's MS4 outfalls; OR
- (4) The pollutant load reductions for discharges from the Responsible Agencies' MS4 outfalls are greater than or equal to the final effluent limitations; OR
- (5) The Responsible Agencies can demonstrate that exceedances of the final receiving water limitations in the receiving water are due to loads from natural sources, AND pollutant loads from the Responsible Agencies' MS4 are not causing or contributing to the exceedances; OR
- (6) There are no exceedances of the interim receiving water limitations in the receiving water at, or downstream of, the Responsible Agency's MS4 outfalls; OR
- (7) The pollutant load reductions for discharges from the Responsible Agencies' MS4 outfalls are greater than or equal to the interim effluent limitations; OR
- (8) The Responsible Agencies submit and are fully implementing a Water Quality Improvement Plan, accepted by the San Diego Water Board, which provides

reasonable assurance that the interim TMDL compliance requirements will be achieved by the interim compliance dates.

Interim goals are identified for each expression of WQBELs and each weather condition. TMDL interim compliance is calculated as the halfway point between the existing, 2002 conditions and the final TMDL target. The MS4 Permit allows an alternative interim compliance date from the original Bacteria TMDL compliance date (MS4 Permit, Attachment E). Interim compliance of receiving water or effluent limitations is most reasonably attained in FY24 for wet weather and FY19 for dry weather. Updates to existing programs, changes in municipal ordinances, and collaboration within jurisdictions, WMAs, and the region have been occurring since the Bacteria TMDL and the 2013 MS4 Permit were adopted and are ongoing. Through CLRP and Water Quality Improvement Plan development, planning efforts are underway, including measures to secure funding and increase general momentum to implement and expand storm water and water conservation measures. The alternative compliance dates allow for the success of the monitoring, assessment, and goal and strategy adaptation process detailed within this Water Quality Improvement Plan.

The TMDL model used data through 2002, which is why 2002 is considered the existing condition. The existing condition does not necessarily reflect current conditions, nor is it the Water Quality Improvement Plan baseline for all goals. The existing condition for load reductions is assumed to be 0% in 2002, as that was the beginning of implementation planning. The Bacteria TMDL estimated the 2002 existing exceedance frequency for wet weather since wet weather data was not available. The MS4 permit requires the dry weather exceedance frequency to be calculated and presented in the Water Quality Improvement Plans. For each indicator bacteria, available monitoring data collected between January 1, 1996 and December 31, 2002 was assessed and compared to 30-day geometric mean WQOs. Table I-4 presents the existing condition for the receiving water and effluent limitations and the interim TMDL compliance target for Tecolote Creek.

The Bacteria TMDL estimates that the 2002 wet weather exceedance frequency for fecal coliform at the mouth of Tecolote Creek was 75 percent and 81% for *Enterococcus* based on modeling results. To calculate dry weather exceedance frequencies in Tecolote Creek, 104 results were available for *Enterococcus* and 20 results for fecal coliform between 1996 and 2002. The exceedance frequency using geomeans (percent of dry weather days with a geomean exceeding the geomean WQO in Tecolote Creek) was 100% for both indicators, requiring an interim exceedance of 50%.

Table I-4
Existing Conditions and Interim TMDL Targets within
the Tecolote Creek Subwatershed

Bacteria Indicator	Receiving Water Exceedance Frequency		Effluent Load Reduction		Interim Compliance Date
	Existing 2002 Condition	Interim Compliance ¹	Existing 2002 Condition	Interim Compliance ¹	
Wet Weather					
Fecal coliform	75% ²	49%	0%	8.9% ³	April 4, 2024
<i>Enterococcus</i>	81% ²	51%	0%	5.8% ³	
Total coliform	NA	NA	0%	5.0% ³	
Dry Weather					
Fecal coliform	100% ⁴	50%	0%	49.3% ³	April 4, 2019
<i>Enterococcus</i>	100% ⁴	50%	0%	50.0% ³	
Total coliform	NA	NA	0%	49.9% ³	

Note:

- Interim compliance is calculated as 50% between the existing condition and the final TMDL target.
 - Source: Bacteria TMDL
 - Source: Updated modeling results
 - Source: Monitoring data
- % = percent; N/A = not applicable

Table I-5 presents the existing condition for the receiving water and effluent limitations and the interim TMDL compliance target for the Scripps subwatershed. In Scripps, four shoreline monitoring stations have historical data: 1) La Jolla Shores at Vallecitos, 2) La Jolla Shores at Avenida de la Playa, 3) Children's Pool at Casa Beach, and 4) Whispering Sands Beach at Ravina Street. Table I-6 presents the existing exceedance frequencies calculated at each monitoring site and the overall exceedance frequency. The overall existing dry weather exceedance frequency was selected to calculate the Scripps interim goals, 50% of the reduction required between existing and final exceedance frequencies. In the interim compliance year, the interim goal will be met if the exceedance frequency is equal to or less than 6% for *Enterococcus*, 7% for fecal coliform, and 3% for total coliform.

Table I-5
Existing Conditions and Interim TMDL Targets within
the Scripps Subwatershed

Bacteria Indicator	Receiving Water Exceedance Frequency		Effluent Load Reduction		Interim Compliance Date
	Existing 2002 Condition	Interim Compliance ¹	Existing 2002 Condition	Interim Compliance ¹	
Wet Weather					
Fecal coliform	52% ²	37%	0%	4.8% ³	April 4, 2024
<i>Enterococcus</i>	52% ²	37%	0%	3.2% ³	
Total coliform	52% ²	37%	0%	2.5% ³	
Dry Weather					
Fecal coliform	15% ⁴	7%	0%	49.6% ³	April 4, 2019
<i>Enterococcus</i>	13% ⁴	6%	0%	50.0% ³	
Total coliform	6% ⁴	3%	0%	49.9% ³	

Note:

- Interim compliance is calculated as 50% between the existing condition and the final TMDL target.
 - Source: Bacteria TMDL
 - Source: Updated modeling results
 - Source: Monitoring data
- % = percent; N/A = not applicable

Table I-6
Scripps Shoreline Dry Weather Existing Exceedance Frequencies

Site ID	Constituent	RWL	Historic Number of Geomeans	Historic Number of Exceedances	Existing Exceedance Frequency
Whispering Sands Beach at Ravina Street	Total Coliforms	1000	99	1	1.0%
	Fecal Coliforms	200	99	0	0.0%
	<i>Enterococcus</i>	35	99	4	4.0%
Children's Pool	Total Coliforms	1000	59	9	15.3%
	Fecal Coliforms	200	59	56	94.9%
	<i>Enterococcus</i>	35	59	0	0.0%
La Jolla Shores at Vallecitos	Total Coliforms	1000	2	0	0.0%
	Fecal Coliforms	200	2	0	0.0%
	<i>Enterococcus</i>	35	2	2	100%
La Jolla Shores at Avenida de la Playa	Total Coliforms	1000	230	12	5.2%
	Fecal Coliforms	200	230	1	0.4%

Site ID	Constituent	RWL	Historic Number of Geomeans	Historic Number of Exceedances	Existing Exceedance Frequency
	<i>Enterococcus</i>	35	230	44	19.1%
TOTAL	Total Coliforms		390	22	5.6%
	Fecal Coliforms		390	57	14.6%
	<i>Enterococcus</i>		390	50	12.8%

1.1.4 Compliance Pathways

Interim and final compliance with the Bacteria TMDL, as incorporated into the MS4 Permit, may be demonstrated by the Responsible Agencies using any one of the methods presented in the previous sections. Section 5 of the Water Quality Improvement Plan provides additional information on the monitoring that will be completed for assessment. The compliance analysis, modeling conducted to provide assurance that interim and final goals will be met, is discussed in more detail in Appendix K and Section 4.3 of the Water Quality Improvement Plan.

1.2 Identification of Goals from ASBS Special Protections

The California Ocean Plan prohibits waste discharges to ASBS with exceptions granted for select discharges (SWRCB, 2005). Storm water runoff from the City is permitted into the La Jolla State Marine Conservation Area (ASBS No. 29) per Resolution 2012-0012 (SWRCB, 2012). The Resolution includes narrative effluent limitations that require an iterative approach for evaluating and implementing BMPs that will prevent storm water from altering natural ocean water quality. BMPs to control storm water discharges to the ASBS shall be designed to achieve the Ocean Plan Table B instantaneous maximum WQOs or a 90% reduction in pollutant loading.

For the Comprehensive Load Reduction Plan (CLRP) Phase II and Water Quality Improvement Plan modeling analysis, concentration-based Ocean Plan effluent limitations, rather than the narrative requirements, form the basis for determining ASBS load reduction targets (SWRCB, 2005; City of San Diego, 2013). The Ocean Plan effluent limitations were also used in favor of the more generic 90% pollutant load reduction target. To focus the list of Table B constituents, the greatest threats to the ASBS were selected. The La Jolla Shores Coastal Watershed Management Plan identified metals (copper, chromium, nickel and arsenic), bacteria, and sediment as high priority pollutants of concern within the ASBS (SIO et al., 2008). The 2012 ASBS Special Protections provide protection for marine aquatic life and natural water quality, as opposed to the Bacteria TMDL, which focuses protection of human health. Bacteria are not required constituents for discharge, ocean, or reference monitoring because ASBS No. 29 is outside of the range of the southern sea otter. Therefore, the greatest threats to ASBS No. 29 are metals and sediment, for the purpose of this Water Quality Improvement Plan.

The WQOs listed in Table B of the Ocean Plan are equal to the instantaneous maximum concentration acceptable after initial dilution within the receiving water. To calculate

concentration limits that would apply to storm water effluent, the Ocean Plan provides an equation based on background seawater concentrations and the minimum probable initial dilution of the effluent. To obtain an appropriate minimum initial dilution value, the City conducted a dilution and dispersion study for ASBS No. 29 similar to the study conducted and used in the University of California – San Diego, Scripps Institute of Oceanography (UCSD/SIO) discharge effluent limitations to the San Diego-Scripps State Marine Conservation Area (ASBS No. 31) (Jenkins et al., 2013; Jenkins et al., 2007). The goal was to produce a site-specific minimum probable initial dilution for the ASBS. The most conservative dilution factor was estimated to be 12.6:1 (based on storm drain SDL-062). CLRP (ASBS) load reduction targets were calculated based on the instantaneous maximum concentrations specified in Table B of the Ocean Plan for the ASBS priority pollutants. Dilution-adjusted discharge effluent limitations were calculated using the conservative initial dilution estimate (12.6:1). The Table B concentrations (with dilution) were used to calculate the Water Quality Improvement Plan load reduction targets for the ASBS drainage area and demonstrate compliance with the ASBS requirements.

Copper was used to represent metals for the Water Quality Improvement Plan load reduction calculations considering copper has one of the lowest effluent limit concentrations and extensive literature and monitoring data were available to develop modeling parameters (Table I-7). The models simulate total metals rather than total recoverable (dissolved) metals due to the availability of extensive literature and monitoring data relating model parameters to total metals. As a result, the total-to-dissolved metals conversion factor specified in the Chollas dissolved metals TMDL was used to convert the Table B total recoverable value to total copper (Regional Board, 2007). This value was then multiplied by the daily modeled flows to calculate the total copper wet weather load target for the ASBS drainage area. The required wet weather load reduction represents the difference between the modeled (existing) load and the target load for the ASBS drainage area.

Table I-7
Ocean Plan Table B: Priority Metals Water Quality Objectives

	Instantaneous Maximum Concentration at Completion of Initial Dilution	Discharge Effluent Limitations ASBS No. 29 (Dm = 12.6:1)
Total Recoverable Arsenic (µg/L)	80	1050.2
Total Recoverable/ Hexavalent Chromium (µg/L)	20	272
Total Recoverable Copper (µg/L)	30	382.8
Total Recoverable Nickel (µg/L)	50	680

Sedimentation measures were not included in Table B of the Ocean Plan. The Ocean Plan does list effluent limitations (after initial dilution is completed) specifically for POTWs and industrial discharges for suspended solids, settleable solids, and turbidity. Although these effluent limits do not apply to municipal stormwater discharges, they were used to

gauge the amount of sediment load reduction that may be needed. The Water Quality Improvement Plan models include TSS; therefore TSS was used to represent sediment loading for the ASBS. While Table A does not include a TSS maximum limit, the narrative objective states that the limit shall not be lower than 60 mg/l. This value was used to calculate the sediment load reduction target for the ASBS drainage area (multiplied by modeled daily flows) for TSS (Table I-8). Since the Ocean Plan values are effluent limits, separate calculations were not needed to adjust for initial dilution.

Table I-8
Ocean Plan Table A: Effluent Limitations

	Maximum at Any Time
Suspended Solids (mg/l)	+ (calculated using default value of 60)
Settleable Solids (ml/l)	3.0
Turbidity (NTU)	225

+ Dischargers shall remove 75% of suspended solids from the influent stream before discharging wastewater to the ocean, except that the effluent limitation to be met shall not be lower than 60 mg/l unless a lower effluent concentration is approved by the Regional Board and EPA.

1.2.1 ASBS Pollutant Load Reductions

The wet weather load reductions required for the two pollutants of concern were calculated for the ASBS drainage area and are presented in Table I-9. Total copper does not require a watershed load reduction and therefore sediment in the ASBS drainage area was determined to be the highest priority water quality condition. It is anticipated that by targeting sediment and bacteria throughout Scripps subwatershed, other pollutants will also be addressed.

Table I-9
ASBS Pollutant Load Reductions

Pollutant	Subwatershed Percent Load Reduction
Total Suspended Sediment (TSS)	0.25% ¹
Total Copper	<0.01% ¹

Note:

1. Calculated based on the cumulative total of the sub-basins draining to the ASBS.

1.2.2 Compliance with ASBS Special Protections

Within 30 months of the effective date of the ASBS Exception, a final ASBS Compliance Plan must be submitted to the Regional Board. The ASBS Compliance Plan is included as an appendix to the Mission Bay Water Quality Improvement Plan as Appendix G. Within six years of the effective date, any structural controls that are necessary to comply with the special conditions must be implemented and discharges into the affected ASBS maintain natural ocean water quality. Compliance with the Special Protections is measured by comparing monitoring results with the 85th percentile threshold of reference water quality, which is currently being investigated. Additional information on compliance with ASBS Special Protections is provided in Appendix G.

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APPENDIX J

Jurisdictional Strategies and Schedules

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APPENDIX J. JURISDICTIONAL STRATEGIES AND SCHEDULES

Strategy selection within the Mission Bay WMA is discussed in Section 4.2.1 and Appendix K. This appendix provides the selected strategies for each Responsible Agency including the implementation approach and level of effort required. The corresponding implementation year and duration provide context for when the strategy will be implemented. Strategies not being implemented upon approval of the Water Quality Improvement Plan provide a future date for implementation or a trigger for implementation in the future. Responsible Agencies are continually collaborating with internal jurisdictional departments, other Responsible Agencies, stakeholders, and watershed groups, and these collaborating entities are presented in the jurisdictional strategies tables as well. The strategies are subject to change and will be modified through the adaptive management process, as needed.

J.1 City of San Diego Strategies and Funding Needs

The City of San Diego (City) has identified water quality improvement strategies that are expected to provide the greatest benefits to the watershed and its residents, businesses, communities within the City's jurisdictional boundaries.

Strategies were selected by evaluating the following considerations, in descending priority:

- ❖ Potential to reduce pollutant loads for the highest priority condition condition(s)
- ❖ Potential to reduce loads for other pollutants (including priority water quality conditions)
- ❖ Cost effectiveness
- ❖ Feasibility and ease of implementation
- ❖ Social impacts and benefits
- ❖ Other¹ impacts and benefits

The strategies that provide the best value, most return on investment, and greatest range of benefits will be recommended, as needed, as the City moves forward in its water quality improvement efforts. The recommended strategies identified are consistent with those already identified in the Comprehensive Load Reduction Plans (CLRPs) for various TMDLs in the San Diego Region.

The City is currently developing a framework to evaluate potential other benefits the recommended strategies may provide beyond improved water quality. These benefits may be financial, environmental, or societal. The recommended strategies will be scored

¹ Other benefits refer to outcomes of a strategy beyond water quality improvements. Other benefits can include reduced air pollution, increased water conservation, watershed protection, public open space, aesthetics-induced property value increases, and increased business investments.

based on the number of other benefits they provide, and may guide future updates to the Water Quality Improvement Plan (Appendix M).

The cumulative storm water quality benefits of the recommended strategies identified in this Plan are needed to achieve the level of effort needed to demonstrate progress toward achieving the Water Quality Improvement Plan's interim and final numeric goals. It is important to note that these strategies are subject to change through the iterative, adaptive management process set forth in this Water Quality Improvement Plan. Through the adaptive management process the City will be able to implement strategies and assess their impact to water quality and use new available information to refine, modify, remove, replace, or add strategies which will ensure the most effective suite of strategies are being implemented. Therefore, actual implementation of strategies is dependent upon both approval of funding in future annual budgets and adjustments that may occur as part of the iterative process.

The recommended strategies will be implemented by the City; they are not intended to be implemented by private entities (e.g., development, business, industry, etc.). Some of the City's strategies, such as development planning, may have implications for private entities. The City has also developed a schedule as a best estimate of the shortest amount of time required to plan and implement the strategies. A compliance analysis using a watershed model was conducted to identify the strategies required to be implemented to meet interim and final goals. The adaptive management process provides the framework to evaluate progress toward meeting the goals and allows for modification of strategies. As strategies are modified, the compliance analysis will be updated as needed to provide assurance that numeric goals will be met.

Optional strategies are activities that may be implemented by the City at its discretion through the iterative approach. Unlike the recommended strategies, optional strategies have not been determined to be necessary in order to achieve the Plan's interim and final numeric goals. However, the City may select from the optional strategies at any time when identified triggers are met, or if the current suite of recommended strategies is not demonstrating sufficient progress toward achieving interim or final numeric goals. The City acknowledges watershed stakeholder concerns that opportunities for optional strategies may occur prior to achieving or not achieving interim goals. The City will implement optional strategies, such as land conservation, at any time during the compliance period if opportunities become available and identified triggers are met.

The City's Storm Water Division leads the City's efforts to protect and improve water quality and reduce flood risk. These activities include but are not limited to: public education, employee training, water quality monitoring, source identification, code enforcement, watershed management, and Best Management Practices development/implementation within the City's jurisdictional boundaries. The Storm Water Division is also tasked with providing the most efficient storm drain system operation and maintenance services including inspection, maintenance, and repair of storm drain systems in the public right of way and drainage easements. The complete list of strategies undertaken by the Storm Water Division is presented in this section.

The City has developed projected funding needs that will be used to submit annual budget requests to secure the resources necessary to comply with the Municipal Permit. These funding needs include four general categories:

- (1) Storm Water Division funding needs to implement day-to-day operational JRMP activities as required by Provision E in the Municipal Permit;
- (2) Storm Water Division funding needs for flood risk management programs associated with the JRMP, such as infrastructure repair and replacement;
- (3) Storm Water Division funding needs for activities managed by the Storm Water Division to meet the goals identified in the WQIP; and
- (4) Funding needs for City departments and divisions other than the Storm Water Division to implement day-to-day operational JRMP activities, as required by the Municipal Permit. Examples of JRMP activities include administration, training, and best management (BMP) implementation.

The City's Storm Water Division funding needs (which represent the first three categories above) are presented below as "City of San Diego" funding needs, but do not include funding needs for other City departments and divisions to implement required JRMP activities (category four above) because the recommended strategies included in this plan only apply to the City's Storm Water Division. For more information about the funding needs for non-Storm Water Division departments and divisions, please refer to the fiscal analysis in the City's Jurisdictional Runoff Management Plan (Section 10). Table J-1 presents the projected funding needs to implement the Mission Bay WMA Water Quality Improvement Plan through FY40. The compliance period for Mission Bay is through FY31, when the final goals are expected to be met. To maintain comparability among Water Quality Improvement Plan projected funding needs for different WMAs (the City is in six WMAs with different compliance schedules), ongoing operation and maintenance costs after the compliance period (between FY32 and FY40 for Mission Bay) are included in Table J-1. However, the majority of the funding will be needed within the first 15 years to meet the numeric goals. Twenty five year funding needs (FY16 - FY40) for the Mission Bay WMA are presented for JRMP activities, flood risk management programs, and Water Quality Improvement Plan activities by funding source: the City's General Fund (GF) or Capital Improvement Projects (CIP) funds. The General Fund is generally used for nonstructural strategies, design support, and operations and maintenance (O&M) of structural projects. CIP funding is used during the design and construction phase of structural projects. The source of the funding needs is the Storm Water Division's 2015 Watershed Asset Management Plan (WAMP) Cost Update, which will be made available on the Storm Water Division's website² in July 2015.

Figure J-1 illustrates the projected fiscal year annual funding needs over the 25-year compliance period for the Storm Water Division to implement its JRMP activities, flood risk management programs, and Water Quality Improvement Plan activities in the Mission

² <http://www.sandiego.gov/stormwater/plansreports/>

Bay WMA. Figure J-2 shows the projected fiscal year GF and CIP funding needs for each of these years. Figure J-3 and Figure J-4 show the projected fiscal year GF and CIP funding needs, respectively, by category for each of these years.

The recommended strategies selected are presented in Table J-2. The City's schedule table is found in Table J-3.

Table J-1
City of San Diego Projected Fiscal Year Funding Needs by Funding Source and Category for the Mission Bay WMA (FY16-40)¹

General Fund	
Water Quality Improvement Plan	\$12,494,279
JRMP	\$66,860,733
Flood Risk Management	\$144,714,554
Sub Total General Fund:	\$224,069,566
CIP	
Water Quality Improvement Plan	\$26,114,687
JRMP	\$0
Flood Risk Management	\$41,273,491
Sub Total CIP:	\$67,388,178
Total	
25 FY Mission Bay WMA Total Need	\$291,457,744

1. Does not include funding needs for other City of San Diego Departments or Divisions to implement JRMP required activities.

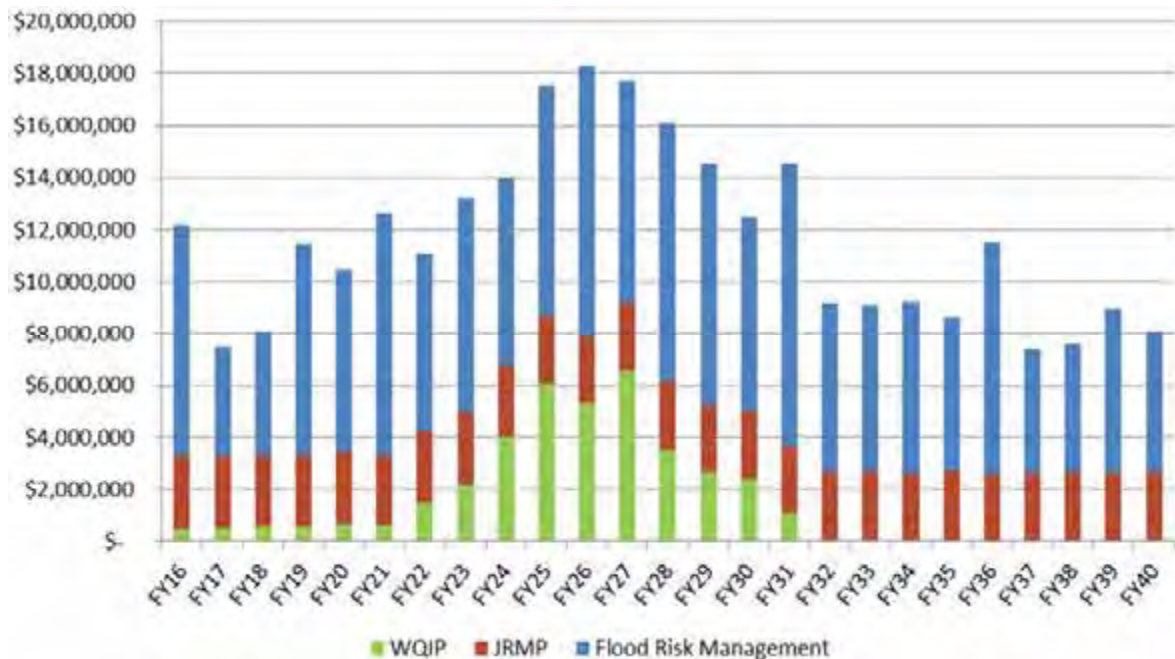


Figure J-1
City of San Diego Projected Fiscal Year Annual Funding Needs by Category for the Mission Bay WMA

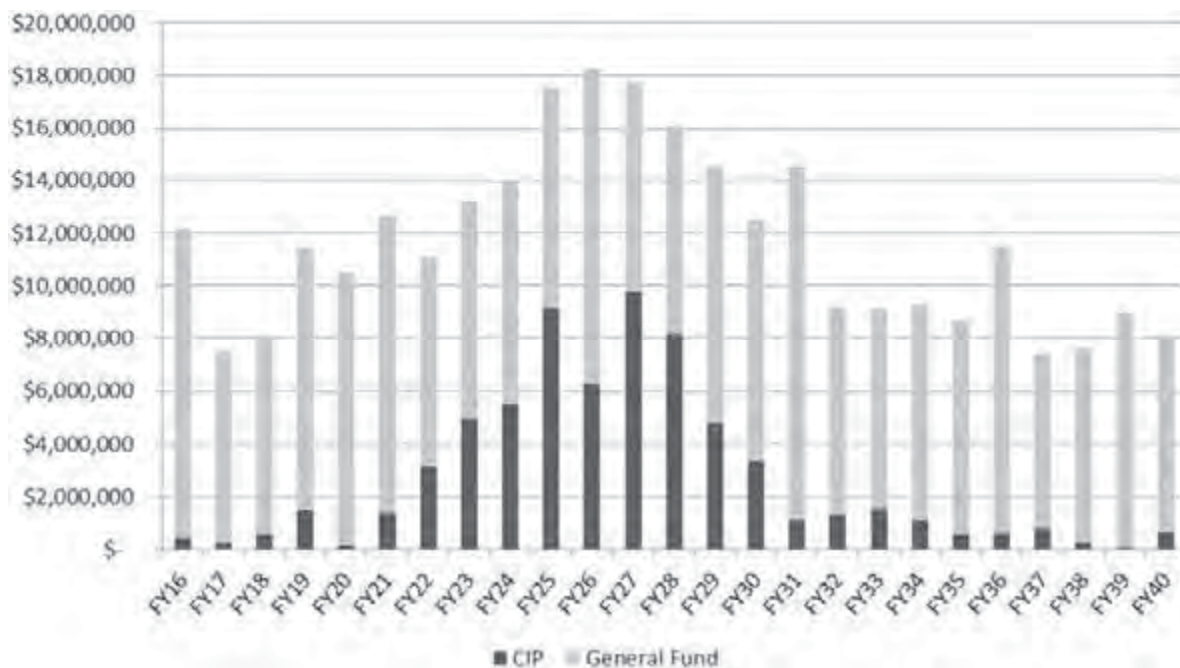


Figure J-2
City of San Diego Projected Fiscal Year Annual Funding Needs by Funding Source for the Mission Bay WMA

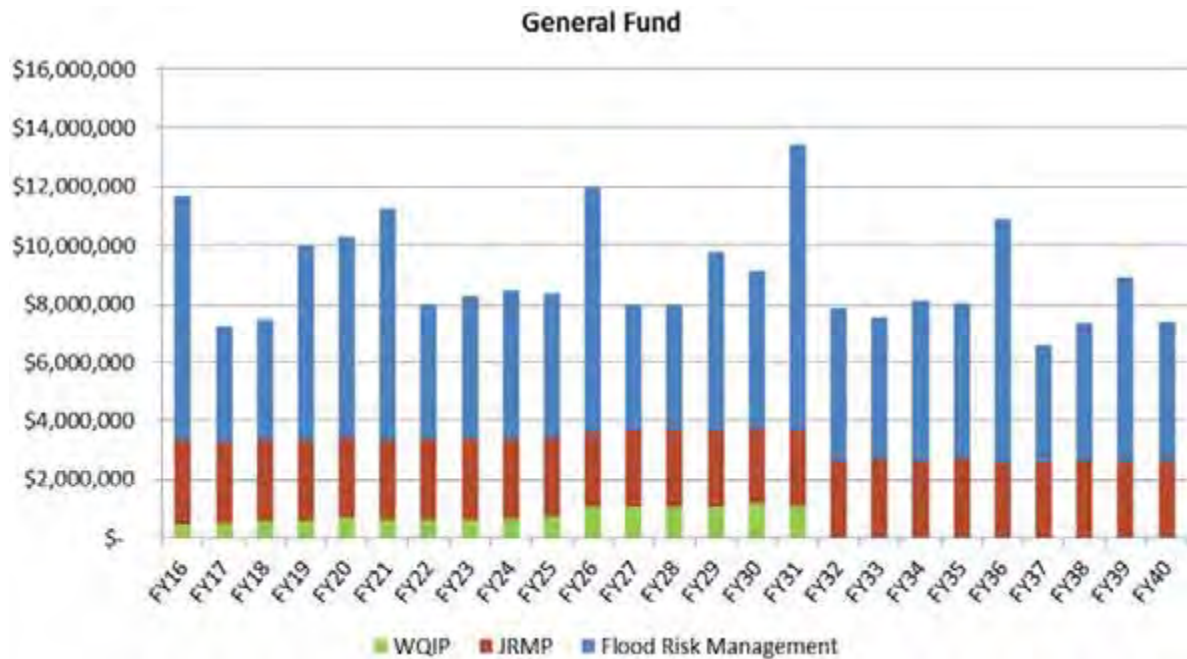


Figure J-3
City of San Diego Projected Fiscal Year Annual General Fund Funding Needs for the Mission Bay WMA



Figure J-4
City of San Diego Projected Fiscal Year Annual CIP Funding Needs for the Mission Bay WMA

Table J-2
City of San Diego Jurisdictional Strategies

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
Jurisdictional Strategies						
<i>Development Planning</i>						
<i>All Development Projects</i>						
CSD-1	Establish guidelines and standards for all development projects; provide technical support related to implementation of source control BMPs to minimize pollutant generation at each project and implement LID BMPs to maintain or restore hydrology of the area or implement easements to protect water quality, where applicable and feasible. Includes internal coordination and collaboration between City departments (DSD, PWD, and Engineering) to improve success and long-term benefits of BMPs.	Refer to JRMP Section 4.	City-wide	Prior to FY16	Ongoing	T&SW with DSD, PWD, B/A, NGOs, Coopermittees, and Engineering Community
CSD-1.1	Investigation and research of emerging technology.	Annually the Construction & Development Standards Group identifies new tasks to conduct literature review, communication with researchers outside of the City, physical testing and experimentation of new or emerging technologies, and other research with the goal of updating tools available for reducing pollutant loads from development and redevelopment sites. The City will begin developing a policy in FY16 that will increase the green infrastructure requirements for City CIP projects. This policy will be coordinated with ongoing efforts to update City design manuals and LID design standards for public LID BMPs.	City-wide	Prior to FY16	As needed	T&SW with DSD, PWD, B/A, NGOs, Coopermittees, and Engineering Community
CSD-1.2	Approve and implement a green infrastructure policy.	Improve quality of design to ensure efficiency and reliability in public designs.	City-wide	FY16 (Begin)	As needed	T&SW with DSD and PWD
CSD-1.3	Develop Design Standards for Public LID BMPs.	Affects commercial, industrial, and residential development.	City-wide	FY14-FY15	As needed	T&SW with DSD, PWD, B/A, NGOs, Coopermittees, and Engineering Community
CSD-1.4	Outreach to impacted industry regarding minimum BMP requirement updates.	Formal training is required for all staff involved in development plan review to increase knowledge of LID BMPs. Goal of training associated with LID practices and regulations is to promote LID implementation and to avoid adverse conditions such as trees planted within swales, or planned drainage patterns which obstruct or inhibit LID performance.	City-wide	FY15	As needed	TBD
CSD-2	Train staff on LID regulatory changes and LID practices.	Municipal codes and ordinances will be brought to City Council for consideration to encourage LID implementation (e.g., runoff detention and filtration using natural filters and stormwater retention for reuse). LID stormwater management will be encouraged in proposed codes and ordinances associated with development and redevelopment projects, which are brought to City Council for consideration.	City-wide	FY16	As needed	T&SW with DSD, PWD, B/A, NGOs, Coopermittees, and Engineering Community
CSD-3	Amend municipal code and ordinances, including zoning ordinances, to facilitate and encourage LID opportunities to support compliance with the MS4 Permit and TMDLs in a reasonable manner. Ensure consistency with the City of San Diego's BMP Design Manual. Update the Storm Water Standards Manual accordingly.		City-wide	FY15	As needed	T&SW with DSD, PWD, B/A, NGOs, Coopermittees, and Engineering Community

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-4	Create a manual that outlines right-of-way design standards.	Create a manual that includes flood control performance standards, permanent BMP elements design standards, design standards for green streets and other BMPs, and maintenance access. Provides drainage and streets design standards. Opportunity to merge various existing manuals and provide consistency.	City-wide	FY15	One time	T&SW with DSD and PWD
CSD-5	Provide technical education and outreach to the development community on the design and implementation requirements of the MSA Permit and Water Quality Improvement Plan requirements.	Technical education and outreach to the development community includes outreach on design standards, City design manuals, and the WMAA.	City-wide	Prior to FY16	Ongoing	T&SW with DSD
Priority Development Projects (PDPs)						
CSD-6	For PDPs, provide technical support to other City departments to ensure implementation of on-site structural BMPs to control pollutants and manage hydromodification by developing City wide storm water development standards and design guidelines.	Coordinate with other City departments to promote and confirm a thorough understanding of requirements for implementing structural BMPs that control pollutants and manage hydromodification. Included in that understanding are requirements to confirm proper design and construction through processes controlled by other City departments.	City-wide	FY16	Ongoing	T&SW with DSD, PWD, B/A, NGOs, Copermittees, and Engineering Community
CSD-6.1	Institute a program to verify and enforce maintenance and performance of treatment control BMPs.	Refer to JRMP Section 4.5.	City-wide	FY16	Ongoing	T&SW with DSD, PWD, B/A, NGOs, Copermittees, and Engineering Community
CSD-7	Update BMP Design Manual procedures to determine nature and extent of storm water requirements applicable to development projects and to identify conditions of concern for selecting, designing, and maintaining appropriate structural BMPs.	Refer to JRMP Section 4.	City-wide	FY15	Every 5 years/ permit cycle	T&SW with DSD, PWD, B/A, NGOs, Copermittees, and Engineering Community
CSD-7.1	Amend BMP Design Manual for trash areas. Require full four-sided enclosure, siting away from storm drains and cover. Consider the retrofit requirement.	Amend BMP Design Manual and zoning standards/requirements which address reduction of pollutants for common areas of trash build-up (e.g. restaurants, supermarkets, "big box" retail stores with food, pet stores). Most effective method for source control of bacteria and trash is to employ four-sided trash enclosures with a cover over trash areas.	City-wide	FY15	One time	T&SW with DSD, PWD, B/A, NGOs, Copermittees, and Engineering Community
CSD-7.2	Amend BMP Design Manual for animal-related facilities, such as such as animal shelters, "doggie day care" facilities, veterinary clinics, breeding, boarding and training facilities, groomers, and pet care stores.	Amend BMP Design Manual and zoning requirements (including retrofits) to provide supplemental standards for animal facilities (including animal shelters, dog daycares, veterinary clinics, groomers, pet car stores, and breeding, boarding, and training facilities). Supplemental standards may include requiring covered trash enclosures, identification of landscaped relief areas on site plans, ensuring drainage connections and treatment swales for areas that will not drain to the sanitary sewer, as well as inspection of grading, drainage, and landscaping for outdoor exercise areas.	City-wide	FY15	One time	T&SW with DSD, PWD, B/A, NGOs, Copermittees, and Engineering Community
CSD-7.3	Amend BMP Design Manual for nurseries and garden centers.	Amend BMP Design Manual to provide supplemental standards for plant nurseries and garden centers. Standards will focus on reducing irrigation runoff, and loading of sediment, pesticides, and nutrients. Measures may include: covered outdoor storage, green waste management BMPs, improved irrigation efficiency to reduce dry-weather runoff, and containment of runoff from impervious areas where plants and materials are stored.	City-wide	FY15	One time	T&SW with DSD, PWD, B/A, NGOs, Copermittees, and Engineering Community

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-7.4	Amend BMP Design Manual for auto-related uses.	Amend BMP Design Manual to provide supplemental standards for automotive-related uses to reduce loading of metals, oils, grease, and trash. Measures may include: four-sized covered trash enclosures, and careful review of auto-related usage areas (e.g. garage bays at repair shops) for grading, drainage, and drain connections to sanitary sewer systems.	City-wide	FY15	One time	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-8	Develop and administer an alternative compliance program for on-site structural BMP implementation (includes identifying Watershed Management Area Analysis [WMAA] candidate projects). Refer to Section 4.2.5.	Refer to JRMP Section 4.2.3.1.	City-wide	FY15	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-8.1	Create a fund that allows habitat acquisition, protection enhancement, and restoration in conjunction with other cooperating entities including community groups, academic institutions, state county, and federal agencies, etc.	This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, 3) staff resources are identified and secured, 4) partners have been identified and formal MOUs have been developed, and 5) consensus and community support has been achieved.	City-wide	Optional	TBD	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
Construction Management						
CSD-9	Coordinate with other City departments to promote and confirm a thorough understanding of requirements for implementing temporary BMPs that control sediment and other pollutants during the construction phase of projects. Included in that understanding are requirements to inspect at appropriate frequencies and effectively enforce requirements through process controlled by other City departments.	Refer to JRMP Section 5.	City-wide	FY16	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
Existing Development						
Commercial, Industrial, Municipal, and Residential Facilities and Areas						
CSD-10	Administer a program to require implementation of minimum BMPs for existing development (commercial, industrial, municipal, and residential) that are specific to the facility, area types, and PGAs, as appropriate. Includes inspection of existing development at appropriate frequencies and using appropriate methods.	Refer to JRMP Sections 6, 7, and 8.	City-wide	FY16	Ongoing	T&SW with DSD, PUD, & PWD
CSD-10.1	Update minimum BMPs for existing residential, commercial, and industrial development. Specific updates to BMPs include required street sweeping, catch basin cleaning, and maintenance of private roads and parking lots in targeted areas.	Refer to JRMP Appendix IX.	City-wide	FY15	Every 5 years	T&SW
CSD-10.2	Outreach to property managers and trash haulers to elevate the emphasis of power washing as a pollutant source.	Emphasis will be placed on non-compliant washing as an enforceable violation.	City-wide Residential, commercial and industrial areas	FY15	Ongoing	T&SW

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-10.3	Implement property based inspections.	Property-based inspections increase awareness and responsibility for individual properties to tackle issues associated with trash, landscapes, and parking areas. Expanding beyond the business-level inspections will achieve different and more effective opportunities for education, outreach, inspection, and enforcement to encourage water conservation strategies.	City-wide	Prior to FY16	Ongoing	T&SW
CSD-10.4	Review policies and procedures to ensure discharges from swimming pools meet permit requirements.	Verify and bring to City Council for consideration an update (as needed) for the City's Municipal Code (43.0301) to meet new permit requirements for swimming pool discharges.	City-wide	FY15	As needed	T&SW, City Attorney (Civil & Criminal)
CSD-11	Promote and encourage implementation of designated BMPs for residential and non-residential areas.	Landscape-based rebates are a "gateway" for adoption of other beneficial practices and are one of the nonstructural methods which address impacts from single-family residential areas (City of San Diego 2011 program development background study). Residential incentives can include: education and training (neighborhood watershed field days), and aggressive subsidies or rebates for grass replacement and rainwater harvesting. Existing programs will be expanded overall, and also have targeted expansion within specific subwatershed, particularly with highest water quality priority conditions.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, MWD, CWA & local water agencies
CSD-11.1	Residential and Commercial BMP: Rain Barrel	The existing PUD rebate program will continue for residential properties and expand for commercial properties for water collection, conservation, and reuse with rain barrels.	City-wide Residential Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies
CSD-11.2	Residential and Commercial BMP: Grass Replacement	The existing PUD grass replacement cash rebate program will continue and expand for residential and commercial properties. Program encourages a reduction in water use through the conversion of non-artificial grass to water wise plant material, while maintaining a high level of living landscape to benefit the environment. Program does not allow for conversion to artificial turf.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies
CSD-11.3	Residential and Commercial BMP: Downspout Disconnect	Disconnecting downspouts provide alternate runoff pathways from rooftops, sidewalks, driveways, and roads. Disconnecting downspouts from residential areas to pervious land can allow for depression storage and infiltration.	City-wide Residential and Commercial Areas	FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies
CSD-11.4	Residential and Commercial BMP: Microirrigation	The existing PUD micro-irrigation rebate program will continue and increase for residential and commercial properties. Application of microirrigation aims to improve the efficiency of landscape irrigation through the precise application of water.	City-wide Residential Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies
CSD-11.5	Provide Onsite Water Conservation Surveys.	Provide free onsite water conservation surveys to commercial and residential customers to reduce overirrigation and to encourage water conservation.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing	T&SW with DSD, PUD, PWD, & local water agencies

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
MS4 Infrastructure						
	Implementation of operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, channels as allowed by resource agencies, detention basins, pump stations, etc.) for water quality improvement and for flood control risk management.	Refer to JRMP Section 7.	City-wide	FY16	Ongoing	T&SW
CSD-12.1	Proactively repair and replace MS4 components to provide source control from MS4 infrastructure.	In order to limit inflow of pollutants and reduce pollutant loads, proactive measures will be taken to improve, repair, and replace MS4 components. The City of San Diego will start a multi-year program of repairing and replacing storm drain pipes to reduce sediment loading to the MS4. Development of an assessment management program and bond issues will be addressed. Exploration of daylighting pipes will take place where feasible and appropriate.	City-wide	FY16	Ongoing	T&SW
CSD-12.2	Replacement of hard assets including storm drains and structures.	Refer to JRMP Section 7.	City-wide	FY16	Ongoing	T&SW
CSD-13	Coordinate with other City departments (PUD) to implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers.	Refer to JRMP Section 7.	City-wide	FY16	Ongoing	T&SW with PUD
CSD-13.1	Identify sewer leaks and areas for sewer pipe replacement prioritization.	Risk assessment to include identifying targeted areas (age, location, proximity to MS4), coming up with methodology, pilot, desktop exercise/analysis.	City-wide	FY16	As needed	T&SW with PUD
Roads, Street, and Parking Lots						
CSD-14	Implement operation and maintenance activities for public streets, unpaved roads, paved roads, and paved highways.	Refer to JRMP Section 7.	City-wide	FY16	Ongoing	T&SW
CSD-14.1	Initiate sweeping of medians on high-volume arterial roadways.	Medians of roadways are also a potential source of pollutants. Consider implementing or increasing sweeping of medians. Consider mechanical and hand sweeping techniques.	City-wide	FY17	Ongoing	T&SW
Pesticide, Herbicides, and Fertilizer BMP Program						
CSD-15	Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties. Includes education, permits, and certifications.	Refer to JRMP Sections 7, 8, and 9.	City-wide	FY16	Ongoing	T&SW with Parks and Rec
Retrofit and Rehabilitation in Areas of Existing Development						
CSD-16	Develop and implement a strategy to identify candidate areas of existing development appropriate for retrofitting projects and facilitate the implementation of such projects.	Refer to JRMP Appendix XIX. The Offsite Alternative Compliance Program will include methods for identifying and assessing potential retrofit projects in existing development areas. Retrofit project selection will be based upon a variety of factors including proximity to high priority water quality conditions, potential pollutant load removal effectiveness, and feasibility of implementation. The program will include protocols related to funding mechanisms for project construction and long-term maintenance, payment and credit structures, and water quality equivalency standards.	City-wide	TBD	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Cooperatives, and Engineering Community

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-17	Develop and implement a strategy to identify candidate areas of existing development for stream, channel, or habitat rehabilitation projects and facilitate implementation of such projects.	Refer to JRMP Appendix XIX. The Offsite Alternative Compliance Program (Section 4.2.5.2 and Appendix N) will include methods for identifying and assessing potential stream, channel, or habitat rehabilitation projects in existing development areas. Rehabilitation project selection will be based upon a variety of factors including existing stream or habitat degradation, potential future cumulative stream or habitat impacts, and feasibility of implementation. The program will include protocols related to funding mechanisms for project construction and long-term maintenance, payment and credit structures, and water quality equivalency standards.	City-wide	TBD	Ongoing	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
<i>Illicit Discharge, Detection, and Elimination (IDDE) Program</i>						
CSD-18	Implement Illicit Discharge, Detection, and Elimination (IDDE) Program per the JRMP. Requirements include: maintaining an MSA map, using municipal personnel and contractors to identify and report illicit discharges, maintaining a hotline for public reporting of illicit discharges, monitoring MSA outfalls, and investigating and addressing any illicit discharges.	Refer to JRMP Section 3.	City-wide	Prior to FY16	Ongoing	T&SW
<i>Public Education and Participation</i>						
CSD-19	Implement a public education and participation program to promote and encourage development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water prioritized by high-risk behaviors, pollutants of concern, and target audiences.	Refer to JRMP Section 9.	City-wide	Prior to FY16	Ongoing	T&SW
CSD-19.1	Continue implementation of a Pet Waste Program.	Pet Waste Program includes outreach on "Scoop the poop", installation of posts for dispensers, distribution of lawn signs, and attendance at dog-related community activities.	City-wide	Prior to FY16	Ongoing	T&SW with Parks and Rec
CSD-19.2	Consider installing trash bins, pet waste bag dispensers and pickup services along the Rose Creek Bicycle Path and Rose Canyon Bicycle Path.	The City will consider expansion to current service levels for refuse collection and disposal in conjunction with enhanced education and outreach efforts regarding personal responsibility for trash and litter control. The City will also explore opportunities for the addition of refuse containers that can be served with collection by local community groups including the Friends of Rose Creek or through services contracted by a community initiated Maintenance Assessment District. This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, 3) staff resources are identified and secured, 4) partners have been identified and formal MOUs have been developed, and 5) consensus and community support has been achieved.	Mission Bay WMA (Rose Canyon)	Optional	TBD	Friends of Rose Creek
CSD-19.3	Promote and encourage implementation of designated BMPs in commercial and industrial areas.	Provide education and outreach on BMPs for commercial businesses and industrial facilities.	City-wide Non-residential Areas	Prior to FY16	Ongoing	T&SW with PUD; Funding: Prop 84 and water districts (MWD)

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-19.4	Expand outreach to homeowners' association (HOA) common lands and HOA incentives.	Approaches to consider include: offering incentives to HOAs and maintenance districts to adopt water-conserving/efficiency and stormwater-reduction changes to their landscapes, irrigation, and maintenance; conducting workshops with property managers; providing supplemental standards, inspection, or enforcement for HOA-managed properties.	City-wide	FY16	Ongoing	T&SW
CSD-19.5	Develop an outreach and training program for property managers responsible for HOAs and maintenance districts.	Approaches to engage HOAs and property managers include: conducting workshops with property managers, providing supplemental standards, inspections or enforcement around HOA properties, and offering incentives to HOAs and maintenance districts to adopt changes to landscapes, irrigation, or maintenance which promote water conservation or stormwater reduction. Property managers are also a target for enhanced outreach.	City-wide	FY16	Ongoing	T&SW
CSD-19.6	Enhance and expand trash cleanups through community-based organizations involving target audiences.	Increase effectiveness and reach of trash/beach cleanups and community based efforts by engaging community groups to self-define and carry-out trash clean-ups. Longstanding partnerships and sponsorships with I Love A Clean San Diego and others are recommended to be continued and enhanced. To effectively target stream clean-up efforts, focus on partnerships with community organizations which provide strong engagement with target audiences and communities.	City-wide	FY16	Ongoing	T&SW; Park and Rec
CSD-19.7	Improve consistency and content of websites to highlight enforceable conditions and reporting methods.	Websites will be updated to provide a user-friendly format and clarity for stormwater violations, conditions which citizens can and should report, and how to make such reports. Examples of reports for common incidents will be developed and posted which may vary locally and regionally. Photographs of allowable practices as well as illegal practices should be shown for utmost clarity. Displaying hotline numbers prominently on the website and near the photographs of illegal practices will ensure that those seeking to report will be able to do so easily. Also ensure hotline number and website are searchable and can be retrieved by simple internet searches.	City-wide	Prior to FY16	Ongoing	T&SW
CSD-19.8	Enhance school and recreation-based education and outreach.	Develop curriculum and establish distribution in public schools. Includes education on water conservation.	City-wide	FY15	Ongoing	T&SW, PUD with community-based organization
CSD-19.9	Develop education and outreach to reduce irrigation runoff.	Example approaches to reduce or eliminate irrigation runoff may include: education and outreach, prohibition, enhanced enforcement of existing prohibitions, and pilot projects such as the City of Del Mar's pilot door hanger project.	City-wide	Prior to FY16	Ongoing	T&SW with PUD
CSD-19.10	Develop regional training for water-using mobile businesses.	Consider development of supplemental standards for mobile businesses including: covered trash enclosures, careful review of washing areas (grading, drainage, landscaping, sanitary sewer system connectivity), and appropriate signage (either through zoning for retrofits or "best fix" approaches, or through BMP Design Manual standards). Businesses may include carpet cleaners, tile installers, plumbers, etc.	City-wide	FY16	Ongoing	T&SW

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-19.11	Enhance education and outreach based on results of effectiveness survey and changing regulatory requirements.	Use effectiveness surveys to enhance existing education and outreach programs while proactively keeping up with and incorporating changing regulatory requirements.	City-wide	FY16	Ongoing	T&SW
CSD-19.12	Continue to promote and encourage implementation of Integrated Pest Management (IPM) for residents and businesses.	The City will continue to provide education on IPM techniques during presentations and on the City's Think Blue website.	City-wide	Prior to FY16	Ongoing	T&SW
Enforcement Response Plan						
CSD-20	Continue to implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management and existing development in the Storm Water Code Enforcement Unit's Standard Operating Procedures (SOPs) - Enforcement Response Plan.	Refer to JRMPP Appendix XIII.	City-wide	Prior to FY16	Ongoing	T&SW with PUD, other City enforcement compliance programs
CSD-20.1	Increase enforcement of irrigation runoff.	Increased enforcement policies against irrigation runoff will be established in tandem with the education and outreach programs on how these actions lead to pollutant loading. By shifting to property-based inspections irrigation runoff can be handled as enforceable violations once the public is well-informed.	City-wide	FY16	Ongoing	T&SW
CSD-20.2	Increase enforcement of water-using mobile businesses.	In addition to education, pollution associated with mobile business sources can be handled through policy, code development, inspections of business practices, and enforcement.	City-wide	FY16	Ongoing	T&SW
CSD-21	Increase enforcement of all minimum BMPs for existing residential, commercial, and industrial development.	Increased enforcement of existing development minimum BMPs.	City-wide	FY16	As needed	T&SW
CSD-22	Increase enforcement associated with property-based inspections.	Shifting inspections from businesses-specific to property-based will increase effectiveness and sense of responsibility and ownership. Education and outreach must be followed up with inspection and enforcement of regulations to encourage proper landscape and water conservation strategies.	City-wide	FY16	Ongoing	T&SW
CSD-23	Increase enforcement of sweeping and maintenance of private roads and parking lots in targeted areas.	Refer to Minimum BMPs in JRMPP (Appendix IX).	City-wide	FY16	Ongoing	T&SW
CSD-24	Increase identification and enforcement of actionable erosion and slope stabilization issues on private property and require stabilization and repair.	Eroding and unstable slope areas on private property (excluding construction sites) will be identified as potential sediment loading sources and subject to enforcement. In the short term, this will target enhanced inspection and enforcement programs to ensure inspectors address erosion and slope instability for the purpose of education.	City-wide	FY16	Ongoing	T&SW
CSD-24.1	Coordinate and work with Parks and Recreation, where appropriate, to effectively implement the City's brush management program to ensure that the City is not creating erosion issues.	The Storm Water Department Division will work coordinate with the Parks and Recreation Open Space Division, where appropriate, to develop and implement continue effective implementation of City brush management activities.	Mission Bay WMA	FY16	Ongoing	T&SW with Parks and Rec

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
<i>Additional Nonstructural Strategies</i>						
CSD-25	Conduct a Comprehensive Benefits Analysis to identify benefits other than water quality that are applicable to each of the specific WQIP strategies.	The analysis identifies which other benefits apply to each strategy, and documents the assumptions making those linkages. The delineation of other benefits to strategies includes a general description of each benefit, and a listing of the assumptions that were made to link those benefits to strategies. In addition, the other benefits are characterized with respect to who is directly affected: the city, local residents, local businesses, or visitors. This analysis may be used as part of the adaptive management process to modify future strategies.	City-wide	FY15	One time	T&SW
CSD-26	Address and clean up trash from transient encampments with collaboration from the Homeless Outreach Team.	Coordinate with the Homeless Outreach Team to respond to transient encampment trash complaints.	City-wide	FY16	Ongoing	T&SW with Police, ESD, Urban Corps, Alpha Project
CSD-27	Continue participating in source reduction initiatives.	Source reduction initiatives are ultimately the most effective measure to remove pollutants from surface waters, where feasible. Bans or progressive phase-outs that may be considered include: leaf blowers, plastic bags, architectural copper (generally a legacy issue), as well as prohibiting or more aggressively regulating vehicle washing. Additional source reduction initiatives to consider include pesticide sales at hardware stores and irrigation supply stores.	City-wide	Prior to FY16	Ongoing	T&SW
CSD-27.1	Coordinate with Fleet Services to replace City-owned vehicle brake pads with copper-free brake pads as they become commercially available.	Consider legislative mandate and cooperative implementation of copper-free brake pads on city-owned vehicle to reduce pollutant deposition.	City-wide	FY18	Ongoing	T&SW, ESD with PWD (Fleet Services)
CSD-28	Proactively monitor for erosion, and complete minor repair and slope stabilization on municipal property.	Actively identify and repair eroding slopes that may be contributing to sediment loading. Prepare an inventory and assessment of eroding areas and their risk to surface waters. Follow assessment with a schedule for ongoing inspection and stabilization (potentially based on a number or percentage of sites annually). Consider Caltrans program as a template. Special studies will be conducted to gather data to identify pollutant sources, appropriate targets, or other information. Includes collaboration with universities.	City-wide	FY16	Ongoing	T&SW
CSD-29	Conduct special studies.		City-wide	FY16	Ongoing	T&SW
CSD-29.1	Participate in Reference Watershed Study.	The San Diego Regional Reference Stream Study (currently being conducted by the Southern California Coastal Water Research Project). The study will develop numeric targets that account for "natural sources" to establish the concentrations or loads from streams in a minimally disturbed or "reference" condition. Refer to Section 5.1 for further details.	Region-wide	Prior to FY16	One time	T&SW, SCCWRP, Regional committees
CSD-29.2	Participate in Reference Beach Study.	The San Diego Regional Reference Beach Study will develop numeric targets that account for "natural sources" to establish the concentrations or loads from the beach in a minimally disturbed or "reference" condition. The purpose of this monitoring program is to advise the public of potential health risks that could occur with water contact recreation at local beaches. DEH will post a health advisory notice or close a beach when FIB results are above REC-1 water quality standards.	Region-wide (Mission Bay)	Prior to FY16	One time	T&SW, SCCWRP, Regional committees

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-29.3	Tecolote Creek Quantitative Microbial Risk Assessment (QMRA).	The Tecolote Creek Quantitative Microbial Risk Assessment (QMRA) is currently being conducted in response to the Bacteria TMDL. The study is designed to characterize the predominance of non-human sources in the watershed, quantify the potential risks associated with water contact recreation (e.g., swimming), and, if appropriate, calculate WQOs to reflect the watershed's site-specific conditions. Refer to Section 5.1 for further details.	Mission Bay WMA (Tecolote Creek)	FY16	One time	T&SW
CSD-29.4	Using adaptive management, delist the beach segment from the TMDL and Attachment E of the MS4 Permit.	Using the adaptive management process outlined in Section 6, remove 303(d) delisted beach segments from the Bacteria TMDL and Attachment E of the MS4 Permit.	Mission Bay WMA	FY16	Ongoing	T&SW, Potential Stakeholders, Coastkeeper
CSD-29.5	Conduct a Cost of Service Study.	Conduct a Cost of Service Study that will examine the full cost of flood control and storm water strategies needed to comply with storm water regulations for the City of San Diego. The City of San Diego's Watershed Asset Management Plan will be used as the basis for the study.	City-wide	FY16	One time	TBD
CSD-30	Conduct Sustainable Return on Investment (SROI) analysis to estimate strategies' co-benefits and impacts to the public and the private sector on a common scale.	SROI is an economics-based framework for evaluating quantitative and qualitative performance metrics and monetizing them, if possible, along a triple bottom line (i.e. financial, societal, and environmental). This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, 3) staff resources are identified and secured, 4) partners have been identified and formal MOUs have been developed, and 5) consensus and community support has been achieved.	City-wide	Optional	TBD	T&SW and public participation
CSD-31	Collaborate with the County, if a County-led regional social services effort is established, to provide sanitation and trash management for individuals experiencing homelessness and determine if the program is suitable and appropriate for jurisdictional needs to meet goals.	Support a non-profit or consortium to provide sanitation services associated with hygiene as well as trash management for persons experiencing homelessness. Rented or purchased shower/sanitary trailers providing mobile showers may be organized at specifically scheduled locations and times. This provision has been proposed as a method for preventing surface water usage for sanitation and bathing, as well as opportunity for outreach and referral by social service agencies. The trash management services will include providing trash bags, trash collection areas, and shower/sanitary facilities at centers which provide daytime shelter to their clients, or on a mobile-basis for known transit camps. This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, 3) staff resources are identified and secured, 4) partners have been identified and formal MOUs have been developed, and 5) consensus and community support has been achieved.	City-wide	Optional	TBD	T&SW

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-32	Participate in an assessment to determine if implementation of an urban tree canopy (UTC) program would benefit water quality and other City goals, where feasible.	Perform a feasibility study to determine if implementing an UTC program would be beneficial to the City's goals. UTC intercepts rainfall through increased coverage of leaves, branches, and stems and reduces runoff from the storm drainage system. Benefits associated with enhancing an UTC include reducing heat island effects and air pollution in addition to aesthetics and community benefits. Where feasible, native trees will be utilized to prevent invasive trees from migrating to open spaces and to conserve water. This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, and 3) staff resources are identified and secured.	City-wide	Optional	TBD	Planning Dept. with T&SW, SANDAG, and Nature Conservancy
CSD-33	Conduct a feasibility study to test Permeable Friction Course (PFC), a porous asphalt that overlays impermeable asphalt.	Perform an assessment to determine the feasibility of implementing PFC on City streets. PFC, an overlay of porous asphalt, is an innovative roadway material that improves driving conditions in wet weather and water quality. Placed in a layer 25-50mm thick on top of regular impermeable pavement, PFC allows rainfall to drain within the porous layer rather than on top of the pavement. PFC has also been shown to reduce concentrations of pollutants commonly observed in highway runoff. PFC incorporates stormwater treatment into the roadway surface and does not require additional right-of-way. This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, and 3) staff resources are identified and secured.	City-wide	Optional	One time	T&SW with DSD, PWD, BIA, NGOs, Copermittees, and Engineering Community
CSD-34	As opportunities arise and funding sources are identified, protect areas that are functioning naturally by avoiding impervious development and degradation on unpaved open space areas, creating permanent open space protections on undeveloped city-owned land, and accepting privately-owned undeveloped open areas.	This strategy may be implemented if there is interest in participation by the public or private entity with current control of the land. Conditions to be met also include 1) identification of partners, if needed (public, private, non-profit), 2) identification of costs and potential sources of funding, 3) final agreement by public or private entity with current control of the land, 4) final agreement by all other participating partners including acceptance by intended land- or asset-owning City department, and 5) funding in place.	City-wide	Optional	TBD	TBD

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-34.1	Add permanent open spaces protections to underdeveloped city-owned land in and on the rim of all canyons, including but not limited to Rose Canyon, San Clemente Canyon, Gilman Canyon, and Carroll Canyon.	This strategy may be implemented if there is interest in participation by the public or private entity with current control of the land. Conditions to be met also include 1) identification of partners, if needed (public, private, non-profit), 2) identification of costs and potential sources of funding, 3) final agreement by public or private entity with current control of the land, 4) final agreement by all other participating partners including acceptance by intended land- or asset-owning City department, and 5) funding in place.	Mission Bay WMA	Optional	TBD	TBD
CSD-34.2	Add permanent open space protection to undeveloped land in the Mission Bay watershed.	This strategy may be implemented if there is interest in participation by the public or private entity with current control of the land. Conditions to be met also include 1) identification of partners, if needed (public, private, non-profit), 2) identification of costs and potential sources of funding, 3) final agreement by public or private entity with current control of the land, 4) final agreement by all other participating partners including acceptance by intended land- or asset-owning City department, and 5) funding in place.	Mission Bay WMA	Optional	TBD	TBD
CSD-34.3	Forming a linear “park” from the southern end of Marian Bear Natural Park to the mouth of Rose Creek.	This strategy may be implemented if there is interest in participation by the public or private entity with current control of the land. Conditions to be met also include 1) identification of partners, if needed (public, private, non-profit), 2) identification of costs and potential sources of funding, 3) final agreement by public or private entity with current control of the land, 4) final agreement by all other participating partners including acceptance by intended land- or asset-owning City department, and 5) funding in place.	Mission Bay WMA (Rose Canyon)	Optional	TBD	TBD
CSD-35	Participate in a watershed council or group if one is established.	This strategy may be triggered as 1) partners have been identified and formal MOUs have been developed and 2) consensus and community support has been achieved.	City-wide	Optional	TBD	TBD
CSD-35.1	City coordination with the Mission Bay Wetland Initiative.	This strategy may be triggered as 1) partners have been identified and formal MOUs have been developed and 2) consensus and community support has been achieved.	Mission Bay WMA	Optional	TBD	TBD

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-35.2	Collaborate with stakeholders to identify funding opportunities including the preparation and competition for grants or involvement with existing groups, such as the Integrated Regional Water Management (IRWM) group.	This strategy may be triggered as 1) partners have been identified and formal MOUs have been developed and 2) consensus and community support has been achieved.	Mission Bay WMA	Optional	TBD	TBD
CSD-36	Prohibit introduction of invasive plants in new development and redevelopment projects.	Coordinate with the City's Development Services Department to continue to prohibit introduction of invasive species such as Arundo donax and Cortaderia selloana for new development or redevelopment projects as specified in the City's municipal code for landscape.	City-wide	Prior to FY16	Ongoing	T&SW with DSD
Green Infrastructure						
CSD-37	Green Lot in Kellogg Park.	Green lot of 0.6 acres includes infiltrative treatment systems (porous pavement and bioretention areas) to treat a drainage area of 8.9 acres. This project has been constructed.	Mission Bay WMA (Scripps)	Prior to FY16	Ongoing	T&SW with PWD
CSD-38	Green infrastructure treatment on public parcels with approximately 2.28 acres of bioretention and 0.35 acres of permeable pavement to treat an impervious drainage area of 182.35 acres with a total storage volume of 8.21 ac-ft.	By FY27, implement at least 2.28 acres of bioretention and 0.35 acres of permeable pavement or equivalent treatment capacity to treat an impervious drainage area of 182.35 acres with a total storage volume of 8.21 ac-ft. Ramp up construction over time, constructing most efficient BMPs first and increasing BMP quantity over time.	Mission Bay WMA (Tecolote Creek)	FY26	Ongoing	T&SW with PWD; Potential to collaborate with transit agencies, public school districts, and state and federal agencies
Green Streets						
CSD-39	Mt. Abernathy Avenue	Construction, operation and maintenance of a 0.06 acre (footprint) green street project at Mt. Abernathy and Camber Drive to treat a drainage area of 19.6 acres.	Mission Bay WMA (Tecolote Creek)	Prior to FY16	Ongoing	T&SW with PWD
CSD-40	Bannock Avenue	Construction, operation and maintenance of a 0.47 acre (footprint) green street project at Bannock Avenue and Genesee Avenue to treat a drainage area of 65 acres.	Mission Bay WMA (Tecolote Creek)	2014	Ongoing	T&SW with PWD
Multiuse Treatment Areas						
Infiltration and Detention Basins						
CSD-41	Torrey Pines Golf Course Phase 1 (Project ID 1019)	This project consists of four 185' lengths of perforated 48" HDPE in crushed rock envelope for detention and infiltration. This infiltration system is 0.11 acre and treats a drainage area of 3.7 acres with a total storage volume of 0.43 ac-ft.	Mission Bay WMA (Scripps)	Prior to FY16	Ongoing	T&SW with PWD
CSD-42	Wetland system at Sam Snead All American Golf Course.	Construction, operation and maintenance of an 11.4 acre (footprint) wetland system to treat a total drainage area of 5,642 acres with a total storage volume of 34.2 ac-ft. (on 11.4 acres of available space, APN 4310700600).	Mission Bay WMA (Tecolote Creek)	FY25	Ongoing	T&SW with PWD
CSD-43	Subsurface detention/infiltration system at Tecolote Canyon Park.	Construction, operation and maintenance of a 6.0 acre (footprint) subsurface detention/infiltration system to treat a total drainage area of 6,032 acres with a total storage volume of 18.0 ac-ft. (on 6.0 acres of available space, APN 4362612100). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	Mission Bay WMA (Tecolote Creek)	FY24	Ongoing	T&SW with PWD

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-44	Extended Dry Detention system at James Madison High School.	Construction, operation and maintenance of a 1.36 acre (footprint) extended dry detention system to treat a total drainage area of 97 acres with a total storage volume of 2.7 ac-ft. (on 30.0 acres of available space, APN 3620106900).	Mission Bay WMA (Tecolote Creek)	FY26	Ongoing	T&SW with PWD
CSD-45	Extended Dry Detention system at John Muir School/Anderson School.	Construction, operation and maintenance of a 1.0 acre (footprint) extended dry detention system to treat a total drainage area of 72 acres with a total storage volume of 2.0 ac-ft. (on 10.2 acres of available space, APN 3612900400).	Mission Bay WMA (Tecolote Creek)	FY28	Ongoing	T&SW with PWD
CSD-46	Subsurface detention/infiltration system at Mt. Everest Academy Elementary School.	Construction, operation and maintenance of a 0.22 acre (footprint) subsurface detention/infiltration system to treat a total drainage area of 21 acres with a total storage volume of 0.7 ac-ft. (on 7.4 acres of available space, APN 4190200100). Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	Mission Bay WMA (Tecolote Creek)	FY27	Ongoing	T&SW with PWD
CSD-47	If interim load reduction goals are not met and additional multiuse treatment areas are required, a subsurface detention/infiltration system can be implemented at Pacific Beach Elementary School upon detailed site assessment.	Construction, operation and maintenance of a 1.3 acre (footprint) subsurface detention/infiltration system to treat a total drainage area of 213 acres with a total storage volume of 3.9 ac-ft. (APN 4152711900). This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, and 3) staff resources are identified and secured. Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	Mission Bay WMA (Scripps)	Optional	TBD	T&SW with PWD
CSD-48	If interim load reduction goals are not met and additional multiuse treatment areas are required, a subsurface detention/infiltration system at La Jolla Community Park upon detailed site assessment.	Construction, operation and maintenance of a 0.21 acre (footprint) subsurface detention/infiltration system to treat a total drainage area of 19.3 acres with a total storage volume 0.6 ac-ft. (APN 3503110200). This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, and 3) staff resources are identified and secured. Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	Mission Bay WMA (Scripps)	Optional	TBD	T&SW with PWD
CSD-49	If jurisdictional nonstructural and structural strategies do not meet interim targets by interim load reduction goals, a subsurface detention/infiltration system at Bird Rock Elementary School and Bird Rock Park upon detailed site assessment.	Construction, operation and maintenance of a 0.51 acre (footprint) subsurface detention/infiltration system to treat a total drainage area of 81 acres with a total storage volume of 1.5 ac-ft. (APN 4150700500). This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, and 3) staff resources are identified and secured. Subsurface detention basins would be designed and constructed per all applicable City safety codes and standards.	Mission Bay WMA (Scripps)	Optional	TBD	T&SW with PWD

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CSD-50	If interim load reduction goals are not met and additional multiuse treatment areas are required, an infiltration basin(s) may be considered on publicly owned open spaces in canyon areas on a case-by-case basis when no other opportunities for load reductions exist.	Construction, operation, and maintenance of infiltration basin(s) in canyon areas. Twenty potential canyon sites, owned by City of San Diego, have been identified in Mission Bay WMA (Scripps and Tecolote Creek) that provide up to 143 acres of available space (773 total parcel acreage). This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, 3) staff resources are identified and secured, 4) partners have been identified and formal MOUs have been developed, and 5) permits required by regulatory agencies are secured.	Mission Bay WMA	Optional	TBD	T&SW with PWD
Stream, Channel and Habitat Rehabilitation Projects						
CSD-51	Day lighting Cudahy Creek.	This strategy may be triggered as 1) funding to address MS4 discharges is identified and secured, 2) staff resources are identified and secured, 3) partners have been identified and formal MOUs have been developed, 4) permits required by regulatory agencies are secured, and 5) consensus and community support has been achieved.	Mission Bay WMA (East side of Mission Bay Park between the Park and Claremont)	Optional	TBD	TBD
CSD-52	Restoration of the riparian corridor under Genesee Avenue Bridge.	Restore more natural flow regimes, wetlands, and riparian corridors. This strategy may be triggered as 1) funding to address MS4 discharges is identified and secured, 2) staff resources are identified and secured, 3) partners have been identified and formal MOUs have been developed, 4) permits required by regulatory agencies are secured, and 5) consensus and community support has been achieved.	Mission Bay WMA (Rose Canyon)	Optional	TBD	TBD
CSD-53	If interim load reduction goals are not met and additional stream, channel, and habitat rehabilitation projects are required, implement as needed.	This strategy may be triggered as 1) funding to address MS4 discharges is identified and secured, 2) staff resources are identified and secured, 3) partners have been identified and formal MOUs have been developed, 4) permits required by regulatory agencies are secured, and 5) recommendations from the community are identified and consensus and community support has been achieved.	Areas identified during feasibility studies	Optional	TBD	T&SW

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
Water Quality Improvement BMPs						
<i>Proprietary BMPs</i>						
CSD-54	Torrey Pines Golf Course Phase 1 (Project ID 1019)	9 Kristar FloGards plus drainage inserts have been installed at this site.	Mission Bay WMA (Scripps)	Prior to FY16	Ongoing	T&SW with PWD
CSD-55	Mt. Ashmun Drive (Project ID 1327)	A biocean baffle box has been installed at this site.	Mission Bay WMA (Tecolote Creek)	Prior to FY16	Ongoing	T&SW with PWD
<i>Dry Weather Flow Separation and Treatment Projects</i>						
CSD-56	Dry-weather flow diversion	A dry-weather flow diversion is constructed near 7920 Princess St.	Mission Bay WMA (Scripps)	2014	Ongoing	T&SW with PWD
CSD-57	Dry-weather flow diversion	A dry-weather flow diversion is constructed near 1624 Torrey Pines Rd.	Mission Bay WMA (Scripps)	2014	Ongoing	T&SW with PWD
CSD-58	Dry-weather flow diversion	A dry-weather flow diversion is constructed near Torrey Pines Rd & Charlot.	Mission Bay WMA (Scripps)	2014	Ongoing	T&SW with PWD
CSD-59	Dry-weather flow diversion	A dry-weather flow diversion is constructed near Camino del Oro & El Paseo.	Mission Bay WMA (Scripps)	2014	Ongoing	T&SW with PWD
CSD-60	Dry-weather flow diversion	A dry-weather flow diversion is replaced near Avenida De La Playa.	Mission Bay WMA (Scripps)	2015	Ongoing	T&SW with PWD
CSD-61	Dry-weather flow diversion	Limited low-flow storm drain inlets in Lindberg Park.	Mission Bay WMA (Tecolote Creek)	Optional	TBD	T&SW with PWD
CSD-62	If interim load reduction goals are not met and additional dry weather flow separation and treatment projects are required, implement as needed.	Construction of dry weather flow separation and treatment projects, where identified. This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, 3) staff resources are identified and secured, and 4) permits required by regulatory agencies are secured.	Downstream reaches where persistent dry weather flows have been observed	Optional	TBD	T&SW with PWD

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year Start	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
Trash Segregation						
CSD-63	If interim load reduction goals are not met and additional trash segregation projects are required, implement as needed.	Construction of trash segregation (Trash Guards, etc.) projects, where identified. This strategy may be triggered as 1) interim goals are not met, 2) funding to address MS4 discharges is identified and secured, 3) staff resources are identified and secured, and 4) permits required by regulatory agencies are secured.	High-loading areas city-wide	Optional	TBD	T&SW with PWD

DSD= Development Services Department; PUD = Public Utilities Department; PWD = Public Works Department; T&SW = Transportation and Storm Water Division; WAMP = Watershed Asset Management Plan; TBD = will be determined during the next fiscal year.

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Table J-3
City of San Diego Annual Schedule

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ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-7.1	Amend BMP Design Manual for trash areas. Require full four-sided enclosure, sitting away from storm drains and cover. Consider the retrofit requirement.	City-wide	FY15	One time																
CSD-7.2	Amend BMP Design Manual for animal-related facilities, such as such as animal shelters, "doggie day care" facilities, veterinary clinics, breeding, boarding and training facilities, groomers, and pet care stores.	City-wide	FY15	One time																
CSD-7.3	Amend BMP Design Manual for nurseries and garden centers.	City-wide	FY15	One time																
CSD-7.4	Amend BMP Design Manual for auto-related uses.	City-wide	FY15	One time																
CSD-8	Develop and administer an alternative compliance program for on-site structural BMP implementation (includes identifying Watershed Management Area Analysis [WMAA] candidate projects). Refer to Section 4.2.5.	City-wide	FY15	Ongoing																
CSD-8.1	Create a fund that allows habitat acquisition, protection enhancement, and restoration in conjunction with other cooperating entities including community groups, academic institutions, state county, and federal agencies, etc.	City-wide	Optional		If triggered, begin planning, acquiring funding and resources															
Construction Management																				
	Coordinate with other City departments to promote and confirm a thorough understanding of requirements for implementing temporary BMPs that control sediment and other pollutants during the construction phase of projects. Included in that understanding are requirements to inspect at appropriate frequencies and effectively enforce requirements through process controlled by other City departments.	City-wide	FY16		Ongoing															
CSD-9																				
Existing Development																				
Commercial, Industrial, Municipal, and Residential Facilities and Areas																				
CSD-10	Administer a program to require implementation of minimum BMPs for existing development (commercial, industrial, municipal, and residential) that are specific to the facility, area types, and PCAs, as appropriate. Includes inspection of existing development at appropriate frequencies and using appropriate methods.	City-wide	FY16		Ongoing															
CSD-10.1	Update minimum BMPs for existing residential, commercial, and industrial development. Specific updates to BMPs include required street sweeping, catch basin cleaning, and maintenance of private roads and parking lots in targeted areas.	City-wide	FY15	Cycle																
CSD-10.2	Outreach to property managers and trash haulers to elevate the emphasis of power washing as a pollutant source.	City-wide Residential, commercial and industrial areas	FY15	Ongoing																
CSD-10.3	Implement property based inspections.	City-wide	Prior to FY16	Ongoing																
CSD-10.4	Review policies and procedures to ensure discharges from swimming pools meet permit requirements.	City-wide	FY15	As Needed																
CSD-11	Promote and encourage implementation of designated BMPs for residential and non-residential areas.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing																

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-11.1	Residential and Commercial BMP: Rain Barrel	City-wide Residential Areas	Prior to FY16	Ongoing																
CSD-11.2	Residential and Commercial BMP: Grass Replacement	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing																
CSD-11.3	Residential and Commercial BMP: Downspout Disconnect	City-wide Residential and Commercial Areas	FY16		Ongoing															
CSD-11.4	Residential and Commercial BMP: Microirrigation	City-wide Residential Areas	Prior to FY16	Ongoing																
CSD-11.5	Provide Onsite Water Conservation Surveys.	City-wide Residential and Commercial Areas	Prior to FY16	Ongoing																
MS4 Infrastructure																				
CSD-12	Implementation of operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, channels as allowed by resource agencies, detention basins, pump stations, etc.) for water quality improvement and for flood control risk management.	City-wide	FY16		Ongoing															
CSD-12.1	Proactively repair and replace MS4 components to provide source control from MS4 infrastructure.	City-wide	FY16		Ongoing															
CSD-12.2	Replacement of hard assets including storm drains and structures.	City-wide	FY16		Ongoing															
CSD-13	Coordinate with other City departments (PUD) to implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers.	City-wide	FY16		Ongoing															
CSD-13.1	Identify sewer leaks and areas for sewer pipe replacement prioritization.	City-wide	FY16		As Needed															
Roads, Street, and Parking Lots																				
CSD-14	Implement operation and maintenance activities for public streets, unpaved roads, paved roads, and paved highways.	City-wide	FY16		Ongoing															
CSD-14.1	Initiate sweeping of medians on high-volume arterial roadways.	City-wide	FY17		Ongoing															
Pesticide, Herbicides, and Fertilizer BMP Program																				
CSD-15	Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties. Includes education, permits, and certifications.	City-wide	FY16		Ongoing															
Retrofit and Rehabilitation in Areas of Existing Development																				
CSD-16	Develop and implement a strategy to identify candidate areas of existing development appropriate for retrofitting projects and facilitate the implementation of such projects.	City-wide	TBD																	
CSD-17	Develop and implement a strategy to identify candidate areas of existing development for stream, channel, or habitat rehabilitation projects and facilitate implementation of such projects.	City-wide	TBD																	

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
<i>Illicit Discharge, Detection, and Elimination (IDDE) Program</i>																				
CSD-18	Implement Illicit Discharge, Detection, and Elimination (IDDE) Program per the JRMP. Requirements include: maintaining an MS4 map, using municipal personnel and contractors to identify and report illicit discharges, maintaining a hotline for public reporting of illicit discharges, monitoring MS4 outfalls, and investigating and addressing any illicit discharges.	City-wide	Prior to FY16	Ongoing																
<i>Public Education and Participation</i>																				
CSD-19	Implement a public education and participation program to promote and encourage development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water prioritized by high-risk behaviors, pollutants of concern, and target audiences.	City-wide	Prior to FY16	Ongoing																
CSD-19.1	Continue implementation of a Pet Waste Program.	City-wide	Prior to FY16	Ongoing																
CSD-19.2	Consider installing trash bins, pet waste bag dispensers and pickup services along the Rose Creek Bicycle Path and Rose Canyon Bicycle Path.	Mission Bay WMA (Rose Canyon)	Optional		If triggered, begin planning, acquiring funding and resources															
CSD-19.3	Promote and encourage implementation of designated BMPs in commercial and industrial areas.	City-wide Non-residential Areas	Prior to FY16	Ongoing																
CSD-19.4	Expand outreach to homeowners' association (HOA) common lands and HOA incentives.	City-wide	FY16		Ongoing															
CSD-19.5	Develop an outreach and training program for property managers responsible for HOAs and maintenance districts.	City-wide	FY16		Ongoing															
CSD-19.6	Enhance and expand trash cleanups through community-based organizations involving target audiences.	City-wide	FY16		Ongoing															
CSD-19.7	Improve consistency and content of websites to highlight enforceable conditions and reporting methods.	City-wide	Prior to FY16	Ongoing																
CSD-19.8	Enhance school and recreation-based education and outreach.	City-wide	FY15	Ongoing																
CSD-19.9	Develop education and outreach to reduce irrigation runoff.	City-wide	Prior to FY16	Ongoing																
CSD-19.10	Develop regional training for water-using mobile businesses.	City-wide	FY16		Ongoing															
CSD-19.11	Enhance education and outreach based on results of effectiveness survey and changing regulatory requirements.	City-wide	FY16		Ongoing															
CSD-19.12	Continue to promote and encourage implementation of Integrated Pest Management (IPM) for residents and businesses.	City-wide	Prior to FY16	Ongoing																
<i>Enforcement Response Plan</i>																				
CSD-20	Continue to implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE; development planning, construction management, and existing development in the Storm Water Code Enforcement Unit's Standard Operating Procedures (SOPs) - Enforcement Response Plan.	City-wide	Prior to FY16	Ongoing																
CSD-20.1	Increase enforcement of irrigation runoff.	City-wide	FY16		Ongoing															
CSD-20.2	Increase enforcement of water-using mobile businesses.	City-wide	FY16		Ongoing															
CSD-21	Increase enforcement of all minimum BMPs for existing residential, commercial, and industrial development.	City-wide	FY16		As needed															
CSD-22	Increase enforcement associated with property-based inspections.	City-wide	FY16		Ongoing															

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-23	Increase enforcement of sweeping and maintenance of private roads and parking lots in targeted areas.	City-wide	FY16		Ongoing															
CSD-24	Increase identification and enforcement of actionable erosion and slope stabilization issues on private property and require stabilization and repair.	City-wide	FY16		Ongoing															
CSD-24.1	Coordinate and work with Parks and Recreation, where appropriate, to effectively implement the City's brush management program to ensure that the City is not creating erosion issues.	Mission Bay WMA	FY16		Ongoing															
Additional Nonstructural Strategies																				
CSD-25	Conduct a Comprehensive Benefits Analysis to identify benefits other than water quality that are applicable to each of the specific WQIP strategies.	City-wide	FY15	One time																
CSD-26	Address and clean up trash from transient encampments with collaboration from the Homeless Outreach Team.	City-wide	FY16		Ongoing															
CSD-27	Continue participating in source reduction initiatives.	City-wide	Prior to FY16	Ongoing																
CSD-27.1	Coordinate with Fleet Services to replace City-owned vehicle brake pads with copper-free brake pads as they become commercially available.	City-wide	FY18				Ongoing													
CSD-28	Proactively monitor for erosion, and complete minor repair and slope stabilization on municipal property.	City-wide	FY16		Ongoing															
CSD-29	Conduct special studies.	City-wide	FY16		Ongoing															
CSD-29.1	Participate in Reference Watershed Study.	Region-wide	Prior to FY16	One time																
CSD-29.2	Participate in Reference Beach Study.	Region-wide (Mission Bay)	Prior to FY16	One time																
CSD-29.3	Tecolote Creek Quantitative Microbial Risk Assessment (QMRA).	Mission Bay WMA (Tecolote Creek)	FY16		One time															
CSD-29.4	Using adaptive management, delist the beach segment from the TMDL and Attachment E of the MS4 Permit.	Mission Bay WMA	FY16		Ongoing															
CSD-29.5	Conduct a Cost of Service Study.	City-wide	FY16		One time															
CSD-30	Conduct Sustainable Return on Investment (SROI) analysis to estimate strategies' co-benefits and impacts to the public and the private sector on a common scale.	City-wide	Optional		If triggered, begin planning, acquiring funding and resources															
CSD-31	Collaborate with the County, if a County-led regional social services effort is established, to provide sanitation and trash management for individuals experiencing homelessness and determine if the program is suitable and appropriate for jurisdictional needs to meet goals.	City-wide	Optional		If triggered, begin planning, acquiring funding and resources															
CSD-32	Participate in an assessment to determine if implementation of an urban tree canopy (UTC) program would benefit water quality and other City goals, where feasible.	City-wide	Optional		If triggered, begin planning, acquiring funding and resources															
CSD-33	Conduct a feasibility study to test Permeable Friction Course (PFC), a porous asphalt that overlays impermeable asphalt.	City-wide	Optional		If triggered, begin planning, acquiring funding and resources															

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-34	As opportunities arise and funding sources are identified, protect areas that are functioning naturally by avoiding impervious development and degradation on unpaved open space areas, creating permanent open space protections on undeveloped city-owned land, and accepting privately-owned undeveloped open areas.	City-wide	Optional																	
CSD-34.1	Add permanent open spaces protections to undeveloped city-owned land in and on the rim of all canyons, including but not limited to Rose Canyon, San Clemente Canyon, Gilman Canyon, and Carroll Canyon.	Mission Bay WMA	Optional																	
CSD-34.2	Add permanent open space protection to undeveloped land in the Mission Bay watershed.	Mission Bay WMA	Optional																	
CSD-34.3	Forming a linear "park" from the southern end of Marian Bear Natural Park to the mouth of Rose Creek.	Mission Bay WMA (Rose Canyon)	Optional																	
CSD-35	Participate in a watershed council or group if one is established.	City-wide	Optional																	
CSD-35.1	City coordination with the Mission Bay Wetland Initiative.	Mission Bay WMA	Optional																	
CSD-35.2	Collaborate with stakeholders to identify funding opportunities including the preparation and competition for grants or involvement with existing groups, such as the Integrated Regional Water Management (IRWM) group.	Mission Bay WMA	Optional																	
CSD-36	Prohibit introduction of invasive plants in new development and redevelopment projects.	City-wide	Prior to FY16	Ongoing																
Green Infrastructure																				
CSD-37	Green Lot in Kellogg Park.	Mission Bay WMA (Scripps)	Prior to FY16																	
CSD-38	Green infrastructure treatment on public parcels with approximately 2.28 acres of bioretention and 0.35 acres of permeable pavement to treat an impervious drainage area of 182.35 acres with a total storage volume of 8.21 ac-ft.	Mission Bay WMA (Tecolote Creek)	FY26																	
Green Streets																				
CSD-39	Mt. Abernathy Avenue	Mission Bay WMA (Tecolote Creek)	Prior to FY16																	
CSD-40	Barnock Avenue	Mission Bay WMA (Tecolote Creek)	2014																	
Multituse Treatment Areas																				
Infiltration and Detention Basins																				
CSD-41	Torrey Pines Golf Course Phase 1 (Project ID 1019)	Mission Bay WMA (Scripps)	Prior to FY16																	
CSD-42	Wetland system at Sam Sread All American Golf Course.	Mission Bay WMA (Tecolote Creek)	FY25																	
CSD-43	Subsurface detention/infiltration system at Tecolote Canyon Park.	Mission Bay WMA (Tecolote Creek)	FY24																	
CSD-44	Extended Dry Detention system at James Madison High School.	Mission Bay WMA (Tecolote Creek)	FY26																	
CSD-45	Extended Dry Detention system at John Muir School/Anderson School.	Mission Bay WMA (Tecolote Creek)	FY28																	

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-46	Subsurface detention/infiltration system at Mt. Everest Academy Elementary School.	Mission Bay WMA (Tecolote Creek)	FY27																	
CSD-47	If interim load reduction goals are not met and additional multiuse treatment areas are required, a subsurface detention/infiltration system can be implemented at Pacific Beach Elementary School upon detailed site assessment.	Mission Bay WMA (Scripps)	Optional																	
CSD-48	If interim load reduction goals are not met and additional multiuse treatment areas are required, a subsurface detention/infiltration system at La Jolla Community Park upon detailed site assessment.	Mission Bay WMA (Scripps)	Optional																	
CSD-49	If jurisdictional nonstructural and structural strategies do not meet interim targets by interim load reduction goals, a subsurface detention/infiltration system at Bird Rock Elementary School and Bird Rock Park upon detailed site assessment.	Mission Bay WMA (Scripps)	Optional																	
CSD-50	If interim load reduction goals are not met and additional multiuse treatment areas are required, an infiltration basin(s) may be considered on publicly owned open spaces in canyon areas on a case-by-case basis when no other opportunities for load reductions exist.	Mission Bay WMA	Optional																	
Stream, Channel and Habitat Rehabilitation Projects																				
CSD-51	Day lighting Cudahy Creek.	Mission Bay WMA (East side of Mission Bay Park between the Park and Claremont)	Optional																	
CSD-52	Restoration of the riparian corridor under Genesee Avenue Bridge.	Mission Bay WMA (Rose Canyon)	Optional																	
CSD-53	If interim load reduction goals are not met and additional stream, channel, and habitat rehabilitation projects are required, implement as needed.	Areas identified during feasibility studies	Optional																	
Water Quality Improvement BMPs																				
Proprietary BMPs																				
CSD-54	Torrey Pines Golf Course Phase 1 (Project ID 1019)	Mission Bay WMA (Scripps)	Prior to FY16																	
CSD-55	Mt. Ashmun Drive (Project ID 1327)	Mission Bay WMA (Tecolote Creek)	Prior to FY16																	
Dry Weather Flow Separation and Treatment Projects																				
CSD-56	Dry-weather flow diversion	Mission Bay WMA (Scripps)	2014																	
CSD-57	Dry-weather flow diversion	Mission Bay WMA (Scripps)	2014																	
CSD-58	Dry-weather flow diversion	Mission Bay WMA (Scripps)	2014																	
CSD-59	Dry-weather flow diversion	Mission Bay WMA (Scripps)	2014																	
CSD-60	Dry-weather flow diversion	Mission Bay WMA (Scripps)	2015																	

ID	Strategy	Location	Implementation or Construction Year Start	FY 15 and Earlier	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31
CSD-61	Dry-weather flow diversion	Mission Bay WMA (Tecolote Creek)	Optional	If triggered, begin planning (acquire funding and resources, conduct site feasibility analysis and site selection) to implement dry weather flow separation projects.																
CSD-62	If interim load reduction goals are not met and additional dry weather flow separation and treatment projects are required, implement as needed.	Downstream reaches where persistent dry weather flows have been observed	Optional	If triggered, begin planning (acquire funding and resources, conduct site feasibility analysis and site selection) to implement dry weather flow separation projects.																
Trash Segregation																				
CSD-63	If interim load reduction goals are not met and additional trash segregation projects are required, implement as needed.	High-loading areas city-wide	Optional	If triggered, begin planning (acquire funding and resources, conduct site feasibility analysis and site selection) to implement trash segregation projects.																

J.2 Caltrans Strategies

Caltrans' jurisdiction areas include roadways, land adjacent to roadways, and facilities; Caltrans' jurisdictional strategies specifically focus on BMP implementation to reduce known pollutants within these areas. Caltrans is not permitted within the MS4 Permit; however, Caltrans is subject to similar requirements through its MS4 Permit (SWRCB, 2013). Though not permitted within the MS4 permit, Caltrans has voluntarily contributed to the Water Quality Improvement Plan effort to provide a consistent and subwatershed-wide approach to meeting applicable TMDL requirements. Caltrans voluntary contributions include a detailed list of strategies developed and provided in Table J-4 below. The strategies and schedules presented in Table J-4 are subject to change and are contingent upon annual budget approvals and funding availability. They will be modified through the adaptive management process as needed.

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Table J-4
Caltrans Jurisdictional Strategies

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
Jurisdictional Strategies						
<i>Design Stormwater Program</i>						
CT-1	Update and implement design BMPs.	Office of Stormwater Management Design (OSWMD) develops, evaluates, and enhances guidance documents and tools. Refer to Landscape Architecture Program (LAP).	Jurisdiction-wide	FY16	Ongoing	HQ (OSWMD)
CT-1.1	Update and implement Landscape Architecture Program (LAP).	LAP provides technical assistance on new and ongoing research related to permanent erosion control and permanent BMPs. In addition, the LAP develops methods to enhance roadside vegetation, which protects slopes from erosion and sediment loss, and may remove pollutants from stormwater runoff.	Jurisdiction-wide	FY16	As needed	HQ (OSWMD)
CT-1.2	Implement native landscape/LID Design Guide Strategy.	Require native landscaping/LID in stormwater data report and project plan design guide. Done as part of erosion control. The Project Planning and Design Guide (PPDG) include an online training program. Projects go through the same review process for native landscape reviews. If project is greater than an acre, subject to a stormwater data report. Minor projects are not subject to as extensive reviews. Try to treat 100% of roadway.	Jurisdiction-wide	FY16	Ongoing	District 11 with HQ (OSWMD)
CT-2	Train staff on Design Stormwater Program.	Train staff on Design Stormwater Program. Curriculum updated to reflect the latest strategies.	Jurisdiction-wide	FY16	Ongoing	District 11
CT-3	Plan and implement treatment BMPs as appropriate.	Treatment BMPs are planned and implemented to comply with Caltrans NPDES Permit project development requirements, TMDL waste load allocations, location specific requirements, and the requirements in the Project Planning and Design Guide (PPDG) according to the Targeted Design Constituent (TDC) approach. The treatment BMP consideration process favors infiltration of stormwater and directs staff to evaluate LID strategies first.	Jurisdiction-wide	FY16	Ongoing	District 11 NPDES and Design with HQ (OSWMD)
CT-4	Develop procedures to encourage mitigation for projects within the same watershed.	Caltrans will investigate procedures to mitigate within the same watershed as new projects.	Jurisdiction-wide	FY16	Ongoing and As needed	District 11 NPDES and Stewardship
CT-5	Implement a self-audit program to ensure BMPs are designed, implemented, and maintained.	Design Compliance Monitoring Program is a self-audit program that uses the SWDR (Stormwater Data Report) as a tool for documenting compliance with the design pollution prevention and treatment BMP requirements of the 1999 NPDES Permit, 2012 NPDES Permit, and the Caltrans' 2003 Statewide SWMP. The SWDR and its checklists are reviewed by District staff to ensure that BMPs are being considered and appropriately incorporated into Caltrans' projects. This review also ensures stormwater compliance throughout the project planning and design phases.	Jurisdiction-wide	FY16	Ongoing	District 11 NPDES
Construction Management						
CT-6	Administer a program to oversee implementation of BMPs during the construction phase of Caltrans projects. Includes inspections at an appropriate frequency and enforcement of requirements.	Caltrans complies with the statewide Construction General Permit. The district holds pre-construction meetings for all projects that require a SWPPP. For larger projects, there are year-round, weekly inspections.	Jurisdiction-wide	FY16	Ongoing	District 11 with the Division of Construction

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CT-7	Construction stormwater training for District staff.	Continue implementation of the construction stormwater classes offered throughout the Caltrans districts by the Division of Construction. Classes updated to reflect latest permit requirements.	Jurisdiction-wide	FY16	Ongoing	District 11 with the Division of Construction
CT-8	Implement a self-audit program to ensure compliance with water quality requirements.	Continue implementation of the Construction Compliance Evaluation Plan. Evaluates contractor's SWPPP or WPCP implementation and assesses compliance with water quality requirements, evaluates stormwater contract administration, and incorporates quality control, quality assurance, and independent assurance elements.	Jurisdiction-wide	FY16	Ongoing	District 11 NPDES
CT-9	Maintenance training for employees.	The Division of Maintenance has formal stormwater management training sessions for new employees and refresher training for existing staff. Both types of courses are scheduled from one to 15 hours in length. In addition to formal training, Division of Maintenance policy is that Supervisors conduct stormwater BMP tailgate meetings a minimum of every 10 working days or when there is a change in the type of work activity. These meetings are to review BMPs prior to conducting roadside maintenance activities.	Jurisdiction-wide	FY16	Ongoing	District 11 with Division of Maintenance
CT-10	Administer a program to require implementation of minimum BMPs for facilities and leased space (air space leases).	Refer to SWMP. Leased space is required to meet current stormwater regulations.	Jurisdiction-wide	FY16	Ongoing	District 11 with ROW Dept.
CT-11	Inspection of facilities and leased areas.	The Department will continue to reduce the potential for storm water pollution by the development and implementation of Facility Pollution Prevention Plans (FPPPs), which specify controls to minimize contact between storm water and the various substances at highway maintenance facilities. Per Maintenance Manual Vol.2 under F Family, periodic inspections are conducted to evaluate whether the BMPs are adequate and properly implemented. The SWMP states this provision regarding FPPP. <i>Maintenance Facility Pollution Prevention Plans. Facility Pollution Prevention Plans (FPPP) has been developed for each maintenance facility owned or operated by the Department. The FPPPs describe the activities conducted at the facility and the BMPs to be implemented to reduce the discharge of pollutants in storm water runoff from these facilities. Supervisor's inspect their maintenance facilities monthly to monitor the implementation and adequacy of the BMPs. A report that includes the date of the inspection, the name of the inspector, observations, and recommended corrective actions is prepared by the Supervisor. All inspection records will be maintained for a period of 3 years. Any observed instances of non-compliance will be reported to the District Maintenance.</i>	Jurisdiction-wide	FY16	Ongoing	District 11 with ROW Dept.
CT-12	Implement BMPs targeting reduction of over-irrigation.	Reduce over irrigation by requiring native, drought tolerant plants and irrigation system improvements.	Jurisdiction-wide	FY16	Ongoing	District 11 Landscape and Stewardship
CT-13	Proactively monitor for erosion, and complete repair and slope stabilization.	Division of Maintenance conducts inspections on a five-year cycle. Program includes self-imposed goal to annually inspect approximately 20% of slopes in each District and includes investigating public complaints and widely understood problem areas (WUPAs).	Jurisdiction-wide	FY16	Ongoing	District 11 with Division of Maintenance

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
MS4 Infrastructure						
CT-14	Inspect and clean catch basins and conduct source investigations to identify upstream source of materials.	Inspect catch basins once every three years with 1/3 inspected per year. If needed, catch basins are cleaned. If a catch basin is cleaned, a source inspection is conducted to identify source of sediment or other material.	Jurisdiction-wide	FY16	Ongoing	District 11 with Division of Maintenance
CT-15	Proactively repair and replace MS4 components to provide source control from MS4 infrastructure.	Prioritize MS4 repairs. Funding for repairs based on size of project. Districts are able to conduct small repairs immediately, while larger projects are prioritized for repair out of annual budget.	Jurisdiction-wide	FY16	Ongoing	District 11 with Division of Maintenance
Roads and Streets						
CT-16	Implement operation and maintenance activities on streets and roadways.	Refer to Work Plan.	Jurisdiction-wide	FY16	Ongoing	District 11 with Division of Maintenance
CT-16.1	Implement street sweeping.	Every road swept once a month. To meet performance schedule, street sweepers are replaced on a four-year cycle.	Jurisdiction-wide	FY16	Ongoing	District 11 with Division of Maintenance
CT-16.2	Perform sweeping of medians on high-volume arterial roadways.	Medians with shoulders are swept approximately once per month.	Jurisdiction-wide	FY16	Ongoing	District 11 with Division of Maintenance
Pesticide, Herbicides, and Fertilizer BMP Program						
CT-17	Implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers.	Refer to Vegetation Control Plan. Caltrans is actively reducing fertilizer/pesticide application and only applies to targeted areas. All pesticide use is reported to the California Department of Pesticide Regulation.	Jurisdiction-wide	FY16	Ongoing	District 11 with Roadside Maintenance Office and California DPR
Illicit Connections/Illegal Discharges						
CT-18	Identify and resolve potential illicit connections/illegal discharges (IC/IDs).	Continue maintaining a hotline for reporting of illicit discharges. Majority of calls come from contractors and construction and maintenance staff. Continue coordination with other jurisdictions to address IC/IDs and provide written notification of potential IC/IDs associated with a municipality's jurisdiction.	Jurisdiction-wide	FY16	Ongoing	District 11 with other jurisdictions
CT-19	Identify erosion and slope stabilization issues on private or municipal property and inform the source for repair.	When Caltrans staff or contractors identify erosion or slopes in need of repair, it is treated as an IC/ID and the property owner is notified.	Jurisdiction-wide	FY16	Ongoing	District 11 with Division of Maintenance
Public Education and Participation						
CT-20	Implement a public education and participation program to raise awareness of stormwater pollution and prevention on California's freeways and highways.	Continue to implement the "Don't Trash California" Campaign, Adopt-A-Highway program, and partner with local organizations.	Jurisdiction-wide	FY16	Ongoing	District 11 with HQ (OSWMD)
CT-20.1	Conduct trash cleanups.	Conduct trash cleanups through local probation and adopt-a-highway programs. Encourage prevention through "Don't Trash California" campaign.	Jurisdiction-wide	FY16	Ongoing	District 11 Division of Maintenance
CT-20.2	Target school-based education and outreach.	Provide outreach to schools raising awareness of stormwater pollution through watershed model demonstrations. Hold bring-your-child-to-work days with watershed model.	Jurisdiction-wide	FY16	Ongoing	District 11 with HQ (OSWMD)
Other Nonstructural Strategies						
CT-21	To provide sanitation and trash management, implement access control in targeted areas.	As necessary, implement methods such as rip-rap, chain link fences, and remove low-lying brush to discourage use of right-of-way areas.	Jurisdiction-wide	FY16	Ongoing	District 11 NPDES, Design and Maintenance
CT-22	Continue participating in source reduction initiatives.	Continue participation in Brake Pad Partnership through work with California Stormwater Quality Association.	Jurisdiction-wide	FY16	Ongoing	HQ with CASQA

ID	Strategy	Implementation Approach	Location	Implementation or Construction Year	Frequency of Implementation	Responsible City Department and Other Collaborating Departments or Agencies
CT-23	Removal of invasive plants.	Removal of invasive plants through maintenance and construction programs.	Jurisdiction-wide	FY16	Ongoing	District 11 with Division of Maintenance
CT-24	Protect areas that are functioning naturally.	Required as part of the stormwater data report (SWDR), the Project Planning and Design Guide (PPDG), and the Natural Environment as Treatment (NEAT) programs, Caltrans minimizes disturbance of existing vegetation and avoids hardscapes.	Jurisdiction-wide	TBD	As available	District 11 with HQ (OSWMD)
CT-25	Collaborate with Responsible Agencies on Water Quality Improvement Plans.	Voluntarily participate in the development of the Water Quality Improvement Plan and continue to collaborate with RAs on water quality planning and implementation projects.	Jurisdiction-wide	FY16	Ongoing	District 11

APPENDIX K

Strategy Selection and Compliance Analysis

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APPENDIX K. STRATEGY SELECTION AND COMPLIANCE ANALYSIS

This appendix details the basis for strategy selection and prioritization, implementation assumptions used to estimate strategy effectiveness within the simulation models, and the results of the modeling efforts including anticipated load reductions by strategy, subwatershed, jurisdiction, and pollutant. Figure K-1 provides a conceptual model of the quantification of benefits from the strategies represented in the model and discussed within this appendix. Section 4 of the Water Quality Improvement Plan provides a summary by jurisdiction of selected strategies, and Appendix J provides the schedule for implementation by jurisdiction.

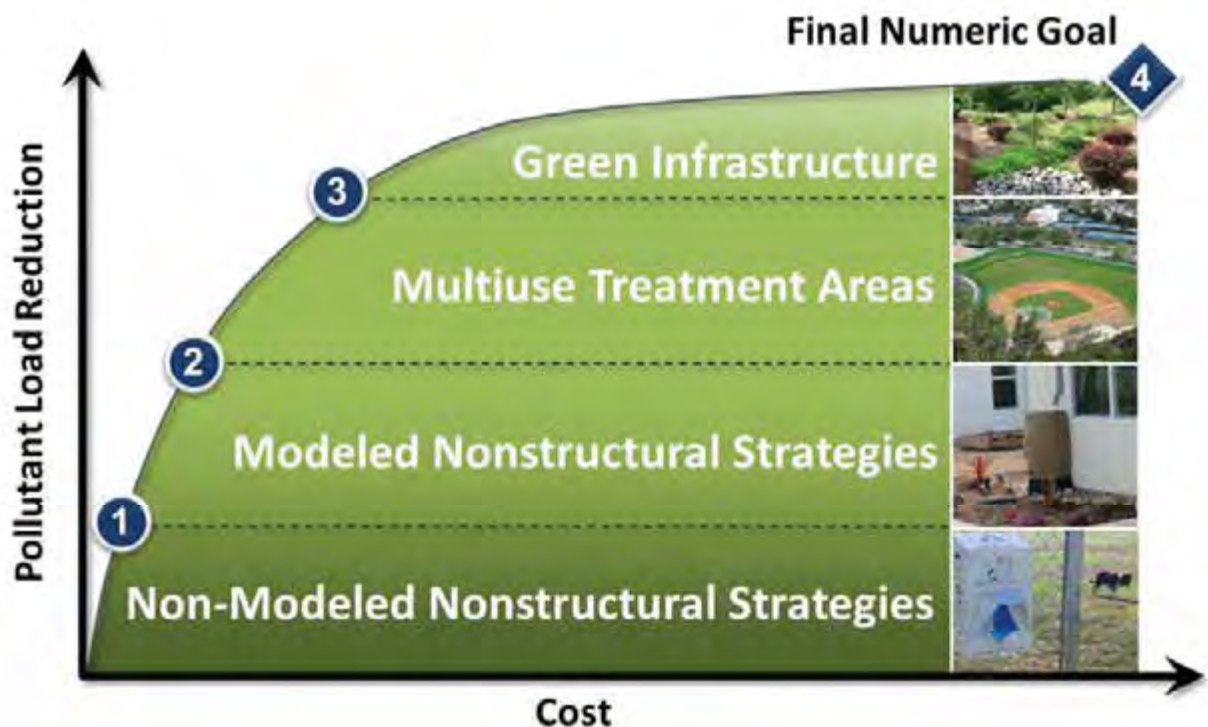


Figure K-1
Conceptual Diagram Illustrating BMP Implementation
(Not to Scale)

Strategies were selected based on their ability to effectively and efficiently eliminate non-storm water discharges to the MS4, reduce pollutants in storm water discharges in the MS4 to the maximum extent practicable (MEP), and achieve the interim and final numeric goals. Efficiency in pollutant reduction is based on identifying the known and suspected areas or sources likely contributing to the highest priority water quality condition and targeting those sources. To assist in the geographical identification of sources, watershed modeling and GIS tools were used to estimate the relative bacteria loading within the Tecolote Creek and Scripps subwatersheds, land ownership and availability of public land

for implementation, and physical watershed characters such as slope and soil types for BMP selection.

Section K.1 presents the relative, estimated bacteria loading by drainage area in Tecolote Creek and Scripps subwatersheds. The relative loading results can assist Responsible Agencies in selecting locations to focus nonstructural and structural strategies within subwatersheds. Section K.2 provides additional detail on nonstructural strategy selection and implementation. Many of the nonstructural strategies overlap with administrative programs. Responsible Agencies may utilize the relative loading results to target application of administrative programs, such as street sweeping, rebate programs or education and outreach programs, in high priority areas. Specific load reductions for select nonstructural programs or activities that had a sufficient amount of data collected to estimate load reductions were modeled. Modeling assumptions for those activities are also presented in Section K.2. Section K.3 provides additional detail on structural strategy selection and implementation. Additional factors to the relative loading analysis were considered in the selection of structural BMPs, such as parcel ownership, slope, and soil type. These additional factors generally have a greater influence on site selection for structural BMPs than just the relative loading by area. They also play an important role in determining the costs for implementation of structural BMPs and affect the cost-efficiency results. The structural BMP modeling assumptions are also provided in this section. Finally, Section K.4 provides a summary of the expected, cumulative load reductions estimated from the suite of strategies selected. A summary of the modeling assumptions used in the projection and the cost-effectiveness assessments are provided.

K.1 Prioritization of Bacteria-Loading Areas

The MS4 Permit requires the identification of known and suspected areas or sources causing or contributing to the highest priority water quality condition within the following Responsible Agency inventories: MS4 outfall, priority development project, construction site, and existing development. The bacteria-generating activities within the WMA were identified in Section 3. To identify potential geographic areas where bacteria-generating activities are contributing to watershed load, subwatersheds delineated in a recent modeling effort were prioritized based on modeled bacteria loading results (City of San Diego, 2012a, 2013a, and City of San Diego and Caltrans 2012b, 2013b).

Modeling was conducted using the Loading Simulation Program in C++ (LSPC) watershed model (Shen et al. 2004; Tetra Tech and USEPA 2002), which estimated bacteria loading based on physical watershed characteristics (e.g., slope, soil types, precipitation zones) and land use-based runoff parameters. LSPC was calibrated to available flow and water quality data measurements in the receiving waters, which incorporate the effects of existing pollutant sources and current management actions upstream of the calibration points. The final calibrated model represents a simulation of baseline existing conditions for Water Year 2003 (which represents typical wet and dry weather conditions, based on an analysis of rainfall data over a 20-year time period) and recent land use data (using the San Diego Association of Governments 2009 data) in the Mission Bay WMA; any pollutant load reductions resulting from jurisdictional strategies

will be subsequently subtracted from the baseline conditions in the following sections to demonstrate progress towards meeting watershed load reduction goals.

The calibrated watershed models were used to prioritize subwatersheds within the Mission Bay WMA using a relative estimate of bacteria loading. All modeled bacteria results were averaged for both wet weather and dry weather and quintiles were established for each subwatershed and assigned to each pollutant. The individual quintiles scores (1–5) for *Enterococcus*, fecal coliform, and total coliform were averaged to create a dry composite bacteria pollutant loading score and a wet composite bacteria pollutant loading score. A score of 5 indicates that the subwatershed pollutant loading was in the top 20th percentile (high pollutant loading), whereas a score of 1 represents a subwatershed loading in the bottom 20th percentile (low pollutant loading). The overall composite water quality score (2–10) is the summation of the dry composite score (Figure K-2) and wet composite score (Figure K-3), which is shown in Figure K-4.

Areas that are expected to contribute the highest loading, and therefore suspected to have more sources, are darker, and areas that are less likely to contribute are lightly shaded. Subwatersheds with more development (western part of the WMA) are expected to contribute more bacteria than less developed, open space. The model simulates bacteria loading based on land use. Sources identified in Section 3 of the Water Quality Improvement Plan are generally associated with land use types, but are not explicitly represented in this prioritization. For example, sources such as episodic sanitary sewer overflows are not explicitly included in the model, however residential areas or areas with general development do have a higher bacteria load associated than undeveloped areas. This prioritization is meant as a guideline for identification of geographic areas within which to investigate sources. Each responsible agency may have additional information to inform jurisdictional strategy implementation. Further analysis to determine the site suitability for structural strategies is discussed in Section K.3.

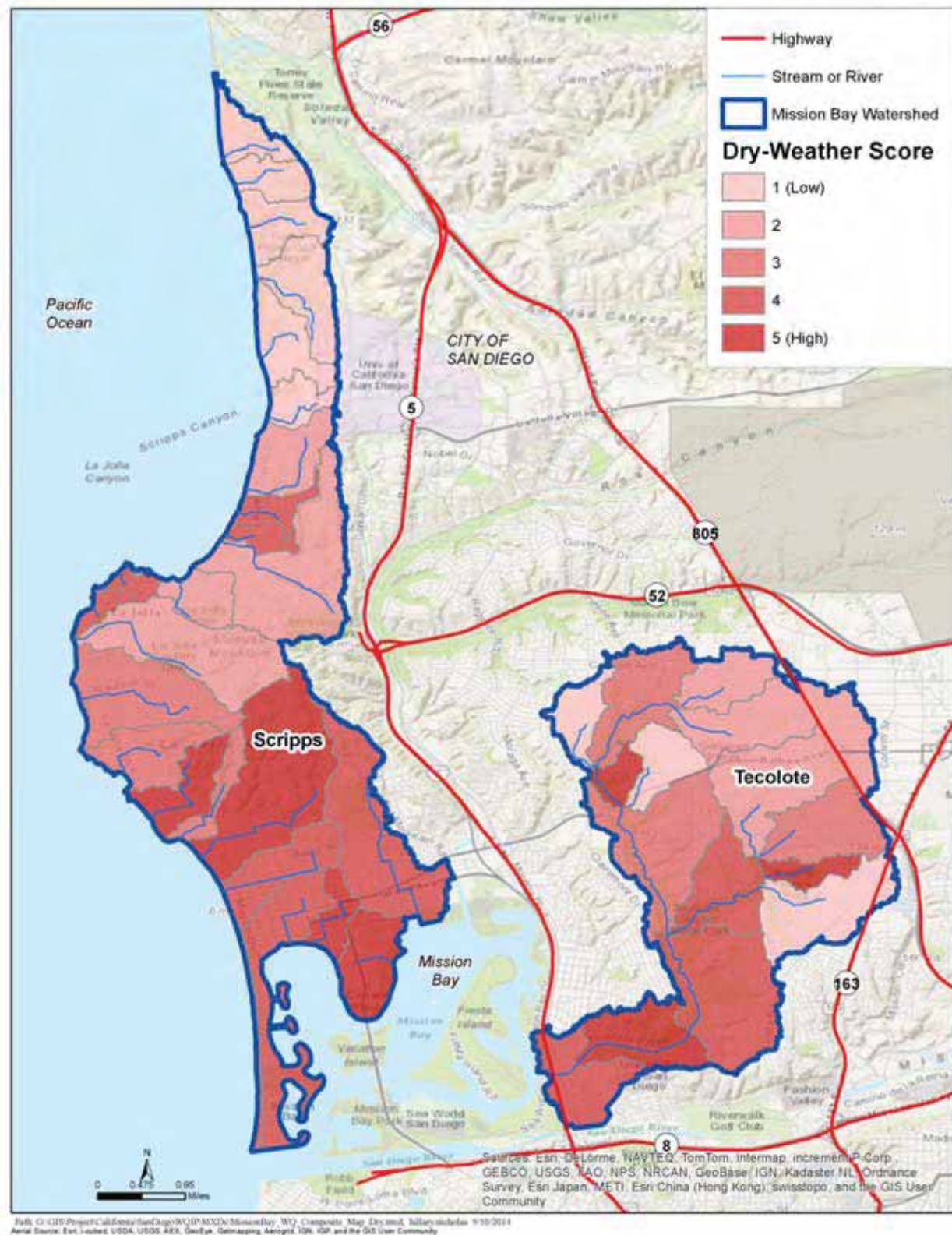


Figure K-2
Dry-Weather Water Quality Composite Score for Bacteria
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Wet-Weather Water Quality Composite Score for Bacteria

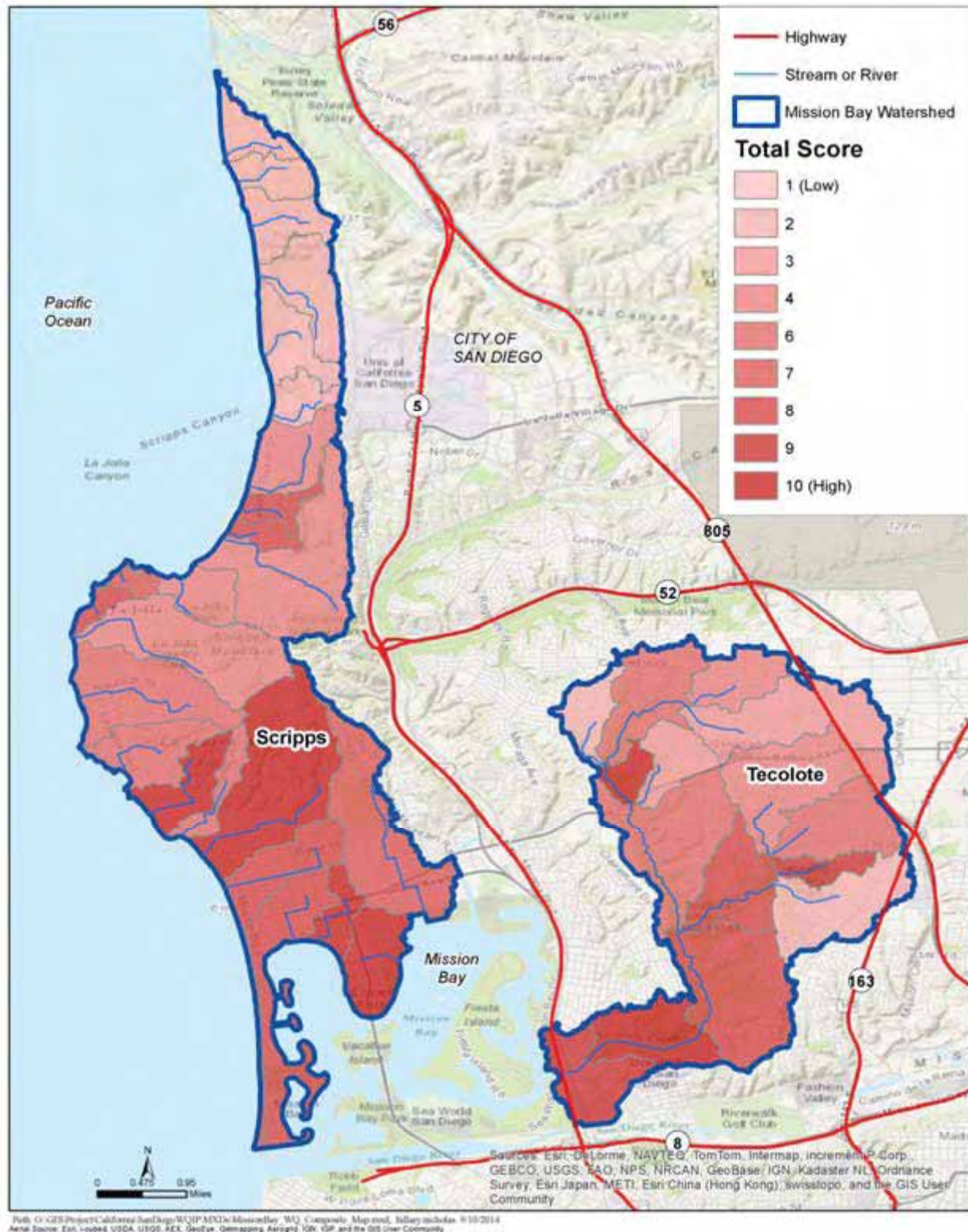


Figure K-4
Total Water Quality Composite Score for Bacteria

K.2 Nonstructural Strategies

To assist in the phased reduction of pollutant loads, various nonstructural strategies have been identified for implementation. Nonstructural reduction strategies are defined as those actions and activities that are intended to reduce storm water pollution and that do not involve construction or implementation of a physical structure to filter and treat storm water. These strategies are improvements of existing nonstructural programs, as well as implementation of new nonstructural best management practices (BMPs). Administrative policies, creation and enforcement of municipal ordinances, education and outreach programs, rebate and other incentive programs, and cooperation and collaboration with other WMA or regional partners are several examples of nonstructural strategies.

It is challenging to accurately quantify most nonstructural BMP benefits in terms of pollutant load reductions because it generally requires extensive survey and monitoring information. In addition, nonstructural BMPs may target pollutants, land uses, or populations, resulting in different load reductions depending on the implementation technique. The nonstructural strategies with sufficient data were modeled using LSPC to determine the pollutant load reductions from implementing these strategies. Pollutant load reductions from all strategies in this appendix are subtracted from loads simulated in the baseline model (discussed in the previous subsection) to quantify progress towards meeting the watershed numeric goals.

Estimated pollutant and flow reduction benefits from the non-modeled and modeled nonstructural BMPs provide the baseline from which additional reductions from structural BMPs will be achieved. Nonstructural BMPs are effective at reducing pollutant loads before they enter the storm drain and are generally cost-effective and require a shorter planning period; therefore, most nonstructural strategies are planned for implementation before or upon approval of the Water Quality Improvement Plan.

A summary of modeling assumptions used to quantify the load reduction potential from nonstructural strategies is provided in this section.

K.2.1 Non-Modeled, Nonstructural Strategy Assumptions

As previously stated, not all nonstructural strategies can be effectively modeled for load reductions due to their variable implementation, so these strategies are referred to as non-modeled nonstructural strategies. Since their benefits are not individually quantifiable, these strategies were assigned a conservative cumulative pollutant load reduction value of 10%, as shown in Figure K-5. Each of these non-modeled nonstructural strategies is described in further detail in the jurisdictional strategy tables in Section 4.



Figure K-5
Non-Modeled Nonstructural Strategies Load Reduction

As described in section 4.2.2.1 of the report, the 10 percent load reduction for non-modeled, nonstructural activities was estimated by averaging the range of measured and anticipated pollutant removal from the list of City of San Diego nonstructural strategies. Strategies were categorized as “high” percent removal, those with greater City control (operation and maintenance of MS4 infrastructure) or “low” percent removal, those requiring public behavior changes. The range of pollutant load reduction was as low as approximately 2 percent and as high as 72%. The overall average percent removal for all constituents and all activities is 10.1% (HDR, 2014).

K.2.2 Modeled Nonstructural Strategy Assumptions

Three of the nonstructural strategies selected for implementation in the Mission Bay WMA were modeled: Rain Barrels Incentive Program, Downspout Disconnection Incentive Program, and Irrigation Runoff Reduction Program. The following sections outline the nonstructural strategies that were modeled for the City of San Diego.

K.2.2.1 Rain Barrels Incentive Program

The City of San Diego Public Utilities Department currently operates a rebate program for customers who harvest rainwater, including with rain barrels and cistern-type devices. The goal of this program is to minimize pollutant loads to receiving waters by reducing the runoff volume and peak flow originating from rooftops. Rooftop runoff can be collected in rain barrels and retained for irrigation reuse or slowly released after a period of storage. Pollutant load is reduced by releasing captured runoff onto landscaped areas, where pollutants are removed by the natural processes of infiltration and evapotranspiration.

The City’s rain barrel rebate program is part of a larger landscape-based rebate program to promote and encourage implementation of specific BMPs for residential and commercial areas. The rain barrel rebate aspect of the program currently focuses on single-family residential landscapes, but it is intended to expand the program to multifamily and commercial areas. The landscape-based rebate program has a budget of

\$250,000 of annual funding to support rebate costs for all aspects of the program including rain barrels, downspout disconnects, micro-irrigation, and grass replacement. Of this rebate budget, it is anticipated that 10% of funds will support rain barrel rebates. In addition to staffing, the City anticipates an annual 4% increase to the annual rebate budget for this program to accommodate program expansion.

Treatment Process Model Overview

Figure K-6 illustrates rain barrel use to reduce runoff volume. As implementation of the rain barrel program grows, more rooftop runoff will be intercepted and temporarily stored in rain barrels. As a result, runoff volume and associated pollutant loads to receiving waters will also decrease. The effectiveness of a rain barrel program in reducing runoff volume is a function of the number of rain barrels installed. As the program encourages more rain barrel installations, reducing runoff volume further can be expected.

Simulating long-term rainfall and runoff processes in the LSPC will help determine the average rain barrel capture performance (runoff reduction) per rooftop drainage acre. Rain barrel modeling parameters are summarized in Table K-1.

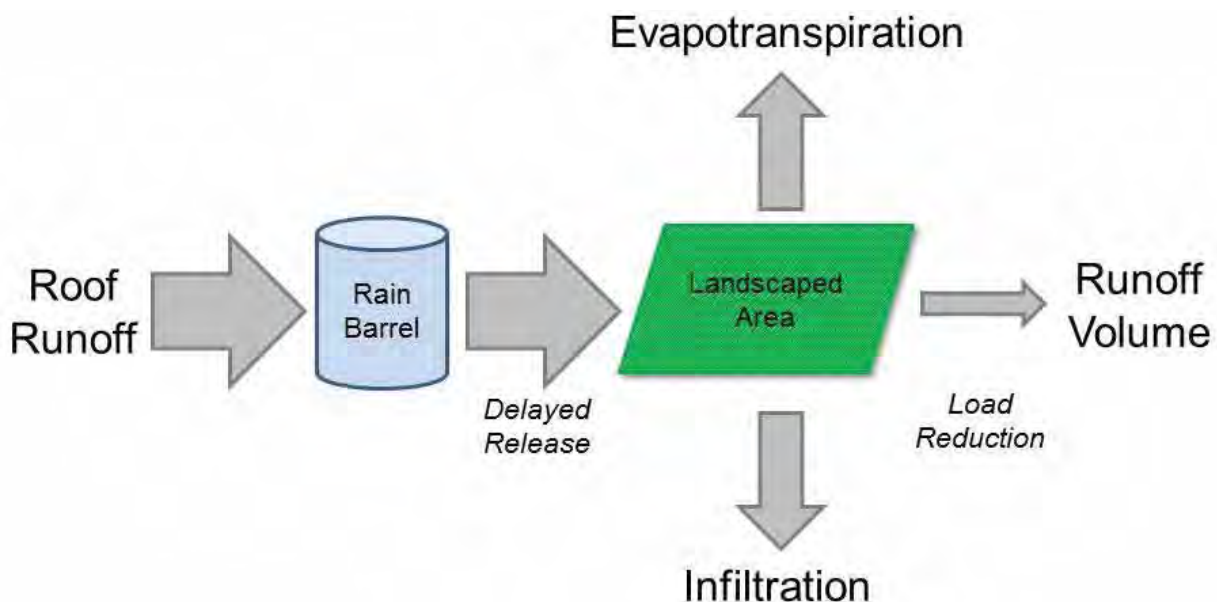


Figure K-6
Rain Barrel Treatment Process

Table K-1
Model Parameters for Rain Barrel Program Enhancements

Parameter	Value	Source
Contributing rooftop area to rain barrel in residential areas	500 square feet	City of San Diego
Rain barrel size (average)	65 gallons	City of San Diego
Primary outlet diameter (minimum)	0.5 inches	City of San Diego
Outlet pipe invert location	< 6 inches above bottom of barrel	City of San Diego
Overflow pipe diameter (minimum)	2 inches	City of San Diego
Maximum rain barrel outflow via 0.5-inch primary outlet	0.010 cubic feet per second	Orifice equation with depth = 2.5 feet
Rain barrel dewatering time	18 minutes	Typical value
Assumed soil infiltration rate at rain barrel discharge	0.03 inches per hour	Type D soil infiltration parameter range
Assumed potential evapotranspiration rate	1.43 inches per month	Minimum monthly value in San Diego region in 2012
Assumed potential evapotranspiration rate	0.002 inches per hour	Typical regional value
Assumed allowable ponding depth in landscaping area	0.75 inches	Typical regional value
Required landscaped area downstream of rain barrel discharge location to prevent rain barrel runoff	144 square feet	Typical regional value
Landscaped area dewatering time	23 hours	Typical regional value

Program Enhancements

To maximize the benefit of implementation and to improve the effectiveness of the current program, program enhancements are recommended. As presented in the CLRP Phase I and II reports (City of San Diego, 2012a and City of San Diego and Caltrans, 2012b), the recommended enhancements were determined based on rain barrel capture volumes and costs, potentially available single-family zoned parcels, available program budget, and discussions with City staff. Based on this information, it was estimated that 26 households and 20 households will take advantage of rain barrel rebates in the Scripps and Tecolote Creek watersheds, respectively. These figures are based on the single-family zoned parcels potentially available for implementation as well as input from City staff; see Table K-2.

Table K-2
Rain Barrel Program Enhancements

Annual Rain Barrel Implementation Metric	City of San Diego	
	Scripps Subwatershed	Tecolote Creek Subwatershed
Single-family zoned parcels (SFZPs)	20,150	15,760
SFZP percentage in City of San Diego	6.57%	5.14%
Rain barrel installations per year (based on number of rebates per year)	20	16

K.2.2.2 Downspout Disconnection Incentive Program

Downspout disconnections are a BMP alternative to reduce runoff volumes in highly impervious watersheds. The purpose of this cost-effective BMP is to disconnect downspouts from rooftop surfaces and reroute downspout runoff to pervious areas where natural processes such as storage, infiltration, and evapotranspiration can remove pollutants.

The City of San Diego has recently initiated a pilot downspout disconnection program in the Newport Avenue area of the Ocean Beach community. The pilot program has demonstrated the effectiveness of downspout disconnections in reducing pollutant loads in highly impervious areas.

As part of the City's larger landscape-based rebate program, implementation of downspout disconnections are encouraged in residential and commercial areas. The landscape-based rebate program has an annual budget of \$250,000 to support rebate costs for all aspects of the program. Of this rebate budget, it is anticipated that 10% of funds will support downspout disconnections in residential areas and 10% of funds will support downspout disconnections in commercial areas. In addition to staffing, the City anticipates an annual 4% increase to the annual rebate budget for this program to accommodate program expansion.

Treatment Process Model Overview

Downspout disconnection is modeled by routing roof runoff to pervious land surfaces where overland flow over a typical lawn can be simulated. As roof runoff flows over a pervious surface, such as a lawn, natural infiltrative and evapotranspiration processes occur, reducing runoff volume and removing pollutants.

An overview of downspout disconnection represented in LSPC is shown in Figure K-7.

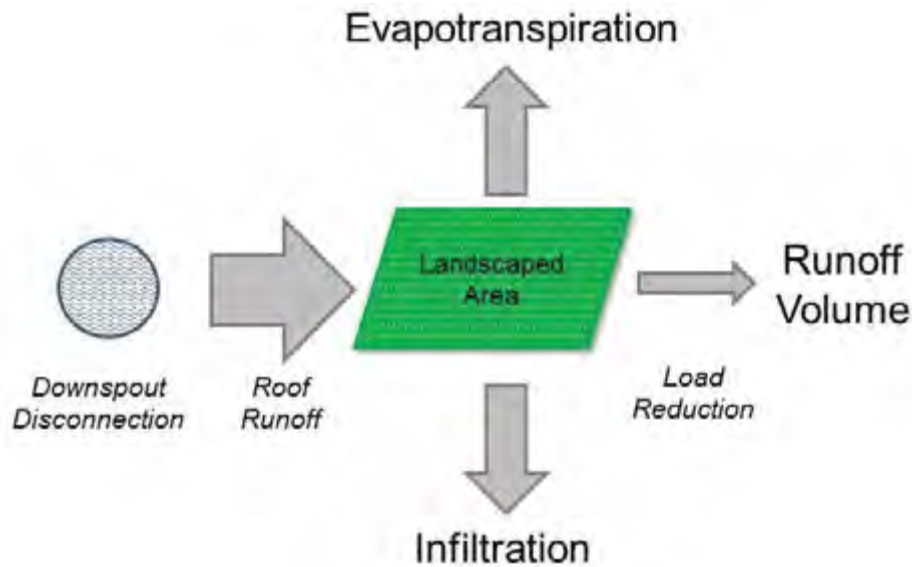


Figure K-7
Downspout Disconnection Treatment Process

Since the downspout disconnection program has recently been initiated, methods for improving runoff volume reduction through downspout disconnections are primarily additional facility installations. Because this program focuses on single-family residential areas, implementation is a function of available single-family zoned parcels in the subwatersheds. To estimate the number of anticipated downspout disconnection rebates in Mission Bay WMA and throughout the City of San Diego, single-family zoned parcels was used as a metric to determine the relative distribution of rebates. Assumptions regarding modeling parameters for downspout disconnections are summarized in Table K-3.

Table K-3
Model Parameters for Downspout Disconnection Program Enhancements

Parameter	Value	Source
Contributing rooftop area to rain barrel (residential areas/commercial areas)	500 square feet 3,600 square feet	Typical area
85th percentile flow to disconnection	0.001 cubic feet per second	Rainfall intensity = 0.2 inches/hour
85th percentile runoff volume to disconnections	10 cubic feet	P = 0.6 inches
Assumed soil infiltration rate at rain barrel discharge	0.03 inches per hour	Type D soil infiltration parameter range
Assumed potential evapotranspiration rate	1.43 inches per month	Minimum monthly value in San Diego region in 2012
Assumed potential evapotranspiration rate	0.002 inches per hour	Typical regional value
Assumed allowable ponding depth in landscaping area	0.75 inches	Typical regional value
Landscaped area dewatering time	23 hours	Typical regional value

Program Enhancements

Based on the available City budget for the program, the cost of installation, relative distribution of single-family zone parcels, and discussion with City staff, it is estimated that 42 and 33 single-family households will take advantage of downspout disconnection rebates in the Scripps subwatershed and Tecolote Creek subwatershed, respectively. Estimated program enhancements and potential single-family parcels for implementation are summarized in Table K-4.

Table K-4
Downspout Disconnection Program Enhancements

Annual Downspout Disconnection Implementation Metric	Scripps Subwatershed	Tecolote Creek Subwatershed
Single-family zoned parcels (SFZP)	20,147	15,759
SFZP percentage in City of San Diego	6.57%	5.14%
Downspout disconnection installations per year (based on number of rebates/year)	33	26

K.2.2.3 Irrigation Runoff Reduction Program

Reductions of irrigation runoff help meet reduction goals for runoff volume and associated pollutant loads. This nonstructural BMP, which doubles as a water conservation initiative, incorporates good landscaping practices to limit irrigation runoff. Measures to reduce

irrigation runoff can be implemented wherever landscapes are irrigated. Residential, commercial, recreational, and industrial land uses can be targeted by incentive policies and programs.

The City of San Diego Public Utilities Department currently operates a rebate program for various landscape-based practices. As part of this program, implementation of irrigation reduction runoff measures, such as micro-irrigation and grass replacement, are encouraged in residential and commercial areas. The landscape-based rebate program has an annual budget of \$250,000 to support rebate costs for all aspects of the program. Of this rebate budget, it is anticipated that 15% of funds will support micro-irrigation rebates in residential areas, 15% will support micro-irrigation rebates in commercial areas, 20% will support grass replacement rebates in residential, and 20% will support grass replacement rebates in commercial areas. In addition to staffing, the City anticipates an annual 4% increase to the annual rebate budget for this program to accommodate program expansion.

Treatment Process Model Overview

The irrigation runoff reduction program encourages three types of practices—grass replacement projects, micro-irrigation system conversions, and weather-based irrigation controllers—to reduce irrigation runoff. These practices reduce runoff by increasing the capacity of runoff infiltration, conserving water, and/or irrigating only as needed, based on weather and soil inputs. These practices, collectively, are modeled by adjusting (reducing) the extent of irrigated areas and adjusting how irrigation overspray is allocated between impervious and pervious land uses. To reduce irrigated runoff, the model simulates a combination of 25% less irrigated area and the elimination of overspray to impervious areas. As implementation of irrigation runoff reduction measures increase, runoff volume and associated pollutant loads to receiving waters decrease. Figure K-8 illustrates the irrigation reduction treatment process as represented in the LSPC model.

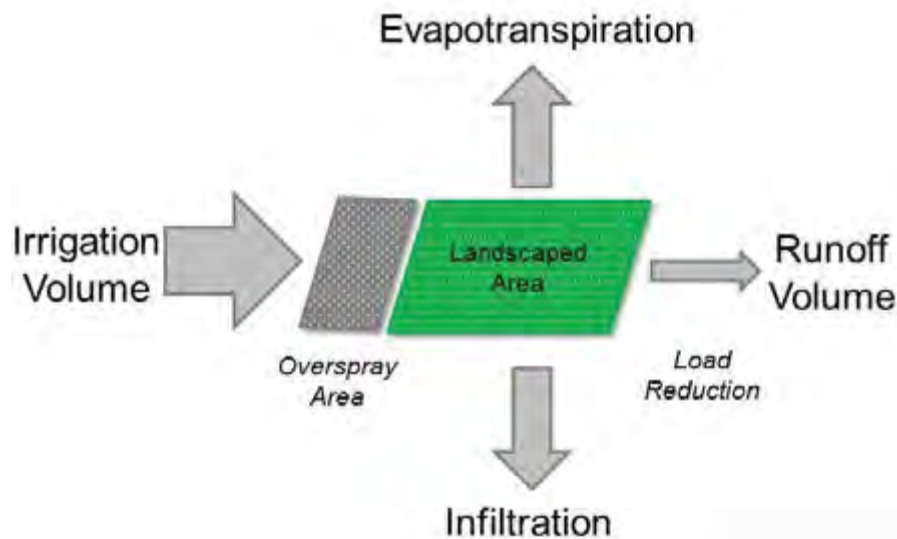


Figure K-8
Irrigation Reduction Treatment Process

Program Enhancements

Based on interviews with City staff and the diverse options and means of implementation in the irrigation runoff reduction program, the recommendation to enhance this program is not a specific action or strategy, but a targeted outcome of 25% irrigation runoff reduction. Regardless of the reduction method, it is recommended that the City reduce runoff from irrigation practices by 25%.

K.2.3 Nonstructural Modeling Results

In compliance with the Settlement Agreement and Release (Settlement) made with San Diegans for Open Government (SDOG) and Coastal Environmental Rights Foundation (CERF), City of San Diego will conduct either increased street sweeping or additional catch basin inspection and cleaning efforts near channel facilities as they are cleared.

Results of nonstructural strategy modeling of the Scripps subwatershed are summarized in Table K-5. Results of nonstructural strategy modeling of the Tecolote Creek subwatershed are summarized in Table K-6 for the City of San Diego.

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Table K-5
Nonstructural BMP Modeling Results for Scripps Subwatershed

Strategy and Level of Implementation ¹		City of San Diego Reduction—Scripps Subwatershed									
		Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc	Total Coliform
Wet Weather											
Nonstructural, non-modeled ³		10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
See Section 4.2.4											
Rain barrel installations		0.01%	<0.01%	0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%	0.01%	0.01%
Assume 20 households take advantage of rebates/year											
Downspout Disconnect		0.13%	0.04%	0.03%	0.05%	0.05%	0.08%	0.04%	0.04%	0.02%	0.02%
Assume 33 installations per year											
Irrigation reduction ⁴		<0.1%	2.4%	1.4%	0.4%	0.6%	0.1%	1.0%	2.5%	<0.1%	<0.1%
Eliminate irrigation overspray and reduce irrigation by 25%											
Total		10.1%	12.4%	11.5%	10.5%	10.6%	10.2%	11.0%	12.5%	10.0%	10.0%
		Goal/= 10.0%								Goal = 6.6%	Goal = 5.1%
Dry Weather											
Nonstructural, non-modeled ³		10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
See Section 4.2.4											
Irrigation reduction ⁴		99%	34%	25%	25%	25%	25%	24%	24%	99%	99%
Eliminate irrigation overspray and reduce irrigation by 25%											

Strategy and Level of Implementation ¹	City of San Diego Reduction—Scripps Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Entero	Total Coliform
	100% ⁵	44%	35%	35%	35%	35%	34%	34%	100% ⁵	100% ⁵
Goal= 99.0%	Goal= 99.9%								Goal = 99.8%	

Note: Orange-shaded cells indicate highest priority water quality conditions for the WMA.

- Note that these numbers are planning-level and calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the numeric goals outlined above at each respective project site.
- Limiting impairment for highest priority water quality condition.
- Nonstructural load reductions include both the modeled and non-modeled load reductions. Non-modeled load reductions are assumed to be 10% for all pollutants (HDR, 2014) and modeled load reductions vary by strategy and pollutant.
- Irrigation reduction strategies include the implementation of turf conversion projects, micro-irrigation system conversions, weather-based irrigation controllers, downspout disconnections, education and outreach, and enforcement of regulations that prohibit runoff. This strategy was only modeled to include surface contributions of bacteria on overspray areas. Non-highest priority water quality pollutants were not modeled.
- Mechanistic, process-based assumptions were not applied to non-modeled nonstructural BMPs, resulting in the cumulative dry weather load reductions exceeding 100% (this implies that the combination of strategies will be more than sufficient to achieve dry weather load reduction goals).

Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

Table K-6
Nonstructural BMP Modeling Results for Tecolote Creek Subwatershed

City of San Diego Reduction—Tecolote Creek Subwatershed											
Strategy and Level of Implementation ¹		Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Entero	Total Coliform
Wet Weather											
Nonstructural, non-modeled ³		10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
See Section 4.2.4											
Rain barrel installations		0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	<0.01%	<0.01%	0.01%	0.01%
Assume 16 households take advantage of rebates/year											
Downspout Disconnect		0.12%	0.04%	0.02%	0.04%	0.04%	0.07%	0.04%	0.04%	0.02%	0.02%
Assume 26 installations per year											
Irrigation reduction ⁴		<0.1%	1.6%	1.5%	0.3%	0.6%	0.1%	0.6%	1.6%	<0.1%	<0.1%
Eliminate irrigation overspray and reduce irrigation by 25%											
Total		10.1%	11.6%	11.5%	10.4%	10.6%	10.2%	10.6%	11.7%	10.0%	10.0%
		Goal= 17.9%								Goal= 11.8% ³	Goal= 10.0%
Dry Weather											
Nonstructural, non-modeled ³		10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
See Section 4.2.4											
Irrigation reduction ⁴		99%	32%	25%	25%	25%	25%	25%	25%	99%	99%
Eliminate irrigation overspray and reduce irrigation by 25%											

Strategy and Level of Implementation ¹	City of San Diego Reduction—Tecolote Creek Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enterococci	Total Coliform
	100% ⁵	42%	35%	35%	35%	35%	35%	35%	100% ⁵	100% ⁵
Total ⁴	Goal= 98.4%								Goal= 99.9%	Goal= 99.6%

Note: Orange-shaded cells indicate highest priority water quality conditions for the WMA.

- Note that these numbers are planning-level calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the numeric goals outlined above at each respective project site. Reported BMP sizes include projects that have already been implemented.
- Limiting impairment for highest priority water quality condition.
- Nonstructural load reductions include both the modeled and non-modeled load reductions. Non-modeled load reductions are assumed to be 10% for all pollutants (HDR, 2014) and modeled load reductions vary by strategy and pollutant.
- Irrigation reduction strategies include the implementation of turf conversion projects, micro-irrigation system conversions, weather-based irrigation controllers, downspout disconnections, education and outreach, and enforcement of regulations that prohibit runoff. This strategy was only modeled to include surface contributions of bacteria on overspray areas. Non-highest priority water quality pollutants were not modeled.
- Mechanistic, process-based assumptions were not applied to non-modeled nonstructural BMPs, resulting in the cumulative dry weather load reductions exceeding 100% (this implies that the combination of strategies will be more than sufficient to achieve dry weather load reduction goals).

Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

K.3 Structural Strategies

Structural strategies provide the opportunity to intercept runoff and filter, infiltrate, and treat stormwater. These structures tend to be more expensive than nonstructural strategies, but they also tend to have predictable and reliable effectiveness in removing pollutant loads. Additionally, structural strategies provide other multiuse benefits to the community, such as habitat, aesthetics, and recreational opportunities.

Three major categories of potential structural strategies were modeled in the Mission Bay WMA, using the LSPC and the System for Urban Stormwater Treatment and Analysis Integration model (SUSTAIN):

- Multiuse treatment areas
- Green infrastructure
- Water quality improvement BMPs

Section 4 describes these structural strategies in detail. This appendix summarizes representative BMP information for the three types of structural BMPs evaluated as part of this analysis.

K.3.1 Structural Strategy Modeling Assumptions

Structural strategies will be an important element of the overall Water Quality Improvement Plan compliance strategy. The following subsections describe the assumptions that were applied to model the structural BMPs.

K.3.1.1 Multiuse Treatment Areas

Large treatment structural BMPs (referred to as multiuse treatment areas) are regional facilities that receive flows from neighborhoods or larger areas, which often serve dual purposes—flood control and groundwater recharge. These BMPs are often located in public spaces and can be collocated within parks or green spaces; these strategies can provide excellent ecosystem services and aesthetic value to stakeholders. The first steps in evaluating potential multiuse treatment areas were primary site-selection screening and prioritization analysis, as shown in Figure K-9.



Figure K-9
Screening and Prioritization Methodology Concept

This analysis began by assessing parcels to screen out unsuitable site parameters for structural BMPs, such as steep slopes. These screened sites were then assessed for landscape characteristics, jurisdictional attributes, water quality needs, and general site sustainability to systematically evaluate and prioritize potential sites in each municipality throughout the WMA. Field investigations determined BMP feasibility and potential configuration; then the water quality and hydrology of the multiuse treatment areas were dynamically modeled. This subsection provides the process details and assumptions.

Screening and Prioritization Methodology

In 2009, the City of San Diego performed the *Parcel Evaluation for BMP Implementation Study* that provided a geographical information system (GIS) analysis and decision criteria for selecting parcels for BMP implementation in the City's jurisdiction. The study methodology was a starting point in developing the prioritization and screening process.

The process was further refined based on the experience of the Responsible Agencies and Tetra Tech, and based on CLRP Task 2 Pollutant Source Characterization data (City of San Diego, 2012a and City of San Diego and Caltrans, 2012b). The site-selection process identified parcels potentially suitable for BMP implementation using GIS-based analyses and the best available landscape and water quality data, as shown conceptually in Figure K-10.



Figure K-10
Parcel Screening Results

Site selection consisted of two major steps, including:

1. A primary screening to eliminate unsuitable parcels on the basis of physical and zoning characteristics; and
2. A separate site prioritization process for green infrastructure and multiuse treatment areas, to rank the suitability of the remaining parcels.

The primary screening for potential BMP opportunities was based on two parameters:

- ❖ **Parcel Zoning:** Parcels classified as single-family residential, based on the Nucleus Use Code attribute (a description of the use of the property provided by the county assessor), were not considered because of their average small size and the typically low cost-benefit ratio of implementing BMPs on single-family residential parcels. Research and experience nationally indicate that the runoff impacts of single-family parcels can be addressed more cost-effectively through outreach and education, or incentives for practices such as harvesting rainwater, improving irrigation, and converting turf and landscape.
- ❖ **Slope:** Parcels with a slope greater than 15 percent were not considered for BMP opportunities, other than parcels located in canyons. The screening was expanded to include areas in and around canyons for multiuse treatment areas. For this analysis, slope was determined on the basis of digital elevation maps or other

available topographic data sets. In areas where the overall slope of the parcel was in question, slope was verified through review of aerial imagery.

The results of the primary screening provided a base list of parcels potentially suitable for BMP implementation. A GIS analysis was performed on the remaining parcels to identify the potential sites for optional multiuse treatment area placement and to rank their potential suitability.

Potential sites were then prioritized on the basis of the parcel characteristics, plus additional considerations and different numerical criteria for multiuse treatment areas that were developed and reviewed in discussions with the Responsible Agencies. The additional considerations for identifying potential sites for multiuse treatment areas mainly regarded the use of open space and contributing watershed characteristics; see the following list.

- ❖ **Hydrologic Soil Group:** The mapped hydrologic soils groups are used as an initial estimate for the infiltration rate and storage capacity of the soils. Sites where mapped hydrologic soils groups have infiltration rates suitable for infiltration BMPs receive higher priority.
- ❖ **Proximity to Wells and Contaminated Soils:** Areas near contaminated sites received lower priority because of their potential for increased costs and complications during implementation.
- ❖ **Proximity to Environmentally Sensitive Areas (ESAs):** Areas where runoff can be treated before draining to an ESA were given a higher priority.
- ❖ **Parcel Percent Impervious:** Parcels with a large extent of existing open space tend to be more cost effective for BMP retrofits. Additionally, multiuse treatment areas can commonly be incorporated into existing recreational facilities to provide enhanced community benefits. Sites with a lower impervious coverage therefore received higher priority.
- ❖ **Parcel Size:** The size of the parcel was used to prioritize sites for multiuse treatment areas, with larger parcels receiving higher priority.
- ❖ **Proximity to Existing BMPs:** To distribute treatment opportunities effectively throughout the watershed, areas close to existing or planned future BMPs were given a lower priority.
- ❖ **Proximity to Parks and Schools:** Parks typically have the largest available open area and the lowest percentage of impervious area, and are well suited for multiuse treatment area implementation. Schools also tend to have large open areas, providing opportunities for BMP implementation. Areas classified as parks were given the highest priority, followed by schools. Other areas were given higher priority because of their opportunity for public outreach and education.
- ❖ **Proximity to the Storm Drainage Network:** Because multiuse treatment areas are especially effective where runoff can be diverted from the existing drainage

network for treatment and control, areas close to the storm drainage network received higher priority.

- ❖ **Contributing Area:** The size of the drainage area that could be diverted and treated at each potential site was evaluated, and areas that capture and effectively treat runoff from the largest drainage areas were given higher priority.
- ❖ **Impervious Coverage of Contributing Area:** During storms, contributing drainage areas with a higher percentage of imperviousness produce increased runoff relative to the watershed size. Drainage areas with higher imperviousness were targeted for greater potential volume reduction and water quality improvements
- ❖ **Proximity to Corrugated Metal Pipe Systems:** To incorporate future upgrades to the storm drainage network in the City of San Diego, the proximity to a corrugated metal pipe system is to be considered and ranked on the basis of the necessity for rehabilitation.

The advantage of this prioritization process is the ability to select BMP locations that are best suited for maximum cost-effectiveness, resulting in the greatest pollutant load reductions per dollar. Because structural BMPs at any scale involve identifying and setting aside land for stormwater treatment, assessing opportunities on existing publicly owned lands is especially important. Structural treatment often can be integrated into parks, playing fields, street rights-of-way, and medians without compromising function, so opportunities for incorporating BMPs in recreation areas, streets, and other public open spaces are typically prioritized and used as a first step in evaluating sites.

The agreed-upon weightings for each factor are listed in Table K-7.

As part of CLRP Phase I efforts, multiple desktop and field-screening exercises were completed to develop a full understanding of the opportunities that exist for multiuse treatment area implementation in this WMA (City of San Diego, 2012a and City of San Diego and Caltrans, 2012b). The sites were pared down and prioritized, based on feasibility, potential for pollutant load reduction, and other physical characteristics. The top-ranked sites in each hydrologic area for each Responsible Agency jurisdiction were identified then each was reviewed using aerial photography to assess the validity of the site. Sites that were potentially feasible per the aerial photography review were used to target parcels where field investigations would be conducted. On the basis of the field evaluations, the sites were ranked by implementation feasibility. Fact sheets were then composed to convey the design intent and potential configuration of each site.

Table K-7
Prioritization Criteria for Multiuse Treatment Area BMP Implementation
(Excluding Canyon Areas)

Factor	Score (1 = Worst; 5 = Best)				
	1	2	3	4	5
Parcel Type	All Others	All Private Commercial or Industrial Parcels	—	Other-Owned Public Parcels (Assigned a Priority Score of 8)	City or County Public Parcels (Assigned a Priority score of 10)
Hydrologic Soil Group	D	—	C	—	A, B
Proximity to Wells and Water Supplies, and Contaminated Soils (Feet)	< 100	—	> 100	—	—
Proximity to Environmental Sensitive Areas (ESAs)	—	—	—	Drains to	Adjacent
Parcel Percent Impervious	> 40	—	—	30–40	≤ 30
Parcel Size (Acres)	< 1	1–100	100–150	150–200	≥ 200
Proximity to Existing and Proposed BMP Site (Miles)	< 2	2–3	3–4	4–5	> 5
Proximity to Parks and Schools (Feet)	—	—	< 1,000	School	Park
Proximity to Storm Drainage Network (Feet)	> 300	< 300	< 100	—	—
Contributing Area (Acres)	< 50	> 50	> 100	> 150	> 250
Impervious Coverage of Contributing Area (%)	< 40	> 40	> 50	> 60	> 70
Proximity to Corrugated Metal Pipe (CMP) Systems	CMP requiring no action	—	CMP needing rehabilitation	—	CMP needing replacement

Note:

1. Schools and universities, state and federal facilities, and utilities

Model Representation

Each of the multiuse treatment area BMPs was represented directly in the LSPC using a storage-discharge relationship to simulate outflow and a background infiltration rate reflective of the underlying soils (as shown in Figure K-11). By incorporating these features directly into the LSPC, the dynamic effect on volume and water quality incorporates all of the spatial variability (land use distribution and precipitation time series) within the model.

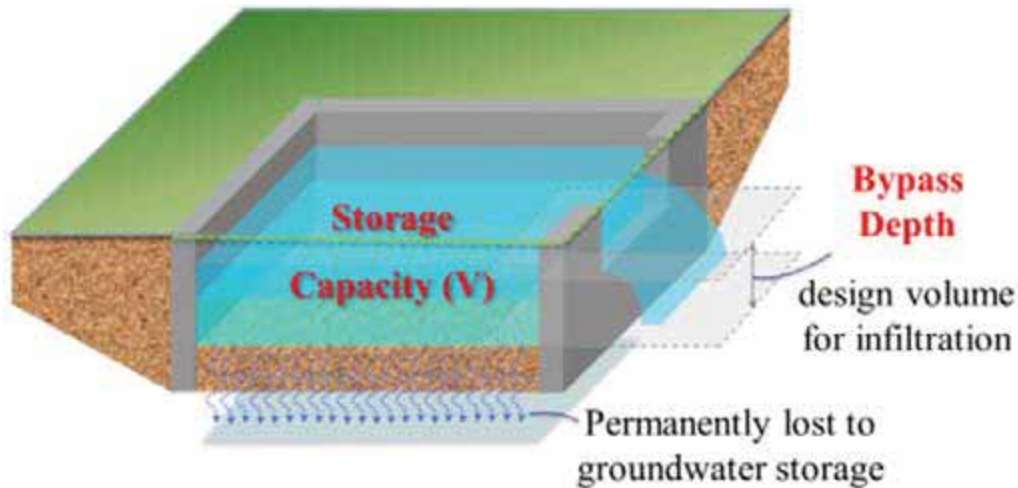


Figure K-11
Multiuse Treatment Area BMP Representation

The static storage volume of each optional multiuse treatment area was initially calculated as the required volume corresponding to the 85th percentile runoff depth, based on the average percent imperviousness in the upstream contributing drainage area (City of San Diego, 2008). The 85th percentile runoff depth was calculated uniquely for each multiuse treatment area, using the weather station assigned to the model subwatershed that includes each BMP. The storage volume and BMP dimensions were then verified and refined based on field reconnaissance to reflect realistic dimensions of the BMPs implemented at each unique location. Additionally, one already-implemented multiuse treatment area (Torrey Pines infiltration gallery) with known dimensions and drainage areas was also modeled.

Modeling Results

From previous site selection optimization analyses, approximately 3,200 parcels were screened for BMP opportunities in the Mission Bay WMA (2,690 parcels in the Scripps subwatershed and 502 parcels in the Tecolote Creek subwatershed). Nine multiuse treatment areas were identified during the screening and prioritization process, as listed in Table K-8 and displayed in Figure K-12.

Table K-8
Tabulation of Identified Potential Multiuse Treatment Areas in the Mission Bay WMA

Name of Multiuse Treatment Area¹	Subwatershed	Type of Best Management Practice (BMP)	Modeled Total Drainage Area (acres)	Modeled Storage Volume (acre-feet)
Torrey Pines Golf Course	Scripps	Infiltration Basin	3.7	0.43
Pacific Beach Elementary School	Scripps	Detention/ Infiltration Basin	213	3.9
La Jolla Community Park	Scripps	Detention/ Infiltration Basin	19	0.6
Bird Rock Elementary School and Bird Rock Park	Scripps	Detention/ Infiltration Basin	81	1.5
Mt. Everest Academy Elementary School	Tecolote Creek	Detention/ Infiltration Basin	21	0.7
John Muir School and Anderson School	Tecolote Creek	Detention/ Infiltration Basin	72	2.0
Tecolote Canyon Park	Tecolote Creek	Detention/ Infiltration Basin	6,032	18.0
James Madison High School	Tecolote Creek	Detention/ Infiltration Basin	97	2.7
Sam Snead All American Golf Course	Tecolote Creek	Wetland	5,642	34.2

Note:

1. Kellogg Park, an optional multiuse treatment area identified during the CLRP I efforts (City of San Diego, 2012a), was omitted from the Water Quality Improvement Plan as a multiuse treatment area BMP because green infrastructure BMPs have since been constructed at this location.

Source: City of San Diego, 2012a and City of San Diego

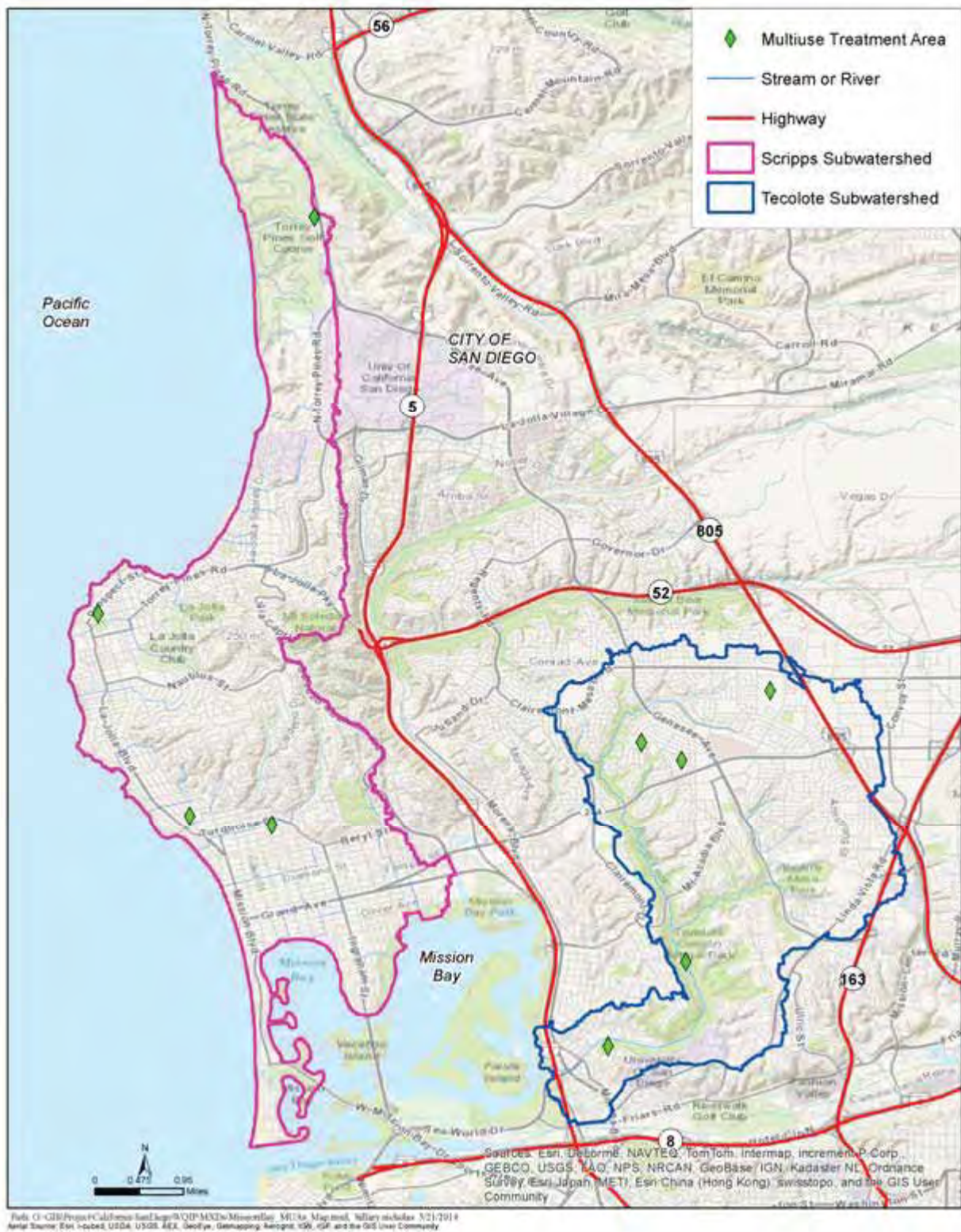


Figure K-12
Locations of Multiuse Treatment Area BMPs in the Mission Bay WMA

Tecolote Creek Subwatershed Modeling Results. The multiuse treatment area BMPs on public parcels incorporated in the Tecolote Creek model are mostly detention and infiltration facilities (see Table K-8). These features were largely located on soils with low infiltration capacities. Table K-9 summarizes the planning-level pollutant and flow reductions predicted for these facilities. All sites should be analyzed in detail to optimize their design and to maximize the subwatershed-wide load reductions.

Scripps Subwatershed Modeling Results. No optional multiuse treatment areas were incorporated into the Scripps model because the wet weather fecal coliform load reduction goal is attained by nonstructural strategies. However, as it has already been constructed, the multiuse treatment area at Torrey Pines golf course was modeled to demonstrate the City of San Diego's progress towards exceeding the load reduction goal. Table K-10 presents the modeled flow and load reductions attributed to the jurisdictional multiuse treatment area in the Scripps subwatershed.

Table K-9
Flow and Pollutant Load Reduction Attributed to Multiuse Treatment Areas
on Public Parcels in Tecolote Creek Subwatershed

Strategy and Level of Implementation ¹	City of San Diego Reduction—Tecolote Creek Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
Wet Weather										
Multiuse Treatment Areas: 20 acre BMP to treat a total drainage area of 11,864 acres with a total storage volume of 57.6 acre-feet	4.2%	1.1%	0.4%	0.5%	0.5%	0.5%	2.1%	1.1%	5.0%	4.1%
Dry Weather										
Multiuse Treatment Areas: 20 acre BMP to treat a total drainage area of 11,864 acres with a total storage volume of 57.6 acre-feet	96%	95%	96%	96%	96%	96%	96%	96%	96%	96%

Note:

1. Note that these numbers are planning-level values and calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the above numeric goals at each respective project site.
2. Orange-shaded cells indicate highest priority water quality conditions for the Mission Bay WMA.
Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

Table K-10
Flow and Pollutant Load Reduction Attributed to Already-Constructed Multiuse Treatment Areas on Public Parcels in Scripps Subwatershed

Strategy and Level of Implementation ¹	City of San Diego Reduction—Scripps Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment ²	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
Wet Weather										
Torrey Pines Golf Course: 0.11 acre BMP to treat a drainage area of 3.7 acres with a total storage volume of 0.43 acre-feet	0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.03%	0.02%
Dry Weather										
Torrey Pines Golf Course: 0.11 acre BMP to treat a drainage area of 3.7 acres with a total storage volume of 0.43 acre-feet	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.2%	0.2%

Note:

1. Note that these numbers are planning-level values and calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the above numeric goals at each respective project site.
2. Orange-shaded cells indicate highest priority water quality conditions for the Mission Bay WMA.
Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

K.3.1.2 Green Infrastructure

As with multiuse treatment areas, the first step in selecting the best potential new locations for green infrastructure BMPs (outside of the right-of-way) was a site-selection and prioritization analysis. This analysis follows the concept presented in Section K.3.1.1, with some modifications specific to green infrastructure practices. The following analyses evaluated opportunities for green infrastructure only outside of the right-of-way because modeling results predicted that green street implementation would not be required to meet water quality goals in the Mission Bay WMA. Green infrastructure on public parcels tends to be more cost-effective than green streets and provides many multiuse benefits.

Screening and Prioritization Methodology

The same primary screening criteria presented in Section K.3.1.1 for multiuse treatment areas were used to initially screen out potentially unsuitable parcels for green infrastructure, based on slopes and land ownership. The results of the primary screening provided a base list of parcels potentially suitable for BMP implementation. Then a GIS analysis was performed on the remaining parcels to identify the potential sites for green infrastructure BMP placement and to rank their potential suitability. The following characteristics were used in this ranking:

- ❖ **Pollutant Loading:** Parcels where estimated pollutant loadings are greatest were given a higher priority. Land-based pollutant loadings were obtained from the CLRP Task 2 Pollutant Source Characterization modeling results. Pollutant loading percentiles were determined on a watershed basis, and represent the average pollutant loading scores. A composite wet- and dry-weather areal loading score was developed for each applicable TMDL pollutant in each watershed.
- ❖ **Parcel Zoning and Ownership:** Land costs generally are minimized by using existing public lands; therefore, a higher priority was placed on publicly owned parcels.
- ❖ **Hydrologic Soil Groups:** The mapped hydrologic soils groups were used as an initial estimate of the infiltration rate and storage capacity of the soils. Sites where mapped hydrologic soils groups have infiltration rates suitable for infiltration BMPs received higher priority.
- ❖ **Wells, Water Supplies, and Contaminated Sites:** Areas near contaminated sites received lower priority because of their potential for increased costs and complications during implementation.
- ❖ **Environmentally Sensitive Areas:** Areas where runoff can be treated before draining to an ESA were given a higher priority.
- **Total Impervious Area:** Parcels with a larger total impervious area typically generate more runoff and greater pollutant loads, and so were given a higher priority. Where impervious data were not available, the impervious area was estimated using aerial imagery.

- ❖ **Percent Impervious:** Parcels with a higher percentage of impervious area also typically produce more runoff, and so were targeted on the basis of their greater potential to reduce volume and improve water quality.
- ❖ **Proximity to Existing BMPs:** To distribute treatment opportunities effectively throughout the watershed, areas close to existing or planned future BMPs were given a lower priority.
- ❖ **Proximity to Parks and Schools:** Areas closest to parks and schools were given a higher priority, in part to provide a greater opportunity for public outreach and education.
- ❖ **Proximity to the Storm Drainage Network:** Areas close to the storm drain network were given a higher priority. Green infrastructure BMPs on poorly draining soils require underdrain systems that tap into existing infrastructure, and siting these near the storm drain network can minimize cost.

Potential sites were prioritized using a scoring methodology developed in conjunction with the City and presented in Table K-11. This scoring methodology puts an equally high emphasis on municipal or public ownership and areas most affected by land-based pollutant loadings (combined wet and dry weather loading). Ownership and pollutant loading can achieve a maximum score of 10; the remaining scoring criteria can achieve a maximum score of 5. Therefore, this methodology not only prioritizes locations where green infrastructure BMPs are practicably feasible but allows for selecting BMPs in public parcels where the load reduction would be potentially most effective.

The top-ranked sites in each hydrologic or subwatershed area were also identified.

Table K-11
Prioritization Criteria for Potential Green Infrastructure BMP Locations

Factor	Score (1 = Worst; 5 = Best)				
	1	2	3	4	5
Wet Weather Areal Pollutant Loading	<20 th percentile	40-20 th percentile	60-40 th percentile	80-60 th percentile	>80 th percentile
Dry Weather Areal Pollutant Loading	<20 th percentile	40-20 th percentile	60-40 th percentile	80-60 th percentile	>80 th percentile
Parcel Zoning and Ownership	All Other Parcels	All Private Commercial or Industrial Parcels	—	Other-Owned Public Parcels: Priority Score of 8	City- or County-Owned Public Parcels and Rights-of-Way: Priority Score of 10
Hydrologic Soil Group	D	—	C	—	A, B
Proximity to Wells, Water Supplies, and Contaminated Soils (Feet)	< 100	—	> 100	—	—
Proximity to ESA (Optional)	—	—	—	Drains to	Adjacent to
Impervious Area (Acres)	—	> 0.1	> 0.25	> 0.5	> 1
Percentage Impervious	< 50	—	—	80–90	60–80
Proximity to Existing or Proposed BMP Site (Miles)	< 2	2–3	3–4	4–5	> 5
Proximity to Parks and Schools (Feet)	> 1,000	—	< 1,000	—	—
Proximity to Storm Drainage Network (Feet)	> 300	< 300	< 100	—	—

Note:

1. Schools and universities, state and federal facilities, utilities, etc.

Model Representation

Green infrastructure BMPs were simulated in the LSPC, using bioretention or permeable pavement features. These BMPs' runoff and pollutant loading boundary conditions were generated for the modeling framework and were selected for evaluation in consideration of their suitability in various site configurations and their multiuse benefits. The model represented green infrastructure BMPs using a set of (a) physical characteristics that describe the feature geometry and (b) process-based parameters that describe the mechanisms related to flow and pollutant transport, such as evapotranspiration, infiltration, and pollutant loss. Physically, both bioretention and pervious pavement were conceptualized as having three compartments: (a) surface storage, which provides volume for ponding, (b) soil media or aggregate substrate, and (c) an optional underdrain reservoir when required by background soil conditions. Both bioretention and permeable

pavement options were configured with and without underdrains, depending on the underlying soils. For instance, HSG B areas were modeled without underdrains and HSG C and D areas were modeled with underdrains.

These modeling parameters are outlined in Table K-12.

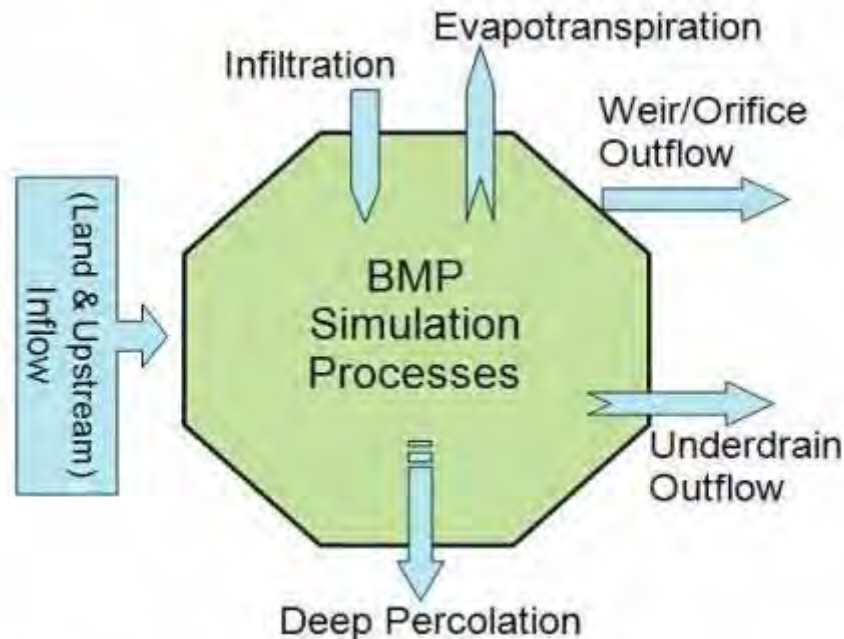
Table K-12
Detailed Model Representation for Green Infrastructure BMPs

Parameter	Bioretention	Permeable Pavement
Surface Parameters		
Unit size (square feet) (Varies with 85th percentile rainfall depth)	808–1,520	1,388–2,610
Design drainage area (acres)*	1	1
Substrate depth (feet)	3	2
Underdrain depth (feet)	None for B Soil; 1.5 for C, D Soil	None for B Soil; 1.5 for C, D Soil
Ponding depth (feet)	0.75	0.01
Subsurface Parameters		
Substrate layer porosity	0.4	0.4
Substrate layer field capacity	0.25	0.1
Substrate layer wilting point	0.1	0.05
Underdrain gravel layer porosity	0.4	0.4
Vegetative parameter, A	1	0
Monthly growth index	1	0
Background soil infiltration rate (in./hr.), f_c	B–0.8; C–0.2; D–0.01	B–0.8; C–0.2; D–0.01
Media final constant infiltration rate (inches per hour), f_c	2	2

The modeled BMPs incorporated a variety of pathways through which water and pollutants travel through the BMP (i.e., infiltration, evapotranspiration, weir overflow, and underdrain outflow). Figure K-13 is a schematic diagram of the soil media and underdrain components illustrating the related physical and process-based parameters. As discussed above, inflow from the land was represented using the time series from the LSPC.

While the model representation of permeable pavement is similar to that of bioretention, the two features are distinguished by a different set of physical and process-based

parameters that describe the function of infiltration, both through the aggregate media and into background soils. For example, the ponding depth of pervious pavement is physically much shallower than that of bioretention, because, in practice, stormwater would not be allowed to accumulate on the paved surface. Also, because permeable pavement is not vegetated, its potential for evapotranspiration is also greatly diminished as compared to that of bioretention.



Source: Lee et al., 2012

Figure K-13
Conceptual Diagram of Selected Processes Associated with Structural BMPs

Green infrastructure BMPs were modeled in CLRP Phase II by assuming that BMPs were sized to capture the 85th percentile runoff volume from each suitable public parcel in each subwatershed (City of San Diego 2013a, and City of San Diego. Additionally, the City of San Diego is demonstrating progress towards reducing fecal coliform loads through a number of green infrastructure BMP projects that have already been implemented. Those green infrastructure projects (identified in Table K-13) were modeled with project-specific details to consider the water quality benefits provided by these practices.

Table K-13
Tabulation of Identified Mission Bay
Green Infrastructure Projects Already Implemented

Green Infrastructure	Subwatershed	Best Management Practice Type	Drainage Area (acres)	BMP Footprint (acres)
Kellogg Park Green Lot	Scripps	Permeable Pavement and Bioretention	8.9	0.6
Mt. Abernathy and Camber Green Infiltration BMP	Tecolote Creek	Green Street	19.6	0.06
Bannock Avenue Green Street	Tecolote Creek	Green Street	65	0.47

For the Scripps subwatershed, only those green infrastructure projects that were already implemented were considered because water quality goals are achieved by nonstructural strategies.

Modeling Results

The screening and prioritization process identified the potentially suitable parcels for optional green infrastructure implementation in the Mission Bay WMA, as shown in Figure K-14. Although not all optional opportunities are needed to meet water quality goals, these prioritized parcels provide opportunities for future green infrastructure projects if future adaptive management exercises reveal that the strategies identified in the Water Quality Improvement Plan require augmentation.

Tecolote Creek Subwatershed. The modeled quantities of green infrastructure that were predicted (in addition to nonstructural strategies and multiuse treatment areas) to meet the fecal coliform wet weather load reductions are listed in Table K-14. These BMPs should be applied throughout each modeled subwatershed, based on the list of prioritized parcels identified during CLRP I efforts (City of San Diego and Caltrans, 2012b) and shown in Figure K-15.

Table K-15 presents the modeled flow and pollutant load reduction attributed to implementation of green infrastructure BMPs by the City of San Diego in the Tecolote Creek subwatershed.

Table K-16 presents the additional modeled flow and pollutant load reduction (above and beyond reductions predicted for nonstructural and multiuse treatment area strategies) attributed to the implementation of green infrastructure BMPs in the Scripps subwatershed.



Figure K-14
High-Ranked Locations
of Optional Green Infrastructure Best Management Practices

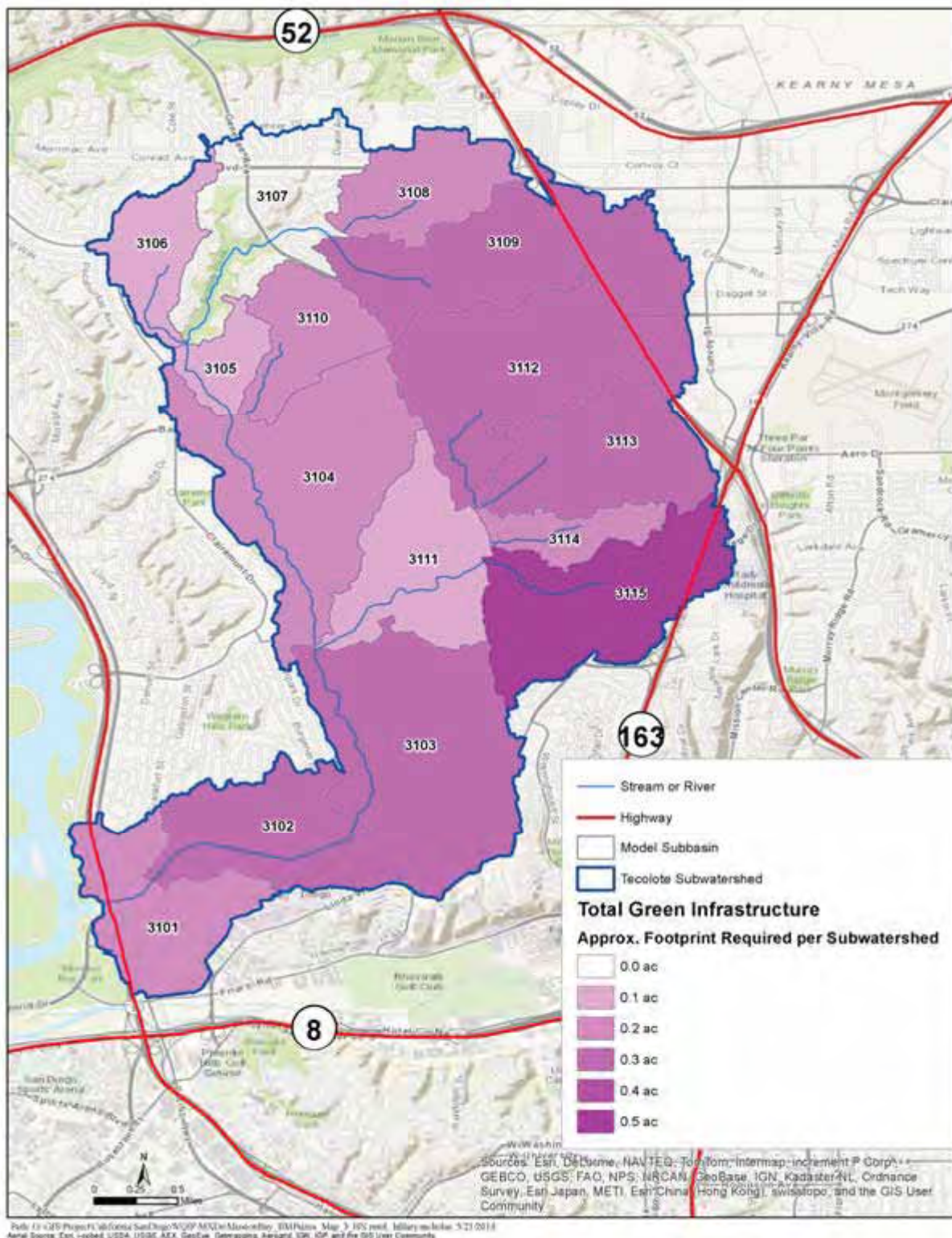


Figure K-15
Required Extent of Green Infrastructure in Tecolote Creek Subwatershed
in Addition to Projects Already Implemented

Table K-14
Required Extent of Green Infrastructure (Sized and Sited To Capture
the 85th Percentile Runoff Volume from Public Parcels)
in Addition to Existing Projects in Tecolote Creek Subwatershed¹

Subwatershed (See Figure K-15)	Bioretention Footprint Modeled (acres)	Permeable Pavement Footprint Modeled (acres)	Total Optional Green Infrastructure Footprint (acres)
3101	0.12	0.02	0.14
3102	0.19	0.03	0.21
3103	0.25	0.04	0.29
3104	0.13	0.02	0.15
3105	0.00	0.00	0.00
3106	0.02	0.00	0.02
3107	0.00	0.00	0.00
3108	0.11	0.01	0.12
3109	0.20	0.06	0.26
3110	0.13	0.02	0.15
3111	0.04	0.01	0.05
3112	0.24	0.03	0.27
3113	0.24	0.03	0.27
3114	0.16	0.03	0.19
3115	0.44	0.06	0.50
Totals	2.28	0.35	2.63

Note:

1. Note that these numbers are planning-level recommendations and are calculated at a subwatershed scale; structural BMPs should be sited and designed to meet both jurisdictional standards and the numeric goals for the subwatershed.

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Table K-15
Flow and Pollutant Load Reduction Attributed
to Green Infrastructure BMPs on Public Parcels in Tecolote Creek Subwatershed

Strategy and Level of Implementation ¹	City of San Diego Reduction—Tecolote Creek Subwatershed							
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P
Wet Weather								
Green infrastructure: 2.28 acres of bioretention and 0.35 acre of permeable pavement to treat an impervious drainage area of 182.35 acres with a total storage volume of 8.21 acre-feet	3.6%	2.0%	1.8%	1.1%	1.6%	1.7%	2.0%	2.7%
							2.8%	0.8%
Dry Weather								
Green infrastructure: 2.28 acres of bioretention and 0.35 acre of permeable pavement to treat an impervious drainage area of 182.35 acres with a total storage volume of 8.21 acre-feet	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%

Note:

- Note that these numbers are planning-level values and are calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the above numeric goals at each respective project site. Reported quantities include the extent of projects that have already been implemented.
- Orange-shaded cells indicate highest priority water quality conditions for the Mission Bay WMA.
Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

Table K-16
Flow and Pollutant Load Reduction Attributed to Green Infrastructure BMPs
on Public Parcels in Scripps Subwatershed

Strategy and Level of Implementation ¹	City of San Diego Reduction—Scripps Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment ²	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
Wet Weather										
Kellogg Park: 0.6 acre of permeable pavement to treat a drainage area of 8.9 acres	0.4%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.3%	0.1%
Dry Weather										
Kellogg Park: 0.6 acre of permeable pavement to treat a drainage area of 8.9 acres	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%

Note:

1. Note that these numbers are planning-level values and are calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the above numeric goals at each respective project site.
2. Orange-shaded cells indicate highest priority water quality conditions for the Mission Bay WMA.
Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

K.3.1.3 Water Quality Improvement BMPs

Water quality improvement BMPs include strategies such as low-flow diversions and proprietary BMPs. These BMPs can be useful where green infrastructure is not suitable because of design constraints. Identified water quality improvement BMPs within the Mission Bay WMA are displayed in Figure K-16.

K.3.1.4 Tecolote Creek Subwatershed

The City of San Diego currently operates one low-flow diversion facility within the Tecolote Creek main channel Figure K-17. This was included in the baseline model of existing conditions and was therefore not included in the flow and pollutant load estimates for dry weather presented herein. Based on review of information on this diversion and communications with City staff, a diverted flow rate of 1.4 cubic feet per second (cfs) was assumed in the model for this facility.

K.3.1.5 Scripps Subwatershed

The City currently operates 31 low-flow diversion facilities within the Scripps subwatershed (Figure K-18). These were included in the baseline model of existing conditions and are therefore not included in the flow and pollutant load estimates for dry weather presented herein. Based on review of information on these diversions and communications with City staff, a cumulative diverted flow rate of 12.9 cfs was assumed in the model for these facilities, with individual facility locations and diversion rates represented appropriately.



Figure K-16
Water Quality Improvement BMPs



Figure K-17
Low-Flow Diversion in Tecolote Creek Subwatershed



Figure K-18
Low-Flow Diversion in Scripps Subwatershed

K.3.2 Structural Modeling Results

The results of all structural strategy modeling for the Mission Bay WMA are summarized below. Note that these results do not include the reductions associated with nonstructural strategies presented in Section K.2.3.

Table K-17 summarizes the predicted reductions from structural BMPs in the Scripps subwatershed. BMPs were first optimized for wet weather, and then the models were used to simulate pollutant reductions for dry weather.

Table K-18 tabulates the predicted reductions from structural strategies in the Tecolote Creek subwatershed.

Table K-17
Scripps Subwatershed Structural BMP Model Results

Strategy and Level of Implementation ¹	City of San Diego Reduction—Scripps Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
Wet Weather										
Multiuse Treatment Areas: 0.11 acre BMP to treat a drainage area of 3.7 acres with a total storage volume of 0.43 acre-feet	0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.03%	0.02%
Green Infrastructure: 0.6 acre of permeable pavement to treat a drainage area of 8.9 acres	0.4%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.3%	0.1%
Totals	0.5%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.3%	0.1%
Dry Weather										
Multiuse Treatment Areas: 0.11 acre BMP to treat a drainage area of 3.7 acres with a total storage volume of 0.43 acre-feet	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.2%	0.2%
Green Infrastructure: 0.6 acre of permeable pavement to treat a drainage area of 8.9 acres	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Totals	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.2%	0.2%

Note:

- Note that these numbers are planning-level values and are calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the above numeric goals at each respective project site. Reported quantities include the extent of projects that have already been implemented.
- Orange-shaded cells indicate highest priority water quality conditions for the Mission Bay WMA.
Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

Table K-18
Tecolote Creek Subwatershed Structural BMP Model Results

Strategy and Level of Implementation ¹	City of San Diego Reduction—Tecolote Creek Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
Wet Weather										
Multiuse Treatment Areas: 20 acre BMP to treat a total drainage area of 11,864 acres with a total storage volume of 57.6 acre-feet	4.2%	1.1%	0.4%	0.5%	0.5%	0.5%	2.1%	1.1%	5.0%	4.1%
Green Infrastructure: 2.28 acres of bioretention and 0.35 acre of permeable pavement to treat an impervious drainage area of 182.35 acres with a total storage volume of 8.21 acre-feet	3.6%	2.0%	1.8%	1.1%	1.6%	1.7%	2.0%	2.7%	2.8%	0.8%
Totals	7.8%	3.1%	2.2%	1.6%	2.1%	2.2%	4.1%	3.8%	7.8%	4.9%
Dry Weather										
Multiuse Treatment Areas: 20 acre BMP to treat a total drainage area of 11,864 acres with a total storage volume of 57.6 acre-feet	96%	95%	96%	96%	96%	96%	96%	96%	96%	96%

Strategy and Level of Implementation ¹	City of San Diego Reduction—Tecolote Creek Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
Green Infrastructure: 2.28 acres of bioretention and 0.35 acre of permeable pavement to treat an impervious drainage area of 182.35 acres with a total storage volume of 8.21 acre-feet	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Totals	96%	95%	96%	96%	96%	96%	96%	96%	96%	96%

Note:

- Note that these numbers are planning-level values and are calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the above numeric goals at each respective project site. Reported quantities include the extent of projects that have already been implemented.
- Orange-shaded cells indicate highest priority water quality conditions for the Mission Bay WMA.
Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

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K.4 Comprehensive Strategy Results

Nonstructural and structural strategies were modeled to demonstrate progress toward attaining the numeric goals outlined in the main body of this document. The focus of the optimization analysis is to consider the cost-effectiveness of subwatershed-wide implementation of BMPs. Optimization incrementally considers costs of BMP implementation and accounts for progress toward achieving the load reduction goals. The targets for optimization are the jurisdictional goals, the percent load reduction goal equitably distributed among jurisdictions, presented in Section 4.1. An equitable percent load reduction goal ensures an overall net load reduction for the entire subwatershed with the ability for each Responsible Agency to achieve the load reduction appropriately and effectively for each jurisdiction. A relative percent load reduction goal also ensures equitable distribution of the pollutant mass to be reduced.

Strategies were prioritized by order of those that are most cost-effective, following the order shown in Figure K-1. For instance, nonstructural strategies are effective in reducing pollutant loads before they enter the storm drain and are generally cost-effective and require a shorter planning period. Therefore, most nonstructural strategies are planned for implementation before or upon approval of the Water Quality Improvement Plan. Structural BMPs can be cost-effective when greater load reductions are needed and treatment must occur after the pollutants enter the storm drain system, particularly when benefits other than water quality improvements are considered. However, planning for structural BMPs requires more time to secure resources, design BMPs, and obtain permits. Most of the structural BMPs are planned for later in the compliance period to allow more time to ensure that the implementation is necessary to meet numeric goals and is designed to achieve the load reductions required, and that alternatives to construction have been evaluated.

The following sections summarize the combined load reductions predicted for all modeled strategies.

K.4.1 Tecolote Creek Subwatershed

The final wet weather subwatershed percent load reduction goal for the City of San Diego is 17.9% for the critical pollutant, fecal coliform. BMPs were first optimized to meet wet weather goals, and then the models were used to simulate pollutant reductions for dry weather. This technique was used because wet weather load reduction goals tend to be more conservative (i.e., they require larger BMPs for compliance) than are dry weather load reduction goals. In other words, BMPs optimized to capture and treat dry weather flows (generally minimal discharges over short periods of time) would not likely be adequate to capture and treat wet weather (storm) flows. Table K-19 summarizes pollutant load reductions for wet and dry weather conditions for the critical pollutant, fecal coliform. No process-based assumptions were applied to non-modeled, nonstructural BMPs, which implies that the combination of strategies will be more than sufficient to achieve dry weather load reduction goals. These tables present the load reductions predicted for all modeled strategies within the Tecolote Creek subwatershed and demonstrate that the strategies presented in the Water Quality Improvement Plan will reach the dry and wet weather subwatershed percent load reduction goals.

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Table K-19
Water Quality Improvement Plan Wet and Dry Weather Reductions in the Tecolote Creek Subwatershed

Strategy and Level of Implementation ¹	City of San Diego Reduction—Tecolote Creek Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
Wet Weather										
Nonstructural, non-modeled	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
See Section 4.2.4										
Nonstructural, modeled	0.1%	1.6%	1.5%	0.4%	0.6%	0.2%	0.6%	1.7%	<0.1%	<0.1%
Rain Barrels, Downspout Disconnections, and Irrigation Reductions ³										
Multiuse Treatment Areas	4.2%	1.1%	0.4%	0.5%	0.5%	0.5%	2.1%	1.1%	5.0%	4.1%
20 acre BMP to treat a total drainage area of 11,864 acres with a total storage volume of 57.6 acre-feet										
Green Infrastructure	3.6%	2.0%	1.8%	1.1%	1.6%	1.7%	2.0%	2.7%	2.8%	0.8%
2.28 acres of bioretention and 0.35 acre of permeable pavement to treat an impervious drainage area of 182.35 acres with a total storage volume of 8.21 acre-feet										
Total⁴	17.9%	14.7%	13.7%	12.0%	12.8%	12.4%	14.8%	15.4%	17.8%	14.9%
	Goal = 17.9%								Goal = 11.8%	Goal = 10.0%

Strategy and Level of Implementation ¹	City of San Diego Reduction—Tecolote Creek Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
Dry Weather										
Nonstructural, non-modeled	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
See Section 4.2.4										
Nonstructural, modeled	99%	32%	25%	25%	25%	25%	25%	25%	99%	99%
Irrigation Reduction³	100% ⁵								100% ⁵	100% ⁵
Total	Goal = 98.4%	42%	35%	35%	35%	35%	35%	35%	Goal = 99.9%	Goal = 99.6%

Note:

- Note that these numbers are planning-level values and are calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the above numeric goals at each respective project site. Reported BMP sizes are in addition to projects that have already been implemented.
- Orange-shaded cells indicate highest priority water quality conditions for the Mission Bay WMA.
- Irrigation reduction strategies include the implementation of turf conversion projects, micro-irrigation system conversions, weather-based irrigation controllers, downspout disconnections, education and outreach and enforcement of regulations that prohibit runoff. This strategy was only modeled to include surface contributions of bacteria on overspray areas. Non-highest priority water quality pollutants were not modeled.
- Load reduction totals that exceed the goals reflect coarseness in the model that can be improved with finer physical data at the parcel and/or street scale.
- Mechanistic, process-based assumptions were not applied to non-modeled nonstructural BMPs, resulting in the cumulative dry weather load reductions exceeding 100% (this implies that the combination of strategies will be more than sufficient to achieve dry weather load reduction goals).

Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

For the City of San Diego, the implementation of nonstructural (both non-modeled and modeled), multiuse treatment areas and green infrastructure strategies is required to meet the fecal coliform load reduction goal of 17.9% for wet weather. The City of San Diego has more cost-efficient, nonstructural BMPs that result in a lower cost of nonstructural strategy implementation. Nonstructural strategies achieve a greater load reduction for a lower cost, because costs are often primarily administrative or programmatic. Multiuse treatment areas are large, structural strategies and can treat a greater load compared to the storage capability of green infrastructure strategies. The larger storage volume per area is more cost-effective per-unit; therefore, multiuse treatment area costs tend to be lower than green infrastructure costs and should be implemented after nonstructural strategies.

It should be noted that although BMPs sized for wet weather tend to provide adequate capacity to treat contributing dry weather flows, they must be sited such that dry weather flows are intercepted before reaching the storm drain or waterway. In the modeled scenario, dry weather flows are generated by various land uses across the entire subwatershed, whereas wet weather BMPs were modeled at specific locations (allowing a portion of dry weather flows to bypass wet weather BMPs). During the implementation phase, higher-precision analysis can be used to target sources of dry weather flows and to place BMPs where they will be most effective. Additionally, nonstructural strategies to eliminate dry weather loads will be further investigated through a sensitivity analysis. Progress towards achieving the dry weather goal will be addressed through the iterative process and additional strategies will be identified, if interim goals are not being met.

While cost and efficiency are primary concerns for selecting BMPs, additional factors based on public input were considered (such as specific BMP strategies, sites, and levels of implementation that were preferred by stakeholders and Responsible Agencies). Therefore, the implementation schedules for strategies do not necessarily follow the cost-effectiveness, but do assist in planning and management decisions.

Caltrans will voluntarily implement the strategies outlined in Section 4.2 of the Water Quality Improvement Plan, as resources are available, per the schedule provided in Appendix I. Attachment IV to the Caltrans MS4 permit, outlines a methodology for prioritizing stream segments included in TMDLs in which Caltrans is subject to. The permit establishes BMP implementation requirements evaluated in terms of compliance units, as opposed to load reduction targets. Caltrans is expected to achieve 1650 compliance units per year through the implementation of retrofit BMPs, cooperative implementation, and post construction treatment beyond permit requirements.

For Bacteria TMDLs, Caltrans is expected to eliminate dry weather flows by implementing control measures to ensure effective prohibition (Provision B.2 of the Permit). For wet weather flows, Caltrans is expected to implement control measures/BMPs to prevent discharge of bacteria from the ROW; this can be source control and preemptive activities such as street sweeping, clean-up of illegal dumping and public education on littering. Implementation of these controls is per the TMDL prioritization list currently under development.

K.4.2 Scripps Subwatershed

The modeling results demonstrate that implementation of the nonstructural and structural strategies in the entire Scripps subwatershed (excluding the Mission Bay drainage area) will meet and exceed both the wet and dry weather load reduction required for fecal coliform (Table K-20). As discussed in Section K.2.1, the non-modeled, nonstructural strategies were assumed to achieve an overall load reduction of 10% (HDR, 2014). In addition, the City of San Diego is implementing multiuse treatment area and green infrastructure BMPs on public land, which provide additional reductions.

Table K-20
Water Quality Improvement Plan Wet and Dry Weather Reductions for Scripps Subwatershed

Strategy and Level of Implementation ¹		City of San Diego Reduction—Scripps Subwatershed									
		Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
Wet Weather											
Nonstructural, non-modeled	See Section 4.2.4	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Nonstructural, modeled		0.1%	2.4%	1.5%	0.5%	0.6%	0.2%	1.0%	2.5%	<0.1%	<0.1%
Rain Barrels, Downspout Disconnections, and Irrigation Reductions ³											
Multise Treatment Areas	0.11 acre BMP to treat a drainage area of 3.7 acres with a total storage volume of 0.43 acre-feet	0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.03%	0.02%
Green Infrastructure		0.4%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.3%	0.1%
Total ⁴	10.6%	12.5%	11.6%	10.6%	10.7%	10.3%	11.1%	12.6%	10.4%	10.1%	
	Goal/= 10.0%		Goal/ = 0.6%						Goal = 6.6%	Goal= 5.1%	
Dry Weather											
Nonstructural, non-modeled	See Section 4.2.4	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Nonstructural, modeled		99%	34%	25%	25%	25%	24%	24%	99%	99%	
Irrigation Reduction ³											

Strategy and Level of Implementation ¹	City of San Diego Reduction—Scripps Subwatershed									
	Fecal Coliform ²	Flow	Total Sediment	Total Cu	Total Pb	Total Zn	Total N	Total P	Enteroc ²	Total Coliform ²
	100% ⁵	44%	35%	35%	35%	35%	34%	34%	100% ⁵	100% ⁵
Total	Goal = 99.0%								Goal = 99.9%	Goal = 99.8%

Note:

- Note that these numbers are planning-level values and are calculated at a subwatershed scale; structural BMPs should be designed to meet both jurisdictional standards and the above numeric goals at each respective project site.
 - Orange-shaded cells indicate highest priority water quality conditions for the Mission Bay WMA.
 - Irrigation reduction strategies include the implementation of turf conversion projects, micro-irrigation system conversions, weather-based irrigation controllers, downspout disconnections, education and outreach and enforcement of regulations that prohibit runoff.
 - Load reduction totals that exceed the goals reflect coarseness in the model that can be improved with finer physical data at the parcel and/or street scale.
 - Mechanistic, process-based assumptions were not applied to non-modeled nonstructural BMPs, resulting in the cumulative dry weather load reductions exceeding 100% (this implies that the combination of strategies will be more than sufficient to achieve dry weather load reduction goals).
- Cu = copper; N = nitrogen; P = phosphorus; Pb = lead; Zn = zinc

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APPENDIX L

Strategy Benefits and References

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APPENDIX L. STRATEGY BENEFITS AND REFERENCES

The following references provide supporting documentation for the water chemistry, physical, and biological benefits associated with strategy categories presented in the strategy benefit tables in Section 4.2.

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APPENDIX M

Comprehensive Benefits Analysis of Water Quality Improvement Plan Strategies

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Appendix M

Comprehensive Benefits Analysis of Water Quality Improvement Plan Strategies

Final Technical Memorandum

November 2014

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Summary

The City of San Diego Storm Water Division (“Division”) is developing Water Quality Improvement Plans (WQIPs) that consist of a range of structural and nonstructural strategies for meeting TMDL regulatory requirements in each watershed. However, the Division recognizes that these strategies differ with respect to their contribution to “additional” or “other” benefits to the local community, environment, and economy that are beyond specific water quality improvements in streams. This assessment has been implemented to provide the Division with supplemental information on these potential benefits. The Division aims to consider these other benefits in selecting strategies only in cases when strategies yield the same level of water quality improvements but which may produce markedly different levels of other benefits.

This document outlines a framework for assessing other benefits from these strategies. The framework assesses how each type of strategy could impact one or more types of other benefits. These additional benefits consist of various types of changes beyond water quality improvements in terms of environmental resources, quality of life, property values, business development, and others.

In the WQIPs, individual strategies are grouped into a series of categories that are defined as either ‘Nonstructural’ or ‘Structural.’ Over 20 categories of strategies have been defined based on their similarity in how they can improve water quality and include *Development Planning, Construction Management, Existing Development, Illicit Discharge, Detection, and Elimination (IDDE) Program, Public Education and Participation, and Enforcement Response Plan.*

The framework for assessing the potential for additional benefits from strategies has several dimensions including::

- ❖ *Strategy Categories* are defined by how they influence water quality improvements (see Section 2). There are three Structural and four Nonstructural types of strategy categories including.
 - *Structural Strategies*, as defined in the WQIP include: (a) Green infrastructure, (b) multi-use treatment areas, or (c) water quality improvement BMPs
 - *Nonstructural Strategies*, as defined in this assessment based on how these strategies aim to: (a) Improve Structural Systems Performance, (b) Increase the Number of Structural Systems, (c) Change Behavior; or (d) Reduce Pollutants Directly.
- ❖ *Benefit Categories* include a range of economic, social and environmental outcomes. This assessment determines the relevance and impact of each strategy category on a benefit category (see Section 3).

- ❖ *Impact Levels* of a strategy category in a benefit category is classified as either (a) monetizable, (b) measurable, (c) potential, or (d) not applicable. (See Section 3). These impact levels are indented to provide *order of magnitude* information about the potential impact of a strategy on each type of benefit.
- ❖ A scoring system is established for the magnitude of benefits evaluation to compare different strategies (see Section 3). In addition, the total number of applicable benefits is provided for additional information about the relative advantage of different strategies.

A discussion and rationale for assessing the level of impact for a given strategy on a benefit category is provided in Section 4. This assessment is intended to be an initial, order of magnitude of benefits of different strategies. It can only be an illustrative assessment since details on the design and location of any individual strategy is not available at this stage. The framework however is intended to indicate how and to what degree benefits could be estimated once a strategy is in place. As an order of magnitude assessment, strategies with measurable and monetizable would be expected to exhibit successively higher levels of estimable benefits compared to strategies that are classified as only having a potential connection to benefits.

The results, as presented in Section 5, indicate that structural strategies (especially, Green Infrastructure and Multiuse Treatment Areas) have the highest potential to generate sizable benefits. However, a number of nonstructural strategies (e.g. Initiatives to Change Behavior for Existing Development, Priority Development Projects, Construction Management, Public Education and Enforcement, among others) could also provide additional benefits. Many other non-structural strategies have the potential to generate a wide range of different benefits for the community.

A cross-cutting theme in this assessment is the impact of strategies on property values and business development. Some strategies, such as ones that foster on-site water retention and reduction of street debris, have the potential to provide tangible and intangible benefit to communities and local businesses by reducing water and clean-up costs and providing an overall improved aesthetic environment. Depending on where and how a strategy is implemented, benefits can be higher or lower. The literature review in Appendix 1 discusses cases where these benefits have measured.

A next step for this assessment would entail site-specific evaluations of strategies and potential additional benefits of WQIP at a planning level. As strategies become more defined and specific data becomes available on project conditions, this framework could be adapted further to create more detailed results for prioritizing strategies. This step would include applying current research to site specific projects to more direct monetize and quantify the outcomes of strategies in terms of cost savings and property value enhancements. Better still would be a pre- and post-monitoring program to assess the singular and combined effects of strategies to different stakeholders.

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Acronyms and Abbreviations

Acronym or Abbreviation	Definition
ac	Acres
BCA	Benefit Cost Analysis
BES	Bureau Of Environmental Services
BMP	Best Management Practice
Btu	British Thermal Unit
CAMX	California-Mexico Power Area
CEA	Cost-Effectiveness Analysis
CLRP	Comprehensive Load Reduction Plan
CNT	Center For Neighborhood Technology
CO ₂	Carbon Dioxide
CSO	Combined Sewer Overflow
DOT	Department Of Transportation
EIA	Economic Impact Analysis
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
GI	Green Infrastructure
HOA	Home Owner's Association
IDDE	Illicit Discharge, Detection, And Elimination
kWh	Kilowatt Hour
LACDPW	Los Angeles County Department Of Public Works
LID	Low Impact Development
M Wh	Mega Watt Hour
MMSD	Milwaukee Metropolitan Sewage District
MODA	Multi-Objective Decision Analysis
MS ₄	Municipal Separate Storm Sewer System
NO _x	Nitric Oxide And Nitrogen Dioxide
NPV	Net Present Value
NRDC	Natural Resources Defense Council
O&M	Operations And Maintenance
O ₃	Oxide
PDP	Priority Development Projects
PFC	Permeable Friction Course
PGA	Pollutant Generating Activities

Acronyms and Abbreviations (continued)

Acronym or Abbreviation	Definition
PM	Particulate Matter
PWD	Philadelphia Water District
QMRA	Quantitative Microbial Risk Assessment
SO ₂	Sulfur Dioxide
SPU	Seattle Public Utilities
SROI	Sustainable Return On Investment
TBL	Triple Bottom Line
TIGER	Transportation Investment Generating Economic Recovery
TMDL	Total Maximum Daily Load
UTC	Urban Tree Canopy
WAMP	Watershed Asset Management Plan
WERF	Water Environment Research Foundation
WQIP	Water Quality Improvement Plan

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1 Introduction

The City of San Diego Storm Water Division (Division) has prepared many potential strategies as part of its Water Quality Improvement Plan (WQIP). These strategies have identified a range of structural best management practices (BMPs) (e.g., a constructed runoff reduction system, such as a bio-swale), and nonstructural BMP activities (e.g., programs that promote installation of constructed systems, or reduce pollutants directly through education and outreach). This memo seeks to assess the potential for strategies to generate “additional” or “other” benefits beyond water quality improvements. The Division seeks such information to contribute to prioritization of strategies that meets regulatory requirements and generates the best value for the community and local businesses.

The concept for evaluating the other benefits of proposed strategies has been under discussion since April 2014. A technical memo was developed as an initial task to classify additional benefits from the Division’s stormwater management strategies. That memo is contained in Appendix 1 and includes a literature review of potential benefit categories and case studies of green infrastructure program benefits. The economic framework was presented to stakeholders at a meeting on May 20, 2014. Feedback was elicited during and after that meeting, and has been incorporated into this document and to the Division’s current approach to evaluating strategies (see presentation, handout, and comments from workshop in Appendix 2).

The next several sections in this document present the approach and draft evaluation of additional benefits. The evaluation has been applied to a comprehensive list of strategies from the City’s three draft WQIPs (Mission Bay, Los Peñasquitos, and San Dieguito). The framework entails the characterization of strategy categories by type of impact (Section 2), definition of potential types of benefit categories (Section 3) and a classification of benefits for each strategy category (Section 4). Results of this evaluation are contained in Section 5.

This assessment of additional benefits of WQIP strategies is conducted for initial planning purposes only. As strategies become more defined and specific data becomes available on project conditions, this framework could be adapted further to create more detailed results for prioritizing strategies. This step would include applying current research to site specific projects to more directly monetize and quantify the outcomes of strategies areas such as recreational, property value and business development benefits.

2 Strategy Classifications

The WQIP identifies a number of strategy categories as either “Nonstructural” or “Structural”, and in terms of whether they are Jurisdictional Strategies or Optional Jurisdictional Strategies. Optional strategies are those strategies that may be triggered in the future to achieve the interim and final numeric goals.” In the analysis of benefits, the main distinction is between Nonstructural or Structural types which are defined in the following ways.

Nonstructural Strategies include “those actions and activities intended to reduce storm water pollution, which do not involve construction of a physical component or structure to filter and treat storm water.” Individual strategies are grouped into over 25 different categories including: *Development Planning, Construction Management, Existing Development, Illicit Discharge, Detection, and Elimination (IDDE) Program, Public Education and Participation, Enforcement Response Plan, and Non-JRMP Strategies*. For each watershed, a list of potential nonstructural strategies has been developed that reflect the needs, opportunities and constraints in different locations. In general, many of these initiatives have been implemented by the Division for many years and are integral to regulatory compliance on a watershed-specific basis.

Nonstructural strategy categories are further defined in this assessment by *how* they improve water quality, which in turn indicates how they may generate other benefits. For example, four types of mechanisms include the ways in which strategies:

- ❖ **Improve Structural Systems Performance:** These include strategies that relate to new design standards and performance monitoring would be measured by the improvement in the performance of installed structural systems. The benefits of these nonstructural strategies would ultimately draw from the benefits of structural systems that are implemented.
- ❖ **Increase the Number of Structural Systems:** These strategies aim to increase the rate of BMP adoption is due to training in the community or general promotion of BMPs, lead to benefits whenever they are installed. The outcome of these strategies then depends on the number of *additional* systems that are installed.
- ❖ **Change Behavior:** These strategies target efforts to encourage improved environmental stewardship and storm water protection by residents and businesses throughout the community. Various types of actions that people may take who become more aware of environmental impacts through these strategies include adoption of rain barrels, reducing litter, and reducing unnecessary levels of pesticides, herbicides and fertilizers.

- ❖ **Reduce Pollutants Directly:** These strategies include those that aim to directly control pollution through actions that the Division and other public agencies can take independently, such as internal training, enforcement and administrative changes. These strategies can lead to behavior change by individuals but initially through a focus on public entities.

Structural Strategies, in contrast to Nonstructural strategies, are physical infrastructure that are designed for site-specific conditions and placed strategically across a watershed to improve water quality. The effectiveness and feasibility of implementing any of these BMPs varies depending on their design and site conditions. For example, the effectiveness of a BMP for enhanced infiltration capacity of a watershed depends on amenable soil types. Other site-specific considerations include the physical land area available for effective implementation and maintenance. Also, the capital and maintenance costs of a BMP influence its feasibility for the Division, especially in comparison to other BMPs which can be implemented more cost-effectively. The structural strategies that have been identified as potentially suitable for San Diego watersheds and have been classified as one of three types: (1) green infrastructure, (2) multiuse treatment areas, and (3) water quality improvement BMPs.

- ❖ **Green Infrastructure** covers a range of BMPs that are designed to be integrated in a broader site plan to maintain healthy waters, provide multiple environmental benefits, and support sustainable communities. Green infrastructure is distinguished from other methods by making deliberate and effective use of vegetation and soil to manage storm water.
- ❖ **Multiuse Treatment Areas** in the Water Quality Improvement Plan are identified as large-scale treatment areas such as multiuse basins and stream, channel, and habitat rehabilitation projects. These systems are designed as regional facilities that can receive flows from neighborhoods or larger areas and become cost-effective solutions that provide multiple benefits. For example, such systems can be integrated in public spaces, such as soccer fields and parks, which provide recreational areas and flood control, ground water recharge, restoration, habitat enhancement, and recreation. In addition stream bank projects that reduce erosion can improve water quality and simultaneously improve habitat.
- ❖ **Water Quality Improvement BMPs** include systems that supplement the design performance of existing infrastructure. For example, systems that segregate trash includes inlet devices, such as trash guards or racks that capture debris before they enter surface waters. Another example are proprietary commercial products that often aim to use settling, filtration, absorptive/adsorptive materials, vortex separation, and sometimes vegetative components to remove pollutants from runoff. Finally, dry weather flow separation and treatment projects target non-storm water dry season flows and divert these flows for treatment either on-site or to sanitary sewer systems and ultimately wastewater treatment plants.

Overall, 30 different groups of strategies have been classified as either “Jurisdictional” (strategy types numbered 1-23, in Table 2 and Table 6 or “Optional Jurisdictional” (strategies types numbered 24-30, in Table 3 and Table 7). Optional strategies are those strategies that may be triggered in the future to achieve the interim and final numeric goals.” The number ordering for these strategies follows from documents provided by the Division and reflects the most comprehensive list of current strategies under consideration. Specific strategies have also been identified by the Division within each strategy group.

3 Benefit Categories and Levels of Impact

Stormwater management strategies can generate various types of benefits and have different levels of impact. Economic research has shown that stormwater management strategies can generate a range of benefit categories with economic, environmental and social impacts for the local residents, businesses, and public agencies. The level of impact of a strategy can differ across benefit categories and depends on the design of the strategy, site conditions where the strategy is implemented, and characteristics in the community. Estimation of economic benefits from a strategy depends on the degree to which linkages can be quantified between strategy and a benefit category and then available economic literature to value this change. In some cases, only a part of the link between a strategy and a benefit category can be quantified (e.g. the volume of water retained by a green infrastructure system can be measured, but not its impact on stream bank stabilization).

3.1 Description of Benefit Categories

This section below discusses a number of benefit categories that are found in economic literature. They are grouped by financial, environmental and social dimensions. A broader discussion from the literature is contained in the Appendix 1.

Financial Benefits

- ❖ **Water Cost Savings:** This type of benefit could occur when potable water needed for landscaping, washing or other property maintenance is reduced. Green infrastructure strategies could enable such savings if water retention reduces water demand, or some part of the system improves irrigation efficiency. The reduction in demand lowers water costs. These savings could be quantified and monetized if the volumes of water retained at a site can be measured.
- ❖ **Energy Cost Savings:** Green infrastructure can generate energy cost savings in several ways. For example, buildings which are adjacent to trees or which install green roofs can benefit from lower the heating and cooling energy costs because of shading and insulation, respectively. Some research suggests that if such green infrastructure system were installed throughout a city, the overall ambient temperature would decline and which would in turn reduce cooling loads for other buildings. Finally, in cases when green infrastructure provides water storage that lowers pumping costs, there would be a corresponding reduction in energy costs.

Environmental Benefits

- ❖ **Flood Risk Reduction:** Reduced runoff in an urban watershed can reduce the frequency and severity of flooding in downstream neighborhoods in some cases. The magnitude of these benefits though depends on if such a neighborhood is downstream and on the design and scale of a strategy that reduces flooding. Other factors include rainfall conditions, soil characteristics, slope, elevation and watershed characteristics. A first step in quantifying the potential for flood risk reduction benefits requires an understanding how much water is retained.

- ❖ **Air Particulate Entrapment:** Some green infrastructure systems can trap airborne pollutants, such as particulate matter (e.g. PM10), directly from the environment on their leaves and in turn reduce adverse human health impacts.¹ The total amount of particulate trapping depends on the type of vegetation, and local climate conditions. For trees, the US Forest Service published a report that provides benchmark values for use in calculations.² This type of benefit can be quantified and potentially monetized based on the amount and type of plants.
- ❖ **Climate Impacts:** Carbon sequestration is a natural process in which plants store carbon in biomass and soils as they grow. When atmospheric carbon dioxide is taken up by trees, grasses, and other plants, it can reduce greenhouse gas effects on the planet. The amount of carbon that can be sequestered by a green infrastructure system depends on the above ground quantity of biomass of the tree, green roof or bio-swale. Economic valuation of climate change effects can be used to monetize carbon sequestration.
- ❖ **Habitat Related Benefits:** Green infrastructure that can provide habitat benefits include strategies that create new habitat areas, or improve existing ones. For example, vegetated infiltration systems can improve the habitat for flora and fauna, birds, and insect species. These different types of habitats are usually small in size and have limited impacts. Greater benefits may arise from large-scale strategies that enhance habitat connectivity in existing corridors. This type of benefit is readily quantified based on the acreage and plantings at a green infrastructure site, or stream bank stabilization effects, but more difficult to monetize because of limitations in economic research.
- ❖ **Air Quality Emission Reduction:** The total amount of reduction in criteria air contaminant emissions, such as particulate matter, from a power plant is directly tied to the reduction in energy use as discussed above. Energy savings are readily converted to its emission rate reductions by utilizing data from EPA and other public sources. Reduction in air pollution would generate health-related benefits for people. This benefit can be quantified and monetized if information is available on the amount of water and energy reduced at a treatment facility.
- ❖ **GHG Emission Reduction:** Similar to air quality emission reductions, energy demand reduction also reduces greenhouse gas emissions. The tons of greenhouse gas emissions are computed from the same data sources as criteria air contaminants. The economic damage caused by greenhouse gas emissions are broadly related to changes in productivity and damage costs.

¹ Center for Neighborhood Technology, The Value of Green Infrastructure. 2010

² <http://www.fs.fed.us/psw/programs/uesd/uep/products.shtml>

Social / Community Benefits

- ❖ **Property Value Enhancement:** Green infrastructure and other strategies can lead to enhanced property values under a variety of circumstances. For example, strategies that improve the overall visual appearance of a community simply by having planted material, street trees and bioswales among impervious surfaces have been shown to enhance value of nearby properties. In addition, some BMPs strategies aim to directly reduce litter or debris from public spaces to make it more visually appealing. These effects improve the overall quality of life in those neighborhoods. Benefits can be quantified by measuring the number of properties that are adjacent to the green infrastructure. Monetization of the effect would depend on the applicability of economic research on a site specific basis.
- ❖ **Recreational Benefits:** Certain green infrastructure strategies provide recreational benefits if they facilitate pedestrian, bicycle use, or connect to an existing recreational corridor or trails. Benefits would be monetized by the number of participants in a recreational activity at a site and their value per use. Other quantitative measures include the number and type of design features that offer recreational options.
- ❖ **Business Development & Jobs:** Green infrastructure, such as comprehensive green street designs, and initiatives to reduce street debris can lead to an enhanced sense of place, and increase in foot traffic that can support retail activity. Additionally, spending on capital investments and operations and maintenance (O&M) leads to job creation. This benefit can be measured by assessing the number of jobs created in an area where a green infrastructure strategy is implemented. In addition, these jobs can be associated with wider economic development benefits.
- ❖ **Crime Reduction:** Research suggests that fewer crimes occur near buildings with trees and non-invasive vegetation. Maintained areas of vegetation encourage informal social gatherings outdoors. Incidence of crime declines when with the presence of people and possibly by psychological precursors to crime.
- ❖ **Public Education/ Environmental Stewardship:** Promoting strategies that seek to change people's behaviors and make them more aware of their environmental impacts helps to cultivate a *stewardship perspective* in the community about its local natural resources. Quantification of this type of benefit may be measured in terms of how many people are reached with messages of programs aimed to enhance knowledge and ultimately actions towards to improve stormwater management.
- ❖ **Heat Island Effect:** Trees and other vegetation can reduce ambient temperatures in cities that have higher air temperatures. Lower temperatures can reduce health effects especially in populations that are at risk of heat stroke. Additionally, the overall lowering of temperatures can reduce cooling needs at properties located within the area. This type of benefit is only quantifiable in cases where the strategy is applied over a large scale.

- ❖ **Noise Reduction:** Some green infrastructure systems, such as wetlands or trees, are effective in reducing ambient noise because they can absorb it. This is also true for porous concrete and green roofs, but there is limited research in quantifying these benefits.

3.2 Characterization of the Benefit Level from a Strategy

The potential magnitude of benefits differs across strategy types. To account for these differences, four ‘levels’ are defined that represent a decreasing association between the impact of a strategy and a benefit category. These levels include:

Monetizable – The level of benefits indicates impacts that can be quantified and where economic research has been produced to determine a monetary value.

Measurable – There exists a connection for some measure of non-monetary impact can be identified and measured, even if economic research is not available to monetize the impacts.

Potential - A conceivable connection exists between a strategy and benefit category but it is not likely to be measurable.

Not Applicable - There is no discernible connection between a strategy and benefit category.

At this stage in program implementation and project design, the impact of each strategy on a benefit category can only be considered to be an order of magnitude assessment. An estimation of the actual impact would be highly uncertain since most strategies currently lack site-specific data about the design and implementation. Instead, these levels of impact are intended to provide separable categories that indicate the order of magnitude of benefits that a strategy may be able to generate. That is, it is only possible to assess the likelihood that a project can generate monetizable benefits, not the actual size of monetizable benefits.

At the same time, these four categories are intended to provide a broad degree of separation between strategies in terms of their measurable connection with each benefit category. For instance, if a strategy can be classified as having monetizable benefits, then its overall level of measurable benefits can be reasonably assumed to be higher than another strategy that is classified as being quantifiable, even if only in part. By the same rationale, these classifications would likely have more direct impact for a benefit category than a strategy whose impact can only be presumed.

This assessment aims to achieve consistency in evaluations within a specific strategy outcome group, as well as across strategy outcome groups. While some strategies have design or location specifications (e.g., total acres of bioretention), or target certain groups (developers vs. residential), others entail broad descriptions. Due to this uncertainty, the evaluation has taken a conservative approach to drawing conclusions about the magnitude of benefits that could arise from a strategy.

3.3 Scoring System

A scoring system is established to support comparisons of strategies with respect to the potential benefits they can generate (see Table 1). Each benefit level is assigned a point value that has been established through discussions with the Division. The values are intended to provide an indication of the strategy's impact across all benefit categories. In this case, potentially monetizable benefits are assigned a higher score than one that is only quantifiable (and not monetizable). This approach is intended to separate the types of benefits that are likely to be larger in magnitude from others that cannot be monetized nor quantified.

Table 1. Overview of Benefit Scoring

Level	Description	Point Value
Monetizable	Strategy can realize quantifiable impacts, and sufficient economic evidence supports placing a dollar value on these impacts.	1
Measurable	Strategy can realize quantifiable impacts, but lacks sufficient economic evidence to support placing a dollar value on these impacts.	0.667
Potential	Strategy most likely provides a positive impact, but the magnitude of the impact is uncertain.	0.333
Not Applicable	Strategy will not impact the benefit category in any meaningful way.	0

This scoring system places higher weight on strategies which may generate benefits that can be monetized (3 times the weight of a potential benefit level). Accordingly, in some cases a strategy that influences many additional benefit categories at a “*Potential*” level could score lower than one with fewer categories but with “*Monetizable*” impacts. This scoring system is designed for that type of result to give greater emphasis on strategy impacts that can be measured and are thus more tangible. Potential impacts are circumstantial and small, as compared to more significant impacts that can be measured and monetized. Furthermore, the implications of this scoring system have been taken into account in a consistent approach in determining which impacts of strategy are classified as monetizable, measureable or potential.

This scoring system is applied to the strategies in Table 2 through Table 7. This scoring system is only relevant for comparing strategies with respect to additional benefits, not in ways that influence a ranking towards meeting permit requirements and/or encourages other program objectives such as habitat restoration.

In addition, the total number of applicable benefit categories is also shown in Table 2 through Table 7 for additional reference on the impact of these strategies.

4 Framework for Assessment of Strategies

Determination of the applicability of benefits for each strategy depends primarily on the assignment of a strategy to one of the structural or nonstructural categories (defined in Section 2). Consistency in the applicability of a benefit category (defined in Section 3) for a strategy is maintained by jointly evaluating all strategies of a specific type. This section discusses the framework for assessing potential additional benefits that can arise from the implementation of each strategy. The aim of this exercise is to apply a consistent and transparent rationale for each strategy. Since available evidence is limited with respect to each strategy, the application of a consistent set of assumptions to each strategy underlies the basis for determining (a) which benefit categories are applicable, and (b) the potential magnitude of benefits, if a category is applicable.

The approach to assigning a magnitude level began with an assessment of the strategy for which the most information is available about its potential impact: Green Infrastructure (Ref 19). This type of strategy is used as a benchmark for assigning benefit categories and potential magnitudes of benefits due to the availability of evidence from projects implemented elsewhere in the U.S. To illustrate this approach for Green Infrastructure (Ref 19), consider the rationale below:

- ❖ In some cases, sufficient information available about the specific strategies specifies the area of bioretention and permeable pavement to be installed and the location of the project. Due to the size of these initiatives, and knowing that the vegetation can improve air quality through the uptake of criteria pollutants and improve the climate through carbon sequestration, it is assumed that the total pollutant and CO₂ removal from the atmosphere can be quantified. These quantified amounts of pollutant and CO₂ can then be monetized using standard practices that are currently being used to value these impacts.
- ❖ Additionally, it is assumed that these projects will provide aesthetic improvements to the existing site, which can be quantified with information regarding the number of properties within a certain radius and the property value changes.
- ❖ These sites will also need to be maintained, which will require spending on jobs, and depending on the specific site location, the improved aesthetics can also improve businesses located near the site.
- ❖ The total land area of the bioretention and permeable pavement will allow for quantifying the amount of rain water which gets absorbed onsite, and does not cause localized flooding, where applicable.
- ❖ The remaining other benefit categories are assumed to see positive impacts. For example, GHG emission reductions may occur from the lifecycle CO₂ emissions for permeable pavement being lower than the lifecycle CO₂ emissions of asphalt or pavement. However, there is not enough information at this time to accurately quantify that impact.

- ❖ Similarly, permeable pavement absorbs less heat than conventional pavement, which is a benefit for Urban Heat Island reduction. The amount of heat, and how that will affect public health cannot be quantified.

The potential impacts of all other strategies have been evaluated relative to the benchmark as established by the above assumptions for green infrastructure. As an example, the first group of strategies evaluated below, All Development Projects (Ref 1), focuses on improving existing systems performance. It is assumed that specific actions, such as administrative training or increased monitoring, will have positive impacts for the same benefit categories as a green infrastructure project. But since there is no way to quantify any of those impacts, the magnitude of benefits is assumed to be lower.

The remainder of this section discusses the assessment of Jurisdictional and Optional Jurisdictional Strategies. Note that these strategies represent the latest consideration in an evolving process of identification, specification and assessment. Not all strategies have been implemented or have plans for immediate implementation. At the same time, the specification of the design standards also varies from strategy to strategy. This assessment takes into account the *potential* benefits that may occur, given the information available, and assumptions that are listed in each strategy.

4.1 Jurisdictional Strategies

This section discusses the rationale and methodology for assigning scoring categories to the Jurisdictional Strategies, based on the most recent description of the strategy. This list of individual strategies has been grouped according to the same categories that are proposed for the draft WQIPs and are presented in the same chronological order. The information found in the parenthesis next to the strategy group name (*Ref X*), refers to the number in the far left columns of Table 2 and Table 6. Note that in some cases (e.g., Commercial, Industrial, Municipal, and Residential Facilities and Areas) the strategies are separated into two types (i.e., Improve Structural Systems Performance and Initiatives to Change Behavior) based on the specific ways in which a strategy creates benefits.

4.1.1 All Development Projects (Ref 1)

Strategies in this group consist of administrative and other tasks that center on improving the structural system's performance. Many of these types of strategies focus on broad initiatives such as training or source control. The list of strategies includes the following:

- ❖ Administer a program to ensure implementation of source control BMPs to minimize pollutant generation at each project and implement LID BMPs to maintain or restore hydrology of the area, where applicable and feasible.
- ❖ Investigation and research of emerging technology.
- ❖ Train staff on LID regulatory changes and LID practices.

- ❖ Amend municipal code and ordinances, including zoning ordinances, to facilitate and encourage LID opportunities. Ensure consistency with the City of San Diego's BMP Design Manual.
- ❖ Develop and implement Green Infrastructure Program and Guidelines.
- ❖ Develop Design Standards for Public LID BMPs.
- ❖ Create Right-of-Way Design Manual.

In scoring these strategies, it is assumed that the programs that target the administration or enforcement of BMPs would mostly affect the same benefit categories as a Green Infrastructure (GI) project which increases the acres of bioretention, but on a smaller scale. It is assumed that these projects would generate a positive impact but due to the uncertainty of the implementation and magnitude of the effect of these strategies, it cannot be measured.

Some of the broad initiatives are deemed to have too much uncertainty to reasonably assign a specific benefit level. It is however reasonable to assume that overall public awareness and knowledge of the issue will increase.

4.1.2 Priority Development Projects (PDPs) (Ref 2)

Similar to the strategies in the All Development Projects section, PDP initiatives are assumed to increase the number of structural systems and improve existing structural systems. These strategies include the following:

- ❖ For PDPs, administer a program requiring implementation of on-site structural BMPs to control pollutants and manage hydromodification. Includes confirmation of design, construction, and maintenance of PDP structural BMPs.
- ❖ Update BMP Design Manual procedures to determine nature and extent of storm water requirements applicable to development projects and to identify conditions of concern for selecting, designing, and maintaining appropriate structural BMPs.
 - Amend BMP Design Manual for trash areas. Require full four-sided enclosure, siting away from storm drains and cover. Consider the retrofit requirement.
 - Amend BMP Design Manual for animal-related facilities, such as animal shelters, "doggie day care" facilities, veterinary clinics, breeding, boarding and training facilities, groomers, and pet care stores.
 - Amend BMP Design Manual for nurseries and garden centers.
 - Amend BMP Design Manual for auto-related uses.
- ❖ Administer a program to inspect and enforce updated BMPs in BMP Design Manual

- ❖ Develop and administer an alternative compliance program to on-site structural BMP implementation (includes identifying Watershed Management Area Analysis [WMAA] candidate projects).

Scoring the impact of programs that target the administration or enforcement of BMPs would mostly affect the same benefit categories as a green infrastructure project which increases the acres of bioretention, but on a smaller scale. Initiatives that focus on updating various components of the design manual are assumed to increase the efficiency of the already existing systems. However, the total magnitude of this improvement cannot be estimated without additional information, and thus other benefits for this group cannot be measured.

4.1.3 Construction Management (Ref 3)

There is one specific strategy under this group, and it is assumed it will improve structural system performance. Construction Management strategy is:

- ❖ Administer a program to oversee implementation of BMPs during the construction phase of land development. Includes inspections at an appropriate frequency and enforcement of requirements.

The scoring for this strategy is assumed to be the same as previously discussed strategies that improve the performance of existing systems.

4.1.4 Commercial, Industrial, Municipal, and Residential Facilities and Areas – Improve Structural Systems Performance (Ref 4)

The specific initiatives under this strategy group focus on improving structural systems performance. These strategies differ from the strategies in the next group, which also are included under Commercial, Industrial, Municipal, and Residential Facilities and Areas in the Water Quality Improvement Plan, but target a different outcome. Administering programs which require minimum BMPs are assumed to affect the same benefit categories as a GI project which increases the acres of bioretention, but a smaller scale. These strategies include:

- ❖ Administer a program to require implementation of minimum BMPs for existing development (commercial, industrial, municipal, and residential) that are specific to the facility, area types, and PGAs, as appropriate. Includes inspection of existing development at appropriate frequencies and using appropriate methods.
 - Update minimum BMPs for existing residential, commercial, and industrial development. Specific updates to BMPs include require sweeping, catch basin cleaning and maintenance of private roads and parking lots in targeted areas.
 - Power-washing minimum BMPs: Outreach to property managers and trash haulers to elevate the emphasis of washing as a pollutant source. Emphasize non-compliant washing as an enforceable violation.

- Implement property based inspections.
- Review policies and procedures to ensure discharges from swimming pools meet permit requirements.

Strategies that target pollutants directly, such as the power-washing minimum BMPs, can be assumed to reduce the amount of pollutants entering the environment. However, while these strategies protect habitats and improving aesthetics, the total amount of pollutants reduced cannot be measured until more information is known regarding the current level of pollutant discharges, and how many people are targeted as part of this initiative. These initiatives are assumed to require some level of public outreach or promotion, and public awareness of these issues will be raised.

4.1.5 Commercial, Industrial, Municipal, and Residential Facilities and Areas – Initiatives to Change Behavior (Ref 5)

While also focusing on Commercial, Industrial, Municipal, and Residential Areas, these strategies seek to initiate changes in behavior. This list includes:

- ❖ Implement pet waste program
- ❖ Consider installing trash bins, pet waste bag dispensers and pickup services on Rose Creek Bicycle Path and Rose Canyon Bicycle Path.
- ❖ Promote and encourage implementation of designated BMPs for residential and non-residential areas.
- ❖ Residential BMP: Rain Barrel.
- ❖ Residential and Commercial BMP: Grass Replacement.
- ❖ Residential and Commercial BMP: Downspout Disconnect.
- ❖ Residential and Commercial BMP: Microirrigation.
- ❖ Onsite Water Conservation Survey.

These types of initiatives can also lead to measurable impacts. Specifically, initiatives which encourage water conservation allow for quantification if a simple number of variables are known, such as the number of Rain Barrels, and average annual rainfall.

4.1.6 MS4 Infrastructure (Ref 6)

The specific strategy initiatives for MS4 Infrastructure focus on improving the structural systems performance. The list of MS4 Infrastructure Strategies includes:

- ❖ Implementation of operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, detention basins, etc.) for water quality improvement and for flood control risk management.
 - Optimize catch basin cleaning to maximize pollutant removal (4 times per year for metals and sediment TMDLs, elsewhere 1 per year).

- Increased frequency of catch basin inspection and as-needed cleaning (Settlement Agreement).
- Proactively repair and replace MS4 components to provide source control from MS4 infrastructure.
- ❖ Implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers.
- ❖ Identify sewer leaks and areas for sewer pipe replacement prioritization.

Since these projects specifically focus on sub-surface activities, it is assumed that other benefits associated with changes above ground are not affected. Due to the specificity of these initiatives, it is reasonable to assume they will have a positive impact on local flood risk reduction, which in turn could potentially affect habitat related benefits, and possibly aesthetics.

4.1.7 Roads, Street, and Parking Lots (Ref 7)

These strategies specifically target street litter or debris will create aesthetic improvements. These strategies include:

- ❖ Implement operation and maintenance activities for public streets, unpaved roads, paved roads, and paved highways.
- ❖ Outreach to street sweeping enhancement-targeted areas.
- ❖ Enhance street sweeping through equipment replacement (replace every 4 years) and route optimization (sweep all areas twice a month).
- ❖ Initiate sweeping of medians on high-volume arterial roadways.
- ❖ Implement additional street sweeping near commercial routes adjacent to maintained MS4 channels..

The impact of these strategies can be quantified by estimating the volume of litter and street pollutants removed. Also, depending on the local land-use for the streets targeted, it is conceivable that a cleaner environment can lead to business development and investment. Jobs then would be supported by the money spent on operation and maintenance activities.

4.1.8 Pesticide, Herbicides, and Fertilizer BMP Program (Ref 8)

This category includes a broad initiative to reduce pollutant loads. The strategy entails:

- ❖ Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties. Includes education, permits, and certifications.

While there is too much uncertainty at this time to be able to assign specific measurable benefits, this reduction in pollutants entering the environment will benefit habitats, and aesthetics. It is assumed that overall public awareness and knowledge of the issue will increase.

4.1.9 Retrofit and Rehabilitation in Areas of Existing Development – Improve Structural Systems Performance (Ref 9)

The goal of this strategy is to improve existing systems, specifically:

- ❖ Develop and implement a strategy to identify candidate areas of existing development appropriate for retrofitting projects and facilitate the implementation of such projects.

As this strategy focuses on retrofitting, is assumed to follow the same methodology for scoring other projects which increase the number of structural systems.

4.1.10 Retrofit and Rehabilitation in Areas of Existing Development – Increase the Number of Structural Systems (Ref 10)

This strategy was separated from the previous as it focuses on rehabbing existing ecological areas.

- ❖ Develop and implement a strategy to identify candidate areas of existing development for stream, channel, or habitat rehabilitation projects and facilitate implementation of such projects.

Specific improvements in streams and other systems will improve habitats and aesthetics and can be measured using the area of each project.

4.1.11 Illicit Discharge, Detection, and Elimination (IDDE) Program (Ref 11)

This program is assumed to change behavior, specifically, reduce pollutants entering the environment through illegal discharges and disposal. The strategy is defined as:

- ❖ Implement Illicit Discharge, Detection, and Elimination (IDDE) Program per the JRMP. Requirements include: maintaining an MS4 map, using municipal personnel and contractors to identify and report illicit discharges, maintaining a hotline for public reporting of illicit discharges, monitoring MS4 outfalls, and investigating and addressing any illicit discharges.

While broad strategies cannot be measured, it is assumed that the targeting of pollutants will improve the environment and benefit habitats and aesthetics. It is also assumed that overall public awareness and knowledge of the issue will increase.

4.1.12 Public Education and Participation: Initiatives to Change Behavior (Ref 12)

Strategies under Public Education and Participation are grouped under two categories, those which seek to change behavior, and are targeted at the community at large, and those which seek to reduce pollutants directly, by targeting business and industries. The strategies in this grouping target changing behavior, and are listed below:

- ❖ Implement a public education and participation program to promote and encourage development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water prioritized by high-risk behaviors, pollutants of concern, and target audiences.
- ❖ Expand outreach to homeowners' association (HOA) common lands and HOA incentives.
- ❖ Develop an outreach and training program for property managers responsible for HOAs and maintenance districts.
- ❖ Enhance and expand trash cleanups through community-based organizations involving target audiences.
- ❖ Improve consistency and content of websites to highlight enforceable conditions and reporting methods.
- ❖ Develop a targeted education and outreach program for homeowners with orchards or other agricultural land uses on their property.
- ❖ Enhance school and recreation-based education and outreach.
- ❖ Develop education and outreach to reduce over-irrigation.
- ❖ Enhance education and outreach based on results of effectiveness survey and changing regulatory requirements.

4.1.13 Public Education and Participation: Initiatives to Reduce Pollutants Directly (Ref 13)

These strategies differ from the previous group, in that they aim to reduce pollutants directly by targeting business and industries. This list includes:

- ❖ Provide technical education and outreach to the development community on the design and implementation requirements of the MS4 Permit and Water Quality Improvement Plan requirements.
- ❖ Develop regional training for water-using mobile businesses.
- ❖ Promote and encourage implementation of designated BMPs in commercial and industrial areas.
- ❖ Outreach to impacted industry regarding minimum BMP requirement updates. Affects commercial, industrial, residential development.

While the total effect of the strategies cannot be determined at this time, it is assumed that the targeting of pollutants will improve the environment and benefit habitats and aesthetics.

The strategies which target commercial areas are assumed to effect more benefit categories, consistent benefit category scoring for other strategies which require minimum BMPs.

4.1.14 Enforcement Response Plan: Initiatives to Change Behavior (Ref 14)

The Enforcement Response Plan strategies can be categorized by 3 separate desired outcomes, and have been grouped separately. These strategies are focused at changing behavior.

It can be assumed that irrigation cost savings will occur as one strategy specifically targets over-irrigation. Where irrigation cost savings occur, there can potentially be emission savings. This is due to the reduced energy needed to provide the water, which in turn reduces the emissions generated from energy production. More information would be needed about these projects to determine the extent to which irrigation cost savings are realized.

List of Enforcement Response Plan Strategies to Change Behavior:

- ❖ Continue to implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE, development planning, construction management, and existing development in the Enforcement Response Plan.
- ❖ Increase enforcement of over-irrigation.

4.1.15 Enforcement Response Plan: Initiatives to Reduce Pollutants Directly (Ref 15)

This strategy differs from the previous, in that its outcome creates initiatives to reduce pollutants directly.

List of Enforcement Response Plan Strategies to Reduce Pollutants Directly:

- ❖ Increase enforcement associated with property-based inspections.
- ❖ Increase enforcement of sweeping and maintenance of private roads and parking lots in targeted areas.
- ❖ Increase identification and enforcement of actionable erosion and slope stabilization issues on private property and require stabilization and repair.
- ❖ Increase enforcement of water-using mobile businesses.

4.1.16 Enforcement Response Plan - Improve Structural Systems Performance (Ref 16)

This strategy in the Enforcement Response Plan is assumed to improve structural systems performance through minimum BMP enforcement, which is different from the targeted outcome of the other strategies:

- ❖ Increase enforcement of minimum BMPs for existing residential, commercial, and industrial development, including power washing.

As this strategy targets commercial and industrial areas, consistent benefit category scoring for other strategies which require minimum BMPs is used.

4.1.17 Additional Nonstructural Strategies- Reduce Pollutants Directly (Ref 17)

The remaining Nonstructural strategies related to pollutant reduction are grouped together, and separated from the additional strategies which improve structural systems performance. They are assumed to see habitat related benefits, but due to the broad nature and lack of specific details, that is the only benefit category affected. Additional outreach is assumed to provide Public Education benefits.

List of Additional Nonstructural Strategies which Reduce Pollutants Directly:

- ❖ Address and clean up pollutants from homeless encampments through Homeless Outreach Team
- ❖ Continue participating in source reduction initiatives
- ❖ Coordinate with other City of San Diego Departments to replace City-owned vehicle brake pads with copper-free brake pads as they become commercially available
- ❖ Pesticide Use Reduction
- ❖ Zinc Reduction Program
- ❖ San Dieguito Source Identification and Prioritization Process

4.1.18 Additional Nonstructural Strategies - Improve Structural Systems Performance (Ref 18)

These strategies differ from those which seek to reduce pollutants directly, as these target outcomes to improve structural systems and have specific tasks such as 'actively monitor erosion' are expected to positively impact habitat and flooding benefits. All the strategies which are research studies are assumed to provide public education benefits.

List of Additional Nonstructural Strategies which Improve Structural Systems Performance:

- ❖ Proactively monitor for erosion, and complete minor repair and slope stabilization on municipal property
- ❖ Using adaptive management, delist the beach segment from the TMDL and Attachment E of the MS4 Permit
- ❖ Los Peñasquitos Watershed Special Study
- ❖ Reference watershed study
- ❖ Reference beach study
- ❖ Tecolote Creek Quantitative Microbial Risk Assessment (QMRA)
- ❖ Implement ASBS Compliance Plan
- ❖ Collaborate with City of San Diego PUD and other watershed stakeholders in the Lake Hodges Water Quality Concentration Study. Study will characterize conditions and identify sources.
- ❖ Develop and implement targeted roof replacement incentive program for Chollas

4.1.19 Green Infrastructure (Ref 19)

These strategies produce a large amount of quantifiable benefits due to the research that exists demonstrating the effectiveness of green infrastructure. This means that in most cases, at a minimum, the benefits can be measured. In certain cases, they can be monetized when enough information is available. As the specific strategies vary by watershed, a high level summary is provided.

Several BMPs involve increasing the total area (acres) of bioretention and permeable pavement on public parcels. Other strategies focus on specific target sites such as parks on green lots.

Strategies with specific design features (such as size of bioretention, etc.) allow for the ability to calculate the amount of storm water runoff retained, which can be used in to quantify Flood Risk Reduction, where applicable.

Less information is known about how these systems will fully operate, so it is possible that there could be irrigation cost savings, but such benefits cannot be accurately quantified without additional information. Where instances of irrigation cost savings could occur, some level of emission savings could also occur because of reduced energy use for delivering water.

Changes in biomass at a site (due to green streets plantings, or bioretention) can have quantifiable impacts on air quality and climate. The quantified amount depends on the specific properties of the new vegetation. Assuming that changes in biomass can be quantified, it is possible to suggest that noise reduction is a potential benefit, and local

aesthetics would be improved. Local aesthetics would be quantified by the area of improved land.

An increase in biomass could reduce ambient temperatures, but the scale would be localized and small overall. Thus, we scored this other benefit category as ‘potential.’

In instances where aesthetics are realized, business development can be quantified if enough information is available about the local characteristics of a green Infrastructure site (i.e., the proximity of the site to existing retail businesses).

Projects which provide pedestrian or bike access such as a green street or open space are assumed to provide quantifiable recreational benefits, such as additional miles of walkable or livable streets. The amount of these benefits will depend on data on size of the local population, the area of the site, and site usage.

4.1.20 Green Infrastructure: Green Streets (Ref 20)

Due to the information available regarding bioretention and the size of implementation, it can be assumed green streets will have the same scoring as the green infrastructure projects. As the specific strategies vary by watershed, a high level summary is provided. Several BMPs involve increasing the total area (acres) of green streets on specific avenues or subwatersheds.

4.1.21 Multiuse Treatment Areas: Infiltration and Detention Basins (Ref 21)

This section describes the process for scoring the structural strategies consisting of infiltration and detention basins.

It is assumed that the strategies for both golf courses involve similar wetland system projects, which are assumed to increase total biomass and provide entrainment and sequestration. If the total biomass change can be quantified, air and climate benefits can be measured and monetized.

While underground systems will be able to provide flood risk reduction, which in turn protects local habitats and ecological systems, any benefit categories that depend on changes in the above ground environment (such as habitat benefits) will not be affected, and are indicated as ‘Not Applicable.’ Projects that occur on public land, such as schools, provide the opportunity for educating the public or students about the strategy, and can be quantified by the number of people who learn about the strategy. These benefits depend on the number of students enrolled at the school, or the population of a neighboring community where public outreach about the project occurs.

Where instances of irrigation cost savings are thought to occur, emission savings could occur, but more information would be needed about these projects to determine the extent to which irrigation cost savings are realized.

As the specific strategies vary by watershed, a high level summary is provided. Several BMPs involve the installation of a subsurface detention galley on public parcels. Other options include dry detention systems, sediment basins, infiltration basins, and hyrdomodification BMPs.

4.1.22 Multiuse Treatment Areas: Stream, Channel and Habitat Rehabilitation Projects (Ref 22)

As these strategies target streams and other ecological areas, it is assumed habitats and aesthetics will improve, and can be measured using the area of the project. This strategy is assumed to be similar to the MS4 and Retrofit and Rehabilitation in Areas of Existing Development strategies.

As the specific strategies vary by watershed, a high level summary is provided. Several BMPs involve either wetlands or the Chollas Creek.

4.1.23 Water Quality Improvement BMPs: Proprietary BMPs (Ref 23)

Due to the nature of these projects, a basic assumption is the projects will improve water flow, and flood control and habitat benefits can occur. However, no other benefit categories can reasonably be expected to be impacted until more specific details about the sites and projects are known.

As the specific strategies vary by watershed, a high level summary is provided. Several BMPs involve drainage inserts on public parcels. Others involve hydrodynamic separation systems, dry-weather, or low flow diversions. Some are broader in nature, and provide direction on implementing a certain amount of acres of multiuse treatment area projects on private parcels and/or through public-private partnerships with various total storage sizes.

4.2 Optional Jurisdictional Strategies

This section provides a discussion of the methodology for assigning scoring categories to the Optional Jurisdictional Strategies, as well as sub-categories. Optional strategies are those strategies that may be triggered in the future to achieve the interim and final numeric goals." Many of these strategies are assumed to have a similar outcome and thus a similar other benefit category scoring as their Jurisdictional counterpart. The scores take into account the *potential* benefits that may occur, given the information available, and assumptions that are listed in each strategy. The scoring for these strategies is presented in Section 5, in Table 3 and Table 7. These strategies represent the latest consideration in an evolving process of identification, specification and assessment. Not all strategies have been implemented or have plans for immediate implementation. At the same time, the specification of the design standards also varies from strategy to strategy.

This list of individual strategies has been grouped according to the same categories that are contained in the Water Quality Improvement Plan and are presented in the same chronological order. The information found in the parenthesis next to the strategy group name (*Ref X*), refers to the number in the far left columns of Table 3 and Table 7.

4.2.1 Additional Nonstructural Strategies (*Ref 24*)

Many of these strategies are studies, which until they are completed, and the recommendations are implemented, cannot produce any benefits other than public education at the moment. Additionally, initiatives that involve participating or collaborating with other agencies or organizations are not applicable to other benefit categories at this time. The removal of invasive plants should protect existing habitats.

Additional Nonstructural Strategies include:

Project	Location
Conduct Sustainable Return on Investment (SROI) analysis to estimate strategies' co-benefits and impacts to the public and the private sector on a common scale.	City-wide
Collaborate with the County, if a County-led regional social services effort is established, to provide sanitation and trash management for person experiencing homelessness and determine if the program is suitable and appropriate for jurisdictional needs to meet goals.	City-wide
Identify strategy resources and funding to support mapping and assessment of agricultural operations.	SDG above Lake Hodges
Coordinate with County of San Diego and identify resources and funding to implement a program to target on-site wastewater treatment (septic) systems. May include mapping and risk assessment, inspection, or maintenance practices.	SDG
Participate in an assessment to determine if implementation of an urban tree canopy (UTC) program would benefit water quality and other City goals.	City-wide
Conduct a feasibility study to test Permeable Friction Course (PFC), porous asphalt that overlays impermeable asphalt.	City-wide
As opportunities arise and funding sources are identified, protect areas that are functioning naturally by avoiding impervious development and degradation on unpaved open space areas, creating permanent open space protections on undeveloped city-owned land, and accepting privately-owned undeveloped open areas.	City-wide MB-Rose Canyon
Add permanent open spaces protections to underdeveloped city-owned land in and on the rim of Rose canyon and San Clemente Canyon.	MB, Rose Canyon
Forming a linear "park" from the southern end of Marian Bear Natural Park to the mouth of Rose Creek.	MB, Rose Canyon
Lake Hodges Natural Treatment System Project	SDG: Lake Hodges

Project	Location
If a regional collaboration is established for the Los Peñasquitos Lagoon, participate in restorative efforts in collaboration with TMDL Responsible Parties and TMDL responsible parties and other stakeholders.	Los Peñasquitos Lagoon Subwatershed
Participate in a watershed council or group and support the establishment of a watershed coordinator if one is established.	City-wide
Participate in a watershed council or group and support the establishment of a watershed coordinator if one is established. Includes participation in Rose Creek Watershed Team.	MB, Rose Canyon
Removal of invasive plants.	MB, Rose Canyon

4.2.2 Green Infrastructure – Optional Jurisdictional Strategies (Ref 25)

These strategies follow the same scoring as Jurisdictional Green Infrastructure projects. Under certain circumstances, these Green Infrastructure Strategies could be implemented.

4.2.3 Green Infrastructure: Green Streets – Optional Jurisdictional Strategies (Ref 26)

This strategy follows the same scoring as Jurisdictional Green Streets projects. Green Streets Strategies could be implemented if:

- ❖ If interim load reduction goals are not met and additional green infrastructure is required, the additional acreage of bioretention and permeable pavement can be implemented through green streets if potential opportunities for green infrastructure implementation on public parcels are not available.

4.2.4 Multiuse Treatment Areas: Infiltration and Detention Basins – Optional Jurisdictional Strategies (Ref 27)

These strategies follow the same scoring as Jurisdictional Multiuse Treatment Areas: Infiltration and Detention Basins projects.

4.2.5 Multiuse Treatment Areas: Stream, Channel, and Habitat Rehabilitation Projects – Optional Jurisdictional Strategies (Ref 28)

These strategies follow the same scoring as Jurisdictional Multiuse Treatment Areas: Stream, Channel, and Habitat Rehabilitation projects. List of Stream, Channel, and Habitat Rehabilitation Project includes:

- ❖ If interim load reduction goals are not met and additional stream, channel, and habitat rehabilitation projects are required, implement as needed.

- ❖ Day lighting Cudahy Creek implementation.
- ❖ An example of this would be to lengthen the Genesee Avenue Bridge in Rose Canyon in order to eliminate the berm that bisects the riparian corridor. This would restore the natural riparian corridor and promote wildlife and recreational passage under Genesee.

4.2.6 Multiuse Treatment Areas: Other Opportunities – Optional Jurisdictional Strategies (Ref 29)

This strategy follows the same scoring as Jurisdictional Multiuse Treatment Areas: Other Opportunities projects. Other Opportunity Strategy is defined as:

- ❖ If interim load reduction goals are not met and additional multiuse treatment area projects are required, implement, as needed, on private parcels and/or through public-private partnerships.

4.2.7 Water Quality Improvement BMPs: Trash Segregation – Optional Jurisdictional Strategies (Ref 30)

These projects specifically target street litter or debris, and are assumed to create an aesthetic improvement, and can be quantified with estimates on the volume of litter removed. Depending on the local land-use for the streets targeted, business development could potentially increase. Jobs can also be supported by the money spent on operation and maintenance activities. Trash Segregation Strategies would be implemented under conditions defined as:

- ❖ If interim load reduction goals are not met and additional trash segregation projects are required, implement as needed.
- ❖ If interim load reduction goals are not met and additional proprietary projects are required, implement as needed.
- ❖ If interim load reduction goals are not met and additional dry weather flow separation and treatment projects are required, implement as needed.

5 Results of Assessment

An overview of all the strategies, with the number of benefits, by benefit level, shown in descending order is presented in Table 2 and Table 3. Additionally, the total point value across the other benefit categories is presented in the far right column, with the header 'Total Point Value.' For example, green infrastructure has the greatest benefit score for both the jurisdictional and optional jurisdictional strategies. It is located at the top of Table 2, with a 'Total Point Value' of 7.3. This is calculated by:

- ❖ Multiplying the number of monetizable benefits (2), by their benefit scoring value (1);
- ❖ Multiplying the number of measurable benefits (3), by their benefit scoring value (0.667),
- ❖ Multiplying the number of potential benefits (10), by their benefit scoring value (0.333),
- ❖ Multiplying the number of not applicable benefits (0), by their benefit scoring value (0),
- ❖ Adding the subtotals together results in a total score of $(2 + 2 + 3.3 + 0 = 7.3)$.

A detailed summary of the potential level of impact for each strategy and benefit category is presented in Table 6 and Table 7. For convenience, the number in the far left column, with the header 'Ref,' corresponds to the number next to the strategy group descriptions in the previous sections, and is consistent across all tables. Using Green Infrastructure as an example, the number in the first column of Table 2, (19) can be found in Table 6, and corresponds to the discussion of green infrastructure in the previous section, *Green Infrastructure (Ref 19)*

Table 2: Overview of Jurisdictional Strategies in Descending Order

Ref. ¹	Description of Strategy Group	Category	Strategy Outcome	Monetizable	Measurable	Potential	Not Applicable	Total Point Value	Number of Applicable Benefits
19	Green Infrastructure	Structural	Green Infrastructure	2	3	10	0	7.33	15
20	Green Streets	Structural	Green Infrastructure	2	3	10	0	7.33	15
5	Commercial, Industrial, Municipal, and Residential Facilities and Areas[2]	Non-Structural	Initiatives to Change Behavior	0	5	6	4	5.33	11
21	Multiuse Treatment Areas - Infiltration and Detention Basins	Structural	Multiuse Treatment Areas	2	1	6	6	4.67	9
1	All Development Projects	Non-Structural	Initiatives to Reduce Pollutants Directly	0	0	14	1	4.67	14
2	Priority Development Projects (PDPs)	Non-Structural	Increase # Of Structural Systems	0	0	14	1	4.67	14
3	Construction Management	Non-Structural	Improve Structural Systems Performance	0	0	14	1	4.67	14
4	Commercial, Industrial, Municipal, and Residential Facilities and Areas[1]	Non-Structural	Improve Structural Systems Performance	0	0	14	1	4.67	14
9	Retrofit and Rehabilitation in Areas of Existing Development - Structures	Non-Structural	Increase # Of Structural Systems	0	0	14	1	4.67	14

Table 2: Overview of Jurisdictional Strategies in Descending Order (continued)

Ref. ¹	Description of Strategy Group	Category	Strategy Outcome	Monetizable	Measurable	Potential	Not Applicable	Total Point Value	Number of Applicable Benefits
13	Public Education and Participation: Reduce Pollutants Directly	Non-Structural	Initiatives to Reduce Pollutants Directly	0	0	14	1	4.67	14
15	Enforcement Response Plan: Improve Structural Systems Performance	Non-Structural	Improve Structural Systems Performance	0	0	14	1	4.67	14
22	Multiuse Treatment Areas - Stream, Channel and Habitat Rehabilitation Projects	Structural	Multiuse Treatment Areas	0	2	8	5	4.00	10
14	Enforcement Response Plan: Initiatives to Change Behavior	Non-Structural	Initiatives to Change Behavior	0	1	6	8	2.67	7
10	Retrofit and Rehabilitation in Areas of Existing Development	Non-Structural	Improve Structural Systems Performance	0	2	3	10	2.33	5
16	Enforcement Response Plan: Initiatives to Reduce Pollutants Directly	Non-Structural	Initiatives to Reduce Pollutants Directly	0	2	3	10	2.33	4
12	Public Education and Participation: Initiatives to Change Behavior	Non-Structural	Initiatives to Change Behavior	0	1	4	10	2.00	4
11	Illicit Discharge, Detection, and Elimination (IDDE) Program	Non-Structural	Initiatives to Change Behavior	0	1	3	11	1.67	4
7	Roads, Street, and Parking Lots - Cleaning Maintaining, etc	Non-Structural	Improve Structural Systems Performance	0	1	2	12	1.33	3

Table 2: Overview of Jurisdictional Strategies in Descending Order (continued)

Ref. ¹	Description of Strategy Group	Category	Strategy Outcome	Monetizable	Measurable	Potential	Not Applicable	Total Point Value	Number of Applicable Benefits
8	Pesticide, Herbicides, and Fertilizer BMP Program	Non-Structural	Initiatives to Reduce Pollutants Directly	0	1	2	12	1.33	3
6	MS4 Infrastructure	Non-Structural	Improve Structural Systems Performance	0	0	3	12	1.00	3
18	Additional Nonstructural Strategies: Improve Structural Systems Performance	Non-Structural	Improve Structural Systems Performance	0	0	3	12	1.00	3
17	Additional Nonstructural Strategies: Initiatives to Reduce Pollutants Directly	Non-Structural	Initiatives to Reduce Pollutants Directly	0	0	2	13	0.67	2
23	Water Quality Improvement BMPs - Proprietary BMPs	Structural	Water Quality Improvement	0	0	2	13	0.67	2

1. The reference number refers to strategy groups presented in pages 9-28.

Table 3: Overview of Optional Jurisdictional Strategies by Descending Order

Ref. ¹	Description of Strategy Group	Category	Strategy Outcome	Monetizable	Measurable	Potential	Not Applicable	Total Point Value	Number of Applicable Benefits
25	Green Infrastructure – Optional Strategies	Structural	Green Infrastructure	2	3	10	0	7.33	15
26	Green Streets – Optional Strategies	Structural	Green Infrastructure	2	3	10	0	7.33	15
27	Multiuse Treatment Areas- Infiltration and Detention Basins – Optional Strategies	Structural	Multiuse Treatment Areas	2	1	6	6	4.67	9
28	Multiuse Treatment Areas-Stream, Channel and Habitat Rehabilitation Projects – Optional Jurisdictional Strategies	Structural	Multiuse Treatment Areas	0	2	8	5	4.00	9
29	Multiuse Treatment Areas- Other Opportunities – Optional Strategies	Structural	Multiuse Treatment Areas	0	1	8	6	3.33	9
30	Water Quality Improvement BMPs- Trash Segregation – Optional Strategies	Structural	Water Quality Improvement	0	0	3	12	1.00	2
24	Additional Nonstructural Strategies – Optional Jurisdictional Strategies	Non-Structural	Initiatives to Reduce Pollutants Directly	0	0	2	13	0.67	2

1. The reference number refers to strategy groups presented in pages 9-29.

In Table 6 and Table 7, a detailed summary of the potential level of impact for each strategy and benefit category is presented. For these tables, a key to symbols and point value is presented for each level of impact in Table 4. In some cases, the strategy group includes individual strategies that are classified by different types of strategy outcomes. Table 5 shows the numerical key used in Table 6 and Table 7. To make the evaluation process more transparent, a discussion about the assumptions and rationale for the assignment of a benefit category level to a specific strategy is briefly discussed for each type of Water Quality Improvement Plan strategy following the summary tables. The reference for the discussion below for each strategy is listed in column 1 of Table 6 and Table 7. In addition to presenting point values, the total number of potentially applicable benefits is also shown.

Table 4: Key to Symbols

Symbol	Level of Impact	Point Value
●	Monetizable	1
◐	Measurable	0.67
○	Potential	0.33
⊗	Not Applicable	0

Table 5 provides a key to the number in the column with the header ‘Strategy Outcome.’ For example, the first strategy group listed, All Development Projects, has the number 6 in the ‘Strategy Outcome’ column. The number 6 in Table 5 indicates that All Development Projects are Nonstructural Strategies comprised of Initiatives to Reduce Pollutants Directly.

Table 5: Key to Strategy Outcome

ID	Category of Strategy	Type of Strategy Outcome
1	Structural	Green Infrastructure
2	Structural	Multi Use Treatment
3	Structural	Water Quality Improvement
4	Nonstructural	Improve Structural Systems Performance
5	Nonstructural	Increase the Number of Structural Systems
6	Nonstructural	Initiatives to Reduce Pollutants Directly
7	Nonstructural	Initiatives to Change Behavior

Table 6: Overview of Potential Other Benefits of Water Quality Improvement Plan Jurisdictional Strategies

Ref ¹	Strategy Group	Strategy Outcome ²	Financial		Environmental					Social							Total Point Value	Number of Applicable Benefits	
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship	Noise Reduction			Heat Island Effect
1	All Development Projects	4	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	4.7	14
2	Priority Development Projects (PDPs)	5	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	4.7	14
3	Construction Management	4	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	4.7	14
4	Commercial, Industrial, Municipal, and Residential Facilities and Areas	4	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	4.7	14

**Table 6: Overview of Potential Other Benefits of Water Quality Improvement Plan Jurisdictional Strategies
(continued)**

Ref ¹	Strategy Group	Strategy Outcome ²	Financial		Environmental						Social						Total Point Value	Number of Applicable Benefits	
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship	Noise Reduction			Heat Island Effect
5	Commercial, Industrial, Municipal, and Residential Facilities and Areas	7	● [0.67]	● [0.67]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	● [0.67]	● [0.67]	○ [0.33]	⊗ [0]	○ [0.33]	⊗ [0]	○ [0.33]	○ [0.33]	5.3	11
6	MS4 Infrastructure	4	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	1.0	3
7	Roads, Street, and Parking Lots	4	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	● [0.67]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	1.3	3
8	Pesticide, Herbicides, and Fertilizer BMP Program	6	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	○ [0.33]	⊗ [0]	● [0.67]	⊗ [0]	1.3	3

**Table 6: Overview of Potential Other Benefits of Water Quality Improvement Plan Jurisdictional Strategies
(continued)**

Ref ¹	Strategy Group	Strategy Outcome ²	Financial		Environmental						Social							Total Point Value	Number of Applicable Benefits
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship	Noise Reduction	Heat Island Effect		
9	Retrofit and Rehabilitation in Areas of Existing Development - Improve Structural Systems Performance	5	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	4.7	14
10	Retrofit and Rehabilitation in Areas of Existing Development - Increase the Number of Structural Systems	4	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	● [0.67]	⊗ [0]	⊗ [0]	⊗ [0]	● [0.67]	○ [0.33]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	2.3	5

**Table 6: Overview of Potential Other Benefits of Water Quality Improvement Plan Jurisdictional Strategies
(continued)**

Ref	Strategy Group	Strategy Outcome ²	Financial		Environmental						Social						Total Point Value	Number of Applicable Benefits
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship	Noise Reduction		
11	Illicit Discharge, Detection, and Elimination (IDDE) Program	7	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	● [0.67]	⊗ [0]	⊗ [0]	4	
12	Public Education and Participation: Initiatives to Change Behavior	7	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	● [0.67]	⊗ [0]	⊗ [0]	2.0	4

**Table 6: Overview of Potential Other Benefits of Water Quality Improvement Plan Jurisdictional Strategies
(continued)**

Ref ¹	Strategy Group	Strategy Outcome ²	Financial		Environmental						Social							Total Point Value	Number of Applicable Benefits
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship	Noise Reduction	Heat Island Effect		
13	Public Education and Participation: Initiatives to Reduce Pollutants Directly	6	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	4.7	14
14	Enforcement Response Plan: Initiatives to Change Behavior	7	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	○ [0.33]	● [0.67]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	2.7	9
15	Enforcement Response Plan: Improve Structural Systems Performance	4	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	4.7	14

**Table 6: Overview of Potential Other Benefits of Water Quality Improvement Plan Jurisdictional Strategies
(continued)**

Ref	Strategy Group	Strategy Outcome ²	Financial		Environmental						Social						Total Point Value	Number of Applicable Benefits
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship	Noise Reduction		
16	Enforcement Response Plan: Initiatives to Reduce Pollutants Directly	6	○ [0.33]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	● [0.67]	⊗ [0]	○ [0.33]	○ [0]	● [0.67]	⊗ [0]	⊗ [0]	4	2.3
17	Additional Nonstructural Strategies: Initiatives to Reduce Pollutants Directly	6	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	0.7	2

**Table 6: Overview of Potential Other Benefits of Water Quality Improvement Plan Jurisdictional Strategies
(continued)**

Ref	Strategy Group	Strategy Outcome ²	Financial		Environmental					Social							Total Point Value	Number of Applicable Benefits
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship	Noise Reduction		
18	Additional Nonstructural Strategies: Improve Structural Systems Performance	4	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	1.0	3
19	Green Infrastructure	1	○ [0.33]	○ [0.33]	● [0.67]	● [1]	● [1]	○ [0.33]	○ [0.33]	○ [0.33]	● [0.67]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	7.3	15
20	Green Streets	1	○ [0.33]	○ [0.33]	● [0.67]	● [1]	● [1]	○ [0.33]	○ [0.33]	○ [0.33]	● [0.67]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	7.3	15
21	Multiuse Treatment Areas - Infiltration and Detention Basins	2	○ [0.33]	○ [0.33]	○ [0.33]	● [1]	● [1]	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	● [0.67]	⊗ [0]	⊗ [0]	4.7	9

**Table 6: Overview of Potential Other Benefits of Water Quality Improvement Plan Jurisdictional Strategies
(continued)**

Ref ¹	Strategy Group	Strategy Outcome ²	Financial		Environmental						Social						Total Point Value	Number of Applicable Benefits	
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship	Noise Reduction			Heat Island Effect
22	Multiuse Treatment Areas - Stream, Channel and Habitat Rehabilitation Projects	2	○ [0.33]	○ [0.33]	● [0.67]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0]	○ [0]	○ [0]	○ [0]	○ [0]	○ [0]	4.0	10
23	Water Quality Improvement BMPs	3	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	0.7	2

1. The reference number refers to strategy groups presented in pages 9-29.

2. Strategy Outcome as described in Table 5.

Table 7: Overview of Potential Other Benefits of Water Quality Improvement Plan - Optional Jurisdictional Strategies

Ref ¹	Strategy Group	Strategy Outcome ²	Financial		Environmental					Social						Total Point Value	Number of Applicable Benefits	
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship			Noise Reduction
24	Additional Nonstructural Strategies	6	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	0.7	2
25	Green Infrastructure	1	○ [0.33] └	○ [0.33] └	● [0.67]	● [1]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33] └	● [0.67] └	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	7.3	15
26	Green Streets	1	○ [0.33] └	○ [0.33] └	● [0.67]	● [1]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33] └	● [0.67] └	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	○ [0.33]	7.3	15
27	Multiuse Treatment Areas - Infiltration and Detention Basins	2	○ [0.33] └	○ [0.33] └	○ [0.33]	● [1]	● [1]	○ [0.33]	○ [0.33]	○ [0.33] └	⊗ [0]	⊗ [0]	⊗ [0]	● [0.67]	⊗ [0]	⊗ [0]	4.7	9

Table 7: Overview of Potential Other Benefits of Water Quality Improvement Plan - Optional Jurisdictional Strategies (continued)

Ref ¹	Strategy Group	Strategy Outcome ²	Financial		Environmental						Social						Total Point Value	Number of Applicable Benefits	
			Water Cost Savings	Energy Cost Savings	Flood Risk Reduction	Air Particulate Entrainment	Climate Impacts	Habitat Related Benefits	Air Quality Emission Reduction	GHG Emission Reduction	Property Value Enhancement	Recreational Benefits	Business Development & Jobs	Crime Reduction	Public Education/ Environmental Stewardship	Noise Reduction			Heat Island Effect
28	Multiuse Treatment Areas - Stream, Channel and Habitat Rehabilitation Projects	2	○ [0.33] J	○ [0.33] J	● [0.67]	○ [0.33]	○ [0.33]	○ [0.33] J	○ [0.33]	○ [0.33]	○ [0.33] J	○ [0.33] J	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	⊗ [0]	4.0	9
29	Multiuse Treatment Areas - Other Opportunities	2	○ [0.33] J	○ [0.33] J	● [0.67]	○ [0.33]	○ [0.33]	○ [0.33] J	○ [0.33]	○ [0.33]	○ [0.33] J	○ [0.33] J	○ [0.33]	○ [0.33]	○ [0.33]	⊗ [0]	⊗ [0]	3.3	9
30	Water Quality Improvement BMPs - Trash Segregation	3	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	○ [0.33]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	⊗ [0]	1.0	2

1. The reference number refers to strategy groups presented in pages 9-29.

2. Strategy Outcome as described in Table 5.

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Appendix 1: Sustainable Return on Investment Assessment of Water Quality Improvement Strategies. Draft Report. June 2014

Note to reader: This appendix is a re-print of the Phase 1 Draft Report from this project. Some aspects of the strategies and framework differ from what is included in the main report. The literature review in the following Phase 1 report provides a foundation for all subsequent analysis.

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SUSTAINABLE RETURN ON INVESTMENT ASSESSMENT OF WATER QUALITY IMPROVEMENT STRATEGIES

Draft Report

June 2014

Prepared for:

City of San Diego, Storm Water Division

Prepared by:

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Long Beach, CA 90802

Executive Summary

The aim of this project is to help the City of San Diego Storm Water Division account for the costs and benefits of storm water management strategies. Benefits (sometimes called “co-benefits”) include a variety of outcomes beyond improved water quality that some storm water strategies may achieve. The Division has identified a range of structural best management practices (BMPs (e.g., a constructed runoff reduction system such as a bio-swale), and nonstructural BMP activities (i.e. programs that promote installations of constructed systems, or reduce pollutants directly through education and outreach, for example). The Division now seeks to incorporate information on benefits of strategies into a prioritization approach so that as the Division selects strategies to meet its regulatory requirements, it is generating the best value for the community and local businesses.

This report summarizes the findings of a literature review on storm water management benefits and costs and a programmatic assessment of the Division’s strategies and associated benefits. The purpose of the assessment is to determine which types of benefits, beyond water quality improvements, might arise from the Division’s different storm water management strategies and to determine if and how these benefits can be quantified, and included in a decision making framework.

Our findings in this report indicate that many types of benefits can accrue to local residents, businesses, and the general public. Common types of benefits that have been evaluated in a number of cities around the U.S. include flood risk reduction, reduced energy consumption (and associated air quality emissions), and improved aesthetics. Computing benefits of BMPs has been standardized to some extent in the Center for Neighborhood Technology (CNT) report which outlines the data and calculations for a number of benefits (CNT, 2010). For the Division, a similar calculation process could be implemented and it would be consistent with efforts implemented in other cities. However, a significant level of uncertainty would arise in preparing such estimates without specific data on BMP designs and activities for each strategy as well as site specific information about where they would be implemented.

The City developed several dozen storm water management strategies ranging from types of structural BMPs to projects designed to affect public or municipal employee polluting behavior. Some of the strategies listed are assessment projects that provide information necessary to make decisions or to implement a subsequent non-structural strategy. To initiate this study, we grouped the strategies into specific categories:

- Structural
 - Green Infrastructure
 - Multiuse Treatment Areas
 - Water Quality Improvements

- Non Structural
 - Results in increases in the number of structural systems
 - Results in improved performance of existing structural systems
 - Results in changes in behavior that reduced pollutant loads
 - Results in direct removal of pollutants from watersheds

The next best evaluation strategy for the Division at present would entail a simplified assessment of the likely *existence* of quantifiable net benefits for each strategy. In this report, we have evaluated the degree to which benefits can be quantified (and potentially monetized) for each type of strategy. A net result of benefits exceeding negative attributes has been qualitatively assessed based on findings in the literature. This is not to say that the benefit would be greater than implementation costs, but that co-benefits would likely exceed negative impacts to the community of implementing the strategy.

The results of this assessment are shown in Table 1. A “Yes” in one of the table cells indicates that there would be sufficient evidence to quantifiably determine the value of a strategy, provided that information about the strategy and implementation location is better understood. In this high-level summary, it may be assumed that if a quantifiable benefit exists, they would be large enough to generate observable public value and influence decisions accordingly.

These initial findings however must be developed in more detail to provide practical use in prioritizing strategies for the Division. In particular, the feasibility of estimating benefits must be assessed for each individually identified strategy (see Appendix 2), not its strategy group as shown in Table 1. With this information, the Division can establish an initial indication of specific strategies that provide the best value. This effort is planned for phase two of this project.

Table 1: Summary of Evidence for Estimating Benefits for Structural and Nonstructural Strategies

Strategy	Structural			Nonstructural			
	Green Infrastructure	Multituse Treatment Areas	Water Quality Improvement	Increase # Of Structural Systems	Improve Structural Systems Performance	Initiatives To Change Behavior	Initiatives To Reduce Pollutants Directly
Flood Control	YES	YES	YES	YES	YES	YES	
Irrigation Cost Savings	YES			YES	YES	YES	
Energy Cost Savings	YES			YES		YES	YES
Air Particulate Entrainment	YES			YES		YES	YES
Climate Impacts	YES			YES		YES	YES
Habitat Related Benefits							
Air Quality Emission Reduction	YES			YES		YES	YES
GHG Emission Reduction	YES			YES		YES	YES
Heat Island Effect	YES	YES		YES	YES	YES	
Aesthetics	YES	YES		YES	YES	YES	YES
Recreational Benefits	YES	YES		YES	YES	YES	YES
Noise Reduction							
Business Development & Jobs	YES			YES	YES	YES	YES
Crime Reduction							
Public Education/ Environmental Stewardship							

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Acronyms

BCA – Benefit Cost Analysis
BES – Bureau of Environmental Services
BMP – Best Management Practice
Btu – British Thermal Unit

CAMX - California-Mexico Power Area
CEA – Cost-Effectiveness Analysis
CLRP – Comprehensive Load Reduction Plans
CNT – Center for Neighborhood Technology
CO₂ – Carbon Dioxide
CSO – Combined Sewer Overflow

DOT – Department of Transportation

EIA – Economic Impact Analysis
EPA –Environmental Protection Agency

IDDE – Illicit Discharge, Detection, and Elimination

kWh – Kilowatt Hour

LACDPW – Los Angeles County Department of Public Works
LID – Low Impact Development

MMSD – Milwaukee Metropolitan Sewage District

MODA – Multi-Objective Decision Analysis
M Wh – Mega Watt Hour

NRDC – Natural Resources Defense Council

NO_x - Nitric oxide and nitrogen dioxide

NPV – Net Present Value

O₃ – Oxide

PFC – Permeable Friction Course

PM – Particulate Matter

PWD – Philadelphia Water District

SO₂ – Sulfur Dioxide

SPU – Seattle Public Utilities

SROI – Sustainable Return on Investment

TBL – Triple Bottom Line

TIGER – Transportation Investment Generating Economic Recovery

TMDL – Total Maximum Daily Load

UTC – Urban Tree Canopy

WAMP – Watershed Asset Management Plan

WERF – Water Environment Research Foundation

WQIP – Water Quality Improvement Plan

1 Introduction

The City of San Diego Storm Water Division (Division) seeks a framework for prioritizing storm water management strategies that have been identified as part of the Water Quality Improvement Plans for each watershed. These strategies include a range of best management practices (BMPs) in structural systems (i.e., a constructed runoff reduction system, such as a bio-swale), and nonstructural activities (i.e. programs that promote installations of constructed systems, or reduce pollutants directly through education and outreach, for example). Each of the identified strategies is intended to contribute to meeting Total Maximum Daily Load (TMDL) regulatory requirements.

At the same time, each strategy can also provide *additional* benefits (sometimes called “Co-benefits”) to the community. Depending on the type of strategy, such benefits can include flood risk reduction, reduced energy consumption and associated air quality emissions, improved aesthetics and habitat creation. Of course, not all BMPs generate positive benefits – property damage can occur if infiltration systems are poorly performing or additional street sweeping miles would increase air pollution costs.³ Whatever the case, accounting for such benefits is challenging because each one is measured in different units and data is rarely available to quantify existing conditions and predicting changed conditions. Even so, estimating benefits can contribute to decision making. WERF (2014) notes that while a number of studies have shown storm water BMPs to be cost-effective and efficient at achieving water quality goals, traditional engineering costing methods fail to adequately value the multiple benefits and improved life-cycle costs that storm water BMPs provide.

The Division has contracted HDR to apply its *Sustainable Return on Investment (SROI)* process to develop a sound prioritization framework that accounts for storm water management benefits. SROI is an economics-based approach to evaluating and communicating the economic benefits and expenditure-based impacts across a *triple bottom line* – the financial, environmental and societal outcomes of a project. The process includes: (a) transparent review of evidence; (b) economic framework for evaluation; (c) workshop-based discussion of evidence; and (d) accounting for risk and uncertainty in key drivers of outcomes. SROI is a proven process, having been implemented in billions of dollars in capital projects over the last 8 years. In this project, we apply SROI to evaluate key economic benefits and use this to develop a sound framework for prioritizing strategies.

This document discusses our initial tasks in this effort. We report on findings from a literature review for substantiating the existence of such benefits, and an evaluation of strategies, to assess how different benefit categories may apply. We also discuss an initial assessment of the applicability of different types of benefits for individual BMP strategies. In addition, we report on an introductory workshop with stakeholders on the concept of storm water management benefits and frameworks to include estimated benefits in decision making. In addition, this phase will also determine the methods to account for co-benefits in qualitative, quantitative or monetized metrics.

³ To make the discussion more concise, “Benefits” refer to both positive and negative outcomes.

2 Literature Review on Storm water Management Benefits

Conceptual frameworks and empirical evidence on economic benefits of storm water management have been developed in a number of studies. This chapter characterizes this evidence to establish a foundation for understanding the types of benefits from storm water management that are included in project evaluations in a SROI process. The findings of this literature also indicate that the estimation of benefits beyond water quality improvements is an emerging field. The potential for life cycle cost savings of green infrastructure in suitable locations has been fairly well established. Yet, it has been more difficult to establish standards for estimating the benefits from other aspects of BMPs that affect environmental and societal outcomes. Significant uncertainties remain over the degree to which a BMP can generate tangible benefits. In most cases, benefits depend largely on the design and site conditions.

2.1 What are Economic Benefits and Impacts?

Economic benefits are the fundamental measure of a project's overall worth to society.⁴ Storm water management benefits,⁵ whether they relate to avoided flood damage, improved air quality, or energy cost savings are evaluated in the same theoretical framework. Economic researchers assess the value for products and services from data on people's expenditures and their preferences for goods that are not sold (e.g. air quality).⁶ Research can provide a basis for understanding how people value storm water benefits in terms of financial, environmental and societal benefits. Moreover, this evidence can support agency staff in developing strategies to manage environmental investments to maximize environmental benefits per dollar spent (WERF, 2014, Ecosystem Valuation, 2007).

A complementary measure of the worthiness of a project reflects the expenditures to build and maintain it. These expenditures and their connection to the broader economy are defined as *economic impacts*. The expenditures on materials, labor, land, and monitoring over the project lifecycle are implementation costs that are measureable and tangible. Economic impacts of storm water management spending are straightforward to

⁴ Benefits are a somewhat esoteric theoretical economic construct of how people value a product or service. The benefit of a product or service is derived from the premise that some people gain greater *value* from the use of a product or service, especially its initial use, than the price they paid for it. For example, the first glass of water to a thirsty person would be much more highly valued and than the last one consumed, even if the price is the same for each glass. It is further assumed that they would be *willing to pay* some amount to gain that value from it, even if it is above the market price. The idea that a person's willingness to pay can be greater than a market price is a fundamental principal of the value gained by consumers.

⁵ In standard economic terminology, benefits can be *positive* or *negative* depending on whether they are desirable or undesirable. A negative storm water management benefit can arise if flood control measures that entail infiltration cause damage to neighboring properties.

⁶ Goods that are not sold in markets, such as the recreational value from natural areas, can be derived from the expenditures of persons who visit these areas, or the responses of people to responses to structured surveys which to determine a willingness to pay for the hypothetical avoidance of some undesirable impact to such areas.

estimate since expenditures are readily estimable and the wider economic impacts can be assessed using economic impact multipliers. Results from economic impact analysis, such as the numbers of jobs created from storm water management strategies reflect the impact on the overall economy and can be estimated at the local, regional and even national levels.

2.2 What are the Key Economic Benefits of Storm water Management?

A growing number of researchers have evaluated the economic benefits and impacts of storm water BMPs in addition to cost savings (See: EPA, 2013; WERF, 2014; and CNT, 2010). Some of the most commonly cited benefits stem from the functional ability of BMPs to reduce the risk of flood damage, costs of public infrastructure, and pollution and water treatment costs. EPA (2013) research on case studies of economic benefits of low impact development and green infrastructure revealed that a number of benefits can be characterized along the triple bottom line (Table 2).

Table 2: Examples of Potential Benefits from Green Infrastructure

Environmental benefits	Financial benefits	Societal benefits
Improved water quality	Reduced construction costs relative to grey infrastructure	Improved aesthetics
Improved air quality from trees	Reduced scale of grey infrastructure design	More urban greenways
Improved ground water recharge	–	Increase in public awareness of storm water management
Energy savings from reduced air conditioning	–	Reduced flash flooding
Reduced greenhouse gas emissions	–	Green jobs
Reduced urban heat stress	–	Increase in economic development from improved aesthetics
Reduced sewer overflow		

Source: EPA (2013)

Estimating benefits however can be challenging because of a lack of data on the physical changes and value of such changes. Data gaps can arise for either or both existing site conditions (prior to project implementation) or predicted changes in conditions (after implementation). In all cases, data must be collected at a specific site and project to develop credible benefit estimates. Where data gaps exist, analytical decisions can be made with respect to evaluating some types of benefits in qualitative terms (such as multi-objective decision analyses) or by quantifying uncertainty (using Monte Carlo simulation).

Several categories of benefits have been identified and described in published literature on storm water management benefits. This section reports on results from a literature review that focused on defining benefit categories and describing the conditions when it

can arise. More detail on values and calculation methods are discussed in the Appendix 1. To facilitate the understanding of benefits, several groups of benefit categories are defined including: runoff retention/ detention, energy cost savings, air quality improvements, ecosystem services, and community livability. The categories of benefits in each of these groups are described below.

2.2.1 Runoff Retention / Detention Benefits

Several types of green infrastructure (e.g. green roofs, bio-retention, permeable pavement, rain barrels, etc.) are designed to detain, retain and/or infiltrate rain where it falls. Corresponding reductions in storm water runoff lower the total and peak volumes in the storm water system. Benefits of runoff retention / detention include a reduction in downstream flood risk to properties, and reduced irrigation costs for property owners, that is, if the retention systems can supplement irrigation needs. Another potential benefit includes any reduction in erosion in streams and corresponding habitat impacts, but this are rarely evaluated due to data limitations. The effectiveness of green infrastructure in reducing runoff and generating benefits is determined by several factors including local precipitation characteristics, design capacity and maintenance practices over its functional lifespan.

Flood Risk Reduction: Reduced runoff can reduce the frequency and severity of flooding in neighborhoods that are particularly susceptible to it. The effectiveness of green infrastructure on flooding depends on the design capacity and rainfall conditions, scale of implementation across a watershed, soil characteristics (for systems that facilitate infiltration), and watershed characteristics.⁷ In addition, if the storm sewers are connected to combined sewer systems, the reduced volume can generate operational cost savings at the wastewater treatment plant.⁸ The value of flood control is estimated as a reduction in property damage if flooding occurs.

Irrigation Cost Savings: On-site water retention in rain barrels or other similar systems can supplement irrigation needs in yards and gardens. Available captured water can generate an added benefit of reducing potable demand for irrigation and associated costs for owners. Key drivers of the life cycle cost savings for these systems include local rainfall characteristics (e.g. frequency and depth), storage capacity and water rates. The extent to which these systems can generate irrigation cost savings above installation costs (maintenance costs are often low), depends on the demand for irrigation and ability to meet this demand with stored water. For property owners, supplemental irrigation directly reduces the volumes demanded from public sources and its costs. From a utility and public perspective, reductions in water volumes demanded translate into lower levels of energy consumed for water treatment, which in turn reduces air contamination and greenhouse gas emissions (these benefits are discussed in Section 2.2.3).

⁷ Kane County, IL and Lenexa, KS evaluated flood control benefits of future land development scenarios (EPA, 2013). However, because these benefits are site-specific, the results cannot be generalized to other sites.

⁸ Wastewater treatment operational cost savings, in the context of combined sewer systems, include reductions in: (a) treatment costs; (b) air pollution emissions; and (c) greenhouse gas emissions (CNT, 2010).

2.2.2 Energy Cost Savings Benefits

Several aspects of green infrastructure can lower energy use and generate cost savings. For instance, green roofs and trees can change the gain or loss of energy in buildings, and in turn decrease costs for heating or cooling (NRDC, 2013).⁹ These benefits are influenced by several site and design factors and accrue directly to property owners.

Energy Cost Savings: Site-specific research has shown that the shade that trees provide adjacent buildings and the additional insulation of green roofs on buildings can lower the heating and cooling energy costs in buildings. Of course, the effectiveness of these BMPs in lowering energy use depends on many factors including the BMP design, type of plant material, building characteristics, and climate conditions (CNT, 2010). In addition, for trees, the benefits would not be realized for several years until they have reached a height and width that provides noticeable shading. In another example, green roofs and other storage systems have been installed at water utilities and have provided a supplemental water source that has reduced energy and operational costs for pumping (EPA, 2013).¹⁰ These costs savings would constitute a benefit directly for the utility, and by extension to its rate-payers.

2.2.3 Emissions Reduction Benefits

Generation of electricity is reduced when green infrastructure (e.g. green roofs or trees) reduces energy demand in buildings, or when water harvesting reduces energy demand at treatment plants. Reductions in electricity demand means that some amount of burning fossil fuels is avoided. As a result, there would be a reduction in the harmful emissions of criteria air contaminants (e.g. NO_x, SO_x, PM, etc.) and greenhouse gas emissions. The U.S. electrical grid enables energy to flow from a large interconnected network and makes it nearly impossible to link a specific source of generation with a particular use. Still, it is possible to generalize over the types of energy consumed in a State and to use this information to characterize how a reduction in energy consumption leads to a reduction in pollution. The benefit of emissions reduction is then estimated using established economic valuation standards.

⁹ These cost savings are additive to air pollution emissions savings from avoided energy generation (EPA, 2013).

¹⁰ The L.A. County Department of Public Works in its Sun Valley Watershed Management Plan accounted for decreased energy demand for pumping water because the harvested and infiltrated water provide supplemental supplies. (EPA, 2013)

Air Pollution Emission Reduction: The total amount of reduction in criteria air contaminant emissions from a power plant is directly tied to the reduction in energy use in a specific location. Energy savings are readily converted to its emission rate reductions by utilizing data from EPA and other public sources. The economic value of lower air pollutants is inferred from its impact on human health and lower medical costs. The reduction of each type of criteria air contaminant has a different economic benefit value per ton. Evidence of the conversion of a reduction in emissions to economic benefits relies on published economic research and from Federal regulatory rule-making, in which values are ultimately approved by the US Office of Management and Budget.¹¹

Greenhouse Gas Emission Reduction: Similar to criteria air contaminants, greenhouse gas emissions from energy generation also cause economic damages. The tons of greenhouse gas emissions are computed from the same data sources as criteria air contaminants. The value of lower greenhouse gas emissions is linked to a reduction in in long-term damage to the global economy. While the Federal government provides guidelines on the value per ton of greenhouse gas emission reduction, other agencies have used different values. For example, the Portland Bureau of monetized this reduction in carbon emissions due to cooling and heat savings in buildings with Ecoroofs (EPA, 2013).

2.2.4 Ecosystem Service Benefits

Green infrastructure such as green roofs, bio-swales and trees can also provide a number of additional environmental and ecosystem services. These include entrainment of air particulates, carbon sequestration and habitat creation. Each of these benefit categories is directly related to the plant material that is installed as part of the green infrastructure system. Accrual of benefits depends on a variety of design and site conditions though research is available to quantify some of the physical performance measures of green infrastructure. Estimation of economic benefits at a new site would in most cases require new research at that site since limited information has been broadly developed.

Air Particle Entrainment: Some green infrastructure systems have the ability to uptake pollutants directly from the environment, which reduces adverse human health impacts. The criteria air contaminant pollutants that can be entrained include nitrogen dioxide (NO₂), ozone (O₃), sulfur dioxide (SO₂) and particulate matter classifies as PM₁₀.¹² Key drivers of these benefits include the amount (in square

¹¹ Many economic values originally come from regulatory rule-making in which an economic analysis is reviewed and ultimately accepted by the Office of Management and Budget before the rule becomes a law.

¹² The Charlotte-Mecklenburg Storm Water Services, serving an area of 526 square miles, included these entrainment benefits when analyzing their reforestation in their LID/GI approach, as it is relatively inexpensive but offers large benefits in terms of air quality and storm water management, the county has simply committed to making reforestation a priority (EPA, 2103)

footage, or number of trees) of green infrastructure, as well as the current levels of criteria pollutants, and size of the local population, especially those whose health is more vulnerable to environmental conditions. The quantified amount of pollutants entrained can be monetized using the same economic values per ton that are applied in the air pollution emission reduction calculations.

Carbon Sequestration: Carbon sequestration is the process of storing carbon in biomass and soils as atmospheric carbon dioxide is taken up by trees, grasses, and other plants through photosynthesis. The amount that can be sequestered is dependent on the above ground biomass of the tree, green roof or bio-swale. Sequestration benefits only last as long as the plants or trees are alive and that they vary with the age of the vegetation. Carbon sequestration rates depend on the type of species and location where it is grown (Pepper, 2012). Carbon sequestration in green roofs can have high variability due to roof age and substrate depth.¹³ Other factors that affect carbon sequestration in green roofs are geographic region, plant species and roof management or maintenance (Getter, K. L. et al., 2009; Wise, S. et al., 2010; City of Portland BES, 2010; CNT, 2010). In addition, healthy and large trees can store about 1000 times more carbon than smaller trees and if those trees have a long lifespan they also tend to be the biggest contributor to carbon removal (Nowak, D. J. & Crane, D. E., 2001; Escobedo, et. al. 2012; McPherson, E. G. et al., 2007; CNT, 2010). The value of carbon sequestration is estimated with the same benefit parameters as with greenhouse gas emissions.

Habitat Related Benefits: Green roofs, rain gardens and other vegetated infiltration systems can improve the habitat for flora and fauna, such as bird and insect species. These different types of habitats are usually small in size and have limited impacts. But, it is conceivable that greater benefits may arise from large-scale strategies that are connected to habitat corridors. Limited research is available to directly assess the economic value of habitat creation. As a first step, a biological survey would be required to assess current conditions and to evaluate potential changes in flora and fauna habitat and other ecosystem services. Valuation of these changes though would remain difficult because of a lack of economic research on the benefits of small scale habitats. Potential proxy values may be drawn from wetland valuation research for some types of green infrastructure, but developing accurate estimates would be highly uncertain. Still, in some studies such as the benefit cost analysis in Ann Arbor, the value of habitat creation is estimated (ECONorthwest, 2011).

¹³ One study indicated that three roofs with similar substrate depth had increased carbon with age of the roof and vegetation. Data from another study showed green roofs stored, on average, between 60 to 240 grams of carbon per square meter in the aboveground plant and between 30 and 185 g C·m⁻² in belowground biomass.

2.2.5 Community Livability Benefits

A series of quantifiable and qualitative benefits also enhance the quality of life across a community. Emerging research on these benefits stems in part from the ways in which *social capital* forms and grows in a community. For example, the Portland Bureau of Environmental Services writes “social capital is the benefits that individuals and communities derive from having social contacts and networks throughout their communities and is based on the notion that individuals who interact with each other will support each other to the benefit of the entire community” (Portland BES, 2010). Green infrastructure, and especially ones that encourage use of the outdoors, can help induce interactions and connections across the community. This includes the personal value of health and recreation, as well as an improvement in the level of investment in business district.

Reduced Health Effects - Heat Island Related Impacts: The term “heat island” describes a landscape characteristic in which cities tend to be hotter than nearby rural areas.¹⁴ These hotter temperatures come from the radiant heat off of impervious surfaces and buildings, and a lack of plant material to produce evapotranspiration that cools the air (EPA, 2008; Grimmond, C. et al., 2010; Wise, S. et al., 2010; Burden, D., 2006; City of Portland Bureau of Environmental Services, 2010; Grimmond, C. et al., 2010; and Stratus Consulting Inc., 2009). Across a city, higher temperatures can lead to adverse health effects on people (e.g. respiratory difficulties, exhaustion, heat stroke and heat-related mortality), particularly older and more vulnerable populations.¹⁵ Green infrastructure can reduce temperatures and lead to lower health effects if implemented widely across a city. Urban trees, for example, emit low volatile organic compounds (VOC), and reduce air temperatures through transpiration. Research has shown that trees can reduce local temperatures up to 8.7°F compared to impervious surfaces. In Chicago, a study showed substantial differences in roof surface temperatures between green and conventional coverings. The effect of green infrastructure on mitigating heat island effects depends on wide scale implementation (Stratus, 2009). Data on the demographics of an area also influence related benefits because certain age cohorts are more susceptible to heat related illnesses than others.

Aesthetic Improvements: Some strategies improve the overall visual appearance of a community simply by having planted material among impervious surfaces. In addition, some BMPs strategies aim to directly reduce litter or debris from public spaces to make it more visually appealing. These aesthetic improvements are difficult to estimate directly but can be observed in differences in the prices on properties which are in the vicinity of aesthetically attractive areas. To estimate benefits of these improvements, property value studies are conducted to isolate

¹⁴ <http://www.epa.gov/heatisland/index.htm>

¹⁵ The heat island mitigation to lowering emission levels of air pollutants and greenhouse gases through the reduced energy demand (via greater air conditioning needs) and lower demand for outdoor irrigation needs. These effects, if they can be quantified, are discussed above.

only a small portion of price differences that relate to being near the green infrastructure installation. A number of researchers have evaluated such property value differences and used them in BCAs. For example, the Alachua County Environmental Protection Department and Public Works Department (in Florida) examined the change in property values due to the county's green infrastructure programs and found that the increase in land values for properties adjacent to some measures (EPA, 2103). The application of findings from one site to another is not always straightforward and depends on site specific conditions.

Recreational Benefits: In addition to providing a pleasant visual experience, certain green infrastructure can provide recreational benefits as well. Philadelphia estimated the number of persons who would use (i.e. walk or bike on) a vegetated acre, as part of their triple bottom line analysis of the Combined Sewer Overflow Long Term Control Plan Update (PWD, 2009). The residents of Alachua County in Florida noted that recreational benefits that stem from green infrastructure were a top priority for the impacts of development. Their concerns for these issues have driven the county's pursuit of GI programs (EPA, 2013). For the Blackberry Creek Watershed Alternative Study, open spaces and natural greenways to preserve and connect significant natural features for valued for aesthetic, recreational, and/or alternative transportation uses (EPA, 2013). Valuation of recreational features stems from economic research on the time and money spent to reach a recreational area.

Noise Reduction: Some green infrastructure systems, such as wetlands or trees, are effective in reducing ambient noise because they can absorb it. CNT (2010) discusses the noise-reducing properties of GI for porous concrete and green roofs, but does not provide a methodology for quantifying these benefits. A case study in Lancaster County, PA notes that positive effects of green infrastructure can arise from noise pollution reduction (EPA, 2014).

Crime Reduction: Researchers from the University of Illinois asked the question "Does Vegetation Reduce Crime?" and came to the conclusion that the greener a buildings surroundings were, the fewer crimes reported (Kuo and Sullivan, 2001). This study examined crime activity levels around apartment buildings in Chicago, and measured differences in the amount of trees and grass cover between sites. Vegetation may deter crime both by increasing informal surveillance and by mitigating some of the psychological precursors to violence. While these are just theories and have not been comprehensively examined, what this research shows is that vegetation does not necessarily facilitate crime by providing cover – a long-held belief among some planners. Instead, a green environment encourages outdoor use, and as such, provides a deterrent because more people are in places where crimes can be committed. The benefits of crime reduction would be derived through data per crime on the avoided costs for the judicial system.

Public Education/Environmental Stewardship. Promoting strategies that seek to change people's behaviors and make them more aware of their environmental impacts helps to cultivate a stewardship perspective in the community about its local natural resources. CNT (2010) notes that community tree planting provides a valuable educational opportunity for residents since in this process they become more aware of the benefits of green infrastructure. Research on urban tree planting has shown that such environmental initiatives make environmentally sound behaviors more likely to occur in the future. Other strategies involving public education and advertising has appeared to be less effective in changing attitudes (Kuo and Sullivan, 2001; and Summitt and Sommer, 1997). The economic valuation of such changes though has not been sufficiently studied for it to be included in a BCA. In this case, only a qualitative assessment of changes in stewardship could be included in a decision framework.

Business Development: Green infrastructure, especially on the scale of a comprehensive green street design can lead to an enhanced sense of place, and increase in foot and bicycle traffic can support retail development. The NRDC found that consumers are willing to spend more on products, visit more frequently, or travel farther to shop in areas with attractive landscaping, good tree cover, or green streets (NRDC, 2013). Case studies by the New York City DOT examined before and after changes in Retail Sales Tax Filings, Commercial Leases & Rents, and City-Assessed Market Value. While the study's methodology does not ultimately prove causality between the street improvement projects and any resulting economic changes, some locations of green street development saw a significant increase in retail sales compared to the changes in retail sales for the borough as a whole.

Job Creation and Economic Impacts: Spending on capital investments and operations and maintenance (O&M) leads to job creation. Moreover, since installation and maintenance of most of these systems requires unskilled labor, the economic benefits of job creation often goes directly to those who may be in most need of work. The total economic impact of capital and O&M expenditures is measured in terms of the number of jobs created, change in income, gross regional product, and sales and property tax revenue. In addition, wider impacts across the region can also be estimated by applying appropriate economic *multipliers*. As an example, PWD (2009) focused on the fact that many of these jobs are for unskilled labor, which provides a valuable social benefit in an urban setting.

2.3 What Evidence Of Benefits Have Been Found Elsewhere?

Economic benefits of storm water management depend on site conditions and characteristics of the green infrastructure systems and program. While CNT (2010) establishes a number of methods for computing benefits, for each set of calculations it is necessary to collect (or establish assumptions) site specific data about BMPs performance and establish analytical standards for the suitability of economic valuation parameters. Despite these constraints and uncertainties, some agencies have pushed forward in collecting data and using these methods. The most recent review of economic evaluations of green infrastructure is found in EPA (2013). This document has developed a fairly comprehensive assessment of the efforts by some utilities to evaluate economic benefits of storm water management. Table 3 presents an excerpt from the EPA (2013) report and indicates that some of case studies performed BCAs, as opposed to other analytical approaches such as cost-effectiveness.

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Table 3: Excerpt of EPA Case Studies on Economic Evaluation of Storm water Management BMPs

Entity	LID/GI program description	Type of analysis	Outcome of analysis
Lenexa Public Works Department, KS	Adoption of LID/GI-oriented development standards, BMPs, and systems development fees as part of the Rain to Recreation program.	Capital cost assessment	Savings of tens to hundreds of thousands of dollars in site work and infrastructure costs with GI BMPs.
Charlotte-Mecklenburg Storm Water Services, NC	Restoration of streams damaged by runoff from development, and BMPs to reduce impacts of rapid development, were assessed to determine impacts on drinking water quality.	Cost-effectiveness	Analysis showed that stream restoration is the most cost-effective way to immediately control sediment in this area.
Capitol Region Watershed District (CRWD), MN	Eighteen BMPs in a 298-acre watershed designed to reduce localized flooding and storm water runoff, improve water quality, enhance recreation in local park.	•Capital cost assessment •Cost-effectiveness	Initial capital cost assessment found substantial cost savings with GI compared with grey infrastructure.
New York City Mayor's Office of Long-term Planning and Sustainability, NY	Distributed GI controls to reduce storm water runoff and CSOs, improve water quality, and increase public access to tributaries, compared to conventional CSO controls such as tunnels and basin storage.	Cost-effectiveness	Cost savings with GI compared to grey infrastructure
Seattle Public Utilities (SPU), WA	Natural drainage system (NDS) projects on residential streets; LID/GI-based storm water regulations and Residential Rainwise Program to encourage customers to reduce the volume of storm water sent to the public system.	Cost-effectiveness	By integrating LID/GI into asset management process, SPU can minimize life-cycle costs to meet established levels of service and balance the risks to minimize life-cycle costs.
West Union, IA	Pilot community for Iowa Sustainable Green Streets Initiative to replace aging infrastructure and reduce localized flooding in downtown area.	•Life-cycle cost analysis •Benefit valuation (avoided costs)	Lower maintenance and repair costs for deicing permeable pavement result in projected savings over the life-span of the pavement.
Kirkland Public Works Department, WA	Integration of LID/GI into conceptual design phase of all capital improvement projects within public rights-of-way.	Quantitative ranking of costs, benefits	LID/GI options for CIP projects are investigated as early in the planning phase as possible.
Kane County, IL	Adoption of county storm water ordinance and corresponding LID/GI-based BMPs, including development approaches that preserve natural areas and use naturalized drainage/retention/detention (i.e., conservation-based development).	Fiscal impact analysis	Study found that conservation development alternative incurs a lower public cost than the conventional alternative.

Table 3: Excerpt of EPA Case Studies on Economic Evaluation of Storm water Management BMPs (Continued)

Entity	LID/GI program description	Type of analysis	Outcome of analysis
Milwaukee Metropolitan Sewerage District (MMSD), WI	Integration of distributed LID/GI strategies into overall planning efforts including facilities plans and CSO control plan; projects on both public and private lands.	•Cost effectiveness •Benefit valuation	Results will be used to help select which projects to implement in the future, and to show where the use of GI is a valid and effective approach
Alachua County Environmental Protection and Public Works Departments, FL	County acquires and preserves open-space lands through ACF program to reduce development impacts and improve water quality.	Benefit-cost analysis (BCA)	Proximity to open space adds to parcel value, for an increase in property tax revenue of several million dollars per year.
Portland Bureau of Environmental Services (BES), OR	Ecoroof Program includes incentives for green roofs on privately owned buildings and green roof requirements for new city-owned buildings.	BCA analysis	Ecoroofs generate significant public and environmental benefits, as well as benefits to developers and building owners (due to extended life of ecoroofs compared to traditional roofs).
Sun Valley Watershed, LACDPW, CA	Goal of watershed-based project was to alleviate localized flooding while providing multiple benefits. Fifteen project elements with LID/GI components.	BCA analysis	Demonstrated potential for multi-objective storm water strategies to provide greater community value than a single-objective flood control strategy would provide.
PWD, PA	Green City Clean Waters Program aims to reduce CSOs and improve water quality in part through distributed GI controls and comprehensive stream restoration program.	BCA analysis	LID/GI-based approaches provide important environmental and social benefits that are generally not provided by grey infrastructure.

A summary of several case studies is presented below. These studies integrated local data with some aspects of the CNT (2010) framework to estimate quantifiable benefits.

Economic Benefits of Green Infrastructure in Milwaukee, WI and Ann Arbor, MI:

ECONorthwest (2011), evaluated benefit analyses of storm water management efforts in Milwaukee, WI and Ann Arbor, MI. In *Milwaukee*, the Department of Public Works - Infrastructure Division, manages infrastructure consisting of about 300 miles of sewer pipes, 3,000 miles of municipal pipes, and 3,000 miles of private laterals. A primary focus is to reduce the quantity of total suspended solids entering its waterways by 40 percent by 2013, as required by the Wisconsin Department of Natural Resources (City of Milwaukee, 2011). The Systems Planning Unit in Ann Arbor has a much smaller management responsibility and consists of just 359 miles of underground pipes and over 11,000 inlets and catch basins to manage storm water (City of Ann Arbor, 2011). In both communities, monetizable, quantifiable and qualitative benefits are evaluated (see Table 4) using the methodology established by CNT (2010). Where appropriate and possible, local data was integrated into calculations to estimate benefits. A number of additional assumptions are made to illustrate the scale of benefits that could arise from a much larger future program.

Table 4: Benefits Evaluated in Great Lakes Study

Quantified and Monetized	Quantified, but not Monetized	Qualitative
Avoided costs of reduced storm water runoff and water quality	Flood Reduction	Public Education
Avoided costs related to water quality benefits	Heat Island Effect	
Avoided costs of additional future gray infrastructure capacity	Aesthetics	
Avoided costs of treatment operations and maintenance for combined sewer flows	Improved health and well-being from recreation	
Energy Cost Savings Benefits	Improving well-being by reducing noise pollution	
Decreased air pollution emissions from reduced energy use		
Improved air quality from vegetation on green roofs and trees		
Reduced CO2 equivalent emissions from reduced energy use		
Increased carbon sequestration from trees and green roofs		
Wetland habitat protection		

Economic Benefits of Green Infrastructure in Lancaster, PA: With a population of 60,000, the city has a combined sewer system (CSS) and needed to address burden on the treatment facility when intense precipitation events occurred. The EPA notes that combined sewer overflows (CSOs) discharge approximately 750 million gallons of untreated wastewater and storm water into the Conestoga River (EPA, 2014). To address this issue, Lancaster County published a Green Infrastructure plan which estimated water quality benefits, but not the additional environmental, social, and economic benefits. The EPA published this case study to highlight and bring awareness to quantify and highlight these benefits. The specific benefits they monetized were energy, air quality, and climate-related benefits. They also estimated the avoided capital costs of gray infrastructure, and the avoided wastewater pumping and treatment costs. The methodology used in quantifying and monetizing the benefits followed CNT (2010). They also made several high-level assumptions with regard to long-term reduction, the future distribution of green infrastructure projects, and when the monetary benefits would begin accruing.

Philadelphia Combined Sewer Overflow Long Term Control Plan Update: The purpose of the City's report was to demonstrate the full range of societal benefits of the Green City Clean Waters Program. The program aims to reduce CSOs and improve water quality in part through distributed GI controls and comprehensive stream restoration program. The analysis helped PWD to determine that a GI-based approach, coupled with targeted grey infrastructure, is their preferred approach for city to follow. A table of the monetized benefits over 40 years is presented below. It is assumed that these benefits arise from a 50% level of LID coverage throughout the city.

Table 5: City-wide present value benefits of key CSO options: Cumulative through 2049 (2009 Dollars)

Benefit categories	Value
Increased recreational opportunities	\$524.50
Improved aesthetics/property value (50%)	\$574.70
Reduction in heat stress mortality	\$1,057.60
Water quality/aquatic habitat enhancement	\$336.40
Wetland services	\$1.60
Social costs avoided by green collar jobs	\$124.90
Air quality improvements from trees	\$131.00
Energy savings/usage	\$33.70
Reduced (increased) damage from SO ₂ and NO _x emissions	\$46.30
Reduced (increased) damage from CO ₂ emissions	\$21.20
Disruption costs from construction and maintenance	(\$5.60)
Total	\$2,846.40

Alachua County Environmental Protection and Public Works Departments, FL:

The county developed a comprehensive low impact development (LID) / green infrastructure (GI) program based on three different components: (1) LID/GI-based land development policies and regulations developed through the county's Comprehensive Plan; (2) Alachua County Forever (ACF), a conservation and land acquisition program; and (3) a unique governance structure designed to increase interdepartmental collaboration to promote the adoption of LID/GI program elements. To demonstrate the benefits of ACF and alleviate public concerns that the program reduces property tax revenue, the county calculated the benefits for the increase in property values from increased open space. This measure was used to compare with any lost tax revenue to acquire, protect, and manage environmentally significant lands in order to protect water resources, wildlife habitat, and natural areas suitable for resource-based recreation. Twelve thousand seven hundred parcels in the county are close enough to open space to show an increase in value due to their proximity to water. The total impact on their value is just under \$150 million, which would result in additional property tax revenues of approximately \$3.5 million per year.

Portland Bureau of Environmental Services, OR. The Portland BES performed an analysis of ecoroofs versus conventional roofs to gain support and increase implementation of ecoroofs in the city. Portland receives an average of 37 inches of precipitation per year, which creates an annual volume of storm water runoff of about 10 billion gallons. As part of its storm water management programs, BES has implemented the Sustainable Storm water Management Program, which focuses on green infrastructure initiatives, including the Ecoroof Program.

Table 6: Value of Benefits from 40,000 SQFT Ecoroof (2008 Dollars)

Benefit categories	Total Over 40 Years
Cooling demand reduction	\$19,983
Heating demand reduction	\$23,509
Carbon reduction	\$845
Improved air quality	\$104,576
Habitat creation	\$25,300
Total	\$174,213

Sun Valley Watershed, Los Angeles, California: The Sun Valley watershed is in the San Fernando Valley, about 14 miles northwest of downtown Los Angeles. It encompasses the communities of Sun Valley and North Hollywood. The watershed is approximately 4.4 square miles and six miles in length from north to south.

The economic analysis was undertaken because the county and other stakeholders needed to show that although the costs of the LID/GI-oriented solutions would be much greater than the cost of traditional infrastructure, and they would yield significantly higher benefits. The results of the analysis were used to help to gain public support, bring in outside partners, and raise funds. The tables below show the descriptions of each alternative the value of alternatives compared to a grey infrastructure scenario.

Table 7: Description of Alternatives for Sun Valley Watershed

	1 - Infiltration	2 - Water Conservation	3 - Storm water Reuse	4 - Urban Storm Protection
Descripti on	Widely Distributed Small Projects	Maximizes Wildlife Habitat	Maximizes Storm water Reuse for Industry	Full Conveyance with Regional BMPs
Retention Basin Size	50-Year	50-Year: Subareas 1-6 10-Year: Subareas 7-8	50-Year	10-Year

Table 8: Values by benefit over 50 years (2002 Dollars)

Benefit	Grey Infrastructure	1	2	3	4
County Flood Control					
Regional damage avoidance	\$64.46	\$64.46	\$64.46	\$64.46	\$64.46
Change in downstream flooding	-\$1.03	\$5.37	\$3.65	\$5.37	\$3.22
City Flood Control	\$10.01	\$10.01	\$10.01	\$10.01	\$10.01
Avoided cost of imported water	\$0.00	\$22.35	\$17.89	\$24.07	\$22.65
Energy Reduction	\$0.00	\$4.30	\$1.70	\$4.30	\$1.70
Air Quality	\$0.00	\$20.50	\$8.10	\$20.50	\$8.10
Greenwaste	\$0.00	\$20.00	\$10.00	\$20.00	\$10.00
Ecosystem Restoration	\$0.00	\$1.86	\$4.04	\$4.58	\$4.48
Recreation	\$0.00	\$23.34	\$23.34	\$23.34	\$23.34
Property Values	\$0.00	\$10.20	\$3.90	\$10.20	\$3.90
Total Benefits	\$73.44	\$270.47	\$295.39	\$274.93	\$239.95

3 Summary of Water Quality Improvement Strategies

3.1 Program Background

The Division has been working for several years with other jurisdictions and community groups to establish Water Quality Improvement Plans (WQIPs) for each of its watersheds. WQIPs draw from the processes in developing Watershed Asset Management Plans (WAMPs) and Comprehensive Load Reduction Plans (CLRPs) which aim to protect, preserve, enhance, and restore water quality in receiving waters. WAMPs provide an understanding of critical assets owned by the Division and the management and investment strategies necessary to deliver required services. CLRPs are efforts to identify BMPs and funding levels needed to comply with TMDL and other storm water regulations established by the Regional Water Quality Control Board. These efforts, as described below, have identified a series of projects and initiatives that have been defined as either structural or nonstructural initiatives.

3.2 Structural WQIP Strategies

3.2.1 Types of Strategies

Structural BMPs are physical infrastructures that are designed for site-specific conditions and placed strategically across a watershed to improve water quality. The effectiveness and feasibility of implementing any of these BMPs varies depending on the design and site conditions. For example, the effectiveness of a BMP in enhanced infiltration capacity of a watershed depends on amenable soil types. Other site-specific considerations include the physical land area available for effective implementation and maintenance. Also, the capital and maintenance costs of a BMP influence its feasibility for the Division, especially in comparison to other BMPs which can be implemented more cost-effectively.

Various types of structural strategies have been identified as potentially suitable for San Diego watersheds and have been classified as one of three types: (1) green infrastructure, (2) multiuse treatment areas, and (3) water quality improvement BMPs.¹⁶ Each of these types of structural BMPs is discussed below.

Green Infrastructure

Green infrastructure covers a range of BMPs that are designed to be integrated in a broader site plan to maintain healthy waters, provide multiple environmental benefits, and support sustainable communities. Green infrastructure is distinguished from other methods by making deliberate and effective use of vegetation and soil to manage storm water (USEPA, 2014). Table 9 presents a series of green infrastructure BMPs that can be integrated into site designs and implemented at the site scale (on-site treatment) or street right-of-way scale (green streets).

¹⁶ San Dieguito Potential Strategies Final Draft 4/11/14

Table 9: List of Structural BMPs – Green Infrastructure

BMP*	BMP Description
Bioretention	Shallow vegetated features constructed in green spaces alongside roads, sidewalks, and other paved surfaces. Bioretention includes an engineered soil media designed to encourage pollutant treatment and water storage.
Infiltration Trenches	Narrow, linear BMPs that have similar functions as bioretention areas with variable surface materials, including rock or decorative stone, designed to allow storm water to infiltrate into subsurface soils.
Bioswales	Shallow, open channels designed to reduce runoff volume through infiltration and pollutant removal by filtering water through vegetation within the channel and infiltration into bioretention soil media. Bioswales can serve as storm water conveyance, but the primary objective is water quality enhancement (often referred to as linear bioretention).
Planter Box	Fully contained system containing soil media and vegetation that functions similarly to a small biofiltration BMP, but includes an impermeable liner and underdrain.
Constructed Wetland	Engineered, shallow marsh systems designed to control and treat storm water runoff. Particle-bound pollutants are removed through settling and other pollutants are removed through biogeochemical activity.
Permeable Pavement	Allows streets, parking lots, sidewalks, and other impervious covers to retain their natural infiltration capacity while maintaining the structural and functional features of the materials they replace. Roads such as highways can include PFC overlays which provide water quality benefits when traditional permeable pavement is not suitable.
Sand Filters	Treatment systems that removes particulates and solids from storm water runoff by facilitating physical filtration.
Vegetated Swales	Shallow, open channels that are designed primarily for storm water conveyance. Pollutants such as trash and debris are removed by physically straining/filtering water through vegetation in the channel.
Vegetated Filter Strips	Bands of dense, permanent vegetation with a uniform slope, designed to provide pretreatment of runoff generated from impervious areas before flowing into another BMP as part of a treatment train.
Green Roofs	Roofing systems that layer a soil/vegetative cover over a waterproofing membrane and can reduce runoff through interception and evapotranspiration.

*Source: San Dieguito River WMA Water Quality Improvement Plan (2014)

Table 10 outlines the expected levels of effectiveness in green infrastructure in handling different types of impacts of storm water, including water chemistry and physical and biological impacts. This chart is adapted from the San Dieguito River WMA Water Quality Improvement Plan (2014) provides an initial indication of the kinds of benefits (beyond water quality improvements) that can be achieved by green infrastructure BMPs. In particular, while trash removal is a water chemistry benefit, its removal from streets can lead to more aesthetically pleasing neighborhoods, which in turn can foster economic value. In addition, depending on the extent to which these BMPs improve

physical and biological factors, there can be follow-on improvements in recreational value and ecosystem value of streams and riparian areas. It is noted here that only constructed wetlands have the potential to generate tangible improvements in habitat or wildlife.

Table 10: Green Infrastructure BMPs and Pollutant Reduction BMP

	Water Chemistry Benefit									Physical and Biological Benefits			
	Bacteria ¹	Metals	Organics	Sediment	Pesticides	Nutrients	Oil and grease	Dissolved minerals	Trash	Flow rate	Volume reduction	Habitat or Wildlife	Aquatic Life
Bioretention	●	●	●	●	●	►	●	►	●	●	●	○	►
Infiltration Trenches	●	●	●	●	●	●	●	●	●	●	●	○	●
Bioswales	●	●	●	●	●	►	●	►	●	●	●	○	►
Planter Boxes	●	●	●	●	●	►	●	►	●	►	►	○	►
Permeable Pavement	►	●	►	●	●	►	►	►	►	●	●	○	►
Constructed Wetlands	●	●	►	●	●	●	►	►	●	●	►	●	►
Sand Filters	●	●	●	●	●	►	●	○	●	►	►	○	►
Vegetated Swales	►	►	►	●	►	►	►	○	●	►	►	○	►
Vegetated Filter Strips	►	►	►	●	►	►	►	○	●	►	►	○	►
Green Roofs	►	►	○	●	○	○	○	○	○	●	►	○	►

Key: ● - Primary pollutant reduction; ► - Secondary pollutant reduction; ○ - Minimal or no pollutant reduction.

Multiuse Treatment Areas

San Dieguito River WMA WQIP (2014) identifies large-scale treatment areas such as multiuse basins and stream, channel, and habitat rehabilitation projects. These systems are designed as regional facilities that can receive flows from neighborhoods or larger areas and become cost-effective solutions that provide multiple benefits. For example, such systems can be integrated in public spaces such as active (soccer fields) and passive (parks) recreation areas and provide benefits in flood control, ground water recharge, restoration, habitat enhancement, and recreation. In addition streambank projects that reduce erosion can improve water quality and simultaneously improve habitat. Table 11 defines the list of measures considered in San Dieguito River WMA WQIP (2014).

Table 11: List of Structural BMPs – Multiuse Treatment Areas

BMP*	BMP Description
Infiltration and Detention Basins	Large multiuse surface BMPs (on public parcels) that provide treatment through the runoff detention and infiltration (e.g. infiltration basins and dry extended detention basins). These BMPs are designed to hold runoff for an extended period of time to allow water to evaporate into the atmosphere, infiltrate into native soils, or be transpired by vegetation, while accommodating for overflow and bypass during large storm events.
Stream, Channel, and Habitat Rehabilitation Projects	Stream, channel, and habitat restoration or enhancement projects can help sustain habitat for wildlife and provide water quality benefits downstream of these activities.
Other Opportunities	Construction of multiuse treatment areas BMPs on private land to achieve the load reductions. These BMPs are the cost effective and considered a low priority.

Water Quality Improvement BMPs

Additional structural BMPs include systems that supplement the design performance of existing infrastructure. For example, systems that segregate trash includes inlet devices, such as trash guards or racks that capture debris before they enter surface waters. Another example are proprietary commercial products that often aim to use settling, filtration, absorptive/adsorptive materials, vortex separation, and sometimes vegetative components to remove pollutants from runoff. Finally, dry weather flow separation and treatment projects target non-storm water dry season flows and divert these flows for treatment either on-site or to sanitary sewer systems and ultimately waste water treatment plants.

3.2.2 Measuring Impacts of Structural Strategies

The benefits of structural systems - both the type of benefit and the magnitude – depend on the system’s design and surrounding site characteristics. Some strategies such as constructed wetlands can generate a range of benefits (which are partially indicated by Table 10) and may also include recreational and aesthetic values. Most of these benefits accrue to the general public who may have access or benefit from proximity to the wetland. Green roofs, on the other hand, create both public benefits in water retention as well as potential private benefits for property owners in terms of energy savings, from additional roof insulation.

The effectiveness of each structural system in generating benefits is determined directly from key physical features associated with its design. That is, each system benefit, whether it includes flood risk reduction, air quality improvement, or aesthetics, depends on a characteristic of the system that is measured in physical units. For example, flood risk reduction benefits depend fundamentally on the quantity of water retained by the BMP – that benefit’s *unit of measure*.

The unit of measure of green streets (Figure 1) would certainly include the designs of various BMPs on the street such as bio-swales, permeable pavement and tree plantings. In aggregate however, a standard green street design would be measured by its length in miles. In addition, the features and length of the green street may also influence the value of properties on either side of it. Site specific characteristics associated with the type of neighborhood (e.g. mixed use, residential, commercial, etc.), population / employment density, socio-economic characteristics (e.g. income, household size), safety conditions and other factors could influence different types of benefits.

Figure 1: Illustration of Sample Structural BMP: Green Streets



Bioswales: can reduce runoff and downstream flood potential and create aesthetically appealing environment

Permeable Pavement: can reduce runoff and downstream flood potential

Tree Plantings: can reduce runoff and downstream flood potential, entrain harmful particulates, create aesthetically appealing environments, lower ambient temperatures

3.3 Nonstructural Strategies

3.3.1 Types of Strategies

The Division and its stakeholders have also identified nonstructural strategies that may achieve water quality improvements. Nonstructural strategies include “those actions and activities intended to reduce storm water pollution, which do not involve construction of a physical component or structure to filter and treat storm water.” These strategies include administrative policies, creation and enforcement of municipal ordinances, education and outreach programs, rebate and other incentive programs, and cooperation and collaboration with other watershed or regional partners. In general, many of these initiatives have been implemented by the Division for many years and are considered to be integral to regulatory compliance on a watershed-specific basis.

WQIP documents have organized Nonstructural Strategies into a number of categories (see Table 12). These categories include: Development Planning, Construction Management, Existing Development, Illicit Discharge, Detection, and Elimination (IDDE) Program, Public Education and Participation, Enforcement Response Plan, and Non-JRMP Strategies. Across the watersheds and jurisdictions, a long list of potential nonstructural strategies in each category has been developed – reflecting the differing

site characteristics in different locations. A comprehensive list of specific strategies across all of the watersheds is included in Appendix 2.

Table 12: Nonstructural Strategies

Strategy Category	Strategy Description
Development Planning	Program uses Responsible Agencies' land use and planning authority to require implementation of best management practices (BMPs) to address effects from new development and redevelopment.
Construction Management	Program addresses pollutant generation from construction activities associated with new development or redevelopment.
Existing Development	Program addresses pollutant generation from existing development including commercial, industrial, municipal, and residential land uses. It includes stream, channel, and habitat restoration and retrofitting in areas of existing development.
Illicit Discharge, Detection, and Elimination (IDDE) Program	Program actively detects and eliminates illicit discharges and improper disposal of wastes into the MS4.
Public Education and Participation	Promotes and encourages the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable (MEP), prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.
Enforcement Response Plan	Enforcement of each JRMP is required.
Non-JRMP Strategies	Strategies that are outside of the JRMPs, but are designed to effectively prohibit non-storm water discharges to the MS4, protect the beneficial uses of receiving waters from MS4 discharges, or achieve the interim and final numeric goals identified in the Water Quality Improvement Plan.

3.3.2 Measuring Impacts of Nonstructural Strategies

The economics perspective on nonstructural strategies is manifested in the change that they create, which in turn causes a change in value for the community. In particular, the impact of some nonstructural strategies that are directly related to structural systems, such as new design standards for BMPs, generates value when the design standard is used to improve BMP performance. The value of this nonstructural strategy is captured through the value of the structural systems that are implemented. Other nonstructural strategies directly generate value that is separate from a structural BMP. For example, an educational campaign that aims to reduce litter would directly target people's behavior and its effectiveness would be determined by how many people's behavior is changed. The value of this change would be captured by benefit categories associated with improved community livability and business development.

To reflect these differences in nonstructural strategies, we have developed several categories to differentiate them in terms of how they generate value. These categories include strategies that: (a) Increase # of structural systems; (b) Improve structural systems performance; (c) Initiatives to change behavior; and (d) Initiatives to reduce pollutants directly. The revised grouping of specific nonstructural strategies is briefly described in Table 13.

Table 13: Nonstructural Categories by Type of Impact and Identified Strategies

Changing Behavior to reduce pollutants at the source
Implement pet waste program
Identify and reduce incidents of power washing discharges from nonresidential sites.
Require BMPs to address pesticides, herbicides, and fertilizers issues
Implement Illicit Discharge, Detection, and Elimination (IDDE) Program
Implement a public education and participation program
Enhance education and outreach
Technical education and outreach on the MS4 Permit and WQIP
Implement escalating enforcement responses to compel compliance
Continue participating in source reduction initiatives.
Improve / Maintain BMPs or LIDs
Update BMP Design Manual procedures
Administer an alternative compliance program
Oversee implementation of BMPs during the construction
Require implementation of minimum BMPs for existing development
Gather monitoring information about priority conditions or beneficial uses
Collaborate with entities potentially including, but not limited to:
Increasing # of BMPs or LIDs
For all development projects, ensure source control BMPs
Amend municipal code to encourage LID
Train staff on LID regulatory changes and LID Design Manual.
For PDPs, require implementation of on-site structural BMPs or LIDs
Promote and encourage implementing designated BMPs at residential areas.
Develop pilot project to identify and carry out site disconnections in targeted areas.
Promote and encourage implementation of designated BMPs in nonresidential areas.
Monitor for erosion, and slope stabilization on municipal property.
Identify sites for pilot study to test Permeable Friction Course (PFC)
Identify candidate areas for retrofitting projects
Identify areas for stream, channel, or habitat rehabilitation projects
Enforcement of actionable erosion and slope stabilization issues
Conduct a feasibility study on urban tree canopy (UTC) program
Removing pollutants or sources directly
Implement operation and maintenance activities
Implement controls to prevent infiltration of sewage into the MS4
Implement operation and maintenance activities for public streets
Require sweeping and maintenance of private roads and parking lots in targeted areas.
Develop a program to address and capture trash and debris.
Sanitation and trash management for persons experiencing homelessness.
Protect areas that are functioning naturally.

As mentioned above, the first two of these nonstructural categories relates directly to structural systems themselves. In this case, whether the change in BMP adoption is due to training in the community or general promotion of BMP adoption, the success of these strategies would be determined directly by how many additional BMPs are installed and then by the various benefits generated by their installation. Similarly, new design standards and performance monitoring would be measured by the improvement in the performance of installed structural systems.

On the other hand, nonstructural strategies can generate water quality and other benefits on their own. For example, some of these strategies entail education, enforcement and outreach activities which attempt to alter behavior that leads to water quality pollution. These strategies may at the same time lead to an overall aesthetically better environment with less litter on the street. In addition, programs to promote rain barrels and other water harvesting systems on private property can generate benefits to the property owner and the general public. Measured in terms of their water holding capacity, these systems have the potential to offset water demand for irrigation purposes which has the dual effect of reducing water costs for the owner and water treatment demand from the utility. Lower water demand would reduce energy demanded and associated pollutants.

Figure 2: Illustration of Nonstructural BMP: Water Harvesting



Irrigation costs savings:
Quantity of water retained for irrigation purposes
(retained water also reduces energy emissions from lower energy use at the water treatment plant)

Each of these types of strategies will be discussed in greater detail relative to the benefits that they can generate in the next chapter.

4 Accounting for Benefits of BMP Strategies in San Diego

Discussions above on the economic benefits of storm water management and the varied types of structural and nonstructural BMPs strategies under consideration by that the Division sets up the potential to evaluate strategies with an economic framework. The challenge in performing an economic analysis is that some benefits may not be quantifiable, let alone monetizable. In that case, the Division faces some options in how to account for benefits that are perceived to be relevant in decision making. This section begins with an outline of the types of benefits which could be applicable to different categories of strategies and then closes with a discussion on the options for analytically accounting for benefits with different levels of information.

4.1 Evaluation of Benefits for BMP Strategies

This assessment of the applicability of benefits to different BMP strategies represents an initial effort to characterize and differentiate BMPs by the value that they may create for the economy, environment and community. In a series of tables (Table 14) through Table 17), each category of benefit is evaluated relative to applicability for each type of structural and nonstructural strategy. This initial assessment determines for each strategy type whether a benefit can be: (a) monetized; (b) monetized but depending on site specific conditions; (c) quantified but not monetized; or (d) qualitatively evaluated.

To facilitate the review of these tables, a standard symbol key is created to establish how benefits may be evaluated for each strategy.

Key to Symbols for Table 14 through Table 17	
●	Monetizable
⊙	Monetizable, but site-specific
⊗	Quantifiable
○	Qualitative

The following delineation of how benefits can be evaluated for a general strategy can only be viewed as our initial assessment. Recall that Table 13 briefly identifies individual strategies under each of these major groups. At this stage, only a general indication of applicability of benefits is discussed. Further evaluation of benefits per strategy would be developed in a subsequent report.

4.1.1 Structural Strategies – Economic and Environmental Benefits

Table 14 represents the additional economic and environmental benefits that could arise from various structural strategies. As shown, many benefits are readily monetizable for *Green Infrastructure* strategies. This finding reflects the fact that much of the existing research that can be applied in San Diego has focused on the various BMPs identified as green infrastructure. Such research and the various storm water management BCA case studies that have been produced provide standardized methods, data, and evidence that can be applied to new sites and projects. As noted in the table, with some additional data on site conditions (e.g. evidence of flood risk, and

irrigation demand, for example), many of the green infrastructure systems have the potential to be monetized. Only benefits related to habitat creation would be unlikely to be monetized. The reason is that not only to these types of benefit calculations require detailed biological surveys, but predictions on the improvement in habitat services with green infrastructure are not well understood at present. Any assessment of monetary benefits would be highly uncertainty and thus, this type of benefit is better characterized in quantitative terms, such as in units of habitat area created.

Multiuse Treatment Area strategies differ from green infrastructure because of the scale and placement of these systems. Benefits can arise from these strategies, especially in flood control because of the volumes that can be potentially detained but the quantification of benefits depends on whether there is a downstream flooding risk. The planted material in these systems can provide benefits in air particulate entrainment, carbon sequestration, and habitat creation but the evidence is not established well enough to characterize these impacts in monetary terms. Other benefits would entail a qualitative assessment.

Water Quality Improvement strategies do not have as clear an impact on economic and environmental benefits as green infrastructure and multi-use treatment areas. For example, trash guards or racks that capture debris before they enter surface waters can improve fish habitat but do not have enough supporting documentation to clearly assess benefits from some of the improved livability characteristics. If less trash in surface waters can be attributed to less trash on neighborhood streets, associated benefits in business development and social capital could arise, but such a connection is not likely to be quantifiable.

Table 14: Structural Strategies – Economic and Environmental Benefits

Strategy	Green Infrastructure	Multiuse Treatment Areas	Water Quality Improvement
Flood Risk Reduction	●	●	●
Irrigation Cost Savings	●	○	○
Energy Cost Savings	●	○	○
Air Particulate Entrainment	●	⊗	○
Climate Impacts	●	⊗	○
Habitat Related Benefits	⊗	⊗	⊗
Air Quality Emission Reduction	●	○	○
GHG Emission Reduction	●	○	○

4.1.2 Structural Strategies – Community Livability Benefits

Community livability benefits from structural systems (Table 15) represent benefits which directly or indirectly enhance local development and quality of life. These benefits are largely derived from the physical features of structural strategies in creating benefits

to local residents and property owners. For example, green roofs are noted in their ability to provide noise insulation in a building and tree plantings along green streets can lead to local retail business development because the environment is a more pleasant place to shop.

Similar to economic and environmental benefits in the table above, the applicability of community livability benefits to *Green Infrastructure* also depends on site specific characteristics. For example, the influence of aesthetic improvements on property values usually depends on the type of neighborhood (e.g. residential, commercial, or mixed-use areas). In commercial districts, monetized benefits would be observed in property values, increased sales or employment levels.

The other types of strategies, *Multiuse Treatment Areas* and *Water Quality Improvements*, have fewer types of benefits which can be quantified, let alone monetized. *Multiuse Treatment Areas* certainly have the potential to be located in areas that by design can create recreational opportunities. However, the type of features at the site depends on how it can be used for recreational purposes. The choice of plant materials (e.g. tree species) at the site would affect aesthetics and heat island / health effects but it depends on the location and installation scale of these systems. For *Water Quality Improvements*, it is not clear if there are quantifiable benefits that extend beyond water quality improvements themselves and thus, these benefit categories may be evaluated only in qualitative terms.

Table 15: Structural Strategies – Community Livability Benefits

Strategy	Green Infrastructure	Multiuse Treatment Areas	Water Quality Improvement
Heat Island Effect	⊙	⊙	○
Aesthetics	⊙	⊙	○
Recreational Benefits	⊙	⊙	○
Noise Reduction	⊗	○	○
Business Development & Jobs	⊙	○	○
Crime Reduction	⊗	○	○
Public Education/ Environmental Stewardship	⊗	⊗	⊗

4.1.3 Nonstructural Strategies – Economic and Environmental Benefits

The potential applicability of economic and environmental benefits for *Nonstructural Strategies* is presented in (Table 16). As discussed above, some types of nonstructural strategies relate directly to structural systems by *Increasing the Number of Structural Systems* and *Improving the Structural Systems Performance*. Accordingly, estimating monetary benefits in of these is directly linked to whether the influence of a nonstructural strategy on implementing a structural system can be quantified. If so, then

benefits are assessed relative to the structural system itself. The assessment of benefit estimation in the first two columns is therefore similar to that of structural systems, assuming though that the effectiveness of these nonstructural strategies can be estimated.

The two other nonstructural approaches, *Initiatives to Change Behavior* and *Initiatives to Reduce Pollutants Directly*, generate benefits from their own effectiveness in changing behavior or pollution control initiatives. Initiatives to Change Behavior primarily target efforts to encourage improved environmental stewardship and storm water protection throughout the community. Various types of actions then that people may take who are more area of environmental impacts include adoption of rain barrels, reducing litter, and reducing unnecessary levels of pesticides, herbicides and fertilizers. These types of activities could generate a range of economic and environmental benefits, some of which can be monetized if there is sufficient site specific information. In addition, *Initiatives to Reduce Pollutants Directly*, including a number of public agency initiatives in street sweeping, storm water system maintenance and trash removal, can also generate quantifiable and monetizable benefits. On the other hand, street sweeping initiatives entail some amount of environmental costs (or “negative benefits”) associated with emissions from vehicle use. These costs could be compared with any benefits created from cleaner streets.

Table 16: Nonstructural Strategies – Economic and Environmental Benefits

Strategy	Increase # Of Structural Systems	Improve Structural Systems Performance	Initiatives to Change Behavior	Initiatives to Reduce Pollutants Directly
Flood Risk Reduction	⊙	⊙	⊙	○
Irrigation Cost Savings	⊙	⊙	⊙	○
Energy Cost Savings	●	⊗	⊙	●
Air Particulate Entrainment	●	⊗	⊙	⊙
Climate Impacts	●	⊗	⊙	⊙
Habitat Related Benefits	⊗	⊗	⊗	⊗
Air Quality Emission Reduction	●	⊗	⊙	●
GHG Emission Reduction	●	⊗	⊙	●

4.1.4 Nonstructural Strategies – Community Livability Benefits

The effectiveness of nonstructural strategies in enhancing various aspects of community livability are similar to those for economic and environmental outcomes. That is, some of these strategies influence the adoption and performance of structural systems and some aim to change behavior and municipal operations. Also, similar to

the structural strategies for the same types of benefits, fewer of these benefits can be evaluated without some site specific information. For the most part though, the evaluation of potential benefits for green infrastructure has been applied to nonstructural systems that aim to increase the numbers and performance of these systems.

Strategies which seek to change behavior such as proper storage of pesticides or the use of rain barrels/water harvesting can have a positive impact, but the scale of that impact will be dependent upon factors such as the number of persons or households who change their behavior. This same uncertainty applies to strategies to reduce pollutants directly. While there is likely to be a net positive impact on society, these impacts on the broader quality of life are less clear. With respect to improved education and awareness, it is possible to quantify the numbers of people who attended a class or have been exposed to an advertising campaign, it is less clear how this information changes behavior or leads to increased number or maintenance of BMPs.

Table 17: Non Structural Strategies – Community Livability Benefits

Strategy	Increase # Of Structural Systems	Improve Structural Systems Performance	Initiatives to Change Behavior	Initiatives to Reduce Pollutants Directly
Heat Island Effect	⊙	⊙	⊙	⊙
Aesthetics	⊙	⊙	⊙	⊙
Recreational Benefits	⊙	⊙	⊙	⊙
Noise Reduction	⊗	⊗	⊗	⊗
Business Development & Jobs	⊙	⊙	⊙	⊙
Crime Reduction	⊗	⊗	⊗	⊙
Public Education/ Environmental Stewardship	⊗	⊗	⊗	⊗

4.2 Review of BMP Prioritization Frameworks

In consideration of the types of benefits that can and cannot be estimated with data for various types of BMP strategies, a number of options are available for summarizing the likely outcomes for decision making. As noted in the tables, some benefit categories are readily monetized under certain conditions and others require site specific information to perform computation. Many other benefits may arise from a specific BMP strategy but cannot be explicitly quantified. Evaluations of any of these benefits for consideration in decision making also entails some significant uncertainties.

Accordingly, several approaches for summarizing benefits and impacts for decision making are available including: cost-effectiveness, benefit-cost analysis, multi-criteria analysis, and SROI. Each of these approaches has strengths and weaknesses for meeting the Division's objectives in developing a prioritization strategy. Overall though,

each method can be implemented in a process that applies principles of economics, even in multi-objective decision analyses which do not require monetization, so that the categories of benefits are not overlapping or over-estimating value.

Cost-Effectiveness Analysis (CEA): This type of analysis focuses on identifying the best value for money in achieving a specific goal, such as storm water reduction. The process is not necessarily identifying the least costly strategy but the one that generates the greatest quantity of a goal per unit of cost (e.g. dollars per gallon of water detained). Costs in these analyses include the capital, maintenance and operations for implementing. This type of analysis is suitable for evaluating projects in which outcomes (benefits) can not be measured in dollar units but can be quantified. Cost-effectiveness analyses often apply a 'knee-of-the-curve' criterion to identify selecting the most cost-effective strategy because beyond this level of investment cost the effectiveness may increase but at a declining rate. These analyses have been used by communities across the country to identify opportunities for saving money while achieving storm water management goals.

Benefit-Cost Analysis (BCA): Since storm water BMPs can offer more benefits than conventional storm water management systems, cost-effectiveness analysis fails to offer decision makers adequate information for evaluating the alternatives (MacMullen, 2007). Benefit-cost analyses attempt to monetize as many benefits as possible to compare results with costs. This approach is a more direct way of accounting for multiple environmental, societal and economic benefits on a common basis and is not limited to a single goal as is often performed in a conventional cost-effectiveness framework. In some cases, direct environmental value cannot be computed directly, but observed from avoided damage costs or inferred from changes in property values. BCAs account for separate evaluation of benefit categories provided that they are not overlapping. In addition, BCA can be used to evaluate the benefits and costs to individual stakeholders, and comparison with strictly financial benefits with combined environmental and societal benefits – all in the same units of measure. The comparison of costs and benefits allows an explicit consideration of the trade-offs in project options. A BCA can determine whether the benefits of preservation (or restoration) are "worth" the costs and when the project is best implemented. In this sense, it ensures that the limited resources used to provide goods and services to society are used in the most efficient way—that is, to achieve the greatest net benefit (NRC, undated). The overall economic worth of an option can be summarized with a Net Present Value (NPV) or Benefit/Cost Ratio (BCR).¹⁷ BCA results do not incorporate perspectives on who gains or loses but whether the overall net

¹⁷ The NPV is the difference between the present value of benefits and the present value of costs. The present value of benefits is the discounted sum of all future benefits. The present value of costs is the discounted sum of all future costs. The BCR is a ratio of the present value of benefits to the present value of costs. It measures how much benefit would be obtained for each unit of cost invested in a project or policy.

benefits justify the investment.¹⁸ Also, where impacts are perceived to be important but a lack of data is available to assign monetary values to it, additional consideration must be given beyond BCA metrics. For example, a trade-off analysis can be used to compare monetary net benefits with non-monetary impacts to determine a best overall value.

Economic Impact Analysis (EIA): The creation of jobs and business development is a direct and tangible measure of value to the community from expenditures to install storm water BMPs. As mentioned above, since these systems can be installed by low-skilled labor, implementation of these types of systems can provide opportunities for some of those who are most in need. Economic impact analyses trace the levels of expenditures on BMPs through the economy to reveal a total impact for the region. Also, green infrastructure tends to use more local labor and materials compared to grey infrastructure and as such would generate a larger local economic impact. The results can be determined in units of numbers of jobs created, increased income, value added, output, and tax revenue. To many stakeholders, these outcomes are more tangible because the results are shown in units that can be related to the unemployment rate and in gross regional product. For decision making purposes, economic impacts are directly proportional to the level of expenditure. As a result, larger projects would appear to provide greater value even if they are not the most cost-effective. These analyses also do not account for benefits that affect the local community and environment.

Multi-Objective Decision Analysis (MODA): For some project impacts, quantitative and monetary metrics are difficult to determine and the appropriateness of any related assumptions would be highly uncertain. MODA formalizes the process of including non-monetary characteristics of a project into decision making. Just like monetary measures, non-monetary measures try to account in a transparent way stakeholders' preferences for certain characteristics. These preferences are the basis for weights on criteria, which are used to compute an index for ranking projects. Non-monetized performance measures may be weighted with monetary values to produce a single performance metric, or reported alongside monetized values for assessing tradeoffs in decisions. These approaches can be as simple as establishing an equal weight and equal score to all benefit categories – whether they can be monetized or not – to sophisticated frameworks in which non-monetary and monetary benefits are scored and weighted in ways that can be consistent with economic principles. The drawback is that weights are subjective and not based on economic theory or evidence.

¹⁸ In theory, an initiative or project would be rated positively if the benefits to some are large enough to compensate the losses of others, assuming some mechanism existed.

Sustainable Return on Investment (SROI): SROI is a proven, economics-based method for appropriately estimating the monetary value of infrastructure. In such cases, the SROI process first identifies measurable performance indicators that can determine the impact of the infrastructure in specific categories of monetizable benefits. In the context of storm water, benefit categories can include those readily monetized as well as those with some quantitative indicators. In this way, SROI uses stakeholder input to estimate values for inclusion in monetary valuation. The SROI process has several notable features that separate it from more conventional evaluation methods. For instance, true to its economics roots, SROI ensures that key performance indicators do not measure overlapping outcomes which would ‘double-count’ benefits. In addition, the SROI process is marked by its transparency in accounting for uncertainty through Monte Carlo simulation. Uncertainty in the performance, cost and unit values of green infrastructure benefits would be modeled with probability distributions that account for the entire range of reasonable outcomes. Through Monte Carlo simulation, the full range of value for each strategy would be revealed and decisions can be made relative to the upside and downside risk. To be transparent, the probability distributions are established through facilitated discussions in a workshop setting.¹⁹ The discussions are guided towards reaching consensus on how to best use available evidence, including the formation of quantitative descriptions of the uncertainty in the data.

Each of these approaches has strengths and weaknesses for the Division’s purposes. For example, BCA is an established approach for evaluating the worthiness of an investment, such as green infrastructure. Benefits which cannot be monetized because they lack sufficient evidence would be treated in a qualitative assessment, but not included in a benefit-cost comparison. In such contexts a MODA approach can be taken to establish weights and scores for non-monetary outcomes and produce an index of value that can be compared with BCA results. Alternatively, an SROI approach can be undertaken that establishes monetary values for all key benefit categories through a collaborative review of evidence and then risk analysis methods are applied to quantify the uncertainty in quantitative and monetary parameters. MODA methods in establishing weights and scores can be used to support SROI results but ultimately with a SROI process, all key categories of benefits would be evaluated in monetary terms.

The next step for the Division is to develop a sound basis for using this information to prioritize BMPs across each watershed. Many challenges arise in prioritizing BMP strategies with the types of varying benefits presented in Chapter 4. Ideally, a prioritizing approach would be objective, based on site-specific and peer-reviewed evidence, account for life cycle outcomes and reflect various sources of uncertainty. Several prioritization options exist that address some of these goals for the framework.

¹⁹ An initial workshop was held in May in San Diego to discuss benefit categories, strategies and decision making frameworks. Comments received from this workshop are included in Appendix 3.

5 Summary of Key Findings

Our findings in this report indicate that many types of benefits can accrue to local residents, businesses, and the general public. Computing benefits of BMPs has been standardized to some extent in the Center for Neighborhood Technology (CNT) report which outlines the data and calculations for a number of benefits (CNT, 2010). For the Division, a similar calculation process could be implemented and it would be consistent with efforts implemented in other cities. However, a significant level of uncertainty would arise in preparing such estimates without specific data on BMP designs and activities for each strategy as well as site specific information about where they would be implemented.

The next best evaluation strategy for the Division at present would entail a simplified assessment of the likely *existence* of quantifiable benefits for each strategy. In this report, we have evaluated the degree to which benefits can be quantified and potentially monetized for each type of strategy. Drawing from the previous tables in Chapter 4, the results of this assessment are shown in Table 18. A “Yes” in one of the table cells indicates that there would be sufficient evidence to quantifiably determine the value of a strategy, provided that information about the strategy and implementation location is better understood. In this high-level summary, it may be assumed that if a quantifiable benefit exists, they would be large enough to generate observable public value and influence decisions accordingly.

These initial findings however must be developed in more detail to provide practical use in prioritizing strategies for the Division. In particular, the feasibility of estimating benefits must be assessed for each individually identified strategy (see Appendix 2), not its strategy group as shown in Table 18. With this information, the Division can establish an initial indication of specific strategies that provide the best value. This effort is planned for phase two of this project.

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Table 18: Summary of Evidence for Estimating Benefits for Structural and Nonstructural Strategies

	Structural			Nonstructural			
Strategy	Green Infrastructure	Multiuse Treatment Areas	Water Quality Improvement	Increase # Of Structural Systems	Improve Structural Systems Performance	Initiatives To Change Behavior	Initiatives To Reduce Pollutants Directly
Flood Risk Reduction	YES	YES	YES	YES	YES	YES	
Irrigation Cost Savings	YES			YES	YES	YES	
Energy Cost Savings	YES			YES		YES	YES
Air Particulate Entrainment	YES			YES		YES	YES
Climate Impacts	YES			YES		YES	YES
Habitat Related Benefits							
Air Quality Emission Reduction	YES			YES		YES	YES
GHG Emission Reduction	YES			YES		YES	YES
Heat Island Effect	YES	YES		YES	YES	YES	
Aesthetics	YES	YES		YES	YES	YES	YES
Recreational Benefits	YES	YES		YES	YES	YES	YES
Noise Reduction							
Business Development & Jobs	YES			YES	YES	YES	YES
Crime Reduction							
Public Education/ Environmental Stewardship							

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Appendix 1: Benefit Calculations

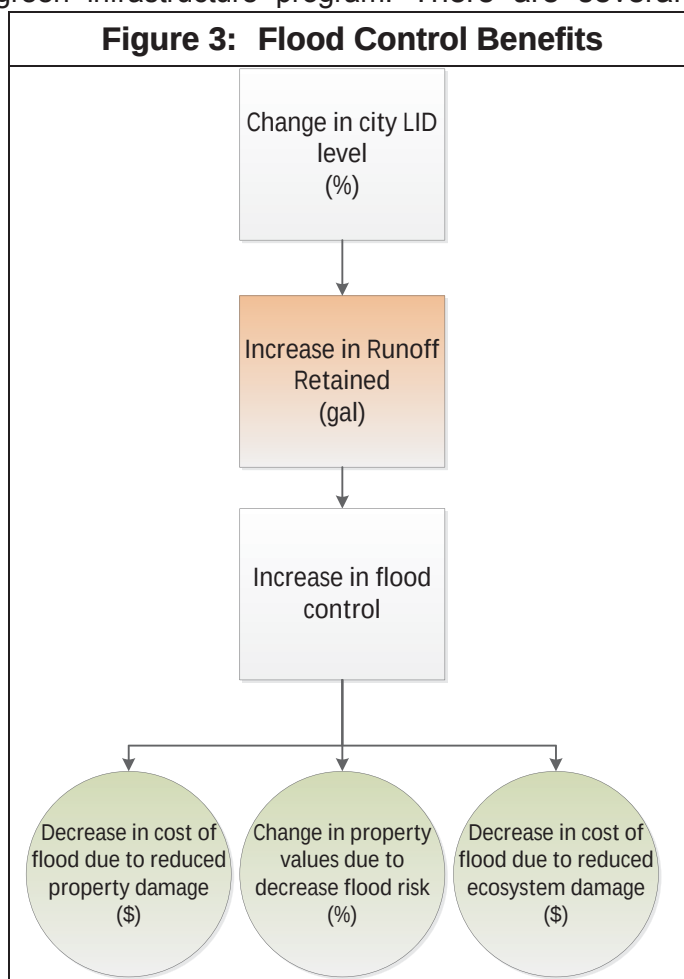
This appendix discusses the quantitative calculations and data involved in estimating benefits for those categories which can be converted to monetary values, given site specific data. Benefit categories that can be readily quantified and monetized are discussed here. Benefit categories that are not included here are: Habitat Creation Benefits, Heat Island Effects, and Environmental Awareness / Stewardship.

Flood Risk Reduction Benefits

By reducing the volume of storm water runoff, the proposed strategies can reduce the frequency and severity of flooding. The impact of green infrastructure on flooding is highly site and watershed specific, and thus this guide does not provide general instructions for quantifying the reduction in flood risk resulting from a green infrastructure program. There are several methods²⁰ for valuing the impact of flood control:

- Hedonic pricing to examine how flood risk is priced into real estate markets;
- Insurance premiums paid for flood damage insurance as a proxy for the value of reducing the risk of flood damage;
- Avoided damage cost approach; and
- Contingent valuation methods

The diagram presents a high level overview of how the benefits could be monetized. The 'Increase in Flood Control' could be monetized using any of the methods suggested above. Some methods have more robust information than others. CNT recommends using a range of 2–5 percent property value increase for removal from the floodplain (CNT, 2010).



²⁰ Downstream Economic Benefits From Storm-Water Management. Journal of Water Resources Planning and Management. Braden, J.B. and D.M. Johnston. November/December, 2004

Irrigation Cost Savings

The method for determining the irrigation cost savings begins with quantifying the reduction in water demand from utilities based on the amount that is harvested on site.

This amount can be calculated by using the various water retention factors for the various green infrastructure and multiplying by the annual precipitation.

A diagram is provided here that determines benefits of retention based on cost avoidance. This information would be used in calculating the Decrease in Potable Water. The cost of the water would be derived from local utilities.

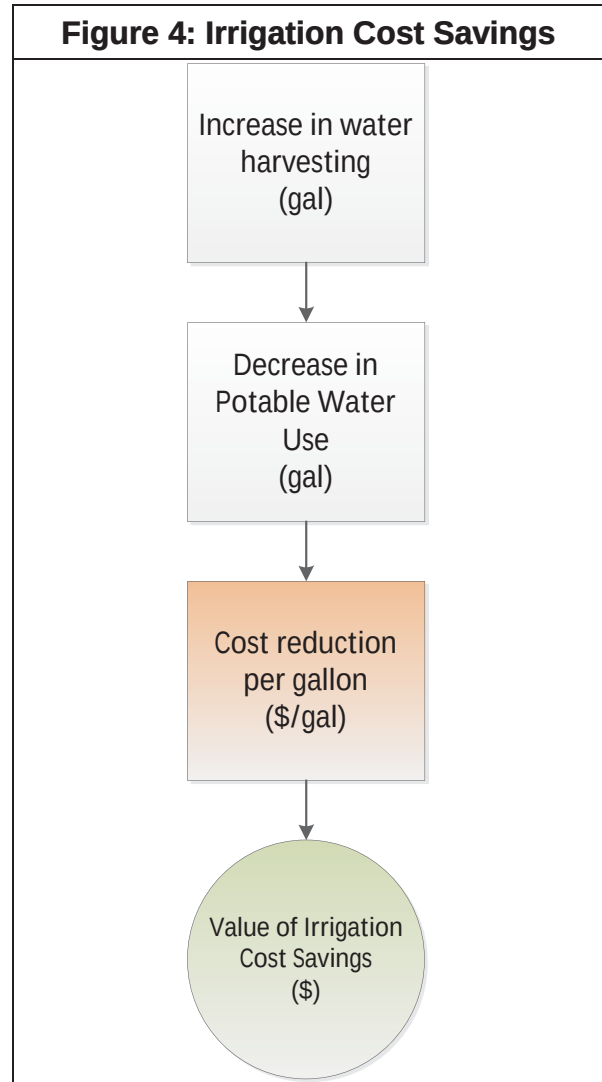


Table 19: Green Infrastructure Retention Parameters

	Amount Retained	Unit	Scale
Water Harvesting	0.62	Gallons of runoff	Per inch of Rain

Source: CNT, 2010, McPherson, E. et al. 2006

Energy Cost Savings

The most important step in this calculation will be the reduced energy needs which will depend on the number of buildings which will benefit from the temperature control provided by green infrastructure and LID and the scale of LID/GI implementation. The data on the physical characteristics of GI to insulate or reduce energy use are provided as well.

The first step to valuing the benefits of reduced energy use is determining the amount of energy saved by BMP. The benefit of energy savings can be terms of kilowatt hours (kWh) of electricity and British thermal units (Btu) of natural gas reduced.

As noted, the total reduction is very specific to the type of improvement/change. The actual benefits realized in terms of energy savings due to the implementation of a green roof will be significantly impacted by the following variables:

- Growing media composition, depth and moisture content
- Plant coverage and type
- Building characteristics, energy loads and use schedules
- Local climate variables and rainfall distribution patterns

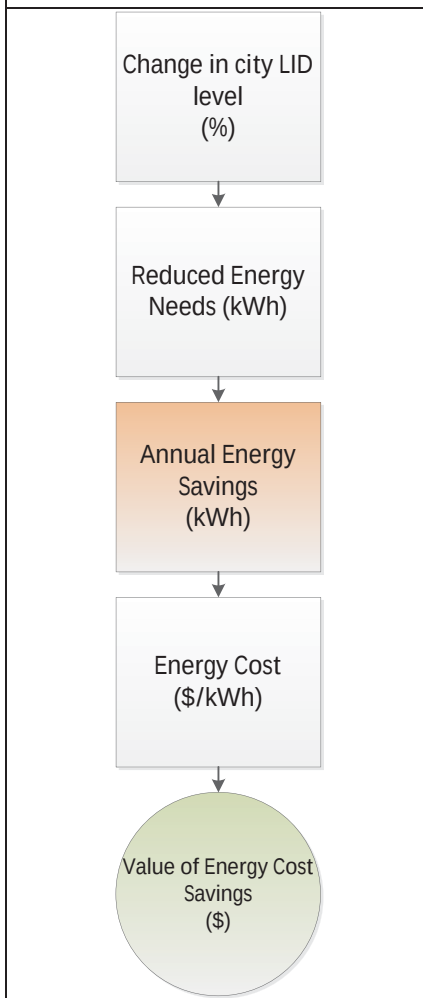
These characteristics will influence the R values for conventional and green roofs in region (which will be used to calculate the annual energy savings from reduced energy needs). Other data needs are:

- Annual number of cooling degree days (°F days) in your region
- Annual number of heating degree days (°F days) in your region

Having calculated the direct kWh and BTU saved in reduced building energy use, it is possible to assign a dollar value to these savings.

One may calculate the direct cost savings by multiplying the kilowatt hours or BTUs of electricity and natural gas, respectively, by local utility rates

Figure 5: Energy Cost Savings



Air Pollution Emission Reduction

Practices that indirectly lower emissions of air pollution include any practices that reduce energy consumption through decreased energy use in neighboring buildings or through reduced water treatment needs.

The kilowatt hours (or million BTUs) of reduced energy from the energy cost savings will be used in calculating the air pollution emission reduction benefit. The total amount of energy saved will be converted to the pounds of criteria pollutants reduced. The values, in dollars per pound, of the pollutants will come from existing guidance from the EPA and other sources that value these pollutants.

The EPA provides estimates for annual output emissions rates of national electricity production and natural gas:

Table 20: Sample Criteria Pollutant Emission Factors

Pollutant	lbs/kWh	lbs/Million Btu
NO ₂	0.001937	0.721
SO ₂	0.005259	0.266

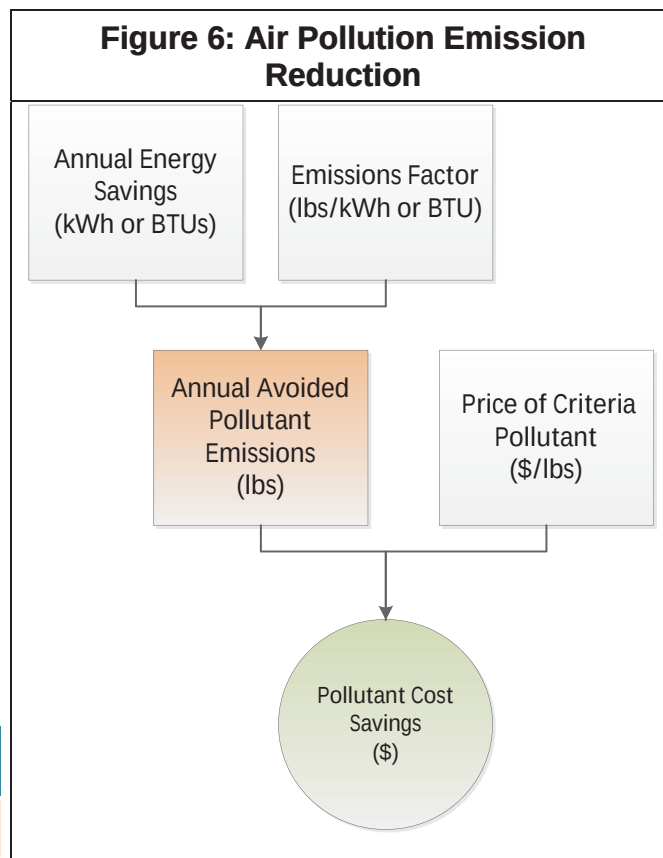


Table 21: Costs of Pollutants

Pollutant	Value per lb
NO ₂	\$3.34
O ₃	\$3.34
SO ₂	\$2.06
PM-10	\$2.84

Source: CNT (2010), McPherson et al. (2006), Wang and Santini (1995)

Greenhouse Gas Emission Reduction

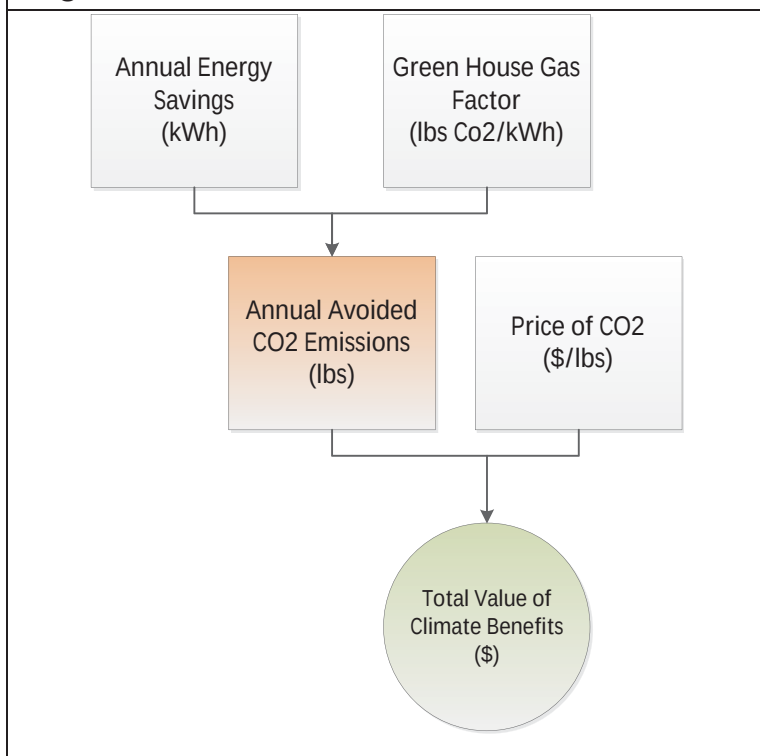
This benefit calculation follows the same methodology as the air pollution emission reduction benefit, only different conversion factors for CO₂ will be used, and different monetary values.

The amount of CO₂ emissions from power plants varies depending on the electricity source (e.g. coal, nuclear, wind, etc), so the EPA eGRID program should be consulted.

The CAMX subregion for 2010 has 932.82 lb per M Wh²¹.

The current recommended price of CO₂ is \$40 per metric ton²².

Figure 7: Greenhouse Gas Emission Reduction



²¹ <http://www.epa.gov/cleanenergy/energy-resources/egrid/>

²² Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (May 2013; revised November 2013), page 18

Air Particle Entrainment

This section quantifies the direct uptake and deposition of air pollutants by green infrastructure and provides a framework for establishing value these impacts in monetary terms. The criteria pollutants addressed here are nitrogen dioxide (NO₂), ozone (O₃), sulfur dioxide (SO₂) and particulate matter of aerodynamic diameter of ten micrometers or fewer (PM-10).

Practices that provide a direct benefit of uptake and deposition include green roofs, trees and bio-infiltration. Similar to the methodology for emission cost savings from reduced energy use, the air particle entrainment benefits will quantify the amount (in pounds) of criteria pollutants removed from the environment. The total amount will depend on the scale of LID/GI and the type of GI. Table 22 provides values compiled by CNT

(2010) per square foot of green roof installed. It should be noted that local values should be used if available (CNT, 2010). Factors such as local climates will influence plants ability to grow, and climates with longer growing seasons will see greater air quality improvements than those with shorter ones. Additionally, trees provide benefits in a similar manner. The Forest Service *Tree Guides* provides information for trees for particular climate regions (Table 23).

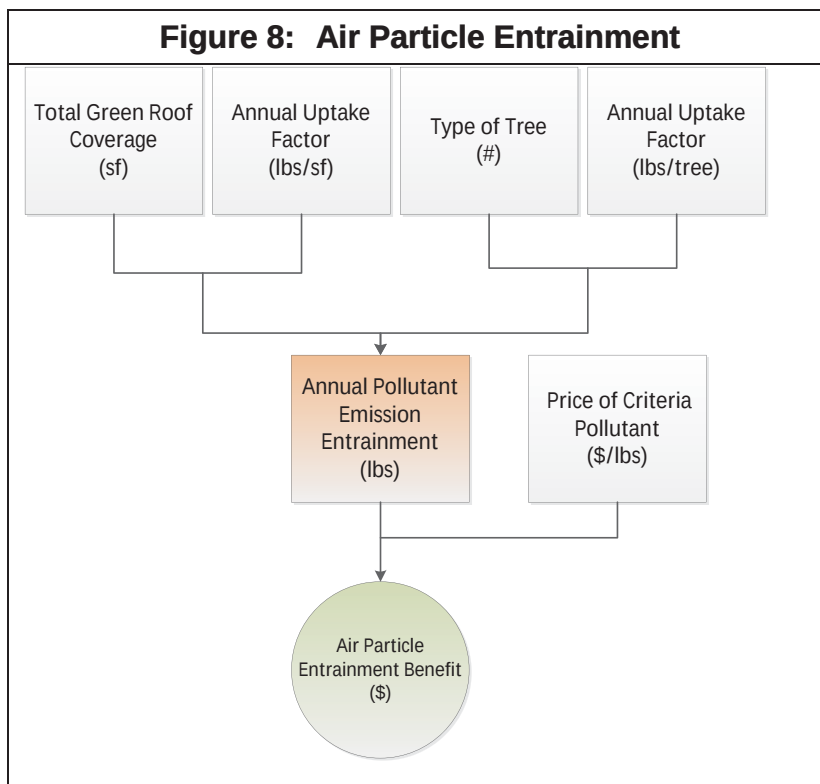


Table 22: Pollutant Removal Factors for Green Roofs

	Low (lbs/SF)	High (lbs/SF)
NO₂	3.00x10 ⁻⁴	4.77x10 ⁻⁴
O₃	5.88x10 ⁻⁴	9.20x10 ⁻⁴
SO₂	2.29x10 ⁻⁴	4.06x10 ⁻⁴
PM-10	1.14x10 ⁻⁴	1.33x10 ⁻⁴

Table 23: Annual Criteria Pollutant Reductions, 40 year Average

	Small tree: Crabapple (22 ft tall, 21 ft spread)	Medium tree: Red Oak (40 ft tall, 27 ft spread)	Large tree: Hackberry (47 ft tall, 37 ft spread)
NO2	0.39 lbs	0.63 lbs	1.11 lbs
SO2	0.23 lbs	0.42 lbs	0.69 lbs
O3	0.15 lbs	0.2 lbs	0.28 lbs
PM-10	0.17 lbs	0.26 lbs	0.35 lbs

Carbon Sequestration

Similar to the air particle entrainment methodology, LID/GI can provide carbon sequestration benefits. The pounds of carbon sequestered per unit area depend on several local factors, including the specific practice, the types of species planted and the local climate.

For green roofs, the recommended range of grams of carbon sequestered per square meter from aboveground biomass, as determined by research synthesized in a Michigan State University report offers average carbon sequestration values provided by extensive green roofs' aboveground biomass (Getter et al. 2009).

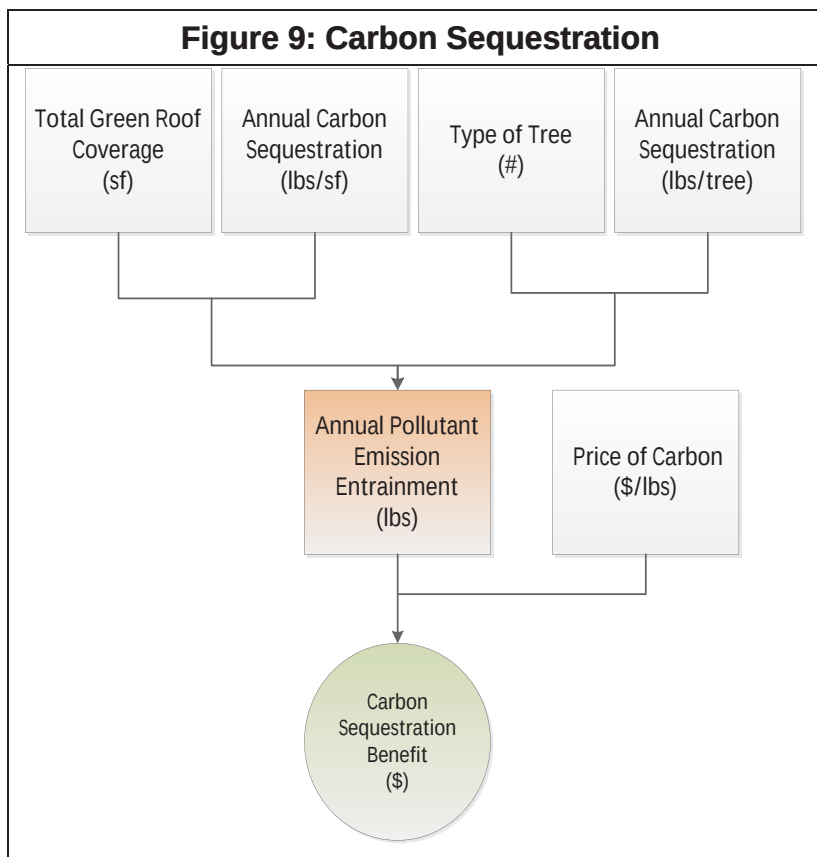


Table 24: Green Roof Carbon Sequestration Rates

	Low (lbs/SF)	High (lbs/SF)
CO2	0.0332	0.0344

Table 25: Sample Carbon Sequestration Rates for Different Trees

Net CO2 (lbs)	Residential Yard Opposite West-Facing Wall	Residential Yard Opposite South-Facing Wall	Residential Yard Opposite East-Facing Wall	Public Tree on a Street or in a Park
Small tree: Crabapple (22 ft tall, 21 ft spread)	390	226	335	336
Medium tree: Red Oak (40 ft tall, 27 ft spread)	594	212	487	444
Large tree: Hackberry (47 ft tall, 37 ft spread)	911	665	806	735

Aesthetic Improvements

The current method to calculate the benefit of aesthetics is to look at the changes in property values due to LID/GI. While the research on this subject supports the belief that there is a positive (increase) in property value due to LID/GI, there is much uncertainty regarding the size and scale of that. The methodology for calculating this benefit is to apply a premium on property that will capitalize on the aesthetic benefits of LID/GI.

Street trees and urban vegetation have been estimated by realtors to add \$15,000 to \$25,000 in value to a property compared to similar areas with no trees. The NRDC notes that buildings with green roofs can rent at a 16% premium.²³ Additionally, the NRDC reports that Tyrväinen and Miettinen (2000) found that units in multifamily buildings with views of trees or forest cover can increase rents by as much as 4.9 percent (Wolf 2007)²⁴.

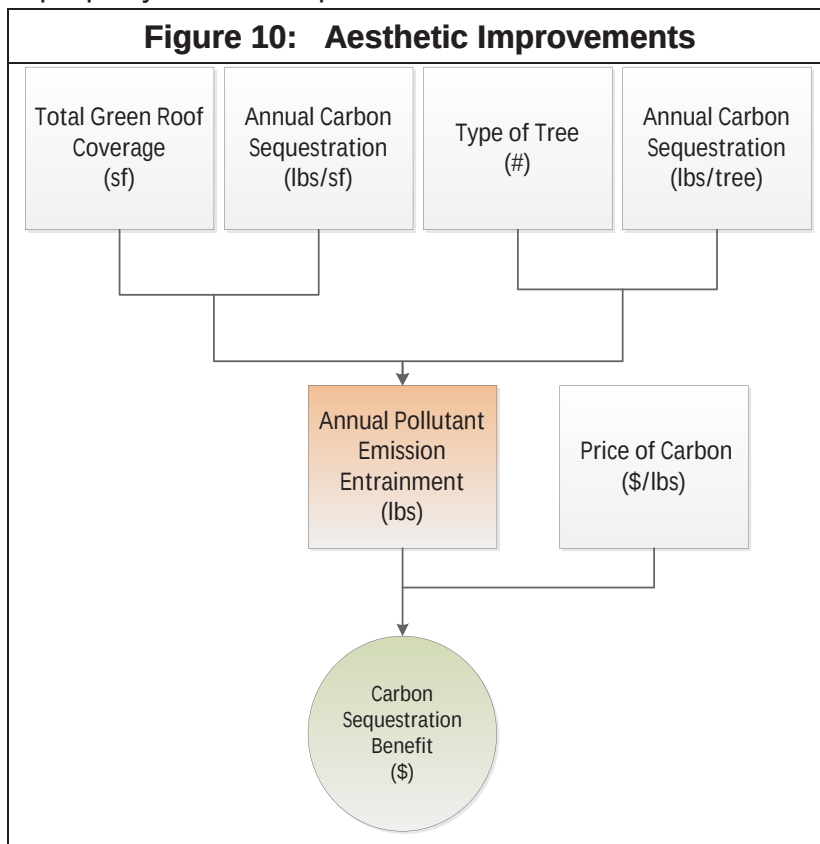


Table 26: Premiums on Property Value due to Aesthetics

Action	Monetized Benefit	Location	Source
LID and proximity to trees and other vegetation	0 to 7% Increase in Property Value	Philadelphia, PA	Stratus 2009
LID of adjacent properties	3.5 to 5% Increase in Property Value	King County, WA	Ward et al. 2008

²³ Natural Resources Defense Council 2013

²⁴ Ibid

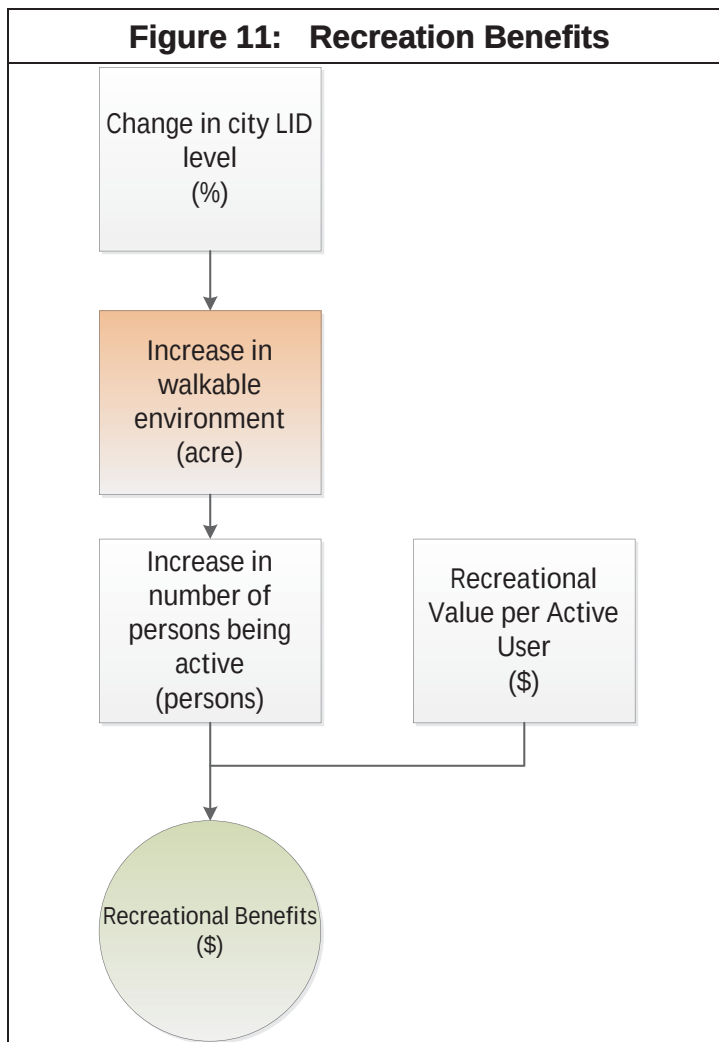
Recreation Benefits

The methodology for calculating this benefit will involve determining the total number of recreational users of the new LID/GI facilities and applying a monetary value per user to get total benefits.

The total number of users will be based on local information. The monetized value of recreational benefits comes from different research fields. Some research from the transportation literature suggests benefits can be determined on an individual user basis. A wide variety of studies of outdoor recreational activities (non-bicycling) generated typical values of about \$40 per day (in 2004 dollars).²⁵

The value of time is estimated based on US DOT guidance for TIGER VI. The value of time for personal travel is \$12.98 per hour. The benefit per trip for the appropriate facility is multiplied by the number of daily existing and induced commuters, and then doubled to include trips both to and from work. This results in a daily mobility benefit.

A premium on the value of a trip is developed from the January 2010 UK's Department of Transport *Guidance on the Appraisal of Walking and Cycling Schemes*. This Guidance reports a premium value of an off-road bicycle track versus an on-road facility. Hopkinson & Wardman (1996) developed estimates of on-road segregated cycle lane assuming benefits of £0.02 per minute. This benefit is assigned to existing recreational cyclists that would enjoy the new bike facility's quality, comfort and convenience.



²⁵ San Francisco County Transportation Authority Department of Parking and Traffic. *Maintain Bicycle Facilities (spreadsheet)*. 2004 2/28/2004, as cited in *Guidelines for Analyzing the Benefits and Costs of Bicycle Facilities*, Krizek et al., 2005.

Crime Reduction Benefits

Residents living in “greener” surroundings report lower levels of fear, fewer incivilities, and less aggressive and violent behavior. While there is not literature with respect to monetizing this benefit, there is research that looks at quantifying the benefit of crime reduction do to a greener environment. This study was performed in a public housing complex in an urban environment, so the actual percentage reduction may not be the same in other areas.

However, that does not mean there is no impact on crime. A possible methodology is to look at current crime levels in areas where proposed LID/GI will occur, and apply a reduction, but smaller in size than those listed below.

	Areas with Medium Level of Vegetation	Areas with High Levels of Vegetation
Total Crimes	42%	52%
Property Crimes	40%	48%
Violent Crimes	44%	56%

Source: Environment and Crime in the Inner City: Does Vegetation Reduce Crime? Kuo & Sullivan. Environment and Behavior, Volume 33 No.3, May, 2001

Business Development Benefits

In areas where green streets lead to an enhanced the sense of place, and increase in foot and bicycle traffic can support retail development. Case studies by the New York City DOT examined before and after changes in Retail Sales Tax Filings, Commercial Leases & Rents, and City-Assessed Market Value. The study's methodology does not ultimately prove causality between the street improvement projects and any resulting economic changes; however, some locations of green street development saw a significant increase in retail sales compared to the changes in retail sales for the borough as a whole.

Researchers do believe that any benefits from the green streets will be fully realized 2 years after development, and so applying this growth to retail sales further in the future is not applicable.

We can apply these percentages to current retail sales of businesses located along areas that will be developed into green streets to see the potential impact on businesses.

Table 27: Increase in Retail Sales after Street Development

Area	Change in Sales Year 1	Change in Sales Year 2
Vanderbilt Ave	39%	59%
Borough	27%	19%
Area	Change in Sales Year 1	Change in Sales Year 2
St. Nicholas Avenue/Amsterdam	18%	48%
Borough	17%	39%

Job Creation Benefits

Determining the number of jobs created, and the economic impact of those jobs, is simply a function of the total amount spent on the program. In general, the larger the area (or economic base) the larger the impact. Direct, indirect and induced economic impacts from spending on the strategies can be calculated using Economic Impact Analysis models.

The creation of jobs, and such, salaries for the workers to spend, would also have tax impacts at the State, Local, and Federal government level.

Current guidance on a methodology from the Council of Economic Advisors' ²⁶ methodology as assumes that for every **\$76,923** of additional government spending, one job-year is created. A job-year means one job for one year. To estimate the employment impacts in terms of job-years one simply adds up the number of jobs created every year over the analysis period.

The number of jobs created is a division of the total spending by the CEA recommended value.

²⁶ Executive Office of the President, Council of Economic Advisers, "Estimates of Job Creation from the American Recovery and Reinvestment Act of 2009," Washington, D.C., May 11, 2009; and September 2011 Update.

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Appendix 2: Comprehensive List of Nonstructural Strategies

This list of strategies has been compiled from a review of each WAMP, CLRP and WQIP document

ID	NONSTRUCTURAL STRATEGY (Official Description)	Short Description	Category
Jurisdictional Runoff Management Program (JRMP) Strategies			
Development Planning			
<i>All Development Projects</i>			
1	For all development projects, administer a program to ensure implementation of source control BMPs to minimize pollutant generation at each project and implement low-impact development (LID) BMPs to maintain or restore hydrology of the area, where applicable and feasible.	For all development projects, ensure source control BMPs	Increasing # of BMPs or LIDs
2	Amend municipal code and ordinances, including zoning ordinances, to facilitate and encourage LID opportunities.	Amend municipal code to encourage LID	Increasing # of BMPs or LIDs
3	Train staff on LID regulatory changes and LID Design Manual.	Train staff on LID regulatory changes and LID Design Manual.	Increasing # of BMPs or LIDs
Priority Development Projects (PDPs)			
4	For PDPs, administer a program requiring implementation of on-site structural BMPs or LIDs to control pollutants and manage hydromodification. Includes confirmation of design, construction, and maintenance of PDP structural BMPs or LIDs.	For PDPs, require implementation of on-site structural BMPs or LIDs	Increasing # of BMPs or LIDs
5	Update BMP Design Manual procedures to determine nature and extent of storm water requirements applicable to development projects and to identify conditions of concern for selecting, designing, and maintaining appropriate structural BMPs or LIDs.	Update BMP Design Manual procedures	Improve / Maintain BMPs or LIDs
	1. Amend BMP Design Manual for trash areas. Require full four-sided enclosure, siting away from storm drains and cover. Consider the retrofit requirement.		Improve / Maintain BMPs or LIDs
	2. Amend BMP Design Manual for animal-related facilities.		Improve / Maintain BMPs or LIDs
	3. Amend BMP Design Manual for nurseries and garden centers.		Improve / Maintain BMPs or LIDs
	4. Amend BMP Design Manual for auto-related uses.		Improve / Maintain BMPs or LIDs

ID	NONSTRUCTURAL STRATEGY (Official Description)	Short Description	Category
6	Administer an alternative compliance program to on-site structural BMP implementation (includes identifying Watershed Management Area Analysis [WMAA] candidate projects).	Administer an alternative compliance program	Improve / Maintain BMPs or LIDs
	1. Develop a mitigation policy for public and private development projects that links development with mitigation within the same watershed.		Improve / Maintain BMPs or LIDs
	1a. Create an In-Lieu Fee		Improve / Maintain BMPs or LIDs
Construction Management			
7	Administer a program to oversee implementation of BMPs during the construction phase of land development. Includes inspections at an appropriate frequency and enforcement of requirements.	Oversee implementation of BMPs during the construction	Improve / Maintain BMPs or LIDs
Existing Development			
<i>Commercial, Industrial, Municipal, and Residential Facilities and Areas</i>			
8	Administer a program to require implementation of minimum BMPs for existing development (commercial, industrial, municipal, and residential) that are specific to the facility, area types, and PGAs, as appropriate. Includes inspecting existing development at appropriate frequencies and using appropriate methods. (Inspections for PGAs of concern: Vehicle Washing area inspections and inspections for food-related businesses, animal-related businesses, nurseries and garden centers, and auto-related businesses.)	Require implementation of minimum BMPs for existing development	Improve / Maintain BMPs or LIDs
	1. Update minimum BMPs for existing residential, commercial, and industrial development and enforce them.		Improve / Maintain BMPs or LIDs
	2. Design, implement, and enforce property- and PGA-based inspections.		Improve / Maintain BMPs or LIDs
	1. Review policies and procedures to ensure discharges from swimming pools meet permit requirements.		Improve / Maintain BMPs or LIDs
	3. Develop a self-reporting inspection option for select industrial and commercial facilities.		Improve / Maintain BMPs or LIDs
9	Implement pet waste program. May include installation and maintenance of pet waste bag dispensers and trash bins, signage and education, physical removal of pet waste, or enforcement.	Implement pet waste program	Changing Behavior to reduce pollutants at the source
10	Promote and encourage implementing designated BMPs at residential areas.	Promote and encourage implementing designated BMPs at residential areas.	Increasing # of BMPs or LIDs
	1. Expand residential BMP (irrigation, rainwater harvesting, and turf conversion) rebate programs to multi-family housing in target areas.		Increasing # of BMPs or LIDs

ID	NONSTRUCTURAL STRATEGY (Official Description)	Short Description	Category
	2. Residential BMP: Rain Barrel		Increasing # of BMPs or LIDs
	3. Residential BMP: Irrigation Control (Turf Conversion)		Increasing # of BMPs or LIDs
	4. Residential BMP: Downspout Disconnect		Increasing # of BMPs or LIDs
	5. Provide financial incentives to property owners to convert landscaping to site-specific native plants.		Increasing # of BMPs or LIDs
11	Develop pilot project to identify and carry out site disconnections in targeted areas.	Develop pilot project to identify and carry out site disconnections in targeted areas.	Increasing # of BMPs or LIDs
12	Identify and reduce incidents of power washing discharges from nonresidential sites.	Identify and reduce incidents of power washing discharges from nonresidential sites.	Changing Behavior to reduce pollutants at the source
13	Promote and encourage implementation of designated BMPs in nonresidential areas.	Promote and encourage implementation of designated BMPs in nonresidential areas.	Increasing # of BMPs or LIDs
14	Proactively monitor for erosion, and complete minor repair and slope stabilization on municipal property.	Monitor for erosion, and slope stabilization on municipal property.	Increasing # of BMPs or LIDs
<i>MS4 Infrastructure</i>			
15	Implement operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, detention basins, etc.).	Implement operation and maintenance activities	Removing pollutants or sources directly
	1. Optimize catch basin cleaning to maximize pollutant removal.		Removing pollutants or sources directly
	2. Proactively repair and replace MS4 components to provide source control from MS4 infrastructure.		Removing pollutants or sources directly
	3. Increase frequency of open-channel cleaning and scour pond repair to reduce pollutant loads.		Removing pollutants or sources directly
16	Implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers.	Implement controls to prevent infiltration of sewage into the MS4	Removing pollutants or sources directly

ID	NONSTRUCTURAL STRATEGY (Official Description)	Short Description	Category
	1. Identify sewer leaks and areas for sewer pipe replacement prioritization.		Removing pollutants or sources directly
	<i>Roads, Streets, and Parking Lots</i>		
17	Implement operation and maintenance activities for public streets, unpaved roads, paved roads, and paved highways.	Implement operation and maintenance activities for public streets	Removing pollutants or sources directly
	1. Enhance street sweeping through equipment replacement and route optimization.		Removing pollutants or sources directly
	2. Initiate sweeping of medians on high-volume arterial roadways.		Removing pollutants or sources directly
	3. Increase maintenance on access roads and trails.		Removing pollutants or sources directly
18	Require sweeping and maintenance of private roads and parking lots in targeted areas.	Require sweeping and maintenance of private roads and parking lots in targeted areas.	Removing pollutants or sources directly
19	Identify sites for pilot study to test Permeable Friction Course (PFC), which is a porous asphalt that overlays impermeable asphalt.	Identify sites for pilot study to test Permeable Friction Course (PFC)	Increasing # of BMPs or LIDs
	<i>Pesticide, Herbicides, and Fertilizer Program</i>		
20	Require implementation of BMPs to address application, storage, and disposal of pesticides, herbicides, and fertilizers on commercial, industrial, and municipal properties. Includes education, permits, and certifications.	Require BMPs to address pesticides, herbicides, and fertilizers issues	Changing Behavior to reduce pollutants at the source
	<i>Retrofit and Rehabilitation in Areas of Existing Development</i>		
21	Develop and implement a strategy to identify candidate areas of existing development appropriate for retrofitting projects and facilitate the implementation of such projects.	Identify candidate areas for retrofitting projects	Increasing # of BMPs or LIDs
22	Develop and implement a strategy to identify candidate areas of existing development for stream, channel, or habitat rehabilitation projects and facilitate implementation of such projects.	Identify areas for stream, channel, or habitat rehabilitation projects	Increasing # of BMPs or LIDs

ID	NONSTRUCTURAL STRATEGY (Official Description)	Short Description	Category
IDDE Program			
23	Implement Illicit Discharge, Detection, and Elimination (IDDE) Program per the JRMPS. Requirements include maintaining an MS4 map, using municipal personnel and contractors to identify and report illicit discharges, maintaining a hotline for publicly reporting illicit discharges, monitoring MS4 outfalls, and investigating and addressing any illicit discharges.	Implement Illicit Discharge, Detection, and Elimination (IDDE) Program	Changing Behavior to reduce pollutants at the source
Public Education and Participation			
24	Implement a public education and participation program to promote and encourage development of programs, management practices, and behaviors that reduce pollutant discharge in storm water prioritized by high-risk behaviors, pollutants of concern, and target audiences.	Implement a public education and participation program	Changing Behavior to reduce pollutants at the source
	1. Expand outreach to homeowners' association (HOA) common lands and HOA rebates.		Changing Behavior to reduce pollutants at the source
	2. Develop an outreach and training program for property managers responsible for HOAs and maintenance districts.		Changing Behavior to reduce pollutants at the source
	3. Conduct trash cleanups through community-based organizations involving target audiences.		Changing Behavior to reduce pollutants at the source
	4. Target human behavior in parks and other public areas including trash reduction or other high-impact behavior to habitat, wildlife, and water quality.		Changing Behavior to reduce pollutants at the source
	5. Improve consistency and content of websites to highlight enforceable conditions and reporting methods.		Changing Behavior to reduce pollutants at the source
	6. Contribute to San Diego County-led effort through regional education group for outreach, education, and policy measures for the equestrian community and property owners.		Changing Behavior to reduce pollutants at the source
	1. Develop a targeted education and outreach program for homeowners adjacent to or with tributaries or streams within their property.		Changing Behavior to reduce pollutants at the source
	1. Develop a targeted education and outreach program for homeowners with orchards or other agricultural land uses on their property.		Changing Behavior to reduce pollutants at the source

ID	NONSTRUCTURAL STRATEGY (Official Description)	Short Description	Category
	2. Enhance school and recreation-based education and outreach		Changing Behavior to reduce pollutants at the source
	3. Develop education and outreach to reduce over-irrigation		Changing Behavior to reduce pollutants at the source
	7. Develop regional training for water-using mobile businesses.		Changing Behavior to reduce pollutants at the source
25	Enhance education and outreach based on results of effectiveness survey and changing regulatory requirements.	Enhance education and outreach	Changing Behavior to reduce pollutants at the source
26	Provide technical education and outreach to the development community on the design and implementation requirements of the MS4 Permit and Water Quality Improvement Plan requirements.	Technical education and outreach on the MS4 Permit and WQIP	Changing Behavior to reduce pollutants at the source
Enforcement Response Plan			
27	Implement escalating enforcement responses to compel compliance with statutes, ordinances, permits, contracts, orders, and other requirements for IDDE; development planning, construction management, and existing development in the Enforcement Response Plan.	Implement escalating enforcement responses to compel compliance	Changing Behavior to reduce pollutants at the source
	1. Increase enforcement of over-irrigation.		Changing Behavior to reduce pollutants at the source
	2. Focus locally on enforcement of water-using mobile businesses.		Changing Behavior to reduce pollutants at the source
28	Increase identification and enforcement of actionable erosion and slope stabilization issues on private property and require stabilization and repair.	Enforcement of actionable erosion and slope stabilization issues	Increasing # of BMPs or LIDs
Optional Strategies			
29	Continue participating in source reduction initiatives. (Varies. For example, the Brake Pad Partnership is existing. Considered may be a plastic bag ban, banning leaf blowers, banning pesticides or herbicide.)	Continue participating in source reduction initiatives.	Changing Behavior to reduce pollutants at the source
30	Develop a program to address and capture trash and debris.	Develop a program to address and capture trash and debris.	Removing pollutants or sources directly

ID	NONSTRUCTURAL STRATEGY (Official Description)	Short Description	Category
31	Support partnership efforts by social service providers to provide sanitation and trash management for persons experiencing homelessness.	Sanitation and trash management for persons experiencing homelessness.	Removing pollutants or sources directly
32	Protect areas that are functioning naturally.	Protect areas that are functioning naturally.	Removing pollutants or sources directly
	1. Develop a policy to avoid additional hardscape development and degradation in unpaved open space areas.		Removing pollutants or sources directly
	2. Add permanent open space protections to undeveloped city-owned land.		Removing pollutants or sources directly
	3. Acquire privately owned undeveloped parcels of land.		Removing pollutants or sources directly
	Mapping and risk assessment of agricultural operations.		Removing pollutants or sources directly
	Implement a program to target on-site wastewater treatment (septic) systems. May include mapping and risk assessment, inspection, or maintenance practices.		Removing pollutants or sources directly
	Removal of invasive plants and animals.		Removing pollutants or sources directly
33	Conduct a feasibility study to determine if implementing an urban tree canopy (UTC) program would benefit water quality and other goals.	Conduct a feasibility study on urban tree canopy (UTC) program	Increasing # of BMPs or LIDs
	Investigate alternative pollutant removal or treatment strategies such as fungus used to remove soil contaminants.		Removing pollutants or sources directly
34	Conduct special studies to gather additional monitoring information about priority conditions or beneficial uses. (Monitoring may include investigative measures such as genetic tracking for bacteria sources or geomorphic studies for sediment sources or processes. - LOS PEN)	Gather monitoring information about priority conditions or beneficial uses	Improve / Maintain BMPs or LIDs

ID	NONSTRUCTURAL STRATEGY (Official Description)	Short Description	Category
35	Collaborate with entities potentially including, but not limited to:	Collaborate with entities potentially including, but not limited to:	Improve / Maintain BMPs or LIDs
	• Departments within the same Responsible Agency.		Improve / Maintain BMPs or LIDs
	• Other governmental agencies such as water, transportation, or public health agencies.		Improve / Maintain BMPs or LIDs
	• Nongovernmental agencies such as environmental and community groups and private corporations.		Improve / Maintain BMPs or LIDs
	• Dischargers regulated under other permits including the Phase II National Pollutant Discharge Elimination System (NPDES) Permit, Industrial General Permit, and Construction General Permit.		Improve / Maintain BMPs or LIDs
	Collaboration may take the form of joint participation in stakeholder meetings, studies or development studies or BMPs, hiring of a Watershed Coordinator to facilitate communication between community groups and the City, formation of a City Watershed team to protect and restore the watershed, or participating in existing groups, such as Integrated Regional Water Management (IRWM) groups.		Improve / Maintain BMPs or LIDs
	1. Funding for collaborative strategies may include providing in-kind services, shared costs through agreements, and preparation and competition for grant funding.		Improve / Maintain BMPs or LIDs
Added			
	Vehicle Washing areas supplemental standards		Improve / Maintain BMPs or LIDs
	Keeping of large animals		Improve / Maintain BMPs or LIDs
	Xeriscaping, turf conversion and other irrigation, pesticide and fertilizer reduction (Caltrans specific. CLRP P. E-19)		Changing Behavior to reduce pollutants at the source
	Garden and landscape practices (primarily for Contractors. Otherwise covered in W.)		Changing Behavior to reduce pollutants at the source
	Increase street sweeping frequency (otherwise covered in P.)		Improve / Maintain BMPs or LIDs
	Rebates/Incentives to residential and non-residential. (Otherwise covered in J.)		Improve / Maintain BMPs or LIDs

Notes: Purple highlighting where there was a modification between the "Potential Strategies" documents.

Appendix 3: Workshop Summary

This section includes the presentation provided to the stakeholders, which guided discussion on benefits. Stakeholder comments were written down post workshop and sent back to the Division for consideration. These comments are included below.

Workshop Presentation

WQIP Strategies Workshop
Sustainable Return on Investment
City of San Diego Storm Water Division
May 20, 2014

Clem Brown, City of San Diego
Karina Danek, City of San Diego
Lewis Michaelson, Katz & Associates
Richard Haimann, HDR
Christopher Behr, HDR

Welcome and Introductions

- Opening remarks
- Introductions

Workshop Purpose

Receive input on which co-benefits should be considered

- Explain the *Sustainable Return on Investment (SROI) Process*
- Explain how the SROI will be incorporated into the WQIPs
- Discuss project schedule and next steps

Workshop Ground Rules

- Listen to understand
- Everyone's perspective is valued
- Everyone has an equal opportunity to participate

Agenda

- Background on Strategies
- Purpose of SROI
- Schedule
- Considerations in Prioritization of Strategies
- Introduction to SROI
- Application of SROI to WQIP Strategies
- Breakout Session on Co-benefits
- Next Steps

Background on Strategies

July 2012	Initial strategies developed for the Comprehensive Load Reductions Plans (CLRPs) to meet TMDL requirements
July 2013	Strategies refined as part of the CLRP updates
April 2014	Strategies updated again through the WQIP public participation process resulting in the "Potential Water Quality Improvement Strategies" documents

Schedule

May 20, 2014	Co-benefit Workshop
May 27, 2014	Comments on Co-benefits Due
June - August 2014	Preliminary SROI Analysis
Late August, 2014 (tentative)	SROI Workshop Review
September, 2014	Finalize Analysis
Late September 2014	Potential Changes to WQIP Strategies (non-structural)

Choices

Co-benefits

Improve Water Quality → Generate Co-Benefits

Ecosystem habitat, Visual aesthetics, Energy Operations Savings, Air pollution reduction, Education/Stewardship

How to choose

- Desirable Elements of Decisions
 - Quantitative measures
 - Transparent assessment
 - Objective evidence
 - Account for uncertainty
 - Provide best value

Ultimately... need to know: What is the best value? How do you know?

Introduction to Sustainable Return on Investment (SROI) Process

- Best practices:
 - Objective, theory-based
 - Peer-reviewed evidence
 - Life cycle monetary outcomes
 - Accounts for uncertainty
 - Avoids double-counting
- Key Features:
 - Comprehensive
 - Transparent analysis
 - Impact distribution
 - Adaptable to local conditions
 - Decision metrics that matter

SROI: A Four Step Process

- Step 1: Determine Co-Benefits**
 - Determine key performance metrics
- Step 2: Preliminary Analysis**
 - Research and analyze potential project performance
- Step 3: Stakeholder Workshop**
 - Review methods, metrics and risks
- Step 4: Quantitative Analysis**
 - Generate results for decision making

Application of SROI to Prioritizing Potential Strategies

- Identify types of co-benefits (examples)
 - Ecosystem habitat
 - Visual aesthetics
 - Energy Operations Savings
 - Air pollution reduction
 - Education/Stewardship
- Identify methods of valuation
 - Identify Metrics
 - Establish Baseline
 - Quantified Impacts
 - Calculate Value
 - Monetized Value of Co-Benefits

Alignment of Strategies to Co-Benefits

Structural Strategy (Examples)	Economic		Environmental				Social (Quality of Life)			
	Go with Energy Savings	Operational Cost Savings	Carbon Footprint Reduction	Water Conservation	Water Quality	Visual Quality	Property Value	Community Engagement	Jobs	
Green roof	○	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
RCW bio-system (with trees)	⊗	⊗	⊗	⊗	⊗	○	⊗	⊗	⊗	
Large Bio-retention Facilities	⊗	⊗	⊗	⊗	⊗	⊗	○	⊗	⊗	
Porous Pavement	⊗	⊗	⊗	⊗	⊗	⊗	○	⊗	⊗	

⊗ Measurable and Monetizable Benefit
 × Measurable Benefit
 ○ Perceived Benefit

Potential Structural Strategies

- **Green Infrastructure**
 - Green streets, permeable pavement, etc.
- **Multiuse Treatment Areas**
 - Infiltration and detention basins, stream rehabilitation, etc.
- **Water Quality Improvement**
 - Trash segregation, Proprietary BMPs, etc.



Co-Benefits of Green Streets

- **Unit of Measure**
 - » Street miles of improvements
- **Drivers of Impact**
 - » Water retained
 - » Type of improvement (trees, etc.)
- **Key Co-Benefits**
 - » Habitat creation
 - » Business investment
 - » Human health improvement
 - » Energy Reduction



Green Streets Co-Benefit Calculations



Potential Non-Structural Strategies

- **Increase # of structural systems**
 - Training, promotion, etc.
- **Improve structural systems performance**
 - Design codes, monitor, etc.
- **Initiatives to change behavior**
 - Education, enforcement, outreach, reduced pesticides, etc.
- **Initiatives to reduce pollutants directly**
 - Street sweeping, protect natural areas, etc.



Co-Benefits of Water Harvesting Strategy



- **Unit of Measure**
 - » Reduction in stormwater runoff
- **Drivers of Impact**
 - » Less water processed
- **Key Co-Benefits**
 - » Reduced water consumption, less municipal water diversion
 - » Reduced energy use and air pollution, GHG impacts

Water Harvesting Co-Benefit Calculations

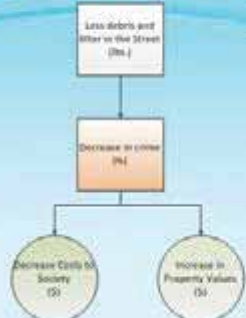


Co-Benefits of Education / Promotion of Think Blue Campaign



- **Unit of Measure**
 - » # of people reached
- **Drivers of Impact**
 - » # of people who reduce litter
- **Key Co-Benefits**
 - » Improved residential neighborhoods aesthetics
 - » Increase in business investment
 - » reduction in crime

Think Blue Program Co-Benefit Calculations (Partial)



- **Evidence**
 - Cleaner environments leads to decrease in crime
 - Urban housing with higher levels of vegetation and clean street showed decline in crime in nearby buildings

Breakout Session

Property Owners	General Public	Other
Aesthetics	Recreational	
Flood Control	Human Health	
Business Investment	Stewardship	
Environmental	Heat Island	
Green House Gas Reductions	Air Quality	
Habitat Creation	Crime Reduction	
Soil Stabilization	Operational Cost Savings	
	Jobs	

Next Steps

- Incorporate workshop feedback to draft co-benefits
- Form working group to link co-benefits to strategies
- Preliminary analysis
- Workshop review
- Final analysis
- Consider changes to WQIP

Closing Remarks

Questions?

Thanks for your participation!

Workshop Handout:

Water Quality Improvement Plans Co-Benefits Description Workbook

Co-Benefit: Aesthetics

Description: Visually appealing environments in communities, especially neighboring properties

Unit of Measure: Area of BMPs or Reduction in Street Debris

Drivers of Value: # and Type of BMP, # of Affected Properties, Proximity to BMP, % increase in Property Value

Unit of Value: \$ increase per property

Comments:

Co-Benefit: Air Quality

Description: Reduction of pollutants which cause health impacts

Unit of Measure: Tons of Pollutant

Drivers of Value: Reduction in Energy Use, Increase in Absorption of Air Pollutants

Unit of Value: \$ per ton of pollutant reduced

Comments:

Co-Benefit: Business Development

Description: Increase in investment and revenue in clean, walkable environments

Unit of Measure: Area of BMPs or Reduction in Street Debris

Drivers of Value: # and Type of BMP, # of Affected Properties,
Proximity to BMP, % pedestrian activity

Unit of Value: \$ increase in retail sales

Comments:

Co-Benefit: Crime Reduction

Description: Clean/green neighborhoods reduce incidents

Unit of Measure: Area of BMPs or Reduction in Street Debris

Drivers of Value: # and Type of BMP, # of Affected Properties,
Proximity to BMP, % decrease in crime incidents

Unit of Value: \$ per incident reduced

Comments:

Co-Benefit: Environmental Stewardship

Description: Increased awareness and environmental responsibility

Unit of Measure: # of persons educated

Drivers of Value: Population

Unit of Value: # of persons educated

Comments:

Co-Benefit: Flood control

Description: Reduced flood risk

Unit of Measure: Area of BMPs or Reduction in Street Debris

Drivers of Value: \$ Cost per flood

Unit of Value: \$ per flood damage reduced

Comments:

Co-Benefit: Green House Gas Reduction

Description: Reduction of CO₂

Unit of Measure: Tons of CO₂

Drivers of Value: Reduction in Energy Use, Increase in Carbon Sequestration

Unit of Value: \$ per ton of CO₂ reduced

Comments:

Co-Benefit: Habitat Creation

Description: Protection or Creation of habitats

Unit of Measure: Area of BMPs or Reduction in Street Debris

Drivers of Value: Acres of urban habitat protected/create

Unit of Value: \$ per reduced heat related illness

Comments:

Co-Benefit: Heat Island Reduction

Description: Reduced ambient temperatures

Unit of Measure: Area of BMPs

Drivers of Value: # of Reduced Heating Degrees Days

Unit of Value: \$ benefits from reduction in health

Comments:

Co-Benefit: Jobs

Description: Increase in # of local jobs in installation and maintenance

Unit of Measure: Capital & Maintenance Expenditures

Drivers of Value: \$ spent

Unit of Value: Number of jobs created

Comments:

Co-Benefit: Operational Savings

Description: Reduction in energy use to process water

Unit of Measure: Gallons of water reduced

Drivers of Value: Cost per gallon processed

Unit of Value: \$ per gallon of Water Reduced

Comments:

Co-Benefit: Public Health

Description: Reduced exposure to pesticides and other chemicals

Unit of Measure: Area of BMPs or Reduction in Street Debris

Drivers of Value: # and Type of BMP, Ton of chemicals reduced

Unit of Value: \$ per ton of chemicals reduced

Comments:

Co-Benefit: Recreation

Description: Increase in walkable environment

Unit of Measure: Size of recreational facility

Drivers of Value: Number of Recreational Users

Unit of Value: \$ per recreational user

Comments:

Co-Benefit: Soil Stabilization

Description: Reduction in soil erosion

Unit of Measure: Area of BMPs or Reduction in Street Debris

Drivers of Value: Acres of Stabilized Soil, Cost of Land Damage

Unit of Value: \$ per acre of soil protect

Comments:

Workshop Comments Received

	Structural		
	Green Infrastructure (co-benefits)	Multi-Treatment Areas	Water Quality Improvements
1	Given that on the mesas, we have mostly clay soils that do not absorb storm water runoff, some of these potentials are limited. However, implementation of cisterns, vegetated filter strips, etc. have the potential to * Decrease flood risks as water is released into existing creeks over a longer period of time * Improve habitat as habitat is changing due to excessive water from urban run off (especially dry weather run off) * Dry water flow diversions will also reduce the excessive flows in many of our streams (compared to historical conditions)		
2	Topographic Blending of BMP/IMP approaches: upper watershed, mid, lower, coast Need to think beyond MS4 Parkways/sidewalks as filters, volume reduction, peakflow	Athletic Fields Parks - temp flooding, sediment capture	Micro - capture/treat; avoid regional systems Let habitat/green space do treatment
3	Comprehensive approach to improve water quality, reduce storm runoff and dry weather flows while providing education/outreach, as well as improving quality of life (improved feeling of “wellness”, reduction in health costs associated with polluted and/or stressful environments). Weight native landscapes (endemic to location) to give higher value than standard palette approach that uses species that excel in erosion control and/or coverage to meet landscaping sign off criteria as quickly as possible	Construct facilities (e.g. detention basins) that are specifically designed for the location versus “cookie-cutter” approach to design and implementation. Favor designs that can be passively converted back to native landscapes (e.g. basin becomes a wetland). Weight native landscapes (endemic to location) to give higher value than standard palette approach that uses species that excel in erosion control and/or coverage to meet landscaping sign off criteria as quickly as possible. Factor in maintenance needs (costs, access, mitigation, permits) and responsibilities into design and implementation. Consult with other divisions and departments within the City, as well as consultation with key stakeholder groups (neighboring communities, jurisdictions, NGOs that include	KEY CO-BENEFITS - Eliminating dry weather flows and reducing peak flows of storm runoff will provide a suite of co-benefits. Freshwater itself causes problems when inputs become perennial (e.g. habitat conversion, non-native species introduction and establishment, vector breeding habitat). More effective management and (hopeful) elimination of dry weather inputs could provide co-benefits by reducing the aforementioned impacts and assist in efforts to mitigate and, eventually, remediate them. Eliminating dry weather inputs will be needed for compliance for the Los Penasquitos Lagoon's Sediment TMDL, since restoring salt marsh habitat within the lagoon in areas recently converted to brackish/freshwater habitat is one of the key compliance targets. Eliminating dry weather flows will also assist in compliance with the County-wide bacteria TMDL, since many “hot spots” are created or exacerbated by dry weather flows. Peak flows of storm runoff augmented by MS4 design or placement can create

	Structural		
	Green Infrastructure (co-benefits)	Multi-Treatment Areas	Water Quality Improvements
		non-profit management entities) to avoid conflicts in BMP implementation that include violation of NPDES permits, TMDLs, downstream impacts to receiving water bodies and valued habitats, creation of breeding habitat for harmful vectors, etc.	another suite of nasty things with regard to water quality that include loaded and delivery of contaminants to receiving water bodies, as well as contribute greatly to erosion and downstream sedimentation that create additional maintenance costs (e.g. digging out a box culvert or clearing sediment from a street) and can impact sensitive habitats that include receiving water bodies. Managing peak flows will also be needed to comply with the Lagoon's sediment TMDL, the county-wide bacteria TMDL, and load reductions for constituents of concern and other harmful pollutants (e.g. pyrethroids) that cause impacts but have yet to be labeled "constituent of concern."
		Follow a comprehensive approach that considers benefits and impacts of both individual BMPs and a network of BMPs implemented throughout the watershed, including 9 receiving water body and valued habitats. Avoid knee-jerk reaction of putting out fires at specific locations. Rather, develop a comprehensive and adaptive approach that can be phased in over time to address water-quality priorities throughout their stages (shortterm, mid-term, long-term), take advantage of windows of opportunities (e.g. grant funding ops) and efficiently use available funding while setting up justification for future (and, when needed continuous) funding needs.	Co-benefits of water quality improvements will need to consider improving the conditions of receiving water bodies (reduced bacteria loads, loss of functional habitats native to the region) rather than box checking to meet compliance targets (reduction of % of load by certain date, sending X amount of educational fliers out to communities). This will most likely involve consideration of qualitative data at some point, which should be captured some how (e.g. using it to weight criteria or alternatives under consideration. 10 Need to internalize costs associated with unintended and/or offsite consequences. For example - habitat conversion or creation of vector breeding habitat as a result of lowflow diversion that simply moves dry weather runoff somewhere else instead of addressing source(s) of the dry weather flows.
4	Possible portable water purification systems that operates on solar/wind energy	Treat the water before it enters the main body of water (canal, creek, river, lagoon, bay, ocean) by means of detention ponds, catch basins, vaults, diversion systems, sump wells, or any underground storage unit.	Removing bacteria and metals that are associated with trash and run-off.
5			

	Non-Structural			
	Increase Number of Structural Systems (co-benefits)	Improve Structural System Performance	Initiatives to Change Behavior (co-benefits)	Reduce Pollutants directly
1	Stream and/or habitat rehabilitation projects will increase biological diversity and provide more nature in our neighborhoods. Multi-treatment areas when focused on habitat restoration will enhance recreational opportunities, improve air quality, enhance aesthetics, contribute to heat island reduction, create jobs for upkeep and maintenance and providing living laboratories for our children to take their classroom learning into the field.		Initiatives to educate public and professional users of pesticides, herbicides and fertilizers will increase human health. Requiring interagency teams to deal with issues of homelessness will increase public safety while at the same time reducing feces and other toxic substances in our water. Initiatives to encourage proper disposal of pet waste will increase human health. Initiatives to more quickly remove trash from recreational areas to keep them out of surface water will also improve recreational experiences and increase human health by limiting the amount of food available to rodents and hence reduce the rat population. Insuring that trash containers are available in all areas will keep trash out of surface water and will also improve recreational experiences and increase human health by limiting the amount of food available to rodents and hence reduce the rat population.	

	Non-Structural			
	Increase Number of Structural Systems (co-benefits)	Improve Structural System Performance	Initiatives to Change Behavior (co-benefits)	Reduce Pollutants directly
2	School Curriculum, Incentives			
3	Improve or replace existing MS4 structures before building new ones when feasible (the City cannot maintain what it has now, let alone new structures) Hire additional staff to manage permits and contracts to third-parties hired to assist Storm Water Division. improve enforcement actions (e.g. controlling dry weather runoff that meets water quality criteria or circumvents MS4 (e.g. freshwater mounding) but still creates impacts to receiving waters, such as habitat conversion, invasive plant establishment, breeding habitat for disease transmitting vectors).	Design and implement monitoring programs that make sense (e.g. answers questions or generates useful data) rather than just following programmatic lines. Review and enforce third-party agreements (e.g. HOAs maintaining private BMPs). Provide incentives to landowners and businesses to comply with hydromod requirements in areas already developed (and exempt from hydromod regs)	Coordinate with other stakeholder groups (e.g. NGOs) to help promote efforts that provide co-benefits to local communities and clarify/modify resource regulation that does not apply or should not in certain cases where lines of evidence support the effort over the regulation. Promote and incentivize native landscapes and water re-use	Improve controls over dry weather flows to address freshwater mounding and seepage into the MS4 or open space areas. Remove City infrastructure (e.g. MS4, sewer lines, water lines) from sensitive lands (e.g. Los Peñasquitos Lagoon).
	Include lessons learned from case studies regarding design, implementation and maintenance. Use site specific design and implementation rather than cookie-cutter approach to BMP and private properties (e.g. Hansen Agregate). Re-locate businesses built and operating in the flood zone (e.g. Sorrento Valley) as a longterm solution that is more cost-effective than annual maintenance and lawsuits.			

	Non-Structural			
	Increase Number of Structural Systems (co-benefits)	Improve Structural System Performance	Initiatives to Change Behavior (co-benefits)	Reduce Pollutants directly
4	Private properties, as mentioned by the participants of the meeting on May 20th. (My company has had the privilege of working with Barona Casino I Barona Creek Golf where we found that they recycle all or their water run-off including rain, pavement, parking structure, landscaping and irrigation, which they all filter into one pond system for treatment. In addition, they are in the process of building reservoirs.)	Retrofit new proprietary technologies into existing structures by enhancing performance, focusing on set goals of contaminants of concern as overseen by SDRWQCB, EPA, etc. (Quantum Ozone has retrofitted into an existing vault/Catch Detention System prior to entering into a State Park, into a County Flood Tunnel, and also into existing ponds/lakes/reservoirs. We are open to any county/city or private property that would be willing to co-venture on a pilot project.)	Research outside the box of standard set BMP guidelines, to more natural /innovative technologies that are not part of existing BMPs. For example, ozone is 3,125 times more powerful than chlorine, and the misconception of it being "harmful" is due to lack of education. When properly applied, ozone will not cause negative bi-products, as Quantum Ozone has proved by not producing one negative bi-product in 7 years. We are an ozone planet, constantly having 0.02 parts per million of ozone constantly around us naturally.	Ground level education and awareness to future generations (3rd grade on up) to have Environmental Stewardship as part of the school curriculum along with' history and math, so that the governments that they create in the future will have these ideas naturally implemented into city maintenance and daily living.
5				Strategy: Elimination, to the maximum extent possible, of toxic chemicals in the environment, including herbicides, pesticides, detergents, poisons, paints, and petrochemicals. Co-benefit: an urban ecosystem that supports, to the maximum extent possible, a functioning food web from micro organisms to invertebrates and vertebrates. Co-benefit: recreation and educational opportunities in the form of diverse and inter-dependent organisms to observe and study. Co--benefit: swimmable and fishable waters.

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APPENDIX N

WMA Alternative Compliance Program Overview

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APPENDIX N. WMA ALTERNATIVE COMPLIANCE PROGRAM OVERVIEW

The 2013 San Diego National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater (MS4) Permit (R9-2013-0001) allows for implementation of offsite alternative compliance methods in lieu of meeting structural best management practice (BMP) design standards and/or hydromodification management criteria on the project site.

To implement an offsite alternative compliance program, a jurisdiction must first complete an optional Watershed Management Area Analysis (WMAA), as detailed in Permit Section B.3.b.(4). The San Diego County Responsible Agencies have collectively funded and provided guidance for development of a regional WMAA. Findings of the regional WMAA, specific to the Mission Bay Watershed Management Area (WMA), are summarized in this appendix in Attachments N-1 and N-2. The full WMAA will be attached as an appendix to the forthcoming *BMP Design Manual*, currently in development under direction from the Responsible Agencies.

In development of the Offsite Alternative Compliance Program framework, Responsible Agencies began with research of potential benefits and barriers to program implementation, as summarized in Sections N.1 and N.2. The sections following that discussion outline the selection of candidate sites and the program implementation schedule.

N.1 Alternative Compliance Program Benefits

The 2013 MS4 Permit (Permit) requirements will result in more priority development projects (PDPs), stricter criteria for onsite storm water retention, and larger hydromodification management facilities as compared to the 2007 Permit. The Responsible Agencies identified these factors as driving the need for offsite alternative compliance program implementation in the Mission Bay WMA.

Alternative compliance methods can be implemented at the subwatershed scale (such as regional detention BMPs) or as green infrastructure BMPs (such as green streets). Regardless of scale, the Responsible Agencies acknowledged that offsite alternative compliance BMPs provide the opportunity to mitigate for pollutants not reliably retained on the project site or hydromodification impacts not reliably mitigated onsite per requirements detailed in Permit Sections E.3.c.(1) and E.3.c.(2). Note that onsite treatment control BMPs will still be required, though such BMPs would not be required to meet the onsite retention requirements.

Offsite alternative compliance methods can provide enhanced benefits for the watershed. For instance, facilities can be designed and customized to maximize targeted pollutant load reductions. If they are located offsite and capable of filtering pollutants from larger contributing watershed areas, the pollutant removal effectiveness can be enhanced.

Thus, such facilities could be used as part of total maximum daily load (TMDL) reduction strategies implemented at the watershed level.

N.2 Alternative Compliance Program Implementation Barriers

Implementation of an offsite alternative compliance program will require updates to jurisdictional ordinances and development of funding mechanisms, water quality credit systems, and payment structures. Thus, a potential barrier to program implementation is the need for funding mechanisms and formulation of payment and/or credit structures for BMP construction and long term maintenance. Such funding options, which are outlined in Table N-1, should be developed to minimize jurisdictional financial risk and to guarantee funding of long-term maintenance activities at the offsite alternative compliance facility. The options should include provisions of jurisdictional responsibility in the event that planned projects do not move forward or projects do not meet funding responsibility after occupancy.

Table N-1
Funding Methods for Offsite Alternative Compliance
Candidate Projects

Funding Option	Comment
In-lieu funding of candidate projects	Project applicant must follow the BMP construction and long-term maintenance payment structure to be developed by the jurisdiction.
Funding and construction of BMP water quality credits	Project applicant must follow the water quality credit structure and BMP construction and long-term maintenance payment structure to be developed by the jurisdiction. This could include a process for water quality credit banking and trading.
Funding to offset temporal mitigation of pollutant loads prior to construction of alternative compliance project	Project applicant must follow the temporal loading payment structure to be developed by the jurisdiction.

For Responsible Agencies to move forward with offering offsite alternative compliance options to land development applicants, it will be necessary to reduce sources of financial risk, public liability risk, and compliance risk through legal agreements and other mechanisms.

The Permit specifies a timing element regarding the amount of time that may lapse between the completion of development project construction and completion of construction for the offsite mitigation. Programs will need to establish some assurance that the development applicant will meet that timeline and that the Responsible Agency will not be subject to enforcement actions caused by the development applicant's failure to meet the timeline. A program must be established with sufficient staffing to prevent delays in approvals, funding releases, or contract procurement required by the Responsible Agency to facilitate implementation of the offsite compliance.

For private development, the Responsible Agency review process provides some assurance that the permanent BMPs are properly designed and constructed to comply with the performance requirements of the Permit. However, the developer and subsequent owner can be held responsible for corrective work if the BMPs are subsequently determined to be out of compliance with performance requirements of the Permit. It will be necessary to give Responsible Agencies the same level of protection for any offsite BMPs used as compliance credit for the development project.

Bonding mechanisms can protect the Responsible Agencies from abandoned projects or other issues that could affect the private development. Similar mechanisms would need to be established for offsite BMPs if the Responsible Agency is relying on the development applicant to supply funds or provide construction.

There are public liability risks associated with any public improvements including the offsite BMPs as well as any associated improvements, such as sidewalks and traffic lanes for the alternative compliance site. Responsible Agencies will need to establish measures that prevent additional risk associated with the introduction of Green Infrastructure into public spaces and having a private entity design and construct non-standard designs within public lands and right-of-ways. One measure could be the development of new design standards and standard drawings specific to Green Infrastructure in public spaces.

The obligation to maintain any offsite BMPs is essentially “into perpetuity.” Therefore, it will be necessary for Responsible Agencies to have durable mechanisms in place that can assure private development financing of maintenance well into the future. Historically, some mechanisms such as homeowner associations and maintenance assessment districts, have not always proven to be durable over long periods of time including the possibility of severe downturns in the economy. Proper maintenance of BMP facilities is essential to provide for the intended BMP function and to prevent health concerns resulting from potential vector issues.

Possible alternative compliance arrangements could include public-to-public (where a public agency is both the project owner and the owner of the land with the offsite BMP), private-to-private, and private-to-public. The mechanisms needed for a public-to-public arrangement, particularly if both sites are within the same agency, are much less than what might be required for private-to-public. Therefore, some Responsible Agencies might be able to exercise alternative compliance in a public-to-public arrangement before all of the assurance mechanisms necessary for private-to-public arrangements are in place.

Per Permit requirements, offsite alternative compliance facilities must be constructed within the Mission Bay WMA and provide for a greater water quality benefit, as compared to implementation of structural BMPs at the project site. To assess the water quality benefit metric, the jurisdiction must either develop or adopt water quality equivalency standards. Development of these equivalency standards, which represents another barrier to program implementation, has begun at the regional level between representatives of the City of San Diego, the County of San Diego, Orange County, and

Riverside County. Equivalency calculations will provide the metric by which watershed improvement is demonstrated.

N.3 Selection of Candidate Projects

Per Permit Section B.3.b.(4)(a), the WMAA must include geographic information system (GIS) mapping layers to characterize the watershed functions detailed in Table N-2. The Responsible Agencies, across the region, have compiled these layers for potential use in selecting candidate project sites. Such detailed information provides for initial project planning guidance, but should be field verified since much of the information was generated using desktop methods.

Table N-2
WMAA GIS Mapping Layers

GIS Mapping Layer	Potential Use
Dominant hydrologic processes	Identify areas prone to overland flow or infiltration.
Existing stream condition	Identify stream bed material, geomorphic processes, flow regime.
Coarse sediment yield areas	Identify buffer areas to minimize reduction in sediment supply and subsequent hydromodification impacts.
Current and future land uses	Determine the developable footprint.
Existing channel structures	Identify flood control channels, grade control structures, and detention facilities that can significantly affect watershed response.

Within the Mission Bay WMA, a detailed stream assessment was prepared for Rose Creek.

In addition to allowing for offsite alternative compliance program development, the WMAA findings can also help determine the feasibility of candidate projects for offsite alternative compliance implementation (Permit Section B.3.b.(4)(b)). The City of San Diego compiled a list of candidate projects that include projects previously identified in Comprehensive Load Reduction Plans (CLRPs), Jurisdictional Runoff Management Plans (JRMPs), and other regulatory documents. The numeric goals of the Mission Bay WMA are also being considered in candidate project selection. Consistent with the Permit, project types being considered are detailed in Table N-3.

Table N-3
Candidate Project Types

Project Type	Potential Mitigation Provided
Infrastructure retrofits	Best management practice (BMP) pollutant mitigation Hydromodification management
Green streets	BMP pollutant mitigation Hydromodification management

Project Type	Potential Mitigation Provided
Regional BMPs	BMP pollutant mitigation Hydromodification management Floodplain management
Stream rehabilitation or restoration	Hydromodification management Floodplain management Natural water quality filtering
Riparian habitat rehabilitation or restoration	Biological resources
Groundwater recharge and water supply augmentation	Water resources BMP Pollutant mitigation Hydromodification management
Floodplain buffer land acquisition	Floodplain management Open space preservation Natural water quality filtering

This appendix and the Water Quality Improvement Plan will be updated to include the final candidate project list for future drafts, as that list is made available.

Responsible Agencies will use the results of the WMAA to develop the formal Offsite Alternative Compliance Program. As part of program development, Responsible Agencies will need to identify funding mechanisms, develop payment and credits structures, formulate water quality equivalency standards, and implement required ordinance updates. Consideration will also focus on the potential roles of regulatory agencies, such as the U.S. Army Corps of Engineers and the State Department of Fish and Wildlife, in helping to implement offsite alternative compliance facilities.

N.4 Alternative Compliance Implementation Schedule

Table N-4 summarizes milestones regarding the WMAA and potential Offsite Alternative Compliance Program initiation.

Table N-4
WMAA and Alternative Compliance Program Implementation

Milestone	Date
WMAA public outreach effort	July 2014 to September 2014
Watershed-specific WMAA GIS layers provided to Water Quality Improvement Plan groups	September 2014
Watershed specific WMAAs provided to Water Quality Improvement Plan groups	October 2014
Draft Water Quality Improvement Plan candidate project list	October 2014
BMP Design Manual submittal (with WMAA as attachment)	June 2015

Milestone	Date
Final Water Quality Improvement Plan submittal with watershed-specific WMAA attached	June 2015
Water quality equivalency standards—final document	December 2015
First potential approval of Offsite Alternative Compliance Program	To be determined

N.5 Mission Bay WMAA Report and attachments

The Mission Bay WMAA report and attachments are included as Attachments N-1 and N-2. These documents were developed as part of a regional Copermitttee effort and included a call for data for information to be included in the analysis. The WMAA document was developed following criteria set forth in the MS4 Permit. Data included in the document are intended for guidance purposes. Where more site specific information is available, then the more detailed information should be used.

The WMAA also provides an assessment of applicable exemptions to hydromodification table management requirements, in addition to the Permit's allowed exemptions regarding direct discharges to exempt receiving waters including the Pacific Ocean and Mission Bay (or direct discharges to underground storm drains or concrete-lined channels directly discharging to the Pacific Ocean or Mission Bay). For the Mission Bay WMA, no additional potential exemptions are recommended with regard to exempt river reaches, stabilized conveyances, highly impervious watersheds, or tidally-influenced lagoons.

The City of San Diego's candidate project list currently available is provided in Attachment N-3.

Attachment N-1

Mission Bay WMAA Report

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Mission Bay and La Jolla Watershed Management Area Analysis



Lake Henshaw

October 3, 2014

Prepared for:
San Diego County Copermittees



Prepared by:

Geosyntec
consultants

Engineering | Construction | Management

RICK
ENGINEERING COMPANY

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DRAFT

ACRONYMS AND ABBREVIATIONS

%	percent
>	greater than
<	less than
BMP	Best Management Practice
CB	Coarse Bedrock
CEG	Certified Engineering Geologist
CIP	Capital Improvement Project
CLRP	Comprehensive Load Reduction Plan
CSI	Coarse Sedimentary Impermeable
CSP	Coarse Sedimentary Permeable
E _p	Erosion Potential
ET	Evapotranspiration
FB	Fine Bedrock
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
FSI	Fine Sedimentary Impermeable
FSP	Fine Sedimentary Permeable
GIS	Geographic Information System
GLU	Geomorphic Landscape Unit
HA	Hydrologic Area
HCP	Hydromodification Control Plan
HMP	Hydromodification Management Plan
HRU	Hydrologic Response Unit
HSA	Hydrologic Sub Area
HSG	Hydrologic Soil Group
IRWM	Integrated Regional Water Management
JURMP	Jurisdictional Urban Runoff Management Plan
LDW	Land Development Workgroup
LID	Low Impact Development
MAP	Mean Annual Precipitation

ACRONYMS AND ABBREVIATIONS *continued*

MHPA	Multiple Habitat Planning Area
MS4	Municipal Separate Storm Sewer System
MSCP	Multiple Species Conservation Program
NED	National Elevation Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Service
PDP	Priority Development Project
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
SCAMP	Southern California Aerial Mapping Project
SCCWRP	Southern California Coastal Water Research Project
SD	San Diego
SDRWQCB	San Diego Regional Water Quality Control Board
S _p	Sediment Supply Potential
SSURGO	Soil Survey Geographic Database
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WMA	Watershed Management Area
WMAA	Watershed Management Area Analysis
WQIP	Water Quality Improvement Plan
WURMP	Watershed Urban Runoff Management Plan

1. Introduction

1.1. Background

On May 8, 2013 the California Regional Water Quality Control Board, San Diego Region adopted Order No. R9-2013-0001; NPDES No. CAS 0109266, National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds within the San Diego Region (Regional MS4 Permit). The Regional MS4 Permit, which became effective on June 27, 2013, replaces the previous MS4 Permits that covered portions of the Counties of San Diego, Orange, and Riverside within the San Diego Region. There were two main goals for the Regional MS4 Permit:

1. To have more consistent implementation, as well as improve inter-agency communication (particularly in the case of watersheds that cross jurisdictional boundaries), and minimize resources spent on the permit renewal process.
2. To establish requirements that focused on the achievement of water quality improvement goals and outcomes rather than completing specific actions, thereby giving the Copermittees more control over how their water quality programs are implemented.

To achieve the second goal, the Regional MS4 Permit requires that Water Quality Improvement Plans (WQIPs) be developed for each Watershed Management Area (WMA) within the San Diego Region. As part of the development of WQIPs, the Regional MS4 Permit provides Copermittees an option to perform a Watershed Management Area Analysis (WMAA) through which watershed-specific requirements for structural BMP implementation for Priority Development Projects can be developed for each WMA. This report presents the Copermittees' approach and results for the regional elements of the WMAA developed for the San Diego County area.

1.2. Watershed Management Area Analysis (WMAA)

The Regional MS4 Permit, through inclusion of the WMAA, provides an optional pathway for Copermittees to develop an integrated approach for their land development programs by promoting evaluation of multiple strategies for water quality improvement and development of watershed-scale solutions for improving overall water quality in the watershed. The WMAA comprises the following three components as indicated in the Regional MS4 Permit:

1. Perform analysis and develop Geographic Information System (GIS) layers (maps) by gathering information pertaining to the physical characteristics of the WMA (referred to herein as WMA Characterization). This includes, for example, identifying potential areas of coarse sediment supply, present and anticipated future land uses, and locations of physical structures within receiving streams and upland areas that affect the watershed hydrology (such as bridges, culverts, and flood management basins).
2. Using the WMA Characterization results, compile a list of candidate projects that could potentially be used as alternative compliance options for Priority Development Projects. Such projects may include, for example, opportunities for stream or riparian area

rehabilitation, opportunities for retrofitting existing infrastructure to incorporate storm water retention or treatment, or opportunities for regional BMPs, among others. Prior to implementing these candidate projects the Copermittees must demonstrate that implementing such a candidate project would provide greater overall benefit to the watershed than requiring implementation of the onsite structural BMPs. Note, compilation or evaluation of potential projects was not performed as part of this regional effort. Identification and listing of candidate projects will be performed for each WMA through the WQIP process for WMAs that elect to submit the optional WMAA as part of the WQIP.

3. Additionally, using the WMA Characterization maps, identify areas within the watershed management area where it is appropriate to allow for exemptions from hydromodification management requirements that are in addition to those already allowed by the Regional MS4 Permit for Priority Development Projects. The Copermittees shall identify such cases on a watershed basis and include them in the WMAA with supporting rationale to support claims for exemptions.

1.3.Scope of Work for Regional WMAA

In July 2013, the Copermittees elected to fund a regional effort to develop elements of the regional WMAA for the 9 San Diego-area WMAs within the County of San Diego that are currently subject to the Regional MS4 Permit, which include:

- Santa Margarita River (for portion in San Diego County)
- San Luis Rey River
- Carlsbad
- San Dieguito River
- Los Peñasquitos
- Mission Bay & La Jolla Watershed
- San Diego River
- San Diego Bay
- Tijuana River (for portion in San Diego County)

The regional-level information developed through this effort is intended to provide consistency across WMAs and serve as the foundation for developing watershed-specific information for each WMA to be developed through the WQIP process. The regional effort scope of work included:

1. Development of GIS map layers that characterize the WMAs using data previously collected, readily available, and provided by the Copermittees, including:
 - a. Description of dominant hydrologic processes, such as areas where infiltration or overland flow likely dominates;
 - b. Description of existing streams in the watershed, including bed material and composition, and if they are perennial or ephemeral;

- c. Current and anticipated future land uses;
 - d. Potential coarse sediment yield areas; and
 - e. Locations of existing flood control structures and channel structures, such as stream armoring, constrictions, grade control structures, and hydromodification or flood management basins.
2. Development of a Microsoft® Excel (Excel) template for use by Copermittees to compile lists of candidate projects for an optional alternative compliance program.
 3. Development of additional criteria and analyses to support reinstating the following proposed exemptions that were originally developed in the approved 2011 Final Hydromodification Management Plan but not included in the Regional MS4 Permit unless provided by the Copermittees in the WMAA. In addition, development of the associated Hydromodification Applicability/Exemption Mapping.
 - a. Exempt River Reaches including:
 - i. San Diego River;
 - ii. Otay River;
 - iii. San Dieguito River;
 - iv. San Luis Rey River; and
 - v. Sweetwater River
 - b. Stabilized Conveyance Systems Draining to Exempt Water Bodies
 - c. Highly Impervious/Highly Urbanized Watersheds and Urban Infill, and
 - d. Tidally Influenced Lagoons (where data/study provided)

The scope of work for the regional effort excluded performing analysis within the following areas unless data was readily available, as Copermittees do not have jurisdiction over these areas:

1. State Lands;
2. U.S. Departments of Defense land;
3. U.S. National Forest land;
4. U.S. Department of Interior land and
5. Tribal land

Additional description of excluded areas, for the purposes of the Regional WMAA, is indicated in Section 2.3 Land Uses.

1.4. Project Process

The process for developing the Regional WMAA included close coordination with the Land Development Workgroup (LDW) at key points during the project. The LDW is composed of the 21 San Diego-area Copermittees and serves to develop and implement regional land development plans and programs necessary to support the requirements of the Regional MS4 Permit. The consultant team (Geosyntec Consultants and Rick Engineering Company) presented

preliminary project assumptions and methodologies proposed to be used to develop the Regional WMAA to meet the requirements of the Regional MS4 Permit in December 2013. The consultant team incorporated workgroup feedback from this meeting and subsequently presented the preliminary Regional WMAA project results to the LDW in March 2014, again to receive direction and incorporate input on the preliminary results. Subsequently, the draft report was released to the public in July 2014, by a public workshop that included Consultation Panel members from each of the WMAs on July 29, 2014. This version of the report including all of the input described above is being issued for optional inclusion into the respective WQIP Provision B.3 submittals to the SDRWQCB in December 2014.

1.5. Report Organization

This report is organized as follows:

- Chapter 1 provides the project background and purpose;
- Chapter 2 describes the technical basis for characterizing the WMA;
- Chapter 3 describes the template that can be used by Copermittees to compile the list of candidate projects;
- Chapter 4 summarizes the analyses performed to support reinstating select exemptions from hydromodification control requirements for PDPs;
- Chapter 5 presents the WMAA conclusions;
- Chapter 6 presents the references used for the WMAA;
- Attachment A presents the exhibits and additional supporting information for watershed management area characterization;
- Attachment B presents the exhibits and additional supporting information for hydromodification management applicability/exemptions;
- Attachment C expands on the structure of the geodatabase that hosts the GIS data developed by the WMAA; and
- Attachment D provides a crosswalk between the Regional MS4 Permit requirements for WMAA and this report.

1.6. Terms of Reference

The work described in this report was conducted by Geosyntec Consultants (Geosyntec) and Rick Engineering Company (RICK) on behalf of the County of San Diego and the regional Copermittees.

2. Watershed Management Area Characterization

Watershed health and function are strongly influenced by hydrological and geomorphological processes occurring in the watershed. Both hydrological response and geomorphological response of the watershed are dependent on a variety of physical characteristics of the watershed. To this end, the Regional MS4 Permit specifies a set of data that is required to adequately characterize overall watershed processes as a foundation to enhancing integration and effectiveness of watershed management and water quality programs. The following GIS map layers were developed to characterize the hydrological and geomorphological processes within the Mission Bay and La Jolla WMA:

- Dominant Hydrologic Processes: A description of dominant hydrologic processes, such as areas where infiltration or overland flow likely dominates;
- Stream Characterization: A description of existing streams in the watershed, including bed material and composition, and if they are perennial or ephemeral;
- Land Uses: Current and anticipated future land uses;
- Potential Critical Coarse Sediment Yield Areas; and
- Physical Structures: Locations of existing flood control structures and channel structures, such as stream armoring, constrictions, grade control structures, and hydromodification or flood management basins.

These GIS layers can be used to:

- Identify the nature and distribution of key macro-scale watershed processes;
- Identify potential opportunities and constraints for regional and sub-regional storm water management facilities that can play a critical role in meeting water quality, hydromodification, water supply, and/or habitat goals within the watershed;
- Assist with determining the most appropriate management actions for specific portions of the watershed; and
- Suggest where further study is appropriate.

2.1.Dominant Hydrologic Processes

The Regional MS4 Permit identifies in the provisions related to the WMAA that a description of dominant hydrologic processes within the watershed must be developed, with GIS layers (maps) as output. The Permit specifically calls for processes “*such as areas where infiltration or overland flow likely dominates.*” These particular aspects of the hydrological mechanics of watersheds are particularly important when attempting to understand the macro-scale opportunities for locating projects that take advantage of either capturing overland flow for treatment or for infiltration.

Investigation of the dominant hydrologic processes in the San Diego-area watersheds indicates that evapotranspiration (ET) is the most dominant hydrologic process for the region based on review of a published study (Sanford and Selnick, 2013). ET is the sum of evaporation and plant transpiration in the hydrologic cycle that transports water from land surfaces to the atmosphere. This conclusion is supported by comparing the 30-year average annual rainfall for the study area (San Diego County east of the peninsular divide) of between 15 and 18 inches per year (San Diego County, 2005) to the average annual ET rates. According to the California Irrigation Management Information System (CIMIS) Reference Evapotranspiration Map (CIMIS, 1999), the study area (within Zones 4, 6, and 9) experiences annual reference ET of 46.6, 49.7 and 59.9 inches, respectively. Therefore, theoretically, if all of the annual precipitation for the San Diego-area watersheds remained stationary where it fell and did not either infiltrate or runoff to local waterbodies where it would be conveyed downstream ultimately to the ocean, it all would be consumed by ET. As such, the effect of ET on the overall hydrologic processes within the San Diego watersheds is a function of the temporal scale over which it acts. Precipitation events often produce runoff in these watersheds, particularly in the urbanized portions, based on the topography and land cover that tend to accelerate the conveyance of runoff downstream rather than collecting, storing, or spreading out that then would maximize the effect of ET.

Because this study is focused on developing information and mapping for the portion of the hydrologic process that informs watershed management decisions, i.e., locating beneficial projects in areas of greatest opportunity, the next tier of dominant hydrologic processes are studied and mapped by this project. As such, the study area was characterized, based on the methodology described in the following section, according to the predicted fate of runoff within the watersheds being either overland flow or infiltration after considering the effects of ET (as well as an intermediate category of interflow). Areas that were mapped as overland flow do not necessarily preclude infiltration but rather indicate the dominant expected process that runoff would experience if not intercepted for the express purpose of infiltrating storm water runoff. The Model BMP Design Manual will provide more detailed guidance and procedures for determining the potential for infiltrating captured storm water at the project level irrespective of the mapping produced in the WMAA. To reiterate, the WMAA mapping is to provide macro-scale processes for high-level analysis and to inform decisions affecting regional scales. Furthermore, the Model BMP Design Manual will indicate the degree to which site-scale BMPs can expect to benefit from ET or how ET is considered in the sizing of BMPs. In brief, typical storm water BMPs only store water for a few days and therefore are not really capable of significant volume disposal through ET. However, pervious area dispersion (i.e., directing storm water runoff to flat areas for spreading and infiltration) has appreciable benefits with regard to ET and is a practice promoted in the BMP Design Manual.

The processes of interest are further defined as follows:

Overland flow: This process can be thought of as the inverse of infiltration; precipitation reaching the ground surface that does not immediately soak in must run over the land surface (thus, “overland” flow). It reflects the relative rates of rainfall intensity and the soil’s infiltration capacity: wherever and whenever the rainfall intensity exceeds the soil’s infiltration capacity, some overland flow will occur. Most uncompacted, vegetated soils have infiltration capacities of one to several inches per hour at the ground surface, which exceeds the rainfall intensity of even unusually intense storms. In contrast, pavement and hard surfaces reduce the effective infiltration capacity of the ground surface to zero, ensuring overland flow regardless of the meteorological attributes of a storm, together with a much faster rate of runoff relative to vegetated surfaces.

Infiltration and groundwater recharge: These closely linked hydrologic processes are most apparent near ephemeral and perennial conveyances in the San Diego region. Their widespread occurrence is expressed by the common absence of surface-water channels on even steep (undisturbed) hillslopes. Thus, on virtually any geologic material on all but the steepest slopes (or bare rock), infiltration of rainfall into the soil is inferred to be widespread, if not ubiquitous. With urbanization, changes to the process of infiltration are also quite simple to characterize: some (typically large) fraction of that once infiltrating water is now converted to overland flow.

Interflow: Interflow takes place following storm events as shallow subsurface flow (usually within 3 to 6 feet of the surface) occurring in a more permeable soil layer above a less permeable substrate. In the storm response of a stream, interflow provides a transition between the rapid response from surface runoff and much slower stream discharge from deeper groundwater. In some geologic settings, the distinction between “interflow” and “deep groundwater” is artificial and largely meaningless; in others, however, there is a strong physical discrimination between “shallow” and “deep” groundwater movement. Development reduces infiltration and thus interflow as discussed previously, as well as reducing the footprint of the area supporting interflow volume.

The datasets used, methodology for creating the dominant hydrologic processes maps, and the results are described in the sections below.

2.1.1. Datasets Used for identifying dominant hydrologic processes

The following datasets were used in the analysis:

Dataset	Source	Year	Description
Elevation	USGS	2013	1/3 rd Arc Second (~10 meter cells) digital elevation model for San Diego County
Soils Data	SanGIS	2013	NRCS (SSURGO) Database for San Diego County downloaded from SanGIS
Land Cover	SanGIS	2013	Ecology-Vegetation layer for San Diego County downloaded from SanGIS

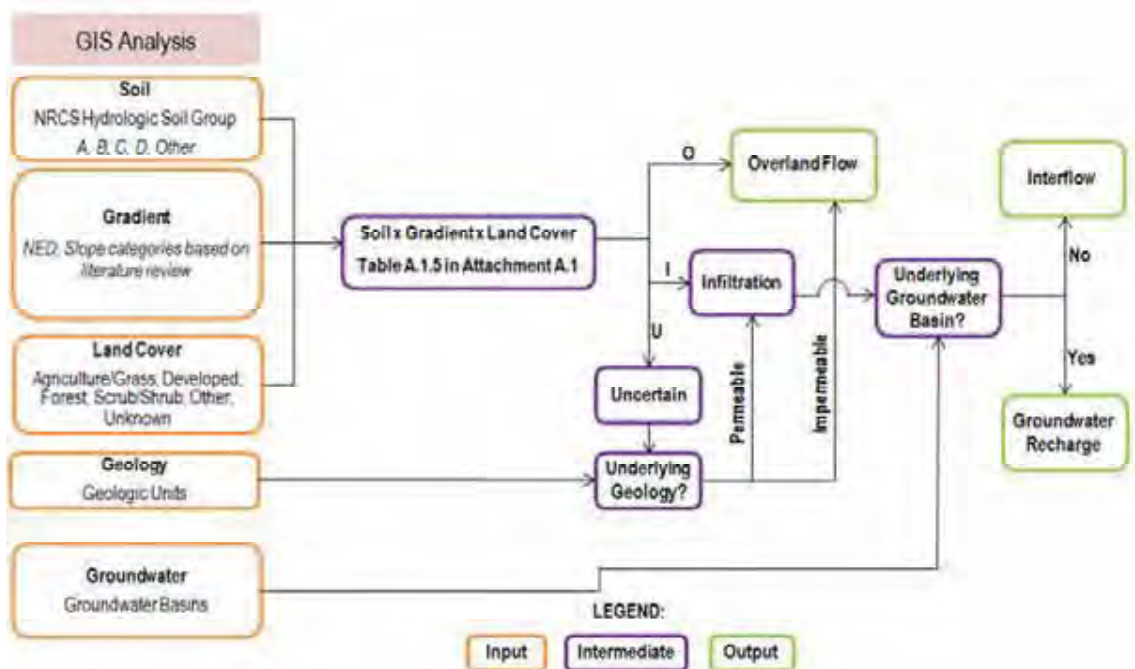
Dataset	Source	Year	Description
Geology	Kennedy, M.P., and Tan, S.S.	2002	Geologic Map of the Oceanside 30'x60' Quadrangle, California, California Geological Survey, Regional Geologic Map No. 2, 1:100,000 scale.
	Kennedy, M.P., and Tan, S.S.	2008	Geologic Map of the San Diego 30'x60' Quadrangle, California, California Geological Survey, Regional Geologic Map No. 3, 1:100,000 scale.
	Todd, V.R.	2004	Preliminary Geologic Map of the El Cajon 30'x60' Quadrangle, Southern California, United States Geological Survey, Southern California Aerial Mapping Project (SCAMP), Open File Report 2004-1361, 1:100,000 scale.
	Jennings et al.	2010	"Geologic Map of California," California Geological Survey, Map No. 2 – Geologic Map of California, 1:750,000 scale
Groundwater Basins	SanGIS	2013	Groundwater Basins in San Diego County downloaded from SanGIS

2.1.2. Methodology/Assumptions/Criteria for identifying dominant hydrologic processes

The methodology used to describe dominant hydrologic processes is based on recommendations included in the Southern California Coastal Water Research Project's (SCCWRP) Technical Report 605 titled "Hydromodification Screening Tools: GIS-Based Catchment Analyses of Potential Changes in Runoff and Sediment Discharge" (SCCWRP, 2010). The foundation for this analysis was to incorporate the Report's concept of grouping common hydrologic attributes into Hydrologic Response Units (HRUs). The report states the following:

"Grouping common hydrologic attributes across a watershed into a tractable number of Hydrologic Response Units (HRUs: a term first used by England and Holtan 1969) has become a well-established approach for condensing the near-infinite variability of a natural watershed into a tractable number of different elements. The normal procedure for developing HRUs is to identify presumptively similar rainfall-runoff characteristics across a watershed by combining spatially distributed climate, geology, soils, land use, and topographic data into areas that are approximately homogeneous in their hydrologic properties (Green and Cruise 1995, Becker and Braun 1999, Beven 2001, Haverkamp et al. 2005). As noted by Beighley et al (2005), this process of merging the landscape into discrete HRUs is a common and effective method for reducing model complexity and data requirements. Using watershed characteristics to predict runoff is the explicit task of hydrologic models, and there is a host of such models available for application to hydromodification evaluation. For purposes of "screening," however, the goal is simplicity and ease of application even if the precision of the resulting analysis is crude."

The following process describes the methodology used to define Hydrologic Response Units (HRUs) and then relate the HRUs to the dominant hydrologic processes (i.e., overland flow, interflow, and groundwater recharge) in the Mission Bay and La Jolla WMA.



The first step is to define the HRUs. Once these are defined, the remaining steps determine the dominant hydrologic process.

1. **Integrate data sets used to determine HRU:** Categories for soil type, gradient, and land cover were defined based on readily available GIS datasets for the region and classifications found in relevant literature, as indicated below. The different combinations of these three categories comprise the distinct HRUs.
 - **Soil Categories:** based on National Resource Conservation Service (NRCS) Hydrologic Soil Group (HSG) classifications, which are commonly used to describe runoff/infiltration potential of soils on a regional scale. These categories include: A, B, C, and D. HSG A soils have the lowest runoff potential, while HSG D soils have the highest runoff potential.
 - **Gradient Categories:** based on slope ranges found in a review of relevant literature identified in Chapter 6. The spatial processing of the slope categories utilized the United States Geologic Survey (USGS) National Elevation Dataset (NED). Slopes were grouped (bins) into the following ranges: 0% to 2%; 2% to 6%; 6% to 10%; and greater than 10%. The 2% and 6% slope thresholds were based on slope ranges included in Table A.1.1 (McCuen, 2005) presented in Attachment A.1. This table provides runoff coefficients as a function of slope, soil group, land cover, and return period and was used for subsequent steps in the mapping effort. The 10% slope threshold was used in SCCWRP's Technical

Report 605 (SCCWRP, 2010) and is a logical cutoff since slopes steeper than 10% are assumed to be dominated by overland flow.

- **Land Cover Categories:** were defined using the Ecology Vegetation GIS map layer developed by the City of San Diego, the County of San Diego and SANDAG and downloaded from SanGIS (2013). The vegetation categories in the GIS layer were grouped (Table A.1.2 in Attachment A.1) to match the following categories used in SCCWRP's Technical Report 605 (SCCWRP, 2010): Agriculture/Grass; Developed; Forest; Scrub/Shrub, Other (Water), and Unknown.

2. **Evaluate Land Cover:** Land cover categories for Agriculture/Grass, Forest, Scrub/Shrub and Other were related to land use categories defined in Table A.1.1 as shown in Table A.1.3 in Attachment A.1. Relating a land use category for the Developed land cover category was not necessary because all Developed cover was assumed to have overland flow as its dominant hydrologic process.
3. **Determine Hydrology Characteristics for Land Covers:** For each of the land cover/land use categories listed in Table A.1.3, the ratio of precipitation lost to evapotranspiration (i.e. an evapotranspiration coefficient) was estimated using Table A.1.1 using the process described below. Since precipitation is considered to be the sum of the resulting runoff, infiltration, and evapotranspiration, the coefficients for these three hydrologic pathways sum to one, as indicated below.

$$\text{Runoff Coefficient} + \text{Infiltration Coefficient} + \text{Evapotranspiration Coefficient} = 1$$

- i) **Estimate Evapotranspiration:** To estimate the evapotranspiration (ET) coefficient for each land cover, first the runoff coefficient was identified in Table A.1.1 for the highest runoff potential (i.e., Group D soil and 6%+ slope) and most common storm conditions (i.e., storm recurrence intervals less than 25 years). The infiltration for these high runoff conditions was assumed to be negligible, resulting in an infiltration coefficient of zero. Since the sum of the three coefficients should sum to one, the ET coefficient was assumed to be the remaining difference (i.e., ET Coefficient = 1 – Runoff Coefficient). The ET coefficient calculated for the highest runoff potential was then applied to all soil types and slopes within that land use category. The calculated ET coefficient for each applicable HRU is provided in Table A.1.4 in Attachment A.1. The ET coefficient for HRUs that have a Developed land cover or a gradient greater than 10% were not calculated since these HRUs were assumed to have overland flow as the dominant hydrologic process.
- ii) **Estimate Infiltration:** The infiltration coefficient for each applicable HRU (i.e., combination of soil, gradient, and land cover) was estimated by subtracting both the runoff coefficient, provided in Table A.1.1, and the ET coefficient, calculated in step 3(i), from one (i.e., Infiltration Coefficient = 1 – Runoff Coefficient – ET Coefficient). The calculated infiltration coefficient for each applicable HRU is provided in Table A.1.4 in Attachment A.1.
- iii) **Estimate Runoff:** For each applicable HRU, the runoff coefficient was divided by

the infiltration coefficient to obtain a ratio representing the potential for runoff or infiltration. The higher the ratio, the greater the potential for runoff to be a more dominant hydrologic process than infiltration. Similarly, the lower the ratio, the greater the potential for infiltration to be a more dominant hydrologic process than runoff. The calculated runoff to infiltration ratios are provided in Table A.1.4 in Attachment A.1.

4. **Associate Runoff and Infiltration to HRUs:** The following designations were assigned to each applicable HRU based on the runoff to infiltration ratio (i.e., runoff coefficient/infiltration coefficient). These designations were based on best engineering judgment with the underlying assumption that if a runoff or infiltration coefficient is more than 50% greater than its counterpart, then the prevailing process is considered dominant.
 - HRUs with runoff to infiltration ratios greater than 1.5 (3:2 ratio) were assumed to have relatively high runoff and overland flow was considered its dominant hydrologic process. These HRUs are designated by the letter “O” (Overland flow is dominant process) in Tables A.1.4 and A.1.5 in Attachment A.1.
 - HRUs with runoff to infiltration ratios less than 0.67 (2:3 ratio) were assumed to have relatively high infiltration and its dominant hydrologic process was either interflow or groundwater recharge, based on analysis described in subsequent steps. These HRUs are designated by the letter “I” (Interflow is dominant process) in Tables A.1.4 and A.1.5.
 - For HRUs with runoff to infiltration ratios between, and including, 1.5 and 0.67 it was uncertain whether it was dominated by overland flow or infiltration. These HRUs are designated by the letter “U” (Dominant process is uncertain) in Tables A.1.4 and A.1.5.
 - For HRUs that have a Developed land cover or a gradient greater than 10%, the runoff to infiltration ratios were not calculated because these HRUs were assumed to have overland flow as the dominant hydrologic process. These HRUs are designated by the letter “O” (Overland flow is dominant process) in Table A.1.5.
5. **Uncertain HRUs Assignment:** For HRUs with an uncertain designation (“U”) in Table A.1.5 in Attachment A.1, the underlying regional geology (Kennedy and Tan, 2002 & 2008; Todd, 2004 and Jennings et al., 2010) was used to evaluate whether overland flow or infiltration were dominant. If the underlying geology was considered impermeable, then these uncertain areas were considered to have overland flow as its dominant hydrologic process. If the underlying geology was considered permeable, then these uncertain areas were considered to be dominated by infiltration. The determination of whether a geologic unit is impermeable or permeable was based on desktop evaluation and the best professional judgment of a Certified Engineering Geologist (CEG). This analysis was performed in GIS and is illustrated in the flowchart above.

6. **Associate Infiltration HRUs with Known Groundwater Basins:** For HRUs with relatively high infiltration and have a designation of “I” in Table A.1.5 in Attachment A.1, the presence or absence of a regional groundwater basin (SanGIS, 2013) underlying these areas determined whether the dominant hydrologic process was designated as interflow or groundwater recharge. The groundwater recharge hydrologic process was assigned as dominant for those applicable areas which had an underlying groundwater basin. The interflow hydrologic process was assigned as dominant for those applicable areas which did not have an underlying groundwater basin directly below it. This analysis was performed in GIS and is illustrated in the flowchart above.
7. **Resulting HRU Data:** The resulting GIS map of dominant hydrologic processes was reviewed by engineering professionals familiar with the hydrology in the County of San Diego to confirm that the mapping is consistent with their experience working in the region.

2.1.3. Results for identifying dominant hydrologic processes

The resulting GIS map showing the spatial distribution of dominant hydrologic processes (i.e., overland flow, interflow, and groundwater recharge) within the Mission Bay and La Jolla WMA is provided in Attachment A.1. An ArcMap document file which presents the results from each step of the methodology is included in Attachment C, as well as a Google Earth KMZ file. Based on this analysis, overland flow is the predominant hydrologic process in all this WMA, which is consistent with the experience of engineering professionals familiar with the hydrology of the County of San Diego.

Summary of Deliverables for Dominant Hydrologic Processes

Format	Item	Description	Location
Report	Figure	"Dominant Hydrologic Processes"	Attachment A.1
GIS	Map Group Title	Hydrologic Processes	Attachment C.1
	Map Layer Title	Soil Land Cover Slope Hydrologic Response Unit Initial Rating Permeability Groundwater Basin Dominant Hydrologic Processes	
	Geodatabase Feature Dataset	HydrologicProcesses	
	Geodatabase Feature Class	HRUAnalysis	
	Geodatabase Geometry Type	Polygon	
KMZ ¹	KMZ File Name	Dominant Hydrologic Processes	Attachment C.2
¹ To enhance the utilization of this data, the Dominant Hydrological Processes map is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zipped) file that can be viewed with the free download version of Google Earth (http://www.google.com/earth/).			

2.1.4. Limitations for identifying dominant hydrologic processes

The resulting GIS map layer only lists the dominant hydrological process (i.e., an HRU assigned a dominant process of overland flow can also experience small amounts of infiltration) and provides a useful, rapid framework to perform screening-level analysis that is appropriate for watershed-scale planning studies. When more precise estimates are required for a particular site and subarea it is recommended that this analysis be augmented with site-specific analysis.

2.2.Stream Characterization

For the purpose of WMAA, the Regional MS4 Permit requires a description of existing streams in the watershed, including bed material and composition, and if they are perennial or ephemeral. Under the Regional WMAA, this analysis was prepared for 27 streams throughout the San Diego Region agreed upon by the consultant team and Copermittees. Within the Mission Bay and La Jolla WMA, stream characterization and detailed mapping is provided for Rose Creek as shown on the exhibit titled "Watershed Management Area Streams" located in Attachment A.2.

2.2.1. Datasets Used for stream characterization

The following data were referenced for the purpose of stream characterization:

- USGS National Hydrography Dataset, downloaded from USGS November 2013
- USGS 7.5-minute quadrangles, compiled image of quadrangles covering San Diego County, various dates
- Floodplains: "National Flood Hazard Layer," provided by Federal Emergency Management Agency October 2012
- Various datasets provided by Copermittees depicting existing storm water conveyance infrastructure within their jurisdictions.
- Aerial photography by Digital Globe dated 2012

2.2.2. Methodology/Assumptions/Criteria for stream characterization

The analysis was prepared by digitizing each of the 27 streams based on review of data listed above. Within the pre-existing datasets depicting streams, floodplains, or infrastructure, no single dataset included a complete, accurate alignment of each stream. Digitizing the streams based on review of all of the data listed above allowed creation of GIS linework with a continuous corrected alignment for each stream. The following data were recorded as GIS attributes for each stream as the stream was digitized:

- River name
- Reach type (engineered or natural, constrained or un-constrained)
- Bed material
- Bank material
- Hydrographic category (perennial or intermittent)

The attributes listed above were collected manually based on interpretation of the reference data. Assumptions used in making the interpretations are listed below. The **Hydrographic Category** section below will provide the rationale as to why perennial and intermittent were the hydrographic categories chosen for this WMAA and not perennial and ephemeral.

Note that stream classification was not prepared within areas of Federal/State/Indian lands unless data was readily available. Stream lines were prepared within these areas for continuity, but some data fields were not populated within these areas.

Reach Type

Streams were classified as either engineered or natural, and either constrained or un-constrained. See the exhibit titled, "Watershed Management Area Streams by Reach Type" in Attachment A.2. The purpose of this exercise was to identify whether the stream has been modified by human activity within the stream itself, which may include addition of crossing structures, stabilization of banks, dredging, or any other human activity. This aids the identification of physical structures including stream armoring, constrictions, grade control, and other modifications as required by the Regional MS4 Permit.

Classification of the streams as either **“engineered”** or **“natural”** was based on the following criteria:

Engineered

- A classification of "engineered" was assigned where the stream itself has been modified by human activity.
- All culvert/bridge/pipe crossings either provided in the Copermittees' storm water conveyance system data or clearly visible on the aerial photo have been assigned as engineered within the limits of the crossing.
- If the Copermittees did not provide storm water conveyance system data for the dirt road crossings/dip sections the streams have been assigned as engineered within the limits of the crossing. These crossings may or may not have culverts.
- If the Copermittees' storm water conveyance system data stated the facility is a detention or desilting basin, they were assigned as engineered.
- Golf courses have been assigned as engineered.
- If aerial photography showed large water bodies (lake, pond, irrigation pond, etc.) they were assigned as engineered.
- If the storm water conveyance system data provided by the Copermittees has identified the stream as “rockbs”, the assumption has been made that these streams have rocks on their bottom and the sides (“bs”), and have been assigned as engineered.
- Sand mining operations have been assigned as engineered. Sand mining is an operation that is in continuous flux and does not typically result in a discrete, engineered geometry in any given channel cross section until restoration is implemented at the conclusion of the sand mining operation. It is assigned as engineered to acknowledge human alteration of the stream.

Natural

- Streams that have no apparent alteration within the stream itself by human activity have been assigned as natural.

Classification of the streams as either **“constrained”** or **“un-constrained”** was based on the following criteria:

Constrained

- All culvers/bridge/pipe crossings either provided in the Copermittes' storm water conveyance system data or clearly visible on the aerial photo have been assigned as constrained.
- If the Copermittes did not provide storm water conveyance system data for the dirt road crossings/dip sections the streams have been assigned as constrained. These crossings may or may not have culverts.
- If the Copermittes' storm water conveyance system data stated the facility is a detention or desilting basin, they were assigned as constrained.
- Golf courses have been assigned as constrained if located within the Federal Emergency Management Agency (FEMA) floodway based on the "National Flood Hazard Layer" data.
- The USGS National Hydrographic Dataset in their hydrographic category had assigned some reaches as artificial paths. In these situations and if the aerial photography shows large water bodies (lake, pond, irrigation pond, etc.) these streams have been assigned as constrained.
- Sand mining operations located within the FEMA floodway based on the "National Flood Hazard Layer" have been assigned as constrained.

Un-constrained

- Golf courses have been assigned as un-constrained if not located within the FEMA floodway based on the "National Flood Hazard Layer" data.
- Sand mining operations not located within the FEMA floodway based on the "National Flood Hazard Layer" data have been assigned un-constrained.
- If the stream is located within the FEMA floodway based on the "National Flood Hazard Layer" and there is available land in the floodway fringe (the area between the floodway and the 100-year floodplain) the area has been assigned un-constrained. Note that there may be only one side or both sides of the stream with available land in the floodway fringe therefore a note was added as to which side of the stream is constrained and un-constrained.
- If the stream is located within a FEMA 100-year floodplain based on the "National Flood Hazard Layer" data with no floodway and the FEMA floodplain width is not within an existing development or bordered by roads have been assigned as un-constrained.

Bed Material and Bank Material

The following bed and bank materials were identified:

- Concrete
- Riprap
- Pipe / culvert
- Earth

The assumptions made to identify the streams bed and bank materials were based on the following criteria:

- If the data provided by the Copermitees provided information about the stream bed and bank material, the provided data was used for the bed and bank material.
- Generally the data provided by the Copermitees did not identify the crossing type (pipe, box culvert, bridge with or without piers, etc.) or the material (RCP, RCB, earth, riprap, concrete, etc.). In that case, all culvert/bridge/pipe crossings were assigned as pipe/culvert for the bed and bank material.
- If the Copermitees did not provide data for the dirt road crossings/dip sections the bed and bank material have been assigned as pipe/culvert. These crossings may or may not have culverts.
- If the Copermitees' storm water conveyance system data stated the facility is a detention or desilting basin, the bed and bank material have been assigned as earth.
- If aerial photography showed large water bodies (lake, pond, irrigation pond, etc.) they were assigned as earth bed and bank material. The USGS National Hydrographic Dataset in their hydrographic category had assigned some of these types of reaches as artificial paths.
- Sand mining operations within the stream have been assigned as earth for bed and bank material.
- If the Copermitees did not provide data for the stream material the bed and bank material have been assigned based on the aerial photography.

See exhibits titled, "Watershed Management Area Streams by Bed Material" in Attachment A.2.

After stream bed and bank material was classified, earthen reaches were further classified by geologic group. This was accomplished by intersecting the streams with the geologic group layer that had been prepared for use in the dominant hydrologic process and potential coarse sediment yield analyses. The result is displayed in exhibits titled, "Watershed Management Area Streams by Geologic Group" in Attachment A.2.

Hydrographic Category

Streams were classified as "perennial" or "intermittent." See exhibits titled, "Watershed Management Area Streams by Hydrographic Category" in Attachment A.2. Classification was obtained from the USGS National Hydrography Dataset (NHD). The definitions of these categories in the USGS National Hydrography Dataset are:

- **Perennial:** Contains water throughout the year, except for infrequent periods of severe drought.
- **Intermittent:** Contains water for only part of the year, but more than just after rainstorms and at snowmelt.

While the specific Regional MS4 Permit language requested classification of perennial or ephemeral, rather than perennial or intermittent, the data that was referenced in order to classify streams did not include "ephemeral" streams. For reference, the USGS National Hydrography Dataset definition of "ephemeral" is: "contains water only during or after a local rainstorm or heavy snowmelt." None of the stream reaches in the study were classified as ephemeral in the NHD dataset, therefore none are classified as ephemeral in the WMAA product. The City of San Diego provided a map titled "City of San Diego Stream Survey" dated April 3, 2013 prepared by AMEC that shows streams that are "dry" and streams that are "flowing". This information in conjunction with the other parameters listed in this section was used to determine if a stream was perennial or intermittent.

USGS NHD includes hydrographic category classification for many of the streams. However data was not available for all reaches of all streams. In order to classify reaches of streams that did not already contain this data in NHD, these assumptions were made:

- The USGS NHD information for the stream hydrographic category has been used when available.
- When USGS NHD has "artificial paths" for portions of the stream, the hydrographic category of the upstream portion of the stream have been assigned to the stream unless other assumptions took precedence.
- If aerial photography shows large waterbody (lake, pond, irrigation pond, etc.) perennial has been assumed for the hydrographic category.
- For ponded areas shown on the aerial photography and if the USGS 7.5-minute quadrangles shows cross hatching for the area, intermittent has been assigned unless the upstream portion of the stream was assigned as perennial pursuant to the USGS National Hydrography Dataset then assigned perennial for the ponded area.
- USGS has a dashed line for intermittent streams. USGS has a solid line for perennial streams. In some situations this information was used to assist in the determination of assigning perennial or intermittent to a stream.

2.2.3. Results for stream characterization

The 27 streams and data are contained in a GIS file titled "SD_Regional_WMAA_Streams" located in Attachment C. The streams are shown in watershed maps included in Attachment A.2.

Summary of Deliverables for Stream Characterization

Format	Item	Description	Location
Report	Title of Figures	• "Watershed Management Area Streams" • "Watershed Management Area Streams by Hydrographic Category" • "Watershed Management Area Streams by Bed Material" • "Watershed Management Area Streams by Geologic Group" • "Watershed Management Area Streams by Reach"	Attachment A.2

Format	Item	Description	Location
		Type"	
GIS	Map Group Title	Not Grouped	Attachment C.1
	Map Layer Title	SD_Regional_WMAA_Streams	
	Geodatabase Feature Dataset	Streams	
	Geodatabase Feature Class	SD_Regional_WMAA_Streams	
	Geodatabase Geometry Type	Line	
KMZ ¹	KMZ File Name	SD_Regional_WMAA_Streams	Attachment C.2
¹ To enhance the utilization of this data, the Stream Characterization map is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zip) file that can be viewed with the free download version of Google Earth (http://www.google.com/earth/).			

In addition to the 27 streams that were subject of detailed analysis, NHD streams have been included on maps and within the geodatabase for reference. The NHD stream alignments have not been corrected and in some cases may be inconsistent with the existing infrastructure. The NHD streams are contained in a GIS file titled, "SD_NHD_Streams."

2.2.4. Limitations for stream characterization

- Only a desktop analysis was performed and no field verification was conducted.
- Infrastructure is only based on storm water conveyance system data provided by Copermittees or clearly visible on aerial photography. If the Copermittee used a numbering or lettering system for describing bed and bank material for example, since the metadata was not provided the bed and bank material could not be verified.
- In some instances concrete channels cannot be identified on aerial photography if it is filled with sediment and/ or vegetation.

2.3.Land Uses

For the purpose of the WMAA, the Regional MS4 Permit requires a description of current and anticipated future land uses. This is presented in the final GIS deliverable as "Land Use Planning" and includes the following representations of land uses in the watersheds: existing land uses, planned land uses, developable lands, redevelopment and infill areas, floodplains, Multiple Species Conservation Program (MSCP) designated areas, and areas not within the Copermittees' jurisdictions (tribal lands, state lands, and federal lands).

2.3.1. Datasets Used for land uses

The following existing regional datasets were referenced to meet this requirement:

- Municipal boundaries: "Municipal_Boundaries" dated August 2012, available from SanGIS/SANDAG
- Ownership: "Parcels" dated December 2013, available from SanGIS/SANDAG
- Existing land use: "SANGIS.LANDUSE_CURRENT" dated December 2012, available from SanGIS/SANDAG (existing land use)
- Planned land use: "PLANLU" (Planned Land Use for the Series 12 Regional Growth Forecast (2050)), dated December 2010, available from SanGIS/SANDAG
- Developable land: "DEVABLE" (Land available for potential development for the Series 12 Regional Growth Forecast), dated December 2010, available from SanGIS/SANDAG
- Redevelopment and infill areas: "REDEVINF" (Redevelopment and infill areas for the Series 12 Regional Growth Forecast), dated December 2010, available from SanGIS/SANDAG
- Floodplains: "National Flood Hazard Layer" provided by Federal Emergency Management Agency October 2012
- Multiple Species Conservation Program (MSCP), total of four datasets available from SanGIS/SANDAG: "MHPA_SD," dated 2012, (Multiple Habitat Planning Areas for City of San Diego); "MSCP_CN," dated 2009 (designations of the County of San Diego's Multiple Species Conservation Program South County Subregional Plan); "MSCP_EAST_DRAFT_CN," dated 2009 (draft East County MSCP Plan); and "Draft_North_County_MSCP_Version_8.0_Categories," dated 2008 (draft North County MSCP Plan)

2.3.2. Methodology/Assumptions/Criteria for land uses

The existing regional datasets for existing land use, planned land use, developable land, redevelopment and infill areas, floodplains, and MSCP designated areas were referenced with no modifications. Areas not within the Copermittees' jurisdictions (tribal lands, state lands, and federal lands) were compiled from SanGIS parcel data (December 2013) based on the "ownership" value. The owners listed below were excluded from the Copermittees jurisdictions and represent the "Federal/State/Indian" layer, which is displayed on various maps included in Attachment A.2.

- Bureau of Land Management
- California Department of Fish and Game
- Indian Reservations
- Military Reservations

- Other Federal
- State
- State of California Land Commission
- State Parks
- U.S. Fish and Wildlife Service
- U.S. Forest Service

When available, relevant data from these areas was included in analyses (e.g., developable land areas within Federal/State/Indian areas). Stream lines were prepared within these areas for continuity. However, stream classification (e.g., bed and bank material) was not prepared within these areas unless data was readily available (e.g., hydrographic category data available from NHD)

2.3.3. Results for land uses

The existing regional datasets are compiled into the Geodatabase in a group titled, "Land Use Planning." Current and anticipated future land uses are depicted in watershed maps included in Attachment C. Federal/State/Indian Lands are also referenced on all other map exhibits included in Attachment A.2.

Summary of Deliverables for Land Uses

Format	Item	Description	Location
Report	Title of Figures	• "Existing Land Use" • "Planned Land Use" • "Developable Land" • "Redevelopment and Infill Areas"	Attachment A.3
GIS	Map Group Title	Land Use Planning	Attachment C.1
	Map Layer Title	Municipal Boundaries Federal/State/Indian Lands SanGIS_ExistingLandUse SanGIS_PlannedLandUse SanGIS_DevelopableLand SanGIS_RedevelopmentandInfill FEMA Floodplain MHPA_SD MSCP_CN MSCP_EAST_DRAFT_CN Draft_North_County_MSCP_Version_8_Categories	
	Geodatabase Feature Dataset	LandUsePlanning	
	Geodatabase Feature Class	SanGIS_MunicipalBoundaries Federal_State_Indian_Lands SanGIS_ExistingLandUse SanGIS_PlannedLandUse	

Format	Item	Description	Location
		SanGIS_DevelopableLand SanGIS_RedevelopmentandInfill FEMA_NFHL SanGIS_MHPA_SD SanGIS_MSCP_CN SanGIS_MSCP_EAST_DRAFT_CN SanGIS_Draft_North_County_MSCP_Version_8_Categories	
	Geodatabase Geometry Type	Polygon	
KMZ ¹	KMZ File Name	Municipal Boundaries Federal/State/Indian Lands Floodplains Due to file size limitations, SanGIS land use datasets were not converted to KMZ.	Attachment C.2
¹ To enhance the utilization of this data, the Land Uses map is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zipped) file that can be viewed with the free download version of Google Earth (http://www.google.com/earth/).			

2.3.4. Limitations

Some jurisdictions may have compiled GIS land use layers that include more detailed or more current information than the regional datasets available from SanGIS. SanGIS layers were selected for the Regional WMAA to provide consistent land use characterization region-wide, and to provide for repeatability of GIS analyses when a land use layer is required for input data. The definition of non-Copermittee areas identified in this document as "Federal/State/Indian Lands" is for the Regional WMAA. Some WQIPs may define non-Copermittee areas differently.

2.4.Potential Critical Coarse Sediment Yield Areas

The Regional MS4 Permit identifies in the provisions related to the WMAA that potential coarse sediment yield areas within the watershed be identified, with GIS layers (maps) as output. With regard to the function and importance of coarse sediment, SCCWRP Technical Report 667 titled “Hydromodification Assessment and Management in California” states the following:

“Coarse sediment functions to naturally armor the stream bed and reduce the erosive forces associated with high flows. Absence of coarse sediment often results in erosion of in-channel substrate during high flows. In addition, coarse sediment contributes to formation of in-channel habitats necessary to support native flora and fauna.”

This report identifies the potential critical coarse sediment yield areas for the Mission Bay and La Jolla WMA in compliance with this permit provision. The applied datasets and methodologies for identifying the coarse sediment yield areas, along with their respective results, are described in the sections below.

2.4.1. Datasets Used for identifying potential critical coarse sediment yield areas

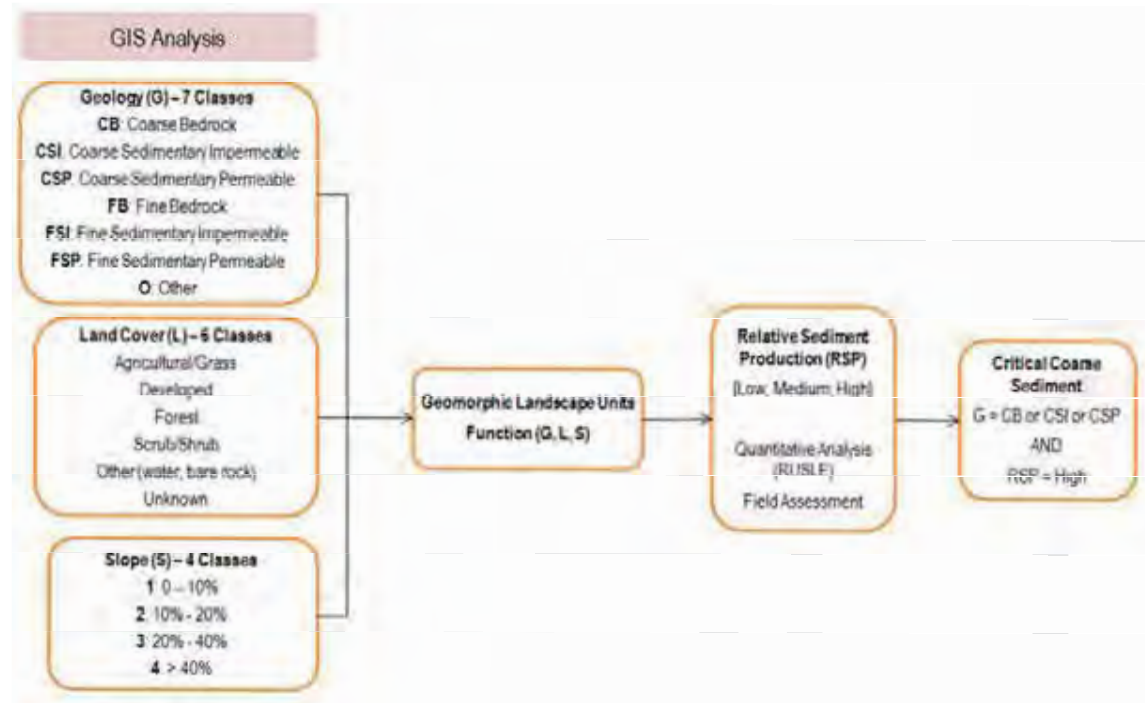
The following datasets were used in the analysis

Dataset	Source	Year	Description
Elevation	USGS	2013	1/3 rd Arc Second (~10 meter cells) digital elevation model for San Diego County
Land Cover	SanGIS	2013	Ecology-Vegetation layer for San Diego County downloaded from SanGIS
Geology	Kennedy, M.P., and Tan, S.S.	2002	Geologic Map of the Oceanside 30’x60’ Quadrangle, California, California Geological Survey, Regional Geologic Map No. 2, 1:100,000 scale.
	Kennedy, M.P., and Tan, S.S.	2008	Geologic Map of the San Diego 30’x60’ Quadrangle, California, California Geological Survey, Regional Geologic Map No. 3, 1:100,000 scale.
	Todd, V.R.	2004	Preliminary Geologic Map of the El Cajon 30’x60’ Quadrangle, Southern California, United States Geological Survey, Southern California Areal Mapping Project (SCAMP), Open File Report 2004-1361, 1:100,000 scale.
	Jennings et al.	2010	“Geologic Map of California,” California Geological Survey, Map No. 2 – Geologic Map of California, 1:750,000 scale

2.4.2. Methodology/Assumptions/Criteria for identifying potential critical coarse sediment yield areas

The methodology used to identify coarse sediment yield areas is based on Geomorphic

Landscape Unit (GLU) methodology presented in the SCCWRP Technical Report 605 titled “Hydromodification Screening Tools: GIS-Based Catchment Analyses of Potential Changes in Runoff and Sediment Discharge” (SCCWRP, 2010). Geomorphic Landscape Units characterize the magnitude of sediment production from areas through three factors judged to exert the greatest influence on the variability on sediment-production rates: geology types, hillslope gradient, and land cover. The GLU approach provides a useful, rapid framework to identify sediment-delivery attributes of the watershed. The process to integrate these factors into GLUs is indicated in the flow chart below.



The following steps were used to define Geomorphic Landscape Units (GLUs), which were then related to the coarse sediment and critical coarse sediment yield areas in the Mission Bay and La Jolla WMA.

1. **Integrate data sets used to determine GLU:** Categories for geology, gradient, and land cover were defined based on readily available GIS datasets for the region and classifications found in relevant literature listed in Chapter 6. The different combinations of these categories make up distinct GLUs.
 - **Geologic Categories:** based on methodology listed in Attachment A.4.1 of Attachment A.4. Resulting geologic categories from this analysis are: Coarse Bedrock (CB), Coarse Sedimentary Impermeable (CSI), Coarse Sedimentary Permeable (CSP), Fine Bedrock (FB), Fine Sedimentary Impermeable (FSI), Fine Sedimentary Permeable (FSP), and Other (O). An exhibit showing the regional geology groupings is presented in Attachment A.4.

- **Land cover categories:** defined using the Ecology Vegetation GIS map layer developed by the City of San Diego, the County of San Diego and SANDAG which were downloaded from SanGIS (2013). The vegetation categories in the GIS layer were grouped (Table A.1.2 in Attachment A.1) to match the following categories used in SCCWRP's Technical Report 605 (SCCWRP, 2010): Agriculture/Grass; Developed; Forest; Scrub/Shrub, Other (Water) and Unknown.
 - **Gradient Categories:** based on slope ranges found in a review of relevant literature (GLU methodology applied in California) listed in Chapter 6. The spatial processing of the slope categories utilized the USGS National Elevation Dataset (NED). Slope ranges used include: 0% to 10%, 10% to 20%, 20% to 40%, and greater than 40%.
2. **GLU Union Results:** GIS mapping exercise for the study area resulted in 166 GLUs within the 9 WMAs in San Diego County. Table A.4.2 in Attachment A.4 provides the list of the 166 GLUs.
- For implementing hydromodification management performance standards in the Regional MS4 Permit, the Copermittees need to identify Critical Coarse Sediment Yield areas in the study region. To provide information on the identification of Critical Coarse Sediment yield, the study assumed that critical coarse sediment would be generated from GLUs that are composed of geologic units likely to generate coarse sediment (based on the methodology listed in Step 3) and have the potential for high relative sediment production (as estimated using the methodology listed in Step 4).
3. **Define Pertinent Geologic groups:** the geologic groups (Attachment A.4.1) considered in this study to have the potential to generate coarse sediment are Coarse Bedrock (CB), Coarse Sedimentary Impermeable (CSI), and Coarse Sedimentary Permeable (CSP). An exhibit showing the regional geologic grouping is presented in Attachment A.4.
4. **Relate GLU to Sediment Production:** For assigning GLUs with a relative sediment production, the following methodology was utilized:
- Conducted quantitative analysis to assign relative sediment production. Analysis was performed based on the assumption that sediment production from an area is proportional to the soil loss from the area, as evaluated using standard soil loss equation. Detailed analysis steps are documented in Attachment A.4.2;
 - To validate the quantitative assignment above, a qualitative field assessment was conducted for 40 sites. Site selection and findings from the field assessment is documented in Attachment A.4.3.
 - The result of the field assessment indicated a 65% match between field conditions and the quantitative assignments. The mismatches are attributed to differences in percent land cover as assumed for the quantitative analysis and those observed in the field. As such, the quantitative assignments were considered to be valid for the purposes of assigning relative sediment production.

2.4.3. Results for identifying potential critical coarse sediment yield areas

The resulting GIS maps showing the spatial distribution of geologic grouping and critical coarse sediment yield areas within the Mission Bay and La Jolla WMA are provided in Attachment A.4. An ArcMap document which presents the results from each step of the methodology is included in Attachment C. Based on this analysis it was estimated that 1.5 % of the study area is a potential critical coarse sediment yield area.

As a result of the regional-scale datasets, and commensurate data resolution, used to map the potential critical coarse sediment yield areas, some areas may have been mapped that in reality do not produce critical coarse sediment as they are existing developed areas. As such, an opportunity for jurisdictions to incorporate more refined data into the preliminary WMAA GIS dataset based on local knowledge and review of current aerial images was provided.

Summary of Deliverables for Potential Critical Coarse Sediment Yield Areas

Format	Item	Description	Location
Report	Figures	"Geologic Grouping" "Potential Critical Coarse Sediment Yield Areas"	Attachment A.4
GIS	Map Group Layer Name	Potential Coarse Sediment Yield	Attachment C.1
	Map Layer Title	Geologic Grouping Land Cover Slope Category Geomorphic Landscape Unit Potential Coarse Sediment Yield Area Relative Sediment Production Potential Critical Coarse Sediment Yield Area	
	Geodatabase Feature Dataset	PotentialCoarseSedimentYield	
	Geodatabase Feature Class	GLUAnalysis PotentialCoarseSedimentYieldAreas PotentialCriticalCoarseSedimentYieldAreas	
	Geodatabase Geometry Type	Polygon	
KMZ ¹	KMZ File Name	Potential Critical Coarse Sediment Yield Areas	Attachment C.2

¹ To enhance the utilization of this data, the Geomorphic Landscape Unit Analysis is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zippped) file that can be viewed with the free download version of Google Earth (<http://www.google.com/earth/>).

2.4.4. Limitations for identifying potential critical coarse sediment yield areas

The resulting GIS layers were developed using regional datasets and provide a useful, rapid framework to perform screening-level analysis that is appropriate for watershed-scale planning studies. The methodology used to identify potential coarse sediment yield areas does not account for instream sediment supply and sediment production from mass failures like landslides which are difficult to estimate on a regional scale without performing extensive field investigation. This data set also does not account for potential existing impediments that may hinder delivery of

coarse sediment to receiving waters or downstream locations within the watershed as this was beyond the scope of a regional study. Where more precise estimates are required for a particular site or subarea it is recommended that this analysis be augmented with site-specific analysis. It is also recognized that this regional data set is a function of the inherent data resolution and therefore may not conform to all site conditions, or does not reflect changes to particular areas that have occurred since the underlying data was developed. As such, the WMAA data for the potential critical coarse sediment yield areas should be verified in the field according to the procedures outlined in the Model BMP Design Manual and/or jurisdiction specific BMP Design Manual.

DRAFT

2.5. Physical Structures

The Regional MS4 Permit requires the Copermittees to identify information regarding locations of existing flood control structures and channel structures, such as stream armoring, constrictions, grade control structures, and hydromodification or flood management basins with GIS layers (maps) as output, for each WMA being analyzed for the purpose of developing watershed-specific requirements for structural BMP implementation. This study identified the physical structures using a desktop-level analysis for the stream(s) identified in Section 2.2 in compliance with this permit provision.

2.5.1. Approach for identifying physical structures

The intent of this portion of the WMAA project was to provide an initial assessment of the structures of interest for the stream(s) identified in Section 2.2. This desktop-level analysis was conducted primarily as a visual survey of aerial imagery and FEMA flood insurance study (FIS) profiles where available. The collected information was entered into a GIS layer for inclusion into the overall WMAA geodatabase containing the characterization layers required by the Regional MS4 Permit. To support overall WMA characterization, the information derived in this task provides insight into water and sediment movement through the watershed (SCCWRP, 2012), the opportunities and limitations for infrastructure retrofits and also informs efforts to identify appropriate locations for habitat or riparian area rehabilitation in relation to proximate infrastructure. Specific information regarding how the survey was performed and the attributes of the generated data is presented in Attachment A.5. Note that concrete channels, pipes/culverts, riprap or other artificial stream armoring, and basins have also been identified in the linework generated for the streams (see Section 2.2).

2.5.2. Results for identifying physical structures

The resulting GIS mapping provided in Attachment A.5 shows the spatial locations of the physical structures within the mapped stream(s).

Summary of Deliverables for Physical Structures

Format	Item	Description	Location
Report	Figure	Watershed Management Area Streams by Reach Type with Channel Structures	Attachment A.5
GIS	Map Group Layer Name	Channel Structures	Attachment C.1
	Map Layer Title	Channel Structures	
	Geodatabase Feature Dataset	ChannelStructures	
	Geodatabase Feature Class	ChannelStructures	
	Geodatabase Geometry Type	Point	
KMZ ¹	Kmz File Name	ChannelStructures	Attachment C.2

¹ To enhance the utilization of this data, the Physical Structures map is provided in both traditional GIS file format (ESRI software license purchase required) and as a Google Earth KMZ (Keyhole Markup Language/Zipped) file that can be viewed with the free download version of Google Earth (<http://www.google.com/earth/>).

3. Template for Candidate Project List

The Regional MS4 Permit requires each WMA to use the results from the WMA characterization to compile a list of candidate projects that could potentially be used as alternative compliance options for Priority Development Projects should an agency or jurisdiction opt to develop an alternative compliance program. Copermittees must first conclude that implementing such a candidate project would provide greater overall benefit to the watershed than requiring implementation of structural BMPs onsite prior to implementing these candidate projects as alternative compliance projects.

The Copermittees elected to identify potential candidate projects as a separate effort from this regional project, and therefore the process for identifying candidate projects is not documented in this report. Instead, this project only developed a template, in a spreadsheet format, for use by the Copermittees to compile lists of potential candidate projects. The template is intended to enhance regional consistency of the information that is gathered for candidate projects. The template spreadsheet file was distributed to the Copermittees on January 28, 2014. A table of the template components is indicated below:

Column	Primary Heading	Secondary Heading	Guidance for Completing the Project List
A	Project Identifier	-	Unique identifier for the project.
B	Watershed Management Area	-	Dropdown menu to select the watershed management area the project is located in
C	Hydrologic Area (HA)	-	Dropdown menu to select the hydrologic area the project is located in Select a WMA in column B for HA (Column C) dropdown menu to activate.
D	Hydrologic Subarea (HSA)	-	Dropdown menu to select the hydrologic subarea the project is located in. Select a HA in column C for HSA (Column D) dropdown menu to activate.
E	Jurisdiction	-	Dropdown menu to select the jurisdiction the project is located in. Select a HSA in column D for Jurisdiction (Column E) dropdown menu to activate.
F	Project Name	-	Indicate the name of the project.
G	Ownership	Type	Dropdown menu to select if the project is a public project, private project, or public-private partnership.
H	Ownership	Ownership Information	List the details for the owner.
I	Project Location	Address	List the address of the project site.
J	Project Location	APN	List the APN of the parcel.
K	Project Location	Latitude	List the latitude of the project site.
L	Project Location	Longitude	List the longitude of the project site.

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Column	Primary Heading	Secondary Heading	Guidance for Completing the Project List
M	Project Origination/ Originator	Name	List the name of the report/organization/individual that provided the idea for the project. Potential origination sources: WQIP, WMAA, JURMPs, WURMPs, CLRPs, IRWM, MSCP, MHPA, Other.
N	Project Origination/ Originator	Contact Information	Link or report title if the proposed project is from a report [or] contact information if from an organization/individual.
O	Project Category	-	Drop Down menu to select the project category; In addition to the 6 project categories explicitly listed in the Regional MS4 Permit, the drop down menu also has a category "Other project types allowed by the MS4 Permit". Example for "Other" project types are agency CIP programs such as Green Streets, LID conversions (medians, parks), agency filter installation, etc.
P	Specific Project Type	-	List the subcategory of the project; for example, list Regional BMP type (i.e. infiltration basin, wetland, etc.).
Q	Potential Pollutant	-	Identify the potential pollutant(s) that can be treated by the proposed project.
R	Project Size & Parameters	Contributing Drainage Area (acres)	List the contributing drainage area to the project.
S	Project Size & Parameters	Parcel Size (acres)	List the size of the parcel the project is located on.
T	Project Size & Parameters	Project Footprint (acres)	List the size of the project footprint.
U	Project Size & Parameters	Parameters (with units as necessary)	Parameters needed to quantify benefits from the project; i.e. for an infiltration basin, list the water quality volume, long-term infiltration rate, depth of the basin, etc.
V	Regulatory Requirement	-	Indicate if the project is proposed to meet particular regulatory requirement such as TMDL, etc.
W	Project Timeline	-	Indicate if a project must be implemented by certain date to meet a grant deadline or other time commitment.
X	Other Notes	-	List any other relevant notes; for example, when retrofitting existing infrastructure project category is selected, input parameters needed to quantify benefits from existing infrastructure into this column as these will be needed to estimate additional benefits that can be used for alternative compliance. If N/A is selected in any dropdown menus, add additional explanation in here

4. Hydromodification Management Applicability/Exemptions

Hydromodification, which is caused by both altered storm water flow and altered sediment flow regimes, is largely responsible for degradation of creeks, streams, and associated habitats in the San Diego Region. The purpose of the hydromodification management requirements in the Regional MS4 Permit is to maintain or restore more natural hydrologic flow regimes to prevent accelerated, unnatural erosion in downstream receiving waters.

In some cases, priority development projects may be exempt from hydromodification management requirements if the project site discharges runoff to receiving waters that are not susceptible to erosion (e.g., a lake, bay, or the Pacific Ocean) either directly or via hardened systems including concrete-lined channels or existing underground storm drain systems.

The March 2011 Final Hydromodification Management Plan (HMP) identified certain exemptions from hydromodification management requirements by presenting "HMP applicability criteria." The Regional MS4 Permit maintains some of these HMP applicability criteria. However, some of the applicability criteria are not included under the Regional MS4 Permit unless the area or receiving water is mapped in the WMAA. The intent of this Section is to provide mapping of areas exempt from hydromodification management requirements, and provide supporting technical analyses for exemptions that are recommended by the WMAA.

4.1. Additional Analysis for Hydromodification Management Exemptions

This section documents additional analysis performed to further evaluate the following exemptions that were already approved by the San Diego Regional Board with the 2011 Final HMP. This study only provides additional analysis, data, and rationale for supporting or eliminating the following existing exemptions and does not propose or study any new exemptions:

- Exempt River Reaches
- Stabilized Conveyance Systems Draining to Exempt Water Bodies
- Highly Impervious Watersheds and Urban Infill and
- Tidally Influenced Lagoons

4.1.1. Exempt River Reaches

There are no river reaches currently recommended for exemption from hydromodification management requirements in the Mission Bay and La Jolla WMA. Potential river reach exemptions may be studied using the recommended approach documented in the Regional WMAA. Refer to the Regional WMAA for the criteria and an example exemption studies that were prepared for the five river reaches included in the San Diego County Final HMP dated March 2011. However, any future proposed HMP exemptions would need to be approved through the WQIP Annual Update process (Regional MS4 Permit Section F.1.2.c.).

4.1.2. Stabilized Conveyance Systems Draining to Exempt Water Bodies

There are no stabilized conveyance systems currently recommended for exemption from hydromodification management requirements in the Mission Bay and La Jolla WMA. If engineered conveyance systems that are stabilized with materials other than concrete, such as riprap, turf reinforcement mat, or vegetation, including rehabilitated stream systems, are identified as potential candidates for exemption, they may be studied and may be recommended exempt if they meet specific criteria presented in the Regional WMAA for this exemption. Refer to the Regional WMAA for the criteria and an example study that was prepared for Forester Creek in the San Diego River WMA. However, any future proposed HMP exemptions would need to be approved through the WQIP Annual Update process (Regional MS4 Permit Section F.1.2.c.).

4.1.3. Highly Impervious/Highly Urbanized Watersheds and Urban Infill

Based on evaluation of the highly impervious/highly urbanized watershed and urban infill exemptions presented in the March 2011 Final HMP, and comparison with more recent research prepared for the Ventura County Hydromodification Control Plan (Ventura County HCP) (Final Draft dated September 2013), resurrection of these exemptions from the March 2011 Final HMP was not recommended by the Regional WMAA. The research prepared in support of the Ventura County HCP determined lower thresholds of additional impervious area (ranging from 0.44% to 1.65%) than the limit presented in the San Diego County Final HMP dated March 2011 (3%). No areas within the Mission Bay / La Jolla WMA are currently recommended for highly impervious/highly urbanized watershed or urban infill exemption.

4.1.4. Tidally Influenced Lagoons

There are no tidally influenced lagoons recommended for exemption from hydromodification management requirements in the Mission Bay / La Jolla WMA. Refer to the Regional WMAA for further information regarding this exemption.

5. Conclusions

5.1. Watershed Management Area Characterization

The WMA Characterization data was developed using available regional data to further understand the macro-scale watershed characteristics and processes in the Mission Bay and La Jolla WMA. The Regional MS4 Permit allows for flexibility in complying with land development requirements when using the information developed in the WMAA to improve water quality planning and implementation associated with land development. This dataset will assist with identifying the opportunities and constraints for projects and management decisions based on a watershed-scale (rather than piecemeal project identification without context within the watershed) and provides Copermittees the ability to exercise the option to create an alternative compliance program that offers the opportunity to develop watershed-specific alternatives to universal onsite structural BMP implementation. The characterization data includes:

Characterization Data	Utilization Potential
Dominant Hydrologic Process: • Overland flow • Infiltration • Interflow	• Identify areas for enhanced infiltration or collection of storm water for treatment • Implement management measures that correspond to pre-development conditions – promotes long-term channel stability and health • Increases understanding of the natural functioning of the watershed and what has been (or is at risk of being) altered by urbanization.
Stream Characterization: • Reach type • Bed material • Bank material • Hydrographic category • Channel Structures	• Preliminary dataset that can be used to conduct stream power evaluations • Identify channel systems for preservation or restoration • Identification of appropriate space for channel processes to occur (e.g., flood plain connectivity) • Insight to sensitivity of receiving stream reach • Indicates the features within channels that affect water and sediment movement through the watershed

Characterization Data	Utilization Potential
Land Use: • Existing • Future	• Foresight (identifies relative risks, opportunities, or constraints) in comparing future to existing land uses, i.e., areas that may be more/less vulnerable to adverse impacts to changes in storm water runoff associated with development • Encourage infill development
Potential Critical Coarse Sediment Yield Areas	• Preservation of areas or function that contributes critical sediment within the watershed to stream armoring/stability • Assist with identifying potentially susceptible stream reaches that require uninterrupted coarse sediment supplies to remain stable • Dual goal of open space conservation

Regarding the identification of the potential critical coarse sediment yield areas in the WMAA using readily available regional datasets, it is anticipated that when more precise estimates for potential critical coarse sediment yield areas are required for a particular site or subarea that this regional study will be augmented with site-specific analysis. Development projects must avoid critical sediment yield areas or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no net impact to the receiving water to meet the requirements of the Regional MS4 permit. As such, projects should consult the Model BMP Design Manual and/or jurisdiction specific BMP Design manual for options to meet the Regional MS4 Permit requirements. It is anticipated that the data will not be static but will be enhanced over time through future studies or field assessments that will refine what is currently a macro-level data set.

5.2.Template for Candidate Project List

It is anticipated the Copermittees that elect to develop alternative compliance programs will conduct a separate exercise to nominate potential candidate projects for inclusion into the WQIPs using the template developed for this project.

5.3.Hydromodification Management Exemptions

Attachment B.2 presents hydromodification management applicability/exemption mapping for the Mission Bay / La Jolla WMA. The mapping includes receiving waters that are exempt based on the Regional MS4 Permit or recommended exempt based on studies.

Receiving waters that are **exempt** based on the Regional MS4 Permit include:

- The Pacific Ocean
- Mission Bay
- Lakes and Reservoirs
- Existing underground storm drains or concrete-lined channels draining directly to Mission Bay or the ocean

There are no additional exemptions recommended based on studies in the Mission Bay / La Jolla WMA.

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Attachment N-2

Mission Bay WMAA Report Attachments

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Mission Bay and La Jolla Watershed Management Area Analysis ATTACHMENTS



Lake Henshaw

September 8, 2014

Prepared for:
San Diego County Copermittees



Prepared by:

Geosyntec
consultants

experience | innovation | leadership

RICK
ENGINEERING COMPANY

ATTACHMENT A
WATERSHED MANAGEMENT AREA
CHARACTERIZATION

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ATTACHMENT A.1

DOMINANT HYDROLOGICAL PROCESS

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A.1 Dominant Hydrological Process

Table A.1.1: Runoff Coefficients versus Land Use, Hydrologic Soil Group (A, B, C, D), and Slope Range

Land Use	A			B			C			D		
	0-2%	2-6%	6% ^a	0-2%	2-6%	6% ^a	0-2%	2-6%	6% ^a	0-2%	2-6%	6% ^a
Cultivated land	0.08 ^a	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
	0.14 ^b	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Pasture	0.12	0.20	0.30	0.18	0.28	0.37	0.24	0.34	0.44	0.30	0.40	0.50
	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Meadow	0.10	0.16	0.25	0.14	0.22	0.30	0.20	0.28	0.36	0.24	0.30	0.40
	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Forest	0.05	0.08	0.11	0.08	0.11	0.14	0.10	0.13	0.16	0.12	0.16	0.20
	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Residential lot size 1/8 acre	0.25	0.28	0.31	0.27	0.30	0.35	0.30	0.33	0.38	0.33	0.36	0.42
	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Residential lot size 1/4 acre	0.22	0.26	0.29	0.24	0.29	0.33	0.27	0.31	0.36	0.30	0.34	0.40
	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
Residential lot size 1/3 acre	0.19	0.23	0.26	0.22	0.26	0.30	0.25	0.29	0.34	0.28	0.32	0.39
	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
Residential lot size 1/2 acre	0.16	0.20	0.24	0.19	0.23	0.28	0.22	0.27	0.32	0.26	0.30	0.37
	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.48
Residential lot size 1 acre	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.29	0.35
	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Industrial	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.71	0.71	0.72	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets	0.70	0.71	0.72	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78
	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Open space	0.05	0.10	0.14	0.08	0.13	0.19	0.12	0.17	0.24	0.15	0.21	0.28
	0.11	0.16	0.20	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Parking	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97

^a Runoff coefficients for storm recurrence intervals less than 25 years.

^b Runoff coefficients for storm recurrence intervals of 25 years or longer.

Source: Table 7-9 in *Hydrologic Analysis and Design* (McCuen, 2005)

Table A.1.2: Land Cover Grouping

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
1	42000 Valley and Foothill Grassland	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	Agricultural/Grass
2	42100 Native Grassland		Agricultural/Grass
3	42110 Valley Needlegrass Grassland		Agricultural/Grass
4	42120 Valley Sacaton Grassland		Agricultural/Grass

Mission Bay and La Jolla WMAA Attachments

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
5	42200 Non-Native Grassland	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	Agricultural/Grass
6	42300 Wildflower Field		Agriculture/Grass
7	42400 Foothill/Mountain Perennial Grassland		Agriculture/Grass
8	42470 Transmontane Dropseed Grassland		Agriculture/Grass
9	45000 Meadow and Seep		Agriculture/Grass
10	45100 Montane Meadow		Agriculture/Grass
11	45110 Wet Montane Meadow		Agriculture/Grass
12	45120 Dry Montane Meadows		Agriculture/Grass
13	45300 Alkali Meadows and Seeps		Agriculture/Grass
14	45320 Alkali Seep		Agriculture/Grass
15	45400 Freshwater Seep		Agriculture/Grass
16	46000 Alkali Playa Community		Agriculture/Grass
17	46100 Badlands/Mudhill Forbs		Agriculture/Grass
18	Non-Native Grassland		Agriculture/Grass
19	18000 General Agriculture	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Agriculture/Grass
20	18100 Orchards and Vineyards		Agriculture/Grass
21	18200 Intensive Agriculture		Agriculture/Grass
22	18200 Intensive Agriculture - Dairies, Nurseries, Chicken Ranches		Agriculture/Grass
23	18300 Extensive Agriculture - Field/Pasture, Row Crops		Agriculture/Grass
24	18310 Field/Pasture		Agriculture/Grass
25	18310 Pasture		Agriculture/Grass
26	18320 Row Crops		Agriculture/Grass
27	12000 Urban/Developed		Developed
28	12000 Urban/Developed		Developed
29	81100 Mixed Evergreen Forest	Forest	Forest
30	81300 Oak Forest		Forest
31	81310 Coast Live Oak Forest		Forest
32	81320 Canyon Live Oak Forest		Forest
33	81340 Black Oak Forest		Forest
34	83140 Torrey Pine Forest		Forest
35	83230 Southern Interior Cypress Forest		Forest
36	84000 Lower Montane Coniferous Forest		Forest
37	84100 Coast Range, Klamath and Peninsular Coniferous Forest		Forest

Mission Bay and La Jolla WMAA Attachments

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
38	84140 Coulter Pine Forest	Forest	Forest
39	84150 Bigcone Spruce (Bigcone Douglas Fir)-Canyon Oak Forest		Forest
40	84230 Sierran Mixed Coniferous Forest		Forest
41	84500 Mixed Oak/Coniferous/Bigcone/Coulter		Forest
42	85100 Jeffrey Pine Forest		Forest
43	11100 Eucalyptus Woodland	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Forest
44	60000 RIPARIAN AND BOTTOMLAND HABITAT	Riparian and Bottomland Habitat	Forest
45	61000 Riparian Forests		Forest
46	61300 Southern Riparian Forest		Forest
47	61310 Southern Coast Live Oak Riparian Forest		Forest
48	61320 Southern Arroyo Willow Riparian Forest		Forest
49	61330 Southern Cottonwood-willow Riparian Forest		Forest
50	61510 White Alder Riparian Forest		Forest
51	61810 Sonoran Cottonwood-willow Riparian Forest		Forest
52	61820 Mesquite Bosque		Forest
53	62000 Riparian Woodlands		Forest
54	62200 Desert Dry Wash Woodland		Forest
55	62300 Desert Fan Palm Oasis Woodland		Forest
56	62400 Southern Sycamore-alder Riparian Woodland		Forest
57	70000 WOODLAND	Woodland	Forest
58	71000 Cismontane Woodland		Forest
59	71100 Oak Woodland		Forest
60	71120 Black Oak Woodland		Forest
61	71160 Coast Live Oak Woodland		Forest
62	71161 Open Coast Live Oak Woodland		Forest
63	71162 Dense Coast Live Oak Woodland		Forest
64	71162 Dense Coast Love Oak Woodland		Forest

Mission Bay and La Jolla WMAA Attachments

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
65	71180 Engelmann Oak Woodland	Woodland	Forest
66	71181 Open Engelmann Oak Woodland		Forest
67	71182 Dense Engelmann Oak Woodland		Forest
68	72300 Peninsular Pinon and Juniper Woodlands		Forest
69	72310 Peninsular Pinon Woodland		Forest
70	72320 Peninsular Juniper Woodland and Scrub		Forest
71	75100 Elephant Tree Woodland		Forest
72	77000 Mixed Oak Woodland		Forest
73	78000 Undifferentiated Open Woodland		Forest
74	79000 Undifferentiated Dense Woodland		Forest
75	Engelmann Oak Woodland		Forest
76	52120 Southern Coastal Salt Marsh	Bog and Marsh	Other
77	52300 Alkali Marsh		Other
78	52310 Cismontane Alkali Marsh		Other
79	52400 Freshwater Marsh		Other
80	52410 Coastal and Valley Freshwater Marsh		Other
81	52420 Transmontane Freshwater Marsh		Other
82	52440 Emergent Wetland		Other
83	44000 Vernal Pool	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	Other
84	44320 San Diego Mesa Vernal Pool		Other
85	44322 San Diego Mesa Claypan Vernal Pool (southern mesas)		Other
86	13100 Open Water	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Other
87	13110 Marine		Other
88	13111 Subtidal		Other
89	13112 Intertidal		Other
90	13121 Deep Bay		Other
91	13122 Intermediate Bay		Other
92	13123 Shallow Bay		Other
93	13130 Estuarine		Other
94	13131 Subtidal		Other
95	13133 Brackishwater		Other

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Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
96	13140 Freshwater	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Other
97	13200 Non-Vegetated Channel, Floodway, Lakeshore Fringe		Other
98	13300 Saltpan/Mudflats		Other
99	13400 Beach		Other
100	21230 Southern Foredunes	Dune Community	Scrub/Shrub
101	22100 Active Desert Dunes		Scrub/Shrub
102	22300 Stabilized and Partially- Stabilized Desert Sand Field		Scrub/Shrub
103	24000 Stabilized Alkaline Dunes		Scrub/Shrub
104	29000 ACACIA SCRUB		Scrub/Shrub
105	63000 Riparian Scrubs	Riparian and Bottomland Habitat	Scrub/Shrub
106	63300 Southern Riparian Scrub		Scrub/Shrub
107	63310 Mule Fat Scrub		Scrub/Shrub
108	63310 Mulefat Scrub		Scrub/Shrub
109	63320 Southern Willow Scrub		Scrub/Shrub
110	63321 Arundo donax Dominant/Southern Willow Scrub		Scrub/Shrub
111	63330 Southern Riparian Scrub		Scrub/Shrub
112	63400 Great Valley Scrub		Scrub/Shrub
113	63410 Great Valley Willow Scrub		Scrub/Shrub
114	63800 Colorado Riparian Scrub		Scrub/Shrub
115	63810 Tamarisk Scrub		Scrub/Shrub
116	63820 Arrowweed Scrub		Scrub/Shrub
117	31200 Southern Coastal Bluff Scrub	Scrub and Chaparral	Scrub/Shrub
118	32000 Coastal Scrub		Scrub/Shrub
119	32400 Maritime Succulent Scrub		Scrub/Shrub
120	32500 Diegan Coastal Sage Scrub		Scrub/Shrub
121	32510 Coastal form		Scrub/Shrub
122	32520 Inland form (> 1,000 ft. elevation)		Scrub/Shrub
123	32700 Riversidian Sage Scrub		Scrub/Shrub
124	32710 Riversidian Upland Sage Scrub		Scrub/Shrub
125	32720 Alluvial Fan Scrub		Scrub/Shrub
126	33000 Sonoran Desert Scrub		Scrub/Shrub
127	33100 Sonoran Creosote Bush Scrub		Scrub/Shrub
128	33200 Sonoran Desert Mixed Scrub		Scrub/Shrub
129	33210 Sonoran Mixed Woody Scrub		Scrub/Shrub

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Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
130	33220 Sonoran Mixed Woody and Succulent Scrub	Scrub and Chaparral	Scrub/Shrub
131	33230 Sonoran Wash Scrub		Scrub/Shrub
132	33300 Colorado Desert Wash Scrub		Scrub/Shrub
133	33600 Encelia Scrub		Scrub/Shrub
134	34000 Mojavean Desert Scrub		Scrub/Shrub
135	34300 Blackbush Scrub		Scrub/Shrub
136	35000 Great Basin Scrub		Scrub/Shrub
137	35200 Sagebrush Scrub		Scrub/Shrub
138	35210 Big Sagebrush Scrub		Scrub/Shrub
139	35210 Sagebrush Scrub		Scrub/Shrub
140	36110 Desert Saltbush Scrub		Scrub/Shrub
141	36120 Desert Sink Scrub		Scrub/Shrub
142	37000 Chaparral		Scrub/Shrub
143	37120 Southern Mixed Chaparral		Scrub/Shrub
144	37120 Southern Mixed Chapparral		Scrub/Shrub
145	37121 Granitic Southern Mixed Chaparral		Scrub/Shrub
146	37121 Southern Mixed Chaparral		Scrub/Shrub
147	37122 Mafic Southern Mixed Chaparral		Scrub/Shrub
148	37130 Northern Mixed Chaparral		Scrub/Shrub
149	37131 Granitic Northern Mixed Chaparral		Scrub/Shrub
150	37132 Mafic Northern Mixed Chaparral		Scrub/Shrub
151	37200 Chamise Chaparral		Scrub/Shrub
152	37210 Granitic Chamise Chaparral		Scrub/Shrub
153	37220 Mafic Chamise Chaparral		Scrub/Shrub
154	37300 Red Shank Chaparral		Scrub/Shrub
155	37400 Semi-Desert Chaparral		Scrub/Shrub
156	37500 Montane Chaparral		Scrub/Shrub
157	37510 Mixed Montane Chaparral		Scrub/Shrub
158	37520 Montane Manzanita Chaparral		Scrub/Shrub
159	37530 Montane Ceanothus Chaparral		Scrub/Shrub
160	37540 Montane Scrub Oak Chaparral		Scrub/Shrub
161	37800 Upper Sonoran Ceanothus Chaparral		Scrub/Shrub
162	37830 Ceanothus crassifolius Chaparral		Scrub/Shrub
163	37900 Scrub Oak Chaparral		Scrub/Shrub
164	37A00 Interior Live Oak Chaparral		Scrub/Shrub

Id	SanGIS Legend	SanGIS Grouping	Land Cover Grouping
165	37C30 Southern Maritime Chaparral	Scrub and Chaparral	Scrub/Shrub
166	37G00 Coastal Sage-Chaparral Scrub		Scrub/Shrub
167	37K00 Flat-topped Buckwheat		Scrub/Shrub
168	39000 Upper Sonoran Subshrub Scrub		Scrub/Shrub
169	Diegan Coastal Sage Scrub		Scrub/Shrub
170	Granitic Northern Mixed Chaparral		Scrub/Shrub
171	Southern Mixed Chaparral		Scrub/Shrub
172	11000 Non-Native Vegetation	Non-Native Vegetation, Developed Areas, or Unvegetated Habitat	Unknown
173	11000 Non-Native VegetationVegetation		Unknown
174	11200 Disturbed Wetland		Unknown
175	11300 Disturbed Habitat		Unknown
176	13000 Unvegetated Habitat		Unknown
177	Disturbed Habitat		Unknown

Table A.1.3: Related Land Cover and Land Use Categories

Land Cover per San Diego County	Land Use per Table A.1.1
Agriculture/Grass	Meadow
Forest	Forest
Scrub/Shrub	Average (Meadow, Forest)
Unknown/Other	Meadow

Table A.1.4: Applicable Hydrologic Response Unit Calculations

Land Cover	Soil	Gradient	Runoff Coeff.	ET Coeff.	Infiltration Coeff.	Runoff/ Infiltration Ratio	Hydrologic Process Designation
Agriculture/Grass	A	0-2%	0.10	0.60	0.30	0.33	I
Agriculture/Grass	A	2-6%	0.16	0.60	0.24	0.67	U
Agriculture/Grass	A	6-10%	0.25	0.60	0.15	1.67	O
Agriculture/Grass	B	0-2%	0.14	0.60	0.26	0.54	I
Agriculture/Grass	B	2-6%	0.22	0.60	0.18	1.22	U
Agriculture/Grass	B	6-10%	0.30	0.60	0.10	3.00	O
Agriculture/Grass	C	0-2%	0.20	0.60	0.20	1.00	U
Agriculture/Grass	C	2-6%	0.28	0.60	0.12	2.33	O
Agriculture/Grass	C	6-10%	0.36	0.60	0.04	9.00	O
Agriculture/Grass	D	0-2%	0.24	0.60	0.16	1.50	U
Agriculture/Grass	D	2-6%	0.30	0.60	0.10	3.00	O
Agriculture/Grass	D	6-10%	0.40	0.60	0.00	infinite	O

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Land Cover	Soil	Gradient	Runoff Coeff.	ET Coeff.	Infiltration Coeff.	Runoff/ Infiltration Ratio	Hydrologic Process Designation
Forest	A	0-2%	0.05	0.80	0.15	0.33	I
Forest	A	2-6%	0.08	0.80	0.12	0.67	U
Forest	A	6-10%	0.11	0.80	0.09	1.22	U
Forest	B	0-2%	0.08	0.80	0.12	0.67	U
Forest	B	2-6%	0.11	0.80	0.09	1.22	U
Forest	B	6-10%	0.14	0.80	0.06	2.33	O
Forest	C	0-2%	0.10	0.80	0.10	1.00	U
Forest	C	2-6%	0.13	0.80	0.07	1.86	O
Forest	C	6-10%	0.16	0.80	0.04	4.00	O
Forest	D	0-2%	0.12	0.80	0.08	1.50	U
Forest	D	2-6%	0.16	0.80	0.04	4.00	O
Forest	D	6-10%	0.20	0.80	0.00	infinite	O
Scrub/Shrub	A	0-2%	0.08	0.70	0.23	0.33	I
Scrub/Shrub	A	2-6%	0.12	0.70	0.18	0.67	U
Scrub/Shrub	A	6-10%	0.18	0.70	0.12	1.50	U
Scrub/Shrub	B	0-2%	0.11	0.70	0.19	0.58	I
Scrub/Shrub	B	2-6%	0.17	0.70	0.14	1.22	U
Scrub/Shrub	B	6-10%	0.22	0.70	0.08	2.75	O
Scrub/Shrub	C	0-2%	0.15	0.70	0.15	1.00	U
Scrub/Shrub	C	2-6%	0.21	0.70	0.10	2.16	O
Scrub/Shrub	C	6-10%	0.26	0.70	0.04	6.50	O
Scrub/Shrub	D	0-2%	0.19	0.70	0.12	1.50	U
Scrub/Shrub	D	2-6%	0.23	0.70	0.07	3.29	O
Scrub/Shrub	D	6-10%	0.30	0.70	0.00	infinite	O

Hydrologic Process Designation: I = Interflow; O = Overland Flow; U = Uncertain

Table A.1.5: Hydrologic Response Unit Designations

Land Cover	Slope	Soil Type				
		A	B	C	D	Other (fill/water)
Agriculture/ Grass/Unknown/ Other	0-2%	I	I	U	U	U
	2-6%	U	U	O	O	U
	6-10%	O	O	O	O	O
	>10%	O	O	O	O	O
Developed	0-2%	O	O	O	O	O
	2-6%	O	O	O	O	O
	6-10%	O	O	O	O	O
	>10%	O	O	O	O	O
Forest	0-2%	I	U	U	U	U
	2-6%	U	U	O	O	U
	6-10%	U	O	O	O	U
	>10%	O	O	O	O	O
Scrub/Shrub	0-2%	I	I	U	U	U
	2-6%	U	U	O	O	U
	6-10%	U	O	O	O	U
	>10%	O	O	O	O	O

Hydrologic Process Designation: I = Interflow; O = Overland Flow; U = Uncertain

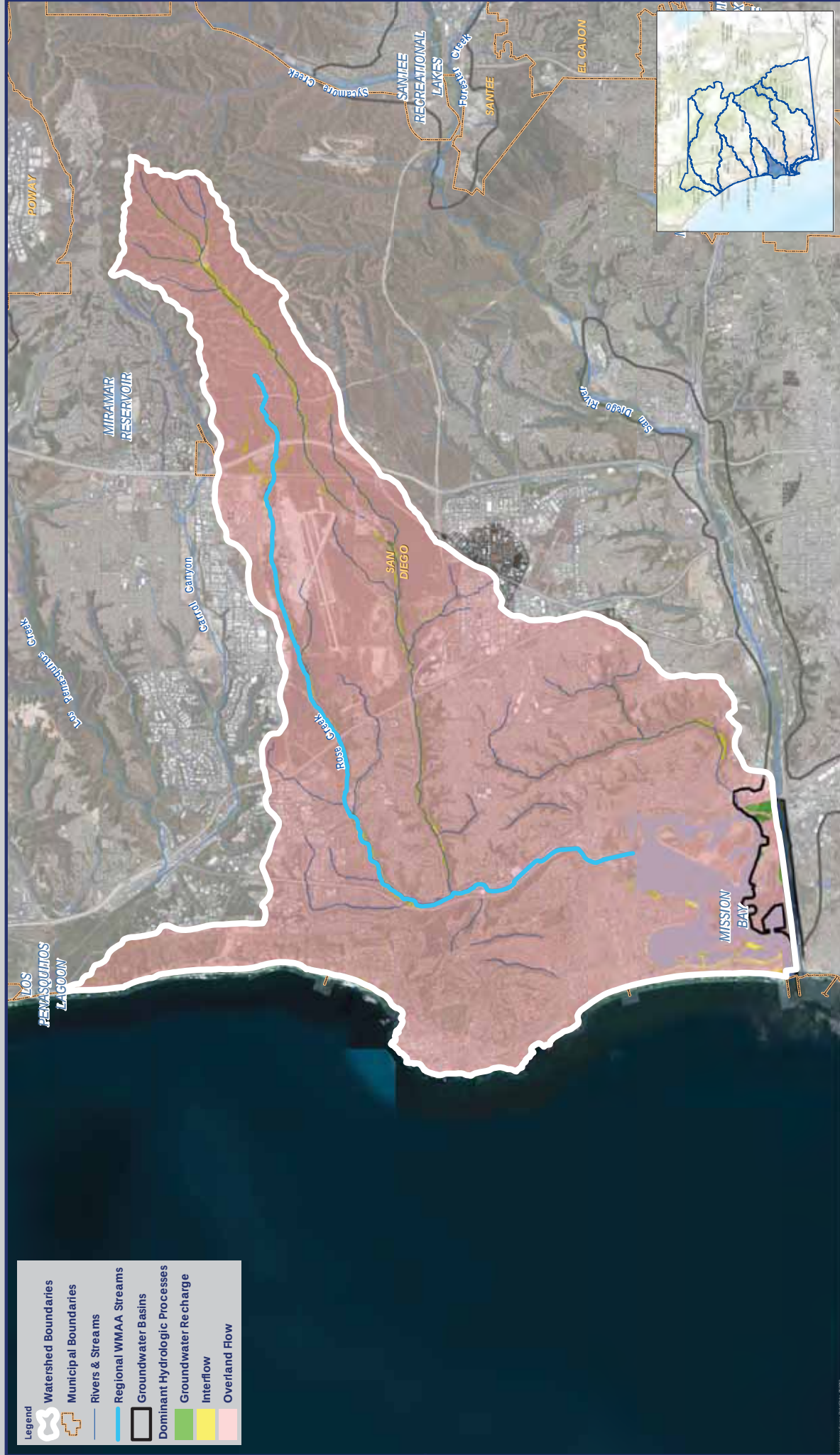


Exhibit Showing Dominant Hydrologic Processes

Mission Bay/La Jolla Watershed - HU 906.00, 68 mi²

ATTACHMENT A.2
STREAM CHARACTERIZATION

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Watershed Management Area Streams

Mission Bay/La Jolla Watershed - HU 906.00, 68 mi2

Exhibit Date: Sept. 8, 2014





Watershed Management Area Streams by Hydrographic Category

Mission Bay/La Jolla Watershed - HU 906.00, 68 mi2

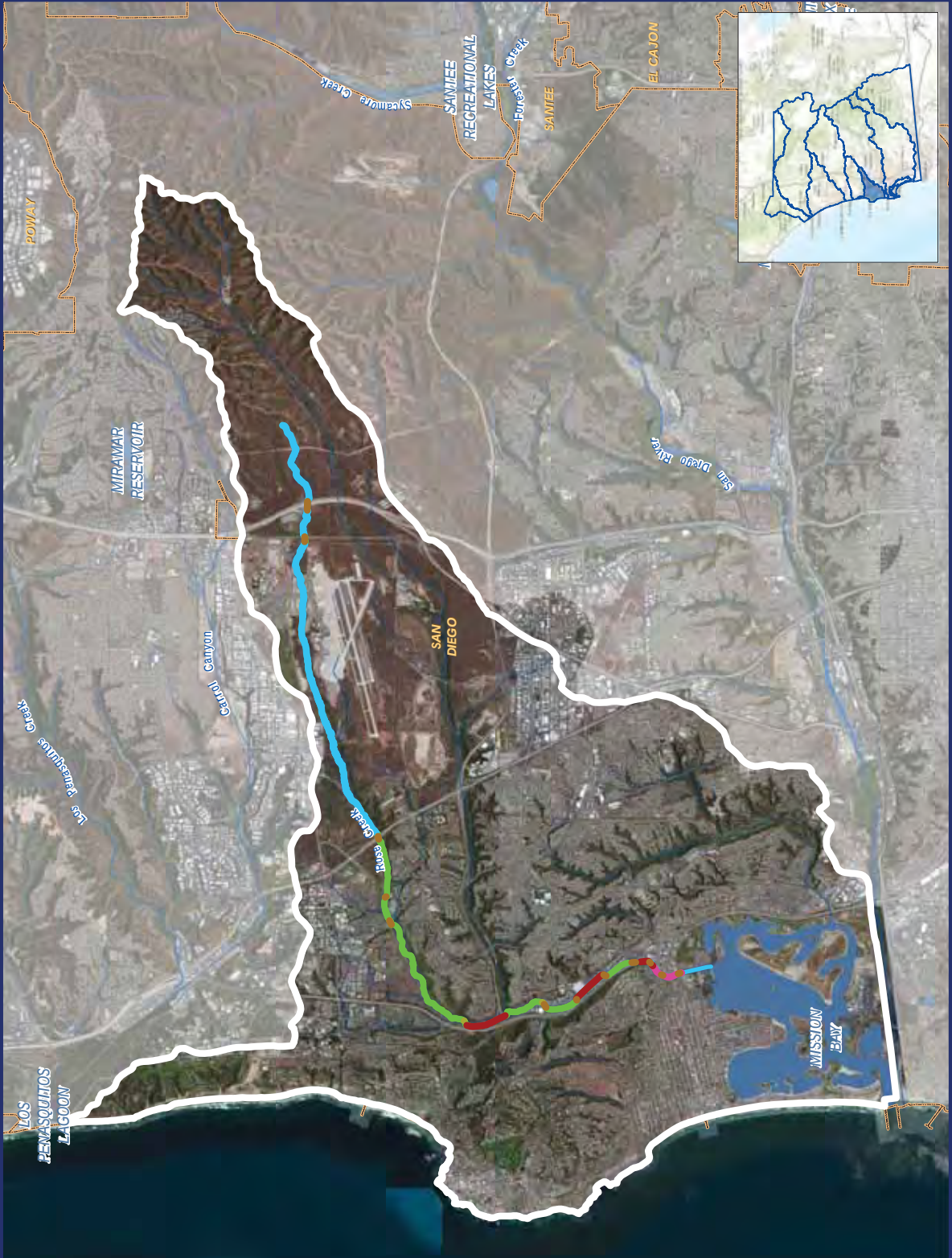
Exhibit Date: Sept. 8, 2014



Watershed Management Area Streams by Bed Material

Mission Bay/La Jolla Watershed - HU 906.00, 68 mi2

Exhibit Date: Sept. 8, 2014



- Legend**
- Watershed Boundaries
 - Municipal Boundaries
 - Rivers & Streams
 - Regional WMAA Streams within Federal/State/Indian Lands (not characterized, displayed for continuity)
 - Other Streams (Non-Earthen)
 - Pipe / Culvert
 - Concrete
 - Riprap
 - Geologic Group of Earthen Streams
 - Coarse Bedrock
 - Coarse Sedimentary Impermeable
 - Coarse Sedimentary Permeable
 - Fine Bedrock
 - Fine Sedimentary Impermeable
 - Fine Sedimentary Permeable

Watershed Management Area Streams by Geologic Group

Mission Bay/La Jolla Watershed - HU 906.00, 68 mi2



Watershed Management Area Streams by Reach Type

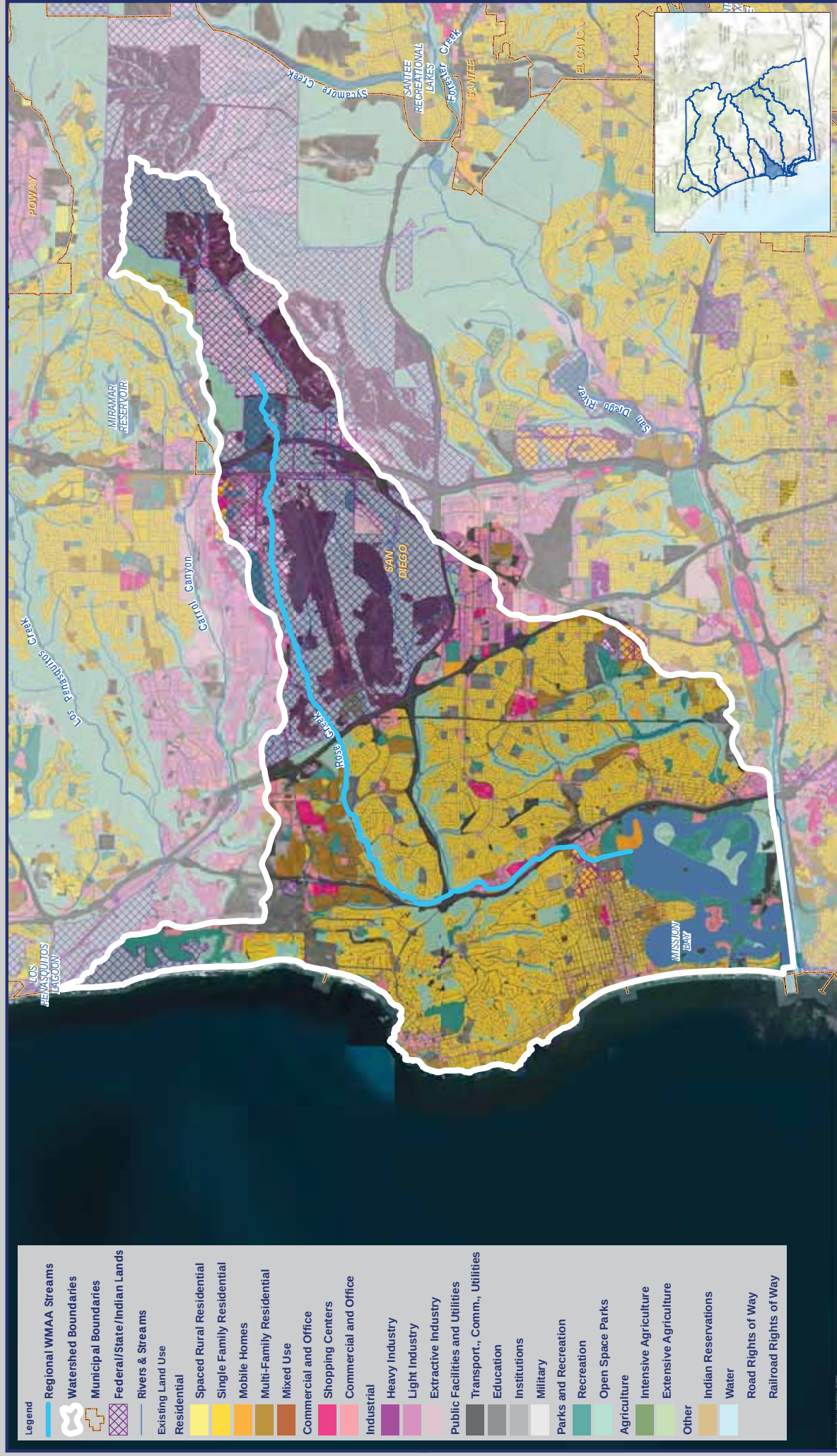
Mission Bay/La Jolla Watershed - HU 906.00, 68 mi2

Exhibit Date: Sept. 8, 2014

ATTACHMENT A.3

LAND USES

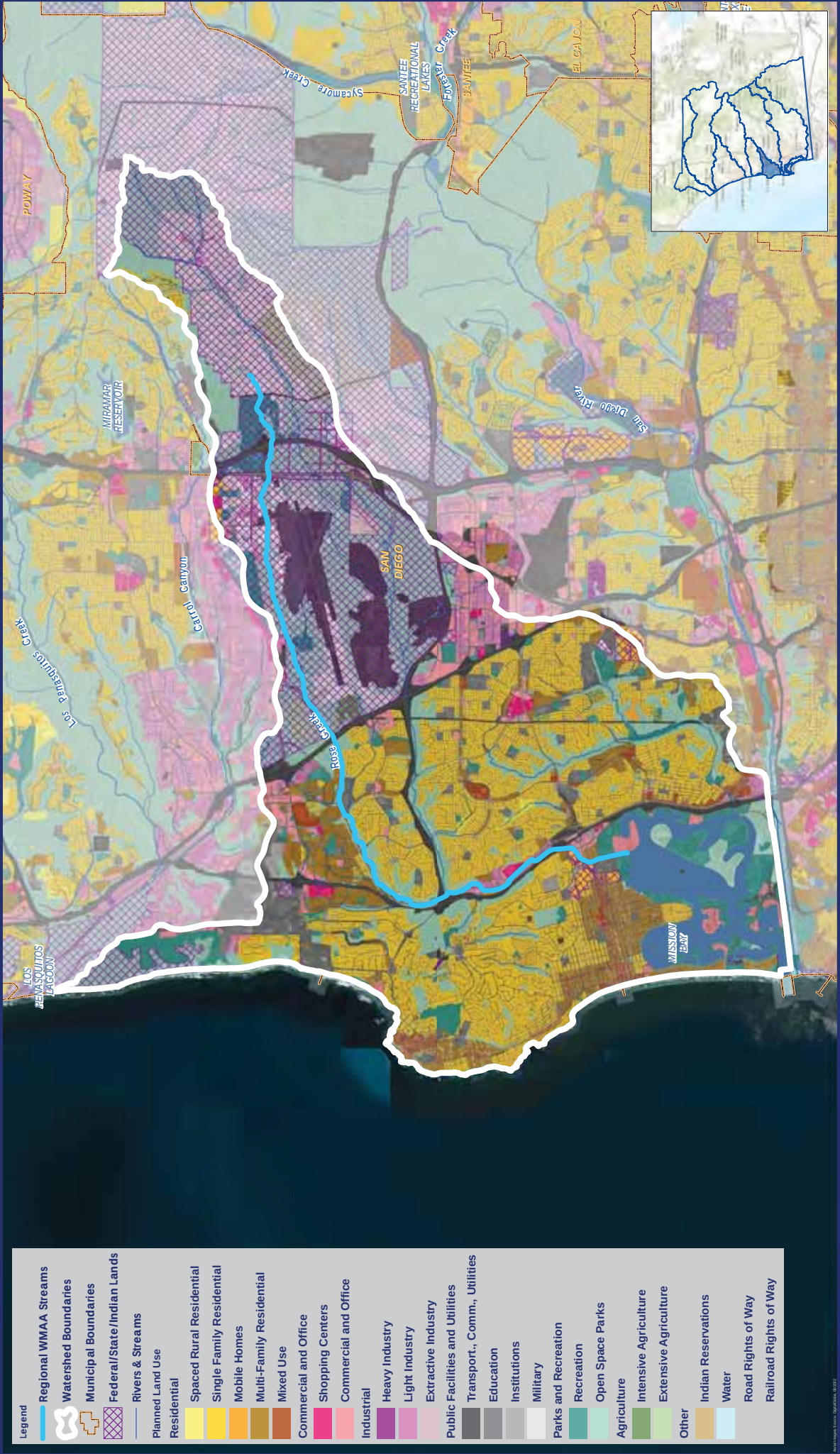
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Existing Land Use

Exhibit Date: Sept. 8, 2014





Legend

- Regional WMAA Streams
- Watershed Boundaries
- Municipal Boundaries
- Federal/State/Indian Lands
- Rivers & Streams
- Planned Land Use
- Residential
 - Spaced Rural Residential
 - Single Family Residential
 - Mobile Homes
 - Multi-Family Residential
 - Mixed Use
- Commercial and Office
 - Shopping Centers
 - Commercial and Office
- Industrial
 - Heavy Industry
 - Light Industry
- Public Facilities and Utilities
 - Transport., Comm., Utilities
 - Education
 - Institutions
 - Military
- Parks and Recreation
 - Recreation
 - Open Space Parks
- Agriculture
 - Intensive Agriculture
 - Extensive Agriculture
- Other
 - Indian Reservations
 - Water
- Road Rights of Way
- Railroad Rights of Way

Planned Land Use

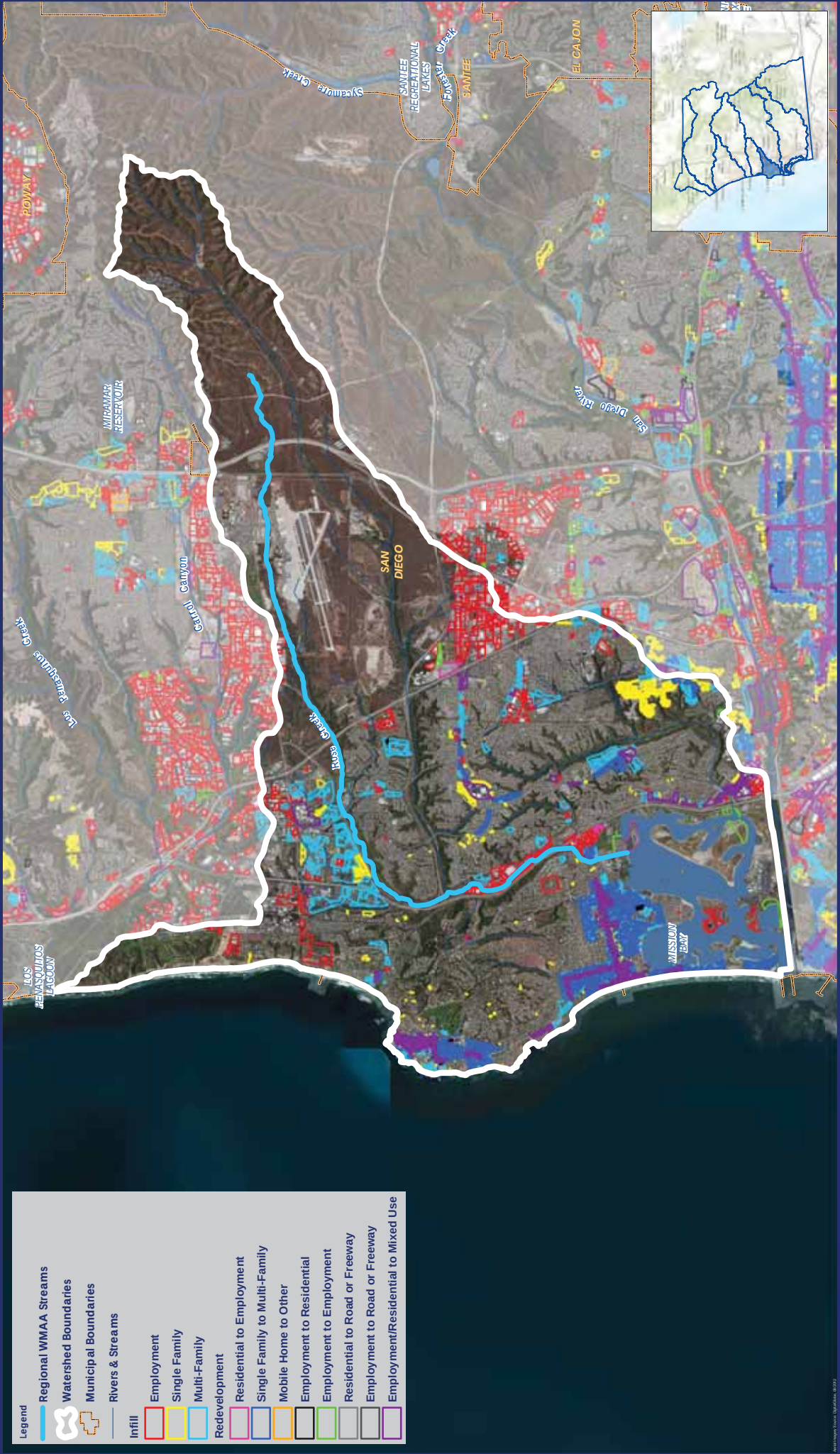
Mission Bay/La Jolla Watershed - HU 906.00, 68 mi2

Exhibit Date: Sept. 8, 2014



Developable Land

Mission Bay/La Jolla Watershed - HU 906.00, 68 mi2



Redevelopment and Infill Areas

Mission Bay/La Jolla Watershed - HU 906.00, 68 mi2

ATTACHMENT A.4

POTENTIAL COARSE SEDIMENT YIELD AREAS

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A.4.1 Geology Grouping

Geologic grouping was based on the mapped geologic unit as determined by published geologic mapping information. The following describes the methodology utilized to determine bedrock or sedimentary characteristics, anticipated grain size, and suitability for infiltration. A complete list of the various geologic maps used in this evaluation is listed in Chapter 6.

Due to the various mapped scales of the published data and differing mapped unit names, the geologic units were initially compiled into similar categories where possible. For example, the Lindavista Formation is mapped as unit Ql on geologic maps at a scale of 1:24,000 but correlates to the same unit Qvop8 on geologic maps at a scale of 1:100,000. Following the compilation of geologic unit names, the units were differentiated between crystalline bedrock and sedimentary formations based on geologic characterization and material behavior. The Point Loma Formation for example, is a Cretaceous-age sandstone, but it was classified as a “coarse bedrock” unit due to its indurated and resistant nature.

For each site location, the predominant geologic units were then described as “coarse” or “fine” based on typical weathering characteristics of the bedrock units, or primary grain size of the sedimentary units. For example, granodiorite or tonalite crystalline rock typically weathers to a coarse material such as a silty sand and therefore was classified as “coarse,” compared to a gabbro which generally weathers to a sandy clay and was characterized as “fine.” Sedimentary formations can be more variable, such as the Mission Valley Formation. In this case, the Mission Valley Formation was characterized as “coarse” since the unit is predominantly comprised of sandstone even if it does contain localities of siltstone and claystone within the unit.

To further characterize the sedimentary formations, these units were evaluated for suitability of infiltration. Since no field investigations were performed for this evaluation to determine permeability, the differentiation between impermeable and permeable were based on the age of the geologic unit with the assumption that relatively younger sedimentary units of Pleistocene-age or younger (<1.6 mya) would be more susceptible to surface water infiltration. Geology grouping of different map units is presented in Table A.4.1

Table A.4.1 Geologic grouping for different map units

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
gr-m	Jennings; CA	Coarse	Bedrock	Impermeable	CB
grMz	Jennings; CA	Coarse	Bedrock	Impermeable	CB
Jcr	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Jhc	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Jsp	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ka	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kbm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kbp	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kcc	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kcg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kcm	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kcp	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kd	San Diego & Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kdl	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgbf	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgd	San Diego & Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgdf	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgh	San Diego 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm1	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm2	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm3	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgm4	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgp	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgr	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kgu	San Diego 30' x 60'	Coarse	Bedrock	Impermeable	CB
Khg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ki	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kis	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kjd	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
KJem	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
KJld	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kjv	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB

Mission Bay and La Jolla WMAA Attachments

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
Klb	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Klh	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Klp	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Km	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kmg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
KmGP	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kmm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kpa	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kpv	El Cajon 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kqbd	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Krm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Krr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kt	San Diego & Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ktr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kvc	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kwm	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kwp	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Kwsr	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
m	Jennings; CA	Coarse	Bedrock	Impermeable	CB
Mzd	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Mzg	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Mzq	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Mzs	Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
sch	Jennings; CA	Coarse	Bedrock	Impermeable	CB
Kp	San Diego & Oceanside 30' x 60'	Coarse	Bedrock	Impermeable	CB
Ql	El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
QTf	El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Ec	Jennings; CA	Coarse	Sedimentary	Impermeable	CSI
K	Jennings; CA	Coarse	Sedimentary	Impermeable	CSI
Kccg	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Kcs	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Kl	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Ku	Jennings; CA	Coarse	Sedimentary	Impermeable	CSI

Mission Bay and La Jolla WMAA Attachments

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
Qvof	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop8a	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop9a	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tmsc	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tmss	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tp	San Diego & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tpm	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsc	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tscu	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsd	San Diego & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsdcg	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsdss	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsm	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tso	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tst	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tt	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tta	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tmv	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsi	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoa	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoa11	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoa12	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoa13	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvoc	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop1	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop10	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop10a	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop11	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI

Mission Bay and La Jolla WMAA Attachments

Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
Qvop11a	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop12	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop13	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop2	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop3	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop4	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop5	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop6	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop7	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop8	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qvop9	San Diego 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Tsa	Oceanside 30' x 60'	Coarse	Sedimentary	Impermeable	CSI
Qof	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qof1	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qof2	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Q	Jennings; CA	Coarse	Sedimentary	Permeable	CSP
Qa	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qd	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qf	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qmb	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qw	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qyf	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qt	El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa1-2	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa2-6	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa5	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa6	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa7	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP

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Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
Qoc	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop1	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qc	El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qu	El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qoa	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop2-4	San Diego 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop3	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop4	Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop6	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qop7	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qya	San Diego, Oceanside & El Cajon 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Qyc	San Diego & Oceanside 30' x 60'	Coarse	Sedimentary	Permeable	CSP
Mzu	San Diego & Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
gb	Jennings; CA	Fine	Bedrock	Impermeable	FB
JTRm	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kat	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Kc	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kgb	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
KJvs	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kmv	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Ksp	El Cajon 30' x 60'	Fine	Bedrock	Impermeable	FB
Kvsp	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Kwmt	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Qv	Jennings; CA	Fine	Bedrock	Impermeable	FB
Tba	San Diego 30' x 60'	Fine	Bedrock	Impermeable	FB
Tda	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Tv	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Tvsr	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Kgdfg	Oceanside 30' x 60'	Fine	Bedrock	Impermeable	FB
Ta	San Diego 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tcs	Oceanside 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Td	San Diego & Oceanside	Fine	Sedimentary	Impermeable	FSI

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Map Unit	Map Name	Anticipated Grain size of Weathered Material	Bedrock or Sedimentary	Impermeable/ Permeable	Geology Grouping
	30' x 60'				
Td+Tf	San Diego 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Qls	San Diego, Oceanside & El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tm	Oceanside 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tf	San Diego, Oceanside & El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Tfr	El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
To	San Diego & El Cajon 30' x 60'	Fine	Sedimentary	Impermeable	FSI
Qpe	San Diego & Oceanside 30' x 60'	Fine	Sedimentary	Permeable	FSP
Mexico	San Diego 30' x 60'	NA	NA	Permeable	Other
Kuo	San Diego 30' x 60'	NA (Offshore)	NA	Permeable	Other
Teo	San Diego & Oceanside 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
Tmo	Oceanside 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
Qmo	San Diego 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
QTso	San Diego 30' x 60'	NA (Offshore)	Sedimentary	Permeable	Other
af	San Diego & Oceanside 30' x 60'	Variable, dependent on source material	Sedimentary		Other

A.4.2 Quantitative Analysis

Soil loss estimates for each Geomorphic Landscape Unit were estimated using the Revised Universal Soil Loss Equation (RUSLE; Renard et al. 1997) listed below:

$$A = R \times K \times LS \times C \times P$$

Where

A = estimated average soil loss in tons/acre/year

R = rainfall-runoff erosivity factor

K = soil erodibility factor

LS = slope length and steepness factor

C = cover-management factor

P = support practice factor; assumed 1 for this analysis

Regional datasets used to estimate the inputs required to estimate the soil loss from each GLU are listed in table below:

Dataset	Source	Download year	Description
RUSLE – R Factor	SWRCB	2014	Regional R factor map was downloaded from ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/RUSLE_R_Factor/
RUSLE – K Factor	SWRCB	2014	Regional K factor map was downloaded from ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/RUSLE_K_Factor/
RUSLE – LS Factor	SWRCB	2014	Regional LS factor map was downloaded from ftp://swrcb2a.waterboards.ca.gov/pub/swrcb/dwq/cgp/Risk/RUSLE/RUSLE_LS_Factor/
RUSLE – C Factor	USEPA	2014	Regional C factor map was downloaded from http://www.epa.gov/esd/land-sci/emap_west_browser/pages/wemap_mm_sl_rusle_c_qt.htm#mapnav

GIS analysis was used to calculate the area weighted estimate of R, K, LS and C factors using the regional datasets listed in the table above. For the developed land cover the C factor was then adjusted to 0 from the regional estimate to account for management actions implemented on developed sites (e.g. impervious surfaces). Soil loss estimates ranged from 0 to 15.2 tons/acre/year.

For evaluating the degree of relative risk to a stream solely arising from changes in sediment and/or water delivery SCCWRP Technical Report 605, 2010 states:

“The challenge in implementing this step is that presently we have insufficient basis to defensibly identify either low-risk or high-risk conditions using these metrics. For example, channels that are close to a threshold for geomorphic change may display significant morphological changes under nothing more than natural year-to-year variability in flow or sediment load.

- *Acknowledging this caveat, we nonetheless anticipate that changes of less than 10% in either driver are unlikely to instigate, on their own, significant channel changes. This value is a conservative estimate of the year-to-year variability in either discharge or sediment flux that can be accommodated by a channel system in a state of dynamic equilibrium. It does not “guarantee,” however, that channel change may not occur—either in response to yet modest alterations in water or sediment delivery, or because of other urbanization impacts (e.g., point discharge of runoff or the trapping of the upstream sediment flux; see Booth 1990) that are not represented with this analysis.*
- *In contrast, recognizing a condition of undisputed “high risk” must await broader collection of regionally relevant data. We note that >60% reductions in predicted sediment production have resulted in both minimal (McGonigle) and dramatic (Agua Hedionda) channel changes, indicating that “more data” may never provide absolute guidance. At present, we suggest using predicted watershed changes of 50% or more in either runoff (as indexed by change in impervious area) or sediment production as provisional criteria for requiring a more detailed evaluation of both the drivers and the resisting factors for channel change, regardless of other screening-level assessments. Clearly, however, only more experience with the application of such “thresholds,” and the actual channel conditions that accompany them, will provide a defensible basis for setting numeric standards.”*

The following criterion was developed using the suggestions listed above and then used to assign relative sediment production rating to each GLU:

- Low: Soil Loss < 5.6 tons/acre/year [GLUs that have a soil loss of 0 to 5.6 tons/acre/year produces around 10% of the total coarse sediment soil loss from the study area]
- Medium: 5.6 tons/acre/year < Soil Loss < 8.4 tons/acre/year
- High: > 8.4 tons/acre/year [GLUs that have a soil loss greater than 8.4 tons/acre/year produces around 42% of the total coarse sediment soil loss from the study area]

Results from the quantitative analysis are summarized in Table A.4.2.

Table A.4.2 Relative Sediment Production for different Geomorphic Landscape Units

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CB-Agricultural/Grass-1	52883	0.20	4.67	0.14	50	6.5	Medium	No
CB-Agricultural/Grass-2	40633	0.21	5.19	0.14	56	8.3	Medium	No
CB-Agricultural/Grass-3	32617	0.22	6.04	0.14	57	10.6	High	Yes
CB-Agricultural/Grass-4	11066	0.23	7.38	0.14	57	13.5	High	Yes
CB-Developed-1	39746	0.22	3.77	0	49	0	Low	No
CB-Developed-2	32614	0.22	4.28	0	50	0	Low	No
CB-Developed-3	15841	0.22	4.86	0	49	0	Low	No
CB-Developed-4	1805	0.22	5.63	0	48	0	Low	No
CB-Forest-1	32231	0.20	6.38	0.14	39	6.8	Medium	No
CB-Forest-2	38507	0.20	7.20	0.13	45	8.8	High	Yes
CB-Forest-3	55303	0.20	8.14	0.13	48	10.6	High	Yes
CB-Forest-4	38217	0.20	9.95	0.14	50	13.6	High	Yes
CB-Other-1	1036	0.20	5.52	0.13	45	6.5	Medium	No
CB-Other-2	317	0.20	6.46	0.13	45	7.9	Medium	No
CB-Other-3	296	0.20	6.96	0.14	43	8.3	Medium	No
CB-Other-4	111	0.21	6.84	0.14	41	8.2	Medium	No
CB-Scrub/Shrub-1	88135	0.20	5.66	0.14	33	5.3	Low	No
CB-Scrub/Shrub-2	143694	0.20	6.51	0.14	37	6.8	Medium	No
CB-Scrub/Shrub-3	246703	0.21	7.33	0.14	41	8.4	Medium	No
CB-Scrub/Shrub-4	191150	0.21	8.28	0.14	42	9.8	High	No
CB-Unknown-1	1727	0.21	5.32	0.13	44	6.3	Medium	No
CB-Unknown-2	1935	0.21	5.95	0.13	44	7.1	Medium	No

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Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CB-Unknown-3	1539	0.22	6.21	0.13	44	7.7	Medium	No
CB-Unknown-4	278	0.22	6.61	0.13	44	8.4	High	Yes
CSI-Agricultural/Grass-1	14609	0.34	2.72	0.14	39	4.8	Low	No
CSI-Agricultural/Grass-2	9059	0.37	3.61	0.14	47	8.7	High	Yes
CSI-Agricultural/Grass-3	10096	0.38	3.99	0.14	47	9.8	High	Yes
CSI-Agricultural/Grass-4	2498	0.37	4.33	0.14	47	10.5	High	Yes
CSI-Developed-1	82371	0.28	2.51	0	39	0	Low	No
CSI-Developed-2	22570	0.30	2.66	0	41	0	Low	No
CSI-Developed-3	13675	0.30	2.89	0	40	0	Low	No
CSI-Developed-4	3064	0.27	3.20	0	39	0	Low	No
CSI-Forest-1	449	0.27	4.26	0.13	43	6.6	Medium	No
CSI-Forest-2	611	0.25	5.11	0.13	44	7.5	Medium	No
CSI-Forest-3	716	0.29	4.43	0.13	44	7.4	Medium	No
CSI-Forest-4	348	0.30	4.49	0.13	43	7.6	Medium	No
CSI-Other-1	319	0.31	2.50	0.13	32	3.2	Low	No
CSI-Other-2	83	0.27	3.01	0.13	39	4.3	Low	No
CSI-Other-3	45	0.28	3.03	0.13	39	4.5	Low	No
CSI-Other-4	13	0.24	4.01	0.14	39	5.2	Low	No
CSI-Scrub/Shrub-1	9051	0.26	3.53	0.13	39	4.7	Low	No
CSI-Scrub/Shrub-2	10802	0.27	4.36	0.13	41	6.3	Medium	No
CSI-Scrub/Shrub-3	28220	0.26	4.82	0.13	41	6.7	Medium	No
CSI-Scrub/Shrub-4	20510	0.26	5.52	0.13	41	7.8	Medium	No
CSI-Unknown-1	5292	0.28	2.38	0.13	36	3.1	Low	No

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Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CSI-Unknown-2	2074	0.29	2.98	0.13	40	4.5	Low	No
CSI-Unknown-3	2171	0.27	3.04	0.13	39	4.2	Low	No
CSI-Unknown-4	676	0.26	3.04	0.13	38	3.8	Low	No
CSP-Agricultural/Grass-1	59327	0.22	3.01	0.14	44	4.0	Low	No
CSP-Agricultural/Grass-2	8426	0.23	3.81	0.14	42	5.2	Low	No
CSP-Agricultural/Grass-3	2377	0.24	4.05	0.14	41	5.6	Low	No
CSP-Agricultural/Grass-4	291	0.22	6.28	0.14	52	10.1	High	Yes
CSP-Developed-1	85283	0.27	2.10	0	42	0	Low	No
CSP-Developed-2	7513	0.26	2.77	0	42	0	Low	No
CSP-Developed-3	2317	0.27	2.70	0	40	0	Low	No
CSP-Developed-4	272	0.27	2.76	0	38	0	Low	No
CSP-Forest-1	14738	0.22	4.52	0.14	44	6.0	Medium	No
CSP-Forest-2	3737	0.22	5.99	0.14	45	8.2	Medium	No
CSP-Forest-3	1858	0.21	6.42	0.14	45	8.5	High	Yes
CSP-Forest-4	484	0.21	7.62	0.14	48	10.2	High	Yes
CSP-Other-1	7404	0.23	2.61	0.14	39	3.2	Low	No
CSP-Other-2	343	0.24	3.68	0.13	40	4.8	Low	No
CSP-Other-3	126	0.24	3.76	0.13	40	4.9	Low	No
CSP-Other-4	17	0.24	4.19	0.13	39	5.3	Low	No
CSP-Scrub/Shrub-1	22583	0.23	3.75	0.14	41	4.8	Low	No
CSP-Scrub/Shrub-2	8938	0.24	5.63	0.14	40	7.1	Medium	No
CSP-Scrub/Shrub-3	7186	0.23	6.15	0.13	39	7.5	Medium	No
CSP-Scrub/Shrub-4	2609	0.22	7.16	0.14	43	9.3	High	Yes

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Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
CSP-Unknown-1	6186	0.25	2.63	0.13	40	3.4	Low	No
CSP-Unknown-2	744	0.27	3.49	0.13	39	4.8	Low	No
CSP-Unknown-3	350	0.28	3.32	0.13	38	4.5	Low	No
CSP-Unknown-4	78	0.28	3.26	0.13	40	4.5	Low	No
FB-Agricultural/Grass-1	6103	0.25	5.49	0.14	49	9.2	High	No
FB-Agricultural/Grass-2	7205	0.25	5.87	0.14	51	10.1	High	No
FB-Agricultural/Grass-3	6730	0.24	6.43	0.14	53	11.3	High	No
FB-Agricultural/Grass-4	2586	0.22	8.62	0.14	57	15.2	High	No
FB-Developed-1	10116	0.28	3.94	0	46	0	Low	No
FB-Developed-2	9075	0.28	4.41	0	45	0	Low	No
FB-Developed-3	5499	0.27	4.72	0	44	0	Low	No
FB-Developed-4	785	0.27	5.08	0	43	0	Low	No
FB-Forest-1	3780	0.21	7.24	0.13	39	8.0	Medium	No
FB-Forest-2	7059	0.21	7.53	0.13	43	8.8	High	No
FB-Forest-3	13753	0.22	8.02	0.13	43	9.7	High	No
FB-Forest-4	8899	0.26	9.63	0.13	35	11.5	High	No
FB-Other-1	172	0.26	5.72	0.13	44	8.6	High	No
FB-Other-2	75	0.26	5.97	0.13	38	7.7	Medium	No
FB-Other-3	76	0.28	6.27	0.13	34	7.6	Medium	No
FB-Other-4	36	0.31	6.70	0.13	33	8.6	High	No
FB-Scrub/Shrub-1	10297	0.24	6.94	0.14	36	8.3	Medium	No
FB-Scrub/Shrub-2	25150	0.25	7.24	0.14	38	9.0	High	No
FB-Scrub/Shrub-3	70895	0.25	7.89	0.13	38	10.0	High	No

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Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
FB-Scrub/Shrub-4	70679	0.26	9.05	0.14	39	12.1	High	No
FB-Unknown-1	654	0.30	5.33	0.13	37	7.6	Medium	No
FB-Unknown-2	829	0.29	5.26	0.13	40	7.9	Medium	No
FB-Unknown-3	1062	0.29	5.54	0.13	39	8.2	Medium	No
FB-Unknown-4	299	0.28	6.02	0.13	38	8.4	High	No
FSI-Agricultural/Grass-1	8462	0.32	3.91	0.13	24	3.9	Low	No
FSI-Agricultural/Grass-2	4979	0.33	4.29	0.13	31	5.7	Medium	No
FSI-Agricultural/Grass-3	4808	0.34	4.26	0.13	34	6.3	Medium	No
FSI-Agricultural/Grass-4	1055	0.35	4.11	0.13	36	6.7	Medium	No
FSI-Developed-1	9953	0.29	3.09	0	34	0	Low	No
FSI-Developed-2	4972	0.31	3.22	0	37	0	Low	No
FSI-Developed-3	3350	0.29	3.30	0	36	0	Low	No
FSI-Developed-4	763	0.28	3.31	0	37	0	Low	No
FSI-Forest-1	186	0.33	4.62	0.13	37	7.2	Medium	No
FSI-Forest-2	217	0.35	4.47	0.13	39	7.9	Medium	No
FSI-Forest-3	262	0.37	4.71	0.13	40	9.2	High	No
FSI-Forest-4	111	0.36	4.73	0.13	40	9.2	High	No
FSI-Other-1	266	0.31	3.11	0.13	24	2.9	Low	No
FSI-Other-2	81	0.30	3.29	0.13	25	3.1	Low	No
FSI-Other-3	56	0.31	3.04	0.13	27	3.2	Low	No
FSI-Other-4	15	0.29	3.57	0.13	33	4.4	Low	No
FSI-Scrub/Shrub-1	2241	0.27	4.46	0.13	29	4.5	Low	No
FSI-Scrub/Shrub-2	3911	0.28	4.96	0.13	31	5.7	Medium	No

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Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
FSI-Scrub/Shrub-3	7590	0.29	5.05	0.13	34	6.3	Medium	No
FSI-Scrub/Shrub-4	3502	0.30	5.14	0.13	37	7.5	Medium	No
FSI-Unknown-1	1117	0.29	2.83	0.13	27	3.0	Low	No
FSI-Unknown-2	780	0.30	3.44	0.13	32	4.3	Low	No
FSI-Unknown-3	855	0.29	3.41	0.13	31	4.0	Low	No
FSI-Unknown-4	285	0.28	3.21	0.13	32	3.7	Low	No
FSP-Agricultural/Grass-1	13	0.22	2.22	0.13	40	2.5	Low	No
FSP-Agricultural/Grass-2	3	0.22	2.59	0.13	40	3.0	Low	No
FSP-Agricultural/Grass-3	2	0.22	2.69	0.13	40	3.2	Low	No
FSP-Agricultural/Grass-4	0	0.20	2.94	0.12	40	2.9	Low	No
FSP-Developed-1	180	0.26	2.85	0	40	0	Low	No
FSP-Developed-2	13	0.25	2.69	0	40	0	Low	No
FSP-Developed-3	8	0.21	2.25	0	40	0	Low	No
FSP-Developed-4	0	0.21	2.29	0	40	0	Low	No
FSP-Forest-1	8	0.22	2.29	0.14	40	2.9	Low	No
FSP-Forest-2	5	0.20	2.22	0.14	40	2.5	Low	No
FSP-Forest-3	0	0.20	2.22	0.14	40	2.5	Low	No
FSP-Other-1	1307	0.20	2.38	0.14	40	2.7	Low	No
FSP-Other-2	34	0.21	2.36	0.14	40	2.7	Low	No
FSP-Other-3	8	0.22	2.56	0.13	40	3.0	Low	No
FSP-Other-4	0	0.43	4.35	0.12	40	9.3	High	No
FSP-Scrub/Shrub-1	147	0.23	2.68	0.14	40	3.3	Low	No
FSP-Scrub/Shrub-2	18	0.23	2.55	0.14	40	3.3	Low	No

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Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
FSP-Scrub/Shrub-3	4	0.20	2.23	0.14	40	2.6	Low	No
FSP-Scrub/Shrub-4	0	0.20	1.70	0.12	40	1.7	Low	No
FSP-Unknown-1	40	0.20	1.87	0.13	40	1.9	Low	No
FSP-Unknown-2	5	0.20	1.99	0.12	40	2.0	Low	No
FSP-Unknown-3	1	0.20	2.39	0.12	40	2.4	Low	No
O-Agricultural/Grass-1	2433	0.20	2.93	0.14	34	2.8	Low	No
O-Agricultural/Grass-2	112	0.21	3.44	0.14	32	3.2	Low	No
O-Agricultural/Grass-3	30	0.23	3.89	0.13	32	3.8	Low	No
O-Agricultural/Grass-4	1	0.26	6.47	0.13	37	7.9	Medium	No
O-Developed-1	8327	0.27	1.37	0	39	0	Low	No
O-Developed-2	474	0.25	2.12	0	40	0	Low	No
O-Developed-3	157	0.26	3.07	0	41	0	Low	No
O-Developed-4	26	0.24	3.89	0	41	0	Low	No
O-Forest-1	235	0.22	6.15	0.13	43	7.6	Medium	No
O-Forest-2	67	0.21	5.07	0.13	45	6.6	Medium	No
O-Forest-3	45	0.21	5.43	0.13	47	7.3	Medium	No
O-Forest-4	20	0.20	5.95	0.13	59	9.0	High	No
O-Other-1	9362	0.25	3.86	0.13	36	4.3	Low	No
O-Other-2	344	0.24	3.32	0.13	35	3.5	Low	No
O-Other-3	120	0.23	4.86	0.13	35	5.0	Low	No
O-Other-4	37	0.22	5.64	0.13	39	6.6	Medium	No
O-Scrub/Shrub-1	688	0.22	4.83	0.13	40	5.7	Medium	No
O-Scrub/Shrub-2	224	0.22	5.80	0.13	36	6.3	Medium	No

Geomorphic Landscape Unit (GLU)	Area (acres)	K	LS	C	R	A	Relative Sediment Production	Critical Coarse Sediment
O-Scrub/Shrub-3	209	0.22	6.47	0.13	41	7.5	Medium	No
O-Scrub/Shrub-4	96	0.22	6.62	0.13	44	8.2	Medium	No
O-Unknown-1	1236	0.28	1.60	0.12	26	1.5	Low	No
O-Unknown-2	62	0.27	1.48	0.13	36	1.8	Low	No
O-Unknown-3	15	0.29	3.52	0.13	38	4.9	Low	No
O-Unknown-4	7	0.34	3.87	0.12	40	6.6	Medium	No

GLU Nomenclature: Geology – Land Cover – Slope Category

Geology Categories:

CB Coarse Bedrock
 CSI Coarse Sedimentary Impermeable
 CSP Coarse Sedimentary Permeable
 FB Fine Bedrock
 FSI Fine Sedimentary Impermeable
 FSP Fine Sedimentary Permeable
 O Other

Slope Categories:

1 0%-10%
 2 10% - 20%
 3 20% - 40%
 4 > 40%

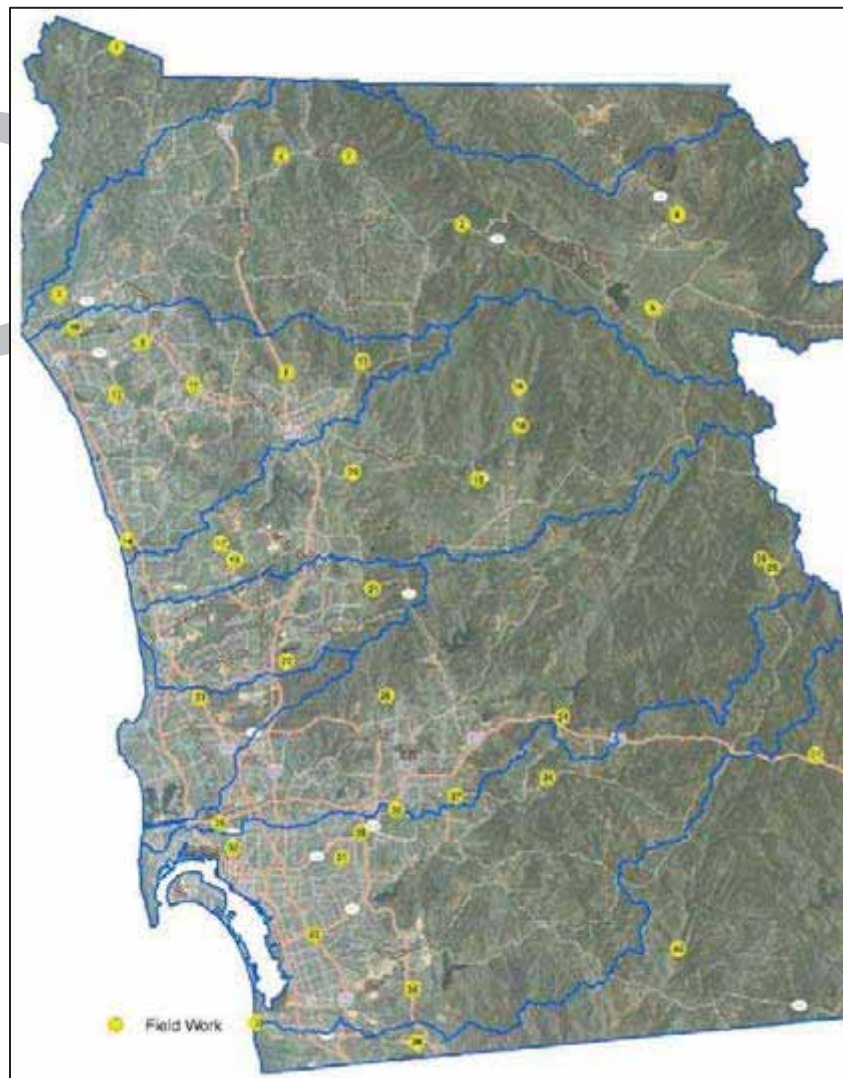
A4.3 Field Assessment

Site Selection:

Forty locations were selected from the study region for field assessment. Sites were selected such that they are accessible by existing road network based on review of satellite imagery and are uniformly distributed considering the following criteria:

- Geologic grouping
- Land cover
- Slope category
- WMA
- Jurisdiction

Yellow circles in the figure below shows the 40 locations for which field assessment was performed.



Pre-Field Activities

Prior to conducting field activities, the consultant team reviewed available published geologic information at each site location and prepared satellite imagery of each site using Google Earth™. Pre-field activities consisted of evaluating site access at each location using aerial imagery and logistics were coordinated based on regional site location to maximize field efficiency.

Site Reconnaissance

Site reconnaissance was performed at forty locations between 22 January and 7 February 2014 by a team of geologists. The reconnaissance consisted of:

- Visual soil classification,
- Assessing existing vegetative cover (0-100%),
- Qualitative assignment of existing sediment production (low, medium, and high) [based on existing vegetative cover],
- Qualitative assignment of potential sediment production (low, medium, and high)[assuming there is 0% vegetative cover], and
- Identifying existing erosional features.

Descriptions and visual classifications of the surficial materials were based on the Unified Soil Classification System (USCS). Underlying geologic units were confirmed where exposed formations were observed within the individual site limits.

SITE AND GEOLOGIC CONDITIONS

Our knowledge of the site conditions has been developed from a review of available geologic literature, previous geologic and geotechnical investigations by the consultant team in the study region, professional experience, site reconnaissance, and field investigations performed for this study.

Surface Conditions

Site locations were sited in open space with the exception of sites ID-27, -30, and -31 which were situated within developed areas with paved streets and sidewalks. The surface conditions at the site locations were characterized by sloping terrain varying from relatively flat (< 5%) to very steep slopes (> 40%). At the time of our reconnaissance the natural hillsides along the areas of interest were covered by varying degrees of moderate to dense growth scrub brush, low grasses, and scattered trees.

Existing erosional and geomorphic features at each site location were identified where possible. The observed erosional features included notable drainages, rilling, scour, and sediment accumulation. Observed geomorphic features included areas of minor slope instability and surficial slumping. Several sources of ground disturbance were identified during the site reconnaissance included active grading operations and bioturbation.

An evaluation of the existing and potential sediment production for each site was determined based on surface conditions. Sediment production was assigned as “high, medium, or low” based on the existing conditions and consultant team’s professional experience.

Surficial Deposits

Surficial deposits, including topsoil, alluvium, colluvium, slopewash, and residual soils are present in portions of the study area within the natural drainages and mantling the slope areas. The composition and grain size of these materials are variable depending on the age, parent sources, and mode of deposition.

Geologic Conditions

Our knowledge of the subsurface conditions at the site locations is based on a review of available published geologic information, professional experience, site reconnaissance, previous explorations and geotechnical investigations performed by the consultant team in the study region.

DRAFT

Field Assessment Photo Log



Field Visit ID-1

GLU: CB-Scrub/Shrub-4

View: Looking southwest

Existing sediment
production: Med

Potential sediment
production: High

Existing veg. cover: 90%



Field Visit ID-2

GLU: CB-Forest-4

View: Looking north

Existing sediment
production: Med

Potential sediment
production: High

Existing veg. cover: 95%



Field Visit ID-3

**GLU: CSI-Agricultural/
Grass-3**

View: Looking southwest

Existing sediment
production: Low to Med

Potential sediment
production:
Med to High

Existing veg. cover:
95-100%



Field Visit ID-4

GLU: CSI-Scrub/Shrub-2

View: Looking north

Existing sediment
production: Med

Potential sediment
production: High

Existing veg. cover: 70%



Field Visit ID-5

**GLU: CSP-Agricultural/
Grass-1**

View: Looking southwest

Existing sediment
production: Low to Med

Potential sediment
production: Med

Existing veg. cover: 90%



Field Visit ID-6

**GLU: CSP-Agricultural/
Grass-3**

View: Looking east

Existing sediment
production: Low to Med

Potential sediment
production:

Low to Med

Existing veg. cover:
Southeast slope ~50%

Northeast slope ~70%



Field Visit ID-7

GLU: CSP-Forest-3

View: Looking east

Existing sediment
production: Med to High

Potential sediment
production: High

Existing veg. cover: 75-80%



Field Visit ID-8

GLU: CB-Scrub/Shrub-3

View: Looking southeast

Existing sediment
production: Low to Med

Potential sediment
production:

Med to High

Existing veg. cover: 90-95%



Field Visit ID-9

**GLU: CB-Agricultural/
Grass-2**

View: Looking northwest

Existing sediment
production: Low to Med

Potential sediment
production: Med

Existing veg. cover: 70%



Field Visit ID-10

GLU: CSI-Unknown-2

View: Looking north

Existing sediment
production: Med to High

Potential sediment
production: High

Existing veg. cover: 75%



Field Visit ID-11

**GLU: CSI-Agricultural/
Grass-2**

View: Looking east

Existing sediment
production: Low

Potential sediment
production: Med

Existing veg. cover: 85%



Field Visit ID-12

GLU: CSP-Unknown-2

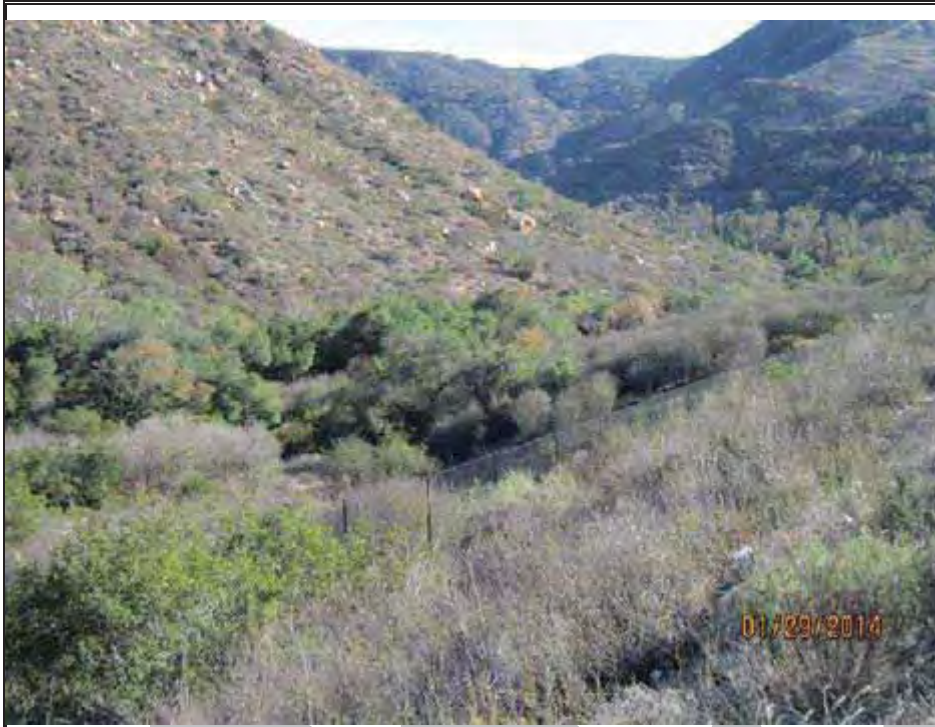
View: Looking southwest

Existing sediment
production: Low

Potential sediment
production:

Low to Med

Existing veg. cover: 50%



Field Visit ID-13

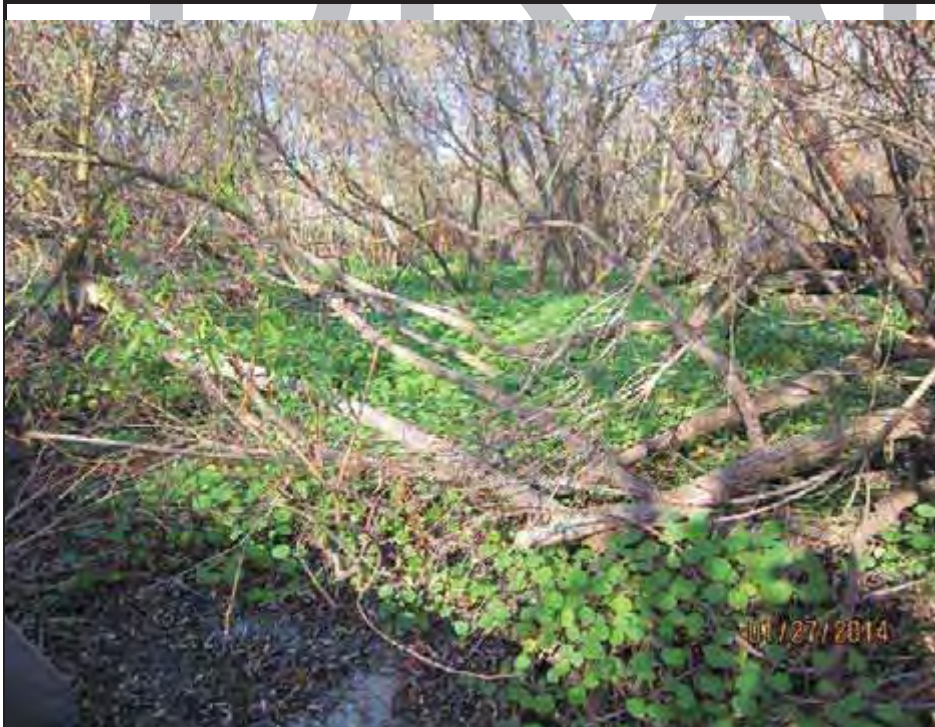
GLU: CSP-Scrub/Shrub-2

View: Looking southeast

Existing sediment
production: Med

Potential sediment
production:
Med to High

Existing veg. cover: 80-85%



Field Visit ID-14

GLU: FSP-Scrub/Shrub-1

View: Looking northeast

Existing sediment
production: Low

Potential sediment
production:
Low to Med

Existing veg. cover:
95-100%



Field Visit ID-15

**GLU: CB-Agricultural/
Grass-4**

View: Looking west

Existing sediment
production: Med

Potential sediment
production: High

Existing veg. cover: 95%



Field Visit ID-16

**GLU: CB-Agricultural/
Grass-3**

View: Looking south

Existing sediment
production: High*

Potential sediment
production: High

Existing veg. cover: 90-95%

* Area was burned in 2014 fires after the field assessment so existing sediment production was adjusted to High (based on potential sediment production) from Medium



Field Visit ID-17

GLU: CSI-Scrub/Shrub-4

View: Looking west

Existing sediment
production: Med

Potential sediment
production: High

Existing veg. cover: 95%



Field Visit ID-18

GLU: CSP-Forest-1

View: Looking southwest

Existing sediment
production: Low to Med

Potential sediment
production: Med

Existing veg. cover: 80%



Field Visit ID-19

GLU: CSP-Scrub/Shrub-3

View: Looking southwest

Existing sediment
production: Low to Med

Potential sediment
production:
Med to High

Existing veg. cover: 60%



Field Visit ID-20

GLU: CSP-Unknown-1

View: Looking southeast

Existing sediment
production: Low

Potential sediment
production: Med

Existing veg. cover: 95%



Field Visit ID-21

GLU: CB-Unknown-3

View: Looking northwest

Existing sediment
production: Low to Med

Potential sediment
production:
Med to High

Existing veg. cover: 50-60%



Field Visit ID-22

GLU: CSI-Forest-3

View: Looking east

Existing sediment
production: Low

Potential sediment
production: Med

Existing veg. cover: 60%



Field Visit ID-23

GLU: CSI-Scrub/Shrub-1

View: Looking north

Existing sediment
production: Low

Potential sediment
production: Low

Existing veg. cover: 80%



Field Visit ID-24

GLU: CB-Unknown-4

View: Looking northeast

Existing sediment
production: Low to Med

Potential sediment
production: High

Existing veg. cover: 80%



Field Visit ID-25

**GLU: CSI-Agricultural/
Grass-4**

View: Looking east

Existing sediment
production: Low

Potential sediment
production: Med-High

Existing veg. cover: 95%



Field Visit ID-26

GLU: CSI-Scrub/Shrub-3

View: Looking east

Existing sediment
production: Low

Potential sediment
production: Med

Existing veg. cover: 100%



Field Visit ID-27

GLU: CSP-Developed-2

View: Looking north

Existing sediment
production: Low

Potential sediment
production: Low

Existing veg. cover: 30-35%



Field Visit ID-28

**GLU: CSP-Agricultural/
Grass-2**

View: Looking north

Existing sediment
production: Low

Potential sediment
production: Med

Existing veg. cover: 90-95%



Field Visit ID-29

GLU: FB-Forest-3

View: Looking northwest

Existing sediment
production: Med

Potential sediment
production: High

Existing veg. cover: 80-85%



Field Visit ID-30

GLU: CB-Developed-4

View: Looking northeast

Existing sediment
production: Low

Potential sediment
production: Med

Existing veg. cover: 70%



Field Visit ID-31

GLU: CSI-Developed-3

View: Looking north

Existing sediment
production: Low

Potential sediment
production: Low

Existing veg. cover: 30-35%



Field Visit ID-32

GLU: CSI-Unknown-3

View: Looking west

Existing sediment
production: Low to Med

Potential sediment
production: Med

Existing veg. cover: 70-75%



Field Visit ID-33

GLU: CSP-Scrub/Shrub-1

View: Looking northeast

Existing sediment
production: Low to Med

Potential sediment
production:
Med to High

Existing veg. cover: 70%



Field Visit ID-34

GLU: CSP-Developed-2

View: Looking south

Existing sediment
production: Low

Potential sediment
production: Low

Existing veg. cover: 95%



Field Visit ID-35

GLU: FB-Scrub/Shrub-3

View: Looking northeast

Existing sediment
production: Low

Potential sediment
production: Med

Existing veg. cover: 90-95%



Field Visit ID-36

**GLU: FSI-Agricultural/
Grass-2**

View: Looking northeast

Existing sediment
production: Low

Potential sediment
production: Med

Existing veg. cover: 95%



Field Visit ID-37

GLU: CB-Forest-3

View: Looking southeast

Existing sediment
production: Med-High

Potential sediment
production: High

Existing veg. cover: 75-80%



Field Visit ID-38

**GLU: CSI-Agricultural/
Grass-1**

View: Looking northeast

Existing sediment
production: Low

Potential sediment
production: Med

Existing veg. cover: 85%



Field Visit ID-39

GLU: CSP-Developed-1

View: Looking west

Existing sediment
production: Low

Potential sediment
production: Low

Existing veg. cover: 30-35%



Field Visit ID-40

GLU: CSP-Scrub/Shrub-4

View: Looking south

Existing sediment
production: Med

Potential sediment
production: High

Existing veg. cover: 90-95%

ATTACHMENT A.5
PHYSICAL STRUCTURES

DRAFT

A.5 Physical Structures

The desktop-level analysis to identify existing physical structures within the nine watershed management areas within the San Diego region utilized the following GIS data sources:

- ESRI ArcMap, Google Earth, and Google Maps products
- Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) Flood Profiles and FEMA Flood Insurance Rate Map (FIRM)
- National Flood Hazard Layer (NFHL)
- Municipal master drainage plans (as provided)
- San Diego Geographic Information Source (SanGIS) Municipal Boundaries and Hydrologic Basins
- United States Geological Survey (USGS) National Hydrography Dataset (NHD) California data
- Stream data generated as indicated in Section 2.2

The following documents the process used to identify the physical structures along the reaches and the resulting GIS data:

- The process began by importing the data sources indicated above into a single ArcMap document that served as a master map file from which all further analysis proceeded.
- The data were screened and selected for inclusion as appropriate to the project scope.
- Point features were placed along river reach line segments to coincide with visually identified structures, utilizing different feature symbols according to the type of infrastructure.
- In the case of levees, the point was placed at the downstream-most end of the FEMA NFHL Shapefile. All point features generated in this task appear in the GIS shapefile.
- Municipal boundaries intersecting river reaches were identified to identify the applicable municipal drainage plan data.
- Point feature attributes and associated information for Physical Structures GIS shapefile is indicated in Table A.5.1 below.

Table A.5.1: Structure Identification Point Feature Attribute Development and Information

Attribute	Description
Struct_ID	The Structure ID field provides a six-digit identification number based upon the structure's specific location within a watershed. The first three digits in the code reflect the structure's Hydrologic Unit (HU) Basin number (ranging between 902-911 for Region 9, as defined in the Water Quality Control Plan for the San Diego Basin). The subsequent three digits reflect the structure's location along the reach, ascending along the channel from the headwaters to tailwaters (ranging between 001-999, beginning at the confluence and increasing in the upstream direction).

Attribute	Description
WMA	The Watershed Management Area field provides the name of the watershed in which the structure exists. The WMA corresponds with the HU identified in the first three digits in the Struct_ID (e.g., 911, Tijuana Watershed).
Channel_ID	The Channel ID field provides the name of the channel in which the structure exists.
Struct_Typ	The Structure Type field classifies known structures as one of the following types:, Bridge, Culvert, Dam, Energy Dissipater, Flood Management Basin, Flood Wall, Grade Control, Levee, Pipeline, Weir.
Struct_Dtl	The Structure Detail field provides known quantitative information for multi-section culverts.
Struct_Mtl	The Structure Material field provides known qualitative information for structure material composition.
Struct_Shp	The Structure Shape field provides known geometric information for culvert shapes, and is classified as one of the following types: Arch, Box, Pipe.
Jurisd_ID	The Jurisdiction ID field, when applicable, provides the known separate structure identification number developed and utilized by the jurisdiction or entity responsible for creating and distributing the coinciding structure Shapefile data used for this analysis. This number was copied from the coinciding external Shapefile data attribute field best representing a unique jurisdiction or entity-based identification number (external Shapefile data received from regional WMAA data call; for jurisdictional information, see "Other" attribute field). Coinciding external Shapefile data was used to determine various structure attributes.
Plan_ID	The Plan ID field, when applicable, provides the known structure plan number corresponding with the Jurisdiction ID. This number was copied from the coinciding external Shapefile data attribute field best representing a unique plan number received from the regional WMAA data call (external Shapefile data received from regional WMAA data call; for jurisdictional information, see "Other" field). Coinciding external Shapefile data was used to determine various structure attributes.
Diameter	The Diameter field, when applicable, provides the known diameter (in US feet) for culverts.
Length	The Length field, when applicable, provides the known length (in US feet) for select structure types. When lengths were determined using FEMA FIS Flood Profiles, the scaled horizontal distances along the indicated roadway or channel slope were used.
Width	The Width field, when applicable, provides the known width (in US feet) for select structure types.
Height	The Height field, when applicable, provides the known height (in US feet) for select structure types. When heights were determined using FEMA FIS Flood Profiles, the scaled vertical distances from channel bed to indicated roadway bottom were used.
US_Invert	The Upstream Invert field, when applicable, provides the known upstream invert elevation (in US feet) for select structure types.
DS_Invert	The Downstream Invert field, when applicable, provides the known downstream invert elevation (in US feet) for select structure types.

Attribute	Description
RD_EL_NAVD	The Roadway Elevation (NAVD) field, when applicable, provides the known roadway elevation (in US feet, NAVD) for select structure types. When roadway elevations were determined using FEMA FIS Flood Profiles, the horizontal projection onto the vertical grid scales were used.
Loc_Descr	The Location Description field, when applicable, provides information for structures crossing a known roadway. In nearly all cases, Google Earth imagery was used to determine the roadway name.
Other	The Other field is used to convey any information not present within the preceding fields. Typically, "other" information includes jurisdictional, plan, and supplemental dimensions for a given structure.

Example Structure Identification

The following example demonstrates the structure identification process for a discrete structure (ID 907029) along the San Diego River. The San Diego River is located in the San Diego River watershed (WMA 907). Scanning the river from lower to higher reached, a new point feature was placed at the road crossing over the San Diego River as indicated in Figure A.5.1. Select attributes of this particular structure were available from the FEMA NFHL as displayed in the highlighted boxes in Figure A.5.1. Additional attributes such as the culvert height, length, roadway elevation, and name were also determined from the FIS Flood Profile as indicated in Figure A.5.2. Satellite imagery (e.g., Google) was used to verify the existence of structure. In this case, the most current Google Map data indicated that the culvert still exists and that the roadway name has been changed to Qualcomm Way. When structures could not be verified with satellite imagery, the structure identification was based solely upon the information provided or readily available and was not physically verified in the field. Figure A.5.3 displays an example of imagery used to identify structures.

Figure A.5.1: Typical ArcMap Window

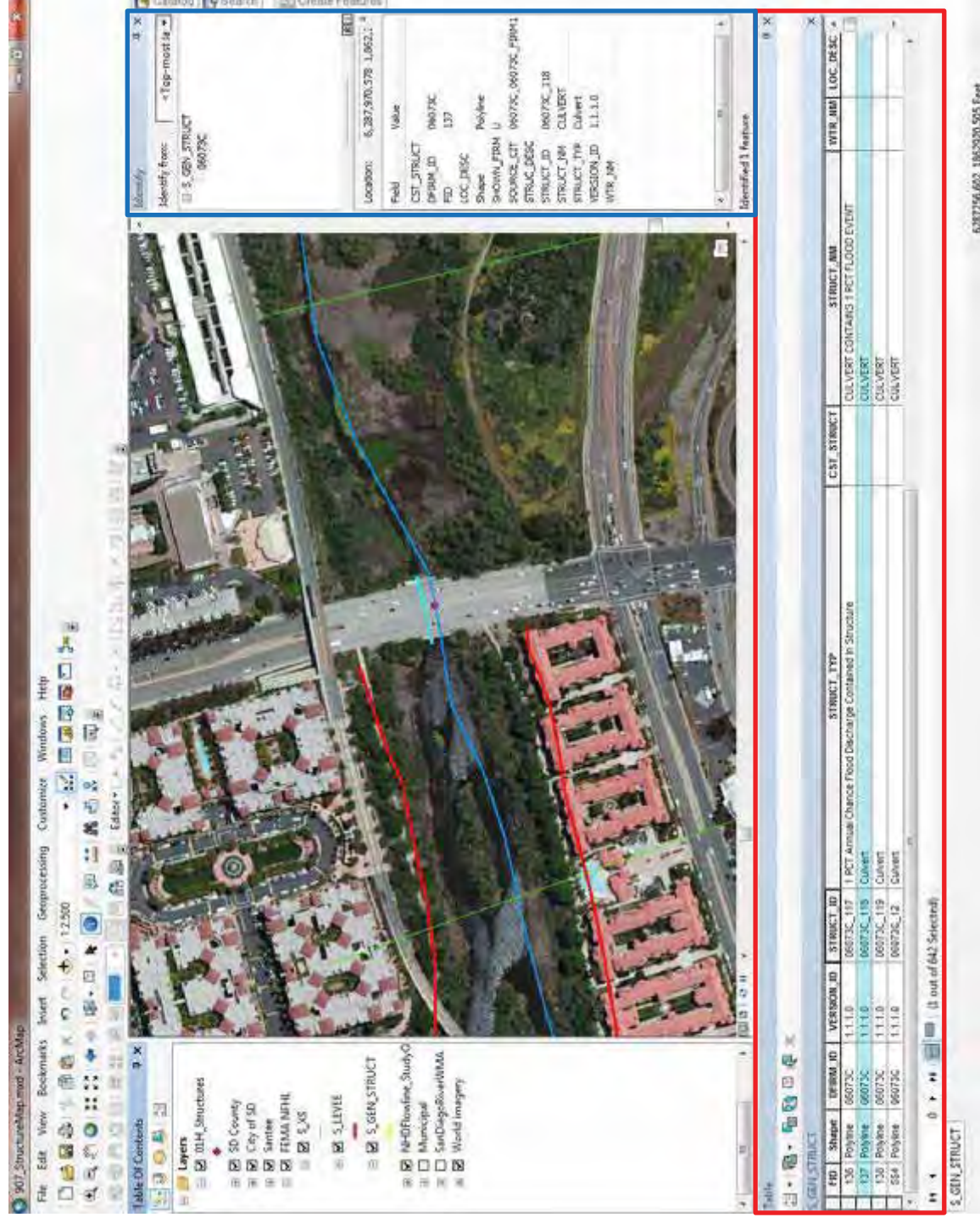
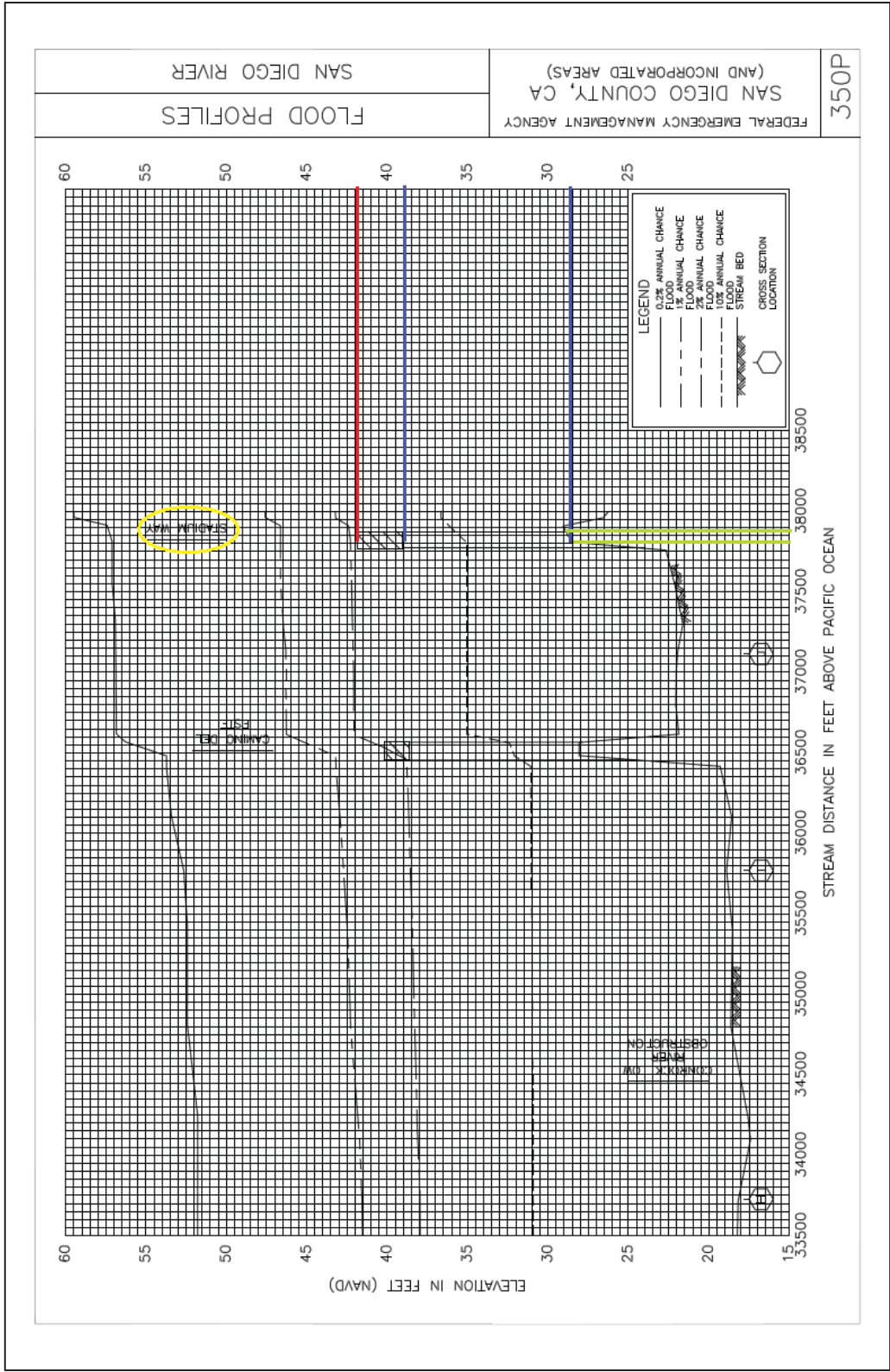


Figure A.5.2: Typical FEMA FIS Flood Profile



Legend: roadway elevation (red), roadway name (yellow), culvert height (blue), culvert width (green)

Figure A.5.3: Google Map Imagery for Structure Identification



The following bridge structure dimensional attributes were included in the point feature attributes:

- length 110 feet
- height 10 feet
- roadway elevation 41.9 feet

The attribute table associated with the identified structure included in the GIS shapefile is indicated in Table A.5.2.

Table A.5.2: Structure 907029 Attribute Table

Attribute	Description
Struct_ID	907029
WMA	San Diego
Channel_ID	San Diego River
Struct_Typ	Culvert
Struct_Dtl	
Struct_Mtl	
Struct_Shp	
Jurisd_ID	06073C_118
Plan_ID	06073C_06073C_FIRM1
Diameter	0
Length	110
Width	0
Height	10
US_Invert	0
DS_Invert	0
RD_EL_NAVD	41.9
Loc_Descr	Qualcomm Way
Other	Info from FEMA NFHL shapefile data/FIS FP V.9-350P

ATTACHMENT B
HYDROMODIFICATION MANAGEMENT
EXEMPTION MAPPING

Mission Bay/La Jolla Watershed Management Area HU 906.00, 68 mi²

Legend

Watershed Boundaries

Municipal Boundaries

Regional WMAA Streams

Exempt Bodies:
Water Storage Reservoirs, Lakes,
Enclosed Embayments, Pacific
Ocean, Buena Vista Lagoon

Exempt River Reaches:
Reaches of San Luis Rey River, San
Dieguito River, San Diego River,
Forester Creek, Sweetwater River,
Otay River

Exempt Conveyance Systems:
Existing underground storm drains or
conveyance channels whose bed
and bank are concrete-lined,
discharging directly to exempt water
bodies, exempt rivers, or localized
areas of Agua Hedionda Lagoon and
Battiquitos Lagoon

MISSION BAY/LA JOLLA WATERSHED MANAGEMENT AREA

Legend

Watershed Boundaries

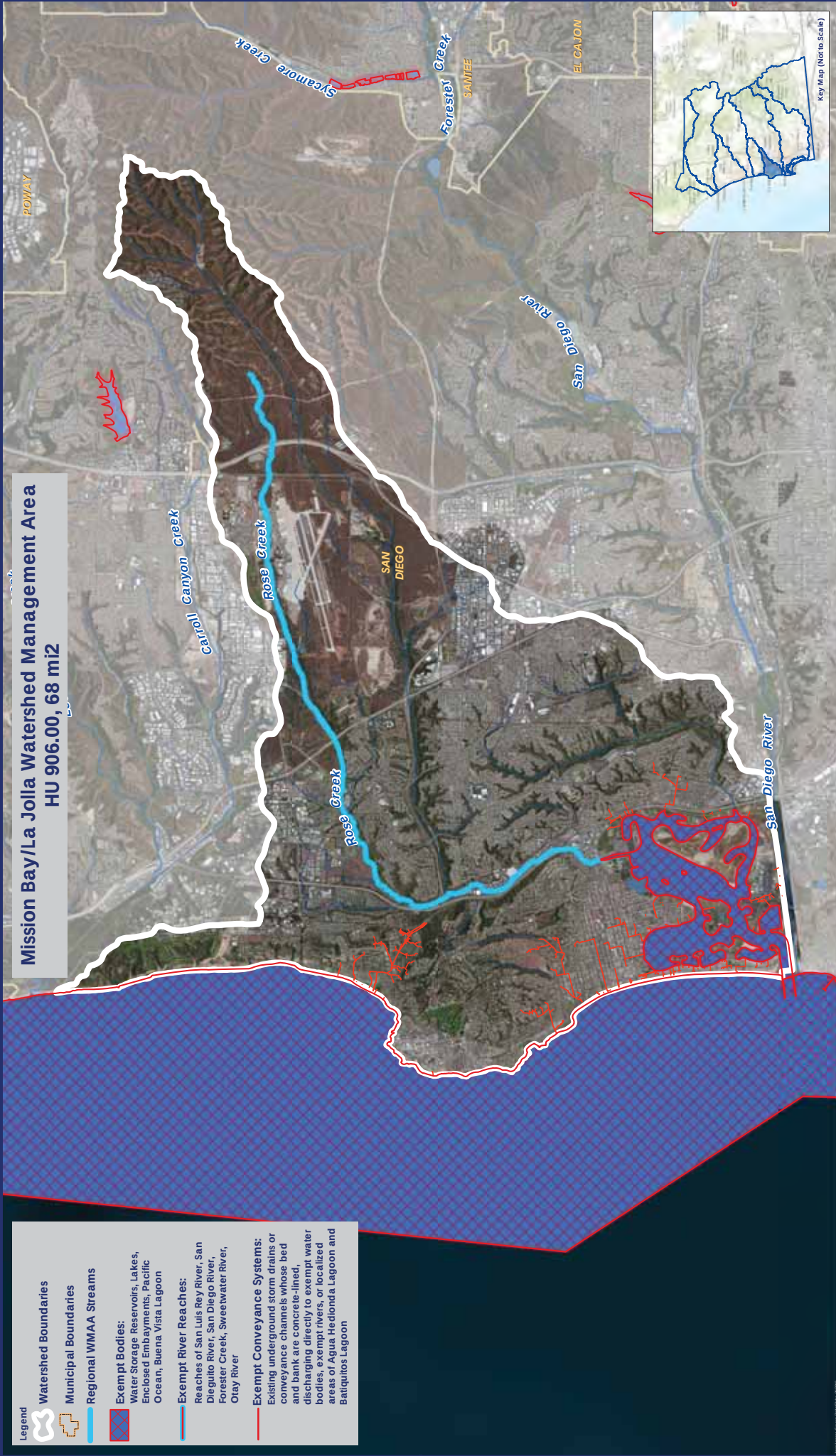
Municipal Boundaries

Regional WMAA Streams

Exempt Bodies:
Water Storage Reservoirs, Lakes,
Enclosed Embayments, Pacific
Ocean, Buena Vista Lagoon

Exempt River Reaches:
Reaches of San Luis Rey River, San
Dieguito River, San Diego River,
Forester Creek, Sweetwater River,
Otay River

Exempt Conveyance Systems:
Existing underground storm drains or
conveyance channels whose bed
and bank are concrete-lined,
discharging directly to exempt water
bodies, exempt rivers, or localized
areas of Agua Hedionda Lagoon and
Battiquitos Lagoon



Receiving Waters and Conveyance Systems Exempt from Hydromodification Management Requirements

Exhibit Date: Sept. 8, 2014

0 1.5 3 6 Miles

Key Map (Not to Scale)

MapSource: Source: MapSource, 2012

ATTACHMENT C
ELECTRONIC FILES

DRAFT

Electronic Folder titled “Mission Bay La Jolla_WMAA_Attachment C Electronic_Data.zip” Contents:

1. ArcMap 10.0 and 10.1 map files created for purpose of viewing Regional WMAA data
 - WMAA_06_MissionBayLaJolla_Data_2014_0908_v10.mxd
 - WMAA_06_MissionBayLaJolla_Data_2014_0908_v101.mxd
2. ESRI Geodatabase titled " WMAA_06_MissionBayLaJolla_Data_2014_0908_v10.gdb" containing the following data:
 - WatershedBoundaries
 - o Watershed_Boundaries
 - HydrologicProcesses
 - o HRUAnalysis
 - Streams – description of existing streams in the watershed
 - o SD_Regional_WMAA_Streams (streams selected for detailed analysis)
 - o SD_NHD_Streams (portion of NHD dataset included for reference)
 - LandUsePlanning
 - o SanGIS_ExistingLandUse
 - o SanGIS_PlannedLandUse
 - o SanGIS_DevelopableLands
 - o SanGIS_RedevelopmentandInfill
 - o SanGIS_MunicipalBoundaries
 - o Federal_State_Indian_Lands
 - o SanGIS_MHPA_SD
 - o SanGIS_MSCP_CN
 - o SanGIS_MSCP_EAST_DRAFT_CN
 - o SanGIS_Draft_North_County_MSCP_Version_8_Categories
 - PotentialCoarseSedimentYield
 - o GLUAnalysis
 - o PotentialCoarseSedimentYieldAreas
 - o MacroLevelPotentialCriticalAreas
 - o PotentialCriticalCoarseSedimentYieldAreas
 - ChannelStructures
 - o ChannelStructures
 - HydromodExemptions
 - o Exempt_Systems
 - o Exempt_Bodies
 - Floodplains: included for reference
 - o FEMA_NFHL
 - Baselayers: included for reference
 - o SanGIS_Lakes
 - o link to ESRI World Imagery (internet connection is required to access ESRI World Imagery basemap)

Electronic Folder titled “Mission Bay La Jolla
_WMAA_Attachment C Electronic_Data.zip” Contents,
continued:

3. Google Earth – KMZ file titled: “WMAA_06_ MissionBayLaJolla
_Data_2014_0908_GoogleEarth.kmz”, containing the following data:
 - WatershedBoundaries
 - Streams
 - o SD Regional WMAA Streams (streams selected for detailed analysis)
 - o SD NHD Streams (portion of NHD dataset included for reference)
 - LandUsePlanning
 - o Municipal Boundaries
 - o Federal/State/Indian Lands
 - ChannelStructures
 - HydromodExemptions
 - o Exempt_Systems
 - o Exempt_Bodies
 - Floodplains: included for reference
 - o FEMA Floodplain
 - Dominant Hydrologic Processes
 - Potential Critical Coarse Sediment Yield Areas

Notes:

- Open a map file (with extension .mxd) using ArcMap to view the data.
- All data contained in the geodatabase is loaded into the map.

ATTACHMENT D

REGIONAL MS4 PERMIT CROSSWALK

DRAFT

Table below provides a linkage between the Regional MS4 Permit requirements for WMAA and this report.

Regional MS4 Permit Provision	Regional WMAA Report
B.3.b.(4)(a)	Chapter 2; Section 5.1; Attachment A and Attachment C
B.3.b.(4)(a)(i)	Section 2.1; Attachment A.1 and Attachment C
B.3.b.(4)(a)(ii)	Section 2.2; Attachment A.2 and Attachment C
B.3.b.(4)(a)(iii)	Section 2.3; Attachment A.3 and Attachment C
B.3.b.(4)(a)(iv)	Section 2.4; Attachment A.4 and Attachment C
B.3.b.(4)(a)(v)	Section 2.5; Attachment A.5 and Attachment C
B.3.b.(4)(b)	Chapter 3 and Section 5.2
B.3.b.(4)(c)	Chapter 4; Section 5.3; Attachment B and Attachment C

DRAFT

Attachment N-3

Alternative Compliance Candidate Projects Lists

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Mission Bay- Tecolote WMAA Candidate Projects in the City of San Diego

Project Identifier	Watershed Management Area	Jurisdiction	Ownership	Project Location			Project Size & Parameters				Other Notes		
				Owner Information	Address	APN	Latitude (X-Coordinate)	Longitude (Y-Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)		Project Footprint (acres)	Parameters (with units as necessary)
Public Parcels Identified as Suitable for Further Assessment to Determine Feasibility of Retrofitting with Green Infrastructure													
Parcels on this list that are 0.25 acres or greater have been assessed using broad assumptions necessary for computer modeling and were found to be potentially effective as an opportunity for contributing to load reduction goals. Considerable further assessment would be required before determining any of these sites to be viable retrofit sites for implementation of Green Infrastructure. That assessment includes verifying public ownership, determining if land use agreements and financing can be established, assessing feasibility based upon further investigation of physical site constraints at a project design level, and determining that construction and necessary approvals, including approvals from regulatory agencies other than the City of San Diego, can be completed within the time constraints in the Municipal Storm Water Permit that pertain to Alternative Compliance.													
1	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4202803600	6281692.20929688	1876553.78273656	TBD	9.85	TBD	TBD	TBD	
2	Tecolote Creek	City of San Diego	Sn Diego Community College District	TBD	4270202300	6280997.99200193	1873845.43404408	TBD	8.33	TBD	TBD	TBD	
3	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4190200100	6273742.25722784	1879426.06598474	TBD	9.67	TBD	TBD	TBD	
4	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4302902000	6273203.62064983	1865929.89208025	TBD	6.33	TBD	TBD	TBD	
5	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	3620106900	6277970.83356293	1883403.82069147	TBD	47.57	TBD	TBD	TBD	
6	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	3602200200	6270327.60723254	1883812.16179012	TBD	10.51	TBD	TBD	TBD	
7	Tecolote Creek	City of San Diego	City Of San Diego	TBD	3612611600	6277491.69165013	1880070.00333333	TBD	3.40	TBD	TBD	TBD	
8	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	3625700200	6279305.68131917	1881623.23173056	TBD	12.36	TBD	TBD	TBD	
9	Tecolote Creek	City of San Diego	City Of San Diego	TBD	4312303000	6278097.85694501	1866950.79970556	TBD	3.44	TBD	TBD	TBD	
10	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4312303100	6277994.21325784	1867687.70590454	TBD	13.12	TBD	TBD	TBD	
11	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	3615430100	6276173.20655641	1882368.89086626	TBD	11.14	TBD	TBD	TBD	
12	Tecolote Creek	City of San Diego	City Of San Diego	TBD	4360303000	6268429.31103686	1861639.39511829	TBD	0.79	TBD	TBD	TBD	
13	Tecolote Creek	City of San Diego	United States Of America	TBD	4272540300								
					4272740400								
					4272630400								
					4273240900								
					4273310300								
					4273700600								
					4273800300	6281718.58338598	1870400.68432754	TBD	56.22	TBD	TBD	TBD	
14	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	3616210700	6275661.04692500	1882132.99395700	TBD	0.02	TBD	TBD	TBD	

Mission Bay- Tecolote WMAA Candidate Projects in the City of San Diego

Project Identifier	Watershed Management Area	Jurisdiction	Ownership Owner Information	Project Location				Project Size & Parameters				Other Notes
				Address	APN	Latitude (X-Coordinate)	Longitude (Y-Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)	Project Footprint (acres)	Parameters (with units as necessary)	
15	Tecolote Creek	City of San Diego	San Diego Metropolitan Transit Development Board	TBD	4360200200 4312600800 4321601200	6267520.29470843	1862914.43838465	TBD	4.72	TBD	TBD	TBD
16	Tecolote Creek	City of San Diego	Northern S D H C F N M A L L C	TBD	4275606400 3602821600 3602821500	6279684.55564697	1868702.92703369	TBD	2.03	TBD	TBD	TBD
17	Tecolote Creek	City of San Diego	City Of San Diego	TBD		6267856.38952281	1882574.39128040	TBD	0.28	TBD	TBD	TBD
18	Tecolote Creek	City of San Diego	City Of San Diego	TBD	4260600200	6274906.02702550	1873497.26449160	TBD	8.65	TBD	TBD	TBD
19	Tecolote Creek	City of San Diego	City Of San Diego	TBD	3624402400	6280503.62323295	1881365.64055541	TBD	3.52	TBD	TBD	TBD
20	Tecolote Creek	City of San Diego	City Of San Diego(Olive Grove Community Park)	TBD	3625700100	6278696.48466130	1881760.12964279	TBD	9.18	TBD	TBD	TBD
21	Tecolote Creek	City of San Diego	State Of California	TBD	3612612600	6275186.07590841	1880627.17223631	TBD	3.41	TBD	TBD	TBD
22	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	3612900400	6271802.86248635	1880491.48441920	TBD	10.21	TBD	TBD	TBD
23	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4316800100	6277606.49988959	1869644.29381406	TBD	8.83	TBD	TBD	TBD
24	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4370101800	6276051.69501562	1862112.26916667	TBD	7.69	TBD	TBD	TBD
25	Tecolote Creek	City of San Diego	City Of San Diego	TBD	3602821700	6267855.35906884	1882509.44822322	TBD	0.16	TBD	TBD	TBD
26	Tecolote Creek	City of San Diego	City Of San Diego	TBD	4264102500 4314300800 4313201500	6275249.23387448	1873346.77312524	TBD	0.02	TBD	TBD	TBD
27	Tecolote Creek	City of San Diego	City Of San Diego	TBD		6278449.51383547	1865904.66572840	TBD	0.92	TBD	TBD	TBD
28	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4270203000	6281155.21880388	1873494.98463836	TBD	0.84	TBD	TBD	TBD
29	Tecolote Creek	City of San Diego	United States Postal Service	TBD	4314301100	6278566.41100000	1865730.21200000	TBD	3.89	TBD	TBD	TBD
30	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4273320800	6281111.46113109	1869611.46563982	TBD	8.64	TBD	TBD	TBD
31	Tecolote Creek	City of San Diego	City Of San Diego	TBD	4191206300	6279867.78004506	1879485.89293972	TBD	0.01	TBD	TBD	TBD
32	Tecolote Creek	City of San Diego	State Of California	TBD	3563803200	6281592.74724408	1880835.20487818	TBD	16.86	TBD	TBD	TBD

Mission Bay- Tecolote WMAA Candidate Projects in the City of San Diego

Project Identifier	Watershed Management Area	Jurisdiction	Ownership Owner Information	Project Location				Project Size & Parameters			Parameters (with units as necessary)	Other Notes
				Address	APN	Latitude (X-Coordinate)	Longitude (Y-Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)	Project Footprint (acres)		
33	Tecolote Creek	City of San Diego	At&T Wireless Services Inc	TBD	3612611200 3612611100	6277067.88014233	1880365.82119874	TBD	2.39	TBD	TBD	TBD
34	Tecolote Creek	City of San Diego	San Diego Housing Commission	TBD	4360301700	6268532.41465263	1861528.78859452	TBD	0.18	TBD	TBD	TBD
35	Tecolote Creek	City of San Diego	San Diego Metropolitan Transit Development Board	TBD	4364401900 4362901000	6268532.79381535	1859599.71581646	TBD	2.69	TBD	TBD	TBD
36	Tecolote Creek	City of San Diego	San Diego Housing Commission	TBD	4312300400	6278262.98013819	1867005.81711677	TBD	0.26	TBD	TBD	TBD
37	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	3560810600 3563801300	6280750.77957031	1882327.99228861	TBD	15.48	TBD	TBD	TBD
38	Tecolote Creek	City of San Diego	Housing Authority City Of San Diego	TBD	4317310100	6275952.42902847	1865028.59591123	TBD	3.80	TBD	TBD	TBD
39	Tecolote Creek	City of San Diego	City Of San Diego	TBD	4270602304	6283584.00000000	1873936.24400000	TBD	0.50	TBD	TBD	TBD
40	Tecolote Creek	City of San Diego	City Of San Diego	TBD	4270602302	6283584.00000000	1873936.24400000	TBD	0.50	TBD	TBD	TBD
41	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	3560813100	6282298.94293431	1883128.95074479	TBD	2.09	TBD	TBD	TBD
42	Tecolote Creek	City of San Diego	City Of San Diego	TBD	4360401200	6268876.68592100	1862084.18945500	TBD	0.00	TBD	TBD	TBD
43	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4313700300	6277894.42162860	1866220.40692185	TBD	0.14	TBD	TBD	TBD
44	Tecolote Creek	City of San Diego	City Of San Diego	TBD	4354801700	6263804.47620761	1859050.99651166	TBD	679.72	TBD	TBD	TBD
45	Tecolote Creek	City of San Diego	San Diego Unified School District	TBD	4313700200	6277850.47897791	1866244.62796641	TBD	0.08	TBD	TBD	TBD
Public Parcels Identified as Suitable for Further Assessment to Determine Feasibility of Retrofitting												
Parcels on this list have been assessed using broad assumptions necessary for computer modeling and were found to be potentially effective as an opportunity for contributing to load reduction goals. Considerable further assessment would be required before determining any of these sites to be viable retrofit. That assessment includes verifying public ownership, determining if land use agreements and financing can be established, assessing feasibility based upon further investigation of physical site constraints at a project design level, and determining that construction and necessary approvals, including approvals from regulatory agencies other than the City of San Diego, can be completed within the time constraints in the Municipal Storm Water Permit that pertain to Alternative Compliance.												
46	Tecolote Creek	City of San Diego	City of San Diego (North Clairemont Community Park)	TBD	3602200100	N/A	N/A	TBD	14.5	TBD	TBD	Canyon Site
47	Tecolote Creek	City of San Diego	City of San Diego	TBD	4361600100	N/A	N/A	TBD	46.83	TBD	TBD	Canyon Site
48	Tecolote Creek	City of San Diego	City of San Diego	TBD	4317310300	N/A	N/A	TBD	6.55	TBD	TBD	Canyon Site

Mission Bay- Tecolote WMAA Candidate Projects in the City of San Diego

Project Identifier	Watershed Management Area	Jurisdiction	Ownership		Project Location			Project Size & Parameters				Other Notes
			Owner Information	Address	APN	Latitude (X-Coordinate)	Longitude (Y-Coordinate)	Contributing Drainage Area (acres)	Parcel Size (acres)	Project Footprint (acres)	Parameters (with units as necessary)	
49	Tecolote Creek	City of San Diego	City of San Diego	TBD	4263101000	N/A	N/A	TBD	83.29	TBD	TBD	Canyon Site
50	Tecolote Creek	City of San Diego	City of San Diego	TBD	4310700600	N/A	N/A	TBD	73.59	TBD	TBD	Canyon Site
51	Tecolote Creek	City of San Diego	City of San Diego	TBD	4311500600	N/A	N/A	TBD	85.68	TBD	TBD	Canyon Site
52	Tecolote Creek	City of San Diego	City of San Diego Open Space Park Facilities District No 1	TBD	4270102400	N/A	N/A	TBD	45.6	TBD	TBD	Canyon Site
53	Tecolote Creek	City of San Diego	City of San Diego	TBD	4270102700	N/A	N/A	TBD	14.66	TBD	TBD	Canyon Site
54	Tecolote Creek	City of San Diego	City of San Diego	TBD	4192100600	N/A	N/A	TBD	25.73	TBD	TBD	Canyon Site
55	Tecolote Creek	City of San Diego	City of San Diego	TBD	4265400500	N/A	N/A	TBD	38.55	TBD	TBD	Canyon Site
Project Concept for Green Streets Retrofits – Quantity and Location of Suitable City Streets To-Be-Determined												
The City of San Diego is in the process of identifying potential public street locations that could feasibly be retrofitted with Green Infrastructure and provide a meaningful contribution to pollutant load reduction goals. As locations become verified for feasibility and effectiveness, funding mechanisms under an Alternate Compliance program could potentially be used to fill gaps in construction and maintenance funding necessary for the project to go forward. This is pending the ability to establish suitable legal mechanisms and verify that approvals and construction can be completed within the time constraints in the Municipal Storm Water Permit that pertain to Alternative Compliance.												
56	Tecolote Creek	City of San Diego	City of San Diego	TBD	N/A	N/A	N/A	TBD	4.54	TBD	TBD	Green Street TBD

APPENDIX O

Alternative BMP Implementation Scenario Methodology

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APPENDIX O. ALTERNATIVE BMP IMPLEMENTATION SCENARIO METHODOLOGY

An alternative modeling analysis was performed for the Tecolote Creek subwatershed as part of the Mission Bay Water Quality Improvement Plan. This analysis was only conducted for one subwatershed within the Mission Bay WMA, Tecolote Creek, because compliance with the Bacteria TMDL requires significant wet weather load reduction strategies in Tecolote Creek subwatershed. Scripps was not included in the analysis because structural strategies are not required in the subwatershed. The pollutant loads from Non-Phase I MS4s (Non-MS4s) can be differentiated from Phase I MS4s (MS4s) loads to more accurately and fairly assess load reduction responsibilities. The purpose of this analysis is to foster future discussions about accurate and fair apportionment of pollutant reduction responsibilities in the subwatershed to ensure that Non-MS4 discharges are regulated before they enter a MS4 to improve water quality throughout the watershed. The current analysis does not differentiate between MS4 loads and Non-MS4 loads. This baseline analysis represents the primary scenario included in this Water Quality Improvement Plan, which provided the foundation for the alternative modeling analysis that was used to estimate MS4 and Non-MS4 loads.

This appendix describes the methodology that was used to perform the alternative analysis, which focused on removing Non-MS4 areas to allow for BMP optimization within MS4 areas to achieve the required MS4 load reductions to meet the Water Quality Improvement Plan numeric goals while maintaining cost efficiencies. There are four classifications that constitute Non-MS4 areas, as summarized below:

- Areas covered by NPDES General Permit No. CA CAS000004—Waste Discharge Requirements for Storm Water Discharges from Small MS4s (General Phase II Permit)
- Industrial Areas, some of which may be covered by NPDES General Permit No. CAS000001 – Waste Discharge Requirements for Dischargers of Storm Water Associated with Industrial Activities Excluding Construction Activities (Industrial General Permit)
- Agricultural areas, some of which may be addressed by the Conditional Waiver of Discharges from Agricultural and Nursery Operations (Ag Waiver)
- Areas identified as Federal and State lands (and Indian lands, if present)

Alternative scenario results are presented in Section 4.4. The MS4s will continue to refine and update the alternative scenario analysis, and engage stakeholders in a dialogue about how all the responsible parties within the watershed can work together to achieve the numeric goals in the Water Quality Improvement Plan. For example, the current list of Industrial General Permit (IGP) non-filers could be added to the analysis to more accurately estimate load reduction responsibilities for industrial dischargers within the watershed.

O.1 Alternative Scenario: Remove Non-MS4 Areas

The baseline watershed model was used to estimate the load reduction requirement for MS4 areas. The contributing load from MS4 areas was derived from the model output. The required load reduction was then calculated based on multiplying the MS4 load by the percent reduction numeric goal. It is important to note that the overall watershed load reduction goal would be met through reductions by both the MS4 and Non-MS4s, thereby maintaining equity among all dischargers. Estimated load reductions were based on the relative loading from each responsible discharger in the watershed.

After defining the load reduction requirement for MS4 areas, BMP optimization using the EPA-released SUSTAIN (version 1.2) model was performed. BMP optimization refers to the modeling analysis that was conducted to identify the “optimal” structural BMP opportunities (considering BMP size, type, and location in the watershed) that would achieve the load reduction with the lowest cost. Figure O-1 provides a conceptual diagram that summarizes the alternative modeling approach. Non-MS4 areas were removed from the modeling analysis.

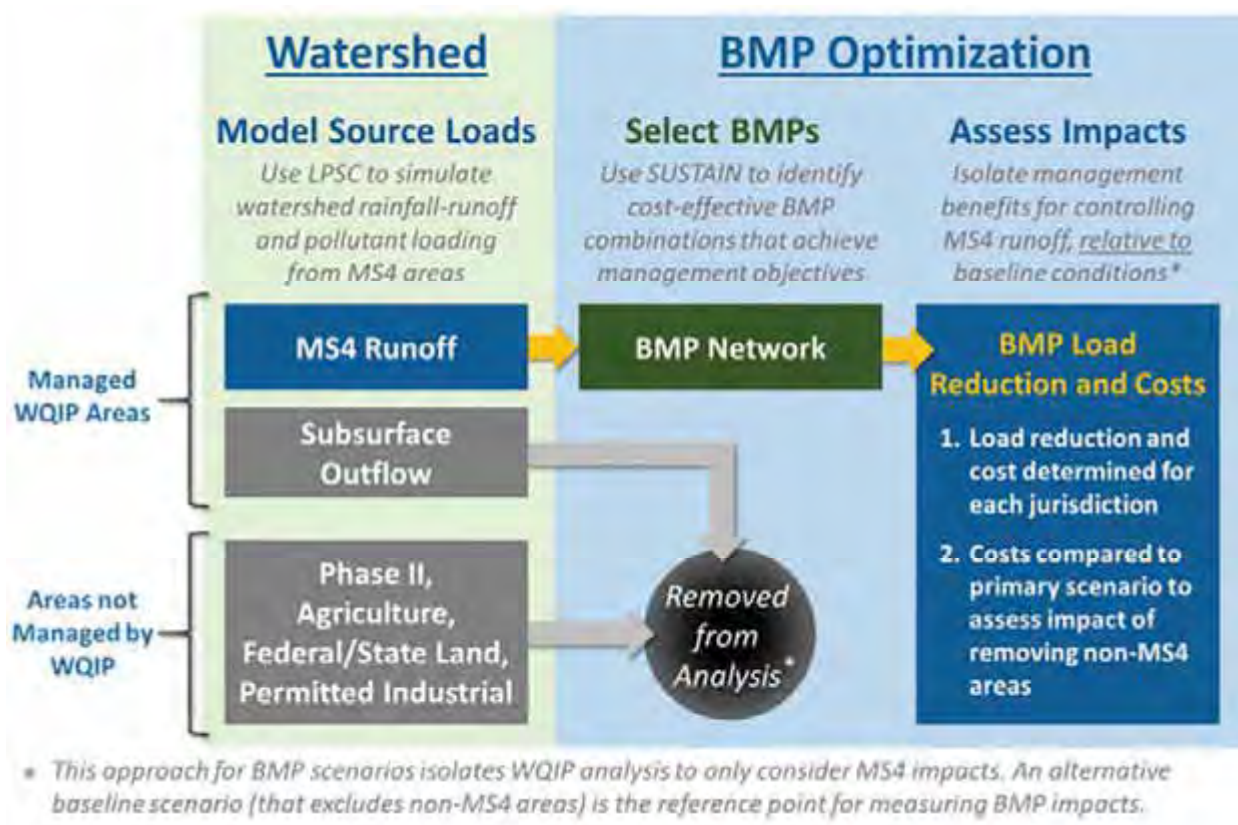


Figure O-1 Conceptual Modeling Approach

The modeling analysis was performed following the same methodology as in the primary scenario (for the entire watershed), except BMPs were optimized to treat runoff from MS4

areas only and a two-tiered optimization approach was used. This approach provides BMP optimization first at the subwatershed level (Tier 1), then watershed-wide to meet the load reduction target (Tier 2).

O.2 Technical Notes and Assumptions

- Areas associated with each Non-MS4 category were delineated based on GIS analysis. Industrial areas are represented by facilities that are currently registered in the Industrial General Permit (IGP) program (from California's SMARTS database). GIS was used to identify the area associated with each facility (based on review of the SANDAG parcel layer and aerial photography). Current Phase II permit areas were also delineated based on review of the SANDAG parcel layer and aerial photography, as well as review of available maps showing the spatial extent of Phase II permitted areas. SANDAG land use data were used to identify agricultural areas and Federal/State/Indian lands.
- Non-Modeled Nonstructural strategies. Although these programs primarily reduce loads from MS4 areas, they implicitly provide benefits to MS4s and Non-MS4s through various programs. For example, MS4 industrial inspection activities help reduce pollutant loads from industrial areas. The ratio of MS4 and Non-MS4 pollutant loading within the watershed was used to estimate the load reduction associated with each MS4/Non-MS4 category. This adjustment was also needed to maintain the estimated 10 percent load reduction associated with this BMP category.
- Modeled Nonstructural BMPs (catch basin cleaning, street sweeping, irrigation reduction, downspout disconnects, and rain barrels incentives) and Green Infrastructure (GI) were assumed to reduce loads from MS4 areas only. Note: The Mt. Abernathy and Bannock Avenue projects incorporate a portion of the load reduction required from Green Infrastructure (GI).
- Multiuse Treatment Areas (MUTAs) and Green Streets. These BMPs generally treat large drainage areas that may include MS4 and Non-MS4 areas. Within each BMP drainage area, MS4 and Non-MS4 loads were estimated based on the modeled pollutant load generated within each drainage area. Pollutant load estimates were based on land use characteristics and other factors that influence pollutant loading. The ratio of MS4 and Non-MS4 areas within each BMP drainage area was used to estimate the load for each MS4/Non-MS4 category. Note: Green Street optimization was not necessary since green street implementation is not required to meet the required load reduction.

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APPENDIX P
Monitoring and Assessment Program Fact Sheets

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P.1 Receiving Water Monitoring

P.1.1 Long-Term Dry Weather Receiving Water Monitoring (Permit Prov. D.1.c)

Overview

Objectives

- ❖ Determine whether the conditions in the receiving water during dry weather are protective or likely protective of beneficial uses
- ❖ Determine the extent and magnitude of the current or potential dry weather receiving water problems
- ❖ Evaluate whether conditions in the receiving water during dry weather are improving or declining.

Sampling Locations

Table P-1
Dry Weather Receiving Water Monitoring Station

Station Name	Waterbody	Subwatershed	Latitude	Longitude
TC-MLS2 ^(a)	Tecolote Creek	Tecolote Creek	32.77294	-117.20308

Notes:

- (a) Due to the presence of a dry weather diversion above TC-MLS, MLS dry weather monitoring is performed at site TC-MLS2

Frequency of Events

- ❖ Water Quality Sampling Events—Three During Permit Term
 - Event 1—During dry season (May 1—Sep. 30)
 - Event 2—During wet season (Oct. 1—Apr. 30)¹
 - Event 3—At-large dry weather event
- ❖ Bioassessment Event – One During Permit Term
- ❖ Hydromodification Event – One During Permit Term

Monitoring Methods Reference

- ❖ Transitional Receiving Water Monitoring Plan (2013-2015)
(www.projectcleanwater.org)

¹ Dry weather sample must be preceded by ≥72 hrs antecedent dry period following rainfall event of >0.1" and occur after the first wet event of the season

- ❖ Receiving Water Monitoring Plan (2015-2018) (www.projectcleanwater.org)

Sample Collection (Shown in Figures P-1 through P-5)

- ❖ Field Observations
- ❖ Flow-Weighted Composites
- ❖ Water Grab Samples
- ❖ Bioassessment Monitoring
- ❖ Hydromodification Monitoring

Sample Analysis

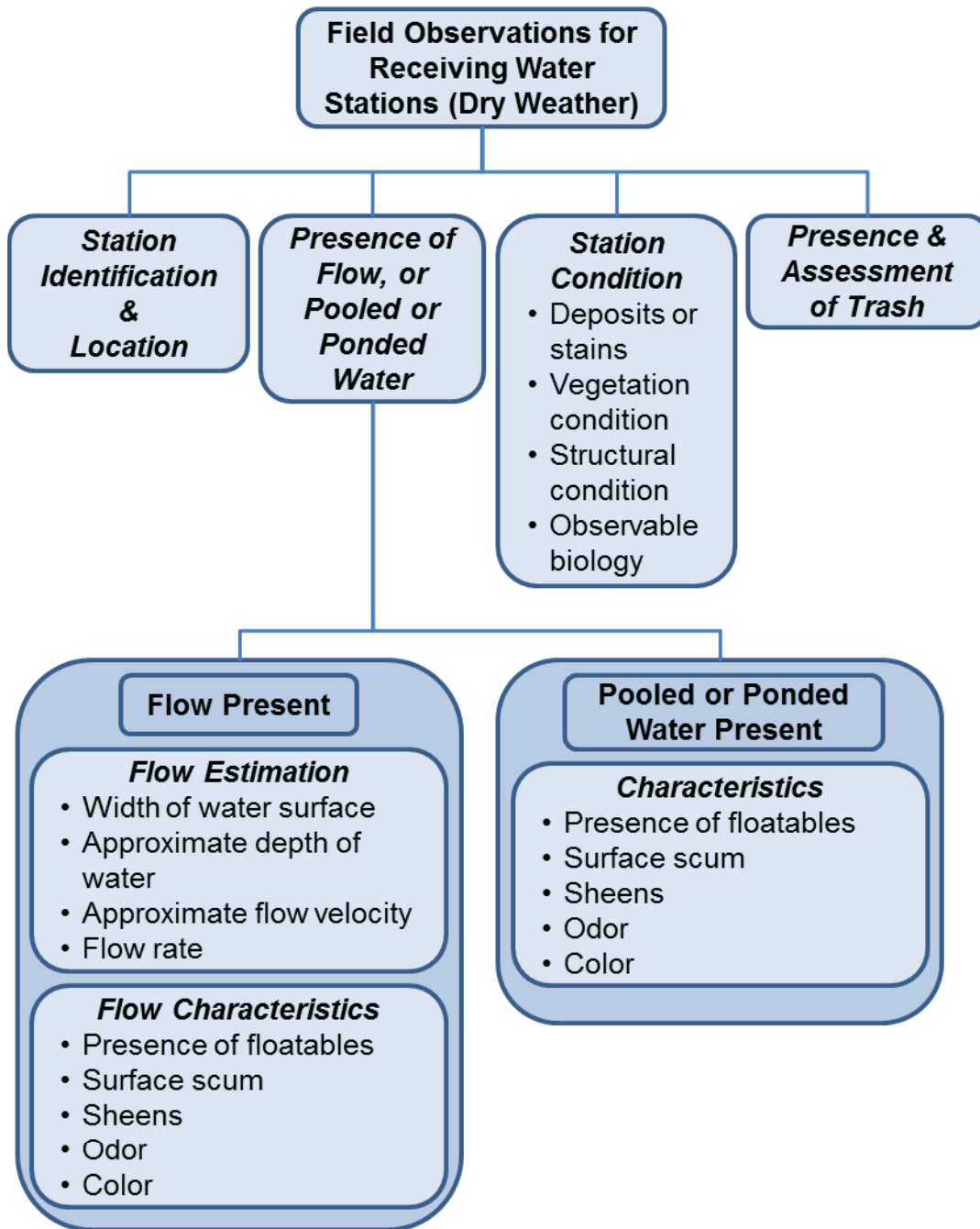


Figure P-1
Dry Weather Receiving Water Field Observations

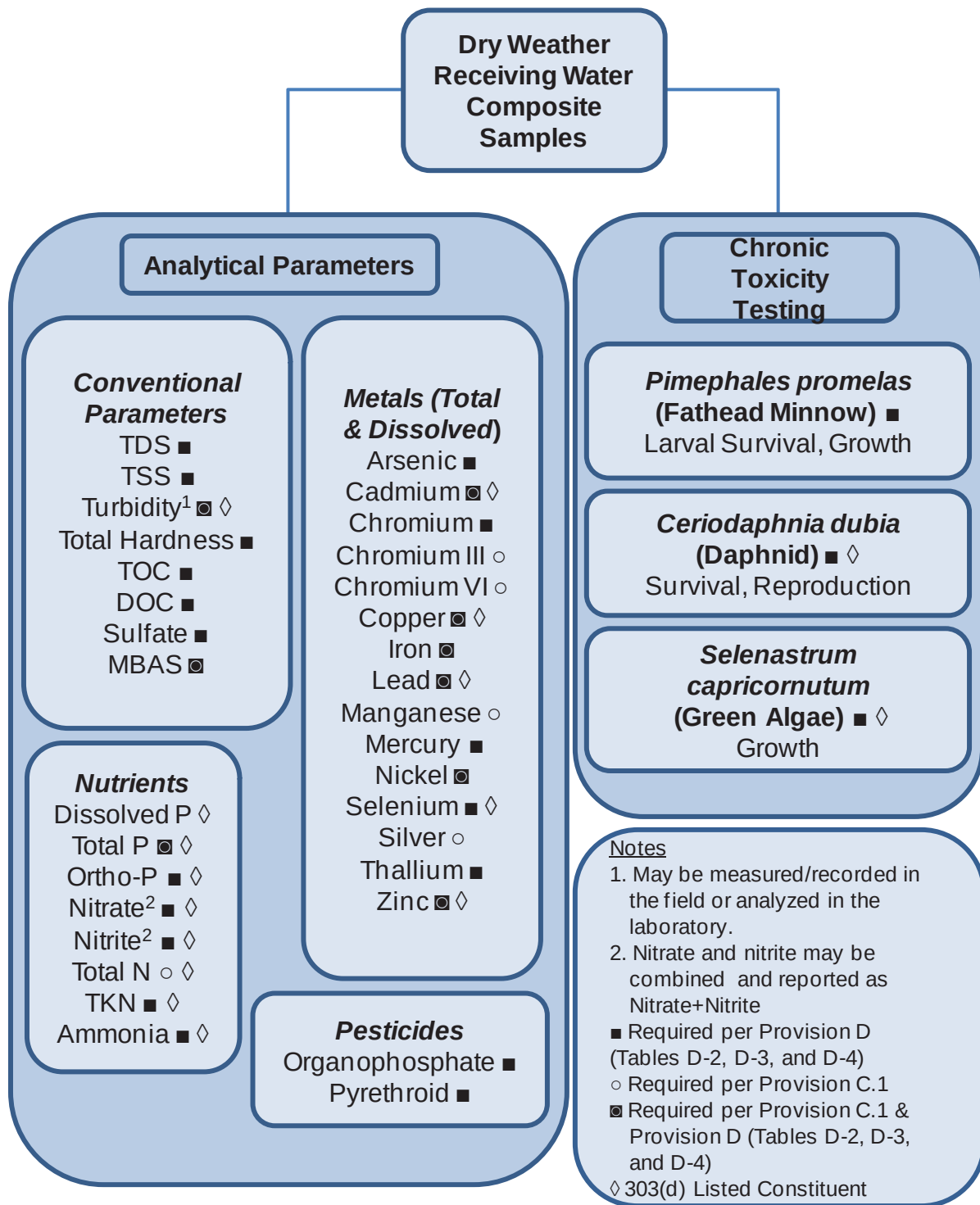


Figure P-2
Dry Weather Receiving Water Monitoring Composite Samples

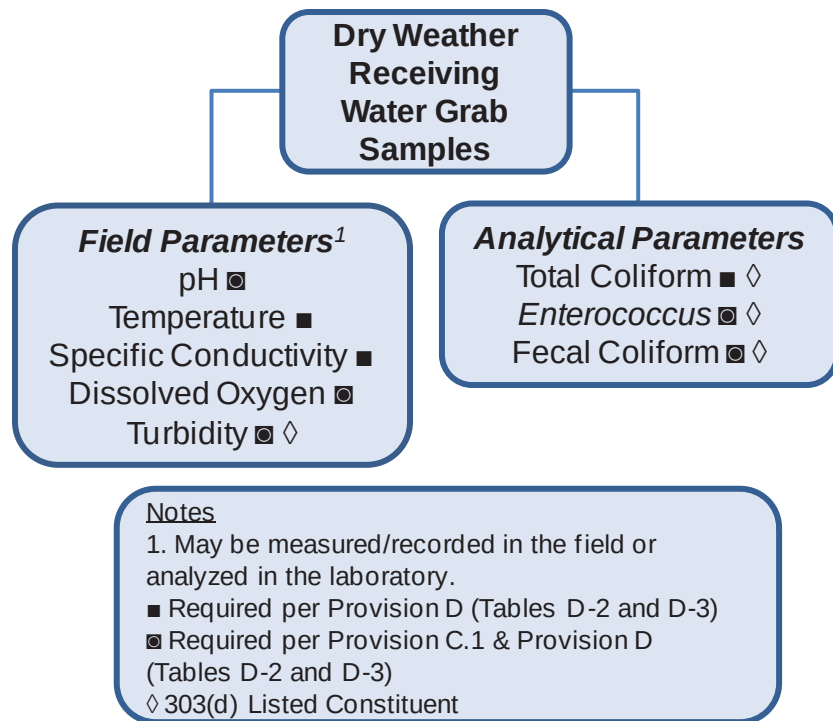


Figure P-3
Dry Weather Receiving Water Monitoring Grab Samples

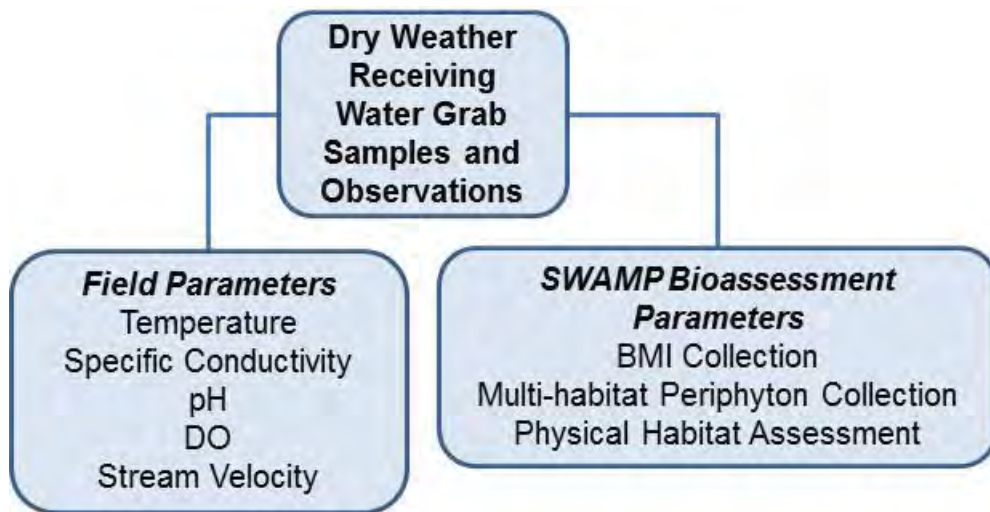


Figure P-4
Dry Weather Receiving Water Bioassessment Monitoring

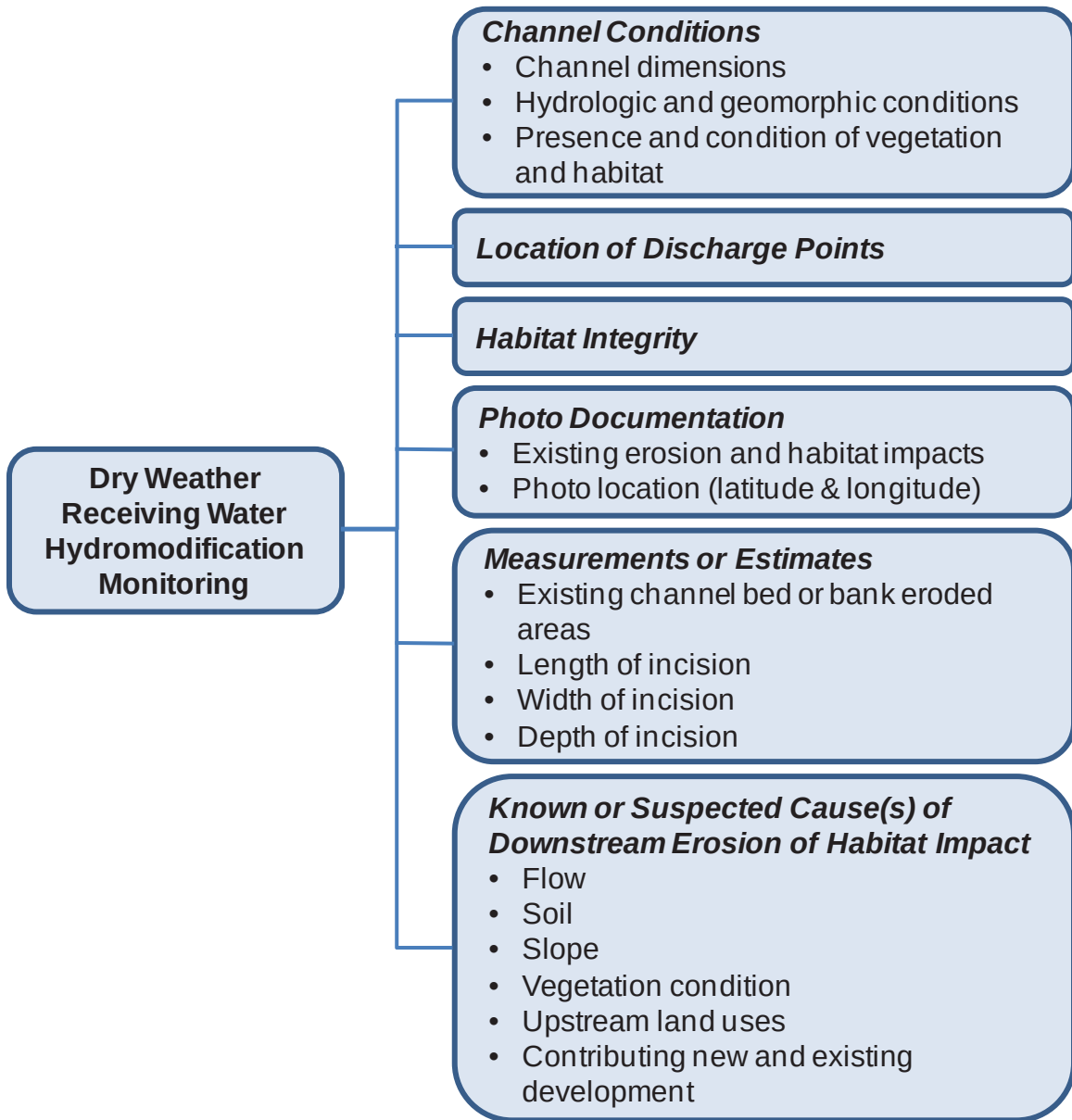


Figure P-5
Dry Weather Receiving Water Hydromodification Monitoring

P.1.2 Long-Term Wet Weather Receiving Water Monitoring (Permit Prov. D.1.d)

Overview

Objectives

- ❖ Determine whether the conditions in the receiving water during wet weather are protective or likely protective of beneficial uses
- ❖ Determine the extent and magnitude of the current or potential wet weather receiving water problems
- ❖ Evaluate whether conditions in the receiving water during wet weather are improving or declining.

Sampling Locations

Table P-2
Wet Weather Receiving Water Monitoring Stations

Station Name	Waterbody	Subwatershed	Latitude	Longitude
TC-MLS	Tecolote Creek	Tecolote Creek	32.77294	-117.20308

Number of Sampling Events—Three During Permit Term

- ❖ Event 1—First wet weather event of wet season (Oct. 1—Apr. 30)
- ❖ Event 2—Event occurring after February 1
- ❖ Event 3—At-large wet weather event

Monitoring Methods Reference

- ❖ Transitional Receiving Water Monitoring Plan (2013-2015) (www.projectcleanwater.org)
- ❖ Receiving Water Monitoring Plan (2015-2018) (www.projectcleanwater.org)

Sample Collection (Shown in Figures P-6 through P-8)

- ❖ Field Observations
- ❖ Flow-Weighted Composites
- ❖ Grab Samples

Sample Analysis

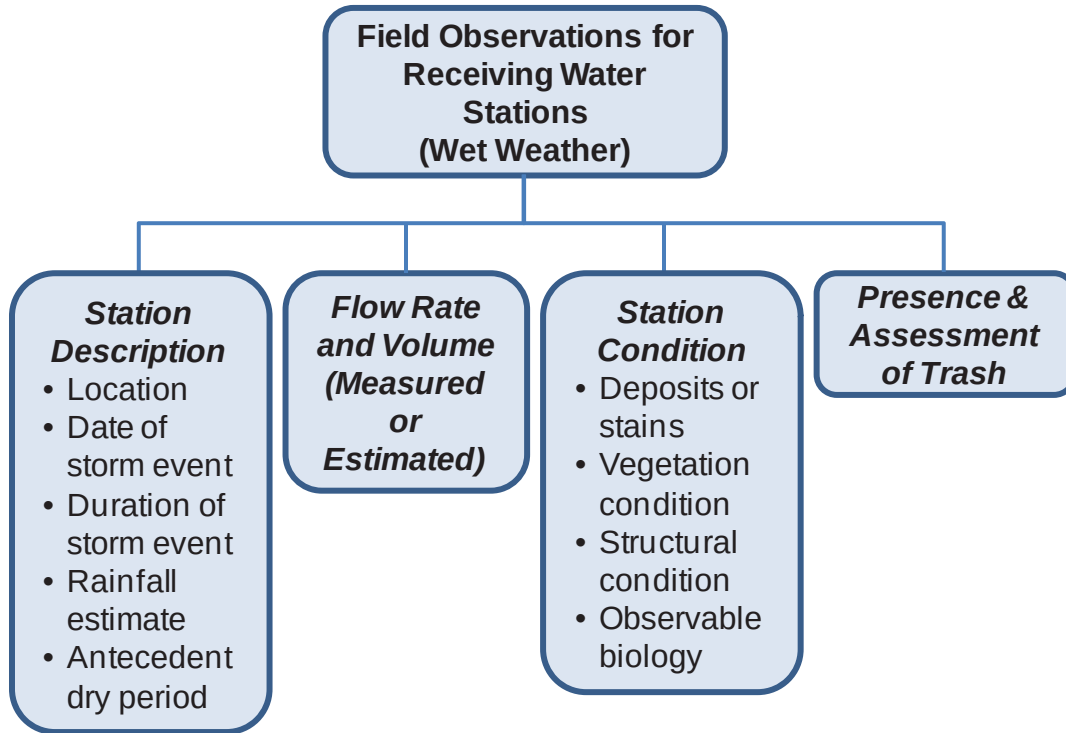


Figure P-6
Wet Weather Receiving Water Field Observations

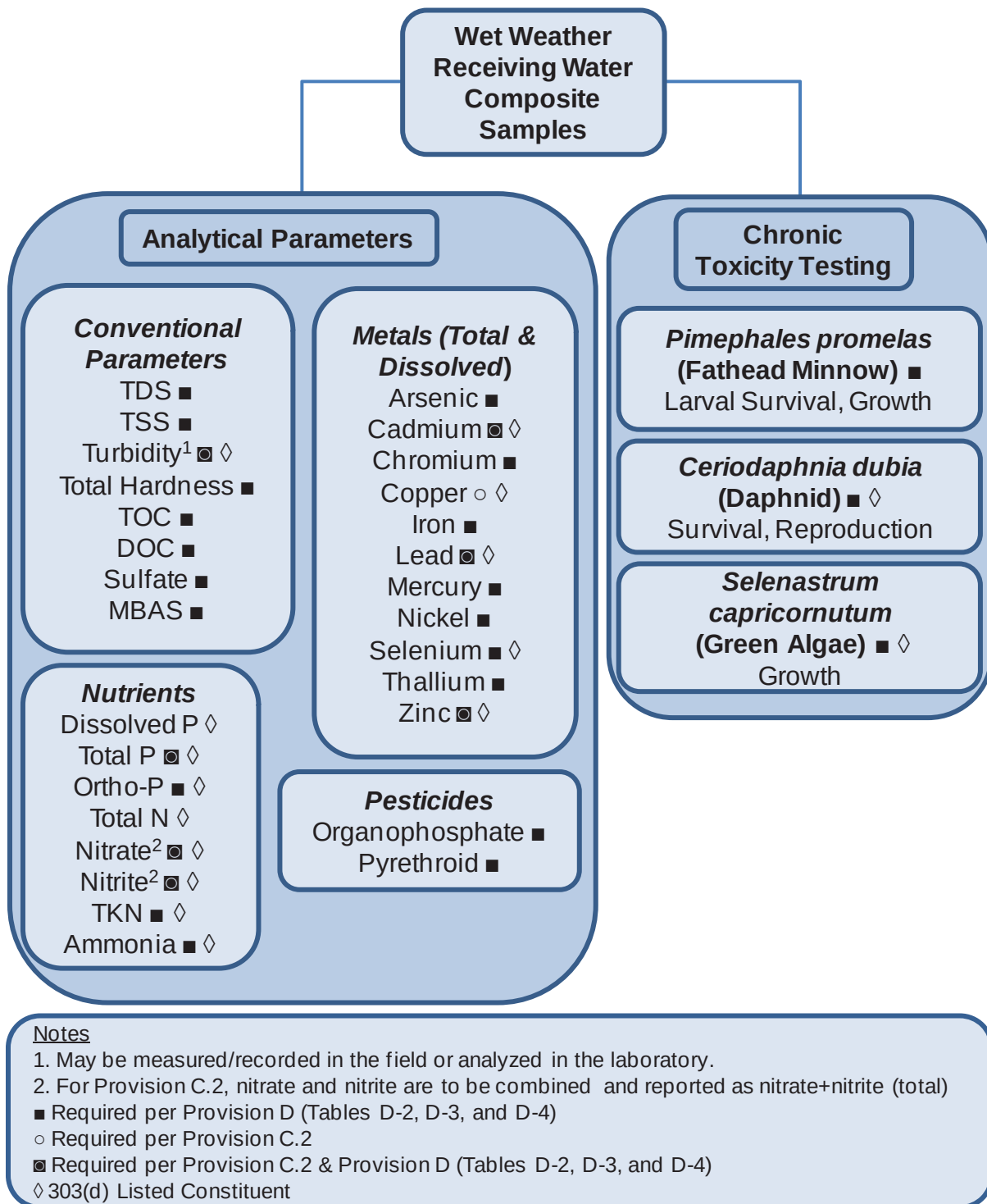


Figure P-7
Wet Weather Receiving Water Monitoring Composite Samples

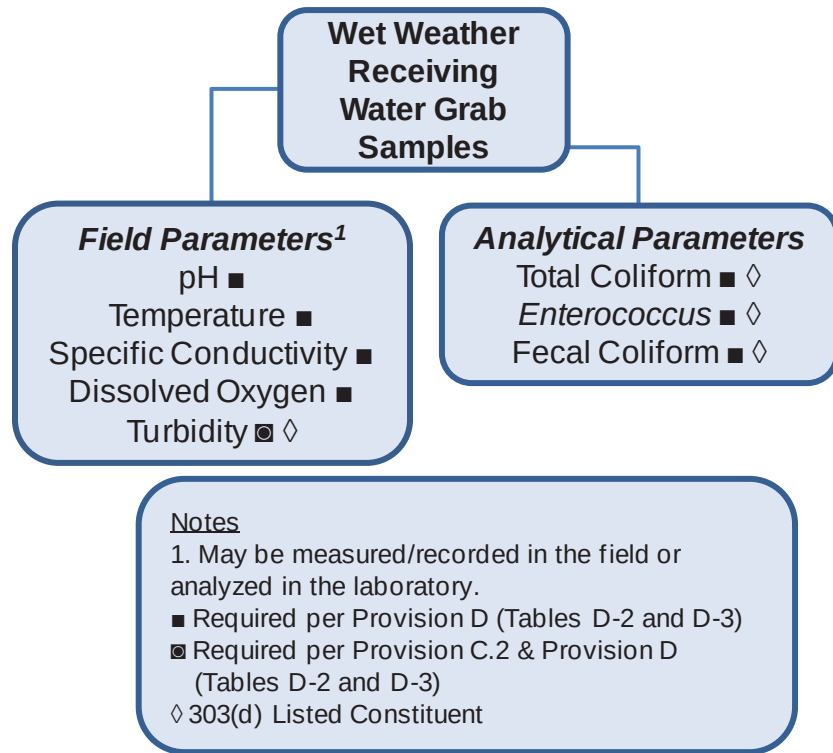


Figure P-8
Wet Weather Receiving Water Monitoring Grab Samples

P.1.3 Southern California Bight Regional Monitoring (Permit Prov. D.1.e.(1))

Overview

Objectives

- ❖ Evaluate the extent and magnitude of direct impact from sediment contaminants
- ❖ Determine how the extent and magnitude of environmental impact varies by habitat
- ❖ Evaluate the trend, in terms of extent and magnitude, of direct impacts from sediment contaminants

Sampling Location

Table P-3
Mission Bay WMA RHMP Monitoring Stations

Waterbody	Site ID	Latitude	Longitude
Mission Bay	B13-8145	32.761696	-117.23813
	B13-8146	32.7623	-117.23618
	B13-8151	32.76715	-117.23551
	B13-8152	32.76749	-117.2416
	B13-8156	32.78093	-117.2496
	B13-8157	32.782822	-117.229979
	B13-8159	32.78439	-117.2155
	B13-8160	32.787206	-117.208679
	B13-8163	32.79459	-117.219968

Sampling Program

- ❖ Sampling of 397 sites in the Southern California Bight
- ❖ Stratified random site selection from 11 sediment subpopulations as shown in Figure P-9
- ❖ Each site sampled once between July 1 and September 30, 2013

Monitoring Methods Reference

- ❖ Bight '13 Contaminant Impact Assessment Work Plan (www.projectcleanwater.org)

- ❖ Bight '13 Sediment Quality 2014 Sampling and Analysis Plan for Follow-up Investigations (www.projectcleanwater.org)
- ❖ Regional Harbor Monitoring Program Work Plan (www.projectcleanwater.com)

Sample Collection (Shown in Figures P-10 through P-13)

- ❖ Sediment sampling indicator types
- ❖ Contaminant exposure in sediments and from marine debris
- ❖ Biological response
- ❖ Sediment habitat condition
- ❖ Bioaccumulation monitoring

Planned Bight '13 Special Studies

- ❖ Analysis of Contaminants of Emerging Concern in Sediment
- ❖ Bioanalytical Screening of Sediment Extracts
- ❖ Sediment Toxicity Identification Evaluation in Embayments
- ❖ Gene Microarray Analysis of Sediment Toxicity Samples
- ❖ Alternative Toxicity Test Species Comparison
- ❖ In situ Toxicity Testing Using the SEA Ring
- ❖ Effects of Macrobenthic Preservation Techniques on Efficacy of Molecular and Morphological Taxonomy
- ❖ Adaptation to Hypoxic, High CO₂ Environments—Phenotypic Plasticity in Echinoderms

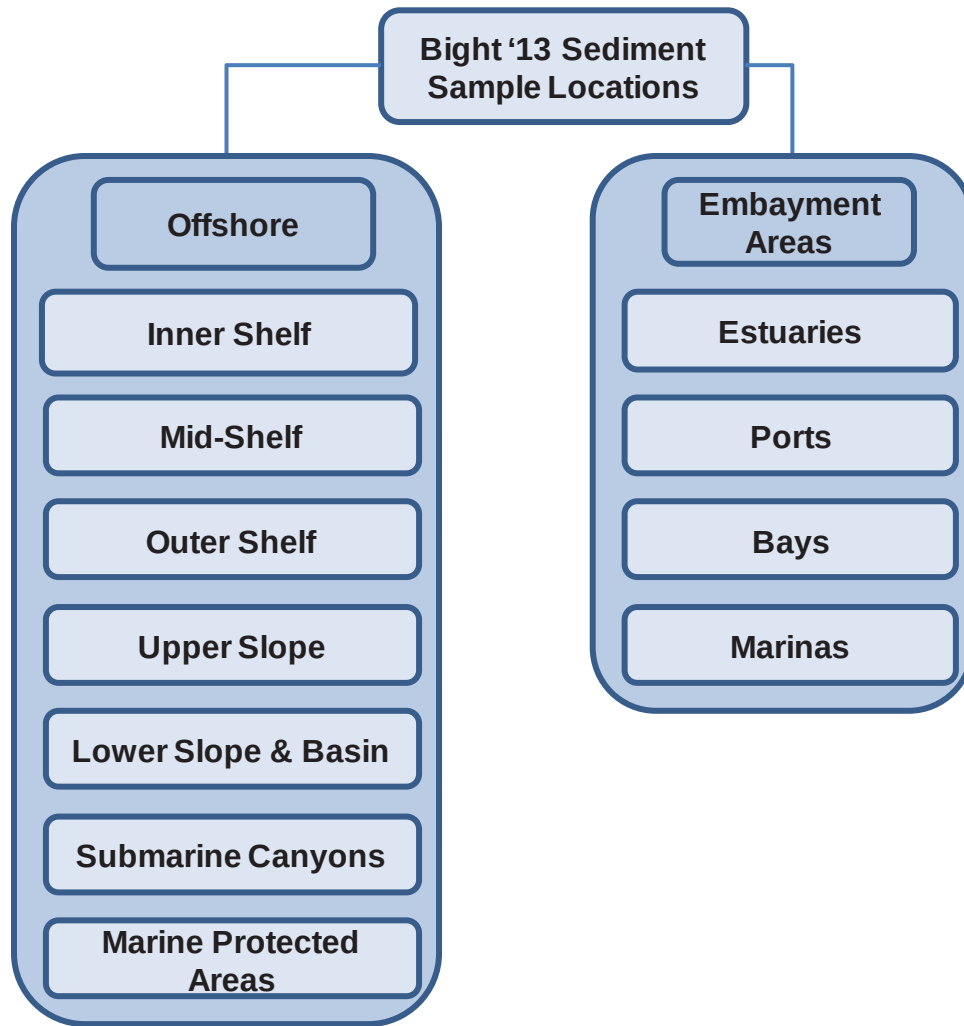


Figure P-9
Bight '13 Sediment Subpopulation Sampling Locations

Sample Analysis

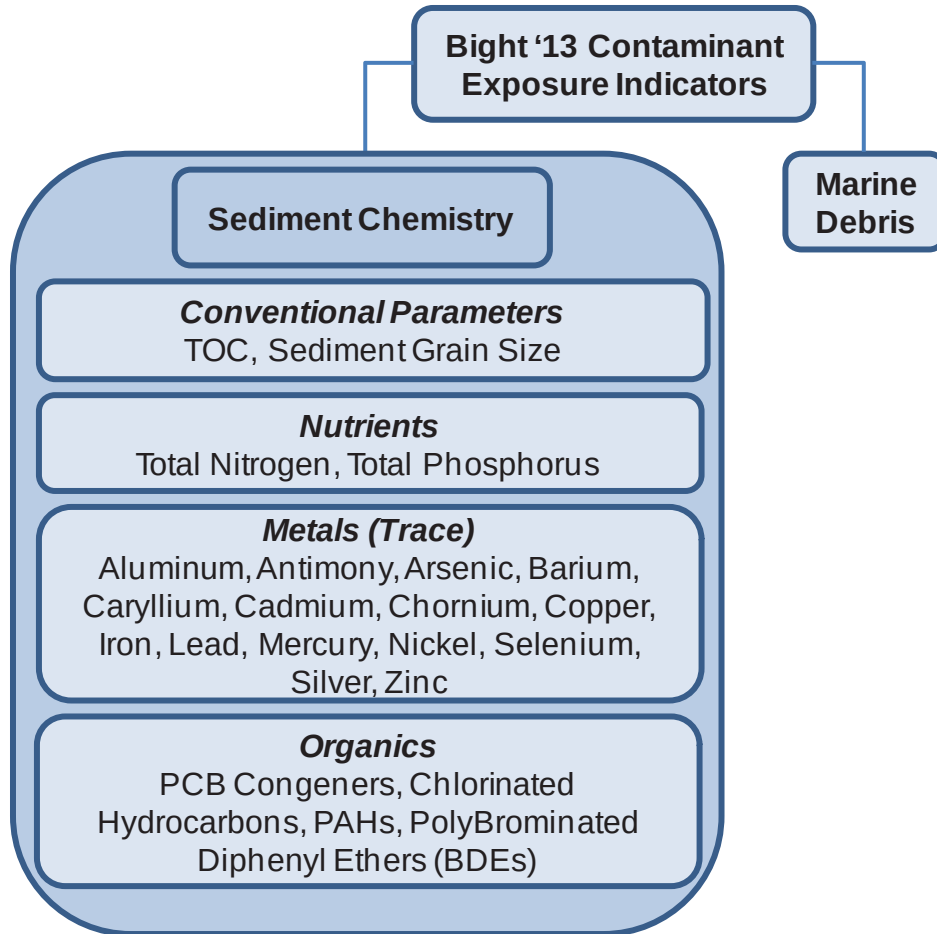


Figure P-10
Bight '13 Sediment Indicators of Contaminant Exposure

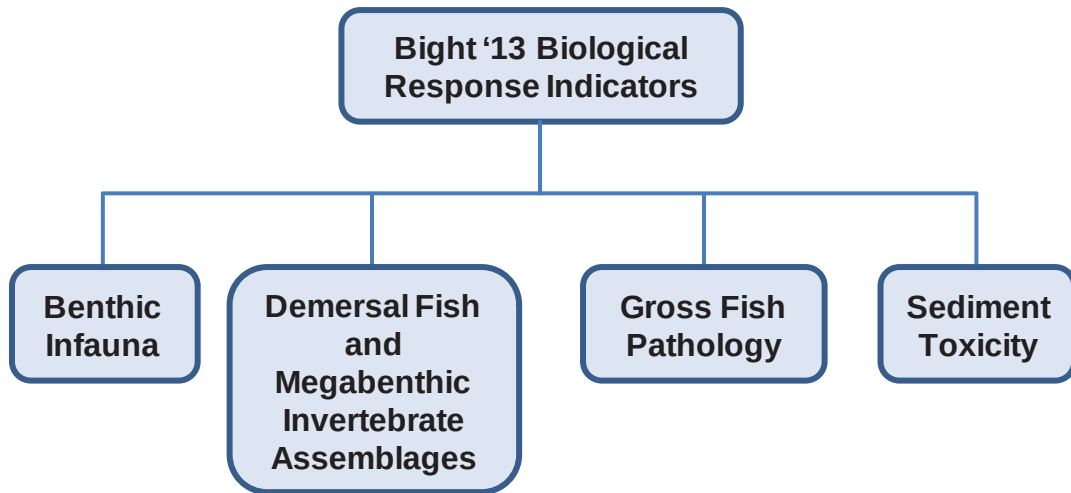


Figure P-11
Bight '13 Sediment Indicators of Biological Response

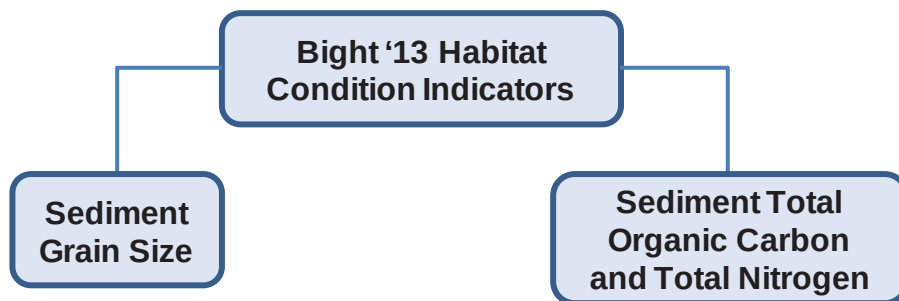


Figure P-12
Bight '13 Sediment Indicators of Habitat Condition

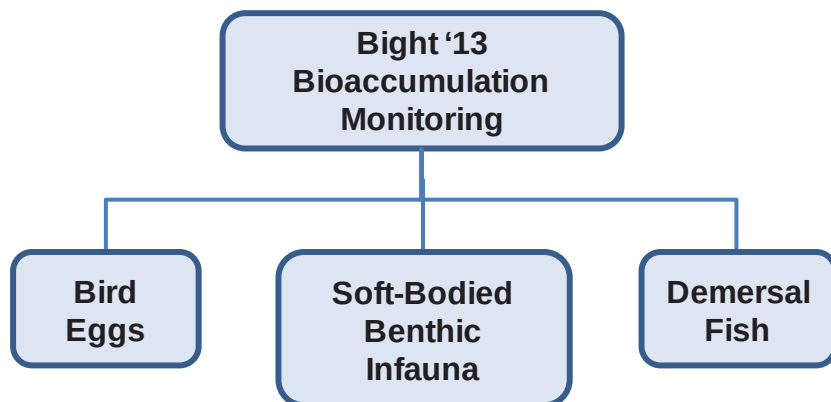


Figure P-13
Bight '13 Bioaccumulation Monitoring Target Organisms

P.1.4 Storm Water Monitoring Coalition Regional Monitoring (Permit Prov. D.1.e.(1))

Overview

Objectives

- ❖ Determine whether the conditions in the receiving water are protective or likely protective of beneficial uses on a regional scale
- ❖ Determine the extent and magnitude of the current or potential receiving water problems

Sampling Location

- ❖ No SMC Regional Bioassessment Sites in Mission Bay during 2013-2014 monitoring year. Locations may be selected in the WMA during future monitoring years

Other Proposed Projects:

- ❖ Twenty-one (21) proposed projects over five years (2014-2019) within four study categories
- ❖ Responsible Agencies have not committed to participate in any of these projects at this time

Monitoring Methods Reference

- ❖ SCCWRP Regional Watershed Monitoring Program – Proposal for 2014 Sampling (available upon request)
- ❖ Southern California Stormwater Monitoring Coalition, Bioassessment Quality Assurance Project Plan (www.projectcleanwater.org)
- ❖ Southern California Stormwater Monitoring Coalition 2014 Research Agenda (http://www.socalsmc.org/Docs/828_SMC2014ResearchAgenda.pdf)
- ❖ *Other methods to be determined* as projects are implemented. Project implementation based on collective need and availability of funding

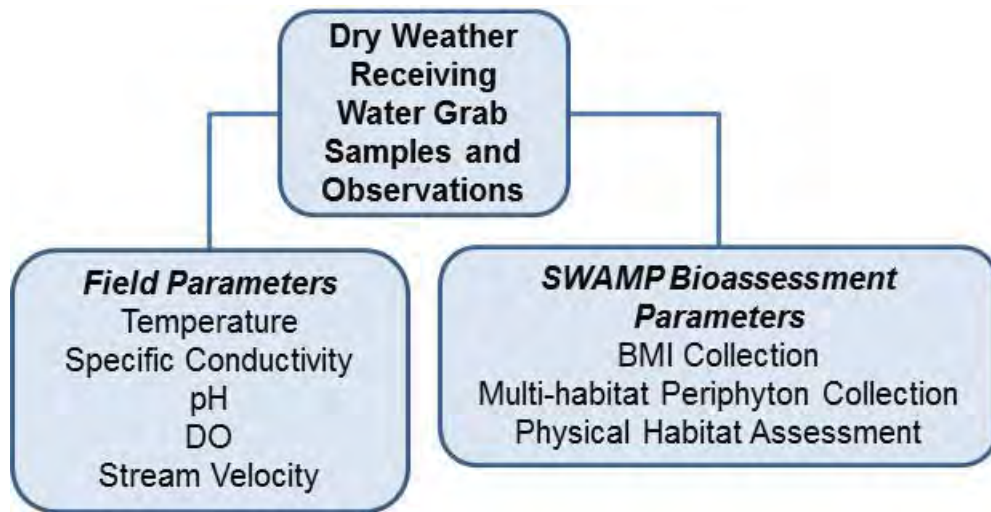


Figure P-14
2013-2014 Storm Water Monitoring Coalition Bioassessment Monitoring

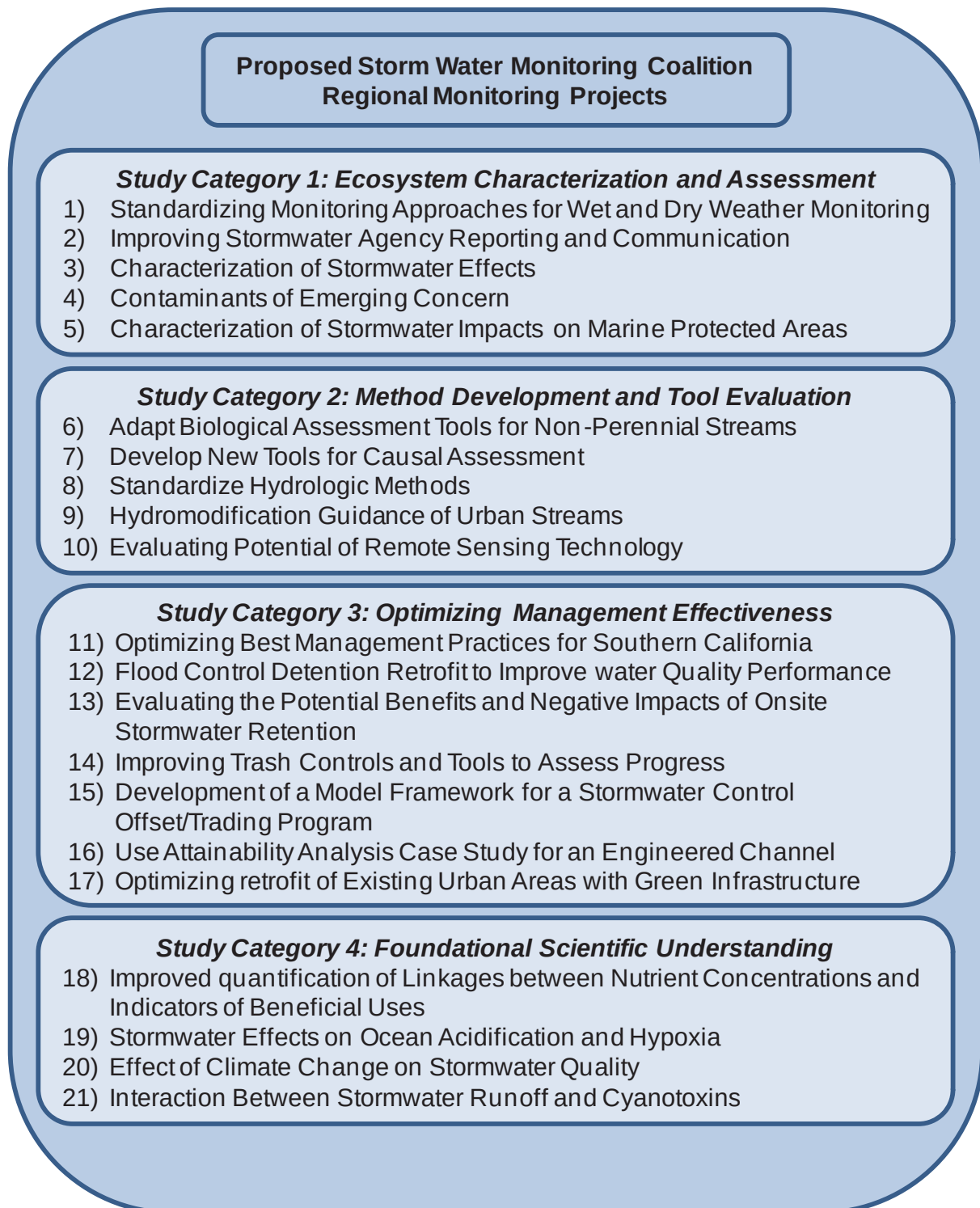


Figure P-15
Storm Water Monitoring Coalition Regional Monitoring Projects
(Proposed Implementation 2014-2019)

P.1.5 Hydromodification Management Plan Monitoring

Overview

Objectives

- ❖ Assess the effectiveness of the Hydromodification Management Plan (HMP) in managing increases in runoff discharge rates and duration from all Priority Development Projects, where such increased rates and durations are likely to cause increased erosion of channel beds and banks, sediment pollutant generation, or other impacts to beneficial uses and stream habitat due to increased erosive forces.

Monitoring Location

- ❖ Nine (9) monitoring locations in San Diego County, including
 - Three (3) HIGH susceptibility Development sites
 - Two (2) HIGH susceptibility Reference sites
 - Two (2) MEDIUM susceptibility Reference sites
 - One (1) HIGH susceptibility Urban site
 - One (1) MEDIUM susceptibility Urban site

Monitoring Methods Reference

- ❖ San Diego HMP Revised Monitoring Plan (www.projectcleanwater.org)

Monitoring Activities

- ❖ Rain gauge analysis
- ❖ Stream gauge analysis
- ❖ Channel assessments
- ❖ Sediment transport analysis
- ❖ Flow duration analysis

P.1.6 Sediment Quality Monitoring (Permit Prov. D.1.e.(2))

Overview

Objectives

- ❖ Evaluate the condition of sediments in enclosed bays or estuaries with respect to the statewide sediment quality objectives

Sampling Locations

- ❖ Conducted as part of Bight '13. See Section P.1.3 for sampling location details.

Sampling Program

- ❖ Sediment monitoring in enclosed bays and estuaries per State Sediment Control Plan (www.projectcleanwater.org)
- ❖ Each site sampled at least twice between June and September during the Permit cycle².

Monitoring Methods Reference

- ❖ State Sediment Control Plan Section VII.D (Receiving Water Limits Monitoring Frequency (www.projectcleanwater.org))
- ❖ State Sediment Control Plan Section VII.E (Sediment Monitoring) (www.projectcleanwater.org)
- ❖ Sediment Quality Monitoring Plan (www.projectcleanwater.org)
- ❖ Sediment Quality Monitoring Quality Assurance Project Plan (www.projectcleanwater.org)

Sample Collection

Sediment Quality Objectives, Multiple Lines of Evidence Approach

- ❖ Chemistry
- ❖ Toxicity
- ❖ Benthic Community Condition

² Monitoring may be reduced to a frequency of once per Permit cycle if station has been classified as unimpacted or likely unimpacted using a Multiple Line of Evidence approach

Sample Analysis

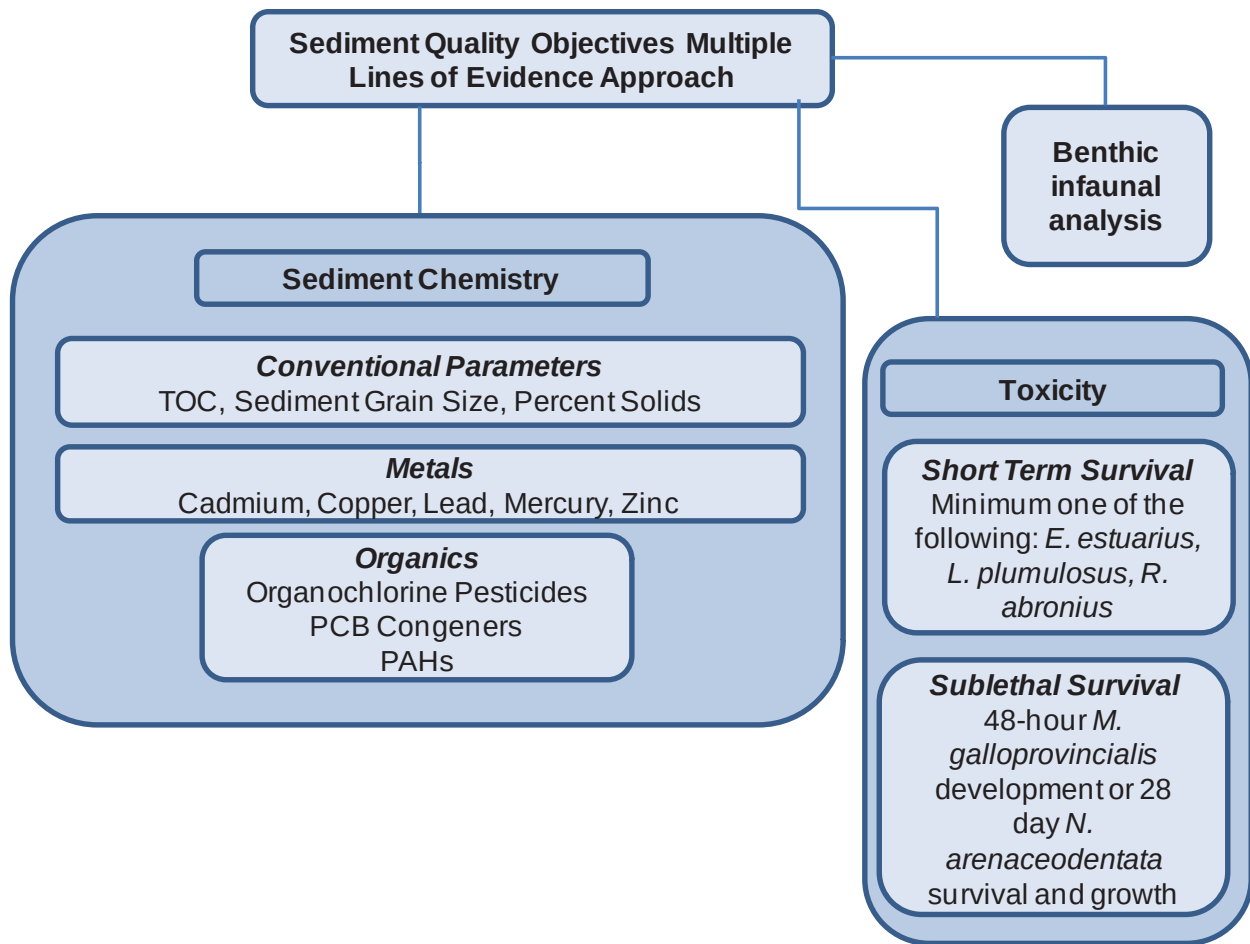


Figure P-16
Sediment Quality Indicators

P.1.7 Area of Special Biological Significance (ASBS) Monitoring (Permit Prov. D.1.a)

Overview

Objectives

- ❖ Assess maintenance and protection of natural water quality conditions in areas that support a variety of aquatic life, and often host unique individual species

Sampling Locations

**Table P-4
ASBS Outfall Monitoring Locations**

Station Name	Waterbody	Subwatershed	Latitude	Longitude
SDL-062	Pacific Ocean	Scripps	32.85384	-117.25491
SDL-063	Pacific Ocean	Scripps	32.85563	-117.25818
SDL-063B	Pacific Ocean	Scripps	32.85913	-117.25608
SDL-157	Pacific Ocean	Scripps	32.86278	-117.25429
SDL-186	Pacific Ocean	Scripps	32.84813	-117.26507

- ❖ Up to five (5) outfall monitoring locations
- ❖ One (1) receiving water monitoring location at the end of Avenida de la Playa (SDL062-RW)

Number of Sampling Events

- ❖ Up to three (3) wet weather events per year

Monitoring Methods Reference

- ❖ ASBS Monitoring Plan for ASBS 29 (www.projectcleanwater.org)

Sample Collection

Receiving Water

- ❖ Grab samples collected pre- and post/during storm

Outfall Monitoring

- ❖ Flow-weighted or equal volume composite
- ❖ Grab samples by protocol

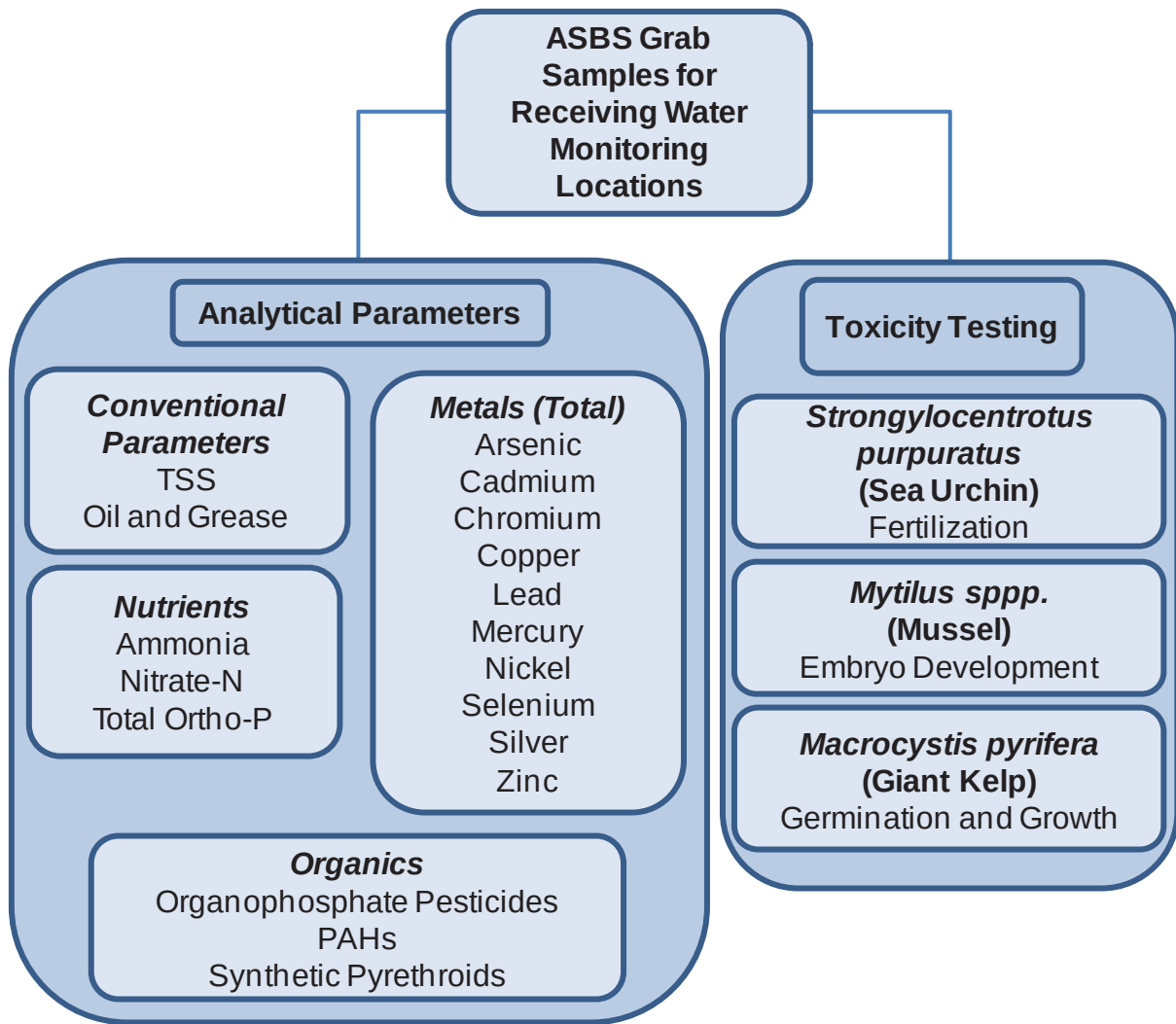


Figure P-17
ASBS Receiving Water Grab Samples

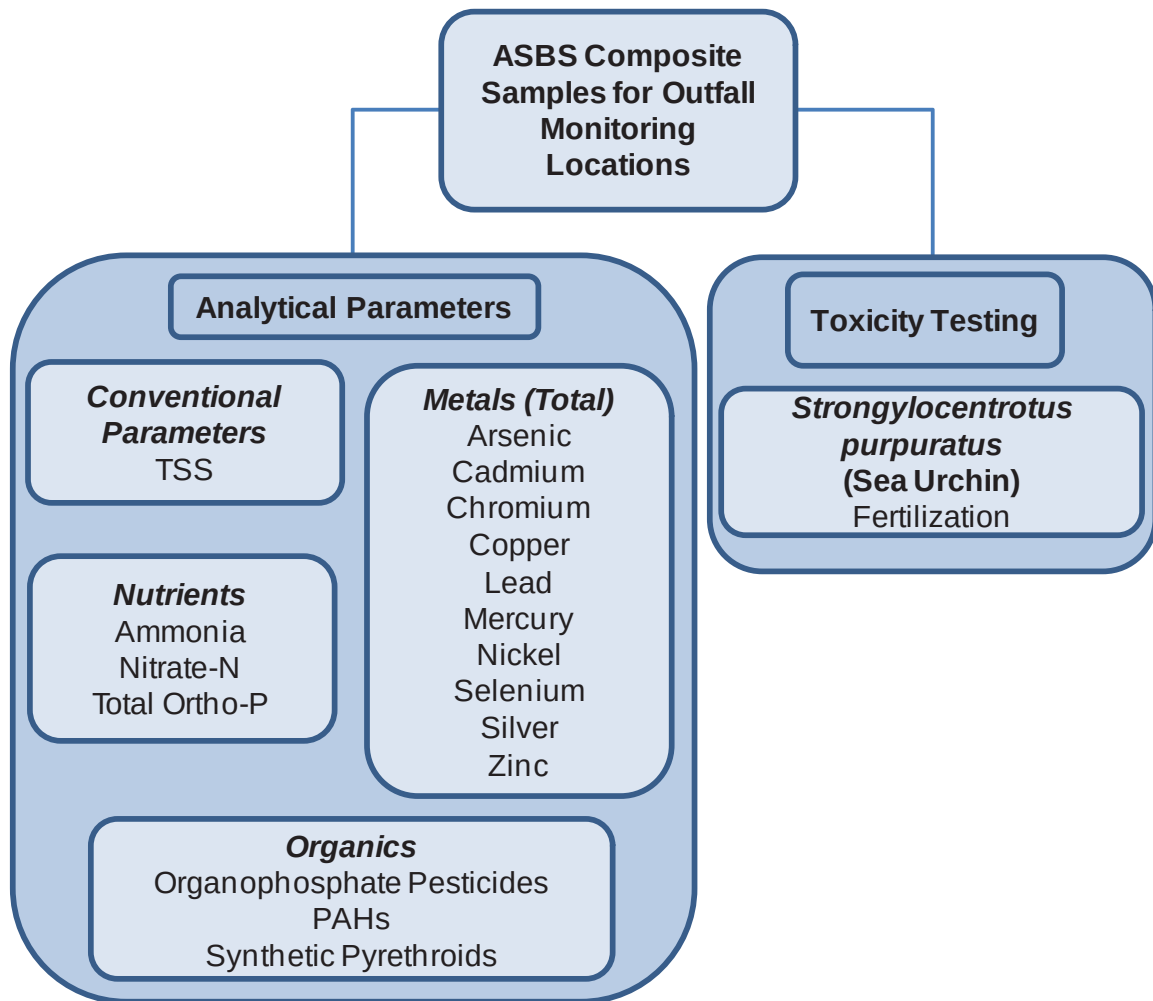


Figure P-18
ASBS Outfall Composite Samples

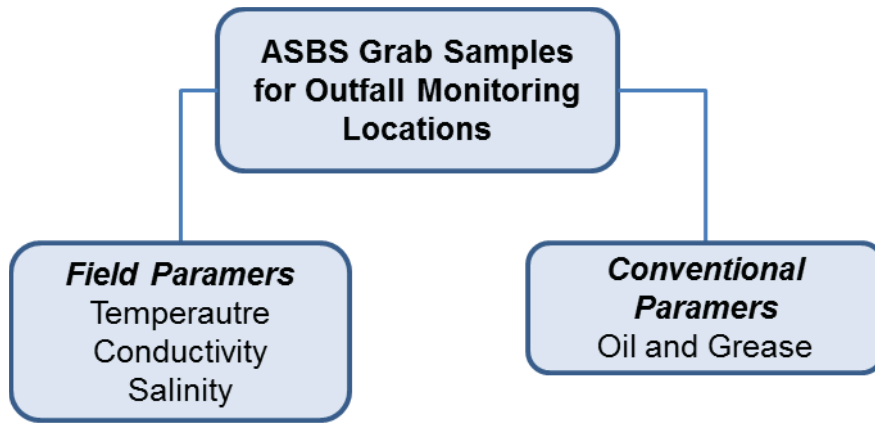


Figure P-19
ASBS Outfall Grab Samples

P.1.8 Bacteria TMDL Monitoring (Permit Attachment E)

Overview

Objectives

- ❖ Determine whether the TMDL numeric targets for bacteria indicators are being met at the compliance monitoring locations
- ❖ Evaluate whether bacteria levels are improving at the compliance monitoring locations

Sampling Locations

- ❖ Tecolote Creek
 - Two (2) monitoring locations
- ❖ Scripps Watershed
 - Thirteen (13) Pacific Ocean Shoreline monitoring locations
- ❖ AB411 Sites

Number of Sampling Events

- ❖ Dry weather monitoring to overlap with the AB411 Monitoring Program during AB411 season
 - Weekly samples from April 1 through October 31
 - Monthly samples from November 1 through March 30
- ❖ Wet weather monitoring at least one (1) and up to three (3) storm events per wet season

Monitoring Methods Reference

- ❖ Tecolote Creek Bacteria TMDL Monitoring Plan (www.projectcleanwater.org)
- ❖ Scripps Watershed Bacteria TMDL Monitoring Plan (www.projectcleanwater.org)

Sample Collection (Shown in Figure P-20)

Wet and Dry Weather

- ❖ Grab Samples
 - Collected within 24 hours of end of precipitation
- ❖ Field Parameters
- ❖ Instantaneous Flow Measurement

Sample Analysis

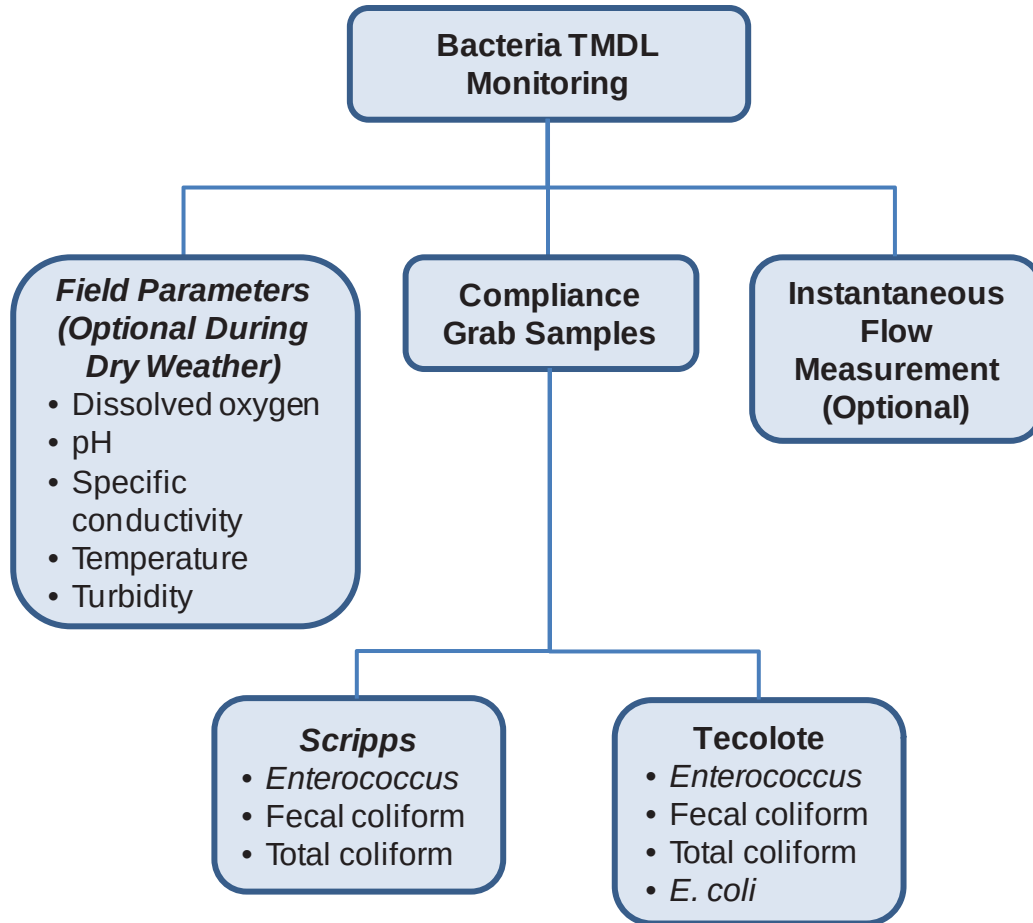


Figure P-20
Bacteria TMDL Wet and Dry Weather Monitoring Program

P.2 MS4 Outfall Discharge Monitoring

P.2.1 Dry Weather MS4 Outfall Discharge Monitoring (Permit Prov. D.2.b.(1))

Overview

Objectives

- ❖ Identify non-storm water and illicit discharges within jurisdiction per Provision E.2.c
- ❖ Determine which discharges are transient vs. persistent flows
- ❖ Prioritize persistent dry weather MS4 discharges to investigate/eliminate per Provision E.2.d

Sampling Locations

- ❖ The outfalls below will be field screened once or twice annually³ following an antecedent dry period of ≥ 72 hours following a rainfall event >0.1 "

Table P-5
MS4 Outfalls for Field Screening

Jurisdiction	Number of MS4 Outfalls for Field Screening
City of San Diego	71 (71) ^(a)

Notes:

- (a) For Copermittees with fewer than 125 major outfalls in the WMA, 80% of major outfalls must be screened twice per year. The total number of outfalls in each Jurisdiction is provided in parentheses. For Copermittees with portions of the jurisdictions in more than one WMA and more than 500 major MS4 outfalls in its jurisdiction, at least 500 major outfalls must be inspected once per year.

Sample Analysis

- ❖ Field Screening Observations (Shown in Figure P-17)
- ❖ MS4 Outfall Discharge Stations
 - For a Copermittee with portions of its jurisdiction in more than one WMA and more than 500 major MS4 outfalls within its jurisdiction, at least 500 major MS4 outfalls within its inventory will be visually inspected at least once annually following an antecedent dry period of ≥ 72 hours following a rainfall event >0.1 "
- ❖ Based on Results of Visual Screening

³ TBD Annual field screening requirements are determined by the number of major outfalls in the jurisdiction and the WMA.

- Identify persistent non-storm water discharges
- Prioritize persistent non-storm water discharges to investigate/eliminate per provision E.2.d

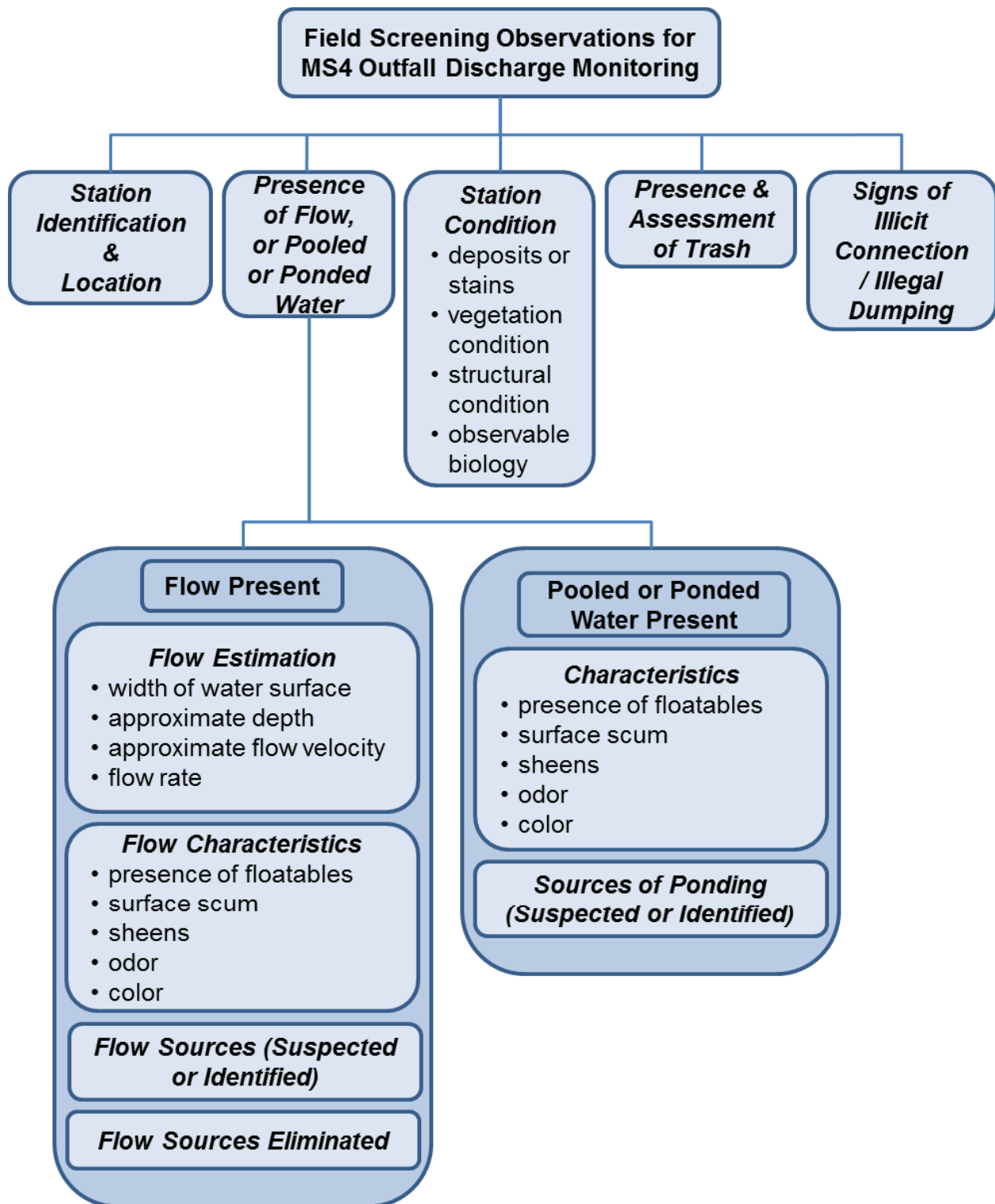


Figure P-21
Field Screening Visual Observations for MS4 Outfall Discharge Monitoring Stations

P.2.2 Non-Storm Water Persistent Flow MS4 Outfall Discharge Monitoring (Permit Prov. D.2.b.(2))

Overview

Objectives

- ❖ Determine which persistent non-storm water discharges contain concentrations of pollutants below non-storm water action levels (NALs) (Permit Provision C.1)
- ❖ Determine the relative contribution of MS4 outfalls to priority water quality conditions during dry weather
- ❖ Investigate the sources of persistent non-storm water flows

Sampling Locations

- ❖ The persistently flowing outfalls below will be monitored following an antecedent dry period of ≥72 hours following a rainfall event >0.1"

Table P-6
MS4 Outfalls for Dry Weather Monitoring

Jurisdiction	MS4 Outfalls for Dry Weather Monitoring
City of San Diego	5 (DW0104, DW0116, DW0273, DW0275, DW0382)

Number of Sampling Events

- ❖ Two events/year during dry weather conditions

Monitoring Methods Reference

- ❖ Mission Bay WMA MS4 Outfall Monitoring Plan (www.projectcleanwater.org)

Prepare Map

- ❖ Identify locations of highest priority non-storm water persistent flow MS4 outfall monitoring stations on map per Provision E.2.b
- ❖ Map to specify which MS4 outfalls are being monitored for compliance with a TMDL

Sample Collection (Shown in Figures P-22 through P-24)

- ❖ Field Parameter Grab Samples
- ❖ Analytical Parameter Grab Samples
- ❖ Receiving Water Grab Samples

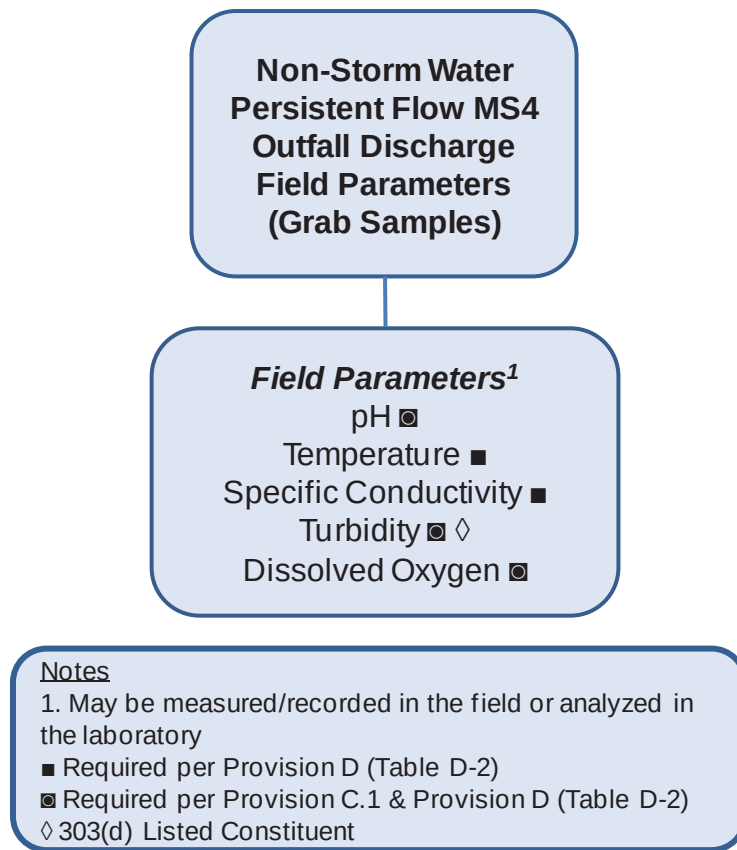


Figure P-22
Non-Storm Water Persistent Flow MS4 Outfall Field Parameters (Grab Samples)

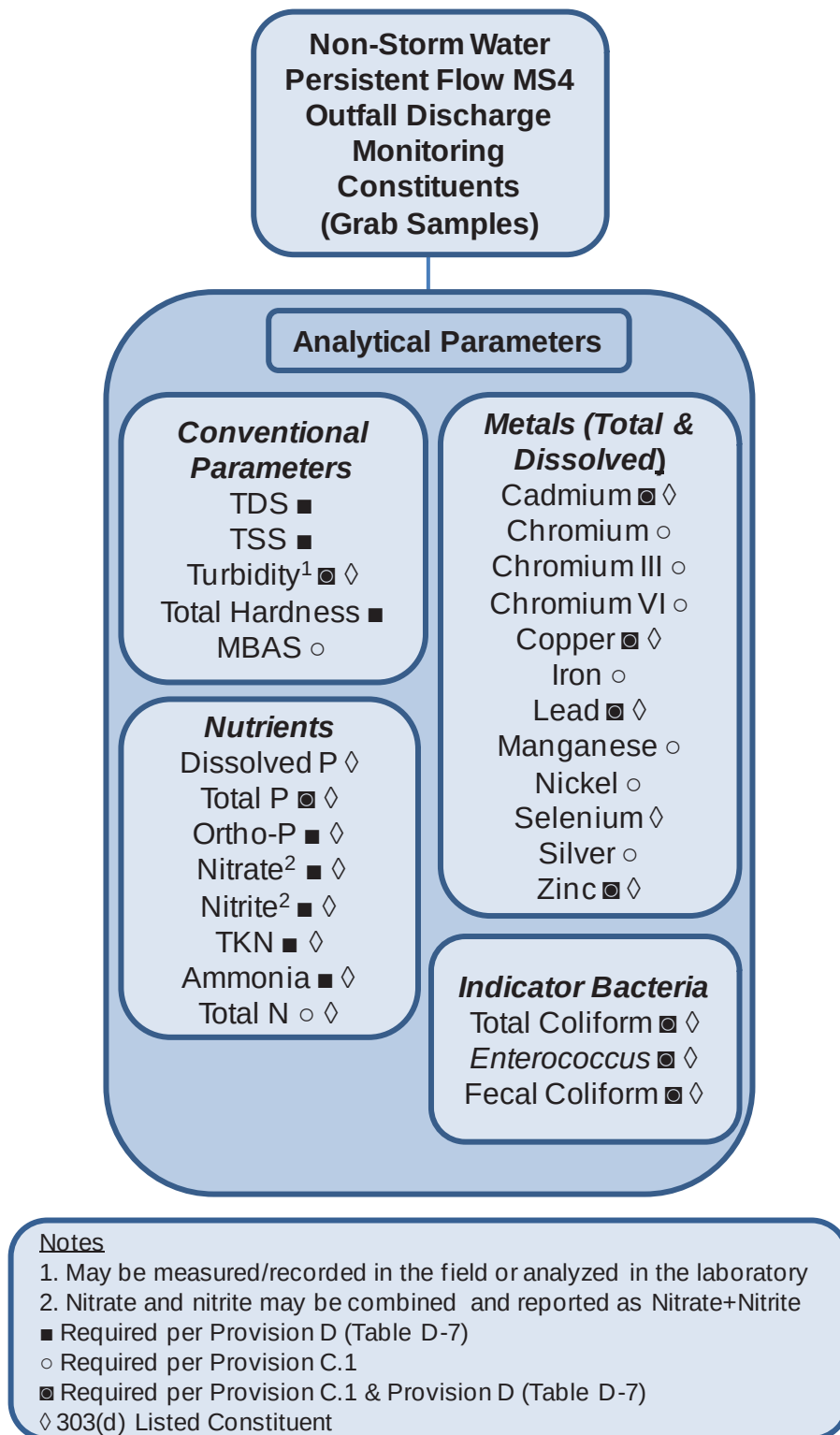


Figure P-23
Non-Storm Water Persistent Flow MS4 Outfall Discharge Monitoring Constituents (Grab Samples)

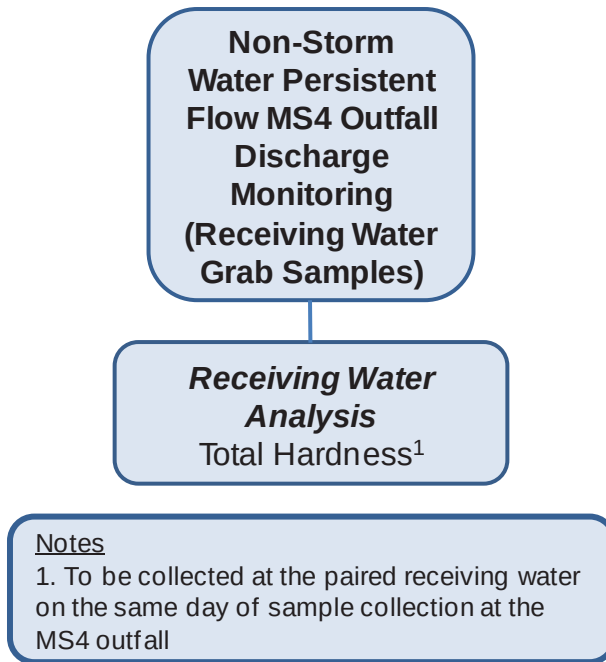


Figure P-24
Non-Storm Water Persistent Flow MS4 Outfall Discharge Monitoring Receiving Water Analysis

P.2.3 Wet Weather MS4 Outfall Discharge Monitoring (Permit Prov. D.2.c)

Overview

Objectives

- ❖ Determine which storm water discharges contain concentrations of pollutants below storm water action levels (SALs) (Permit Provision C.2)
- ❖ Determine the relative contribution of MS4 outfalls to priority water quality conditions during wet weather
- ❖ Investigate how discharge concentrations, loads, and flows change over time at representative MS4 outfalls

Sampling Locations

- ❖ The outfalls below will be monitored annually during the wet season (October 1 – April 30)

Table P-7
MS4 Outfalls for Wet Weather Monitoring

Jurisdiction	MS4 Outfalls for Wet Weather Monitoring
City of San Diego	5 (DW0053, DW0156, DW0171, DW0273, DW0275)

Frequency of Events

- ❖ One wet weather event per monitoring year

Monitoring Methods Reference

- ❖ Mission Bay WMA MS4 Outfall Monitoring Plan (www.projectcleanwater.org)

Sample Collection (shown in Figures P-25 through P-27)

- ❖ Time Weighted Composites
- ❖ Grab Samples
- ❖ Receiving Water Grab Samples

Sample Analysis

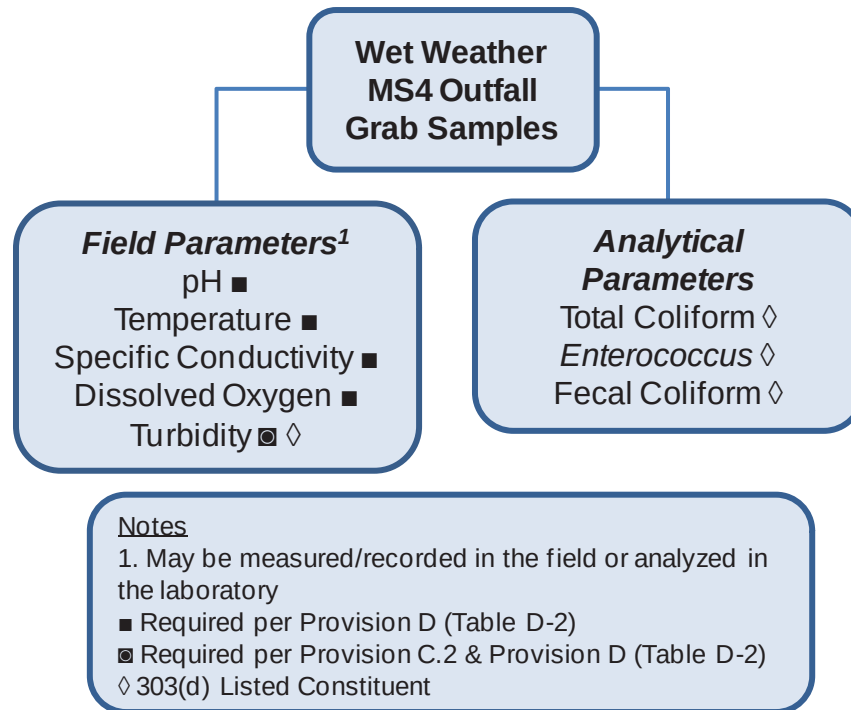


Figure P-25
Wet Weather MS4 Outfall Grab Sample Constituents

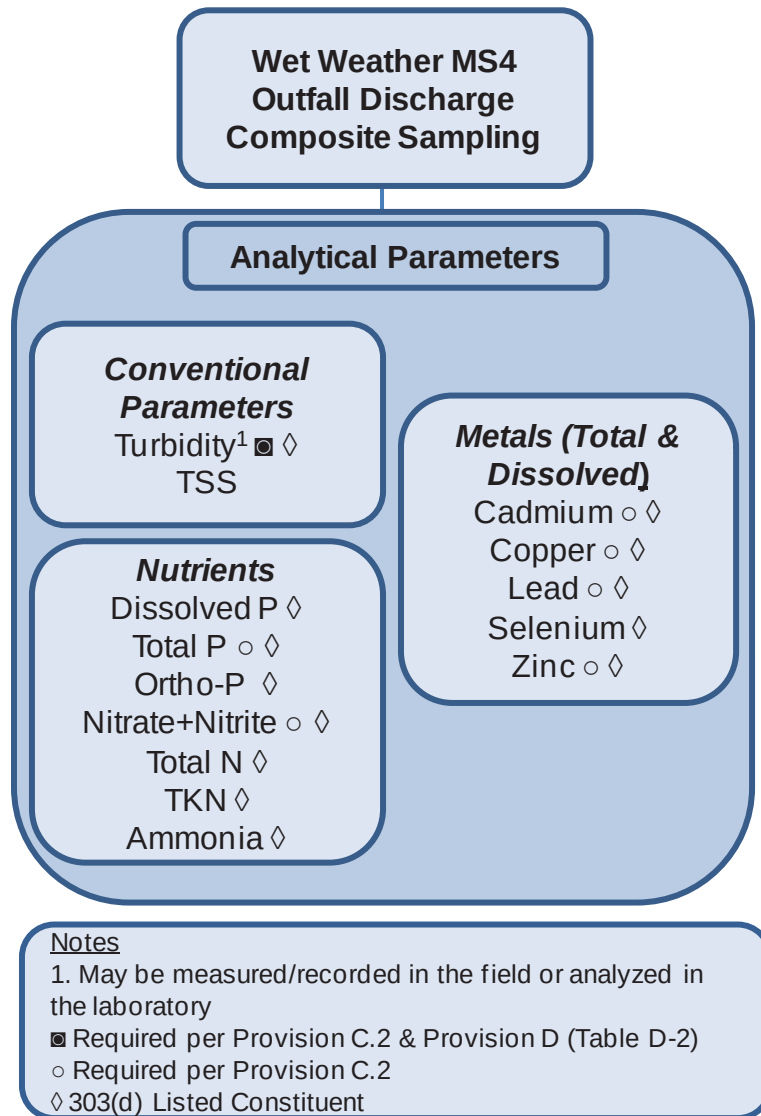


Figure P-26
Wet Weather MS4 Outfall Discharge Monitoring Constituents

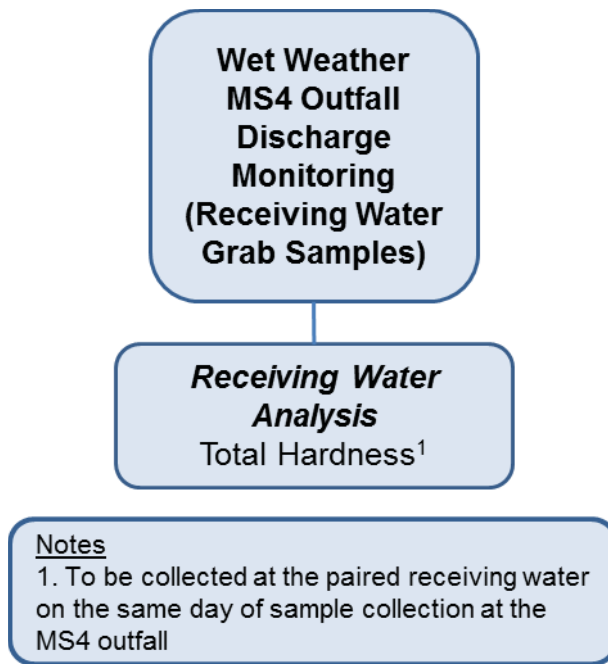


Figure P-27
Wet Weather MS4 Outfall Discharge Monitoring Receiving Water Analysis

P.3 Special Studies

P.3.1 San Diego Regional Reference Stream Study (Permit Prov. D.3)

Overview

Objectives

- ❖ Evaluate variation in Water Quality Objective (WQO) exceedance frequencies between summer dry weather, winter dry weather, and wet weather?
- ❖ Evaluate variation in WQO exceedance frequencies with respect to hydrologic factors, such as:
 - Storm size (wet weather only)
 - Beginning versus end of storm season (wet weather only)
 - Discharge flow rate and volume
- ❖ Evaluate variation in WQO exceedance frequencies with respect to impact factors such as the size and geology of catchments
- ❖ Evaluate variation in WQO exceedance frequencies with respect to biotic and abiotic factors, such as:
 - Algal cover and/or biofilms
 - Water quality (temperature, conductivity, pH, dissolved oxygen, total suspended solids concentrations)

Sampling Locations

- ❖ Three (3) wet weather events at six (6) sites throughout the San Diego Region (two sites are located in San Diego County)
- ❖ Up to 40 weeks of dry weather at up to ten (10) dry weather sites

Monitoring Methods Reference

- ❖ San Diego Reference Stream QAPP (available upon request from the Regional Water Quality Control Board)

Monitoring Approach

Wet Weather Monitoring

- ❖ Time course pollutograph sampling (sampling of concentrations at multiple periods over the course of the storm) over the duration of the storm event and once per day on the following three days
- ❖ *In-situ* field measurements will be recorded at each site to coincide with each pollutograph grab sample

- ❖ Flow and precipitation will be measured throughout the duration of the storm event at each reference site, when feasible
- ❖ During one wet event per site, toxicity composite sample taken over a whole day

Dry Weather Monitoring

- ❖ Up to 40 weeks
- ❖ Water grab-sampling:
 - Weekly bacteria samples will be collected such that 5 samples will occur within each 30-day period
 - Biweekly nutrient, metals, and conventionals sampling
 - Flow calculated weekly at each site using a hand-held March-McBirney flow meter. The meter measures instantaneous velocity, which will be used with cross-sectional area measurements to calculate flow
 - *In-situ* field measurements to coincide with each grab sample
- ❖ Modified algal bioassessment sampling one to two times per Reference Stream site, when feasible
 - Modified SWAMP guidelines for algae collection and stream condition parameters, including physical habitat, benthic algae and chlorophyll *a*

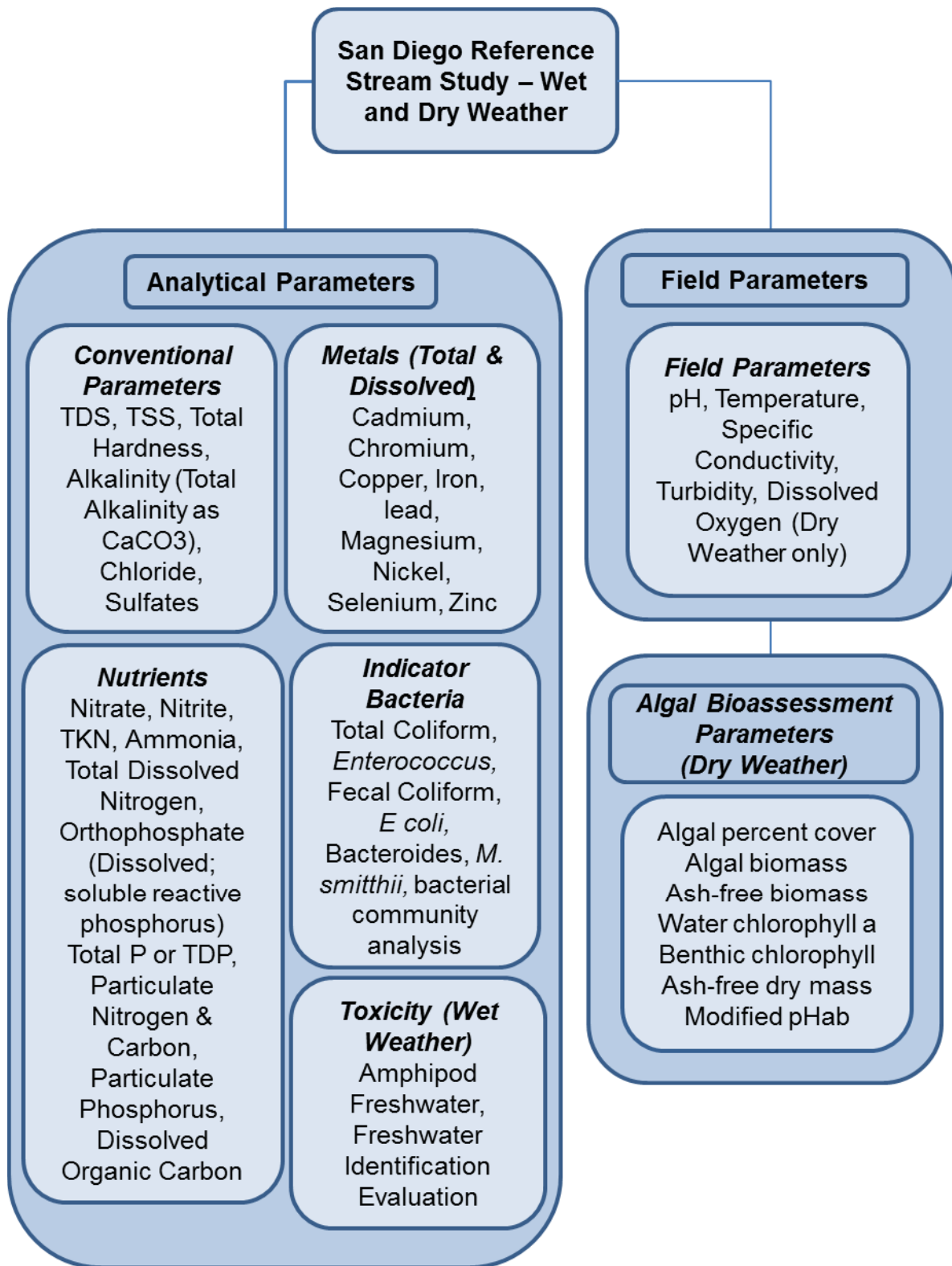


Figure P-28
San Diego Reference Stream Study Monitoring Constituents

P.3.2 San Diego Regional Reference Beach Study (Permit Prov. D.3)

Overview

Objectives

- ❖ Evaluate variation in Water Quality Objective (WQO) exceedance frequencies between summer dry weather, winter dry weather, and wet weather.
- ❖ Evaluate variation in WQO exceedance frequencies with respect to hydrologic factors, such as:
 - Discharge flow rate (wet and dry weather)
 - Status of estuary mouth, if applicable (open or closed, dry weather only)
- ❖ Evaluate wet and dry weather WQO exceedance frequencies in creeks and estuaries (if applicable).

Sampling Locations

- ❖ Three (3) wet weather events at three monitoring (3) points at one (1) site: freshwater creek, estuary, and ocean (site located in San Diego County)
- ❖ Up to 60 weeks of dry weather at two (2) to three (3) monitoring points at two (2) dry weather sites: freshwater creek, estuary (if applicable), and ocean (one in the San Diego Region; one in the Malibu Region)

Monitoring Methods Reference

- ❖ San Diego Reference Beach QAPP (available upon request from the Regional Water Quality Control Board)

Monitoring Approach

Wet Weather Monitoring

- ❖ Monitoring conducted only during storms that produce enough runoff to result in the creek actively discharging to the ocean
- ❖ One grab sample at each monitoring point on the day of the storm event and once per day on the following three days
- ❖ *In-situ* field measurements will be recorded at each monitoring point to coincide with each grab sample
- ❖ Discharge from the creek will be estimated during sampling each day throughout the duration of the monitoring event, when feasible

Dry Weather Monitoring

- ❖ Up to 60 weeks
- ❖ Water grab-sampling:

- Weekly bacteria samples at each monitoring point will be collected such that 5 samples will occur within each 30-day period
- Flow estimated weekly at each creek site and the flow across the beach to the ocean, if flowing.
- *In-situ* field measurements to coincide with each grab sample

❖ Estuary Special Study

- Dry weather only at San Onofre Creek (Deer Creek does not have an estuary)
- Includes two (2) additional sample points within the estuary, for a total of three (3) sample points within the estuary (spatial variability)
- Samples are collected once per sampling day, or twice per sampling day when open to tidal fluctuation (temporal variability)

P.3.3 Tecolote Creek Quantitative Microbial Risk Assessment (QMRA) (Permit Prov. D.3)

Overview

Objectives

- ❖ Determine if the bacteria sources to Tecolote Creek are predominantly non-human, as concluded by previous studies
- ❖ Determine which waterborne pathogens of concern are present in the Tecolote Creek watershed, and at what concentrations they are expected to occur at REC-1 or REC-2 sites
- ❖ Evaluate the risk of gastrointestinal illness (GI) from water contact recreation in Tecolote Creek due to the pathogens of concern
- ❖ Determine what site-specific water quality objectives (WQOs) would reflect the GI risks and protect water contact beneficial uses
- ❖ Determine which best management practices (BMPs) are expected to be most cost-effective in reducing GI risks in coastal watersheds
- ❖ Determine which “lessons learned” from the QMRA study could be used to develop and guide other risk assessment and management activities in the San Diego Region

Sampling Locations

- ❖ Five (5) sampling locations

Number of Sampling Events

- ❖ Three (3) wet weather events targeted per year
- ❖ Seven (7) dry weather events⁴ targeted per year
- ❖ Creek surveys implemented as-needed

Monitoring Methods Reference

- ❖ Tecolote Creek Quantitative Microbial Risk Assessment Work Plan (www.projectcleanwater.org)

Monitoring Approach

Wet Weather Monitoring

- ❖ One site
 - Receiving water composite samples (3 samples per event)

⁴ Antecedent dry period of 7 days targeted.

- Pollutograph grab samples (8-12 samples per event)
- Field Measurements
- ❖ Four remaining sites
 - Grab samples at peak hydrograph conditions (1 sample per site per event)
 - Field Measurements

Dry Weather Monitoring

- ❖ One grab sample per site
- ❖ Field Measurements

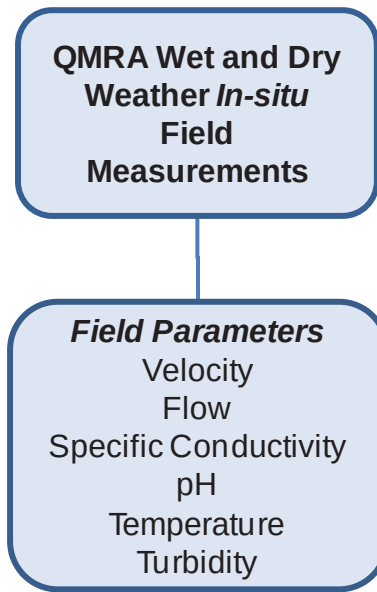


Figure P-29
QMRA Wet and Dry Weather *In-situ* Field Measurements

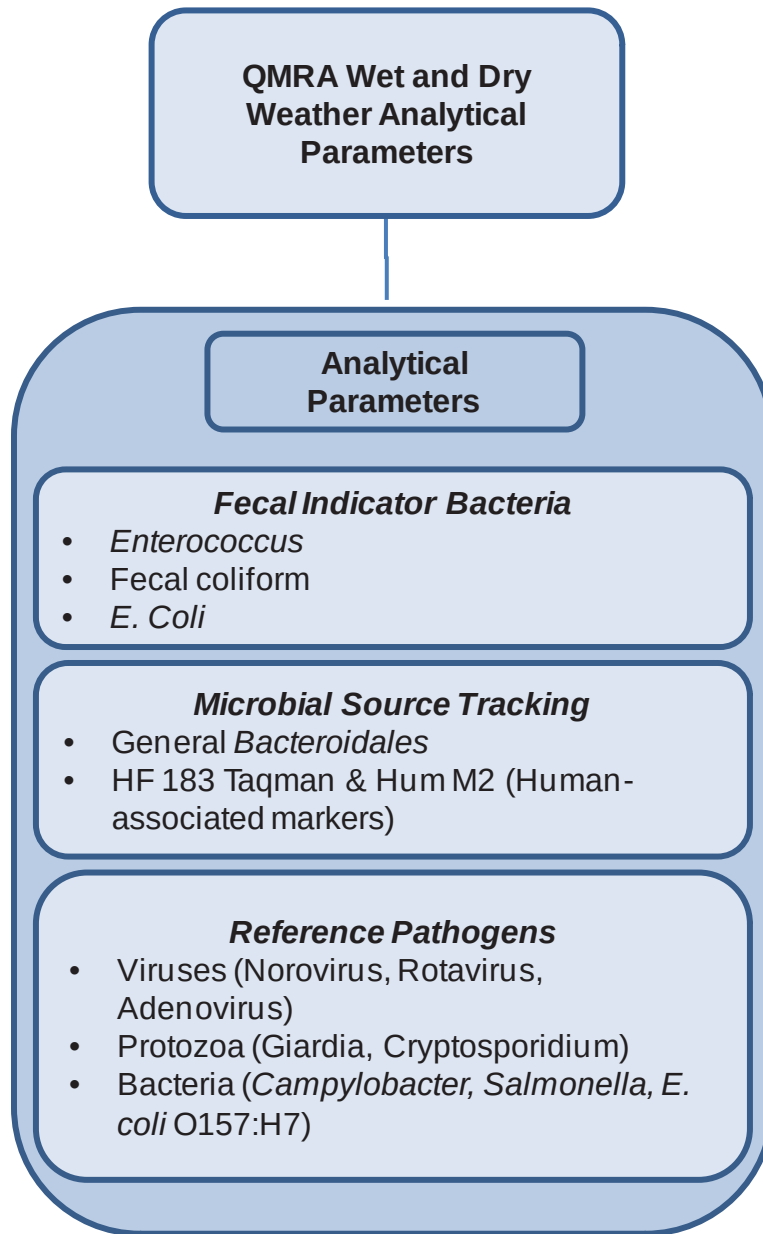


Figure P-30
QMRA Wet and Dry Weather Analytical Parameters

P.3.4 Stream Gauge Study (Permit Prov. D.3)

Overview

Objectives

- ❖ Evaluate the level of flow in local streams
- ❖ Determine which streams are perennial and which streams are ephemeral

Sampling Locations

- ❖ Three (3) locations in Rose Creek
- ❖ One (1) location in San Clemente Canyon
- ❖ Three (3) locations in Tecolote Creek

Monitoring Methods Reference

- ❖ Stream Gauge Study Work Plan (www.projectcleanwater.org)

Data Collection

- ❖ Dataloggers with five minute logging interval for:
 - Water level
 - Temperature
 - Barometric pressure
 - Conductivity (location-dependent)
- ❖ Stream cross section measurements

P.3.5 Bannock Avenue Neighborhood Enhancements and Bacteria Treatment for Tecolote Creek Watershed Protection – BMP Effectiveness Assessment (Permit Prov. D.3)

Overview

Objectives

- ❖ Evaluate whether low-impact development BMPs can effectively reduce storm water runoff pollutant contributions entering the storm drain system in the Tecolote Creek watershed

Sampling Locations

- ❖ Ten (10) inlet/outlet monitoring locations
- ❖ One (1) drainage area outfall monitoring site

Number of Sampling Events

- ❖ Up to five (5) storm events

Monitoring Methods Reference

- ❖ Bannock Avenue Neighborhood Enhancements and Bacteria Treatment for Tecolote Creek Watershed Protection Monitoring Plan (www.projectcleanwater.org)

Sample Collection

Field Parameters

- ❖ Per fact sheet

Pollutograph Grab Samples

- ❖ Field Parameters
- ❖ Other Constituents by Protocol

Flow Weighted Composite Samples

- ❖ At drainage area outfall monitoring location

Time Weighted Composite Samples

- ❖ At inlet/outlet monitoring locations

Sample Collection

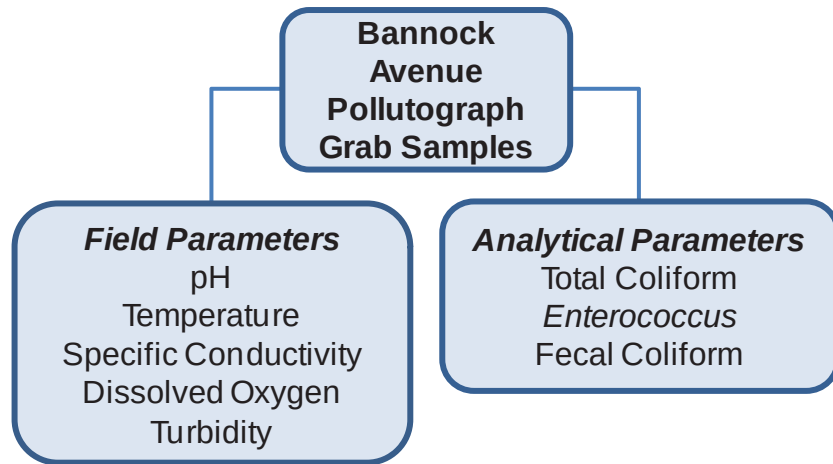


Figure P-31
Bannock Avenue Pollutograph Grab Sample Constituents

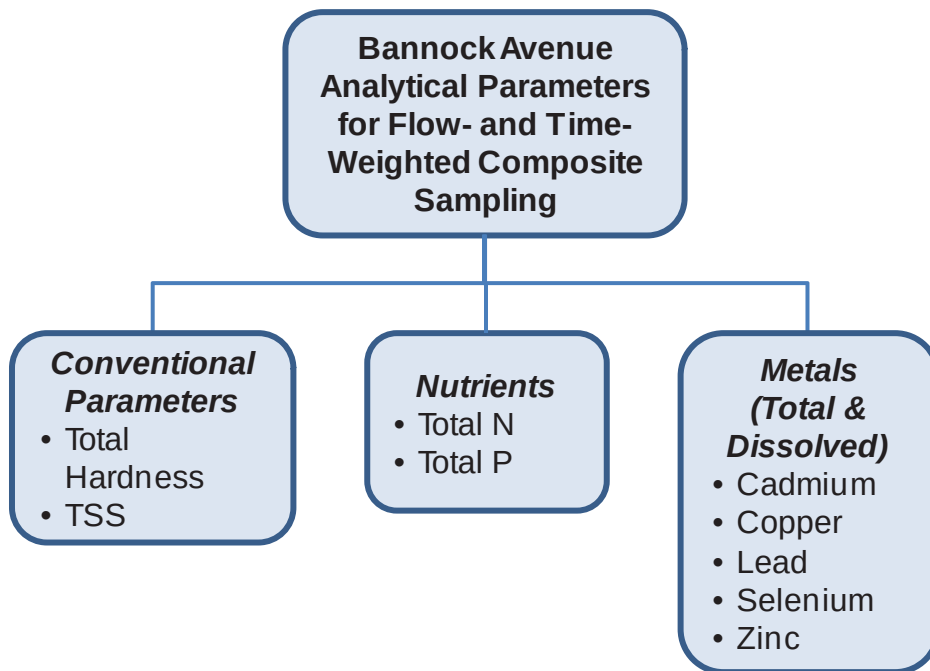


Figure P-32
Bannock Avenue Flow- and Time-Weighted Analytical Parameters for Outfall and Influent/Effluent Monitoring Locations