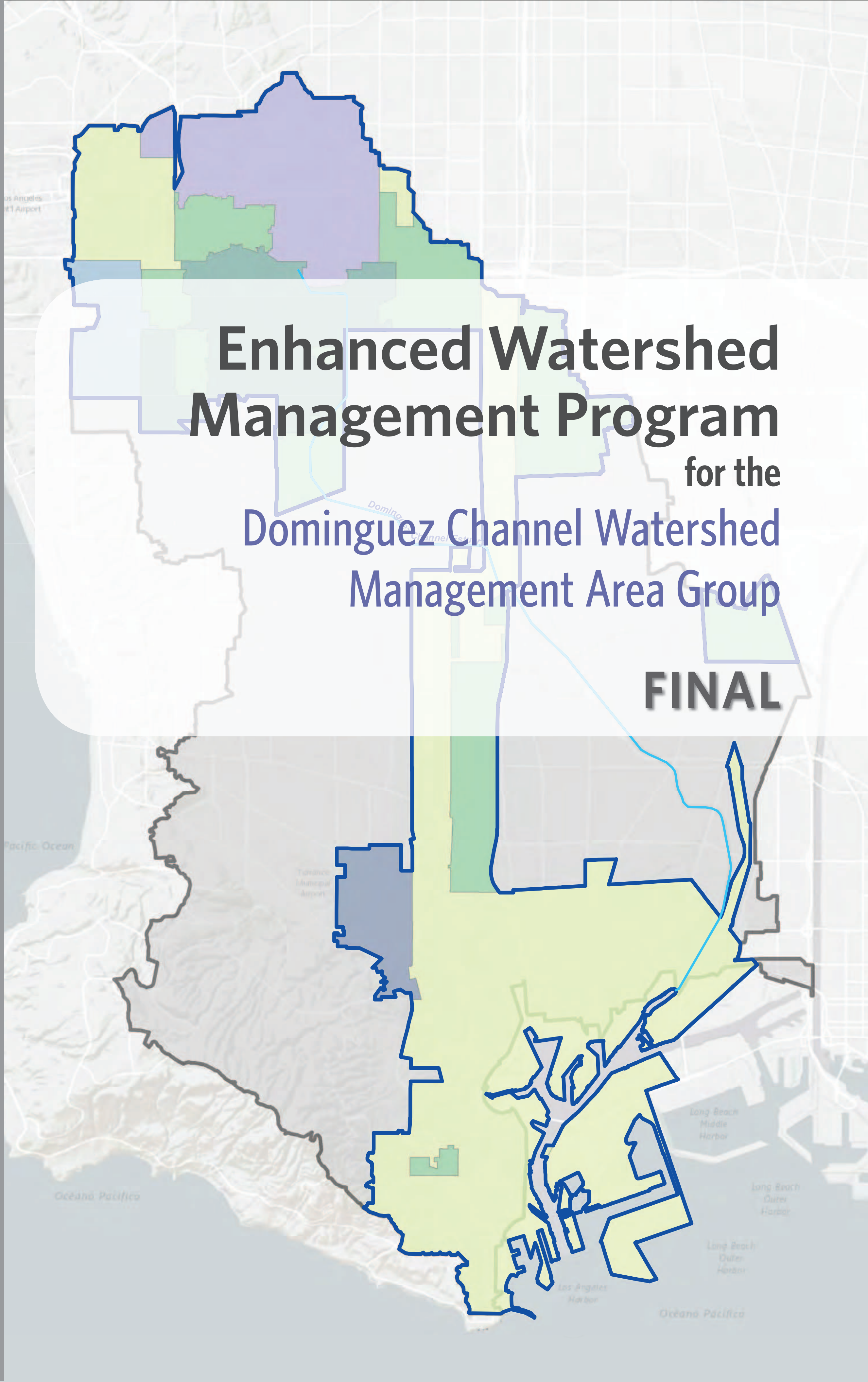
Enhanced Watershed Management Program

for the

Dominguez Channel Watershed Management Area Group

FINAL



JUNE 2015

PAGE INTENTIONALLY LEFT BLANK

Table of Contents

List of Figures

List of Tables

Attachments

Acronyms

ARS	Automatic Retractable Screen
ASCE	American Society of Civil Engineers
BMP	Best Management Practice
BOE	Bureau of Engineering
CASQA	California Stormwater Quality Association
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CO	Current Organics
CPI	Catchment Priority Index
CPS	Connector Pipe Screen
CTR	California Toxics Rule
CWA	Clean Water Act
DC WMA	Dominguez Channel Watershed Management Area
DC WMG	Dominguez Channel Watershed Management Group
DWMMP	Dominguez Watershed Management Master Plan
EMC	Event Mean Concentration
ERL	Effect Range Low
ERM	Effect Range Median
ETo	Evapotranspiration
EWMP	Enhanced Watershed Management Program
GIS	Geographic Information System
GLAC	Greater Los Angeles County
GPS	Global Positioning System
HHWC	Household Hazardous Waste Collection
HO	Historical Organics
HRU	Hydrologic Response Units
HSPF	Hydrologic Simulation Program - FORTRAN
IC/ID	Illicit Connection/Illicit Discharge
IGP	Industrial General Permit
IRWMP	Integrated Regional Watershed Management Plan
LABOS	Los Angeles Bureau of Sanitation
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
LARWQCB	Los Angeles Regional Water Quality Control Board
LB	Long Beach
LID	Low Impact Development
LSPC	Loading Simulation Program in C++
LWQMP	Lake Water Quality Management Plan
MCM	Minimum Control Measure
MEP	Maximum Extent Practicable
MFAC	Minimum Frequency of Assessment and Collection
MOA	Memorandum of Agreement

MS4	Municipal Separate Storm and Sewer System
NCDC	National Climatic Data Center
NEXGEN	Next Generation Radar
NIMS	Nonlinearity-Interval Mapping Scheme
NOI	Notice of Intent
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
PIPP	Public Information and Participation Program
POLA	Port of Los Angeles
POLB	Port of Long Beach
PPP	Pollution Prevention Plan
QA/QC	Quality Assurance/Quality Control
RAA	Reasonable Assurance Analysis
RWL	Receiving Water Limitation
SBPAT	Structural BMP Prioritization and Analysis Tool
SCCWRP	Southern California Coastal Water Research Project
SIC	Standard Industrial Classification
SQO	Sediment Quality Objectives
SRP	Spill Response Plan
SUSMP	Standard Urban Stormwater Mitigation Plan
SUSTAIN	System for Urban Stormwater Treatment and Analysis Integration
SWAMP	Surface Water Ambient Monitoring Program
SWMM	Storm Water Management Model
SWPPP	Stormwater Pollution Prevention Plan
TAC	Technical Advisory Committee
TBD	To Be Determined
TIWRP	Terminal Island Water Reclamation Plant
TMDL	Total Maximum Daily Load
TSO	Time Schedule Order
USEPA	United States Environmental Protection Agency
WBPC	Water Body-Pollutant Combination
WDR	Waste Discharge Requirement
WLA	Waste Load Allocation
WMA	Watershed Management Area
WMMS	Watershed Management Modeling System
WMP	Watershed Management Program
WQBEL	Water Quality Based Effluent Limitation
WQO	Water Quality Objective

Units

µg/kg	Microgram per kilogram
µg/L	Microgram per liter
cfu	Colony Forming Unit
g/day	Grams per day
g/yr	Grams per year
kg	Kilogram
kg/yr	Kilograms per year
mg/L	Milligram per liter
mg/kg	Milligram per kilogram
mL	Milliliter
MPN	Most Probable Number
TUc	Toxic Unit Chronic

1. Introduction

The Dominguez Channel Watershed Management Area Group (DC WMG) has developed this Enhanced Watershed Management Program (EWMP) pursuant to the requirements set forth by Order No. R4-2012-0175, Los Angeles County Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Permit (MS4 Permit). This section describes the applicability of the EWMP, watershed background and geographical characteristics, regulatory requirements set forth by the MS4 Permit, the EWMP development process, and an overview of this EWMP.

1.1 Applicability of EWMP

The agencies participating in this EWMP are the Cities of El Segundo, Hawthorne, Inglewood, Lomita and Los Angeles, the unincorporated areas of the County of Los Angeles, and the Los Angeles County Flood Control District (LACFCD). The area break down for the DC WMG is provided in Table 1-1. Figure 1-1 shows the Dominguez Channel Watershed Management Area (WMA) boundaries and the delineations of the areas of the DC WMG agencies participating in the development of this EWMP. Figure 1-2 illustrates the boundaries of the jurisdictions within the DC WMG area. Additionally other MS4 Permittees in the watershed that are not participating in this EWMP are shown in Figure 1-2. This EWMP is voluntarily submitted to assist the Los Angeles Regional Water Quality Control Board (LARWQCB) in implementing the DC and LA Harbor Waters Toxics Pollutants TMDL[1].

Table 1-1: DC WMG Area

DC WMG Member	Total Area (acres)	Percent of Group
City of El Segundo	1,252.18	3.33%
City of Hawthorne	3,891.93	10.36%
City of Inglewood	3,884.28	10.34%
City of Lomita	1,227.70	3.27%
City of Los Angeles	191,77.30	51.04%
Los Angeles County	8,140.91	21.67%
LACFCD	N/A	N/A
Total	**37,574.30**	**100%**

[1] The DC WMG has entered into an Amended Consent Decree with the United States and the State of California, including the LARWQCB, pursuant to which the LARWQCB has released the DC WMG from responsibility for toxic pollutants in the DC and the harbors (NOAA 1999). Accordingly, no inference should be drawn from the submission of this EWMP or from any action or implementation taken pursuant to it that the DC WMG is obligated to implement the TMDL, including this EWMP or any of the TMDL's other obligations or plans, or that the DC WMG has waived any rights under the Amended Consent Decree. See Attachment A for additional information.

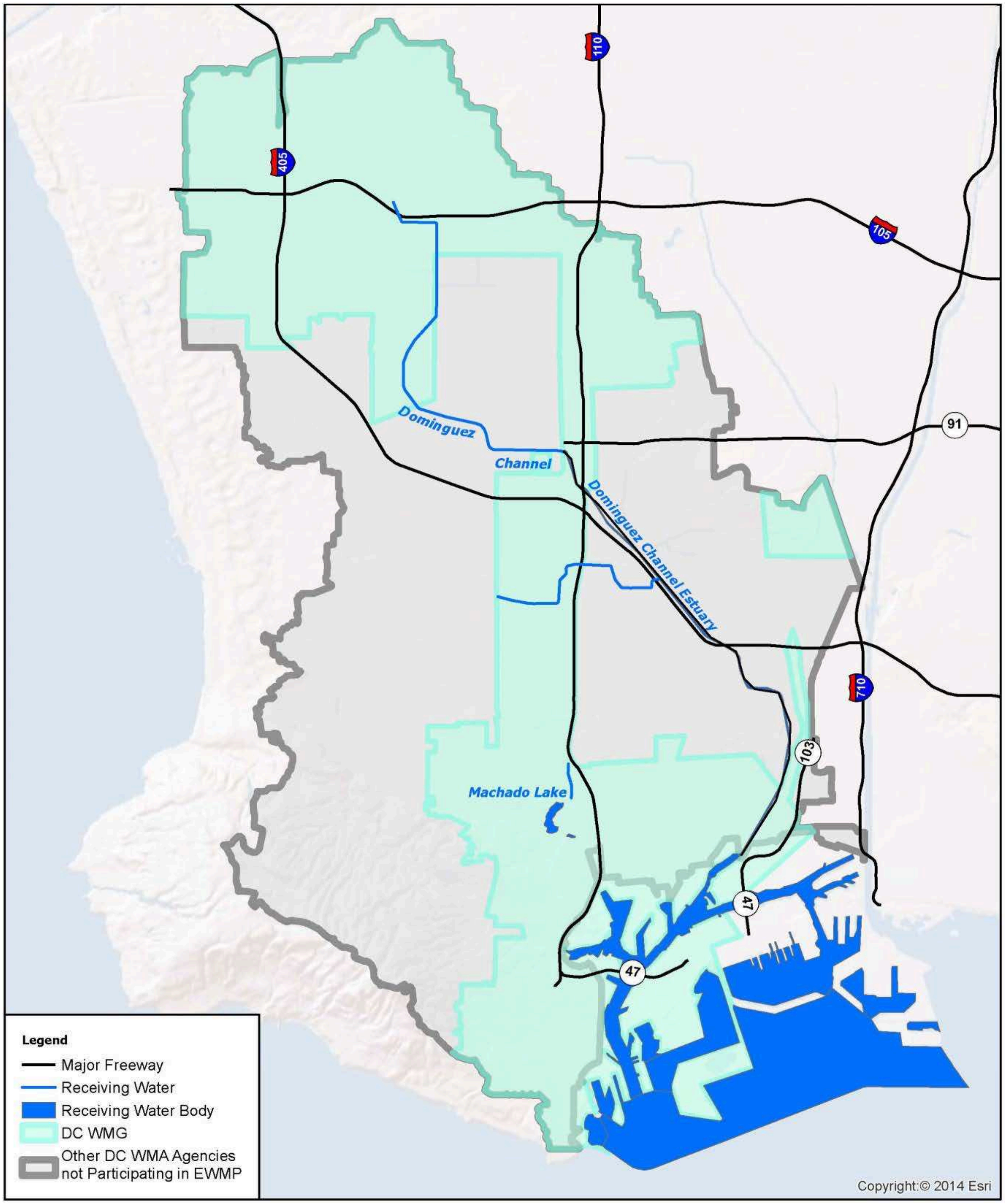


Figure 1-1: Dominguez Channel Watershed Management Area

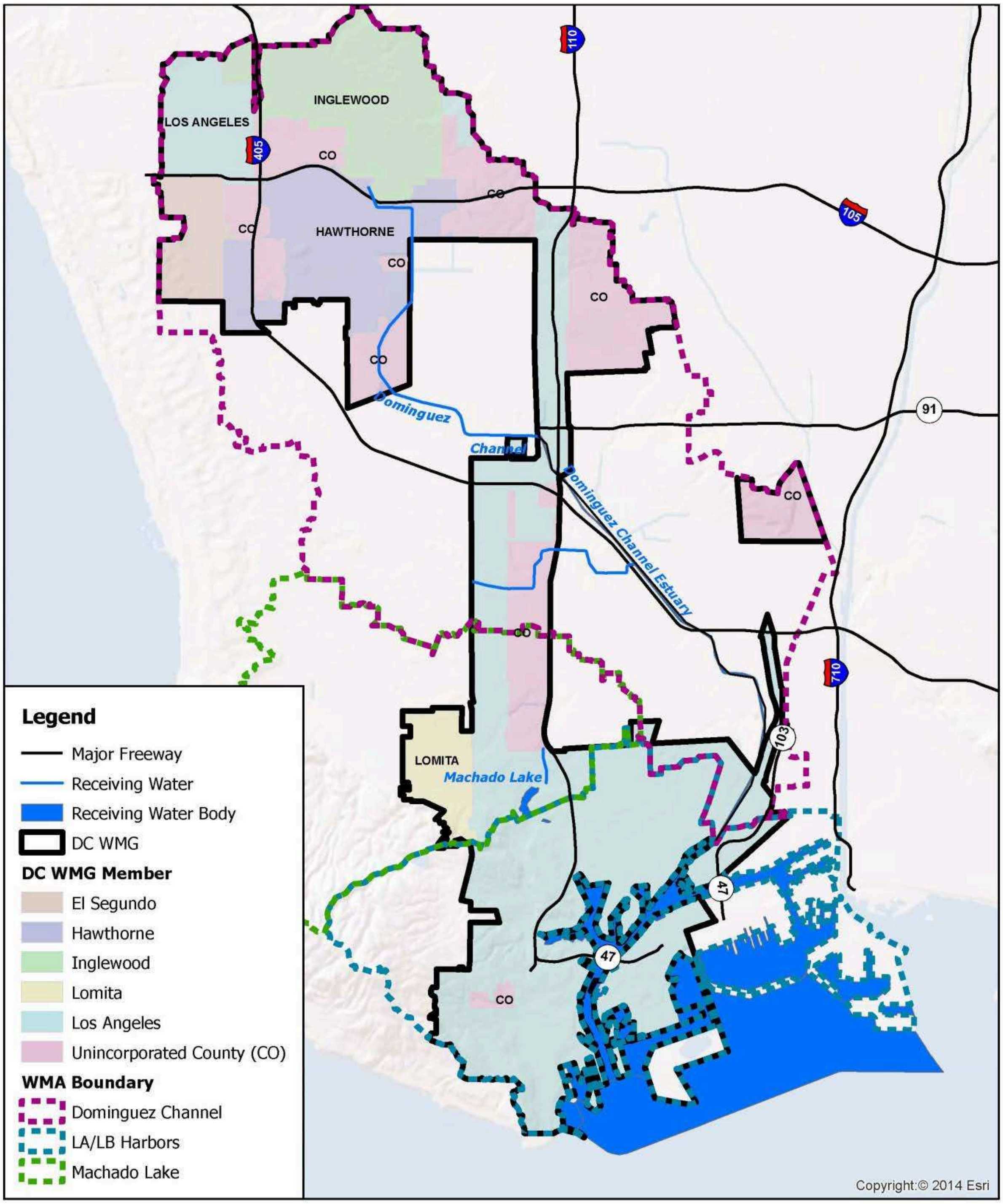


Figure 1-2: DC WMG Jurisdictions

1.2 Geographic Scope and Characteristics

The physical and hydrologic watershed characteristics of the Dominguez Channel WMA are discussed below. In addition, the extent of the MS4 and receiving waters addressed by this EWMP are also discussed.

1.2.1 Watershed Characteristics

The Dominguez Channel WMA is located within the southern portion of Los Angeles County, California, and encompasses approximately 133 square miles of land and water, including the Dominguez Channel Watershed, the Machado Lake Watershed, and the Los Angeles/Long Beach Harbors Watershed as demonstrated in Figure 1-2. The DC WMG accounts for just over 58 square miles, approximately 42 percent of the Dominguez Channel WMA. Table 1-2 and Attachment B, Figure B.3 present the land use break down within the DC WMG.

Table 1-2: DC WMG Land Use

Land Use Category	Area (square miles)	Percentage
Agriculture	0.2	0.3%
Commercial	10.7	18.4%
Industrial	9.1	15.7%
Multi-Family Residential	8.3	14.2%
Single Family Residential	16.1	27.7%
Open	4.6	7.8%
Other Urban	9.3	15.9%
Total	**58.3**	**100%**

The hydrologic characteristics of the DC WMG include:

- Low relief terrain except in the southwest (Attachment B, Figure B.4);
- Fully built-out area with a high percentage of impervious area except in the southwest (Attachment B, Figure B.4);
- Soil types ranging from clay to fine sand based on the Los Angeles County Hydrology Manual (2006) (Attachment B, Figure B.5). Surficial soil infiltration rates ranging from 0.027 to 0.81 inches per hour;
- 50 year, 24 hour storm intensity range from approximately 4.6 inches per hour in the southeast that increases to 6.2 inches per hour in the northwest, as indicated by the 50-year, 24-hour rainfall intensity distribution map (Attachment B, Figure B.6); and
- 85^{th} percentile 24 hour Storm depth ranging from approximately 0.25 inches in the south that increases to the north with a local high point over the Palos Verde Hills of 1.05 inches, as indicated by the 85^{th} percentile, 24-hour rainfall depth distribution map (Attachment B, Figure B.7).

1.2.2 Water Body Characteristics

The DC WMG is tributary to the water bodies listed below, which have been assessed by the State Water Resources Control Board (State Board). A figure illustrating these water bodies can be found in Attachment B, Figure B.8 and Figure B.9 and a summary of the major characteristics can be found in Table 1-3.

- Dominguez Channel
  - Dominguez Channel (lined portion above Vermont Avenue)
  - Dominguez Channel Estuary (unlined portion below Vermont Avenue)
  - Torrance Carson Channel (Torrance Lateral)
- Machado Lake
  - Machado Lake
  - Wilmington Drain
- Los Angeles Harbor
  - Inner Cabrillo Beach
  - Consolidated Slip

1.2.2.1. Dominguez Channel

The lined portion of the Dominguez Channel above Vermont Avenue is 6.7 miles, spanning from West 116th Street near Interstate 105 to Vermont Avenue near Interstate 110 (USEPA, 2014b). Approximately three miles of the lined portion of the Dominguez Channel are within the DC WMG jurisdiction. The Water Quality Control Plan for the Los Angeles Region (LARWQCB, 1994, amended November 10, 2011) (Basin Plan) has identified the existing beneficial uses as RARE and REC-2 and potential beneficial uses as WARM, WILD, and REC-1 for the lined portion of the Dominguez Channel (see footnote for Table 1-3 for definitions of these abbreviations). Further downstream, below Vermont Avenue, is the unlined portion of the Dominguez Channel commonly referred to as the Dominguez Channel Estuary. The Estuary is 8.2 miles in length spanning from the downstream end of the lined portion of the Dominguez Channel to the Los Angeles Harbor, just south of Anaheim Street and west of Interstate 710 (USEPA, 2014b). Approximately 2.2 miles of the Dominguez Channel Estuary is within the DC WMG jurisdiction. The Basin Plan has identified the existing beneficial uses as presented in Table 1-3. The Torrance Carson Channel, also referred to as Torrance Lateral, is 3.4 miles in length and tributary to the Dominguez Channel Estuary. The Torrance Lateral spans from Western Avenue south of Torrance Boulevard to its confluence with the Dominguez Channel Estuary near Avalon Boulevard and Interstate 405. 1.8 miles of the Torrance Lateral is within the DC WMG jurisdiction. The water quality associated with these water bodies is discussed in Section 2 Water Quality Priorities**.**

1.2.2.2. Machado Lake

Machado Lake is considered a freshwater reservoir or lake approximately 40 acres in size located adjacent to Vermont Avenue south of its intersection with Pacific Coast Highway (USEPA, 2014b). Machado Lake is comprised of upper and lower basins separated by a lower earthen dam. The upper basin contains the 40-acre recreational lake created by the impoundment of stormwater runoff while the lower basin is a seasonal freshwater marsh of roughly 63 acres. The Wilmington Drain is a LACFCD facility managed by Los Angeles County Department of Public Works (LACDPW) tributary to Machado Lake. The earthen bottom section is characterized as a soft bottom vegetated channel, approximately 3,000 feet long. This portion of Wilmington Drain spans from Pacific Coast Highway to just north of Lomita Boulevard, bordered by mostly residential land uses to the west and the Interstate 110 to the east. Just south of Interstate 110 and upstream, the channel is concrete lined. Beneficial uses for the Wilmington Drain are not explicitly defined in the Basin Plan. Therefore beneficial uses for the Wilmington Drain, based on the tributary rule (Basin Plan, page 2-4), are assumed to be the same as Machado Lake. The water quality associated with these water bodies is discussed in Section 2.

1.2.2.3. Los Angeles Harbor

There are many components that make up the Los Angeles Harbor as a whole, as illustrated in Attachment B, Figure B.8 and the Los Angeles Harbor watershed is more than just the Harbor District. The Dominguez Channel WMA empties into the northeast side of the Consolidated Slip, the most upstream portion of the Los Angeles Harbor, located downstream of the Dominguez Channel Estuary near Anaheim Street west of Interstate 710 and spans to Shore Road where it confluences with the Los Angeles Inner Harbor. This portion of the harbor is approximately 0.06 square miles, 13.5 acres (USEPA, 2014b). The Basin Plan designates beneficial uses to "all other inner areas", including the Consolidated

Slip. These beneficial uses are shown in Table 1-3. The Los Angeles Inner Harbor is approximately 3,003 acres and is located downstream of the Consolidated Slip. The Inner Harbor includes portions of both the Los Angeles Harbor and Long Beach Harbor (USEPA, 2014b). The Fish Harbor, which is located within the Los Angeles Harbor area, is approximately 0.14 square miles, 91 acres, located east of the harbor near Wharf Street, is also considered part of the Inner Harbor area (USEPA, 2014b) and has the same beneficial uses. The inner and outer portions of Cabrillo Beach are also a part of the Los Angeles Harbor. Inner Cabrillo Beach is considered a bay/harbor and is located to the west of Fish Harbor, adjacent to Shoshonean Road, approximately 0.13 square miles, 82 acres. Outer Cabrillo Beach is considered a coastal shoreline approximately 0.58 miles long on the south side of the peninsula bordering inner and outer Cabrillo Beach (USEPA, 2014). Outer Cabrillo Beach, while in the LA Harbor watershed, is a Los Angeles County beach not part of the Harbor District. The water quality associated with the Los Angeles Harbor water bodies is discussed in Section 2.

Table 1-3: Summary of DC WMG Water Bodies*

Water Body		**Existing Beneficial Uses**	**Potential Beneficial Uses**
Dominguez Channel	Lined portion above Vermont Avenue (Freshwater)	RARE, REC-2	WARM, WILD, REC-1, MUN[1]
	Unlined portion below Vermont Avenue (Estuary)	COMM, EST, MAR, WILD, RARE, MIGR, SPWN, REC-1, REC-2	NAV
	Torrance Carson Channel[2]	RARE, REC-2	WARM, WILD, REC-1, MUN[1]
Machado Lake	Machado Lake	WARM, WILD, WET, REC-1, REC-2	None
	Wilmington Drain[3]	WARM, WILD, WET, REC-1, REC-2	None
Los Angeles Harbor[4]	Consolidated Slip	IND, NAV, REC-2, COMM, MAR, RARE	REC-1, SHELL
	Inner Harbor	IND, NAV, REC-2, COMM, MAR, RARE	REC-1, SHELL
	Fish Harbor	IND, NAV, REC-2, COMM, MAR, RARE	REC-1, SHELL
	Inner Cabrillo Beach	NAV, REC-1, REC-2, COMM, MAR, WILD, MIGR, SPWN, SHELL	None
	Outer Cabrillo Beach (Los Angeles County beach)	NAV, REC-1, REC-2, COMM, MAR, WILD, MIGR, SPWN, SHELL	None

* Abbreviations defined:
COMM – Commercial and Sport Fishing
EST – Estuarine Habitat
IND – Industrial Service Supply
NAV - Navigation
MAR – Marine Habitat
MIGR – Migration of Aquatic Organisms
MUN – Municipal and Domestic Supply
RARE – Rare, Threatened, or Endangered Species
REC-1 – Water Contact Recreation
REC-2 – Non-Contact Water Recreation
SHELL – Shellfish Harvesting
SPWN – Spawning, Reproduction, and/or Early Development
WARM – Warm Freshwater Habitat
WET – Wetland Habitat
WILD – Wildlife Habitat

1 MUN designation is P*. Associated water quality objectives are not applicable until such time as the use is confirmed.
2 Beneficial uses based on TMDL Staff Report (LARWQCB, 2011).
3 Beneficial uses based on the tributary rule (LARWQCB, 1994).

Table 1-3: Summary of DC WMG Water Bodies*		
Water Body	Existing Beneficial Uses	Potential Beneficial Uses

4. Los Angeles Harbor is not the Harbor District. Los Angeles Harbor is the body of water downstream of the Dominguez Channel Estuary.

1.3 Regulatory Framework

The LARWQCB (or Regional Board) adopted Waste Discharge Requirements (WDRs) for MS4 discharges within the Coastal Watersheds of Los Angeles County on June 18, 1990, (Order No. 90-079; NPDES Permit No. CA0061654). The WDRs were later amended on December 13, 2001 (Order No. 01-182; NPDES Permit No. CAS004001 (as amended)). The current MS4 Permit (Order No. R4-2012-0175; NPDES Permit No. CAS004001) was adopted on November 8, 2012 and became effective on December 28, 2012. The MS4 Permit contains effluent limitations, receiving water limitations (RWLs), Minimum Control Measures (MCMs), Total Maximum Daily Load (TMDL) provisions, and outlines the process for developing watershed management programs (WMPs), including the EWMP. The MS4 Permit incorporates the TMDL Waste Load Allocations (WLAs) applicable to dry- and wet-weather as Water Quality-Based Effluent Limitations (WQBELs) and/or Receiving Water Limitations (RWLs). Part V.A (pages 38-39) of the MS4 Permit requires compliance with the WQBELs and/or RWLs as outlined in the respective TMDLs.

1.3.1 Relevant TMDLs

A TMDL is a regulatory term used to describe a value of the maximum amount of a pollutant that a water body can receive while still meeting water quality standards. Attachment N of the MS4 Permit, titled "TMDLs in Dominguez Channel and Greater Harbor Waters Watershed Management Area" lists information on TMDLs and incorporates WQBELs and RWLs relevant to the DC WMG including the TMDLs identified in Table 1-4.

Table 1-4 demonstrates which DC WMG members are affected by each of the TMDLs per Attachment K, Table K.4, of the MS4 Permit. The Water Quality Objectives (WQOs) associated with each of the TMDLs are included in Attachment C.

Table 1-4: Applicability of DC WMG TMDLs

DC WMG Participating Agency	Los Angeles Harbor Bacteria TMDL	Machado Lake Trash TMDL	Machado Lake Nutrient TMDL	Machado Lake Pesticides and PCBs TMDL	DC and LA Harbor Waters Toxic Pollutants TMDL
City of El Segundo					X
City of Hawthorne					X
City of Inglewood					X
City of Los Angeles	X	X	X	X	X
City of Lomita		X	X	X	
County of Los Angeles	X	X	X	X	X
LACFCD	X	X	X	X	X

1.4 EWMP Development Process

According to Part VI.C.1.f.v (page 48) of the MS4 Permit, each watershed management program (WMPs and EWMPs) must provide appropriate opportunity for meaningful stakeholder input, including, but not limited to, a permit-wide watershed management program Technical Advisory Committee (TAC) that will advise and participate in the development of the EWMP. The DC WMG has been part of the TAC and has provided input on the various topics discussed. Additionally the DC WMG worked with local and regional stakeholders to receive input for the EWMP process.

The DC WMG developed a list of stakeholders in order to establish the stakeholder participants, as well as provide guidance on how to engage the identified key stakeholders. The stakeholders include:

- Key administrators, stormwater program managers, council districts, and neighborhood councils.;
- Environmental and community organizations, business associations; and
- Collaborating governmental agencies such as the Regional Board, USEPA Region IX, water districts, and other WMP or EWMP agencies.

A series of three EWMP stakeholder workshops were held jointly with EWMP groups for the Los Angeles River, Ballona Creek, Marina del Rey, Santa Monica Bay Jurisdictions 2 and 3 watersheds. The workshops were conducted, on April 10, 2014, November 20, 2014, and March 19, 2015. Each workshop was held at the Witherbee Auditorium at LA Zoo. More than 500 invitations were sent out to stakeholders. Workshop No. 1 was intended to initiate the process for receiving input from a broad stakeholder group. The agenda consisted of introducing the planned EWMP stakeholder process, explaining the relevance and context of the EWMP process, and solicit input from stakeholders for the Draft EWMP Work Plan and potential projects.

The second workshop discussed the planning progress, discussed the regional projects identified to date, and continued to solicit input from the stakeholders on regional project opportunities, planning criteria to incorporate, the additional benefits sought from the EWMP projects, and other desired outcomes from the program.

The third workshop discussed the draft EWMP, the projects identified, the load reductions that would occur from project implementation, any additional benefits communities would see from implementation of the projects, and the schedules and costs for implementation of the EWMP. Additional information can be found in Attachment D.

The following preparation was conducted for the workshops:

- Meeting notices (one page flier) distributed via email to identified stakeholders and posted on the City of Los Angeles a website for EWMP materials and activities at least one month prior to the workshop;
- Material for each workshop distributed and posted to the www.lastormwater.org website;
- A draft workshop summary, including presentation materials, distributed no later than two weeks after each workshop to solicit additional stakeholder feedback;
- Locations of the workshops that are reasonably accessible and accommodates up to 250 attendees;

In addition to distributing workshop material through the Los Angeles Stormwater website, the DC WMG also set up a web site where interested persons could upload project proposals. This facilitated community inputs into the project development process.

1.5 EWMP Overview

In June 2014, the EWMP Work Plan was developed as required as part of the DC WMG EWMP development process per Part VI.C.4.c.iv (page 57) of the MS4 Permit.

The EWMP Work Plan documented the progress thus far in the development of the EWMP by detailing the water quality priorities within the DC WMG, identifying the existing and potential control measures, outlining the approach to identifying additional projects, and outlining the approach to the RAA. The purpose of identifying significant watershed characteristics and presenting an approach was so that stakeholders could become involved, and feedback could be solicited and incorporated into the EWMP.

That EWMP Work Plan was used as the framework for this EWMP. This EWMP provides the results of the efforts outlined in the EWMP Work Plan and includes the relevant previous information as well as the final RAA, projects for implementation consideration, a framework for assessment and adaptive management, cost and financial strategies, and a discussion on legal authority. This EWMP includes the following sections:

- **Water Quality Priorities (Section 2)**
  The receiving waters are identified and characterized based on the available water quality data. Water body Pollutant Classifications are developed so that each water body-pollutant combination can be classified into an appropriate category in order to develop an approach to prioritizing the identified water quality priorities.
- **Reasonable Assurance Analysis Approach (Section 3)**
  The modeling system and approach to conducting the RAA is presented in this section. The modeling system being used by the DC WMG is highlighted along with the process and modeling approach. The spatial domain, time period, water quality, and Best Management Practices (BMPs) model integration are described. Lastly, the output from the RAA is detailed and examples are provided.
- **Watershed Control Measures (Section 4)**
  This section outlines the existing and planned control measures. Watershed control measures consist of both structural and non-structural BMPs. Existing BMPs are identified in order to identify potential regional projects already under way. The current and future minimum control measures are described and presented. Planned regional and distributed projects are presented.
- **EWMP Implementation Schedule (Section 5)**
  This section presents schedules for project implementation and how the RAA predicts the resulting load reductions that are expected to meet TMDL milestones and milestones established in this EWMP to address non-TMDL water quality priorities.
- **Assessment and Adaptive Management Framework (Section 6)**
  This section outlines the assessment and adaptive management framework of the EWMP. This guides the implementation team in the steps to take to assess the effects of the EWMP on water quality and adjust planned projects to achieve the planning and water quality objectives. Additionally, the linkage between the assessment and the reporting requirements of the Permit is also established.
- **EWMP Implementation Costs and Financial Strategy (Section 7)**
  This section summarizes the costs of implementing the EWMP. Cost ranges were developed for the implementation, operation, and maintenance of the selected BMPs. A summary of potential funding sources or strategies to implement the EWMP is also presented.
- **Legal Authority (Section 8)**
  This section demonstrates that Permittees have the necessary legal authority to implement the BMPs identified in the EWMP or the legal authority exists to compel implementation of the BMPs.

2. Water Quality Priorities

Identification of the water quality priorities in the DC WMG is a key component of the EWMP process. Part VI.C.5.a (page 58-60) of the MS4 Permit outlines the pertinent elements of the prioritization process as follows:

1. Water quality characterization (VI.C.5.a.i, page 58) based on available monitoring data, TMDLs, 303(d) lists, storm water annual reports, etc.;
2. Water body-pollutant classification (VI.C.5.a.ii, page 59) to identify water body-pollutant combinations that fall into three MS4 Permit-defined categories;
3. Source assessment (VI.C.5.a.iii, page 59) for the water body-pollutant combinations in the three categories; and
4. Prioritization of the water body-pollutant combinations (VI.C.5.a.iv, page 60).

The three MS4 Permit defined categories are:

- **Category 1** (Highest Priority): Water body-pollutant combinations for which TMDLs are established in Part VI.E (page 141) and Attachment N of the MS4 Permit.
- **Category 2** (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State's Water Quality Control Policy for Developing California's CWA Section 303(d) List (State Listing Policy) and for which MS4 discharges could potentially be contributing to the impairment.
- **Category 3** (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which have exceeded applicable receiving water limitations contained in the MS4 Permit and for which MS4 discharges could potentially be contributing to the exceedance.

The following sections presented below describe the characterization and prioritization of those water body-pollutant combinations (WBPCs) found to be issues in DC WMG.

2.1 Water Quality Characterization

Water quality monitoring data and reports were gathered for the Dominguez Channel water body segments (including the lined portion above Vermont Avenue, the unlined Dominguez Channel Estuary, and the Torrance Lateral), the Machado Lake water body segments (including the Wilmington Drain), and the Los Angeles Harbor (including the Consolidated Slip and Cabrillo Beach). The raw data available was assessed for quality and compiled into a database by wet-weather and dry-weather conditions and locations. Sources for this data included:

- LACDPW Dominguez Channel MS4 NPDES Mass Emission Monitoring;
- AMEC's Port of Los Angeles (POLA) Artesia Pollutograph Study;
- City of Los Angeles Bureau of Sanitation (LABOS) Special Ammonia Sampling and Status and Trends Monitoring Programs in the Dominguez Channel; and
- LABOS Machado Lake Water Quality Monitoring Program and Nutrient TMDL Monitoring Program.

The sampling locations for the data are shown in Figure 2-1 and Figure 2-2. Additional details regarding the available data, including which sampling effort was conducted at each site, are presented in Attachment E.

In addition to the sampling data, additional water and sediment quality monitoring reports were collected and reviewed as part of the characterization and are included in Attachment E.

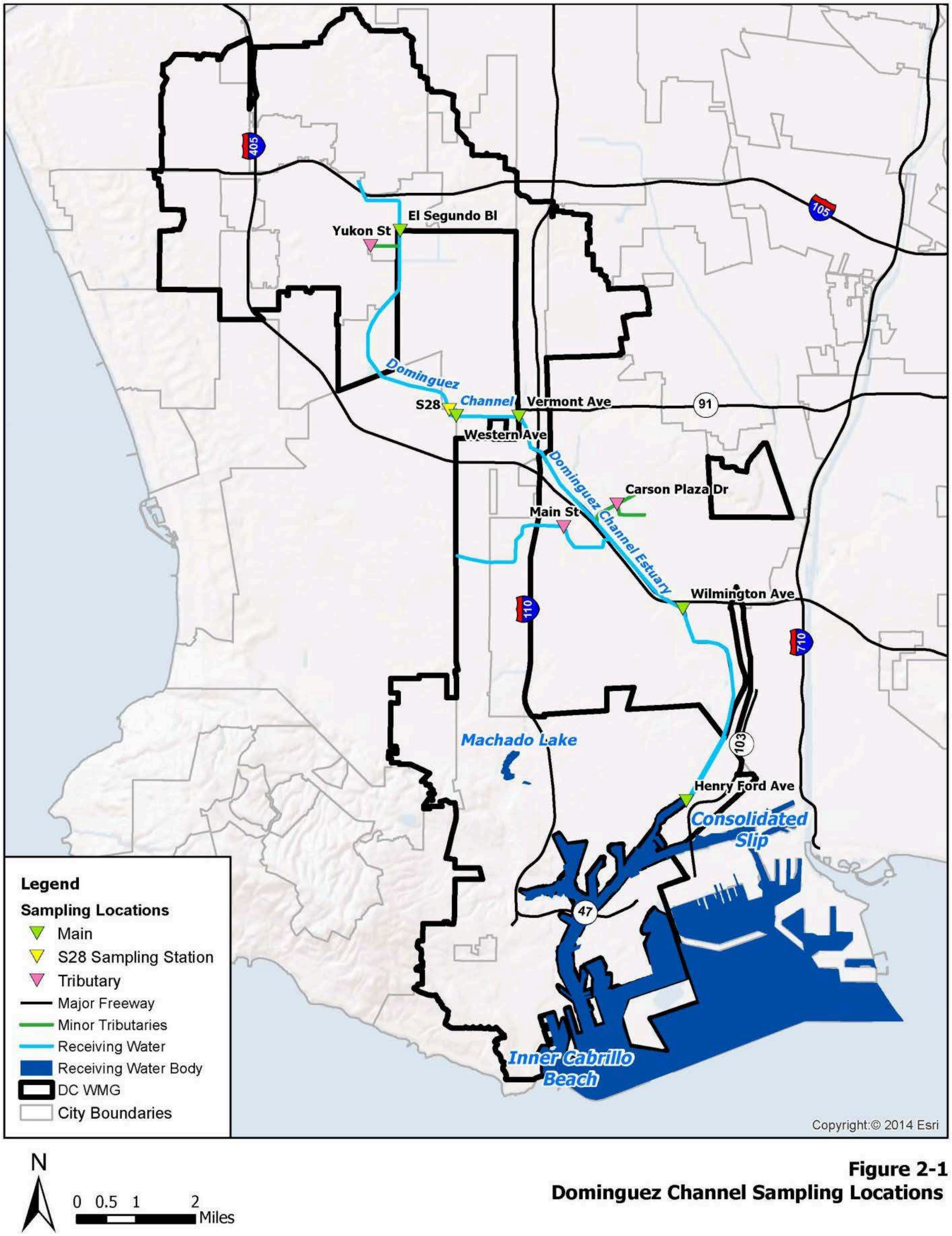


Figure 2-1: Dominguez Channel Sampling Locations

Figure 2-2: Machado Lake Sampling Locations

The data analysis applied screening criteria for potential and existing beneficial uses. In doing so, water quality monitoring samples from the lined portion of the Dominguez Channel were screened against criteria applicable for the protection of REC-1 beneficial uses, which is a potential beneficial use for this receiving water, in addition to criteria for the protection of aquatic life. Criteria for the protection of human health for the consumption of organisms only were applied to segments with either existing or potential REC-1 beneficial uses under both dry- and wet-weather conditions. Where human health criteria were not applicable or established, chronic water quality criteria for the protection of aquatic life were applied to dry-weather samples and acute water quality criteria were applied to wet-weather samples to account for the shorter exposure period consistent with TMDLs in the region.

Water body segments were classified as either freshwater or saltwater to apply the correct WQOs. The lined portion of the Dominguez Channel, as well as tributaries (i.e., the Torrance Lateral), were classified as freshwater, while portions of the Los Angeles Harbor were classified as marine (saltwater). Due to tidal influence in the estuarine portion of the WMA and a lack of salinity data at the sampling locations in the Estuary, water quality samples from the Estuary were screened against both salt and freshwater criteria and the more stringent of the two criteria under the physical conditions at the time of sampling was used. Future confirmation of the salinity level at these monitoring locations can further refine these assumptions.

Hardness measurements at the time of sampling were used to calculate hardness-dependent dissolved metals WQOs. When hardness was not recorded, the median hardness for dry-weather samples at each sample site was used for dry-weather conditions and a value of 50 mg/L was used for wet-weather based on the hardness used in the TMDL for Toxic Pollutants in the Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters.

2.1.1 Characterization of Receiving Water Quality

Statistical summaries of the water quality monitoring (raw) data are presented in Attachment E. Tables of the observed exceedances over the monitoring period and exceedances over the past five years (starting in January 2008) are included in Attachment E. For details on the WQOs utilized to measure exceedances, refer to the Attachment E.

The monitoring reports reviewed during the water quality characterization were for the Dominguez Channel, Machado Lake and Los Angeles Harbor areas. For those programs that investigated sediment quality, exceedances of the Effect Range Low (ERL) sediment quality thresholds were used to assess water body impairment. It was also noted if chemical concentrations exceeded the higher Effect Range Median (ERM) threshold. Significant findings from these reports are summarized in Table 2-1, Table 2-2, and Table 2-3 for the Dominguez Channel water body segments, Machado Lake water body segments, and the Los Angeles Harbor water body segments respectively.

Table 2-1: Summary of Exceedances for Monitoring Programs for the Dominguez Channel			
Water Body	**Program**	**Date Range**	**Exceedances**
Dominguez Channel	LACDPW NPDES MS4 Stormwater Monitoring	2008-2013	Wet-weather: Copper (diss.), Lead (diss.), and Zinc (diss.), Cyanide, Fecal coliforms, pH Dry-weather: Cyanide, Fecal coliforms, E. coli, pH
	LACDPW NPDES MS4 Stormwater Monitoring	2002-2008	Wet weather: Copper (diss.), Lead (diss.), and Zinc (diss.)
	LACDPW NPDES MS4 Stormwater Monitoring	2002, 2003, 2005	Water column toxicity
	LACDPW NPDES MS4 Stormwater Monitoring	Pre- 2005	Diazinon
	SWAMP	2003	pH
	Consolidated Slip Restoration Project Concept Plan Supplemental Report	2002	Sediment (ERM): Zinc
Torrance Lateral	LACDPW NPDES MS4 Stormwater Monitoring	2008-2012	Wet-Weather: Copper (diss.), Lead (diss.), and Zinc (diss.), Cyanide, Fecal coliforms, pH Dry-Weather: Fecal coliforms, pH, ammonia
	Consolidated Slip Restoration Project Concept Plan Supplemental Report	2002	Sediment (ERM): Lead, Zinc, DDT, PCBs, and PAHs
Dominguez Channel Estuary	Consolidated Slip Erosion Study	2011	Sediment (ERM): Chromium, Copper, Lead, Zinc, Mercury, Silver, DDT, PCBs, Chlordane, Dieldrin Sediment (ERL): Arsenic, Cadmium, Chromium, Copper, Lead, Zinc, Mercury, Nickel, Silver, Total PCBs, DDT, PAHs, Chlordane, and Dieldrin
	Surface Water Ambient Monitoring Program (SWAMP) Report	2003	Benthic community effects
	Consolidated Slip Restoration Project Concept Plan Supplemental Report	2002	ERM: Copper, Lead, Zinc, DDT, and PCBs

Table 2-2: Summary of Exceedances for Monitoring Programs for Machado Lake			
Water Body	**Program**	**Date Range**	**Exceedances**
Machado Lake	Machado Lake Nutrients and Toxics TMDL Lake Water Quality Management Plan (Regional Board sediment data set)	2009	Sediment: Chlordane, Total DDT, Total PCBs
	SWAP Report	2003	Dissolved Oxygen
Wilmington Drain	Regional Board Sediment Data	2008	Sediment: Chlordane, Total DDT, Dieldrin
	Wilmington Drain Sediment Characterization Study	2007	Sediment: Chlordane, Total DDT, Total PCBs

Table 2-3: Summary of Exceedances for Monitoring Programs for the Los Angeles Harbor			
Water Body	**Program**	**Date Range**	**Exceedances**
LA Harbor	Southern California Bight Regional Monitoring Program	2008	Sediment (ERL): DDT, Copper
	Southern California Bight Regional Monitoring Program	2003	Sediment (ERL): DDT, Copper, Nickel, Mercury, Sediment Toxicity
Inner Harbor	POLA/POLB Sediment Survey	2006	Copper (diss.), DDT (diss.)
	SWAMP Report	2003	Silver (diss.)
	Southern California Bight Regional Monitoring Program	2003	PCBs
Outer Harbor	City of LA Terminal Island Water Reclamation Plant (TIWRP) Biennial Assessment Report	2010-2011	Sediment (ERL): Cadmium, Copper, Nickel, DDT, Total PCBs
	TIRP Biennial Assessment Report	2008-2011	Total PCBs (tissue), Total DDT (tissue)
	POLA/POLB sediment survey	2006	Copper (diss.), DDT (diss.)
	SWAMP Report	2003	Silver (diss.)
Consolidated Slip	Consolidated Slip Erosion Study	2011	Sediment (ERM): PCBs, DDT, Chlordane, Dieldrin Sediment (ERL): Arsenic, Cadmium, Chromium, Copper, Lead, Zinc, Mercury, Nickel, Silver, Total PCBs, DDT, PAHs, Chlordane, Dieldrin
	SCCWRP Atmospheric Deposition in LA/LB Harbor study	2006	Total DDT (diss.) and Total PCBs (diss.)
	Consolidated Slip Restoration Project Concept Plan Supplemental Report	2002	Sediment (ERM): Copper, Lead, Zinc, Mercury, Total PCBs, DDT, PAHs, Chlordane and Dieldrin

2.1.2 Characterization of Discharge Quality

Stormwater and non-stormwater discharges were characterized based on available data. The available receiving water monitoring data was used to evaluate potential stormwater and non-stormwater discharge data. Water quality data were obtained from the Los Angeles County Department of Public Works (LACDPW), the Port of Los Angeles (POLA), and the City of Los Angeles Department of Public Works, Bureau of Sanitation (LABOS). Monitoring data were available from the mass emission station in Dominguez Channel at Artesia from 2002-2012. Monitoring data from Torrance Lateral leading to Dominguez Channel was available from 2007-2009. Six other tributary's monitoring data were available from 2009-2011. Data from Machado Lake monitoring was available from 2001-2009. Other studies and data were available from studies in the Dominguez Channel estuary, the Consolidated Slip, Inner Harbor, Outer Harbor, Fish Harbor, and the Wilmington Drain, but most studies were for shorter sampling periods. It is important to note that most of these monitoring data were from receiving water sampling stations. In this subsection, discharge water quality is evaluated on the basis of receiving water sampling results. The connection between the effects of discharges on receiving water quality cannot be established until more outfall monitoring data is available. This assessment of discharge quality is tentative and will be confirmed as the Coordinated Integrated Monitoring Program (CIMP) is implemented.

The data were compared to water quality criteria to evaluate the number of exceedances. These are reported in Attachment E. In summary in the Dominguez Channel and Torrance Lateral:

- Wet weather samples exceeded dissolved metals hardness-adjusted CTR criteria for copper, lead, and zinc. No exceedances were observed for the three metals during dry weather. No exceedances were observed for dissolved cadmium, chromium, mercury, nickel, selenium, or silver during wet or dry weather during this time period.
- Water column toxicity was observed. Inhibited *Ceriodaphnia dubia* survival occurred during the 2002, 2003, and 2005 wet weather events, with 6 of 14 wet weather sampling events and one of 14 dry weather sampling events showing toxicity.
- Diazinon exceeded chronic California Department of Fish and Wildlife freshwater assessment criteria in 5 of 21 samples and acute criteria in 3. No exceedances occurred after 2005, which was following the EPA's de-registration of the pesticide.
- The Torrance Lateral sampling station showed exceedances of acute CTR criteria for dissolved copper (8 of 10) and dissolved zinc (9 of 10) during wet weather conditions in 2008 and 2009. Dissolved lead did not exceed CTR acute criteria in wet weather, and no exceedances of chronic CTR water quality criteria were observed in dry weather samples.
- Exceedances of water quality criteria occurred in the six tributary sampling stations for Ammonia, Cyanide, Dissolved copper, Dissolved lead, Dissolved Oxygen, Dissolved zinc, E. coli, and Fecal coliform.
- During the 2003 SWAMP, the Dominguez Channel samples had high levels of bacteria and pH values exceeding Basin Plan objectives. The estuarine portion of the Channel showed adverse impacts to benthic communities with 3 of 5 stations classified as being in poor condition. For Machado Lake, it was found that the stations at the northern end of the Lake, most likely influenced by Wilmington Drain, had more fine grained sediment, dissolved oxygen below the Basin Plan objective of 5 mg/L, low pH, and high ammonia and nitrate. Chlorophyll-a was highest in the southern end and lowest in the northern end. No acute or chronic toxicity was detected throughout the lake. The station closest to the Wilmington Drain in the north had the highest sediment concentrations of metals. Organic pollutants such as PAHs were highest at the southern stations. Harbor sampling sites had elevated copper and silver concentrations in water samples at all stations and exceedances of silver CTR water quality objectives at six of 30 stations located within both the Inner and Outer Harbor areas. Other metals were well below water quality objectives.

- During various studies of estuary and harbor sediments, exceedances of the Effects Range Medium (ERM) and/or Effects Range Low (ERL) thresholds were observed for DDT, DDD, DDE, PCBs, chlordane, Dieldrin, metals (arsenic, cadmium, chromium, copper, lead, zinc, mercury, nickel, and silver), and/or PAHs were observed.
- Machado Lake sediment datasets showed sediment concentrations of total chlordane, total DDT and total PCBs above the sediment targets set in the Machado Lake Pesticides and PCBs TMDL. Wilmington Drain sediment data sets showed elevated levels of total DDT, PCBs, and Chlordane.

2.2 Water Body Pollutant Combinations

Using the data analyses and results from additional monitoring reports, WBPCs were classified into one of the three MS4 Permit categories (Category 1-3). Those WBPCs with a TMDL were classified as Category 1, those WBPCs listed on the State's 303(d) list as impairing a particular water body segment were classified as Category 2, and those remaining WBPCs without an associated TMDL or on the State's 303(d) list, but showing exceedances of water quality criteria were classified as Category 3. A summary of these categorizations is presented in Table 2-4. To assist with future prioritization efforts, the categorized WBPCs were divided into the subcategories described in Attachment E. The subcategorized WBPCs for DC WMG, Torrance Lateral, Dominguez Channel Estuary, Machado Lake, Wilmington Drain, the Consolidated Slip, and the rest of the Los Angeles Harbor areas are listed in Attachment E.

Table 2-4: Categorized Water Body-Pollutant Combinations

Water Body	Category 1 (TMDL)	Category 2 (303(d) List)	Category 3 (Other)
Dominguez Channel (lined portion above Vermont Ave)	Copper (diss.), Lead (diss.), Zinc (diss.), Toxicity	Indicator Bacteria, Ammonia, Diazinon	Cadmium(diss.), Chromium (diss.), Mercury (diss.), Thallium (diss.), Bis (2-Ethylhexl) phthalate, pH, Dissolved Oxygen
Torrance Lateral	Copper (diss.), Lead (diss.), Zinc (diss.)	Coliform Bacteria	Cadmium (diss.), Cyanide, pH, Ammonia, PCBs (sed.), DDT (sed.)
Dominguez Estuary (unlined portion below Vermont Ave)	Cadmium (sed.), Copper (diss. and sed.), Lead (diss., sed., & tissue), Zinc (diss. & sed.), DDT (tissue & sed.), PCBs (sed.), Chlordane (tissue & sed.), Dieldrin (tissue & sed.), PAHs (sed.), Benthic Community Effects, Sediment Toxicity	Ammonia, Coliform Bacteria	Arsenic (sed.), Chromium (sed.), Silver (diss. & sed.), Nickel (diss.), Mercury (sed.), Thallium (diss.)
Machado Lake	Trash, Total Phosphorus, Total Nitrogen, Ammonia, Chlorophyll-a, PCBs (sed.), DDT (sed.), Chlordane (sed.), Dieldrin (sed.), Dissolved Oxygen	None	E. coli, pH
Wilmington Drain	None	Coliform Bacteria, Copper (diss.), Lead (diss.)	Total Nitrogen, DDT (sed.), PCBs (sed.), Chlordane, Dieldrin (sed.)

Table 2-4: Categorized Water Body-Pollutant Combinations			
Water Body	**Category 1 (TMDL)**	**Category 2 (303(d) List)**	**Category 3 (Other)**
LA Harbor[1] - Cabrillo Marina	DDT (tissue & sed.), PCBs (tissue & sed.), PAHs	None	None
LA Harbor[1] - Consolidated Slip	Cadmium, Chromium, Copper, Lead, Mercury, Zinc, DDT (tissue & sed.), PCBs (tissue & sed.), PAHs (sed.), Chlordane (tissue & sed.), Dieldrin, Toxaphene (tissue), Benthic Community Effects, Sediment Toxicity	None	Arsenic, Silver, Nickel
LA Harbor[1] - Fish Harbor	Copper, Lead, Mercury, Zinc, DDT (tissue & sed.), PCBs (tissue & sed.), Chlordane, PAHs, Sediment Toxicity	None	None
LA/LB Inner Harbor[1]	Copper, Zinc, DDT (tissue & sed.), PCBs (tissue & sed.), PAHs, Benthic Community Effects, Sediment Toxicity, Indicator Bacteria	None	Copper (diss.), Silver (diss.)
LA/LB Outer Harbor[1]	DDT (tissue & sed.), PCBs (tissue & sed.), Sediment Toxicity	None	Cadmium, Nickel, Silver (diss.), Copper (diss. & sed.), Mercury
LA Harbor[1] - Inner Cabrillo Beach	Indicator Bacteria, DDT (sed. & tissue), PCBs (tissue & sed.)	None	None

[1] Los Angeles Harbor metals and organic WBPCs are for sediment unless otherwise noted.

2.3 Source Assessment

A catchment priority index (CPI) method was employed to assess sources and identify areas where BMP implementation should be prioritized to have the greatest short and long term effects. CPI is a means of ranking sub-watersheds against one another based on land use to identify the higher priority watersheds as demonstrated in Figure 2-3. The method is based on Event Mean Concentrations (EMCs) developed for different land use types and the areal weighting of different land uses within a given subwatershed. The subwatersheds are ranked against one another to develop a CPI score for each subwatershed. The watersheds with the highest score are considered the highest priorities. This CPI analysis allows one to start from a watershed level and focus on the subcatchments that are likely to be contributing the greatest load of pollutants for BMP implementation and/or monitoring.

2.3.1 Catchment Priority Index

The analysis was completed using the GIS platform ArcGIS. The GIS analysis was based on data developed by the City of Los Angeles and the County of Los Angeles. Within each subcatchment, priority pollutants such as metals (and nutrients in Machado) were weighted the highest. Additional weight was given to sub-watersheds potentially contributing to water body segments with TMDLs or 303(d) listed impairments for particular pollutants. This was used for establishing where to prioritize BMP placement in the long range plan to achieve the greatest benefit as soon as possible during the planning horizon.

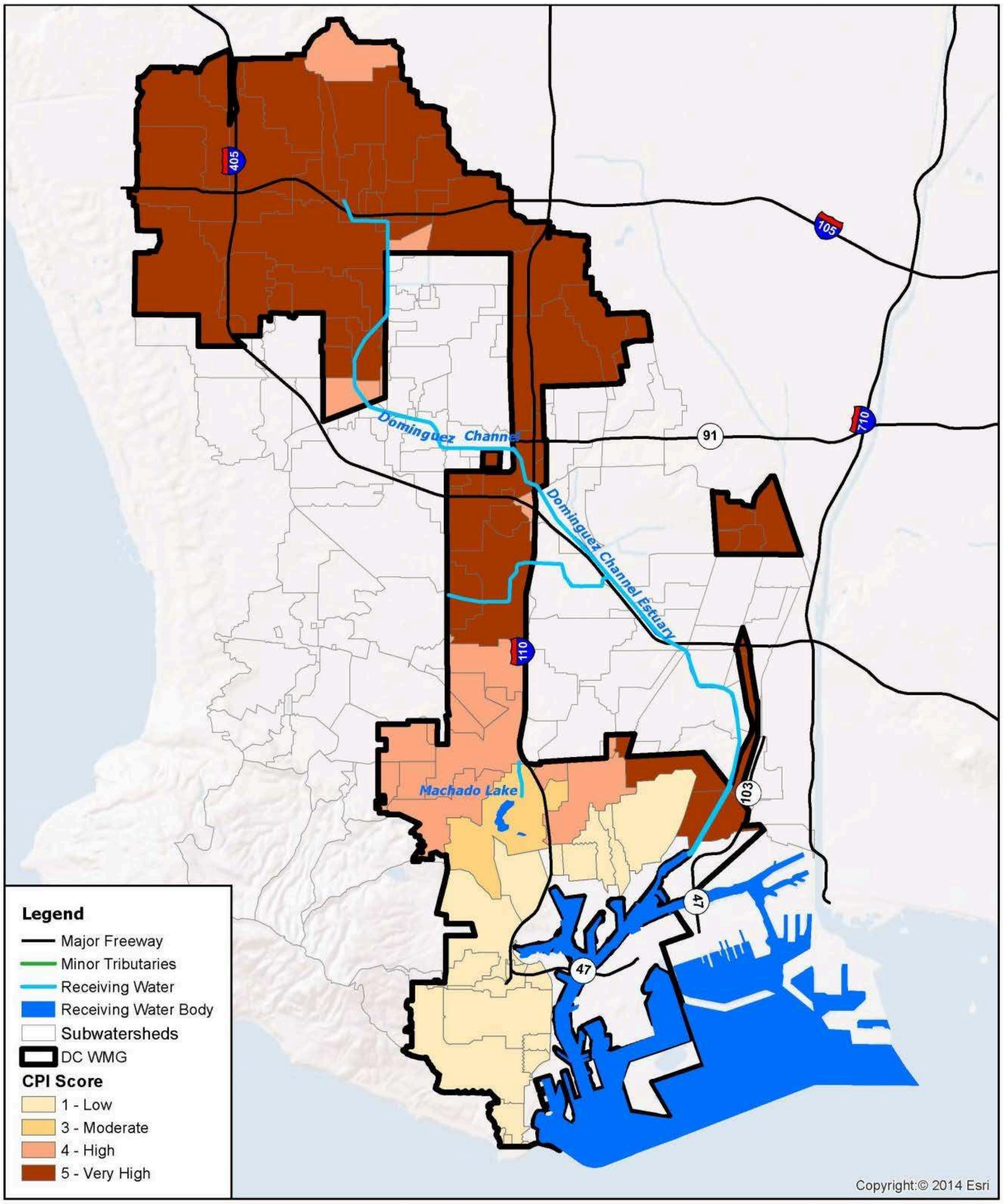


Figure 2-3: Catchment Prioritization Index (CPI) Map

2.3.2 Potential Sources of Contamination

There are several potential point and nonpoint sources of contamination in the DC WMG. Point sources include stormwater and urban runoff flowing through the MS4 as well as other MS4 discharges, such as those from refineries, generating plants, port operations, and the Terminal Island Water Reclamation Plant that discharges into the Outer Harbor. Major MS4 outfalls are shown in Figure 2-4. Nonpoint sources include contaminated sediments already in receiving waters and atmospheric deposition.

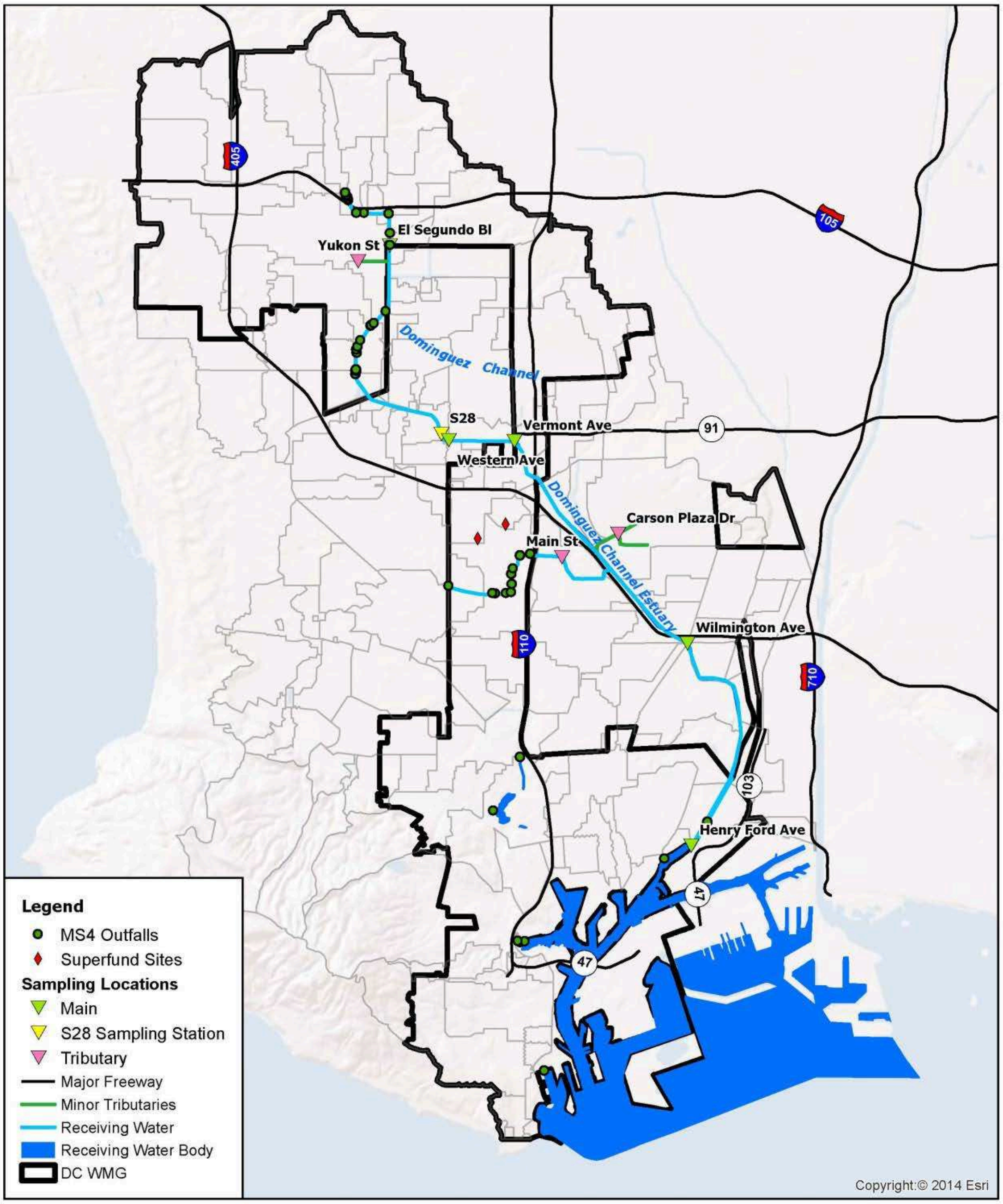


Figure 2-4: MS4 Locations Map

The DC WMG also contains two Superfund Sites that have historically been large contributors of organic pollutants: the Montrose Chemical Corporation Site, and the Del Amo Facility Site. The Montrose site manufactured DDT from 1947 to 1982 and the compound can still be found in the soils around the site. Stormwater runoff from this site, if exposed, can contain DDT from the soils. The site currently is paved with a maintenance plan under an Initial Action taken under USEPA oversight in 1985. The Del Amo Facility was once the center of large-scale production of synthetic rubber, which included a styrene plant and a butadiene plant. Groundwater and soils in the area are contaminated with volatile organic compounds (VOCs), PAHs, and minor amounts of pesticides, PCBs, and heavy metals. Most of the Del Amo facility has been redeveloped into an Industrial park and surficial soils are generally not exposed. The Del Amo pits site, where manufacturing wastes were disposed, was covered with a Resource Conservation Recover Act (RCRA) equivalent hazardous waste cap in 1999. The two Superfund Sites are located next to each other near the Torrance Lateral as shown Figure 2-4.

2.4 Approach to Prioritization

To complete an initial prioritization of the WBPCs, pollutants were sub-categorized based on TMDL compliance schedules and exceedance frequencies as outlined in Section 2.2. Those WBPCs that have TMDLs with past due interim and/or final deadlines or with interim and/or final deadlines within the MS4 Permit term will be prioritized higher than those pollutants with TMDL schedules outside the MS4 Permit term. Other receiving water considerations included pollutants on the 303(d) list and WBPCs that show exceedances within the last 5 years.

The water quality issues identified for the Dominguez Channel, Machado Lake, and the LA Harbor are expected to be addressed with the BMPs designed to address existing TMDLs. This is based on chemical similarities between constituents in which their fate and transport would be expected to behave similarly to pollutants addressed by TMDLs.

2.5 Compliance Schedule

Compliance schedules with applicable milestones were developed for the receiving water bodies in the DC WMA. Attachment E shows the detailed schedules and Table 2-5, found at the end of this section, presents a simplified final compliance schedule. For constituents addressed by a TMDL (Category 1), the compliance schedules are outlined below. Category 2 (303(d) List) and Category 3 (Other) constituent's loads are expected to be reduced by the BMPs implemented to address TMDLs. If not, those pollutants will be fully addressed by 2040 by additional BMPs to be planned in the 2032 EWMP revision.

Dominguez Channel
The DC/Harbor Toxics TMDL addresses metals, historical organics, and current organics. The DC/Harbor Toxics TMDL contains three implementation phases for the Dominguez Channel, Torrance Lateral, and Dominguez Channel Estuary, and three implementation phases for the Greater Los Angeles and Long Beach Harbor Waters (including Consolidated Slip). The Phases are summarized as follows:

- Phase I: Reduce sediment transport from point sources and implement watershed-wide actions.
- Phase II: Implement additional BMPs and site remedial actions based on the success of upstream source control, evaluation of TMDL monitoring data collected during Phase I, and target point source reduction activities.
- Phase III: Implement secondary and additional remedial actions as necessary to be in compliance with final allocations by the end of the implementation period.

These implementation phases are not assigned interim targets in the DC/Harbor Toxics TMDL, but they do provide implementation milestones that can be attributed to other constituents in a similar class (e.g., metals, historical organics, and current organics) that are not addressed in the TMDL. Phase I will be achieved through enhanced street sweeping, catch basin cleanouts, installation of full capture devices and inspection and enforcement. Through the EWMP process, the DC WMG is working collaboratively and has developed a detailed plan of action to address the TMDL limits. The DC WMG has set numeric milestones in this EWMP based on the amount of water that needs to be captured by EWMP projects. These milestones factor into the time needed to establish a construction program to implement the projects. The DC WMG's planned load reduction milestones are:

- Milestone 1: 50 percent reduction to the receiving water limitation in the constituent for which there is a TMDL compared to a baseline established through the RAA Process in Section 3.3 by 3/23/2026.
- Milestone 2: 75 percent reduction to the receiving water limitation in the constituent for which there is a TMDL compared to a baseline established through the RAA Process in Section 3.3 by 3/23/2029
- Milestone 3: Attainment of established receiving water limitations in the constituent which there is a TMDL by 3/23/2032.

Those constituents on the 303(d) list, for which a TMDL has not yet been established, would normally require the development of a TMDL. Because a large portion of the data used for the Water Quality Priorities portion of the EWMP was more than five years old, additional monitoring under the CIMP is recommended as an initial milestone. This will help to assess whether exceedance issues are current and in need of further action or if implementation programs established for DC/Harbor Toxics TMDLs are already addressing the remaining constituents. It is expected that the sediment management measures and BMPs that will be implemented through the DC/Harbor Toxics TMDL will also reduce the remaining constituents. Progress toward reducing exceedances of these constituents can be monitored through the CIMP and will be assessed under the adaptive management framework as outlined in Section 6.

During the development of the DC/Harbor Toxics TMDL, the U.S. EPA found that Diazinon, a constituent currently on the 2010 303(d) list for the Dominguez Channel, was not at levels above water quality benchmarks for this water body. The assessment concluded that the water body was attaining standards for Diazinon and did not require the development of a TMDL for that pollutant. Since its de-registration in 2005, Diazinon levels have decreased in the Dominguez Channel and appear to no longer be the cause of impairment to the water body. Diazinon will continue to be monitored under the CIMP efforts, and monitoring results will be used to evaluate whether specific actions are needed to address this constituent.

The U.S. EPA determined that ammonia levels in the Dominguez Channel and the Dominguez Channel Estuary were meeting water quality objectives (NOAA, 1999). This constituent remains on the 2010 303(d) list for these water bodies, though the State may consider delisting it during the next 305b/303d Integrated Report. For this reason, ammonia remains a water quality priority, but is assumed to be in compliance with water quality objectives. Ammonia will continue to be monitored under the CIMP efforts, and monitoring results will be used to evaluate whether specific actions are needed to address this constituent.

If Category 2 or 3 constituents show ongoing exceedances, an action plan will be developed to identify and mitigate sources of those pollutants within the time frames shown in Attachment E. Progress toward reducing loading of the constituents will be assessed at the end of Milestone 1, and, if necessary, treatment measures for these constituents will be identified.

Machado Lake

Machado Lake will achieve its final trash TMDL deadline of 3/6/2016 through the installation of full capture devices or their equivalent. The Lake will achieve its final nutrient TMDL of 9/11/2018 through the Machado Lake restoration and the replacement of lake water with highly treated water from the Terminal Island Water Reclamation Plant. It will achieve its final toxics TMDL of 9/30/2019 through the Machado Lake and Wilmington Drain restorations, which will remove the residual sediments and associated constituents. Upstream capture devices installed in response to the Trash TMDL and street sweeping activities will reduce discharge of constituents associated with sediments. Monitoring through the CIMP will verify effectiveness. For ongoing nutrient discharges from upstream sources, highly purified water from the Terminal Island Water Reclamation Plant will be used to blend down the nutrient levels to achieve the receiving water limitation in the lakes. Upstream sources will be reduced through the implementation of BMPs associated with achieving receiving water limitations in the Wilmington Drain.

Bacteria is a category 3 pollutant for Machado Lake. Ongoing monitoring through the CIMP will evaluate the frequency and persistence of exceedances. BMPs will be implemented to achieve the water quality criteria by 2040.

Wilmington Drain

No TMDL has been established for the Wilmington Drain, though one for coliform bacteria and one for metals (dissolved copper and dissolved lead) were scheduled to be issued in 2014 and 2019, respectively. During the renegotiation of the Montrose Superfund Site Consent Decree (NOAA, 1999), the U.S. EPA determined that metals in the Wilmington Drain were meeting water quality objectives and that TMDL development was not necessary at that time. Metals remain on the State's 2010 303(d) list for the Wilmington Drain, but may be considered for delisting during the next 305b/303d Integrated Report. Both metals and bacteria will be monitored through the CIMP and will be addressed through TMDL development or in accordance with the approach outlined for constituents not addressed by a TMDL that are not in the same chemical class as those constituents addressed by a TMDL.

Other constituents that showed exceedances of water quality objectives for the Wilmington Drain, but are not on the State's 303(d) list, include total nitrogen and historical organics (DDT, chlordane, Dieldrin, and PCBs).

Because no pollutants in the Wilmington Drain are Category 1, but, instead, are Category 2 and 3, BMPs to achieve water quality objectives for metals and organic toxic pollutants from sources to the Wilmington Drain will be implemented along the same timeframe as those for Machado Lake. If needed, BMPs to achieve water quality criteria for bacteria will be phased in, with ultimate achievement of water quality criteria for bacteria planned in 2040.

An implementation schedule to achieve water quality criteria is provided in Section 5 and explanations of how the schedules were determined are in Section 3.

Los Angeles Harbor Waters

The DC/Harbor Toxics TMDL contains three implementation phases for the Greater Los Angeles and Long Beach Harbor Waters (including Consolidated Slip). The DC WMG has set milestones for achieving load reductions. These implementation phases load reduction milestones are the same as are summarized above for the Dominguez Channel.

The LA Harbor Bacteria TMDL addressed bacteria exceedances in Inner Cabrillo Beach and portions of the Los Angeles Harbor. Monitoring will continue at this site and the Main Ship Channel. The City of Los Angeles has filed a Time Schedule Order for the Inner Cabrillo Beach. Compliance targets have been attained at the Main Ship Channel as there have been zero exceedances at this site.

Table 2-5: DC WMA Receiving Water Bodies Final Compliance Schedule				
Water Body	**Category 1 (TMDL)**			**Category 2 (303(d) List) & 3 (Other)**
	50%	75%	100%	100%
Dominguez Channel (lined portion above Vermont Ave)	2026	2029	2032	2040
Torrance Lateral	2026	2029	2032	2040
Dominguez Estuary (unlined portion below Vermont Ave)	2026	2029	2032	2040
Machado Lake	2019*	2019*	2019*	2040
Wilmington Drain	None	None	None	2040
LA Harbor - Cabrillo Marina	2026	2029	2032	None
LA Harbor -Consolidated Slip	2026	2029	2032	2040
LA Harbor -Fish Harbor	2026	2029	2032	None
LA/LB Inner Harbor	2026	2029	2032	2040
LA/LB Outer Harbor	2026	2029	2032	2040
LA Harbor - Inner Cabrillo Beach	2026	2029	2032	None

*Machado Lake is 2016 for trash, 2018 for nutrients, and 2019 for toxics.

3. Reasonable Assurance Analysis Approach

As specified in Part VI.C.1.g of the MS4 Permit, an EWMP comprehensively evaluates the opportunities that, wherever feasible, retain all non-stormwater, such as overflow irrigation, and stormwater runoff from the 85th percentile, 24-hour storm event from the tributary watershed. These projects are also referred to as regional EWMP projects. Areas that drain to regional EWMP projects are considered in compliance with all water quality standards. For the remaining areas, an RAA must be conducted to demonstrate that selected BMPs provide reasonable assurance that applicable WQBELs and RWLs will be attained.

This section explains the methodology of the RAA for the DC WMG EWMP. The RAA developed by the DC WMG is in conformance with the RAA Guidelines developed by the Regional Board.

Attachment F discusses in detail the model setup, calibration and validation process associated with stormwater flow through the system and the corresponding water quality. The incremental approach for demonstrating compliance with MS4 Permit requirements is also discussed and includes the implementation of modified MCMs, industrial and other permitted sites, regional BMP projects, and green streets. A cost estimate and schedule for implementation have been developed for inclusion in the EWMP based on the RAA and are provided in later sections of this document.

The purpose of the RAA is to demonstrate that the implementation scenarios proposed in the EWMP will meet the applicable WQBELs and RWLs within the DC WMG. This is done by demonstrating load reductions for the 85th percentile 24-hour storm and the 90th percentile load. Typically, the 85th percentile, 24-hour storm event volume is addressed by regional projects. The 90th percentile load criteria was used to propose other control measures, as addressing the 90th percentile load provides reasonable assurance with meeting water quality objectives. Capture of the 90th percentile 24-hour load and volume provides a high threshold for constituent loads to not escape the BMPs. More detail is provided in the following sections on selection of the appropriate storm/load for this criterion and the expected load reductions and constituent concentrations after the BMPs associated with this criterion are implemented. In many cases, 90th percentile loads with similar volumes to the 85th percentile 24-hour storm volume provide a double assurance that loads will meet RWQCB permit requirements and water quality objectives.

3.1 Modeling System

The RAA for the DC WMG was conducted using the BMP modeling system Watershed Management Modeling System (WMMS). WMMS is a regional model developed by the LACFCD and is comprised of two main components: Loading Simulation Program in C++ (LSPC) and the Regional Optimization system. The Regional Optimization system was not used while conducting the DC WMG RAA. LSPC was developed from the Hydrologic Simulation Program - FORTRAN (HSPF) used for simulating hydrology, sediment, and general water quality. The model generates runoff based on rainfall, snow, and groundwater inputs, estimates pollutant loading and transport based on point source data, aerial deposition, and non-point source loadings, estimates chemical and transport interactions within stream reaches, and can provide water quality data based on the interactions for specified locations. WMMS and the LSPC modeling component are included in the list of approved watershed models for conducting a RAA outlined in Part VI.C.5.b.iv.(5) of the MS4 Permit.

Additional information regarding WMMS and LSPC is available from the Los Angeles County Department of Public Works (LACDPW) (2008, 2010a, 2010b, 2010c, 2011, 2013). Information pertaining to LSPC is available from the United States Environmental Protection Agency (USEPA, 2003). The documents can be found on the WMMS homepage (http://dpw.lacounty.gov/wmd/wmms/) where it can also be downloaded.

3.2 RAA Process Approach

The following sections discuss the RAA process approaches for wet weather and dry weather.

3.2.1 Dry-Weather RAA Approach

The approach to the dry-weather portion of the DC WMG RAA was to evaluate the volume and sediment reduction potential provided by proposed regional and distributed BMP projects to estimate how much of the dry-weather flows would be addressed. This approach does not include the use of a hydrologic predictive model due to data set limitations and significant spatial variation throughout the DC WMG for dry-weather flows. Estimated daily yields were derived from local dry-weather flow monitoring data collected at the existing Mass Emissions site (MES) S28 (illustrated in Figure 2-1) and is summarized in Table 3-1. The monitoring data collected at S28 was analyzed to determine an average discharge per acre ratio per month for the period of analysis (2002-2012). The resulting monthly averages were then applied to the DC WMG area to identify the volume per day generated within the group area. The flows presented in the table represent existing conditions and do not take into account the control measures proposed in this EWMP.

Table 3-1: Average Monthly Dry-Weather Flow in DC WMG

Month	Average Flow (cfs)/Acre	DC WMG Volume per Day (acre-feet/day)
January	0.00026	19.41
February	0.00032	23.89
March	0.00033	24.64
April	0.00035	26.13
May	0.00025	18.66
June	0.00041	30.61
July	0.00030	22.4
August	0.00024	17.92
September	0.00022	16.42
October	0.00027	20.16
November	0.00020	14.93
December	0.00022	16.42

Flows captured through regional BMP implementation were subtracted from the total assumed non-stormwater flows (presented in Table 3-1) to quantify pollutant load reductions. The BMPs used for this analysis are discussed further in Section 4. Based on the volume of storage provided by the proposed regional BMPs, the dry-weather flows will be eliminated, as encouraged by the MS4 Permit. The volume provided by the proposed control measures is significantly greater than the volume of dry-weather runoff produced within the DC WMG.

3.2.2 Wet-Weather RAA Approach

The wet-weather RAA approach allowed for estimating the level of BMP implementation needed to meet applicable WQBELs and RWLs. This approach incorporated pollutant prioritization and structural BMP implementation scenarios, while considering stakeholder input through a transparent process.

The wet-weather RAA approach involved the estimation of both the existing pollutant loads (baseline) and target load reductions as a percentage of the total load. WMMS provided optimized load reduction targets, recommended distribution of BMPs, and cost estimates.

Once the baseline conditions were estimated, watershed control measures were selected and modeled to be implemented over time to meet applicable WQBELs and RWLs. The selected control measures, such as regional BMP projects, distributed BMPs (green streets), and MCMs, were then modeled at various stages within the implementation time frame to estimate the quantity, location, and timing of BMP implementation to meet the interim and final WLAs applicable to the DC WMG. Targets for the RAA are based on interim time steps throughout the MS4 Permit time frame.

The Category 1, 2, and 3 pollutant loads were assessed – either directly based on the loading functions in WMMS, or indirectly, based on their similar fate and transport properties to the pollutants for which there are loading functions in WMMS. Trash was not explicitly modeled because trash will be addressed through the installation of full capture or equivalent devices as required by the Machado Lake Trash TMDL by 2016. Bacteria was modeled, however, it is not the limiting pollutant based on high flow suspension and allowable exceedance days. The limiting pollutant is that one pollutant that, when its load is reduced to the planning objectives, all other pollutants are commensurately reduced to their planning objectives in the same collection of BMPs.

3.3 Modeling Approach

Demonstrating compliance through the RAA is an iterative process. The model includes different BMP scenarios at the compliance time steps and different approaches to BMP implementation are modeled to evaluate the most cost effective approach. The iterative process involves model calibration, model validation, baseline simulation, evaluation of the limiting pollutant, evaluation of required volume and load reductions, and control measure implementation, all of which are further detailed in Attachment F. A brief overview is presented in the sections below.

3.3.1 Model Calibration

LSPC Calibration

Calibration refers to the adjustment or fine-tuning of modeling parameters to reproduce model outputs that match, within some tolerable variance, observations of field monitoring data. The goal of the LSPC model calibration was to obtain physically realistic model predictions by selecting parameter values that reflect the unique characteristics of the DC WMA. Spatial and temporal aspects were evaluated through the calibration process. Model calibration and validation were necessary to demonstrate the calibrated model properly assessed all the model parameters and modeling conditions that can affect model results for hydrologic and water quality analyses. The Regional Board provided acceptable model calibration criteria in Table 3.0 of the RAA Guidelines.

Water Quality Calibration

The LACFCD operates the Los Angeles County Monitoring Program to provide technical data and information to support effective watershed stormwater quality management programs in Los Angeles County which includes MES S28. MES are equipped with automated water samplers and stage recorders that collect both composite and grab samples during storm events. The subwatershed tributary to MES S28 is comprised of 42 subbasins within the greater DC WMA. Although MES S28 is located in the upper half of the DC WMA, the subwatershed land use and hydrological characteristics are representative of the entire DC WMA with respect to water quality constituent composition and concentrations. As more water quality data is collected through the CIMP, validation and fine tuning of the water quality parameters may be possible. The data collected at MES S28 is collected as an event mean concentration (EMC), which is done by either collecting one sample throughout the event or combining multiple samples collected throughout time into a combined sample for lab analysis. One sample represents the mean concentration for that event, which is generally 24 hours or more. The model then simulates daily outputs and the simulated daily values are averaged over the time frame of the observed rain event. For example, an observed rain event may last two to three days and the observed EMC is derived from the number of samples collected (at the particular location) and mixed together and averaged over the length of event. The simulated results are taken from the same time period and averaged to derive a simulated EMC.

Note that this calibration does not take into account any mixing in the estuary or harbor that may occur. Monitoring data of sufficient time periods is not available for calibration at those points.
The model used for the DC WMG RAA was calibrated based on the following water quality calibration parameters.

- Total Suspended Solids (TSS)
- Metal parameters – copper, lead, and zinc
- Fecal coliform
- Total nitrogen and total phosphorus

Fecal coliform was used rather than E. coli because there are modeling parameters established for fecal coliform, but not E. coli.
Historical organics, such as PCBs and DDT, are often correlated to sediments. Relationships between TSS and historical organics were evaluated to determine if TSS could be used as a surrogate. As there are significant non-detects in the available water quality data, a relationship between historic organics and TSS could not be established in the available Dominguez Channel monitoring data. Other studies have shown that relationship between TSS and historical organics can exist; however, the water quality depends on the storm event, soil disturbance, and other factors. Historical organics are typically deposited over time in water bodies with low velocities. Removing the accumulated sediments will help address historic organics and the existing superfund programs and other construction site regulations will reduce the amount of historic organics conveyed to downstream receiving waters. It is expected that organics will not be an issue once the historic sediment deposits are removed. Additionally, the control measures proposed by this EWMP will reduce discharges to these water bodies by capturing flows for infiltration. Legacy organic pollutants will be addressed by capturing the other pollutants throughout the DC WMG.

Dry-weather flows were also calibrated in the initial phases of model calibration. Empirical data was incorporated into the model as point source to simulate dry-weather conditions. Current dry-weather flows are expected to occur until the proposed wet-weather control measures are implemented, which will capture those flows as explained in Section 3.2.1. Once it was determined that wet-weather control measures would address dry-weather runoff, it was no longer considered a major component of the modeling.

The results from the calibration are provided in Figure 3-1 through Figure 3-8. Additional details regarding the calibration process are provided in Attachment F. The figures demonstrate the goodness of fit between the calibrated model and the existing data.

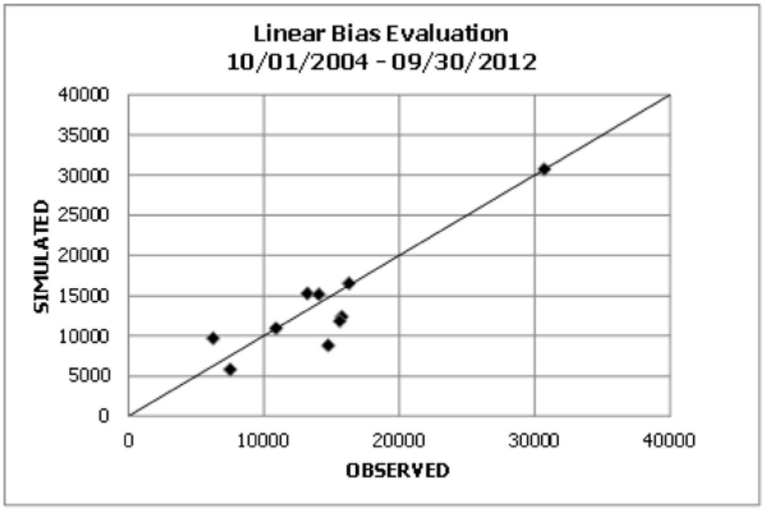


Figure 3-1: Flow Calibration Statistics at MES S28

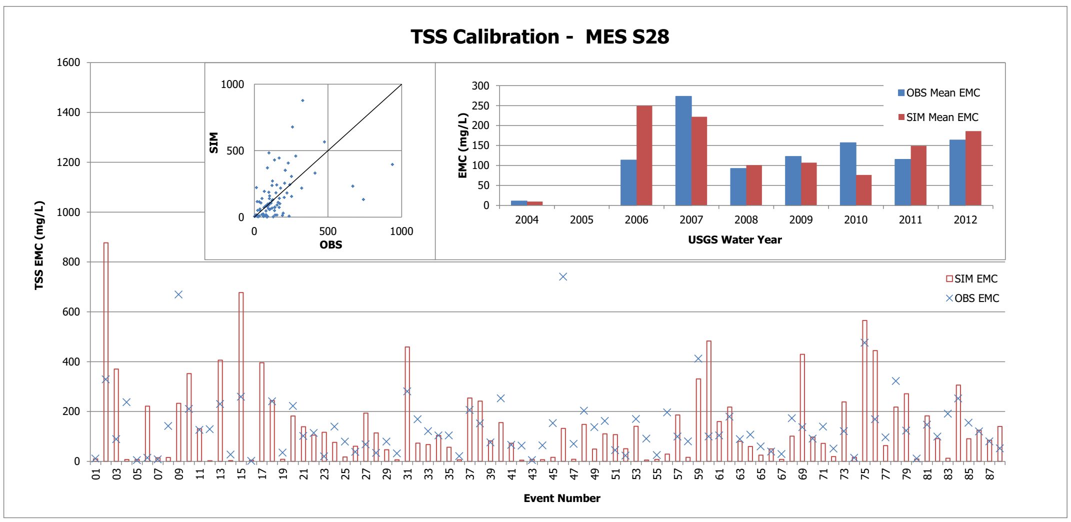


Figure 3-2: TSS Calibration Statistics at MES S28

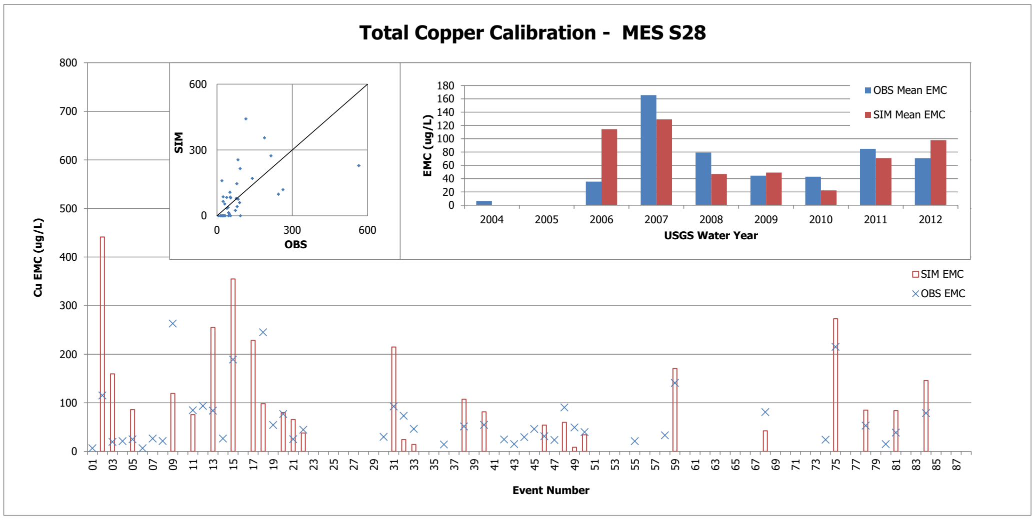


Figure 3-3: Copper Calibration Statistics at MES S28

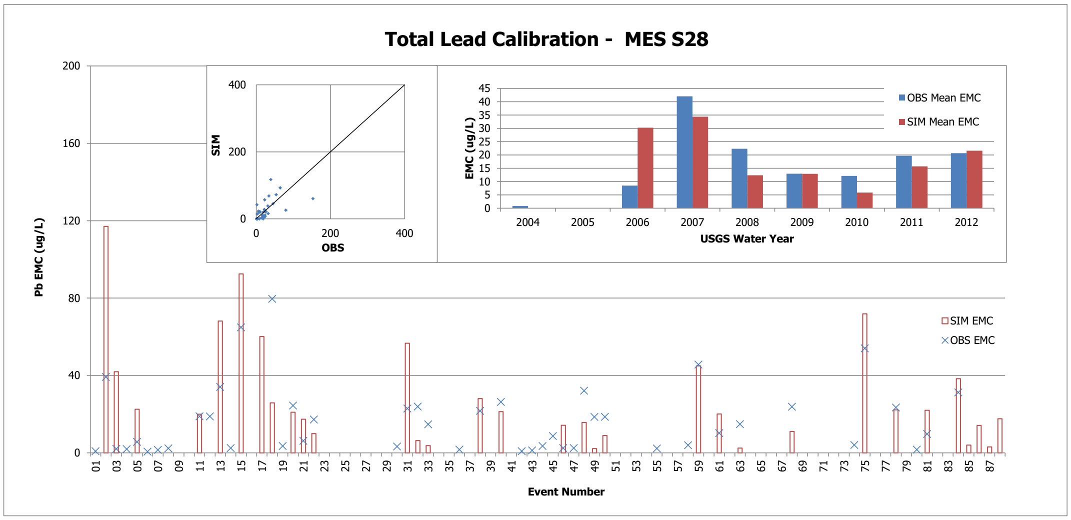


Figure 3-4: Lead Calibration Statistics at MES S28

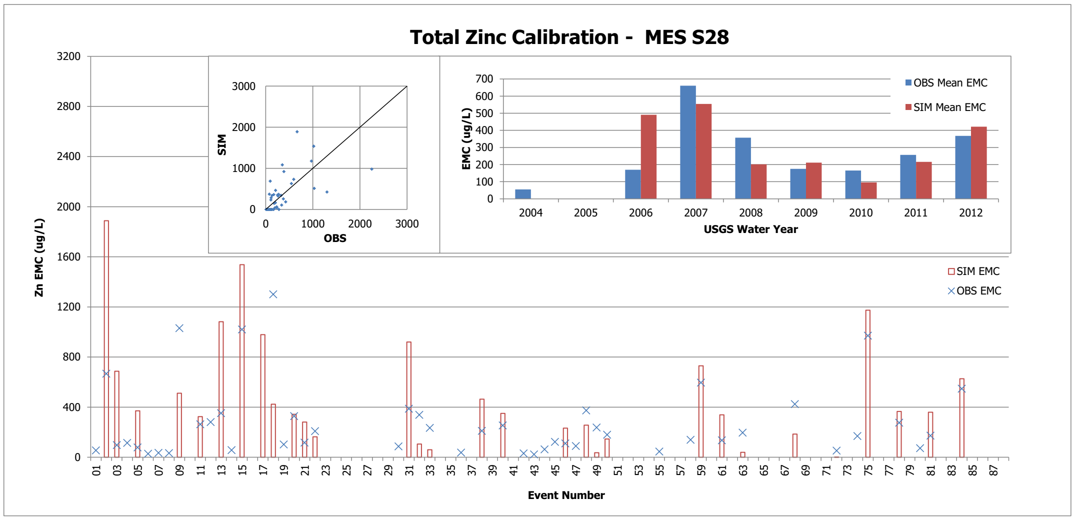


Figure 3-5: Zinc Calibration Statistics at MES S28

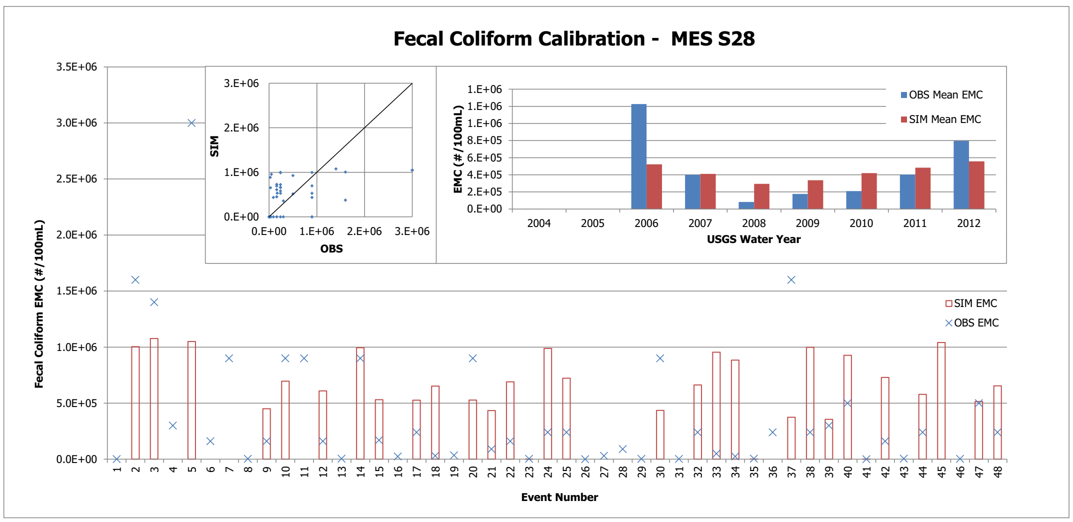


Figure 3-6: Fecal Coliform Calibration Statistics at MES S28

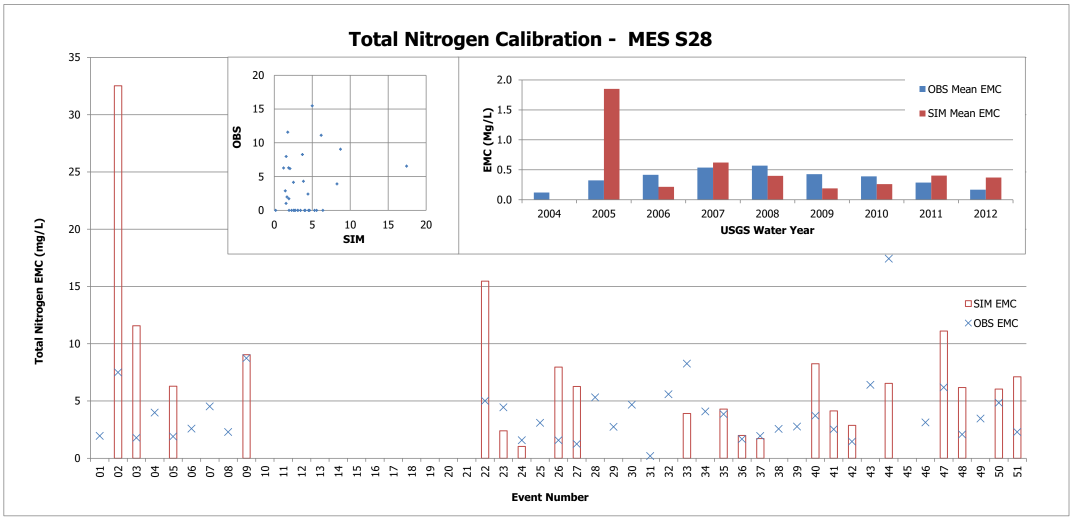


Figure 3-7: Total Nitrogen Calibration Statistics at MES S28

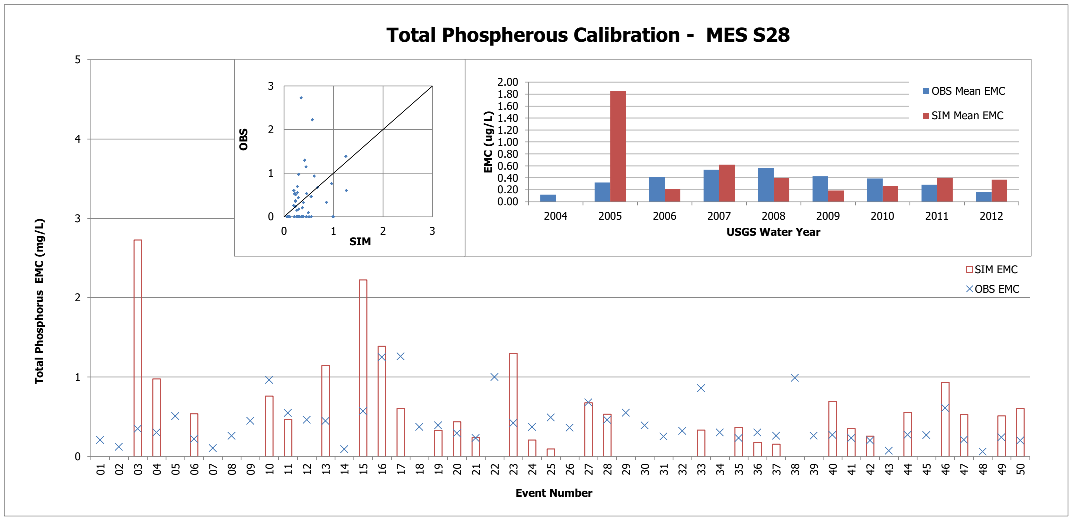


Figure 3-8: Total Phosphorus Calibration Statistics at MES S28

3.3.2 Model Validation

After the model was calibrated it was validated. During the calibration effort, hydrology, sediment, and general water quality parameters were varied to develop a best fit of Hydrologic Response Unit (HRU) and EMC responses. The validation effort evaluated responses at tributary stations (TS) where the record is not long enough to be used for calibration, but may be used to evaluate performance of the model by comparing simulated model results with the observed record at each TS. The TS are located at the following locations, all within LACFCD facilities:

- TS 19: Reinforced concrete rectangular channel at Figueroa Street, south of Del Amo Boulevard
- TS 20: Del Amo Channel - reinforced concrete trapezoidal channel at Avalon Boulevard
- TS 21: Reinforced concrete rectangular channel near 173rd Street and Merit Avenue
- TS 22: Hollypark Drain - reinforced concrete rectangular channel at 135th Street
- TS 23: Yukon Lateral - reinforced concrete rectangular channel at Crenshaw Boulevard
- TS 24: Dominguez Channel - reinforced concrete box near 116th Street and Isis Avenue

The validation effort used simulated model results of the general water quality constituents – TSS, copper, lead, zinc, fecal coliform, total nitrogen, and total phosphorus, and compared them to the observed records at TS19 – 24. Validation of the baseline condition at the various temporary stations has bias numbers that reflect the lack of long term records and the potential issue of the EMC of observed samples not being representative of the event pollutographs during collection. Dry-weather data was not validated because it was determined that wet-weather controls would address dry-weather runoff. Additionally, the limited dry-weather data was not sufficient to perform validations for dry-weather flows on an average monthly basis.

3.3.3 Baseline Simulation

A baseline analysis was performed which represents the current watershed condition based on existing stormwater programs. Stormwater runoff was simulated based on the time series record of rainfall between October 2002 and September 2012. This period represents the most recent 10 years of record as required by the MS4 Permit. The water quality constituent mass loading is estimated by multiplying the stormwater runoff volume by the water quality constituent concentration. As part of the baseline analysis, the industrial permitted and other permitted facilities were identified. These facilities are modeled as compliant, meaning the parcels did not contribute to the flow, volume, or constituent loading, as they are covered under other stormwater permits. These facilities are illustrated in Figure 3-9 and listed in Attachment G and Attachment H.

The baseline and subsequent simulations analyzed the DC WMG area based on five distinct watersheds, each tributary to different receiving waters. The five watersheds include the Dominguez Channel, Dominguez Channel Estuary, Wilmington Drain, Machado Lake, and the Harbor. These watersheds are shown in Figure 3-10. The baseline simulation and 90th percentile analysis were performed for each of the watersheds.

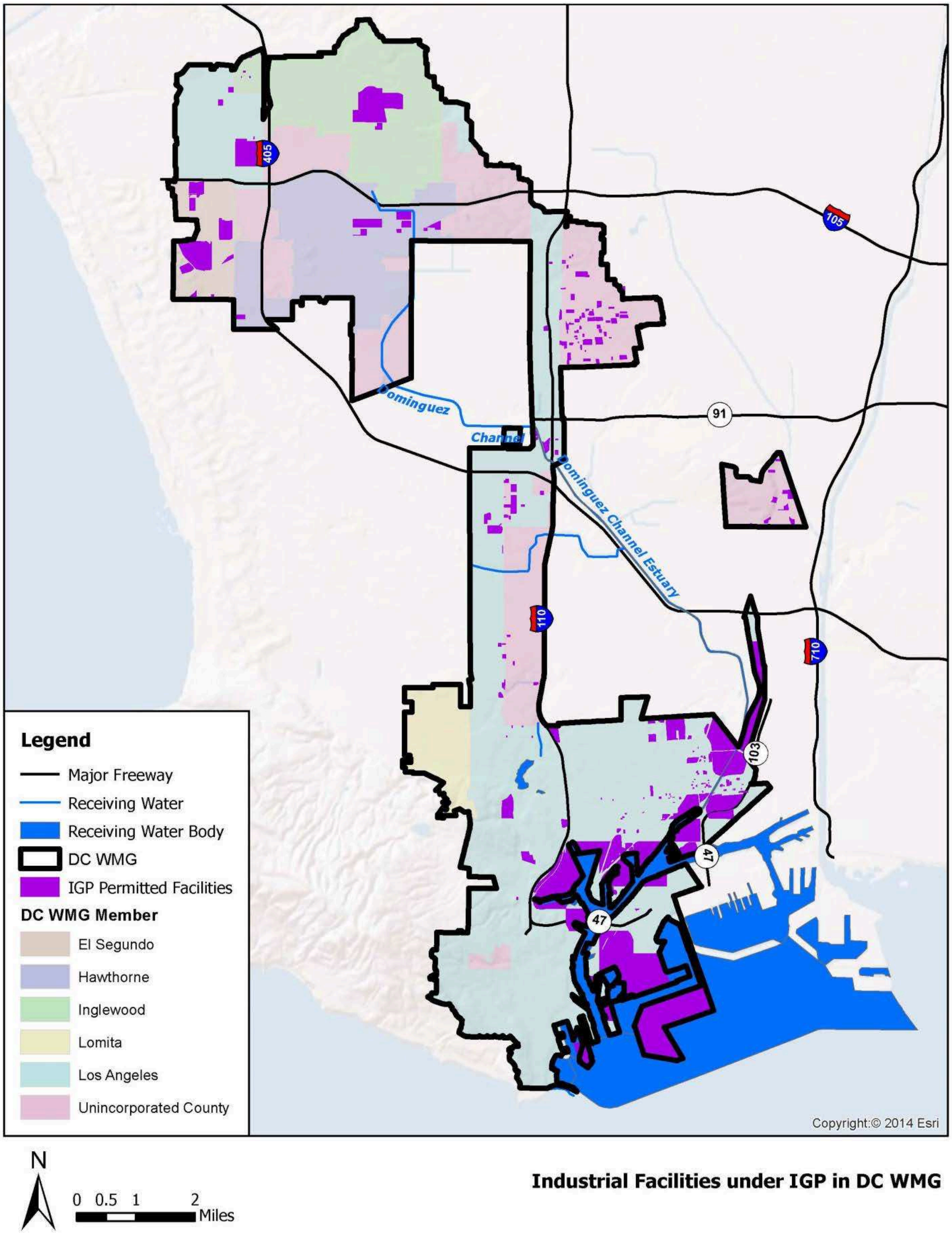


Figure 3-9: Industrial Facilities under IGP in DC WMG

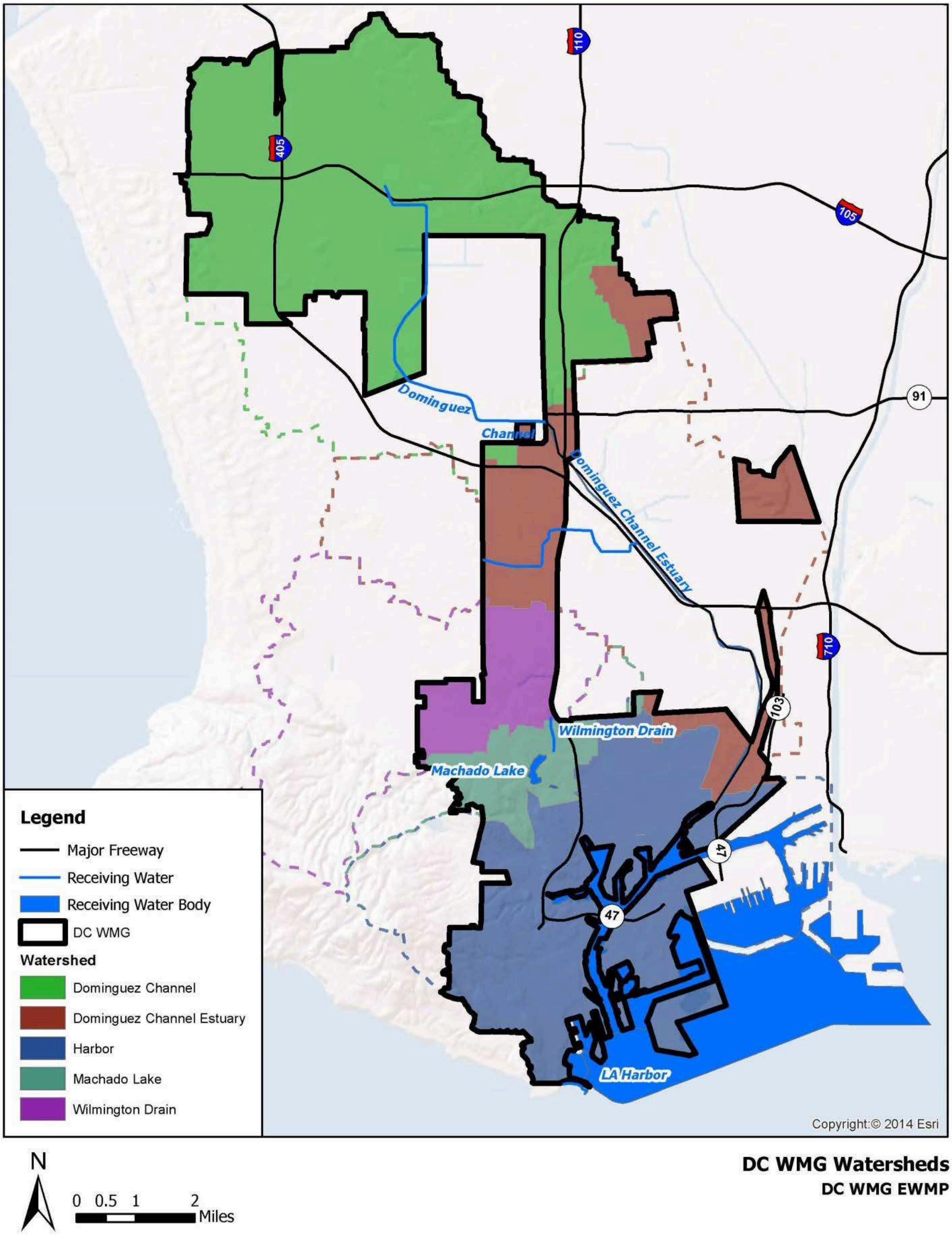


Figure 3-10: DC WMG Watersheds

The baseline hydrology and simulated constituent loading serves as the basis for compliance. The load reductions represent the difference between the baseline conditions and the water quality objectives. The 85th percentile, 24-hour rainfall event baseline simulation is based on the LACFCD 85th percentile rainfall isohyets and unit hyetograph, consistent with the Standard Urban Stormwater Mitigation Plan (SUSMP) and Low Impact Development (LID) methods used within the County. The loads for this event are generated by the model. The volume of runoff for capture under this criterion is estimated from the LSPC output to be 1,523 acre-feet.

The 90th percentile load baseline is estimated from the 2002-2012 water years based on the loads generated before any BMPs are implemented. This analysis was performed for each of the five watersheds and is presented in Section 3.4.4, as this information was also used in determining the required volume and load reduction.

Table 3-2 through Table 3-6 summarize the results of the LSPC simulation for the water years beginning October 1st and ending September 30th from 2002 to 2012 for each of the five major watersheds. The table compares the six major water quality constituents with adopted TMDLs and identifies the annual load and corresponding volume for each year analyzed. The average annual loads are also provided for the simulation period. Total nitrogen and total phosphorus are included for the Wilmington Drain and Machado Lake Watersheds because of the Machado Lake Nutrients TMDL.

Table 3-2: Dominguez Channel Watershed – Annual Loads and Volume							
Start	**End**	**Volume (ac-ft)**	**TSS (kg)**	**Copper (kg)**	**Lead (kg)**	**Zinc (kg)**	**Fecal Coliform (MPN)**
10/1/02	9/30/03	10,785.64	1,653,025.57	692.82	162.88	2,697.80	1.06E+17
10/1/03	9/30/04	8,224.93	1,217,251.86	578.41	132.83	2,215.55	6.84E+16
10/1/04	9/30/05	23,889.84	3,590,190.72	1,066.94	205.39	3,168.54	2.65E+17
10/1/05	9/30/06	8,721.22	1,488,277.84	730.87	173.42	2,871.92	7.51E+16
10/1/06	9/30/07	3,586.61	426,006.76	377.42	79.68	1,359.38	8.21E+15
10/1/07	9/30/08	10,589.63	1,336,606.77	561.38	126.51	2,106.17	1.03E+17
10/1/08	9/30/09	8,139.89	1,147,055.49	550.43	125.58	2,099.04	6.87E+16
10/1/09	9/30/10	10,885.81	1,602,439.10	689.04	162.07	2,690.55	1.05E+17
10/1/10	9/30/11	15,477.34	1,952,793.20	721.63	168.11	2,778.03	1.64E+17
10/1/11	9/30/12	7,236.76	1,369,686.88	740.79	175.86	2,914.19	5.68E+16
Average Annual:		**25,649**	**4,989,383**	**1,513**	**322**	**5,986**	**4.42E+17**

Table 3-3: Dominguez Channel Estuary Watershed – Annual Loads and Volume							
Start	**End**	**Volume (ac-ft)**	**TSS (kg)**	**Copper (kg)**	**Lead (kg)**	**Zinc (kg)**	**Fecal Coliform (MPN)**
10/1/02	9/30/03	4,861.77	694,715.88	243.97	49.86	1,021.84	8.73E+16
10/1/03	9/30/04	3,135.93	420,958.55	187.35	36.81	750.84	4.48E+16
10/1/04	9/30/05	9,952.87	1,162,293.46	273.30	54.21	1,092.27	2.01E+17
10/1/05	9/30/06	3,222.85	499,614.41	223.42	44.96	920.85	4.74E+16
10/1/06	9/30/07	1,421.54	179,264.43	138.18	25.40	524.27	5.69E+15
10/1/07	9/30/08	4,522.77	584,767.06	204.65	40.64	831.22	7.80E+16
10/1/08	9/30/09	3,818.80	476,251.09	182.00	35.25	722.60	6.17E+16
10/1/09	9/30/10	5,292.34	770,497.66	256.92	51.29	1,043.02	9.51E+16
10/1/10	9/30/11	6,780.96	901,271.36	310.72	58.11	1,144.16	1.28E+17
10/1/11	9/30/12	2,898.58	546,749.57	253.16	51.75	1,059.08	3.99E+16
Average Annual:		**4,590.84**	**623,638.35**	**227.37**	**44.83**	**911.01**	**7.89E+16**

Table 3-4: Wilmington Drain Watershed – Annual Loads and Volume

Start	End	Volume (ac-ft)	TSS (kg)	Copper (kg)	Lead (kg)	Zinc (kg)	Fecal Coliform (MPN)	Total Nitrogen (kg)	Total Phosphorus (kg)
10/1/02	9/30/03	2,009.77	339,107.92	127.24	28.13	448.19	1.75E+16	9,025.56	859.23
10/1/03	9/30/04	1,215.21	157,036.98	74.13	16.42	272.96	8.32E+15	5,979.13	563.85
10/1/04	9/30/05	3,754.98	834,479.83	285.77	48.19	684.59	3.53E+16	14,654.85	1,626.27
10/1/05	9/30/06	1,336.46	203,415.91	99.31	23.27	382.06	9.69E+15	7,788.94	715.67
10/1/06	9/30/07	712.80	159,474.41	102.05	24.03	393.97	2.48E+15	7,999.65	725.93
10/1/07	9/30/08	1,815.29	208,272.28	78.56	17.64	292.34	1.53E+16	6,302.86	597.77
10/1/08	9/30/09	1,432.70	187,697.17	79.57	17.71	292.41	1.08E+16	6,309.17	596.37
10/1/09	9/30/10	2,367.94	380,187.83	132.97	28.43	449.50	2.10E+16	9,192.61	892.44
10/1/10	9/30/11	2,547.68	331,262.56	115.65	27.49	448.20	2.37E+16	8,907.66	825.72
10/1/11	9/30/12	1,156.48	206,660.51	112.37	26.82	437.70	7.64E+15	8,715.54	791.20
Average Annual:		**1,834.93**	**300,759.54**	**120.76**	**25.81**	**410.19**	**1.52E+16**	**8,487.60**	**819.45**

Table 3-5: Machado Lake Watershed – Annual Loads and Volume

Start	End	Volume (ac-ft)	TSS (kg)	Coppe r (kg)	Lead (kg)	Zinc (kg)	Fecal Coliform (MPN)	Total Nitrogen (kg)	Total Phosphorus (kg)
10/1/02	9/30/03	1,565.22	349,726.31	133.03	22.61	341.45	1.38E+16	7,712.97	822.70
10/1/03	9/30/04	918.20	110,541.16	52.93	10.94	189.36	6.16E+15	4,461.29	426.00
10/1/04	9/30/05	2,637.23	532,556.39	174.83	28.44	419.75	2.55E+16	9,520.55	1,049.75
10/1/05	9/30/06	991.32	156,228.00	74.53	16.77	283.85	7.05E+15	6,059.23	559.14
10/1/06	9/30/07	556.30	110,719.45	69.93	15.43	264.93	1.71E+15	5,786.09	531.16
10/1/07	9/30/08	1,327.33	152,887.64	57.00	11.92	205.09	1.12E+16	4,741.95	455.44
10/1/08	9/30/09	1,007.99	126,020.52	57.63	12.26	210.27	7.33E+15	4,802.14	454.95
10/1/09	9/30/10	1,814.18	347,631.37	124.90	21.73	333.03	1.64E+16	7,524.73	794.25
10/1/10	9/30/11	2,014.21	282,987.89	92.06	19.64	325.00	1.91E+16	6,909.76	663.20
10/1/11	9/30/12	801.67	124,080.47	65.66	14.23	246.89	4.84E+15	5,502.40	510.54
Average Annual:		**1,363.37**	**229,337.92**	**90.25**	**17.40**	**281.96**	**1.13E+16**	**6,302.11**	**626.71**

Table 3-6: Harbor Watershed – Annual Loads and Volume							
Start	**End**	**Volume (ac-ft)**	**TSS (kg)**	**Copper (kg)**	**Lead (kg)**	**Zinc (kg)**	**Fecal Coliform (MPN)**
10/1/02	9/30/03	12,003.98	2,095,957.03	571.09	93.62	2,081.62	2.32E+17
10/1/03	9/30/04	6,825.41	1,034,047.48	339.14	58.63	1,406.83	1.07E+17
10/1/04	9/30/05	20,160.47	3,033,366.45	657.76	108.45	2,401.93	4.12E+17
10/1/05	9/30/06	6,749.71	1,342,996.20	456.18	82.43	1,989.55	1.04E+17
10/1/06	9/30/07	3,719.28	967,491.79	418.54	75.46	1,796.73	3.26E+16
10/1/07	9/30/08	10,945.49	1,500,407.62	385.57	62.98	1,434.51	2.05E+17
10/1/08	9/30/09	6,174.41	958,435.33	333.54	57.78	1,376.68	8.89E+16
10/1/09	9/30/10	13,643.10	2,721,003.99	781.23	114.38	2,288.11	2.62E+17
10/1/10	9/30/11	14,501.56	2,744,594.68	756.12	116.18	2,435.63	2.83E+17
10/1/11	9/30/12	5,062.31	1,047,431.77	403.57	71.95	1,726.03	6.31E+16
Average Annual:		**9,978.57**	**1,744,573.23**	**510.27**	**84.19**	**1,893.76**	**1.79E+17**

3.3.4 Evaluation of Required Volume and Load Reductions

The DC WMG RAA examines the 85th percentile, 24-hour storm event volume and the 90th percentile constituent load to estimate the limiting pollutant and the corresponding volumes of required treatment. The limiting pollutant is the constituent with the highest mass load associated with a relevant TMDL. This section discusses the limiting pollutant evaluation, 85th percentile, 24-hour storm volume, and the 90th percentile, 24-hour storm load. These factors establish the control measure implementation requirements. Evaluation of the limiting pollutant requires estimating the volumes and loads associated with the 85th percentile, 24-hour runoff volume and the 90th percentile load for baseline conditions and multiple pollutants. Once these values are estimated, the limiting pollutant can be evaluated. The limiting pollutant is that pollutant for which the greatest amount of volume control is required to achieve the 90th percentile load reduction.

85th Percentile, 24-Hour Storm Event Volume

The 85th percentile, 24-hour storm event represents the rainfall event that is greater than 85 percent of all rainfall events over 0.1 inches in a 24-hour period. The 85th percentile isohyetal map developed by LACDPW was used to estimate the appropriate rainfall value for each subarea within the DC WMA. The total rainfall for each subarea was distributed temporally over the 24-hour period using the Los Angeles County unit hyetograph to remain consistent with the SUSMP and LID criteria. This rainfall event was placed in a rainfall file for use with LSPC and the model was run to estimate runoff volumes to compare the 90th percentile volumes on an equal basis. Another analysis was done using the LACDPW Tc (time of concentration) Calculator, developed to simplify use of the modified rational method. The results from LSPC and the Tc Calculator models were reasonably similar and so the LSPC output was used in all future evaluations of the runoff volume from the 85th percentile, 24-hour storm. Figure 3-11 shows the rainfall hyetograph of the 85th percentile, 24-hour storm, along with the associated runoff hydrograph for the DC WMG. The total runoff volume for the 85th percentile, 24-hour storm is 1,523 acre-feet within the DC WMG jurisdiction.

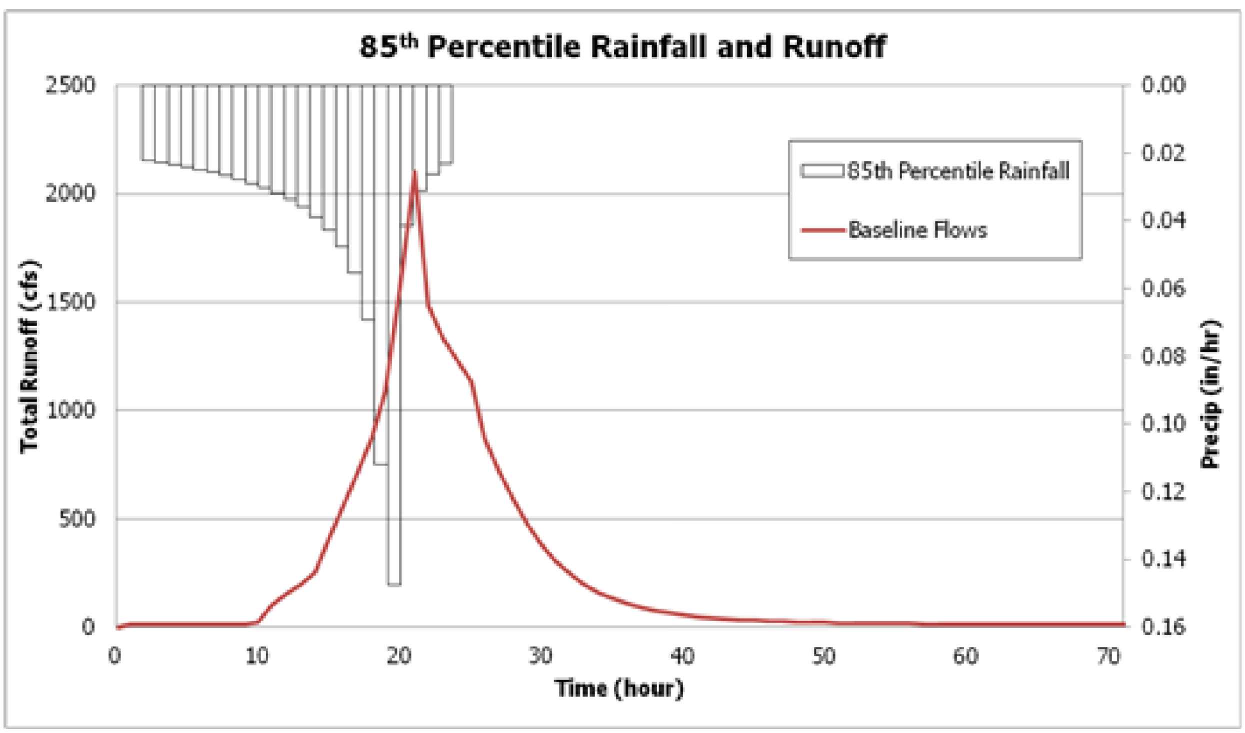


Figure 3-11: 85th Percentile, 24-Hour Storm Hyetograph and Runoff Hydrograph

90th Percentile, 24-Hour Storm Event Constituent Load

Development of the 90th percentile load analysis required analyzing model output following a five step process. The steps in the process are provided below:

1. Evaluated 90th percentile load based on percentile analysis
2. Evaluated 87th through 93rd percentile loads, storm events, volumes, and concentrations
3. Analyzed statistics of these events due to the large range in volume and concentrations providing similar loads
4. Picked storm events for use in determining volumes for capture based on median and mean volumes and concentrations from the 87th through 93rd percentile events
5. Evaluated the 85th percentile, 24-hour volumes and 90th percentile load volumes for similarity

Selection of the storms utilizing this process provides a sound criterion for compliance by evaluating the range in volumes, concentrations, and loads to provide a treatment volume that has the potential to meet the criteria for the 85th percentile, 24-hour event and 90th percentile load reduction. The variability in the data shows that selecting a storm is an important step in the analysis process. By selecting the appropriate storm, flows that exceed the capture volume will mainly have pollutant concentrations below the TMDL concentration limits due to dilution of remaining pollutants. The details of the selection process are provided in the following paragraphs. The results of the analysis are provided later to demonstrate compliance and the reasonableness of the approach.

The 90th percentile load related to entire DC WMG was estimated using LSPC. The 90th percentile constituent loads represent the daily constituent loads that are greater than 89 percent and less than 10 percent of all simulated loads at the output station. The method for estimating the 90th percentile load was to sort all flow days greater than 63 cubic feet per second (cfs) from the calibrated hydrology simulation model for the time series beginning on October 1, 2002 and ending on September 30, 2012. This method is consistent with the Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants TMDL. Any flow days less than 63 cfs were considered dry-weather and were removed from the wet-weather analysis and treated separately. Flow days greater than 63 cfs have simulated hourly constituent loads in concentration units associated with model storm events and an hourly storm volume was estimated from the runoff hydrograph. The hourly and daily mass loads were the product of the simulated storm volume and the simulated hourly constituent concentration for DC WMG flows. The 90th percentile load was estimated from the simulated daily load. The volume capture for the 90th percentile load was estimated on the day of the actual event plus the following day if flows were greater than 63 cfs on the second day.

Baseline simulations were run with no storm runoff volume reduction. Table 3-7 through Table 3-11 summarize the water quality constituents and the date of the 90th percentile event derived from the simulated model results following the criteria previously outlined in the preceding paragraph for each of the five analyzed watersheds. The volume associated with the 90th percentile load is shown along with the expected (modeled) and objective concentrations and loads. The limiting pollutant is bold in each table and further discussed in Section 3.3.5.

Table 3-7: Dominguez Channel Watershed - 90th Percentile Constituent Load Events

Constituent	Date	Volume[1] (ac-ft)	Concentration[2]			Load[3]		
			Units	Expected	Objective[3]	Units	Expected	Objective
Copper	1/21/2012	420.9	µg/L	179.19	9.7	kg	92.97	5.03
Lead	1/21/2012	420.9	µg/L	47.32	42.7	kg	24.55	22.16
Zinc	**12/16/2002**	**718.17**	**µg/L**	**397.15**	**69.6**	**kg**	**351.61**	**61.62**
Fecal Coliform	10/30/2010	137.04	MPN/100 mL	1.15E+06	400.0	MPN/100 mL	1.94E+15	6.76E+11

1 24-hour volume.
2 Concentration is the LSPC modeled value using the storm runoff hydrograph for the date specified.
3 Expected and objective loads equal the concentration multiplied by the volume of storm runoff.

Table 3-8: Dominguez Channel Estuary – 90th Percentile Constituent Load Events

Constituent	Date	Volume[1] (ac-ft)	Concentration[2]			Load[3]		
			Units	Expected	Objective[3]	Units	Expected	Objective
Copper	2/27/2006	220.86	µg/L	128.92	9.7	kg	35.1	2.64
Lead	1/21/2012	132.02	µg/L	44.41	42.7	kg	7.23	6.95
Zinc	**2/27/2006**	**220.86**	**µg/L**	**603.59**	**69.6**	**kg**	**164.34**	**18.95**
Fecal Coliform	10/30/2010	50.62	MPN/100 mL	1.99E+06	400.0	MPN/100 mL	1.24E+15	2.50E+11

1 24-hour volume.
2 Concentration is the LSPC modeled value using the storm runoff hydrograph for the date specified.
3 Expected and objective loads equal the concentration multiplied by the volume of storm runoff.

Table 3-9: Wilmington Drain Watershed – 90th Percentile Constituent Load Events

Constituent	Date	Volume[1] (ac-ft)	Concentration[2]			Load[3]		
			Units	Expected	Objective[3]	Units	Expected	Objective
Copper	12/7/2009	91.38	µg/L	150.29	9.7	kg	16.93	1.09
Lead	4/12/2010	60.77	µg/L	49.44	42.7	kg	3.70	3.20
Zinc	12/17/2010	112.65	µg/L	395.76	69.6	kg	54.96	9.67
Fecal Coliform	10/14/2004	44.58	MPN/100 mL	1.06E+06	235.0	MPN/100 mL	5.84E+14	1.29E+11
Total Nitrogen	**12/17/2010**	**112.65**	**mg/L**	**6.62**	**1.0**	**kg**	**918.93**	**138.87**
Total Phosphorus	4/12/2010	60.77	mg/L	1.11	0.1	kg	83.20	7.49

[1] 24-hour volume.
[2] Concentration is the LSPC modeled value using the storm runoff hydrograph for the date specified.
[3] Expected and objective loads equal the concentration multiplied by the volume of storm runoff.

Table 3-10: Machado Lake Watershed – 90th Percentile Constituent Load Events

Constituent	Date	Volume[1] (ac-ft)	Concentration[2]			Load[3]		
			Units	Expected	Objective[3]	Units	Expected	Objective
Copper	2/18/2005	49.17	µg/L	152.40	9.7	kg	9.24	0.59
Lead	10/14/2004	23.66	µg/L	64.71	42.7	kg	1.89	1.25
Zinc	12/31/2005	69.74	µg/L	352.80	69.6	kg	30.33	5.98
Fecal Coliform	**2/21/2011**	**24.26**	**MPN/100 mL**	**9.02E+05**	**235.0**	**MPN/100 mL**	**2.70E+14**	**7.03E+10**
Total Nitrogen	12/31/2005	69.74	mg/L	6.56	1.0	kg	563.84	85.98
Total Phosphorus	4/12/2010	41.35	mg/L	1.04	0.1	kg	52.78	5.10

[1] 24-hour volume.
[2] Concentration is the LSPC modeled value using the storm runoff hydrograph for the date specified.
[3] Expected and objective loads equal the concentration multiplied by the volume of storm runoff.

Table 3-11: Harbor Watershed – 90th Percentile Constituent Load Events

Constituent	Date	Volume[1] (ac-ft)	Concentration[2]			Load[3]		
			Units	Expected	Objective[3]	Units	Expected	Objective
Copper	3/25/2012	589.85	µg/L	89.23	9.7	kg	64.88	7.05
Lead	10/17/2005	150.67	µg/L	69.49	42.7	kg	12.91	7.93
Zinc	**12/23/2003**	**516.60**	**µg/L**	**378.91**	**69.6**	**kg**	**241.31**	**44.32**
Fecal Coliform	12/31/2003	136.85	MPN/100 mL	2.13E+06	400.0	MPN/100 mL	3.60E+15	6.75E+11

[1] 24-hour volume.
[2] Concentration is the LSPC modeled value using the storm runoff hydrograph for the date specified.
[3] Expected and objective loads equal the concentration multiplied by the volume of storm runoff.

3.3.5 Limiting Pollutant Evaluation

The limiting pollutant idea is the concept that if the WBPC that requires the largest load reduction and associated treatment capacity to meet WQBELs and RWLs is captured and treated, all other constituents will be addressed. Meeting all of the WQBELs and RWLs in the DC WMG can be achieved through control of the limiting pollutant. The limiting pollutant in the DC WMG will be determined based on the largest volume of treatment required to capture and infiltrate the 90th percentile load since the DC WMG will implement only infiltration BMPs. The limiting pollutant will control implementation actions and will dictate the volume the control measures must address.

The limiting pollutant was evaluated for each of the five analyzed watersheds. The limiting pollutant is the pollutant with the highest volume associated with the 90th percentile load. By addressing this volume, the 90th percentile load will be addressed for all pollutants. The results of the 90th percentile constituent loads are presented in Table 3-12 through Table 3-16 for each of the watersheds. The volume associated with zinc is the highest for the Dominguez Channel Watershed; therefore zinc is the limiting pollutant. For the Dominguez Channel Estuary, the volume associated with both copper and zinc are the highest, however, copper loads are expected to reduce over fifty percent due to SB 346; therefore zinc was chosen as the limiting pollutant. SB 346 requires incremental reductions in the amount of copper in vehicle brake pads. SB 346 requires most brake pads sold in California to contain less than five percent copper by weight after January 1, 2021. For the Wilmington Drain Watershed, the volume associated with zinc and nitrogen are the greatest; however, zinc is not a priority pollutant as it is not identified as a category 1, 2, or 3 WBPC (as discussed in Section 2). Therefore, nitrogen is the limiting pollutant for the Wilmington Drain Watershed. The volumes associated with zinc and nitrogen are the greatest in the Machado Lake Watershed, however, similar to Wilmington Drain Watershed, zinc is not a category 1, 2, or 3 WBPC. Additionally, nitrogen is expected to be addressed through the Machado Lake Ecosystem Rehabilitation Project discussed below. Copper and phosphorus have the next greatest volumes, but they are also not categorized WBPCs in the Machado Lake watershed; therefore fecal coliform is the limiting pollutant, as it has been identified as a category 3 WBPC in Machado Lake. Lastly, for the Harbor Watershed, copper has the greatest volume followed by zinc. As previously stated, significant copper load reductions are anticipated due to SB 346; therefore zinc is the limiting pollutant. The stormwater volume used for demonstrating compliance is associated with the limiting pollutants identified for each of the watersheds. Mitigating the limiting pollutant means that all other constituents will also be mitigated, as the required volume reductions are less than that associated with the limiting pollutant.

The limiting pollutant for the Wilmington Drain and Machado Lake Watersheds are based on the category 2 and 3 WBPCs identified in Section 2, which are based on 303(d) listings and observed exceedances. The limiting pollutant was not determined based on the Machado Lake Toxics and Nutrients TMDLs, as these TMDLs will be addressed by the Machado Lake Ecosystem Rehabilitation Project. The City of Los Angeles is leading the project that will be under construction in 2015. The project includes dredging the lake to remove accumulated sediments and constructing a pipeline that will discharge highly treated recycled water into the lake to offset evapotranspiration at a cost over $100 million. The treated water that will be added to the lake will dilute the stormwater stored in the lake and lower the concentration of all pollutants, including nutrients (nitrogen) and toxics (zinc). If necessary, the entire volume of water in the lake could be replaced with the reclaimed water within 30 days to meet the TMDL requirements for nutrients. Replacement would result in dilution of water with elevated levels of constituents with treated water.

The loads in DC WMG are influenced by both the flow volume and the constituent concentrations. A large storm with low concentrations may create a load equal to a small storm with high concentrations. The 87th through 93rd percentile events for zinc were evaluated to estimate the statistical range of volumes and loads at the model outlet to see which events produced regional rainfall and volumes for the watershed resulting in this load. Table 3-12, Table 3-14, Table 3-16, Table 3-18 and Table 3-20 show the events analyzed and the range in volumes, concentrations, and loads for events with loads of approximately the same magnitude as the 90th percentile load event for each of the five analyzed watersheds. The bold values in the table show the numerically selected 90th percentile load. The tables below are presented for zinc and for all other pollutants in Attachment I. Statistical analysis of the data shown in the percentile load event tables are the basis for the data shown in Table 3-13, Table 3-15, Table 3-17, Table 3-19 and Table 3-21. These tables include statistical values for both loads and volumes which were used in selecting the final modeled storm event for analysis of the 90th percentile load for permit compliance evaluation.

Table 3-12: Dominguez Channel Watershed – Zinc Percentile Loads and Storm Events

Date	Flow (cfs)	Volume (ac-ft)	Concentration (µg/l)	Lead Load (kg)
4/12/2010	237.20	470.48	716.77	415.72
9/22/2007	86.62	171.81	1910.75	404.70
1/21/2012	212.20	420.90	767.35	398.15
12/28/2004	1559.54	3093.31	100.01	381.37
1/18/2010	332.66	659.82	461.51	375.39
12/16/2002	**362.08**	**718.17**	**397.15**	**351.61**
2/11/2003	213.08	422.63	669.17	348.64
5/22/2006	149.49	296.50	941.96	344.30
11/26/2008	343.78	681.88	401.68	337.65
11/6/2011	99.65	197.65	1315.56	320.54
2/27/2006	282.68	560.68	450.53	311.40

Table 3-13: Dominguez Channel Watershed – Zinc Percentile Load Statistics

Statistical Analysis	Volume (ac-ft)	Zinc Load (kg)
Mean	699.44	362.68
Standard Error	245.90	10.46
Median	470.48	351.61
Standard Deviation	815.55	34.69
Sample Variance	665,125.16	1,203.72
Kurtosis	9.52	-1.21
Skewness	3.00	0.12
Range	2,921.49	104.32
Minimum	171.81	311.40
Maximum	3,093.31	415.72
95% Confidence Range for Mean	963.92	41.01

Table 3-14: Dominguez Channel Estuary – Zinc Percentile Loads and Storm Events				
Date	**Flow (cfs)**	**Volume (ac-ft)**	**Concentration (µg/l)**	**Zinc Load (kg)**
3/17/2012	49.56	98.31	1414.74	171.45
10/13/2007	54.05	107.21	1292.39	170.8
12/25/2003	100.43	199.21	673.97	165.51
4/12/2010	99.88	198.11	675.31	164.92
2/27/2006	**111.35**	**220.86**	**603.59**	**164.34**
5/22/2006	72.22	143.25	874.65	154.45
12/28/2004	326.94	648.49	191.28	152.91
1/21/2012	66.56	132.02	911.48	148.34
2/5/2009	71.71	142.23	824.4	144.54

Table 3-15: Dominguez Channel Estuary – Zinc Percentile Load Statistics		
Statistical Analysis	**Volume (ac-ft)**	**Zinc Load (kg)**
Mean	209.96	159.7
Standard Error	56.62	3.28
Median	143.25	164.34
Standard Deviation	169.86	9.85
Sample Variance	28,851.97	97.05
Kurtosis	7.44	-1.47
Skewness	2.65	-0.33
Range	550.18	26.91
Minimum	98.31	144.54
Maximum	648.49	171.45
95% Confidence Range for Mean	221.95	12.87

Table 3-16: Wilmington Drain Watershed – Nitrogen Percentile Loads and Storm Events				
Date	**Flow (cfs)**	**Volume (ac-ft)**	**Concentration (µg/l)**	**Nitrogen Load (kg)**
2/11/2003	194.83	386.44	2.53	1,204.68
12/27/2004	106.40	211.05	4.44	1,155.85
10/14/2004	22.48	44.58	19.85	1,090.73
12/12/2003	14.23	28.23	30.34	1,056.02
10/5/2011	15.23	30.21	27.70	1,031.86
4/12/2010	30.64	60.77	13.17	987.00
12/15/2002	73.72	146.22	5.21	939.74
12/17/2010	**56.80**	**112.65**	**6.62**	**918.93**

Table 3-17: Wilmington Drain Watershed – Nitrogen Percentile Load Statistics		
Statistical Analysis	**Volume (ac-ft)**	**Nitrogen Load (kg)**
Mean	127.52	1,048.10
Standard Error	43.35	35.46
Median	86.71	1,043.94
Standard Deviation	122.62	100.31
Sample Variance	15,035.41	10,061.55
Kurtosis	2.38	-0.94
Skewness	1.57	0.28
Range	358.21	285.75
Minimum	28.23	918.93
Maximum	386.44	1,204.68
95% Confidence Range for Mean	169.94	139.02

Table 3-18: Machado Lake Watershed – Fecal Coliform Percentile Loads and Storm Events				
Date	**Flow (cfs)**	**Volume (ac-ft)**	**Concentration (MPN/100 mL)**	**Fecal Coliform Load (MPN)**
2/28/2011	13.74	27.26	905,009.24	3.04E+14
2/21/2011	**12.23**	**24.26**	**901,607.98**	**2.70E+14**
4/21/2005	8.50	16.86	1,211,501.63	2.52E+14
3/20/2005	8.77	17.40	1,157,856.24	2.48E+14

Table 3-19: Machado Lake Watershed – Fecal Coliform Percentile Load Statistics		
Statistical Analysis	**Volume (ac-ft)**	**Fecal Coliform Load (MPN)**
Mean	21.44	2.68E+14
Standard Error	2.57	1.28E+13
Median	20.83	2.61E+14
Standard Deviation	5.14	2.55E+13
Sample Variance	26.39	6.52E+26
Kurtosis	-4.32	1.06E+00
Skewness	0.28	1.30E+00
Range	10.41	5.58E+13
Minimum	16.86	2.48E+14
Maximum	27.26	3.04E+14
95% Confidence Range for Mean	10.07	5.01E+13

Table 3-20: Harbor Watershed – Zinc Percentile Loads and Storm Events				
Date	**Flow (cfs)**	**Volume (ac-ft)**	**Concentration (µg/l)**	**Zinc Load (kg)**
3/25/2012	297.39	589.85	441.07	320.72
12/15/2002	476.17	944.48	268.17	312.23
11/20/2011	171.78	340.72	721.76	303.15
10/17/2005	75.96	150.67	1577.85	293.07
2/19/2007	175.05	347.21	672.12	287.68
2/18/2011	115.47	229.04	938.95	265.11
12/23/2003	260.45	516.60	378.91	241.31
1/20/2010	1,176.45	2,333.45	81.12	233.36
1/18/2010	484.40	960.80	194.12	229.92
1/23/2012	152.28	302.05	610.3	227.24
5/18/2011	105.88	210.01	874.59	226.42
3/15/2003	1,143.71	2,268.52	79.31	221.78
12/1/2005	59.04	117.10	1442.49	208.23
3/28/2006	378.42	750.58	220.84	204.33
10/13/2007	177.21	351.49	460.84	199.68
3/20/2011	628.05	1245.72	128.7	197.64

Table 3-21: Harbor Watershed – Zinc Percentile Load Statistics		
Statistical Analysis	**Volume (ac-ft)**	**Zinc Load (kg)**
Mean	728.64	248.24
Standard Error	173.52	10.58
Median	434.05	231.64
Standard Deviation	694.07	42.33
Sample Variance	481,732.36	1,792.18
Kurtosis	1.79	-1.24
Skewness	1.60	0.53
Range	2,216.35	123.08
Minimum	117.10	197.64
Maximum	2,333.45	320.72
95% Confidence Range for Mean	680.19	41.49

The values in the tables show the relatively wide range of variability. Based on the results of the statistical analyses and engineering judgment, the bold storm event was chosen to represent the 90th percentile load event for each watershed. These events generally have loads and volumes up to 10 percent higher than the median statistical 90th percentile load, with a volume that is also up to 30 percent higher. The storm events that generated these volumes and loads were spatially consistent over the entire watershed. The values for volumes and loads generally fall well within the 95 percent confidence interval. The volume generated is also consistent with the 85th percentile 24-hour storm volume.

The storms that generated the 87th to 93rd percentile loads were evaluated to determine the pollutant load distribution throughout the storm hydrograph. Standard literature reviews and studies within the region show that pollutant load concentrations often follow a similar shape with the hydrograph, but lagging in time. An analysis of the hourly loads and volumes showed which hours of the storm exceeded pollutant load objectives. The percentage of the volume associated with these exceedances was determined for each storm. The average percentage of the volume required to capture all flows with concentrations exceeding the water quality objective concentrations. This volume was then used to determine the volume of treatment required within the watersheds. Table 3-22 shows the volume reduction percentages required to capture the 90th percentile loads in the five watersheds within the DC WMG. The tables showing the analysis of each watershed storm event are provided in Attachment J.

Table 3-22: Limiting Pollutant Percentile Load Statistics

Watershed	Percent Storm Volume Reduction	Limiting Pollutant Analyzed
Dominguez Channel	90	Zinc
Dominguez Channel Estuary	90	Zinc
Wilmington Drain	80	Total Nitrogen
Machado Lake	90	Fecal Coliform
Harbor	70	Zinc

The table shows the percentage of the storm volume on the date of the 90th percentile load event that would need to be captured to capture all of the flow that exceeded the water quality objective concentrations. The table shows that the range of volume capture ranged between 70 and 90 percent of the total storm volume. This is due to the nature of land use within the watersheds. The volumes were used to determine the volume of regional projects and green streets required for compliance with water quality objectives.

Figure 3-12 below illustrates the required capture volume density for the subareas within the DC WMG. Each subarea is shaded based on the volume (in cubic feet) of capture required per acre. The capture volume was determined based on the baseline model results associated with the 90th percentile event within each watershed. The five analyzed watersheds are identified in the figure along with the 90th percentile event date associated with the limiting pollutant for each of the watersheds. Figure 3-13 illustrates the load density within each of the subareas. Similar to the capture volume density map, the load density is based on the baseline model and the 90th percentile event for each of the five watersheds. The subareas are shaded based on the load per acre generated from the subarea. The figure demonstrates that loading is greater in the upper portions of the Dominguez Channel Watershed and near the Harbor.

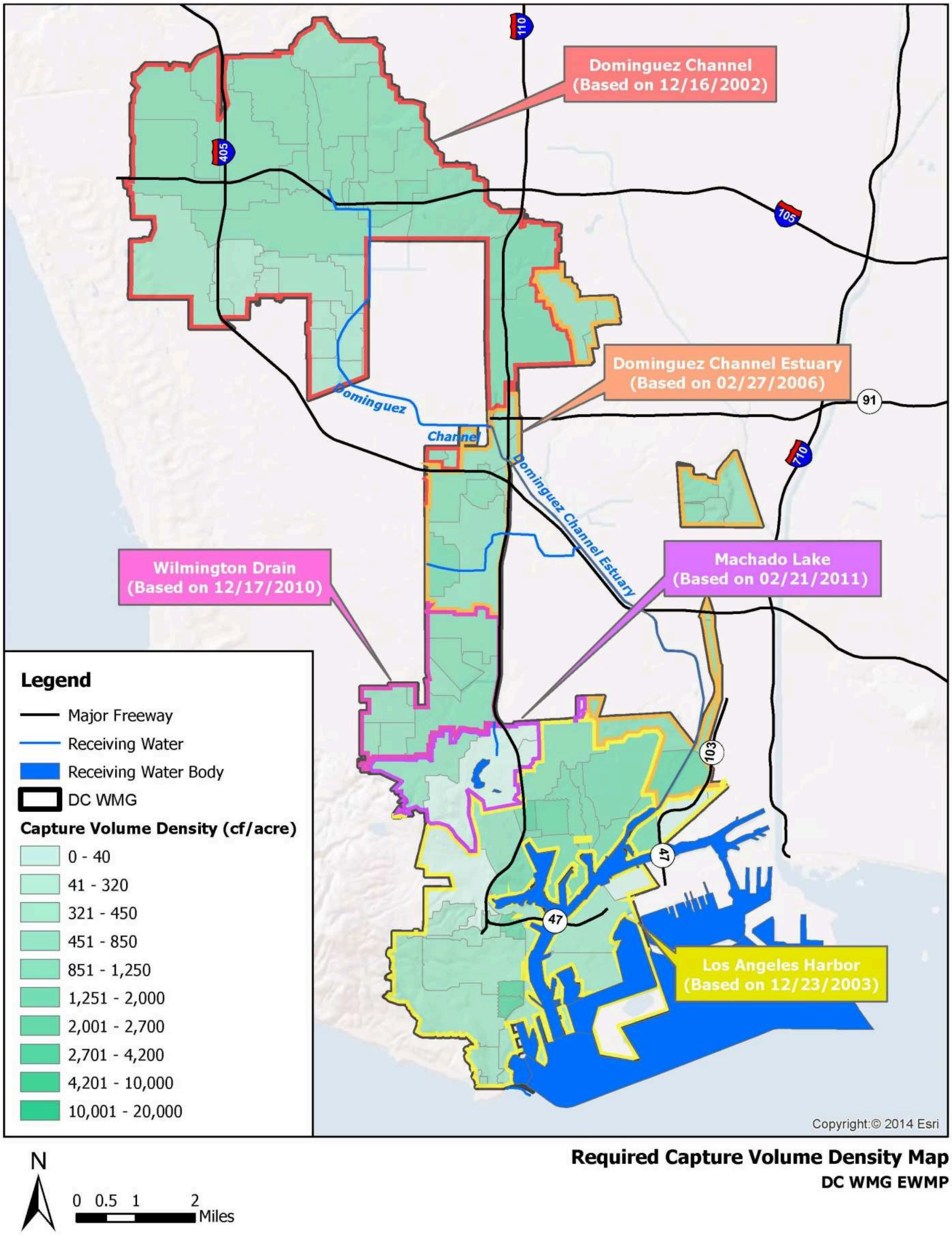


Figure 3-12: Required Capture Volume Density Map

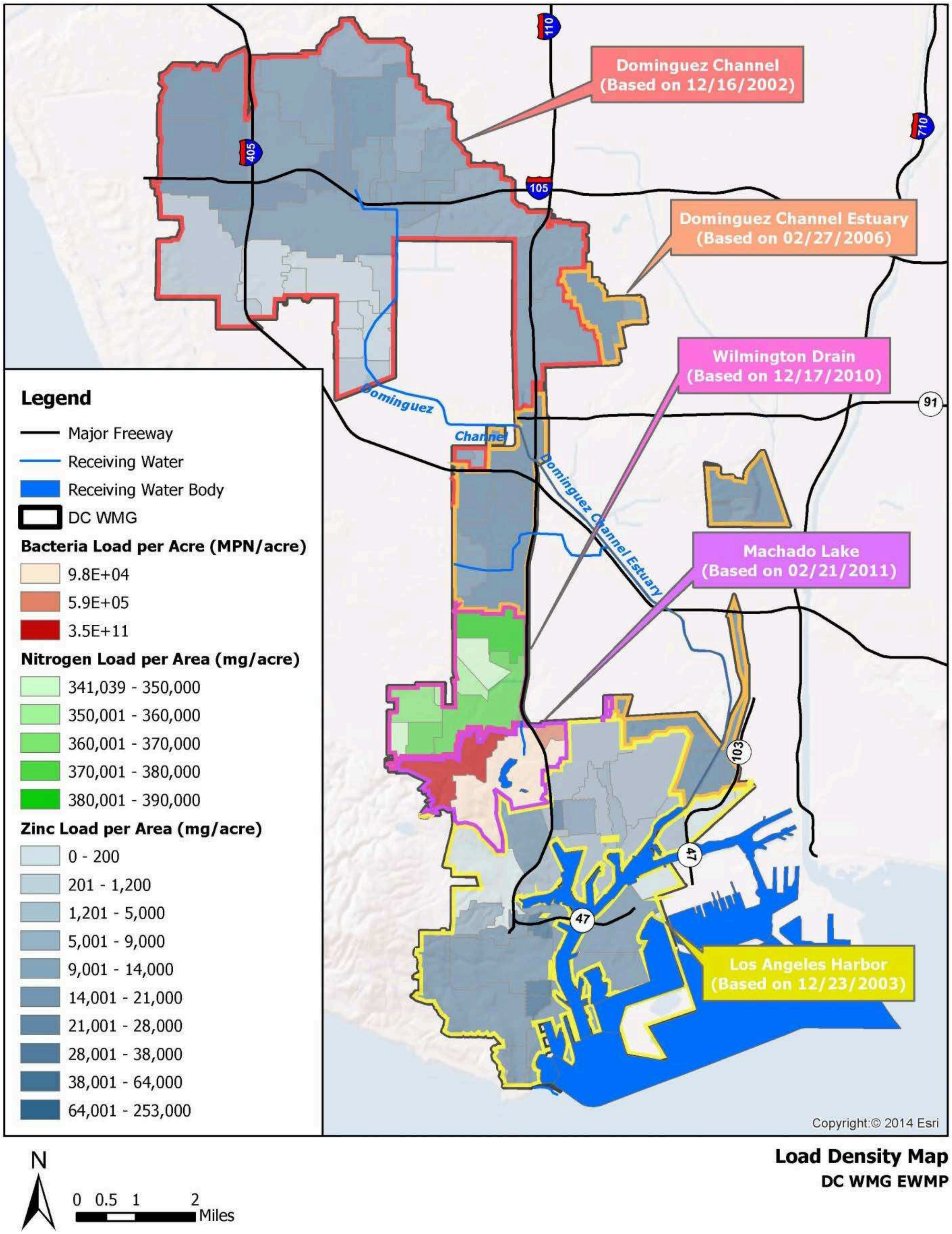


Figure 3-13: Load Density Map

3.4 Volume and Load Reduction Strategies

Various load reduction strategies were used to achieve compliance through the RAA including non-structural and structural BMPs. This is considered the "recipe for compliance" and is shown generally in Figure 3-14. Control measures are implemented strategically throughout the compliance period at specific time steps so that the interim and final WQOs are met. The three types of control measures that are the focus of the volume and load reduction strategy are non-structural BMPs (MCMs and LID ordinances), regional projects, and distributed projects (green streets). Details can be found in Section 4. Figure 3-15 shows the target load reduction for the 90th percentile load associate with zinc using the identified elements. The schedule of implementation is discussed in Section 5 and represents a feasible implementation timeline considering regional BMP implementation will take a long time while MCMs and distributed BMPs may be implemented with less planning, engineering, and design effort.

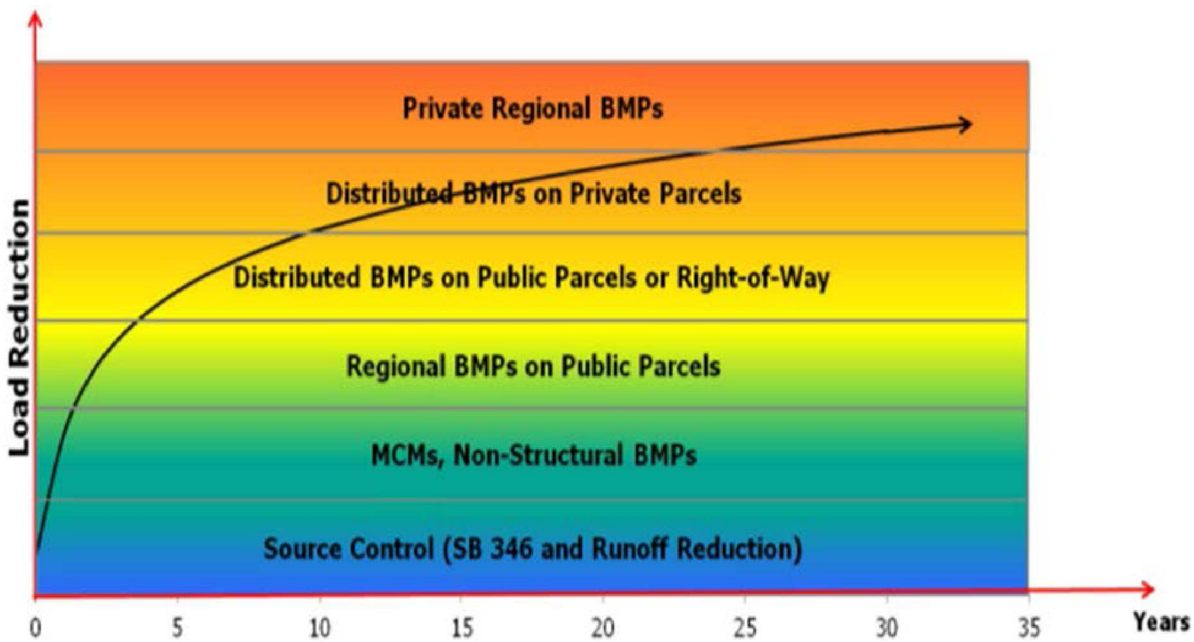


Figure 3-14: Pollution Reduction Strategies

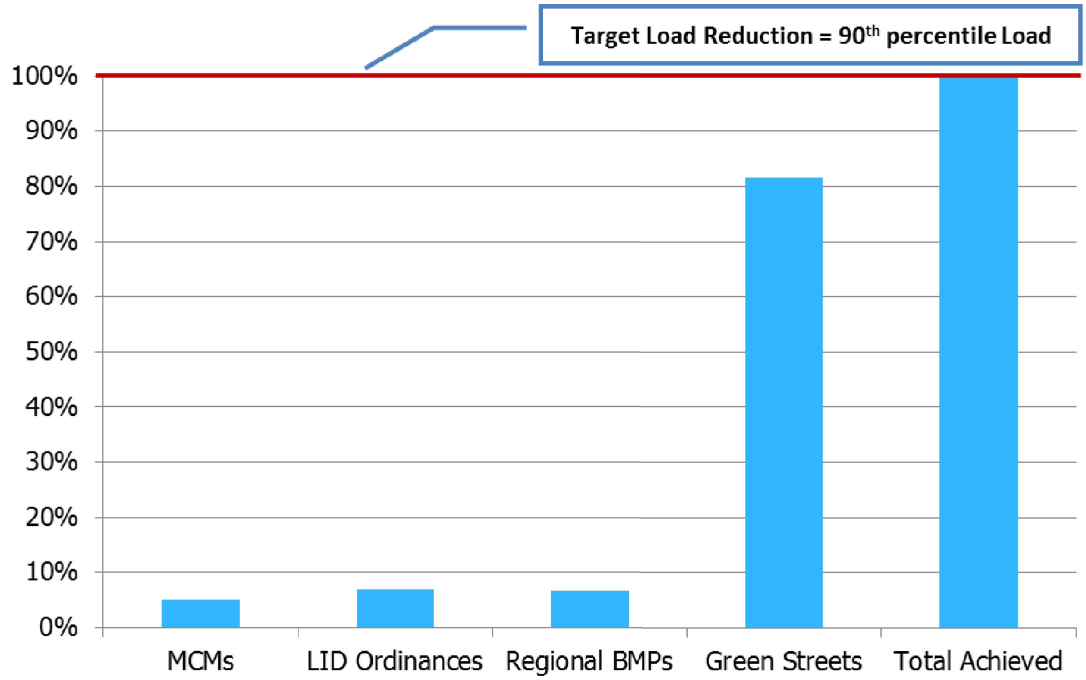


Figure 3-15: Target Load Reduction

4. Watershed Control Measures

In order to comply with EWMP requirements, an evaluation was performed that considered opportunities within the participating Permittees jurisdictions to utilize multi-benefit regional projects that, when feasible, retain non-stormwater discharge and the flows produced by the 85^{th} percentile, 24-hour storm event. A review of relevant TMDL implementation plans and watershed management plans was performed to identify previously identified regional projects within the DC WMG. These projects were then evaluated to identify if they meet the regional EWMP project criteria. An approach was then developed and used to evaluate additional potential regional project sites. This section includes the approach and results of the evaluation.

The control measures analyzed and proposed in this EWMP are for reducing discharges of pollutants to the receiving waters to meet the planning objectives. Measures for managing sediments already within the Estuary are being developed as part of the Contaminated Sediment Management Plan (CSMP): Dominguez Channel Estuary submitted to the Regional Water Quality Control Board in March of 2014 and are not described in this EWMP.

4.1 MCMs/Institutional BMPs

MS4 Permit Part VI.C.5.b.iv.(1) (pages 61-62) directs that the MCMs identified in Parts VI.D.4 to VI.D.10 (pages 70-141) be incorporated as part of the EWMP. The placement of this reference section within the EWMP portion of the permit (Part VI.C, pages 47-67) allows the MCMs in the subsequent section (VI.D, pages 67-141) to be assessed for potential effectiveness and even modified to emphasize the pollution control priorities identified within the EWMP Plan. Part VI.C.5.b.iv.(1).(c) (page 62) explicitly allows some MCM sections to be deleted, and wholly replaced, when accompanied by appropriate justification. The Planning and Land Development Program, is not identified as an MCM that must be evaluated for potential modifications or elimination. The general MCMs categories identified in Part VI.D (pages 67-141) of the MS4 Permit are listed below. Some of the MCM categories are also applicable to the LACFCD, as identified indicated with an asterisk (*).

1. Public Information and Participation Program (PIPP) (Part VI.D.5, pages 86-88)*
2. Industrial/Commercial Facilities Program (Part VI.D.6, pages 88-94)*
3. Planning and Land Development Program (Part VI.D.7, pages 94-113)
4. Development and Construction Program (Part VI.D.8, pages 113-130)
5. Public Agency Activities Program (Part VI.D.9. pages 130-137)*
6. Illicit Connections and Illicit Discharges (IC/ID) Detection and Elimination Program (Part VI.D.10, pages 137-141)*

The 2012 MS4 Permit (VI.D.1.b.ii, page 68) requires that the MCM programs, as specified in the 2001 MS4 Permit, continue to be implemented until the EWMP is approved by the Regional Board. The same six categories listed above were to be implemented under the 2001 MS4 Permit, with the 2012 MS4 Permit having more stringent requirements, some of which are listed below. Attachment J provides a detailed comparison of the program requirements of the 2001 MS4 Permit and the current 2012 MS4 Permit.

- New requirements for erosion and sediment control procedures, especially for sites less than one acre, and for Erosion and Sediment Control Plans;
- Additional tracking requirements as part of the Industrial/Commercial Facilities Program; and
- Extensive new requirements for LID and hydromodification controls as part of the Planning and Land Development Program.

MCMs are considered a subset of institutional BMPs (City of Los Angeles, 2013). Institutional BMPs are non-constructed control measures that prevent the release of flow/pollutants or transport of pollutants within the MS4 area (City of Los Angeles, 2013). Institutional BMPs include:

- Irrigation control
- Brake pad replacement (such as SB 346)
- Replacement of lead in wheel weights
- Street sweeping
- Catch basin cleaning
- Downspout disconnect program

4.1.1 Summary of Existing MCMs/Institutional BMPs

The existing MCMs/institutional BMPs within the DC WMG were evaluated and summarized based on the Los Angeles County Unified Annual Stormwater Reports for the Fiscal Years 2010-2011 and 2011-2012. Tables summarizing the existing MCMs/Institutional BMPs by DC WMG are presented in Attachment K.

4.1.2 MCM Evaluation

This section presents a brief summary of the research used to quantify pollutant load reductions. The research is presented in detail in Attachment L.

The implementation of MCMs relies significantly on behavioral modifications, either of the public or of agency employees. The public education and outreach MCM is specific in attempting to modify public behavior through increasing education and awareness and seeking to obtain specific social constructs that correlate with behavior change. Such constructs include:

- Behavior Change. The actual adoption of the intended pro-environmental behavior.
- Intention. The intention to adopt a pro-environmental behavior.
- Moral norm. The belief that oneself has a moral obligation to adopt a pro-environmental behavior.
- Attitude. A positive attitude or disposition towards a pro-environmental behavior.
- PBC. Stands for "Perceived Behavioral Control." The belief that adopting a pro-environmental behavior is within your power and you have the tools to do so.
- Guilt. The feeling that one ought to adopt a pro-environmental behavior and failure to do so includes negative emotions.
- Social norm. The belief that everyone else has adopted a pro-environmental behavior and that to not adopt the same would set you apart.
- Problem awareness. Awareness that a behavior is a problem and understanding of the consequences of that problem.

Other MCMs also tend to rely on behavior modification. New and re-development programs require builders to comply and agency staff to enforce. Construction control programs require similar behaviors. Illicit discharge detection and elimination similarly requires the public to comply with requirements not to discharge or conduct certain activities, and agency staff to monitor, detect, and enforce such behaviors.

Research suggests that implementation of MCMs has a varying degree of behavior change effectiveness depending on the social construct that occurs through the implementation of those MCMs. The precise methods to achieve the social constructs that would result in the greatest amount of behavior change is still uncertain in the research. Because of this, a range of probable behavior changes may occur through the implementation of various MCMs. MCMs that rely heavily on agency staff behavior change tend to have higher ranges of probabilities of that behavior change occurring because an agency has more direct influence on staff behavior through employment and other contracts.

Yet, behavior change is one side of the pollutant load reduction analysis. The other side is evaluating what pollutant the behavior causes the discharge of, and how much reduction in discharge would occur from changing the behavior. This is another level of uncertainty in the analysis. Some behaviors, when changed, would have a very close correlation with reducing pollutant discharge; such as how changing landscaping, fertilizer application, and irrigation practices can have a very direct effect on nutrient discharges in runoff. Other behaviors may have a less direct effect on pollutant discharge, such as changing automobile driving behavior. Starting and stopping at lower rates of acceleration and deceleration may reduce break and tire wear, but it is impossible to drive without accelerating or decelerating at all and, therefore, the reduction in copper and zinc discharges due to changing driving behaviors or moving to public transportation, which will still discharge those pollutants, may be less direct.

A third level of uncertainty is the degree to which a polluting behavior is responsible for all the pollutant discharges in a watershed. Many pollutants have multiple sources and changing one behavior may only affect one of those many sources, thus having significantly less effectiveness. An example of this is the correlation between pet waste pick up programs and reductions in bacteria levels. Indicator bacteria can have many sources in a watershed, including regrowth in sediments. While reductions in pet waste running off into receiving water will reduce bacteria loads, its effect on overall bacteria concentrations can be difficult to discern.

Given these uncertainties, an attempt at identifying the ranges in potential pollutant load reductions through the implementation of the MCMs in the permit was made. The strongest basis in research was the possible ranges of behavior changes that could occur from different MCM implementation activities. Correlating the reduction of pollutant load reductions that could occur from changing those behaviors was done using current best professional judgment. For example, landscaping behaviors would be considered to affect nutrient, pesticide, and sediment loads, but not necessarily metals loads. Using this approach, possible ranges of load reductions from MCM implementation could be presented. Averaging across the potential ranges, it was estimated that with aggressive and consistent MCM implementation, it is reasonable to see pollutant load reductions overall on the order of approximately 12%. Yet, it is important to note that this averaging methodology has significant limitations in its use and further field studies measuring pollutant loads associated with various behaviors is necessary to verify and refine the model.

The differences between the 2001 and 2012 MCMs were evaluated (Attachment J) and then the research conducted as described above and presented in detail in Attachment L was used to estimate potential pollutant load reductions that one might expect from implementation of the 2012 MCMs. Table 4-1 presents the range of reduction that may be anticipated for each pollutant for each MCM/Institutional program.

PAGE INTENTIONALLY LEFT BLANK

Table 4-1. Range of Pollutant Load Percent Removal													
Minimum Control Measure	**Permit Section (New for 2012)**	**Sediment**		**Nutrients**		**Metals**		**Bacteria**		**Trash**		**Toxins**	
		Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Public Information and Participation Program													
Public Education - proper handling (fertilizer)	VI.D.5.d.i.(2)	0.0%	0.0%	10.7%	47.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	15.8%
Public Education - activity specific (trash clean-up and maintenance procedures)	VI.D.5.d.i.(3)	0.0%	0.0%	0.0%	0.0%	3.6%	15.8%	7.1%	31.7%	10.7%	47.5%	0.0%	0.0%
Public Education - activity specific (over-irrigation)	VI.D.5.d.i.(3)	1.8%	7.9%	3.6%	15.8%	1.8%	7.9%	0.0%	0.0%	1.8%	7.9%	3.6%	15.8%
Public Education - activity specific (pet waste pick up)	VI.D.5.d.i.(3)	0.0%	0.0%	10.7%	47.5%	0.0%	0.0%	10.7%	47.5%	0.0%	0.0%	0.0%	0.0%
Public Education - activity specific (household hazardous waste collection)	VI.D.5.d.i.(3)	0.0%	0.0%	5.4%	24.0%	10.8%	48.0%	5.4%	24.0%	16.2%	72.0%	16.2%	72.0%
Maintain storm water websites	VI.D.5.d.i.(4)	7.1%	31.7%	7.1%	31.7%	7.1%	31.7%	3.6%	15.8%	0.0%	0.0%	3.6%	15.8%
Industrial/Commercial Facilities Program													
Track critical sources - nurseries and nursery centers (enforce/amend BMPs)	VI.D.6.b.i.(1)	10.7%	47.5%	10.7%	47.5%	0.0%	0.0%	7.1%	31.7%	0.0%	0.0%	10.7%	47.5%
Track critical sources - other commercial/industrial facilities that Permittee determines may contribute substantial constituent load to MS4 (self-reporting inspections)	VI.D.6.b.i.(4)	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%
Evaluate all operations of industrial facilities inspected to verify whether their operations are subject to the Industrial General Permit (IGP).	VI.D.6.b.ii.(2,4,7,8,11), VI.D.6.c.i, VI.D.6.c.ii, VI.D.6.e.i.(3)	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%
Facility information - ID whether tributary to 303(d) listed water and generates constituents for which water is impaired (enforce/amend BMPs)	VI.D.6.b.ii.(9)	16.2%	72.0%	10.8%	48.0%	10.8%	48.0%	16.2%	72.0%	5.4%	24.0%	10.8%	48.0%
Planning and Land Development Program													
Alternative compliance measures through groundwater replenishment	VI.D.7.c.ii	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%
Alternative compliance measures through biofiltration on- or off-site	VI.D.7.c.iii	16.2%	72.0%	10.8%	48.0%	10.8%	48.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Bioretention and biofiltration systems	VI.D.7.c.iii.(1)	16.2%	72.0%	10.8%	48.0%	10.8%	48.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Annual reporting of mitigation project descriptions	VI.D.7.c.vi	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%	5.4%	24.0%
Implement post construction BMP maintenance inspections	VI.D.7.d.iv.(c)	16.2%	72.0%	10.8%	48.0%	10.8%	48.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 4-1. Range of Pollutant Load Percent Removal

Minimum Control Measure	Permit Section (New for 2012)	Sediment		Nutrients		Metals		Bacteria		Trash		Toxins	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Development and Construction Program													
For sites less than 1 acre, implement erosion and sediment control BMPs through the use of a erosion and sediment control ordinance	VI.D.8.d	5.3%	23.8%	3.6%	15.8%	1.8%	7.9%	1.8%	7.9%	0.0%	0.0%	0.0%	0.0%
Implement technical BMP standards	VI.D.8.i.i	10.7%	47.5%	3.6%	15.8%	3.6%	15.8%	0.0%	0.0%	7.1%	31.7%	7.1%	31.7%
IC/ID Program													
Procedures for public reporting of ID	VI.D.10.d	10.8%	48.0%	5.4%	24.0%	5.4%	24.0%	16.2%	72.0%	0.0%	0.0%	16.2%	72.0%
Public Agency Activities Program													
Employee training	VI.D.9.k	16.2%	72.0%	16.2%	72.0%	16.2%	72.0%	16.2%	72.0%	16.2%	72.0%	16.2%	72.0%
More frequent street sweeping, especially in areas that lack full capture certified trash control devices.	VI.D.4.c.	10.7%	47.5%	3.6%	15.8%	7.1%	31.7%	0.0%	0.0%	7.1%	31.7%	3.6%	15.8%
Utilize street vacuuming in land use areas that generate high metals loads.	VI.D.9.h	10.7%	47.5%	3.6%	15.8%	7.1%	31.7%	0.0%	0.0%	7.1%	31.7%	3.6%	15.8%
Set maximum street sweeper speeds to optimize effectiveness in removing trash, debris, and sediments.	VI.D.9.h	10.7%	47.5%	3.6%	15.8%	7.1%	31.7%	0.0%	0.0%	7.1%	31.7%	3.6%	15.8%
Sweeping center median gutters, and "pork chop" islands at street intersections.	VI.D.9.h	10.7%	47.5%	3.6%	15.8%	7.1%	31.7%	0.0%	0.0%	7.1%	31.7%	3.6%	15.8%
Revise curb miles cleaned as an indicator to volume of trash collected.	VI.D.9.h	10.7%	47.5%	3.6%	15.8%	7.1%	31.7%	0.0%	0.0%	7.1%	31.7%	3.6%	15.8%
Enhanced maintenance of catch basins, especially those with connector pipe screens.	VI.D.9.h	10.7%	47.5%	3.6%	15.8%	7.1%	31.7%	0.0%	0.0%	7.1%	31.7%	3.6%	15.8%

To streamline the modeling of pollutant load reduction, a generalized average percent removal that can be used for all MCMs to be implemented and for all pollutants was estimated. Table 4-2 presents an example showing two activities and the average percent removal of each constituent. For example, operations and maintenance of roads would be controlled by the implementing agency. The evaluation presented both the high and low range of percent removal that may be anticipated. Because this is an implementing agency controlled activity, the higher percent removal could be used and the value used to calculate the average percent pollutant removal is shown with a highlight in Table 4-2. An activity like pet waste pickup would rely more on public education and participation and the lower value could be used (shown highlighted). It should be noted that this value does not include any additional behavioral factors that certain messaging campaigns may create, such as guilt, which would increase the percent removal that may be anticipated.

Table 4-2: Range of Pollutant Load Reduction Effectiveness (%)

Pollutant Generating Activity	**Sediment**		**Nutrients**		**Metals**		**Bacteria**		**Trash**		**Toxins**	
Description	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
O&M for streets and roads.	10.7%	47.5%	3.6%	15.8%	7.1%	31.7%	0.0%	0.0%	7.1%	31.7%	3.6%	15.8%
Public Education - Pet Waste Pick Up	0.0%	0.0%	10.7%	47.5%	0.0%	0.0%	10.7%	47.5%	0.0%	0.0%	0.0%	0.0%
Average Percent	23.8%		13.3%		15.8%		5.3%		15.8%		7.9%	

Results

Using the values as described above (high value for implementing agency controlled activities, low value for public activities) for each constituent, the average removals for each of the constituents (sediment, nutrients, metals, bacteria, trash, and toxins) were calculated. The results are presented in Table 4-3 below.

Table 4-3: Average Pollutant Removal per Constituent

Description	**%**
Sediment	19.6%
Nutrients	11.7%
Metals	14.4%
Bacteria	6.5%
Trash	13.0%
Toxins	10.4%
Average of the Averages Above	12.6%

Conclusions

The overall average percent removal for all constituents and all activities is 12.6%. Because the lower public education value used does not consider any of the other constructs that are affected by the outreach campaigns (guilt, social norm, etc.), this overall percent removal may be lower than what might be observed. Given the uncertainties in this analysis, the fact that the only actual data the analysis is based on is behavioral change studies and not pollutant load reduction studies, the fact that there are uncertainties over how widespread the effectiveness of a behavior change may be in achieving pollutant load reduction across the watershed, while the analysis suggests a 12 percent pollutant load reduction may occur, the RWQCB suggested 5 percent pollutant load reduction will be used for the load reductions associated with implementing the MCMs in the permit.

Some of the WMG agencies are implementing more aggressive or enhanced MCMs. Because of this, additional load reductions are likely to occur. For the agencies installing full capture devices, and catch basin cleanouts for those devices, in high trash areas, as stated in the California statewide trash policy, based on the results above, an additional two percent load reduction may occur for the constituents associated with trash and the sediments captured by the devices. For enhanced street sweeping using vacuum regenerative sweepers, an additional three percent load reduction for the constituents associated with fine particulates the street sweepers remove should be plausible. This is based on studies by SPAWAR and others (SPAWAR, May 2008, "Metals Load Reduction in Storm Water Using High---Efficiency Sweepers", presentation to a Joint Services Environmental Management Conference) The load reductions based on MCMs are summarized in Table 4-4for each of the DC WMG jurisdictions. The City of Los Angeles is not taking credit for an enhanced MCM program. The catch basin cleanouts and full capture devices will be implemented after 2017, therefore credit will not be given until the next milestone, which is 2026. The table shows the area weighted averages by watershed which were used during the RAA process.

Table 4-4: Average Pollutant Removal per Constituent

Jurisdiction	**2017 MCM Reduction**	**2026 MCM Reduction**
El Segundo	5%	10%
Hawthorne	5%	10%
Inglewood	5%	10%
Lomita	5%	10%
Los Angeles	5%	5%
County Unincorporated	10%	10%
Weighted Averages by Watershed		
Dominguez Channel	6.35%	9.05%
Dominguez Channel Estuary	7.18%	7.18%
Wilmington Drain	6.65%	8.36%
Machado Lake	5.00%	5.92%
Harbor	5.07%	5.07%

4.1.3 New and Re-Development

Part VI.C.4.c.i.(1) of the MS4 Permit requires Permittees to develop and implement LID ordinances applicable to new and re-development projects meeting specified thresholds of disturbance. Average annual redevelopment rates released by the City of Los Angeles (LAR UR2 WMA, 2015) were used to project the area that is expected to be developed between the modeled milestone dates. It can be assumed that the new and re-development projects will implement BMPs as required by the MS4 Permit, thus providing a load reduction based on the 85th percentile rainfall. Table 4-5 summarizes the percent of area re-developed at each of the milestone dates.

Table 4-5: Re-Development Rates by Land Use						
Land Use	**Annual Dev. Rate**	**Percent of Area to be Developed by Milestone Year**				
		2018 Nutrient (100%)	**2019 Toxics (100%)**	**2026 Metal (50%)**	**2029 Metal (75%)**	**2032 Metal (100%)**
Commercial	0.15	0.45	0.60	1.65	2.10	2.55
Education	0.16	0.48	0.64	1.76	2.24	2.72
Industrial	0.34	1.02	1.36	3.74	4.76	5.78
Residential	0.18	0.54	0.72	1.98	2.52	3.06
Transportation	2.70	8.10	10.8	29.70	37.80	45.9

Areas being redeveloped, as a result of the LID ordinances enforced within the DC WMG, were modeled using volume reduction BMPs sized for the 85th percentile storm depth. Table 4-6 summarizes the volume reduction associated with the re-developed area within each DC WMG jurisdiction at each of the compliance milestones for each of the analyzed watersheds. The volume identified at each milestone is cumulative starting with 2015. It is expected that the transportation redevelopment will involve green street design, as discussed in Section 4.2.5; therefore it is not included in the expected volume reduction to avoid double counting of benefits. Tables identifying the volume reductions by land use for each jurisdiction and each watershed are provided in Attachment M.

Table 4-6: Volume Reduction based on Re-Development by Watershed						
Jurisdiction	**Volume Reduction (acre-feet)**					
	2018 Nutrient (100%)	**2019 Toxics (100%)**	**2026 Metal (50%)**	**2029 Metal (75%)**	**2032 Metal (100%)**	**2040 Bacteria (100%)**
Dominguez Channel Watershed						
El Segundo	-	-	1.96	2.50	3.03	4.46
Hawthorne	-	-	4.89	6.22	7.55	11.11
Inglewood	-	-	4.90	6.24	7.58	11.15
Los Angeles	-	-	2.86	3.64	4.42	6.50
County Unincorporated	-	-	5.54	7.05	8.56	12.59
Total	**-**	**-**	**20.16**	**25.65**	**31.15**	**45.81**
Dominguez Channel Estuary Watershed						
Los Angeles	-	-	4.37	5.56	6.75	9.93
County Unincorporated	-	-	3.22	4.10	4.98	7.33
Total	**-**	**-**	**7.49**	**9.67**	**11.74**	**17.26**
Wilmington Drain Watershed						
Lomita	0.29	0.39	1.06	1.35	1.64	2.42
Los Angeles	0.30	0.40	1.11	1.41	1.72	2.52
County Unincorporated	0.28	0.37	1.03	1.31	1.59	2.33
Total	**0.87**	**1.16**	**3.20**	**4.07**	**4.95**	**7.27**
Machado Lake Watershed						
Lomita	0.13	0.17	0.48	0.61	0.74	1.08
Los Angeles	0.40	0.53	1.45	1.85	2.25	3.31
Total	**0.53**	**0.70**	**1.93**	**2.46**	**2.99**	**4.39**
Harbor Watershed						
Lomita	-	-	0.00	0.00	0.01	0.01
Los Angeles	-	-	9.18	11.68	14.19	20.87
County Unincorporated	-	-	0.15	0.19	0.23	0.34
Total	**-**	**-**	**9.33**	**11.88**	**14.42**	**21.21**

4.2 Structural BMPs

In order to address the identified priorities within a watershed, structural BMPs made up of both Regional and Distributed BMPs will be utilized.

Regional BMPs

Generally, regional BMPs will be installed on large public parcels. The strategy employed in this EWMP is to reduce volume to achieve the planning objectives. BMPs that reduce concentrations (treat and release) tend to achieve less pollutant load reduction per acre of land controlled. Additionally, the WMG members seek to achieve the additional benefit of water supply, if possible, among other additional benefits, from implementation of BMPs to meet the water quality planning objectives. This would emphasize BMPs that capture and store or capture and infiltrate water. Thus, the regional project BMP types that are generally sought and evaluated in this EWMP are:

- Infiltration Basins
- Detention Basins

Such regional projects can be structured to provide water for local irrigation or can be structured to augment a potable water supply, such as a municipal supply aquifer.

Distributed BMPs

BMPs installed by private property owners under an agency's new and re-development program are accounted for as described in 4.1.3. and as such, are not evaluated as distributed BMPs to achieve the water quality planning objectives.

Distributed BMPs for purposes of this EWMP are those BMPs installed directly by one or more of the DC WMG agencies that tend to have smaller footprints and capture and store or infiltrate water from smaller catchments than regional projects. As described above as well, emphasis in this EWMP is on storm water capture, storage, use, and/or infiltration type of BMPs that achieve a volume reduction in the watershed rather than treat and release type BMPs. Thus, the distributed BMPs in this EWMP are primarily:

- Green Streets

To be specific, green streets, in the context of this EWMP, are modifications to streets that allow them to capture, store, and/or infiltrate some volume of water from the catchment leading to that street section. This can include a variety of design features including, but not limited to:

- Porous/Permeable Pavers
- Bioswales/Buffer Strips (that infiltrate)
- Biofiltration (that infiltrate)
- Bioretention (that infiltrate)
- Rainfall Harvesting (Rain Barrels & Cisterns) (in the street right of way)

Figure 4-1 shows a depiction of possible green street features. The specific features of the green streets in this plan have not been determined yet, but will be evaluated and established on a case by case basis for each street where a green street is considered optimal for meeting the water quality planning objectives.

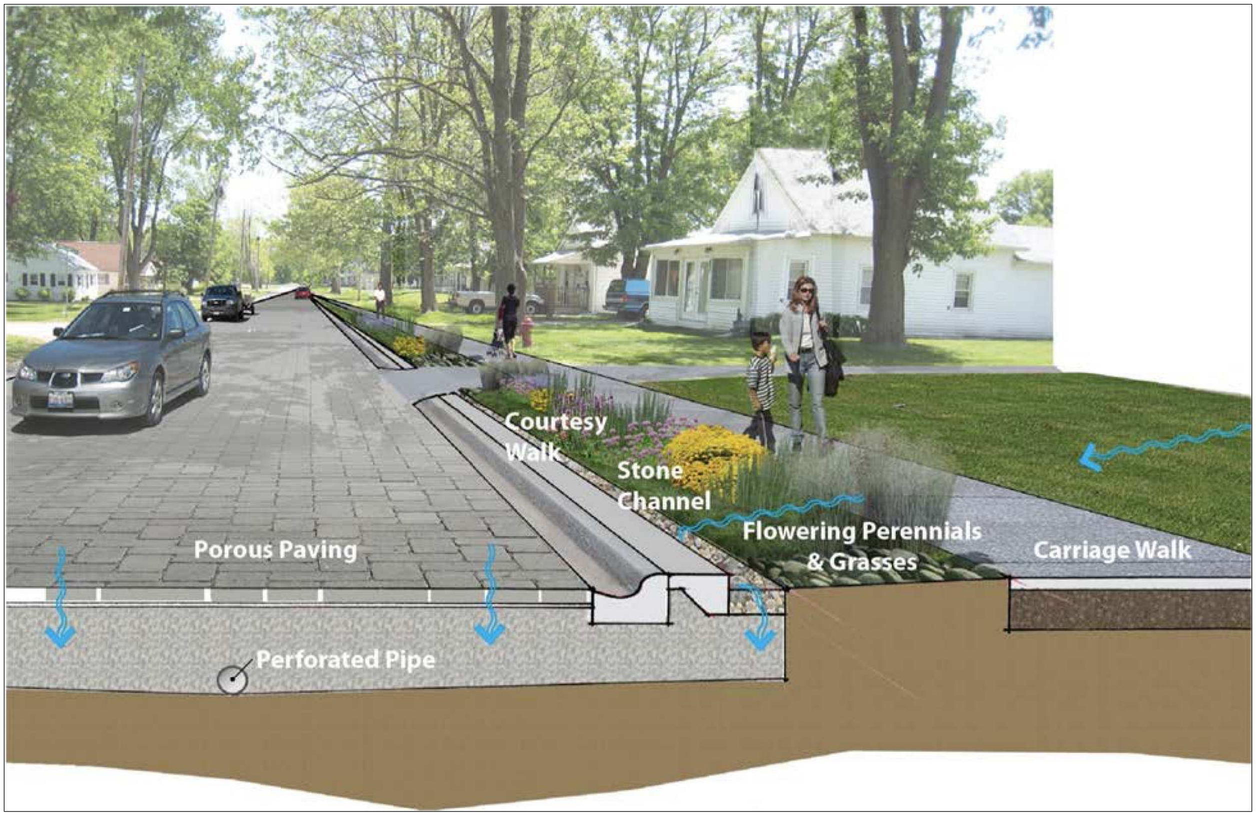


Figure 4-1: Possible Green Street Features

4.2.1 Categories of Structural BMPs

Table 4-7 illustrates the categories and subcategories of structural BMPs. This presents a broad overview of the types of structural BMPs that are available. Some of these BMPs types are currently installed, mostly on private parcels through the new and re-development program, within the DC WMG area and are presented in Figure 4-2. The BMPs in Table 4-7 were also considered as potential project alternatives. Based on project site characteristics, which are evaluated in a later section, an appropriate BMP type can be selected.

Table 4-7: Categories and Subcategories of Structural BMPs Within DC WMG		
Category	**Subcategory**	**Example BMP Types**
Regional	Infiltration	Surface infiltration basin, subsurface infiltration gallery
	Detention	Surface detention basin, subsurface detention gallery
	Constructed Wetland	Constructed wetland, flow-through/linear wetland
	Treatment Facilities	Facilities designed to treat runoff from and return it to the receiving water
	Low Flow Diversions	BMPs that divert runoff to the sanitary sewer (normally dry weather only)
Distributed	Site-Scale Detention	Dry detention pond, wet detention pond, detention chambers, etc.
	Green Infrastructure	**Biofiltration** includes vegetated BMPs with underdrains
		Bioretention includes vegetated BMPs without underdrains
		Permeable pavement
		Green streets (often an aggregate of bioretention, biofiltration and/or permeable pavement)
		Infiltration BMPs include non-vegetated dry wells, infiltration trenches, etc.
		Bioswales include vegetative filter strip and vegetative swales
		Rainfall harvest (rain barrels, green roofs and cisterns)
	Flow-through Treatment BMPs	Treatment BMPs with a minor (or non-existent) infiltration component, often modular/vault-type BMPs including cartridge media filters
	Source Control Structural BMPs	Catch basin inserts, screens, hydrodynamic separators, trash enclosures, etc.

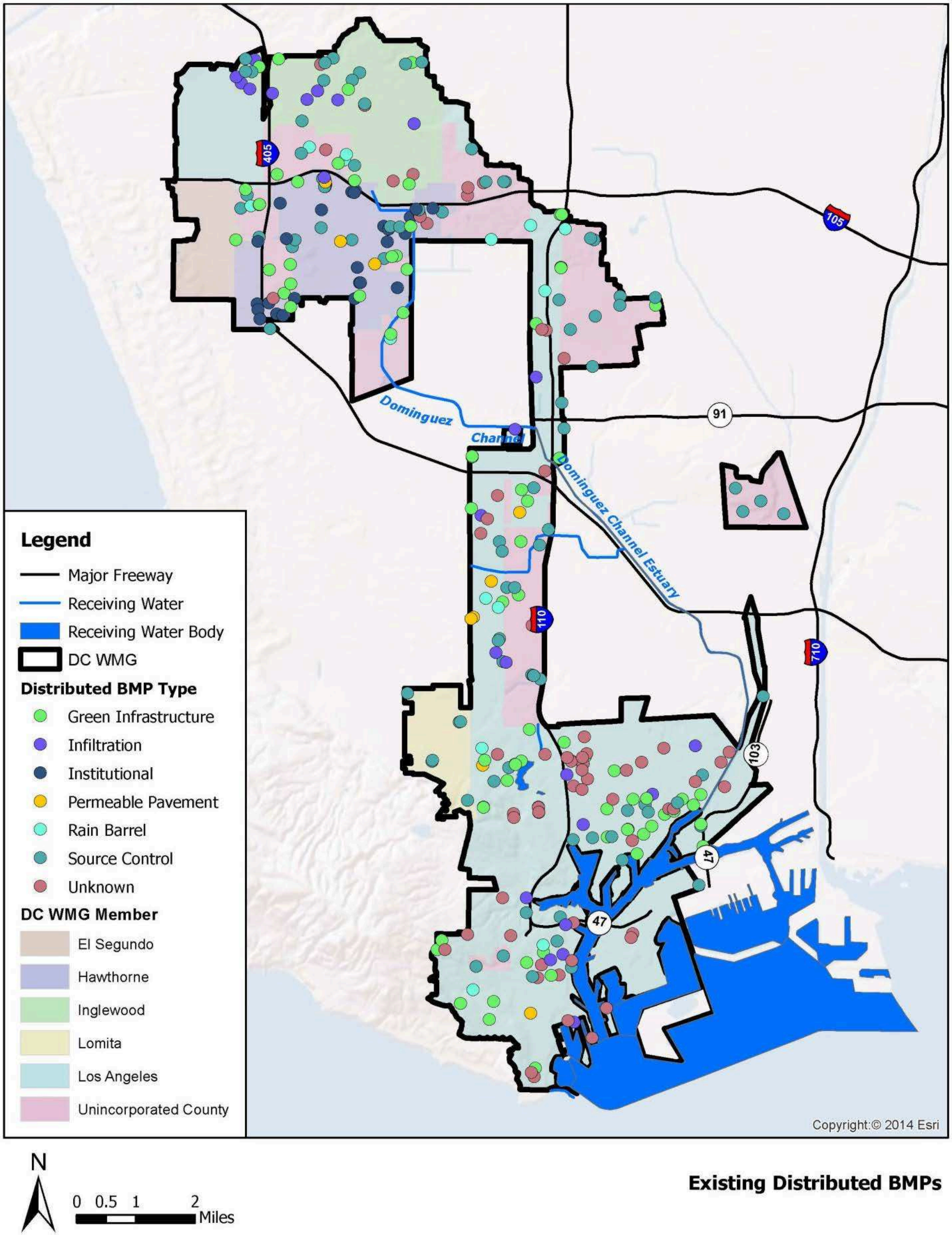


Figure 4-2: Existing Distributed BMPs

4.2.2 Summary of Existing Structural BMPs

To compile information on existing control measures, including MCMs and BMP programs already in effect for each of the participating Permittees in the EWMP, information was collected from the following available sources:

- Los Angeles County Unified Annual Stormwater Report for Fiscal Years 2010-2011 and 2011-2012
  - Summary of MCMs for the Dominguez Channel Watershed
  - Summary of BMPs Installed and Maintained for the Dominguez Channel Watershed
  - Individual Annual Reports for each of the participating Permittees
- Standard Urban Stormwater Mitigation Plans (SUSMP) and LID projects in DC WMG
- City of Los Angeles Green Infrastructure Project List
- Proposition O Project Website (www.lapropo.org)
- Opti Website (http://irwm.rmcwater.com/la/login.php)

The Los Angeles County Unified Annual Stormwater Report for Fiscal Years 2010-2011 and 2011-2012 has been used to create tables identifying the existing structural BMPs installed and maintained by the DC WMG and is included as Attachment N. The information provided by the DC WMG has been incorporated into the tables. Information pertaining to the existing MCMs implemented by the DC WMG are discussed in Section 4.1, and tables created based on the Unified Annual Stormwater Reports for Fiscal Years 2010-2011 and 2011-2012 can be found in Attachment K.

The SUSMP and LID project listings provided by the DC WMG have been used to map the existing distributed BMPs located in Figure 4-2. The figure only includes the BMPs for which an address or global positioning system (GPS) coordinates was provided. It is assumed that the SUSMP and LID BMPs were also reported as part of the annual reports.

BMPs, including regional BMP projects, implemented prior to the baseline pollutant loads being used for the RAA calibration (2012) are considered part of the baseline. BMPs, including regional projects, which were implemented after the baseline pollutant loads, can be modeled in the RAA in order to demonstrate a load reduction. A few regional projects have been implemented in the DC WMG utilizing City of Los Angeles Proposition O funding. The Lake Machado Water Quality Improvements Project and the Rosecrans Recreation Center Stormwater Enhancements Project were constructed following the pollutant load baseline estimation and are evaluated below based on EWMP project criteria.

Lake Machado Water Quality Improvements, including Wilmington Drain

Specific drivers for the Machado Lake Ecosystem Rehabilitation and Wilmington Drain Multi-Use projects are to improve water quality, meet adopted and future TMDLs, enhance riparian, wetland, and upland habitat, improve hydrologic and hydraulic conditions, and create and restore recreational amenities (City of Los Angeles, 2009). The project received its Notice to Proceed in May 2013, broke ground on March 22, 2014, and has an anticipated completion date in April 2016 (Prop O, 2014). The Wilmington Drain is a channelized stream that conveys urban runoff and stormwater flows to Machado Lake. The Wilmington Drain feeds more than 80% of the water that flows into Machado Lake from its 15,553 acre watershed. A majority of the Machado Lake and Wilmington Drain improvements involve enhancing the habitat and incorporating BMPs that will help with treatment components. The area will utilize bioswales in the parking areas, incorporate smart irrigation systems, install trash netting systems, include the use of biofilters and similar vegetated BMPs, and improve the pedestrian trail system (Measure O). This project has been jointly funded by the City of Los Angeles and the LACFCD. The project incorporates numerous distributed BMPs that will reduce the amount of flow reaching downstream receiving waters, but the main intention of the project is to provide treatment. This project is not projected to provide a volume reduction; it would be characterized as a "treat and release" type of project.

Machado Lake will be recharged with advance treated water conveyed from the Terminal Island Water Reclamation Plant (TIWRP). This highly treated water will dilute local runoff to achieve the waste load allocations in Machado Lake.

Rosecrans Recreation Center Stormwater Enhancements

The Rosecrans Recreation Center Stormwater Enhancement project was completed in October 2013. The project achieved some of the goals outlined in the 2013 IRWMP and included the installation of smart irrigation systems, bioswales in parking lots, permeable parking lots, vegetated retention basins, infiltration cisterns/irrigation cisterns, a synthetic soccer field, landscaped areas, and decomposed granite pathways. The project treats a tributary watershed of 12.73 acres made up of mostly the park and some surrounding residential areas (CDM Rosecrans Recreation Center, 2006). This project incorporates water capture and use of stormwater; however, most of the water captured is from outside of the DC WMG area. Because of this, the impact of this project is negligible and does not affect the RAA or meeting the EWMP water quality planning objectives.

4.2.3 BMP Planning Process Completed Prior to Development of the EWMP

The following existing TMDL implementation plans and watershed management planning documents were reviewed as part of the development of the EWMP to identify potential projects for inclusion:

- 2013 Public Draft Update for the Greater Los Angeles County (GLAC) Integrated Regional Water Management Plan (IRWMP);
- 2013 Proposition O (Clean Water Bond Program) October Monthly Report;
- 2012 GLAC IRWMP Update, the Greater Los Angeles County Open Space for Habitat and Recreation;
- 2012 GLAC IRWM South Bay Subregional Plan;
- 2011 Multi-pollutant TMDL Implementation Plan for the County of Los Angeles Unincorporated Area of Machado Lake Watershed;
- 2004 Dominguez Watershed Management Master Plan (DWMMP);
- 2003 Dry-Weather Discharge Treatment Feasibility Study submitted by the County of Los Angeles Department of Public Works Watershed Management Division;
- Opti, part of the GLAC IRWMP online project database; and
- Los Angeles County Clean Water, Clean Beaches online project database.

These documents were also reviewed in an effort to identify planned projects that were evaluated to determine if they meet the EWMP criteria for regional projects and represent feasible implementation options. These projects are included in Figure 4-2 and, because they were in service prior to 2012, their effects on load reductions and receiving water concentrations are built into the receiving water data used to calibrate the model and are represented by the baseline. Some of the references include broad plans outlining the steps necessary towards improving water quality and recommending different BMPs under different conditions. These documents provided conceptual scenarios without going into great detail. In addition, data was obtained from Opti and the Los Angeles Clean Water, Clean Beaches online project databases. The data reviewed included no information regarding planned distributed public BMP projects.

Plans Reviewed and Incorporated into this EWMP

The existing plans developed by DC WMG members were reviewed and are listed below. The EWMP and associated implementation actions replace the previous plans and addresses the various TMDLs.

- Los Angeles Harbor Bacteria TMDL
- Dominguez Channel and Greater Los Angeles and Long Beach Harbor Toxics TMDL
- Machado Lake Nutrient TMDL
- Machado Lake Nutrient & Toxic TMDL Monitoring & Reporting Plan for the Los Angeles County Flood Control District
- Multipollutant TMDL Implementation Plan for the County of Los Angeles Unincorporated Area of the Machado Lake Watershed
- Machado Lake Pesticides and PCBs TMDL

4.2.4 Process of Identifying and Selecting Multi-Benefit Regional Projects (EWMP Regional Projects)

The approach described below was used to identify, screen, and evaluate potential regional projects. This approach included a watershed based assessment of all publicly-owned and some private parcels within the DC WMG to evaluate if they would be suitable to support a regional stormwater enhancement project. The approach to identifying potential regional projects is illustrated in Figure 4-3. The process is discussed generally in the sections below and in detail in Attachment O.

Table 4-8 lists scoring and ranking criteria and how the parcels were scored based on those criteria. The right most column of Table 4-8 lists if Geographical Information System (GIS) data were useable for autonomous scoring of the parcels. Following the autonomous scoring of the parcels, parcels were visually evaluated to assess if they could conceivably provide sufficient space for a regional project that retains the 85th percentile storm from a catchment area outside the parcel itself.

For visual evaluation, the following screening criteria were adhered to:

1. Score using the GIS approach.
2. Identify Assessors Identification Numbers (AIN) ending in 900s. These represented tax exempt parcels, which, if tax-exempt, were assumed therefore to be government owned and likely owned by a DC WMG agency. Once identified in the Tier 1 list as noted below and considered potentially suitable, ownership research was conducted to verify if they were owned by a DC WMG agency.
3. Specify which Tier a parcel should be categorized in based on its land use.

   Tier 1: 900 coded open space, parks, golf courses, vacant

   Tier 2: 900 coded everything else, with the exception of education

   Tier 3: non-900 coded (privately owned) open space, parks, golf courses, vacant

   Tier 4: education – both 900 and non-900 coded

   Tier 5: everything else – non-900, non-education, non-park/open space/golf course/vacant.
4. Exclude Tier 5; if a Watershed Management Group (WMG) member or stakeholder brings a Tier 5 parcel forward, it can be evaluated further for feasibility.
5. Exclude parcels < 0.25 acres. These would have insufficient space for regional retention.
6. Exclude parcels that are part of natural water body.
7. Exclude parcels at edge of the DC WMGA. These would not collect significant water from the DC WMGA jurisdictions.
8. Exclude parcels with more than 60 to 70% buildings based on visual inspection of Google Earth and views available on or after December 2014.

9. Exclude open space parcels that have been developed based on visual inspection. It is important to note that a number of parcels labeled as "open space" were developed and their land use designation not changed in the parcel data available.
10. Exclude parcels that have less than approximately 10 acres tributary to them. This was not strictly adhered to, but in general, parcels that could collect water from 10 acres upstream of them were preferred.
11. Of the 900 series that survive this screening, review the ownership. If available data indicates the property is owned by WMG agencies, select as potential regional projects.
12. Review the unselected 900 series and the non-900 series that survive this screening and list the top 100 to 200 scores from those.
13. Visually inspect the top 100 to 200 and identify those that may have better potential to explore further based on potential catchment area, potential space on site and size of site, and potential ownership.

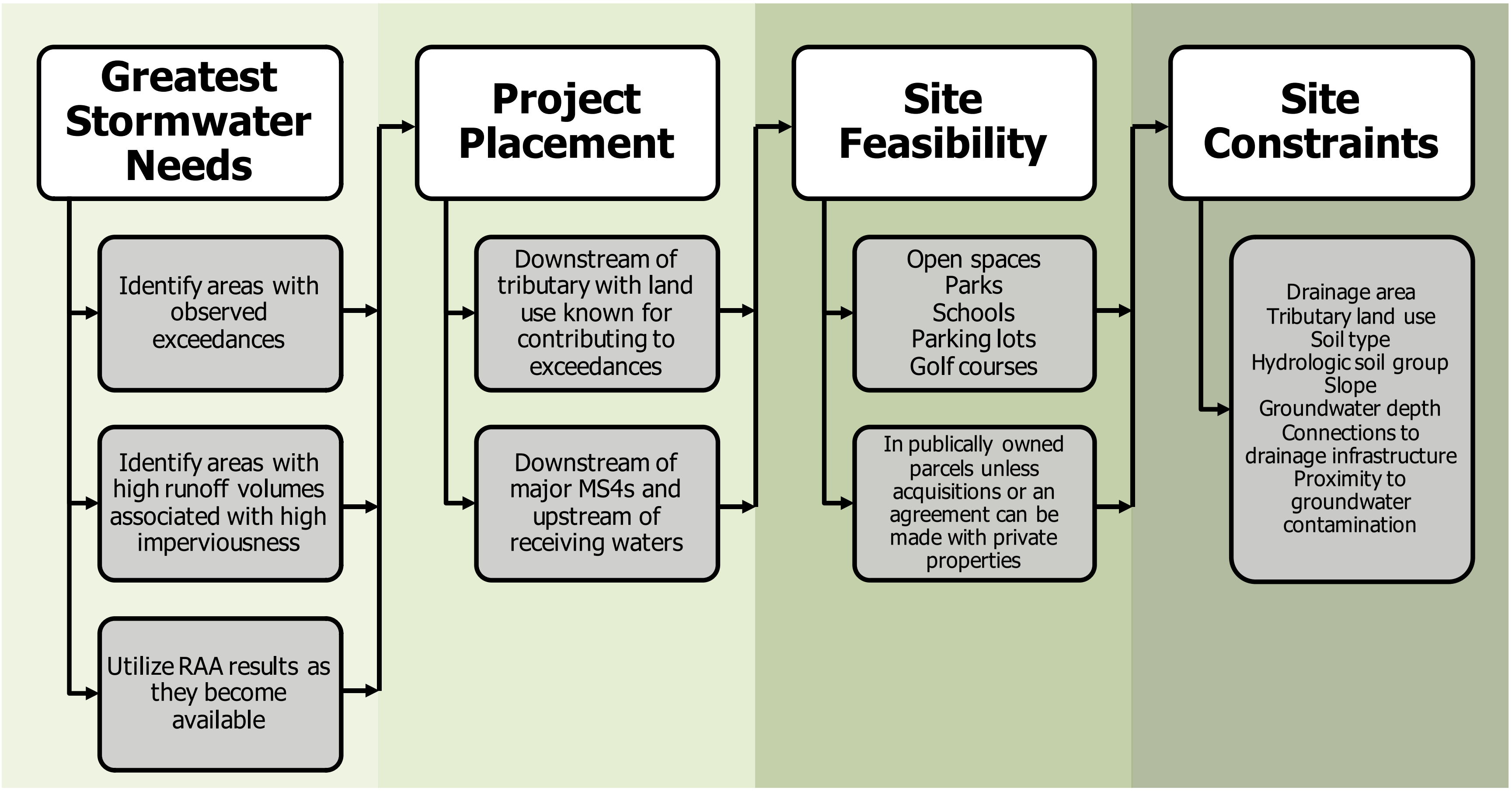


Figure 4-3: Approach to Identifying Potential Regional Projects

Table 4-8: Ranking Criteria

Criteria		Points						GIS Coverage
		0	1	2	3	4	5	
General Criteria	Proximity to an Outfall (mile) (x2)	3.0 ≤ X	2.5 ≤ X < 3.0	2.0 ≤ X < 2.5	1.5 ≤ X < 2.0	1.0 ≤ X < 1.5	0 ≤ X < 1.0	X
	Proximity to 36" Storm Drain (feet)[1]	1,000 ≤ X	800 ≤ X < 1000	600 ≤ X < 800	400 ≤ X < 600	200 ≤ X < 400	0 ≤ X < 200	X
	Land Use (x2)	Restricted Area (DOD)	Private requiring demolition of structures	Private with large parking lots requiring no changes to land use	Schools and Golf Courses	Public Buildings	Public Open Space	X
	Parcel Size (acre)	X < 0.25	0.25 ≤ X < 1.0	1.0 ≤ X < 2.0	2.0 ≤ X < 3.0	3.0 ≤ X < 4.0	4.0 ≤ X	X
	Catchment Area[2]	X<1	1 ≤ X < 25	25 ≤ X < 50	50 ≤ X < 75	75 ≤ X < 100	100 ≤ X	
Underlying Soil Conditions	Contamination[3]	Superfund	Possible Contamination				Certain no contamination	X
	CPI		1	2	3	4	5	X
	Soil Infiltration Rate (inches/hour)	X < 0.3	0.3 ≤ X < 0.5	0.5 ≤ X < 0.7	0.7 ≤ X < 0.9	0.9 ≤ X < 1.1	1.1 ≤ X	X
	Slope (%)	10 < X	5 < X ≤ 10	3 < X ≤ 5	2 < X ≤ 3	1 < X ≤ 2	0 < X ≤ 1	
	Liquefaction Areas	Possible Liquefaction					No Liquefaction	X
	Landslide Areas	Possible Landslide					No Landslide	X
	Depth to Groundwater (feet)[2,4]		X ≤ 10				10 < X	
	Depth to Storm Drain Infrastructure (feet)[2]	15 ≤ X	10 ≤ X < 15	5 ≤ X < 10	3 ≤ X < 5	0 < X < 3	X=0 (open channel/ gutter)	

Notes:
1. Based on distance to midpoint of GIS pipeline segment to centroid of parcel.
2 GIS data coverage not currently available.
3 Superfund information only.
4 Site specific conditions may allow variances.

The potential project footprints are based on stormwater storage areas of sufficient size to infiltrate in 72 hours or to store the 85th percentile storm in 10 feet of depth unless otherwise noted. In most cases, areas needed to infiltrate in 72 hours were larger than the area needed to store the storm volume in 10 feet of depth.

From the tier 1 list, after the additional manual screening, a total of nine parcels were identified that show promise for placement of regional projects that capture some catchment area and may be controlled by Watershed Management Group (WMG) members for: (listed in order from the northern part of the watershed to the southern part)

1. Chester Washington Golf Course
2. El Segundo Pump Station
3. Jim Thorpe Park
4. Ramona Park
5. Hawthorne Memorial Park
6. Darby Park
7. Harbor City Park
8. Averill Park
9. Wilmington Recreation Center

These top ranked project parcels were recommended for implementation and a preliminary feasibility evaluation was performed. Concept drawings were prepared for the recommended projects and are provided in Attachment P. Table 4-9 lists the recommended projects within the DC WMG and identifies the space available, drainage area, design volume (associated with the 85th percentile, 24-hour rain event), and volume provided based on the concept drawings. The project sites are illustrated in Figure 4-4. Although these top nine projects were the only projects evaluated, additional tier 1 parcels will continue to be investigated by the DC WMG, as appropriate.

Table 4-9: Regional Project Site Summary

Recommended Project Site	Ownership	Parcel Size (ac)	Drainage Area (ac)	Design Volume (ac-ft)	Storage Volume (ac-ft)
Chester Washington Golf Course (North)	County[1]	116	636	25.8	26.4
Chester Washington Golf Course (South)			542	22.0	26.1
El Segundo Pump Station	El Segundo	6.2	574	27.0	27.0
Jim Thorpe Park	Hawthorne	7.6	378	16.0	16.0
Ramona Park	Hawthorne	1.7	273	12.9	12.9
Hawthorne Memorial Park	Hawthorne	6.6	202	8.2	8.2
Darby Park	Inglewood	19.5	106	5.2	5.2
Harbor City Park	Los Angeles	14.8	4,460	77.0	80.7
Averill Park	Los Angeles	10.7	1,376	21.4	21.4
Wilmington Recreation Center	Los Angeles	7.2	273	12.9	12.9

[1] Facility is owned by the County, but operated under lease by American Golf.

A field investigation was completed at six of the nine identified sites. The investigation consisted of background geologic literature review and a Cone Penetrometer Tests (CPT) to depths below the bottom of the planned retention systems or when refusal was encountered. The results of these field investigations are provided in Attachment Q. The investigations suggested that the infiltration rates being used to assess the performance of the regional projects are within appropriate ranges.

All of the regional project concepts, with the exception of the El Segundo Pump Station, involve subsurface storage that promotes infiltration using perforated steel reinforced poly-ethylene (SRPE) cisterns or a concrete vault with a perforated bottom. It is preferable to infiltrate the captured volume of water within 72 hours as that is the presumptive vector (mosquito) control standard for the Los Angeles County Department of Public Health. In some locations, there was insufficient footprint to infiltrate within 72 hours given the published potential infiltration rates of the site surficial soils as they are currently mapped. In those locations, deeper vaults were considered necessary to capture the control volume. It would infiltrate, but not within 72 hours. These locations were at such depth that, based on prior work siting subsurface retention in Los Angeles County, the Department of Public Health would be likely to consider the depth of the vault to be sufficient to prevent vector breeding from occurring in the vault.

Flows from the existing storm drain system will be diverted to the project sites through gravity. No pump stations are planned at this time. The need for pumping would be evaluated on a case by case basis during project concept planning.

The water captured could potentially be used to supplement irrigation, where the demand justifies such use. If not used for irrigation, it would generally infiltrate into the shallow groundwater basin. To move the water into a drinking water aquifer, injection would be necessary as described in Section 4.2.6.

At the El Segundo Pump Station site, the existing pump stations basin will be re-graded to promote better infiltration and increased capacity. The El Segundo Pump Station site recharge will increase the groundwater pressures to assist with the West Coast Basin Seawater Barrier.

The recommended regional project sites were modeled in the RAA by setting the drainage area tributary to the sites as compliant when the project provides the 85th percentile, 24-hour storm event volume or greater capture. These projects are considered regional EWMP projects and satisfy the criteria identified in Part VI.C.1.g of the MS4 Permit. All of the regional project sites proposed capture a volume greater than or equal to the 85th percentile, 24-hour storm volume generated from their subcatchments within the DC WMG.

4.2.4.1. Regional Projects Descriptions

The concepts for the recommended regional projects vary based on the water storage required, available surface area, and infiltration rates of the project's location. Some projects utilize large diameter perforated pipes for subsurface infiltration while others utilize concrete vaults with perforated bottoms. All of the regional projects include one project concept, except the Chester Washington Site. The Chester Washington has two tributary areas and has one storage system in the northern portion of the site and a second in the southern portion of the site to capture flow from both tributary areas. Factsheets for the recommended regional projects showing each projects' cross section, site and design parameters, site renderings, and locations within the DC WMG boundary area are provided in Figure 4-5 through Figure 4-13 below. Additional information regarding cone penetrometer testing for a preliminary assessment of soil types at selected locations can by found in Attachment Q. The sites are shown on a map in Figure 4-4.

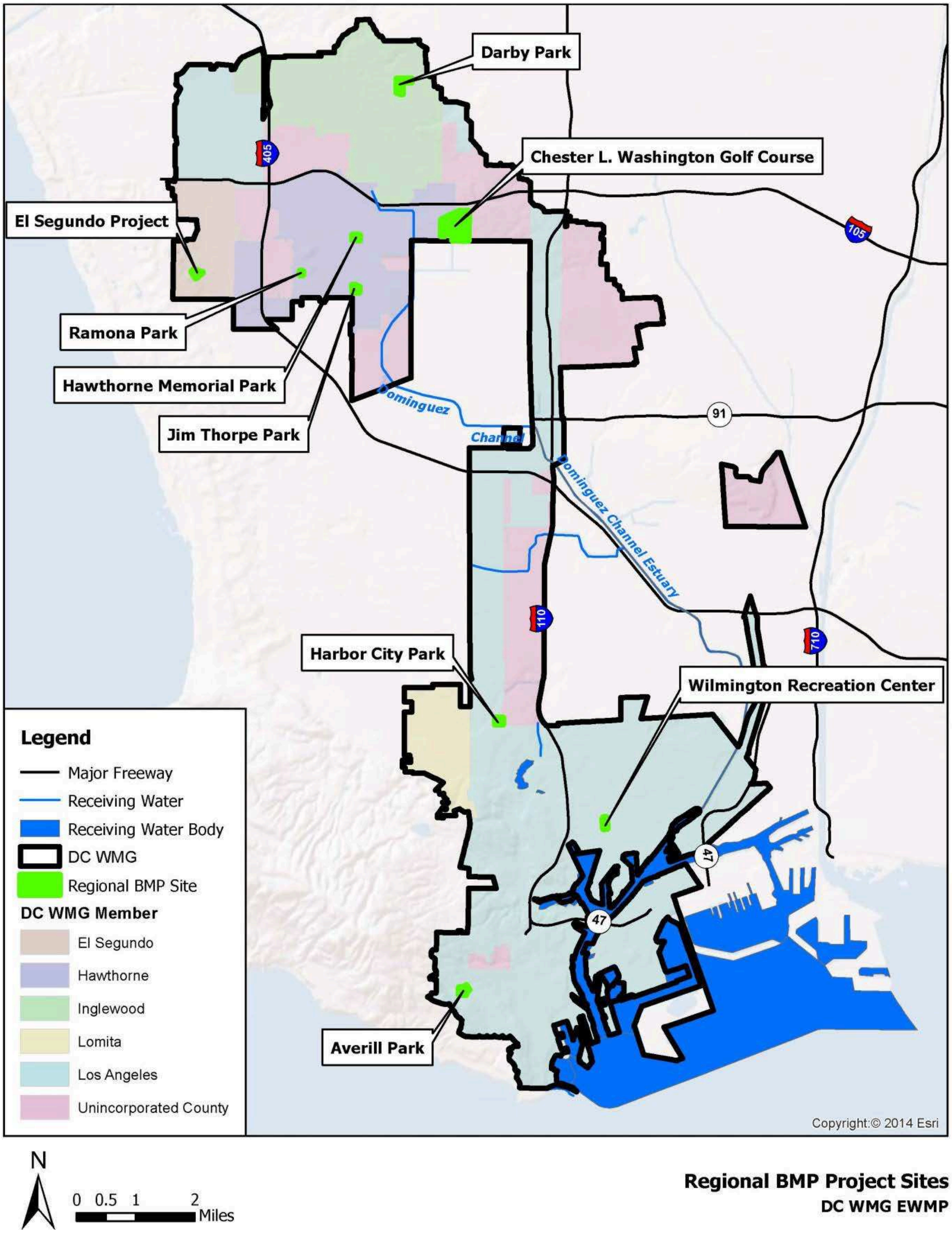
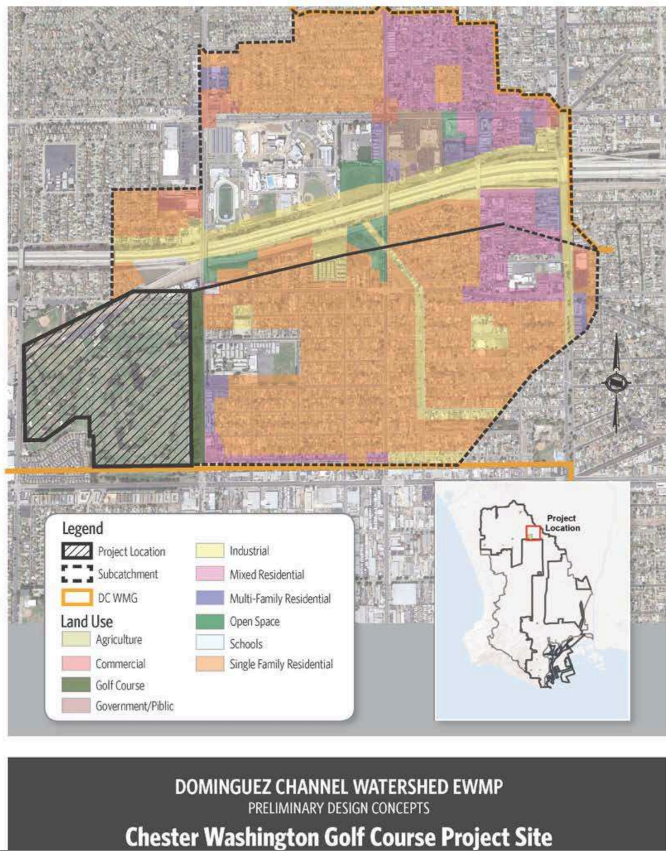


Figure 4-4: Regional BMP Project Sites

PAGE INTENTIONALLY LEFT BLANK



Chester Washington Golf Course

Item	Detail	
Ownership	Los Angeles County	
AIN	4057-032-900	
Address	1930 W 120th St., Los Angeles, CA 90047	
Infiltration Rate (in/hr)	0.45	
Groundwater Basin	West Coast and Central	
Site Area (acre)	116	
	NORTH	SOUTHWEST
Drainage Area (acre)	636	542
Design Volume (ac-ft)	25.8	22
Latitude and Longitude	33°55'23.61"N 118°18'36.90"W	33°55'1.51"N 118°18'36.90"W
Major Watershed/Tributary	Dominguez Channel	
Existing Site Description	Golf Course, Open Space	
Soil Type	Ramona Loam	
Drainage Area Total Impervious (%)	3	
Design Storm Event Rainfall Depth (in)	0.95	
Proposed Retrofit Description	Concrete Vault with Perforated Bottom	23 Rows of 120" Perforated Pipe
BMP Footprint (Cubic Feet)	96,000	141, 252
Media Depth (Feet)	31	33
Construction Cost ($, millions)	59.6	
Annual Maintenance Cost ($, millions)	0.5	
Design and Construction Time	7.5	
Completion Year	2026	

NOTES:

1. Rendering does not include all details of the proposed project and existing site conditions.
2. All figures are not to scale (NTS) and shall be used for conceptual purposes only.
3. Rendering only shows Chester Washington South Project.

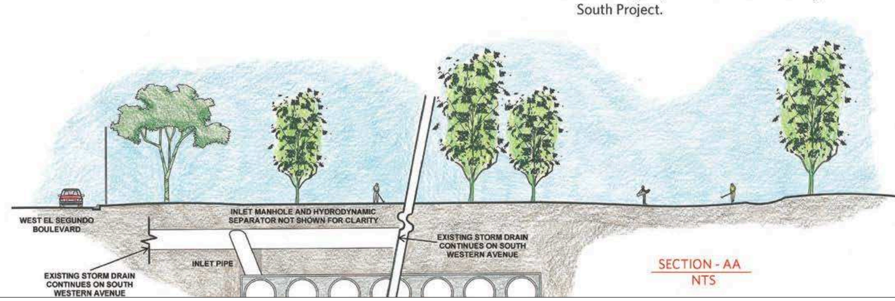
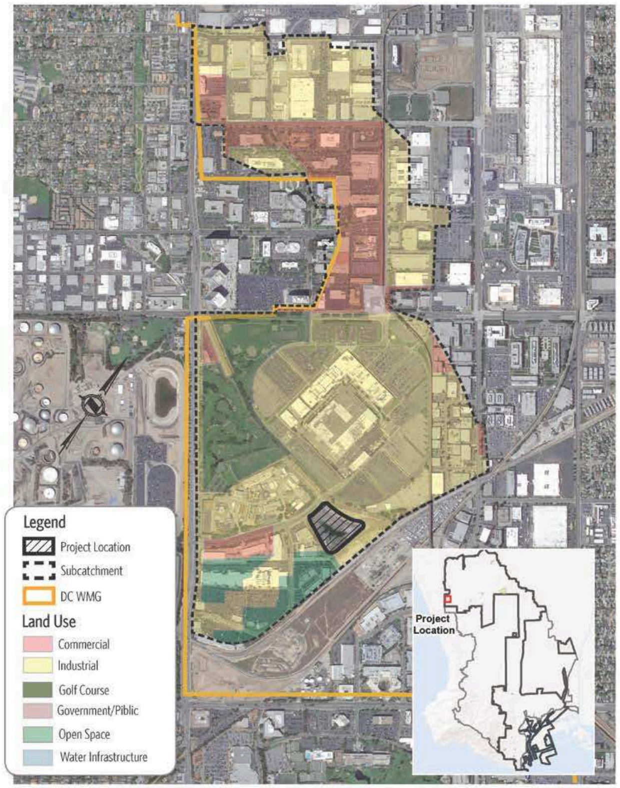
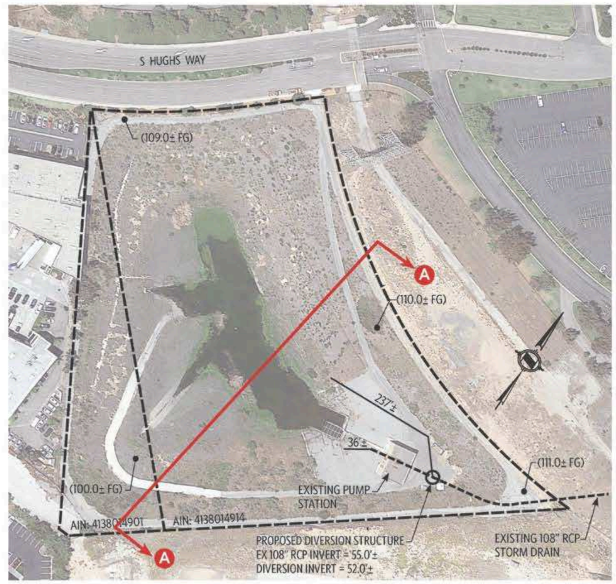


Figure 4-5: Chester Washington Golf Course



DOMINGUEZ CHANNEL WATERSHED EWMP
PRELIMINARY DESIGN CONCEPTS



El Segundo Pump Station	
Item	**Detail**
Ownership	City of El Segundo
AIN	4138-014-901; 4138-014-914
Address	S Hughes Way and Allied Way, El Segundo, CA
Infiltration Rate (in/hr)	0.81
Groundwater Basin	West Coast
Site Area (acre)	7.39 (6.2 + 1.19)
Drainage Area (acre)	574
Design Volume (ac-ft)	27
Latitude and Longitude	33°54'29.96"N 118°23'23.34"W
Major Watershed/Tributary	Dominguez Channel
Existing Site Description	Open Space, Ex-Pump Station
Soil Type	Ramona Sandy Loam
Drainage Area Total Impervious (%)	70
Design Storm Event Rainfall Depth (in)	0.9
Proposed Retrofit Description	Re-grade for Better Infiltration
BMP Footprint (Square Feet)	112,817
Media Depth (Feet)	N/A
Construction Cost ($, millions)	1.4
Annual Maintenance Cost ($, millions)	0.016
Design and Construction Time	3.5
Completion Year	2026

NOTES:
1. Rendering does not include all details of the proposed project and existing site conditions.
2. All figures are not to scale (NTS) and shall be used for conceptual purposes only.

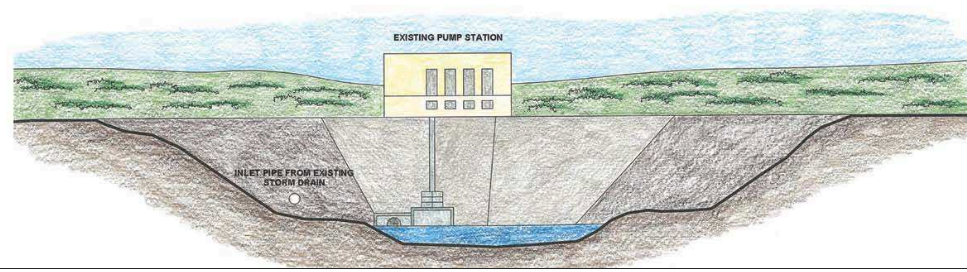
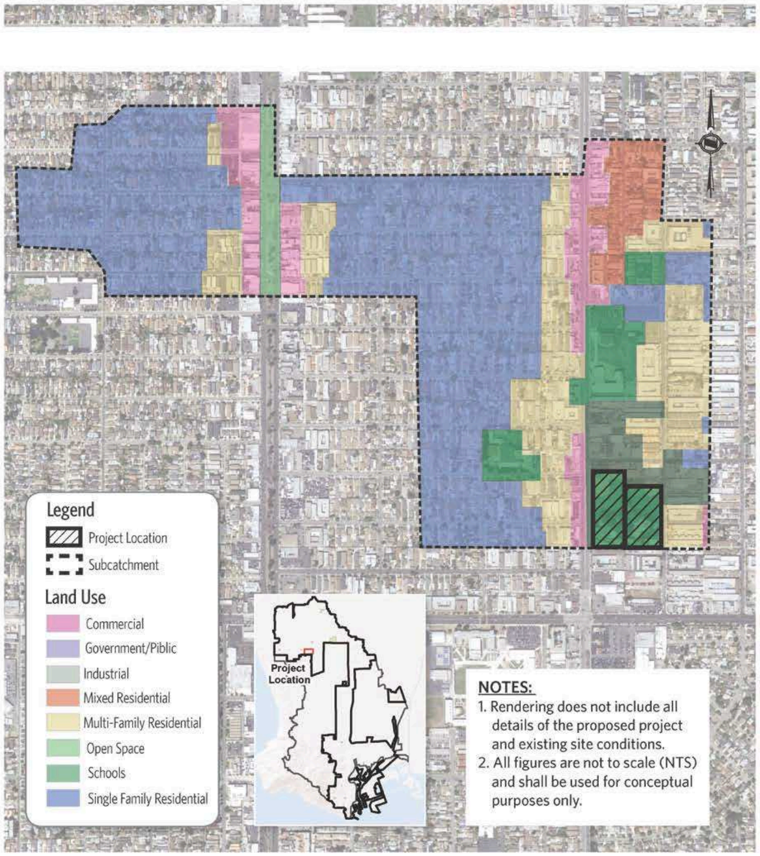
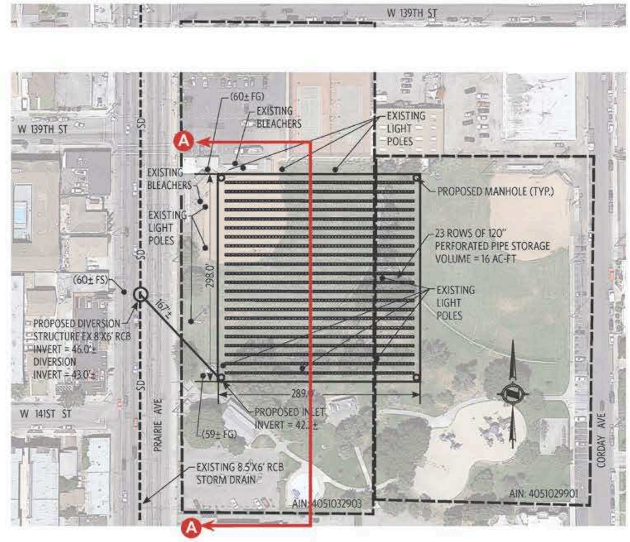


Figure 4-6: El Segundo Pump Station



DOMINGUEZ CHANNEL WATERSHED EWMP
PRELIMINARY DESIGN CONCEPTS
Jim Thorpe Park Project Site



Jim Thorpe Park	
Item	**Detail**
Ownership	City of Hawthorne
AIN	4051-032-903; 4051-029-901; 4051-030-901
Address	14100 Prairie Ave., Hawthorne, CA 90250
Infiltration Rate (in/hr)	0.27
Groundwater Basin	West Coast
Site Area (acre)	8.65(4.1 + 3.53 + 1.02)
Drainage Area (acre)	378
Design Volume (ac-ft)	16
Latitude and Longitude	33°54'16.09"N 118°20'34.20"W
Major Watershed/Tributary	Dominguez Channel

Jim Thorpe Park (cont'd)	
Item	**Detail**
Existing Site Description	Park, Open Space
Soil Type	Montezuma Clay Adobe
Drainage Area Total Impervious (%)	51
Design Storm Event Rainfall Depth (in)	0.95
Proposed Retrofit Description	23 Rows of 120" Perforated Pipe
BMP Footprint (Square Feet)	86,122
Media Depth (Feet)	28
Construction Cost ($, millions)	18.0
Annual Maintenance Cost ($, millions)	0.23
Design and Construction Time	4.5
Completion Year	2026

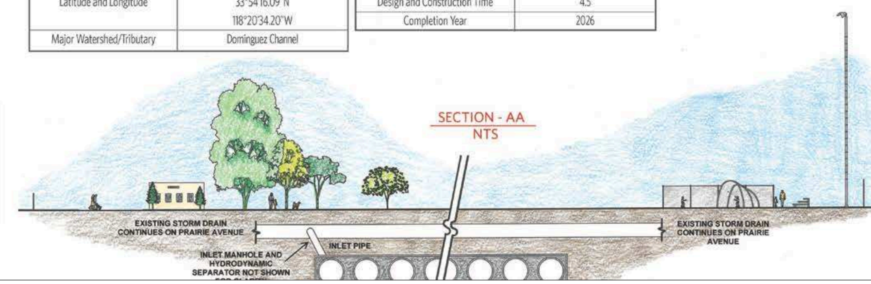


Figure 4-7: Jim Thorpe Park

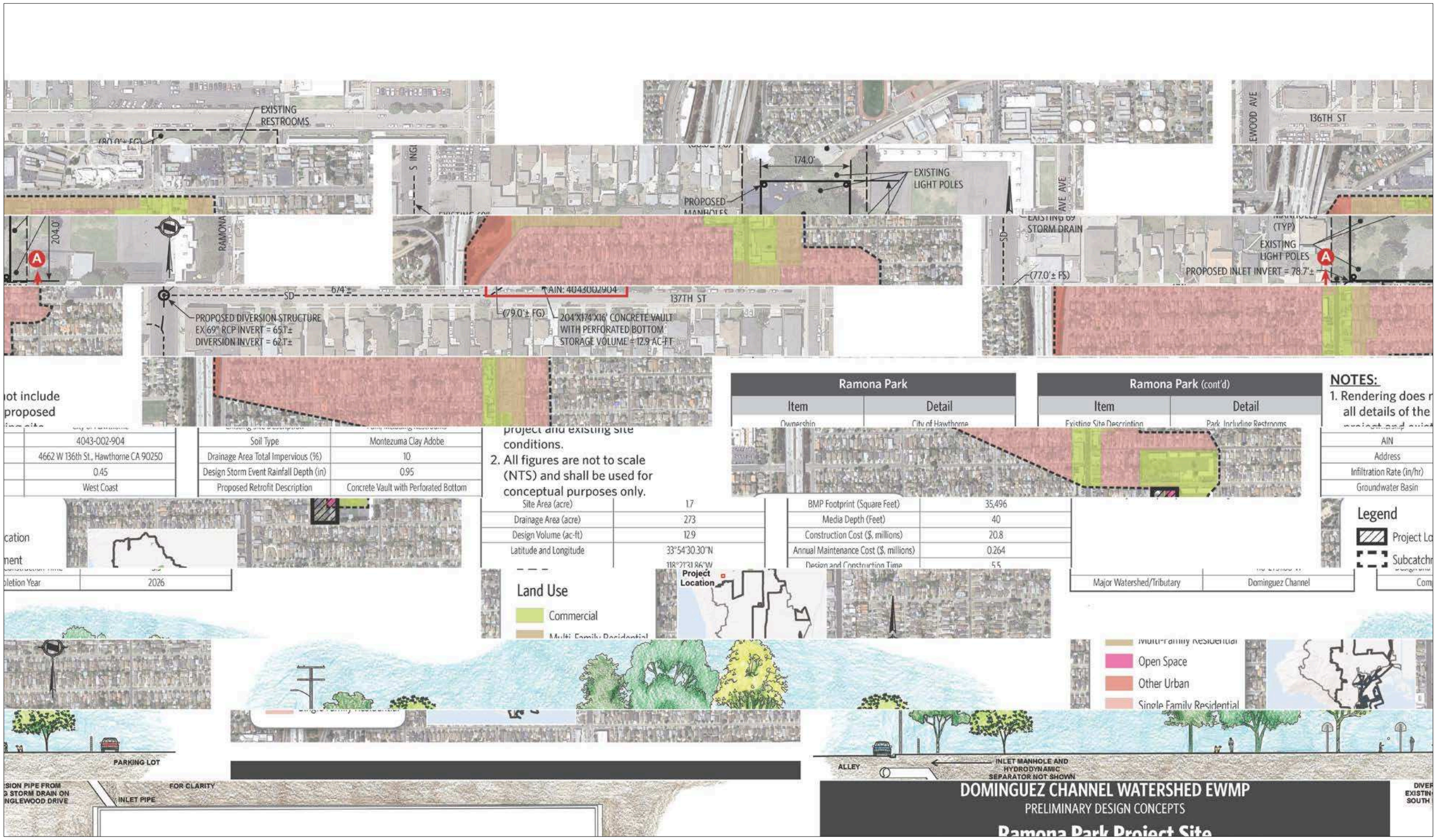


Figure 4-8: Ramona Park

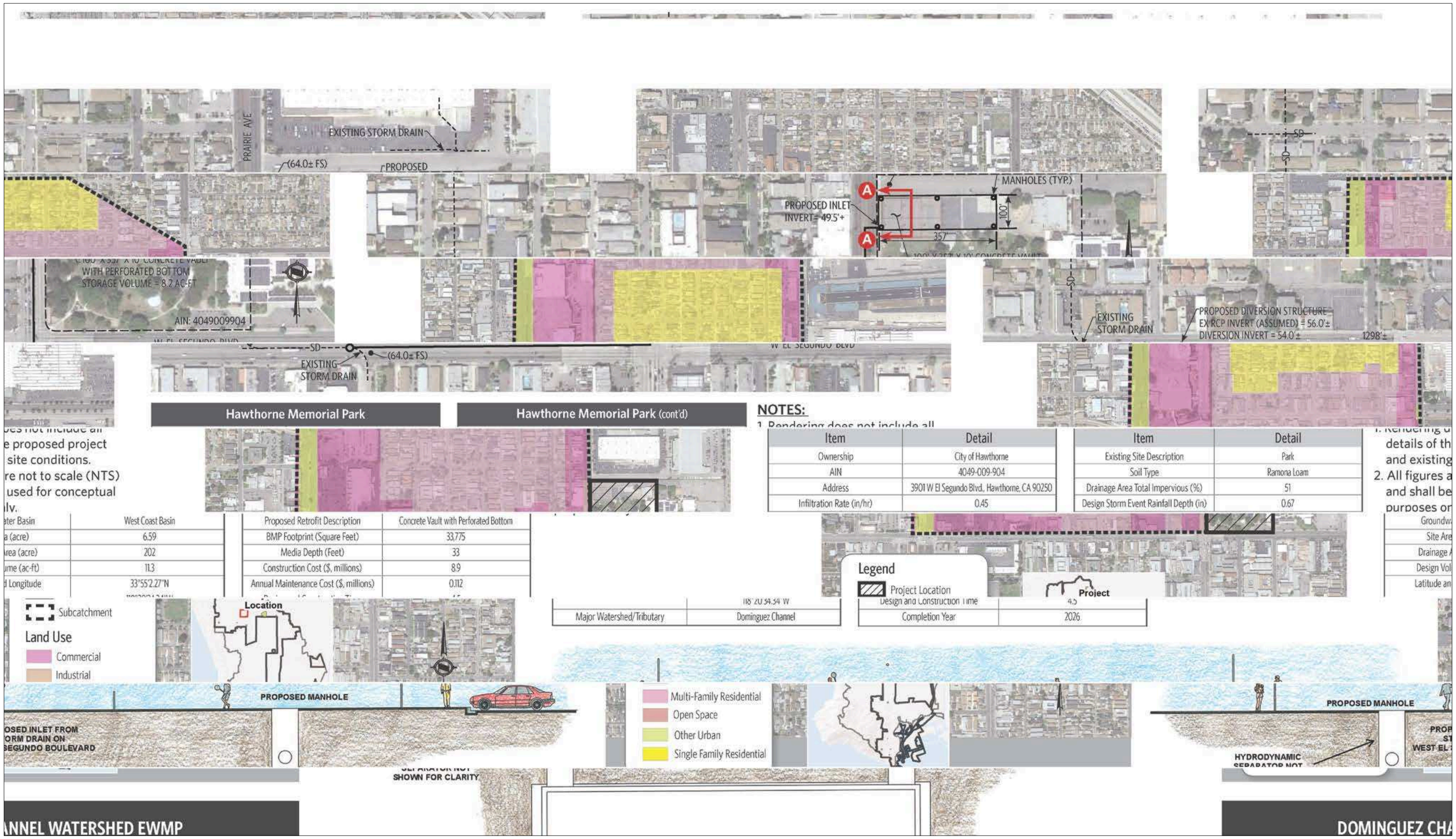


Figure 4-9: Hawthorne Memorial Park

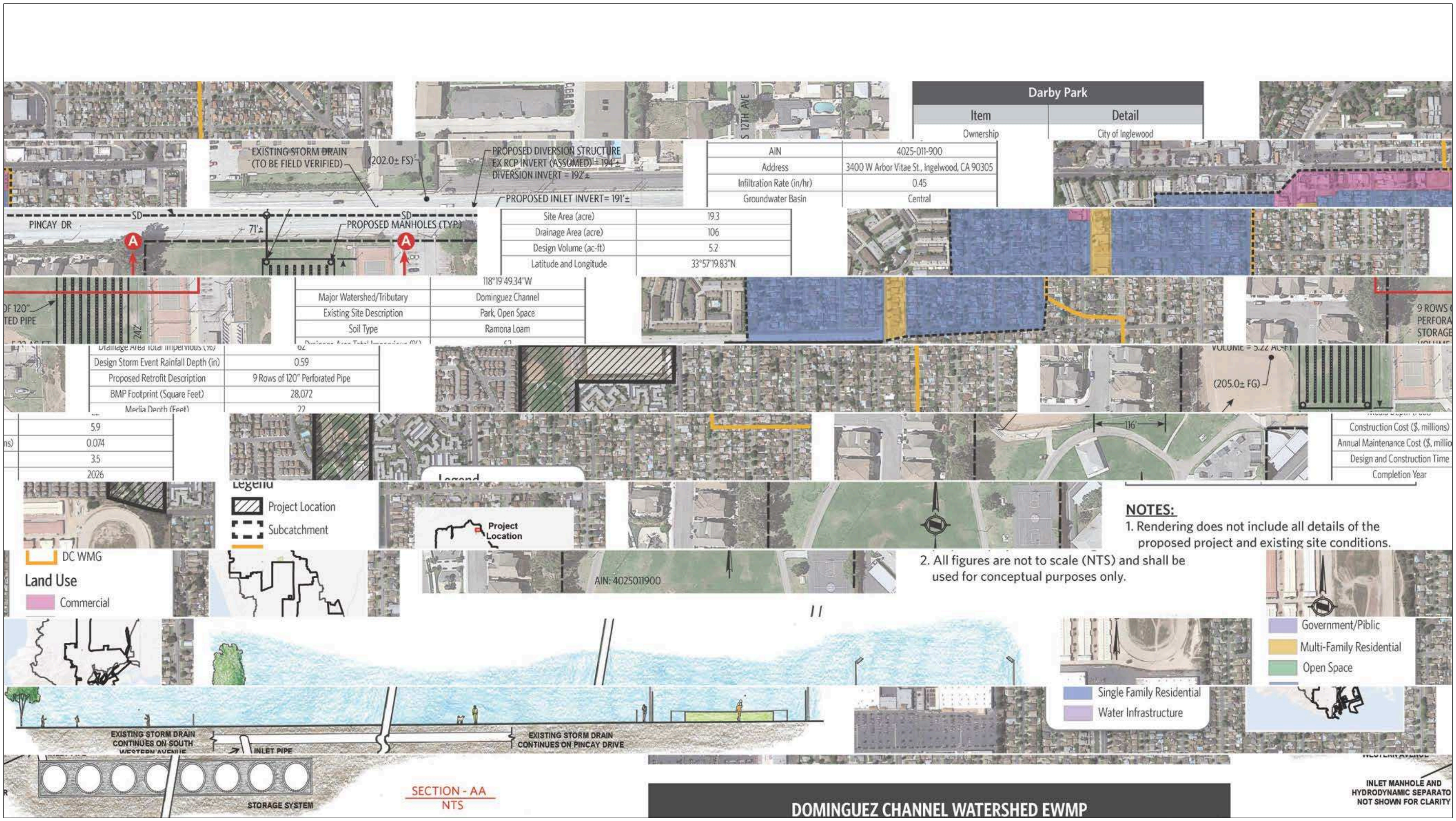


Figure 4-10: Darby Park

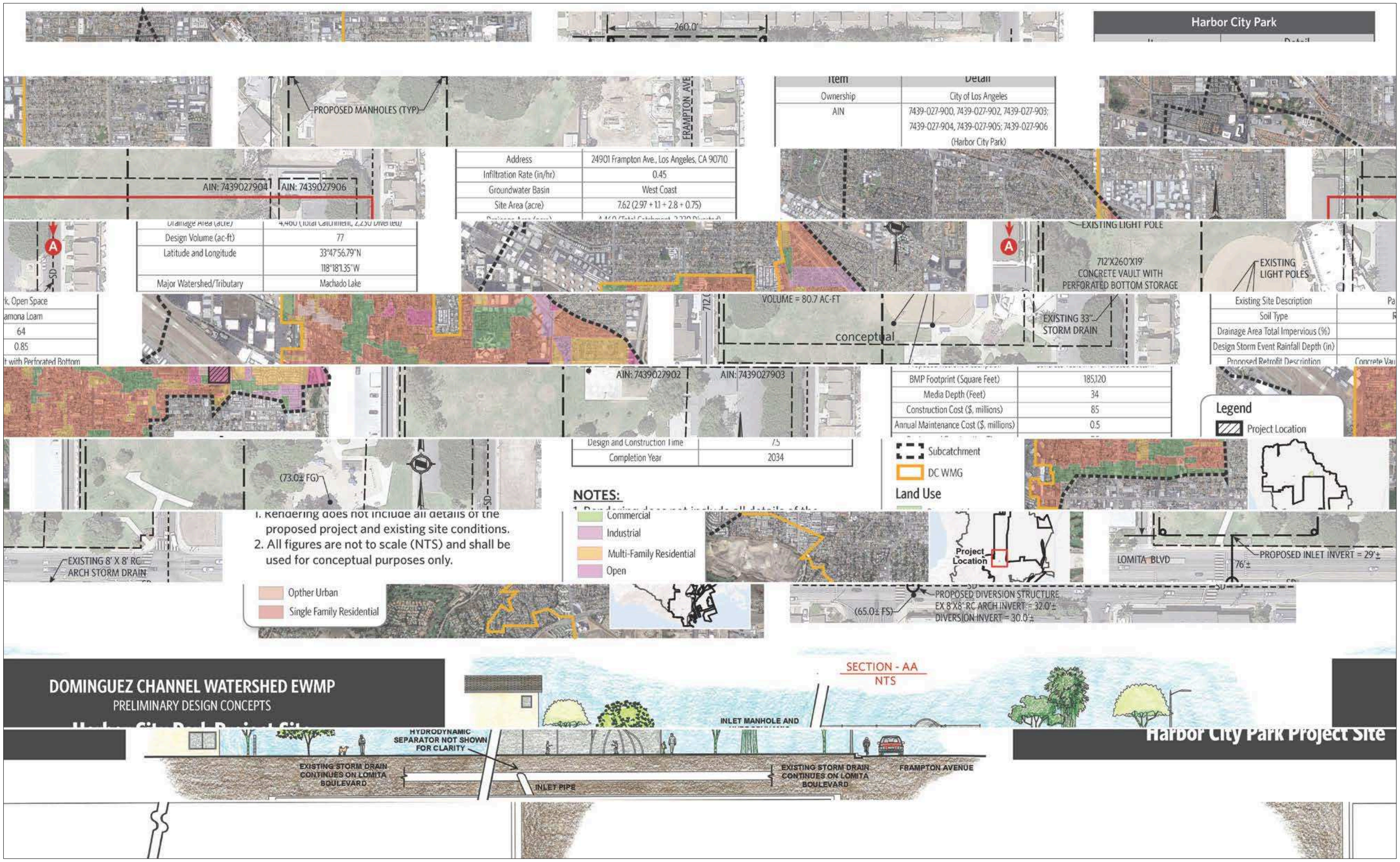
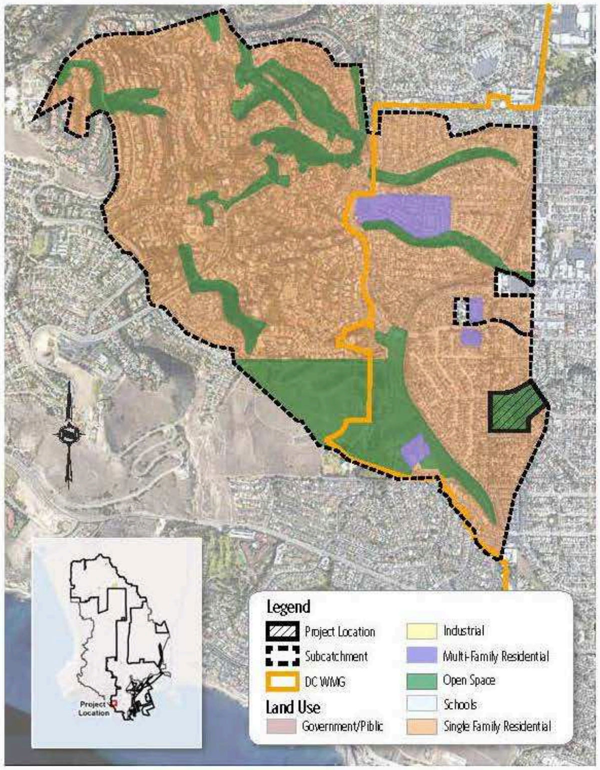
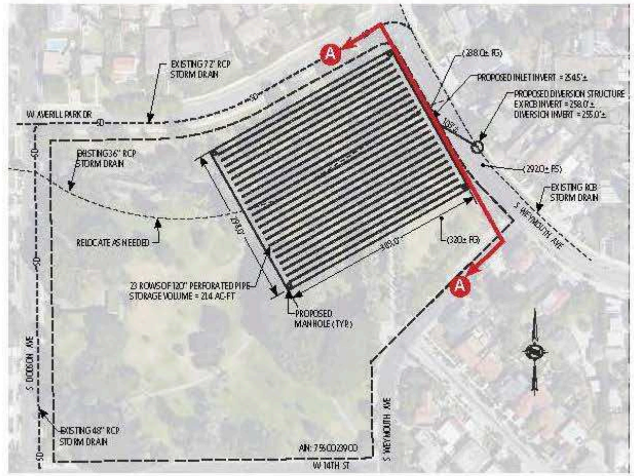


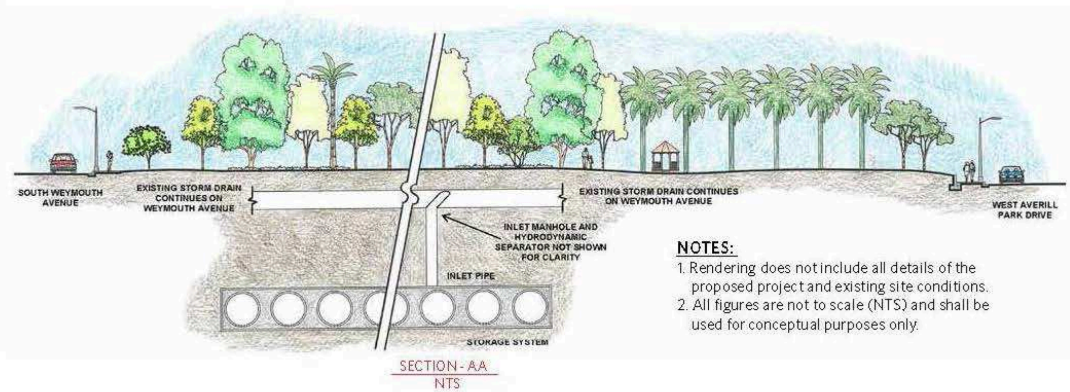
Figure 4-11: Harbor City Park



DOMINGUEZ CHANNEL WATERSHED EWMP
PRELIMINARY DESIGN CONCEPTS
Averill Park Project Site



Item	Detail
Ownership	City of Los Angeles
AIN	7560-023-900
Address	1300 S Dodson Ave., San Pedro, CA 90732
Infiltration Rate (in/hr)	0.4
Groundwater Basin	West Coast
Site Area (acre)	10.7
Drainage Area (acre)	1,376
Design Volume (ac-ft)	21.4
Latitude and Longitude	33°43'57.55"N 118°18'37.84"W
Major Watershed/Tributary	Los Angeles/Long Beach Harbor
Existing Site Description	Park, Open Space
Soil Type	Diablo Clay Loam
Drainage Area Total Impervious (%)	10
Design Storm Event Rainfall Depth (in)	0.19
Proposed Retrofit Description	23 Rows of 120" Perforated Pipe
BMP Footprint (Square Feet)	115,922
Media Depth (Feet)	4.4
Construction Cost ($, millions)	25.5
Annual Maintenance Cost ($, millions)	0.324
Design and Construction Time	5.5
Completion Year	2026



NOTES:
1. Rendering does not include all details of the proposed project and existing site conditions.
2. All figures are not to scale (NTS) and shall be used for conceptual purposes only.

Figure 4-12: Averill Park

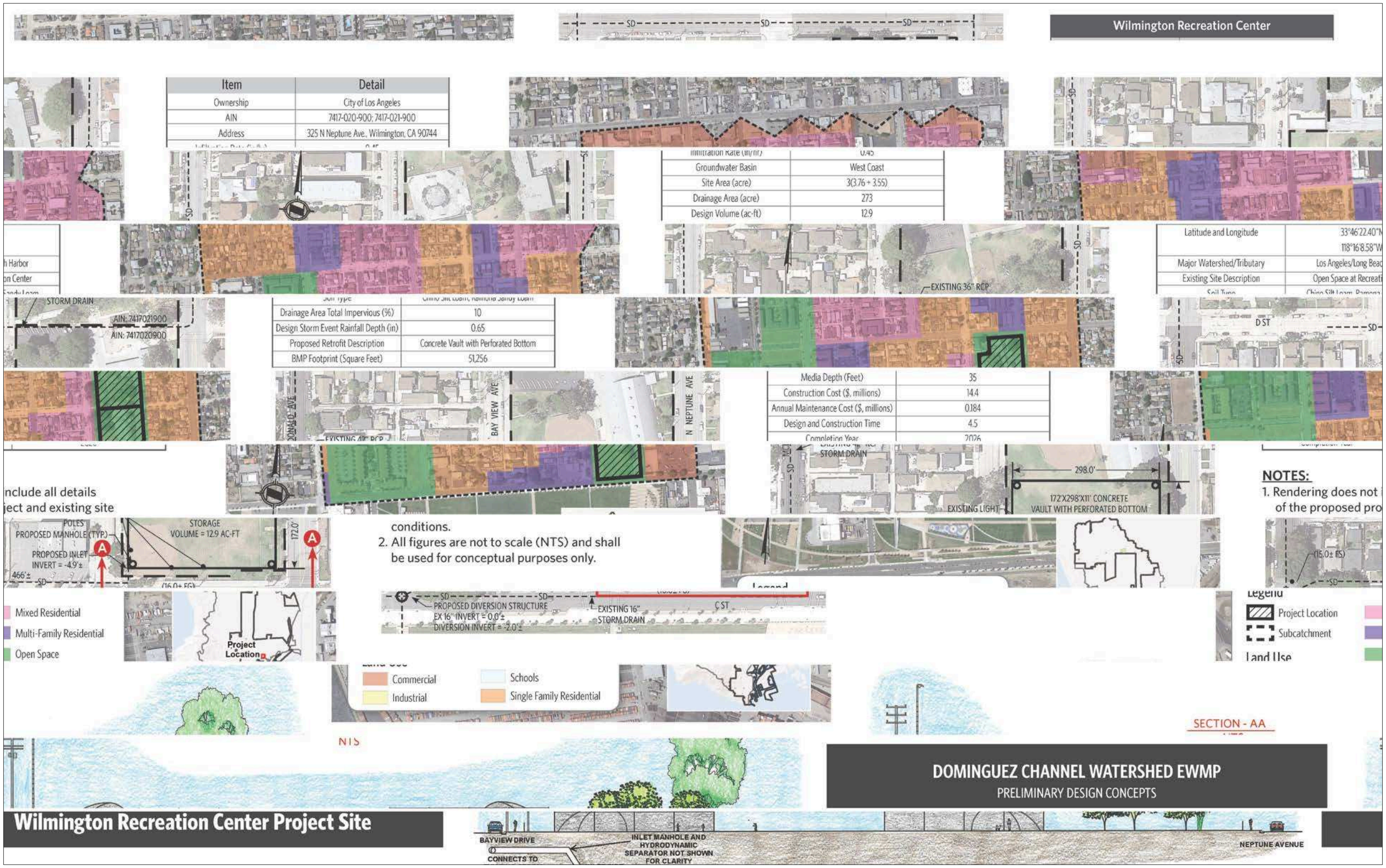


Figure 4-13: Wilmington Recreation Center

PAGE INTENTIONALLY LEFT BLANK

4.2.4.2. Additional Parcel Evaluation

Additionally, tables in Attachment O show parcels for each agency in the WMG that had relatively high scores, had potentially useable features, and were evaluated for the potential to accommodate a regional project. Generally these parcels drained significantly smaller catchments and the cost-effectiveness of using them for stormwater capture would be expected to be comparable to green streets. During future implementation, green streets may be more desirable due to their community benefits outweighing those of subsurface stormwater capture and infiltration projects.

It is important to note that under-utilized properties that could have the potential for conversion to park facilities with stormwater capture systems were sought. None were identified among the DC WMG agencies.

4.2.5 Distributed Projects (Green Streets)

Green streets are consistent with some DC WMG agency plans for various projects. They also provide additional opportunities for volume reduction with the potential for capturing water for municipal use. Once hydrologic and loading scenarios were simulated with the MCM, new and re-development (LID ordinance), and regional BMP implementation, the volume associated with capturing the remainder of the 90th percentile load for the limiting pollutant was estimated. Then, the lane miles of green streets to achieve this storage volume was estimated. The green streets represent distributed BMPs and are modeled to the extent that the required volume reduction is satisfied. Green streets were used as distributed BMPs as they are located in the public right-of-way, are distributed throughout the DC WMG area, and could be implemented as streets are rehabilitated. The volume reduction provided by a green street can be replaced with alternative distributed BMPs as desired.

A green streets analysis was performed for the entire DC WMG area to estimate which streets are most suitable for green street implementation. The following criteria were examined and ranked to establish a green street implementation hierarchy:

1. Slope;
2. Soil infiltration capacity; and
3. Street type.

Each criterion was analyzed based on the methodology described in Attachment R. A ranking system was developed, which was used to classify streets in terms of their potential as green streets (high, medium, or low). The analysis was performed using ArcGIS and Microsoft Excel. Once the streets were ranked for their feasibility as green streets, a subarea analysis was conducted to estimate which streets within each subarea could be implemented as a green street to satisfy the 85th percentile storm event volume criteria or the 90th percentile load criteria, whichever is greater. An infiltration rate of 0.3 inches per hour was used when quantifying the length of green-street required.

Green Street Implementation Summary

The implementation needs based on the subarea analysis were merged together once completed to estimate the quantity of green streets required by jurisdiction and subarea. Table 4-10 identifies the lane mile needs for each jurisdiction within the DC WMG.

Table 4-10: Green Street Implementation Summary by Jurisdiction		
Permittee	**Green Street Lane Miles**	**Percent by Agency**
Dominguez Channel Watershed		
El Segundo	5	3%
Hawthorne	61	26%
Inglewood	33	20%
Los Angeles	43	24%
County Unincorporated	64	27%
Total:	**206**	**100%**
Dominguez Channel Estuary Watershed		
Los Angeles	20	325%
County Unincorporated	61	75%
Total:	**81**	**100%**
Wilmington Drain Watershed		
Lomita	0	
Los Angeles	0	
County Unincorporated	0	
Total:	0	
Machado Lake Watershed		
Lomita	0	0%
Los Angeles	9	100%
Total:	**9**	**100%**
Harbor Watershed		
Lomita	0	0%
Los Angeles	112	98%
County Unincorporated	3	2%
Total:	115	100%
	411	-

Figure 4-14 illustrates the lane miles required throughout the DC WMG, compiling the information from the subarea analysis. Similar to the subarea maps, the green street recommendations are shown as bold green lines. The figure also shows the subareas that are completely within a regional project tributary area, as green streets are not required in these subareas as they are mitigated by the regional project.

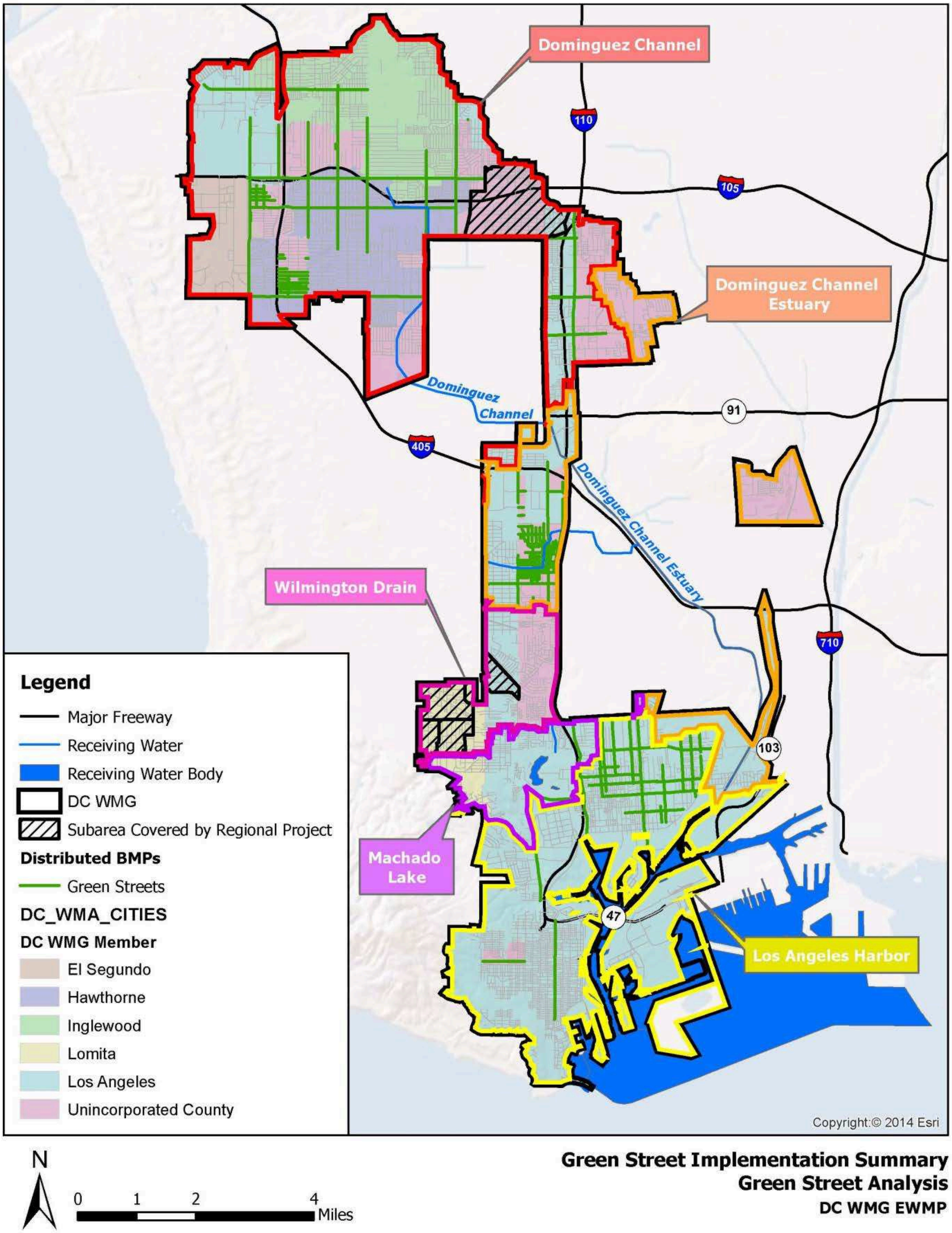


Figure 4-14: Green Street Implementation Summary

Attachment R contains a subarea summary table listing the subarea requirements along with the lane miles provided. A figure is also included so that subarea names can be associated spatially. Additionally, Attachment R contains watershed summary figures demonstrating the streets selected for green street implementation in the five analyzed watersheds. Where it is impractical to implement enough BMPs within a specific subarea, other BMPs are implemented in other subareas to provide the required volume and load reductions on a watershed basis.

4.2.6 Multi-Use Benefits from Injection Well Aquifer Recharge

There is a potential for utilizing the captured stormwater for municipal use within the watershed. One way of doing this is to directly irrigate with the stored water. This can offset some potable water uses. However, the irrigation demands tend to be very low shortly after rain occurs and, therefore, it would be necessary to store the water until irrigation demands increase, which does not replenish the storage volume for capturing a subsequent storm. Another option for utilizing the water for municipal use would be to move it to a drinking water aquifer.

In the DC WMG area, the upper drinking water aquifer (Lynwood aquifers) ranges from 200 to 400 feet below ground surface. The shallow unconfined aquifers are not used for municipal supply due to low yields and uncertain water quality. In order to move captured stormwater to the deeper drinking water aquifers, it would be necessary to inject that water via injection wells. This would require approval from the Regional Water Quality Control Board. Once the water is placed in the drinking water aquifers, then the DC WMG agencies would need to obtain the rights to pump that new water from the drinking water aquifers.

The DC WMG is underlain primarily by the West Coast Groundwater Basin. A small portion of the eastern section of the DC WMG is underlain by the Central Basin Groundwater Basin. Both of these basins are adjudicated. Most water captured by projects in the DC WMG is likely to be injected, if feasible and practicable, into the West Coast Groundwater basin.

Adjudicated Rights in the West Coast Groundwater Basin, as of June 2014, for the cities in the DC WMG are shown Table 4-11.

Table 4-11: West Basin Allowable Pumping Allocation (APA)

Agency	AFY
City of Los Angeles	1,503
El Segundo	953
Hawthorne	1,882
Inglewood	4,450
Lomita	1,352
Total	10,140

The requirements for obtaining increases in Allowable Pumping Allocations (APAs) and requirements for obtaining approval from the Regional Water Quality Control Board to inject captured storm water are presented in Attachment S and the following was found:

> "… injection of captured stormwater is potentially a viable means of achieving additional water rights within the Dominguez Channel Watershed. Both the Central and West Coast Basin Judgments provide specifically for approval of enhanced water rights as a result of augmentation projects developed by parties to one or both judgments. Whether injection projects developed through EWMP implementation are cost effective and viable will depend greatly on the quality of

> the stormwater captured, the parties participating and their respective resources, and the volume of water proposed for development. On balance, projects that are solely in the West Coast Basin are likely to be easier to permit from a water rights perspective given the somewhat more permissive nature of the West Coast Basin Judgment, as well as the fact that eight of the nine project sites overlie the West Coast Basin. Regulatory approvals from the LA Regional Water Quality Control Board are obtainable, and indeed likely to be supported by Regional Board staff (because of the water supply benefit), if the quality of water to be injected meets or exceeds all water quality objectives in the groundwater basin it overlies."

The key constraint to injection of the water into the potable drinking water aquifers is based on the water quality, rather than adjudicated water rights. The report indicated that to the extent that injected water exceeds receiving water limitations, permitting would require demonstration of no impairment of the municipal beneficial use designation from the Basin Plan, or the implementation of treatment that would eliminate such impairment prior to injection.

Due to the water quality of stormwater, it is expected that pre-treatment would be necessary. The costs of pre-treatment are related to acquiring storage area and the cost of the treatment system. The storage required for the injection wells would be for storing and pumping located at regional and distributed facilities. These costs have not been developed for this study. However, a small section discussing the expected capital construction costs and O&M costs for wells to inject the water captured by regional projects and green streets is provided in Section 7 for potential future discussion purposes.

An option being explored by the Water Replenishment District of Southern California (WRD) for replenishing the drinking water aquifers with captured surface water is called an Aquifer Recharge and Recovery Facility (ARRF). This is a system where captured surface water is allowed to infiltrate to the shallow groundwater aquifer, then this shallow groundwater is pumped and then injected into the deeper drinking water aquifer. The infiltration process acts as a natural filter for surface water pollutants, thus potentially preventing the need for additional pre-treatment (other than removing trash and sediment to prevent clogging of the infiltration system). WRD has not completed the approval process for ARRF yet, but it may be a promising method for treating captured surface water prior to injecting it. Additionally, this ARRF allows for one to extract the shallow groundwater and inject it months after the rain occurs, when the deeper aquifers have greater storage capacity due to pumping that occurs in the dryer months.

4.2.7 Approach to Identifying Additional Distributed BMPs

Opportunities for additional distributed BMPs may exist at sites that do not fall under SUSMP, LID, or green streets policies. These sites will be further evaluated in order to evaluate if water quality improvements could be incorporated at a relatively low cost. Distributed BMPs also may be incorporated through future stakeholder processes, allowing the stakeholders to provide input on additional distributed BMP locations and types and help to stimulate volunteerism amongst private property owners to implement BMPs on their properties that may achieve a pollutant load reduction benefit. The adaptive management process will be used to evaluate how effective such distributed BMPs are and evaluate if modifications to planned regional or green streets projects are necessary.

4.3 Non-Storm Water Discharge Control Measures

The following section discusses the approach to non-storm water discharge control measures and the non-storm water outfall program.

4.3.1 Potential Approaches to Additional Non-Stormwater Discharge Control Measures

Non-stormwater discharge is from an activity that generally consists of washing down something, over irrigating, or an illicit/illegal connection or discharge. MCMs and other institutional BMPs are in place in an attempt to reduce non-stormwater discharges. One source of non-stormwater discharge that is not addressed through the MCMs and other institutional BMPs are exempt non-stormwater discharges as specified in Part III of the MS4 Permit.

In order to evaluate effective non-stormwater discharge control measures, in addition to those already required, the dry weather discharge monitoring element of the CIMP will be used as an evaluation tool. As specified in the CIMP, the DC WMG will report non-stormwater discharges that occur in their jurisdiction and actions taken to evaluate if they are persistent, exempt and, if non-exempt, actions taken and/or BMPs implemented to eliminate them. Exempt non-stormwater discharges often include non-emergency firefighting activities, discharges from drinking water supplies, dewatering of lakes, landscape irrigation, swimming-pool discharges, decorative fountain dewatering, car washes, and street/sidewalk washing per Part III.2 of the MS4 Permit.

Non-Storm Water Outfall Program

This section presents the method for the NSW outfall program component as prepared in the CIMP for the DC WMA Group. The NSW Outfall Monitoring Program is a major component of the monitoring and reporting program (MRP) and is intended to be a collaborative effort between all of the agencies in the DC WMA Group. The NSW outfall monitoring program component is intended to enhance the existing permit required programs that include LACFCD's efforts under the IC/ID Program to detect, investigate, and eliminate the IC/IDs to the MS4, pursuant to Part VI.D.4.d and the responsibilities of the County of Los Angeles and the Cities of El Segundo, Hawthorne, Inglewood, and Los Angeles under Part VI.D.10 of the Permit.

The NSW Monitoring Program is comprised of the following elements.

1. Identification of Outfalls with Significant NSW Discharge
2. Inventory of MS4 Outfalls with NSW Discharge
3. Prioritized Source Identification
4. Identification of Sources of Significant NSW Discharge
5. Monitoring of Significant NSW Discharges Exceeding Criteria

Objectives of the NSW Program

The intent of the NSW Program is to meet the requirements of the NSW Outfall Program (Section II.E.3, Page E-4) outlined in the MRP of the Permit by achieving the following objectives:

a. Evaluate whether a Permittee's discharge is in compliance with applicable non-storm water TMDL WLAs.
b. Evaluate whether a Permittee's discharge exceeds non-storm water action levels, as described in Attachment G of the Permit.
c. Assist the Permittee in identifying illicit discharges as described in Sections VI.D.4.d and VI.D.10 of the Permit.

Approach Overview

The approach to addressing NSW discharges is to implement a programmatic approach to identifying non-storm water discharges and estimating if the discharge is a persistent and significant non-permitted discharge that affects the quality of the downstream receiving water and as such, is a significant NSW discharge. Figure 4-15 illustrates the process by which these discharges are evaluated and incorporated into the NSW Program. Table 4-12 provides the required program components of the NSW Program and the relative timing required.

In order to address significant NSW discharges in the watershed, a progressive approach consisting of visual inspections, investigations, and evaluations combined with the existing IC/ID enforcement framework that exists for industrial waste dischargers will be used. This process will be a multi-step procedure to categorize outfall sites for their potential for persistent and significant discharge that may affect the water quality of the downstream receiving water body during dry weather. The initial identification of outfalls with significant non-storm water discharges will utilize screening based on visual observations (at least three visual surveys) and recorded observational data. The location of these outfalls will be compared against the known permitted discharges in order to eliminate those outfalls from further screening. If necessary, the DCWMA Group may follow up with the permitted dischargers through the existing Industrial Waste permit framework to confirm that the discharge is meeting permit requirements. For other discharges, the agencies would utilize the existing IC/ID investigation framework to track down the source of the non-permitted discharge. The information from the investigation would be used to address illicit discharges. Once the source is determined, or determined to be unknown, and cannot be eliminated, the next step will consist of monitoring, and an assessment of impacts to downstream receiving waters based on the monitoring results. This stage would use a combination of flow monitoring and analytical chemistry to assess the pollutant loading contributed by the site. If the site is found to be contributing to an exceedance, the DC WMA Group or the jurisdiction will address the non-storm water discharge through the EWMP.

Table 4-12: NSW Outfall Program Summary Table

NSW Program Component	Description	Timing of Completion
1. Outfall Screening	In order to implement the NSW Outfall Program, the DCWMA Group will implement a screening process to identify outfalls that exhibit significant NSW discharges and those that do not.	Prior to initiating source investigations
2. Develop Inventory of NSW Outfalls with discharge	An inventory will be developed of major MS4 outfalls with known significant NSW discharges and those requiring no further assessment.	
3. Develop Prioritization Criteria	Based on data collected during the Outfall Screening process, the DCWMA Group will identify MS4 outfalls with significant NSW discharges and those requiring no further action.	
4. Prioritized source investigation	The data collected as part of the Outfall Screening process will be used to prioritize outfalls for source investigations.	
5. Identify sources of significant NSW discharges	For outfalls exhibiting significant NSW discharges, source investigations per the established prioritization.	Source investigations will be conducted for 25% of the outfalls with significant NSW discharges by December 28, 2015 and 100% by December 28, 2017.
6. Monitor NSW discharges exceeding criteria	The DCWMA Group will monitor outfalls that have been determined to convey significant NSW discharges comprised of either unknown or non-essential conditionally exempt NSW discharges, or continuing discharges attributed to illicit discharges.	Monitoring will commence after completion of source investigations.

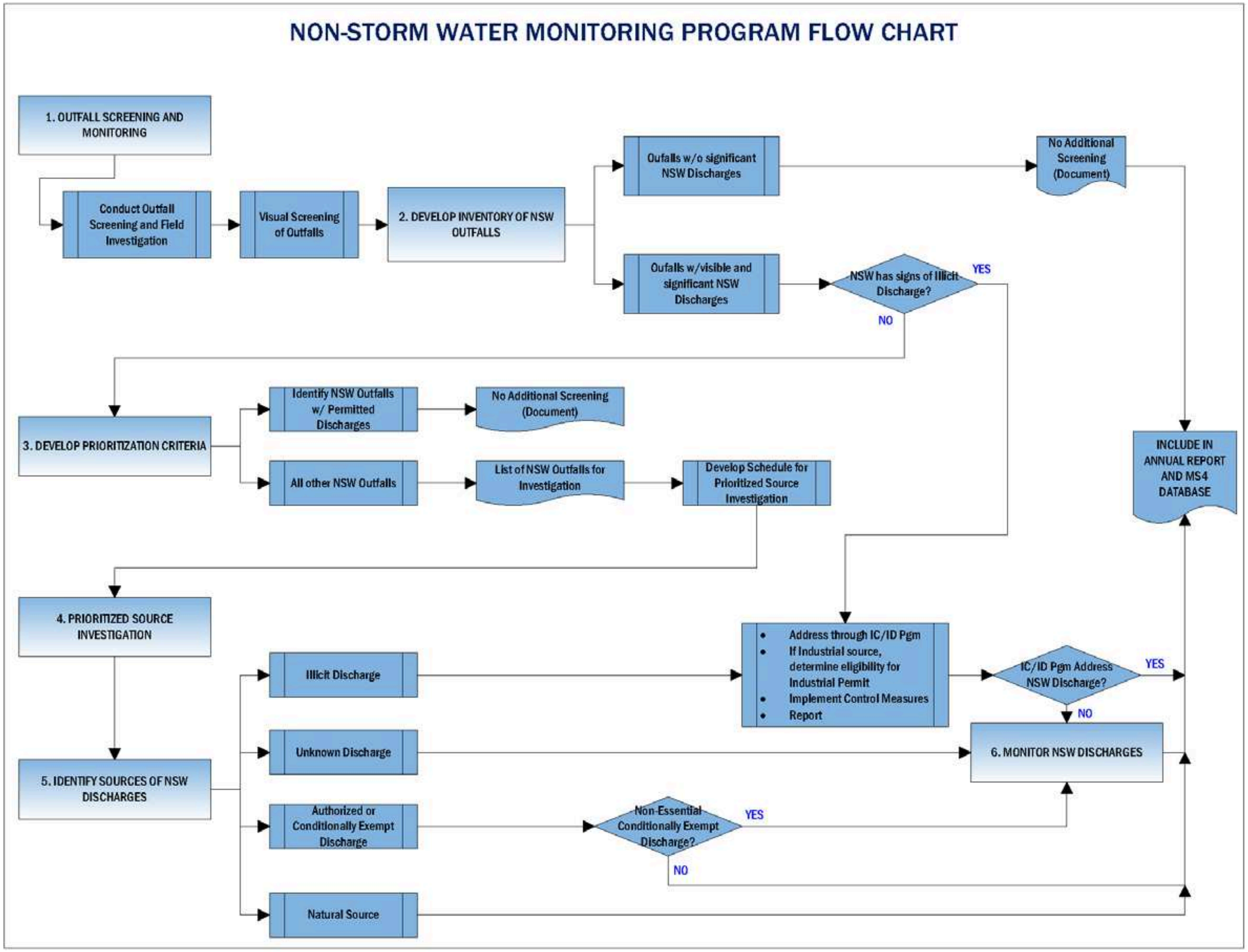


Figure 4-15: NSW Monitoring Program Process Chart

The LID ordinances, regional projects, and green streets projects, due to their water capture and infiltration capacities will also capture and infiltrate dry weather incidental (non-stormwater) discharges in addition to the wet weather discharges for which they are sized and configured. Analysis suggests that these projects will reduce non-stormwater discharges to meet the water quality planning objectives as they are implemented. The implementation schedules for the projects (Section 5) suggest that the milestones for reducing non-stormwater discharges will also be met.

4.4 Summary of BMP Performance Data

To summarize performance data of structural (regional and distributed), and institutional (non-structural) control measures for reducing stormwater and non-stormwater flows and priority pollutants, the following sources were reviewed and performance data was compiled:

- CASQA Development and Municipal BMP Handbooks
- California Department of Transportation (Caltrans) BMP Retrofit Pilot Program Report
- Center for Watershed Protection's National Pollutant Removal Performance Database Vers. 3
- Priority A and B Catch Basin Cleanout Data

Tables summarizing the BMP performance data can be found in Attachment T. The table associated with the CASQA Development and Municipal BMPs handbook provides a general summary of BMP performance within Southern California, while the tables associated with the other sources provides site specific performance data based on site specific testing.

PAGE INTENTIONALLY LEFT BLANK

5. EWMP Implementation Schedule

5.1 Control Measure Implementation Schedule

Control measures were modeled in the RAA so that compliance was demonstrated at each of the milestones. As previously discussed, milestone dates are defined by the applicable TMDLs. Lead is the limiting priority pollutant for most of the DC WMG. Nitrogen is the limiting pollutant for the areas draining to Machado Lake. Based on the limiting pollutants and water quality priorities, the milestone dates are related to both the Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants TMDL and the Machado Lake Nutrients TMDL. This section outlines the control measure implementation schedule related to the non-structural BMPs, regional projects, and distributed BMPs (green streets).

5.1.1 Non-Structural BMPs

As discussed in Section 4 non-structural BMPs (MCMs) and the LID (new and re-development) programs that will be implemented and evaluated in the RAA include enhanced MCMs, other non-structural BMPs such as the SB 346 (copper brake pad elimination), and the new and re-development LID program. These control measures will be ongoing throughout the simulation period. The load reductions associated with implementing enhanced MCMs will be applied prior to the first milestone date, as these enhancements will be implemented once the EWMP is approved. The new and re-development program will be implemented throughout the simulation period at the rates described in Table 4-5.

5.1.2 Regional Projects

The regional projects modeled for the DC WMG RAA are planned to be implemented prior to 2026 milestone. Table 5-1 summarizes the anticipated project timeline including the design, bid, and construction phases. Operation and maintenance (O&M) of each of the projects will begin following construction.

Table 5-1: Regional Project Timeline

Regional Project	Design (years)	Bid (months)	Construction (years)	Total Time (years)	Completion Year
Darby Park	1	6	2	3.5	2026
El Segundo Pump Station	1	6	2	3.5	2026
Ramona Park	1	6	4	5.5	2026
Jim Thorpe Park	1	6	3	4.5	2026
Hawthorne Memorial Park	1	6	3	4.5	2026
Chester Washington Golf Course	2	6	5	7.5	2026
Harbor City Park	1	6	6	7.5	2034
Wilmington Recreation Center	1	6	3	4.5	2026
Averill Park	2	6	3	5.5	2026

5.1.3 Distributed BMPs (Green Streets)

The distribution of green streets implementation is based on the volume/load reductions that are not satisfied by other control measures at each of the compliance deadlines. Additionally, the green streets were distributed over the years so that the cost can be distributed. Table 5-2 summarizes the green street implementation timeline.

Table 5-2: Green Street Implementation Timeline	
Implementation Year	**Lane Miles of Green Streets**
Initial Construction	
2017	-
2018	-
2019	-
2020	-
2021	-
2022	-
2023	-
2024	-
2025	-
2026	163
2027	53
2028	53
2029	53
2030	27
2031	27
2032	27
2033	1
2034	1
2035	1
2036	1
2037	1
2038	1
2039	1
2040	1

5.2 RAA of Control Measure Implementation Schedule

This section presents the results of the RAA based on the implementation schedule. To demonstrate compliance the baseline analysis was used to estimate the baseline water quality, which was then compared to the existing water quality based on the calibrated model. The required load reduction was estimated and appropriate control measures were scheduled for implementation so that the planning objectives would be satisfied at each of the applicable milestone dates. As discussed in Section 3, the limiting pollutant for the DC WMG is zinc except for the Wilmington Drain/Machado Lake Watershed where the limiting pollutants are total nitrogen (Wilmington Drain) and fecal coliform (Machado Lake). By demonstrating compliance with the limiting pollutant using volume reduction, it can be reasonably concluded that compliance will be achieved for all other pollutants. Table 5-3 through Table 5-7 summarize the load reductions within each of the five analyzed watersheds for zinc and total nitrogen for the Wilmington Drain Watershed, due to control measure implementation at the schedule discussed above. The table demonstrates that compliance will be met at each of the milestones as the load reduction is greater than the target. The structural control measures to be implemented by 2032 are illustrated in Figure 5-1. The load reductions for all other pollutants are provided in Attachment U.

Table 5-3: Dominguez Channel Watershed - Load Reductions based on Control Measure Implementation

Control Measure Implementation		Load Reduction (kg and MPN)			
		2026 Metal (50%)	**2029 Metal (75%)**	**2032 Metal (100%)**	**2040 Bacteria (100%)**
Enhanced MCMs		30.70	30.70	30.70	9.71E+13
New and Re-Development		9.87	12.55	15.25	6.49E+14
Green Streets		64.26	149.48	231.16	2.73E+14
Regional Projects	Darby Park	3.06	3.06	3.06	3.96E+13
Regional Projects	El Segundo Pump Station	15.94	15.94	15.94	2.07E+14
Regional Projects	Ramona Park	7.33	7.33	7.33	9.49E+13
Regional Projects	Jim Thorpe Park	9.40	9.40	9.40	1.22E+14
Regional Projects	Hawthorne Memorial Park	4.74	4.74	4.74	6.14E+13
Regional Projects	Chester Washington Golf Course	30.50	30.50	30.50	3.96E+14
Target Load Reduction:		**175.80**	**263.70**	**351.60**	**1.94E+15**
Total Load Reduction:		**175.80**	**263.70**	**348.08**	**1.94E+15**
Percent of Final Target:		**50%**	**75%**	**99%**	**100%**

Table 5-4: Dominguez Channel Estuary Watershed – Load Reductions based on Control Measure Implementation

Control Measure Implementation	Load Reduction (kg and MPN)			
	2026 Metal (50%)	**2029 Metal (75%)**	**2032 Metal (100%)**	**2040 Bacteria (100%)**
Enhanced MCMs	10.93	10.93	10.93	3.59E+14
New and Re-Development	5.64	7.19	8.73	4.22E+14
Green Streets	65.6	105.13	143.04	4.59E+14
Target Load Reduction:	**82.17**	**123.25**	**164.34**	**1.24E+15**
Total Load Reduction:	**82.17**	**123.25**	**162.70**	**1.24E+15**
Percent of Final Target:	**50%**	**75%**	**99%**	**100%**

Table 5-5: Wilmington Drain Watershed - Load Reductions based on Control Measure Implementation			
Control Measure Implementation	**Load Reduction (kg)**		
	Machado Lake TMDLs		**303(d)**
	2018 Nutrients (100%)	**2019 Toxics (100%)**	**2040 Nitrogen (100%)**
Enhanced MCMs	-	-	77.61
New and Re-Development	-	-	59.32
Green Streets	-	-	
Harbor City Park	-	-	782.00
Target Load Reduction:	-	-	**918.93**
Total Load Reduction:	-	-	**918.93**
Percent of Final Target:	**100%**	**100%**	**100%**

Table 5-6: Machado Lake Watershed – Load Reductions based on Control Measure Implementation			
Control Measure Implementation	**Load Reduction (kg and MPN)**		
	Machado Lake TMDLs		**303(d)**
	2018 Nutrients (100%)[1]	**2019 Toxics (100%)[1]**	**2040 Bacteria (100%)**
Enhanced MCMs	-	-	1.63E+13
New and Re-Development	-	-	4.88E+13
Green Streets	-	-	1.85E+14
Target Load Reduction:	-	-	**2.70E+14**
Total Load Reduction:	-	-	**2.70E+14**
Percent of Final Target:	**100%**-	**100%**-	**100%**

Table 5-7: Harbor Watershed – Load Reductions based on Control Measure Implementation

Control Measure Implementation	Load Reduction (kg and MPN)			
	2026 Metal (50%)	**2029 Metal (75%)**	**2032 Metal (100%)**	**2040 Bacteria (100%)**
Enhanced MCMs	9.9	9.9	9.9	5.70E+14
New and Re-Development	4.35	5.54	6.73	5.70E+14
Green Streets	82.98	142.12	184.37	1.48E+15
Wilmington Recreation Center	8.71	8.71	8.71	3.65E+14
Averill Park	14.71	14.71	14.71	6.18E+14
Target Load Reduction:	**120.65**	**180.98**	**241.31**	**3.60E+15**
Total Load Reduction:	**120.65**	**180.98**	**224.42**	**3.60E+15**
Percent of Final Target:	**50%**	**75%**	**93%**	**100%**

The pollutant loads associated with the selected storm events capture the 90th percentile load. The selected event also captures many of the smaller more intense storms with similar loads, but lower volumes. The volumes captured and treated will meet the 85th percentile, 24-hour volume and 90th percentile load criteria. Meeting both criteria provides a reasonable assurance that WQOs will be met. Many of the events that exceed the capture volumes proposed in this plan will have lower concentrations due to the wash-off of pollutants for runoff less than the capture volume and diluted concentrations for the constituents that remain after capturing the volumes related to the 90th percentile load criteria.

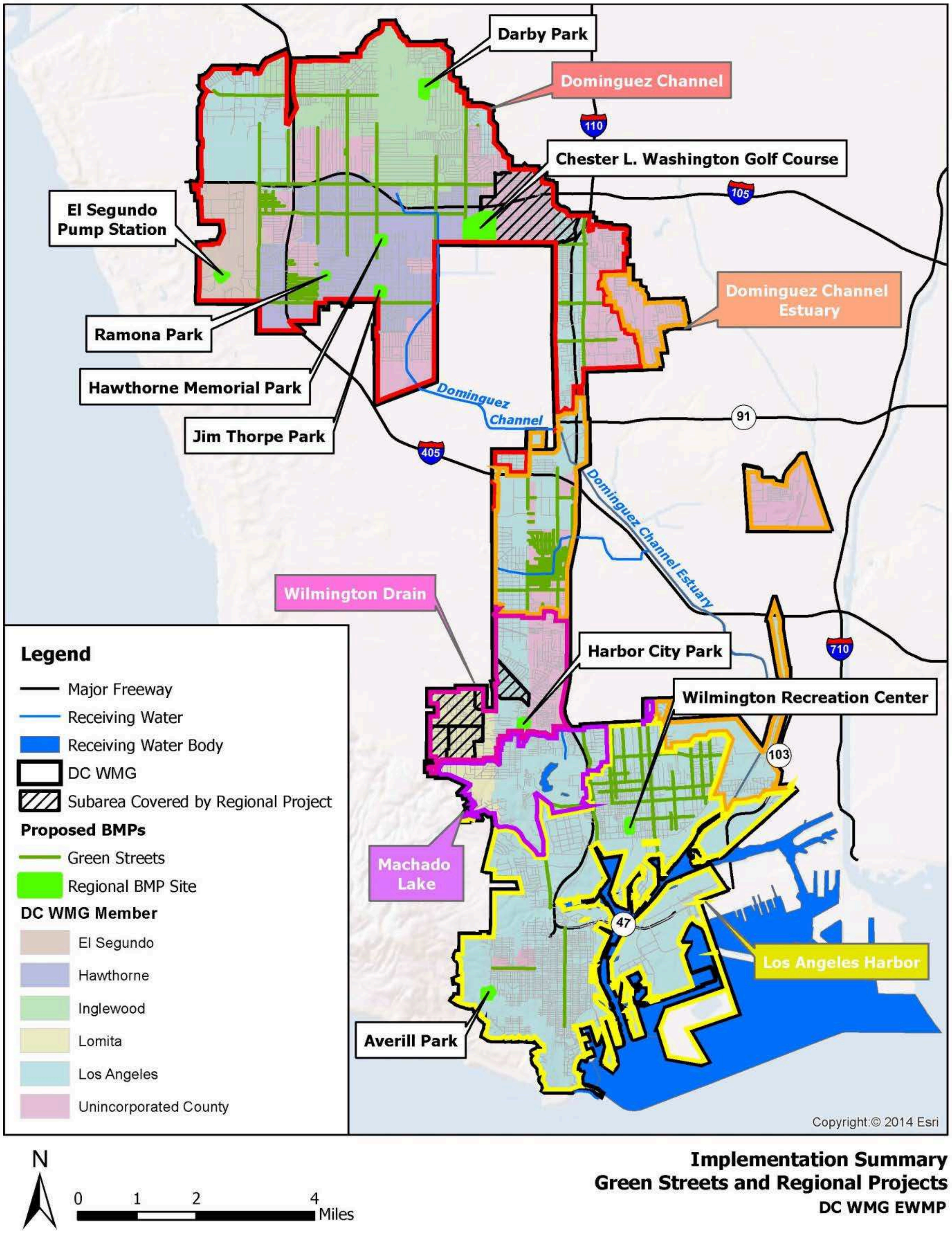


Figure 5-1: Implementation Summary

The average annual volume captured with the planned projects after full implementation was estimated using the model each year between 2002 and 2011. This analysis assumed that all captured volumes would be removed within 72 hours, either through natural infiltration, or by injecting the water into the drinking water aquifers. Table 5-8 through Table 5-12 summarize the average annual volume captured each year along with the average annual captured volume based on control measure implementation in each of the five analyzed watersheds.

Table 5-8: Dominguez Channel Watershed – Average Annual Volume Summary

Start	End	Year	Total Volume (acre-feet)	Total Captured Volume (acre-feet)	Captured by Regional Project, MCM, and LID (ac-ft)	Captured by Green Streets (ac-ft)	Total Zinc (kg)	Captured Zinc (kg)	Percent Annual Load Reduction (%)
10/1/2002	9/30/2003	2002	10,785.64	8,350.34	5,937.05	2,413.29	2,697.80	2,453.11	90.93%
10/1/2003	9/30/2004	2003	8,224.93	7,213.35	5,561.55	1,651.81	2,215.55	2,142.54	96.70%
10/1/2004	9/30/2005	2004	23,889.84	13,876.92	8,067.09	5,809.83	3,168.54	2,574.98	81.27%
10/1/2005	9/30/2006	2005	8,721.22	7,802.40	5,490.19	2,312.20	2,871.92	2,752.32	95.84%
10/1/2006	9/30/2007	2006	3,586.61	3,586.61	3,586.61	0.00	1,359.38	1,359.38	100.00%
10/1/2007	9/30/2008	2007	10,589.63	9,250.42	5,937.88	3,312.55	2,106.17	2,084.71	98.98%
10/1/2008	9/30/2009	2008	8,139.89	6,937.16	5,186.37	1,750.79	2,099.04	1,946.28	92.72%
10/1/2009	9/30/2010	2009	10,885.81	8,234.32	5,395.54	2,838.78	2,690.55	2,458.33	91.37%
10/1/2010	9/30/2011	2010	15,477.34	9,696.36	6,834.40	2,861.96	2,778.03	2,570.55	92.53%
10/1/2011	9/30/2012	2011	7,236.76	7,236.76	5,693.85	1,542.91	2,914.19	2,914.19	100.00%
		Average:	**10,753.77**	**8,218.46**	**5,769.05**	**2,449.41**	**2,490.12**	**2,325.64**	**94.03%**

Table 5-9: Dominguez Channel Estuary – Average Annual Volume Summary									
Start	**End**	**Year**	**Total Volume (acre-feet)**	**Total Captured Volume (acre-feet)**	**Captured by Regional Project, MCM, and LID (ac-ft)**	**Captured by Green Streets (ac-ft)**	**Total Zinc (kg)**	**Captured Zinc (kg)**	**Percent Annual Load Reduction (%)**
10/1/2002	9/30/2003	2002	4,861.77	3,233.42	1,716.72	1,516.70	1,021.84	767.48	75.11%
10/1/2003	9/30/2004	2003	3,135.93	2,722.97	1,697.06	1,025.91	750.84	723.62	96.38%
10/1/2004	9/30/2005	2004	9,952.87	5,244.36	2,485.31	2,759.05	1,092.27	841.95	77.08%
10/1/2005	9/30/2006	2005	3,222.85	2,740.55	1,588.94	1,151.60	920.85	855.24	92.87%
10/1/2006	9/30/2007	2006	1,421.54	1,421.54	1,323.69	97.85	524.27	524.27	100.00%
10/1/2007	9/30/2008	2007	4,522.77	3,381.82	1,685.55	1,696.27	831.22	715.36	86.06%
10/1/2008	9/30/2009	2008	3,818.80	2,593.74	1,614.86	978.88	722.60	510.85	70.70%
10/1/2009	9/30/2010	2009	5,292.34	3,104.88	1,691.86	1,413.02	1,043.02	743.81	71.31%
10/1/2010	9/30/2011	2010	6,780.96	3,912.73	2,053.62	1,859.11	1,144.16	1,041.15	91.00%
10/1/2011	9/30/2012	2011	2,898.58	2,780.62	1,584.73	1,195.89	1,059.08	1,040.20	98.22%
		Average:	**4,590.84**	**3,113.66**	**1,744.23**	**1,369.43**	**911.01**	**776.39**	**85.87%**

Table 5-10: Wilmington Drain Watershed – Average Annual Volume Summary									
Start	**End**	**Year**	**Total Volume (acre-feet)**	**Total Captured Volume (acre-feet)**	**Captured by Regional Project, MCM, and LID (ac-ft)**	**Captured by Green Streets (ac-ft)**	**Total Nitrogen (kg)**	**Captured Nitrogen (kg)**	**Percent Annual Load Reduction (%)**
10/1/2002	9/30/2003	2002	2,009.77	1,372.45	1,372.45	0.00	9,025.56	7,578.81	83.97%
10/1/2003	9/30/2004	2003	1,215.21	1,012.40	1,012.40	0.00	5,979.13	5,722.55	95.71%
10/1/2004	9/30/2005	2004	3,754.98	1,941.04	1,941.04	0.00	14,654.85	10,988.13	74.98%
10/1/2005	9/30/2006	2005	1,336.46	1,125.25	1,125.25	0.00	7,788.94	6,590.85	84.62%
10/1/2006	9/30/2007	2006	712.80	712.80	712.80	0.00	7,999.65	7,999.65	100.00%
10/1/2007	9/30/2008	2007	1,815.29	1,237.72	1,237.72	0.00	6,302.86	6,021.18	95.53%
10/1/2008	9/30/2009	2008	1,432.70	1,031.82	1,031.82	0.00	6,309.17	5,582.97	88.49%
10/1/2009	9/30/2010	2009	2,367.94	1,290.98	1,290.98	0.00	9,192.61	7,587.30	82.54%
10/1/2010	9/30/2011	2010	2,547.68	1,426.64	1,426.64	0.00	8,907.66	7,613.56	85.47%
10/1/2011	9/30/2012	2011	1,156.48	1,127.06	1,127.06	0.00	8,715.54	8,565.58	98.28%
		Average:	**1,834.93**	**1,227.82**	**1,227.82**	**0.00**	**8,487.60**	**7,425.06**	**88.96%**

Table 5-11: Machado Lake Watershed – Average Annual Volume Summary

Start	End	Year	Total Volume (acre-feet)	Total Captured Volume (acre-feet)	Captured by Regional Project, MCM, and LID (ac-ft)	Captured by Green Streets (ac-ft)	Total Fecal Coliform Load (MPN)	Captured Fecal Coliform Load (MPN)	Percent Annual Load Reduction (%)
10/1/2002	9/30/2003	2002	1,565.22	777.01	557.42	219.59	1.38E+16	1.38E+16	98.00%
10/1/2003	9/30/2004	2003	918.20	683.98	533.82	150.16	6.16E+15	6.16E+15	99.00%
10/1/2004	9/30/2005	2004	2,637.23	1,201.09	753.52	447.58	2.55E+16	2.55E+16	98.00%
10/1/2005	9/30/2006	2005	991.32	702.03	540.26	161.78	7.05E+15	7.05E+15	98.00%
10/1/2006	9/30/2007	2006	556.30	543.62	477.71	65.92	1.71E+15	1.71E+15	99.00%
10/1/2007	9/30/2008	2007	1,327.33	722.00	537.61	184.39	1.12E+16	1.12E+16	98.00%
10/1/2008	9/30/2009	2008	1,007.99	624.54	499.04	125.50	7.33E+15	7.33E+15	98.00%
10/1/2009	9/30/2010	2009	1,814.18	778.13	560.78	217.35	1.64E+16	1.64E+16	98.00%
10/1/2010	9/30/2011	2010	2,014.21	930.46	636.76	293.70	1.91E+16	1.91E+16	98.00%
10/1/2011	9/30/2012	2011	801.67	624.25	497.45	126.80	4.84E+15	4.84E+15	99.00%
		Average:	**1,363.37**	**758.71**	**559.44**	**199.28**	**1.13E+16**	**1.13E+16**	**98.30%**

Table 5-12: Harbor Watershed – Average Annual Volume Summary

Start	End	Year	Total Volume (acre-feet)	Total Captured Volume (acre-feet)	Captured by Regional Project, MCM, and LID (ac-ft)	Captured by Green Streets (ac-ft)	Total Zinc (kg)	Captured Zinc (kg)	Percent Annual Load Reduction (%)
10/1/2002	9/30/2003	2002	12,003.98	5,773.10	3,512.56	6,230.88	2,081.62	1,071.05	51.45%
10/1/2003	9/30/2004	2003	6,825.41	5,294.96	3,445.03	1,530.45	1,406.83	1,302.10	92.56%
10/1/2004	9/30/2005	2004	20,160.47	10,133.85	5,069.42	10,026.63	2,401.93	1,951.85	81.26%
10/1/2005	9/30/2006	2005	6,749.71	4,860.06	3,408.46	1,889.65	1,989.55	1,482.97	74.54%
10/1/2006	9/30/2007	2006	3,719.28	3,637.50	2,880.85	81.78	1,796.73	1,759.13	97.91%
10/1/2007	9/30/2008	2007	10,945.49	6,412.86	3,524.69	4,532.62	1,434.51	1,079.21	75.23%
10/1/2008	9/30/2009	2008	6,174.41	4,811.82	3,211.34	1,362.59	1,376.68	1,044.39	75.86%
10/1/2009	9/30/2010	2009	13,643.10	5,723.71	3,564.23	7,919.39	2,288.11	1,271.83	55.58%
10/1/2010	9/30/2011	2010	14,501.56	7,503.51	4,120.40	6,998.04	2,435.63	1,621.24	66.56%
10/1/2011	9/30/2012	2011	5,062.31	4,525.36	3,213.97	536.95	1,726.03	1,478.35	85.65%
		Average:	**9,978.57**	**5,867.67**	**3,595.10**	**4,110.90**	**1,893.76**	**1,406.21**	**75.66%**

It is important to note that not all of the planned BMPs will drain within 72 hours. This will be site and project dependent. However, this analysis suggests that there is a water supply potential associated with this EWMP of approximately 19,186 acre-feet/year (afy) on average. As shown in Table 4-11, the current total APA for the DC WMG agencies is 10,140 afy. The projects in this EWMP have the potential of increasing local groundwater supplies by 166%.

6. Assessment and Adaptive Management Framework

The EWMP is part of an adaptive management process as described in Part VI.C.8 (pages 66-67) of the MS4 Permit. Part VI.C.8 (page 66-67) states that every two years the EWMP will adapt to become more effective, based on, but not limited to, the following:

- Progress towards achieving interim and/or final WQBELs/RWLs according to TMDL schedules;
- Progress towards achieving improved water quality in MS4 discharges and achieving receiving water limitations through implementation of watershed control measures based on an evaluation of outfall-based and receiving water monitoring data;
- Achievement of interim milestones;
- Re-evaluation of the water quality priorities identified for the DC WMG based on more recent water quality data for discharges from the MS4 and receiving waters(s) and a reassessment of sources of pollutants;
- Availability of new information and data from sources other than the Permittees monitoring programs within the DC WMG that informs the effectiveness of the actions implemented;
- Regional Board recommendations; and
- Recommendations for modifications to the EWMP through a public participation process.

The adaptive nature of the EWMP allows the process to be iterative, allowing the DC WMG and other groups to identify a plan that is successful in improving water quality in their region. Figure 6-1 displays a flow chart of how this framework may be used.

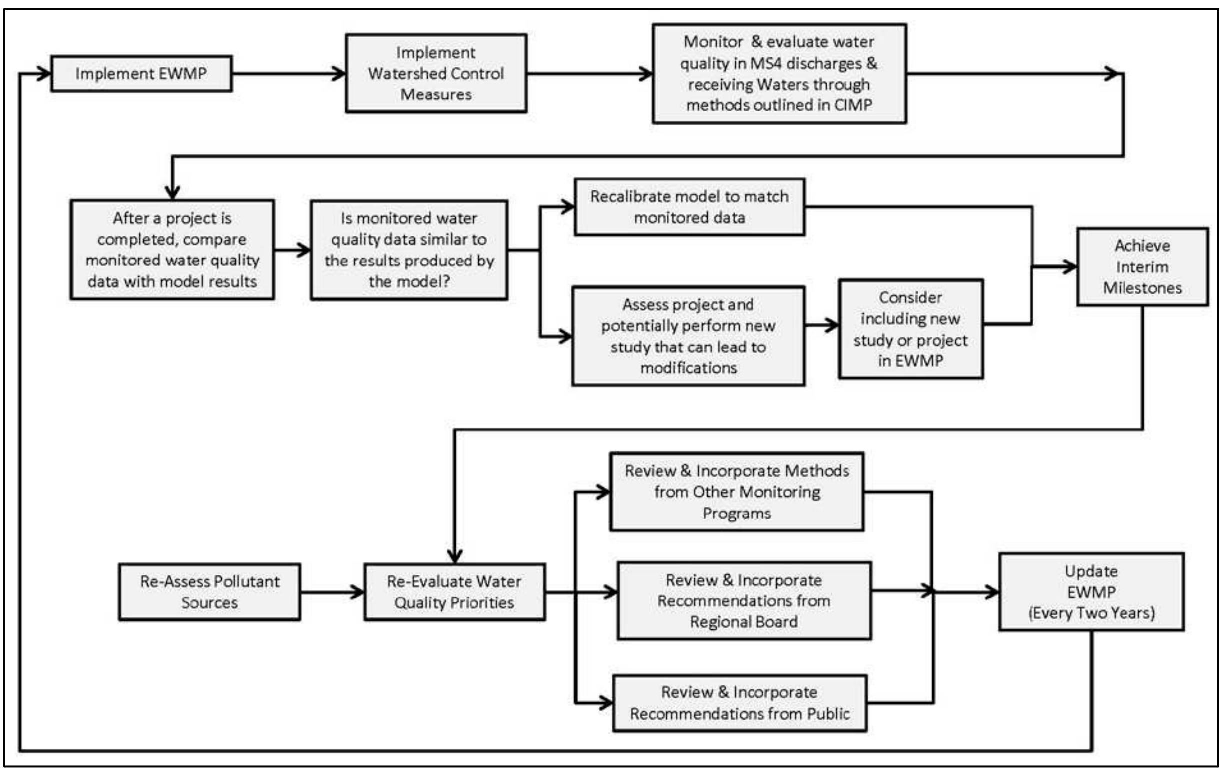


Figure 6-1: Assessment and Adaptive Management Flow Chart

As shown in this flow chart, a primary tool proposed for evaluating if implementing the EWMP is meeting the planning objectives is the model. Monitoring data will be used to check and, if necessary, adjust the model calibration, which will then be used to simulate the effects of existing and future projects on flows and concentrations. This will evaluate if the projects, as modeled, are meeting the planning objectives.

This calibration checkwill then be used to either 1) update the model calibration and run simulations to see if the EWMP projects need modifications, or 2) stay the course.

7. EWMP Implementation Costs and Financial Strategy

The purpose of this section is to present the financial strategy for addressing the additional costs of implementing the EWMP as described in the 2012 MS4 permit. The definition of a financial strategy varies across industries. In the context of the EWMP, the financial strategy is interpreted to represent the strategic options available to the Permittees to finance the program costs associated with implementing the EWMP.

Currently, most of the projects described in this EWMP are not explicitly funded from a dedicated revenue source. Obtaining funds for all of the activities identified in the EWMP is anticipated to take many years. This section describes the probable costs of the projects, the amount of funding currently available to meet the needs described in the EWMP, and potential funding sources that may be available to fund elements of the program. The section is intended to serve as high level financial strategy by addressing the following items:

- Documentation of probable EWMP program costs;
- Assessment of impact of program costs on Permittees;
- Review of existing policies, revenues and costs affecting stormwater; and
- Identification of financial strategies for financing program costs including identification of future steps needed to implement the financial strategy.

7.1 Program Costs

7.1.1 Probable EWMP Program Costs

The purpose of this section is to present the probable order-of-magnitude cost opinions to implement the EWMP. The cost opinion for program costs were developed using feasibility study level engineering cost estimation procedures. The EWMP identified projects to be completed along a timeline. These projects are broken into four categories: (1) Minimum Control Measures (MCMs), excluding implementation of LID ordinances for new and re-development, (2) LID ordinance implementation for new and re-development, (3) regional projects, and (4) distributed projects, which are primarily green streets.

Non-Structural BMPs

As discussed in Section 4, numerous non-structural BMPs will be implemented:

- MCMs as specified in the MS4 permit.
- Adoption of SB 346, which reduces sources of copper.
- Implementation of LID ordinances in the Permittees new and re-development programs.

For these non-structural BMPs, the incremental costs beyond those currently being spent by the Permittees are expected to be negligible. The enhanced MCMs have been implemented in the current budgets. Administration of the LID ordinances has been implemented in the current budgets. Adoption and phasing in of SB 346 requires no administrative costs on the part of the DC WMG agencies.

Regional Projects

Based on the concept drawings shown in Figure 4-5 through Figure 4-13 and estimated sizing requirements for the regional projects, preliminary probable capital and operations and maintenance cost opinions were developed for each of the regional projects. The probable cost opinions were developed using standard engineering cost estimation procedures, which rely on published unit costs for work and materials where available and the cost estimator's best judgment based on prior experience with engineering and construction for relative costs (e.g. design = 10% of construction). Table 7-1 summarizes some of the typical line items included in the cost opinions and their associated assumptions. The items included are broken into three categories: engineering, construction support, and construction.

Table 7-1: Regional Project Probable Cost Opinion Assumptions	
Description	**Assumption(s)**
Engineering	
Design Plan and Specifications	10 percent of construction cost
Permits	Does not include CEQA
Environmental Assessment (CEQA)	Initial study/mitigated negative declaration equivalent to 25 percent of engineering design cost
Construction Support	
Construction Administration and Inspections	10 percent of construction cost
Construction	
Mobilization	10 percent of construction cost
Excavation	Extended arm not needed, bench available for equipment entry, shoring not needed, includes clearing, grubbing, and debris disposal
Fill	Fill from excavated material, no import necessary
Soil Export	30 mile or less haul route
Landscaping and Irrigation	Includes tree replacement
Diversion Pipe	Includes traffic control, road excavation, pipe installation, road restoration, and sidewalk restoration
Storage (Pipes or Concrete)	Includes pretreatment cost. Unit cost is based on past experience with similar sized projects and goals.

Table 7-2 summarizes the engineering, construction support, construction, and total costs associated with each of the regional projects included in the RAA. Attachment V includes a more detailed breakdown of associated costs.

Table 7-2: Regional Project Cost Summary				
Regional Project	**Engineering**	**Construction Support**	**Construction**	**Total**
Darby Park	$520,000	$396,000	$4,947,000	$5,863,000
El Segundo Pump Station	$162,000	$109,000	$1,086,000	$1,357,000
Ramona Park	$1,788,000	$1,410,000	$17,623,000	$20,821,000
Jim Thorpe Park	$1,559,000	$1,116,000	$15,337,000	$18,012,000
Hawthorne Memorial Park	$827,000	$583,000	$8,013,000	$9,423,000
Chester Washington Golf Course	$5,074,000	$4,039,000	$50,488,000	$59,601,000
Harbor City Park	$7,225,000	$5,760,000	$71,994,000	$84,979,000
Wilmington Recreation Center	$1,252,000	$892,000	$12,255,000	$14,399,000
Averill Park	$2,183,000	$1,726,000	$21,568,000	$25,477,000
Total Cost[1]:				**$239,932,000**

The annual operations and maintenance costs were also estimated for the regional projects. Based on the California Stormwater Quality Association (CASQA) BMP Handbooks and experience, one to two percent of the construction cost is recommended as the annual maintenance cost. An annual maintenance cost of 1.5 percent was used for all of the regional projects with a not to exceed cost of $500,000. Table 7-3 summarizes the annual maintenance costs. All maintenance will start once the project is constructed.

Table 7-3: Regional Project Annual Maintenance Costs

Regional Project	**Annual Maintenance Cost**
Darby Park	$74,205
El Segundo Pump Station	$16,290
Ramona Park	$264,345
Jim Thorpe Park	$230,055
Hawthorne Memorial Park	$120,195
Chester Washington Golf Course	$500,000
Harbor City Park	$500,000
Wilmington Recreation Center	$183,825
Averill Park	$323,520

Distributed BMPs (Green Streets)

A probable cost opinion, similar to those developed for the regional projects, was developed for a 1,000 linear foot section of green street within one lane (0.19 lane miles) and is provided in Attachment V. This unit cost opinion is $478 per lineal foot per lane mile of green streets. Based on the implementation schedule summarized in Section 5, the cost per year of green street implementation is shown in Table 7-4. The green streets will also require some maintenance throughout the year to make sure they function as intended. The annual maintenance cost associated with green streets was estimated to be one percent of the construction cost, which is consistent with general CASQA BMP guidance. The maintenance cost will start once the streets have been constructed and are shown to begin the following year. Annual maintenance costs increase as more green streets are added.

Table 7-4: Green Street Implementation Cost			
Implementation Year	**Number of Lane Miles**	**Implementation Cost**	**Annual Maintenance**
2017	-	-	-
2018	-	-	-
2019	-	-	-
2020	-	-	-
2021	-	-	-
2022	-	-	-
2023	-	-	-
2024	-	-	-
2025	-	-	-
2026	163	$411,127,728	
2027	53	$132,838,816	$4,111,277
2028	53	$132,838,816	$5,439,665
2029	53	$132,838,816	$6,768,054
2030	27	$69,021,605	$8,096,442
2031	27	$69,021,605	$8,786,658
2032	27	$69,021,605	$9,476,874
2033	1	$2,871,396	$10,167,090
2034	1	$2,871,396	$10,195,804
2035	1	$2,871,396	$10,224,518
2036	1	$2,871,396	$10,253,232
2037	1	$2,871,396	$10,281,946
2038	1	$2,871,396	$10,310,660
2039	1	$2,871,396	$10,339,374
2040	1	$2,871,396	$10,368,088
2041	-	-	$10,396,802

Drinking Water Aquifer Recharge by Injection Wells

The project cost opinions provided above do not include costs for injecting water into the drinking water aquifers. Because much of the volume reduction proposed is through green streets, and a survey to identify collection points within green streets systems where injection wells can be effectively used has not been completed yet, the number of injection wells and total amount of water that can be feasibly injected is highly uncertain. For this reason, the incremental probable cost opinion for implementing one injection well and the amount of water that injection well can potentially move into the drinking water aquifer is provided in this section.

The probable cost opinion for an injection well is based on the Alamitos and West Coast Seawater Barriers operated by LACDPW along with engineering experience. LACDPW staff suggested that an average injection well can consistently inject at a rate of 0.35 cubic feet per second (cfs). If a well would be sited such that, it would be able to operate constantly for 3 days following a storm (there was that much volume accumulated), this would provide approximately 2 acre-feet of water per well per operational period. Table 7-5 shows the probable cost opinions for such a well based on information provided by LACDPW. Based on the operating history of the LACDPW injection barriers, each well generally needs to be redeveloped every two years and replaced every 25 years due to well degradation that occurs from scaling and other processes. Injected water would need to be filtered to maintain well life to within these parameters. A more detailed probable cost opinion that includes probable opinions of design costs, construction support, and construction costs is provided in Attachment V. Future costs are not discounted to present value and not escalated for inflation.

Table 7-5: Injection Well Cost Summary per Well

Cost Item Description	Total Cost
Engineering, Construction Support, and Construction	$1,000,000
Annual Maintenance of Injection Well	$100,000
Well Redevelopment (every 2 years)	$2,000
Well Head Replacement (every 25 years)	$1,000,000

Opinion of Probable Cost Summary

The probable cost opinions associated with regional and distributed project implementation were placed along the implementation timeline to show a potential future cash flow scenario. All cost opinions are shown in 2014 dollars. Future costs are neither discounted nor escalated. Figure 7-1 shows the probable capital and O&M cost opinions per year based on the implementation schedule. The spike seen in the figure corresponding with 2026 is due to green street implementation. The cost prior to 2026 is associated with the design and construction of regional projects. In 2026, all of the regional projects except for Harbor City Park will be completed and green street implementation will start. Harbor City Park will be completed 2034. The design and construction costs were spread out depending on the amount of time anticipated for the design and construction.

Future replacement costs based on expected useful lives of the systems are not shown in Figure 7-1. Injection well costs are not shown Figure 7-1.

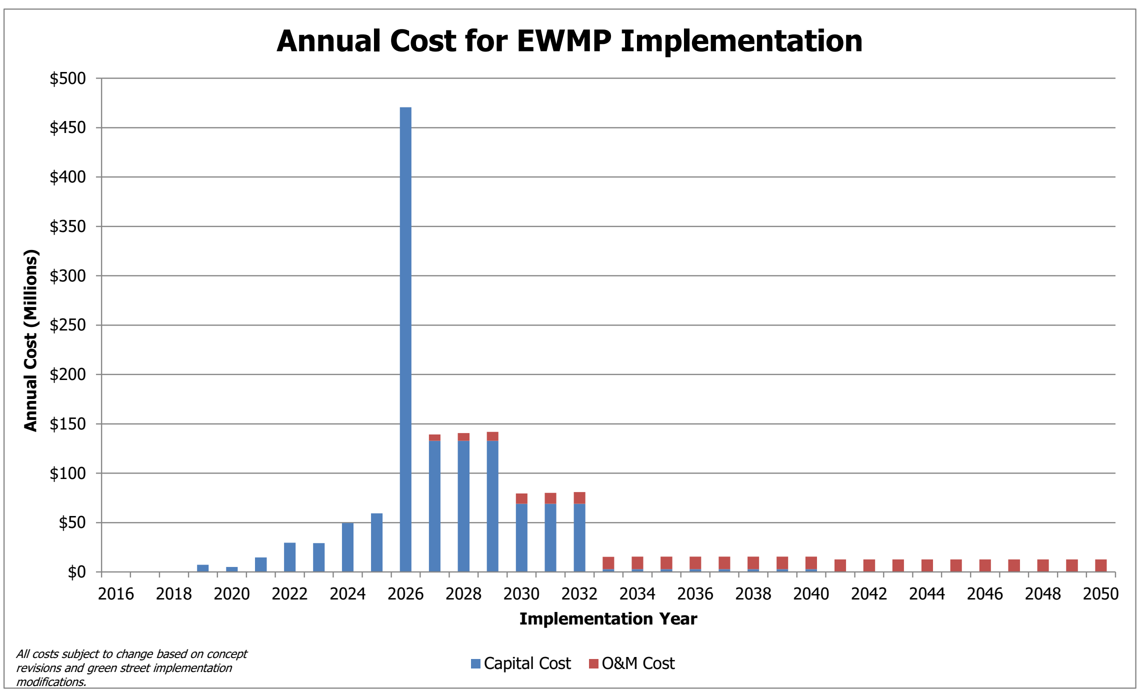


Figure 7-1: Annual Cost for EWMP Implementation

EWMP Costs by Type

The total probable cost opinions by type are shown in Table 7-6.

Table 7-6: Total Estimated EWMP Costs by Type		
Type	**Capital Cost**	**Annual O&M at Build-out**
MCMs	$0	Current budgets
LID + Redevelopment	$0	Current budgets
Regional BMPs	$254,000,000	$2,400,000
Green Streets	$1,040,000,000	$10,000,000
Total	$1,294,000,000	$12,400,000

EWMP Costs by Jurisdiction

The capital and O&M cost for the proposed control measure implementation based on jurisdiction is summarized in Table 7-7. An annual O&M cost is presented for each jurisdiction and is based on 1.5% of the capital costs of control measures within that jurisdiction. This percentage is similar to the percentage used for the O&M costs of Regional Projects, which is based on the California Stormwater Quality Association (CASQA) BMP Handbooks. Table 7-8 through Table 7-12 identifies the cost per jurisdiction within each of the five analyzed watersheds. The cost for regional projects was shared based on the percent of the catchment in the participating jurisdiction.

Table 7-7: EWMP Implementation Cost by Jurisdiction

Jurisdiction	Regional Projects		Green Streets			Total Capital Cost	Annual O&M Cost at Build-Out
	Volume (ac-ft)	Capital Cost	Lane Miles	Volume (ac-ft)	Capital Cost		
El Segundo	27.0	$1,357,000	5	6.3	$13,118,511	$14,475,511	$217,133
Hawthorne	28.5	$34,412,250	61	74.5	$155,115,607	$189,527,857	$2,842,918
Inglewood	5.2	$5,863,000	33	39.7	$82,692,321	$88,555,321	$1,328,330
Lomita	54.7	$57,593,055	0	0.0	$0	$57,593,055	$863,896
Los Angeles	60.7	$67,744,164	184	223.4	$464,866,999	$532,611,163	$7,989,167
Unincorporated County	60.7	$72,962,531	128	155.7	$323,886,719	$396,849,250	$5,952,739
Total:	**236.8**	**$239,932,000**	**411**	**499.6**	**$1,039,680,157**	**$1,279,612,157**	**$19,194,182**

Table 7-8: Dominguez Channel Watershed – EWMP Implementation Cost by Jurisdiction

Jurisdiction	Regional Projects		Green Streets			Total Capital Cost	Annual O&M Cost at Build-Out
	Volume (ac-ft)	Capital Cost	Lane Miles	Volume (ac-ft)	Capital Cost		
El Segundo	27.0	$1,357,000	5	6.3	$13,118,511	$14,475,511	$217,133
Hawthorne	28.5	$34,412,250	61	74.5	$155,115,607	$189,527,857	$2,842,918
Inglewood	5.2	$5,863,000	33	39.7	$82,692,321	$88,555,321	$1,328,330
Los Angeles	60.2	$72,412,059	43	52.0	$108,257,447	$109,290,137	$1,639,352
Unincorporated County	27.0	$1,357,000	64	77.8	$161,811,649	$234,223,708	$3,513,356
Total:	**121.8**	**$115,077,000**	**206**	**250.3**	**$520,995,535**	**$636,072,534**	**$9,541,088**

Table 7-9: Dominguez Channel Estuary Watershed – EWMP Implementation Cost by Jurisdiction

Jurisdiction	Regional Projects		Green Streets			Total Cost	Annual O&M Cost at Build-Out
	Volume (ac-ft)	Capital Cost	Lane Miles	Volume (ac-ft)	Capital Cost		
Los Angeles	0.0	$0	20	24.4	$50,809,976	$50,809,976	$762,150
Unincorporated County	0.0	$0	61	74.5	$154,944,527	$154,944,527	$2,324,168
Total:	**0.0**	**$0**	**81**	**98.9**	**$205,754,503**	**$205,754,503**	**$3,086,318**

Table 7-10: Wilmington Drain Watershed – EWMP Implementation Cost by Jurisdiction

Jurisdiction	Regional Projects		Green Streets			Total Cost	Annual O&M Cost at Build-Out
	Volume (ac-ft)	Capital Cost	Lane Miles	Volume (ac-ft)	Capital Cost		
Lomita	54.7	$57,593,055	0	0.0	$0	$57,593,055	$863,896
Los Angeles	25.5	$26,835,474	0	0.0	$0	$26,835,474	$402,532
Unincorporated County	0.5	$550,471	0	0.0	$0	$550,471	$8,257
Total:	**80.7**	**$84,979,000**	**0**	**0.0**	**$0**	**$84,979,000**	**$1,274,685**

Table 7-11: Machado Lake Watershed – EWMP Implementation Cost by Jurisdiction

Jurisdiction	Regional Projects		Green Streets			Total Cost	Annual O&M Cost at Build-Out
	Volume (ac-ft)	Capital Cost	Lane Miles	Volume (ac-ft)	Capital Cost		
Lomita	0.0	$0	0	0.0	$0	$0	$0
Los Angeles	0.0	$0	9	11.0	$22,971,167	$22,971,167	$344,568
Total:	**0.0**	**$0**	**9**	**11.0**	**$22,971,167**	**$22,971,167**	**$344,568**

Table 7-12: Harbor Watershed – EWMP Implementation Cost by Jurisdiction

Jurisdiction	Regional Projects		Green Streets			Total Cost	Annual O&M Cost at Build-Out
	Volume (ac-ft)	Capital Cost	Lane Miles	Volume (ac-ft)	Capital Cost		
Los Angeles	34.3	$39,876,000	112	135.9	$282,828,410	$322,704,410	$4,840,566
Unincorporated County	0.0	$0	3	3.4	$7,130,543	$7,130,543	$106,958
Total:	**34.3**	**$39,876,000**	**115**	**139.3**	**$289,958,953**	**$329,834,953**	**$4,947,524**

7.1.2 Existing Stormwater Programs

The DC WMG agencies have been addressing stormwater discharge requirements since adoption of the first phase I NPDES MS4 permit in the early 1990s. They have increased their budgets since that time to meet additional compliance needs. The DC WMG agencies have existing recurring costs associated with stormwater activities in excess of $50M annually (across all watersheds in which they reside). Table 7-13 is a summary listing of current expenditures and associated revenue sources. Given that the DC WMG agencies have, for the most part, implemented enhanced MCMs and have adopted LID ordinances and are administering their new and re-development programs, it is expected that these recurring costs will continue, for the most part, as is. CIMP monitoring costs are not included in Table 7-13 and are not in the EWMP implementation costs. The purpose of this financial strategy is focused on developing a set of options to address the expected additional costs associated with compliance with the new MS4 permit, and is not intended to incorporate the costs of the existing stormwater activities.

Table 7-13: Existing Stormwater Costs

Jurisdiction	Existing Utility? (Yes/No)	Funding Source	Description of Costs	Total Costs ($)
City of Los Angeles	Yes	Stormwater Fee Plan Check and Grants	O&M and Capital, Planning, Program Management, Monitoring, Emergency Repairs	~$3M/yr (Dominguez Channel Area; not including Prop O)
Los Angeles County	No	General Fund, Gasoline Tax, Solid Waste Fund, Prop C, and Prop A	Management, O&M, Outreach, Inspection, Enforcement, Monitoring	~80M/yr (County wide)
Los Angeles County Flood Control District	Yes[1]	Flood Control Benefit Assessment	Program Management, O&M, Public Outreach, Monitoring	~36M/yr (County wide)
City of Hawthorne	Yes	General Fund	Program Management, Outreach, Administration	~$335,000/yr
City of Inglewood	Yes	Sewer Fund	O&M and Capital, Runoff Investigation	Not Available
City of El Segundo	Not Available	Not Available	Not Available	Not Available
City of Lomita	No	General Fund	Permit Fee, Match Funding for County Projects	~$73,000/yr

1 The Los Angeles County Flood Control District is, by definition, a utility with a responsibility for draining storm water.

7.2 Financial Strategies

As described in this EWMP, the projects being envisioned represent new infrastructure or revisions to existing infrastructure that will be expected to operate in perpetuity. For example, the County of Los Angeles is preparing a Green Street Strategic Plan. Also, members of the DC WMG are already beginning planning for projects identified in this EWMP. This new infrastructure or increased costs associated with revising existing infrastructure were never envisioned when the DC WMG agencies were developing their revenue and budgeting models. Therefore, the DC WMG agencies do not currently have revenue sources allocated specifically to this new infrastructure. New revenue sources need to be identified, or revenue sources currently allocated to other programs need to be used to fund the implementation of this EWMP.

Flexibility in identifying potential funding opportunities will be important for successful financing of EWMP implementation.

The financial strategy presented in this EWMP outlines a set of multiple approaches that allows each DC WMG agency to select those strategies that best fit their specific circumstances.

The detailed financial strategy for EWMP costs will be highly dependent and vary by agency. Each permittee has different resources as presented in Table 7-13; therefore each permittee will use a different set of options at its disposal. The following are high-level alternatives that can be examined as each permittee moved forward as a group or as individuals. The alternatives are categorized by type. Acknowledgement is given to *Stormwater Funding Options – Providing Sustainable Water Quality Funding in Los Angeles County,* a report authored by Ken Farfsing and Richard Watson dated May 21, 2014.

Grants and Low Interest Loans

The financial strategies available to the Permittees associated with grants and low interest loans are summarized below and described in further detail in Attachment W:

- Apply for grants through the recently passed Prop 1 – 2014 Water Bond. Over $400M is available for stormwater capture, IRWMP and urban creek restoration projects.
- Apply for other grants (state and federal) for stormwater improvement, beach water quality improvement, and green infrastructure projects. (e.g. Prop. 84, CBI, etc.)
- Apply for a low interest loan through the State Water Resources Control Board's Clean Water State Revolving Fund (CWSRF) program for implementation of programs and projects to control pollution from nonpoint sources and stormwater drainage.

Table 7-14 lists grant and low interest loan programs that the DC WMG will investigate for EWMP projects. They programs range from Federal to State and can apply to transportation, waters supply, water quality, habitat enhancement, recreation, or a range of potential project benefits. Table 7-14 shows which project benefit criteria apply most to the different grant programs. As projects are developed and concept planned, incorporating the benefits that position them for grants and low interest loans can be beneficial in improving odds at successfully obtaining such funds.

Table 7-14: Grant and Loan Programs and Project Criteria

Funding Source	Priority Project Elements									
	Drought Preparedness	**Increase Local Water Supply**	**Conservation Programs**	**Water Quality**	**Pollution Reduction**	**Flood Management Programs**	**Drinking Water Protection**	**Ecosystem Protection**	**Restoration**	**Public Health/ Environmental Impact**
EPA Section 319				X	X					
Proposition 1:										
Regional Water Security		X		X				X	X	
Flood Management		X		X				X	X	
Clean, Safe, Reliable Drinking Water		X		X			X	X	X	
Water Recycling		X		X				X	X	
Ecosystem and Watershed Protection		X		X				X	X	
Groundwater Sustainability		X		X				X	X	X
Water Storage Capacity		X		X				X	X	
Clean Beaches Initiatives				X	X			X	X	
TIGER Discretionary *				X						
Supplemental Environmental Project Funds:										
Federal			X	X	X					X
State			X	X	X			X	X	
Clean Water State Revolving Fund	X			X	X					X
California Infrastructure Development Bank – Infrastructure State Revolving Fund Program				X		X				

* Transportation projects that are coordinated with interdisciplinary factors including Stormwater and other infrastructure investments

Fees and Charges

The financial strategies DC WMG agencies will consider associated with fees and charges are:

- Use existing revenue streams for stormwater/water supply/flood control projects to support stormwater quality projects as legally allowable.
- AB 2403 – Use new state law to allow water rates to be used for the water supply benefit of stormwater projects as legally allowable.
- Establish a means by which private developers can fund regional or green streets project in lieu of retaining water on private development. To get sufficient benefit from this, the in lieu project would need to get greater water quality benefit than the potential private development project.
- Use solid waste management fees to cover the cost of enhanced street sweeping and other measures to reduce trash for compliance with TMDLs.
- Use water rates to fund programs to reduce irrigated runoff.
- Pursue a proposition 218 compliant stormwater fee or tax initiative (modified after the 2012 Clean Water Clean Beaches Initiative).
- Pursue proposition 218 compliant special product taxes on those projects that result in greater amounts of pollution causing water quality impairments. Examples include pesticides, fertilizers, automobile tires or other automotive products. Use the revenue to fund EWMP projects.

Legislative and Policy

The financial strategies DC WMG agencies will consider that require legislative or policy changes are summarized below:

- Lobby the Metropolitan Water District (MWD) of Southern California to reevaluate their approach for managing the Local Resource Program (LRP) to fund stormwater capture and use projects that offset the use of imported water supplies. This is related to a water rate increase in that MWD would incorporate the costs into their imported water rates.
- Pursue pollutant source control legislation patterned after SB 346 that either limits pollutants of concerns in products (e.g. copper in brake pads, or zinc in tires) or assesses a fee on those products that can be used by local governments to mitigate those pollutants.
- Form Special Assessment Districts and fees tailored to the Watershed Management Groups.
- Explore the use of Enhanced Infrastructure Finance Districts tailored to the Watershed Management Group, as outlined in recently adopted (2014) California legislation SB628.
- 2014 Water Resources Reform and Development Act of 2014 (WRRDA). Partner with USACE to model the watershed impervious surface effects on the federal interests under WRRDA to secure USACE cost sharing for EWMP programs.

Future Steps

The financial strategies mentioned herein are options for funding sources, some or all of which can potentially be implemented to develop a comprehensive financial solution. As each DC WMG agency determines the appropriate funding strategy, they will consider the following items as well:

- Development of public support for financial strategies though outreach efforts
- Create inter-jurisdiction WMG financial working group(s)

The Watershed Management Group as a whole, as well as individual members of the WMG are currently prioritizing and selecting the specific financial strategies that best fit their needs.

PAGE INTENTIONALLY LEFT BLANK

8. Legal Authority

As part of the Standard Provisions of the MS4 Permit, Permittees must demonstrate through a certified statement annually that their legal authority to implement and enforce the requirements of the order exists. Legal authority is described in the MS4 Permit (Part VI.A.2, pages 39-41) as follows:

a. Each Permittee must establish and maintain adequate legal authority, within its respective jurisdiction, to control pollutant discharges into and from its MS4 through ordinance, statute, permit, contract or similar means. This legal authority must, at a minimum, authorize or enable the Permittee to:

   i. Control the contribution of pollutants to its MS4 from storm water discharges associated with industrial and construction activity and control the quality of storm water discharged from industrial and construction sites. This requirement applies both to industrial and construction sites with coverage under an NPDES permit, as well as to those sites that do not have coverage under an NPDES permit.

   ii. Prohibit all non-storm water discharges through the MS4 to receiving waters not otherwise authorized or conditionally exempt pursuant to Part III.A;

   iii. Prohibit and eliminate illicit discharges and illicit connections to the MS4;

   iv. Control the discharge of spills, dumping, or disposal of materials other than storm water to its MS4;

   v. Require compliance with conditions in Permittee ordinances, permits, contracts or orders (i.e., hold dischargers to its MS4 accountable for their contributions of pollutants and flows);

   vi. Utilize enforcement mechanisms to require compliance with applicable ordinances, permits, contracts, or orders;

   vii. Control the contribution of pollutants from one portion of the shared MS4 to another portion of the MS4 through interagency agreements among Copermittees;

   viii. Control of the contribution of pollutants from one portion of the shared MS4 to another portion of the MS4 through interagency agreements with other owners of the MS4 such as the State of California Department of Transportation;

   ix. Carry out all inspections, surveillance, and monitoring procedures necessary to determine compliance and noncompliance with applicable municipal ordinances, permits, contracts and orders, and with the provisions of this Order, including the prohibition of non-storm water discharges into the MS4 and receiving waters. This means the Permittee must have authority to enter, monitor, inspect, take measurements, review and copy records, and require regular reports from entities discharging into its MS4;

   x. Require the use of control measures to prevent or reduce the discharge of pollutants to achieve water quality standards/receiving water limitations;

   xi. Require that structural BMPs are properly operated and maintained; and

   xii. Require documentation on the operation and maintenance of structural BMPs and their effectiveness in reducing the discharge of pollutants to the MS4.

Each of the DC WMG agencies has provided their latest certified statement for inclusion in Attachment W for reference.

PAGE INTENTIONALLY LEFT BLANK

9. References

AMEC Earth & Environmental, Inc. 2003. Supplemental Report Consolidated Slip Restoration Project Concept Plan. Prepared for Regional Water Quality Control Board Los Angeles Region and the Port of Los Angeles.

AMEC. 2011. Port of Los Angeles Dominguez Channel and Consolidated Slip Erosion Study Chemistry EDDs.

Attachment A to Resolution No. R4-2007-006. Adopted by RWQCB June 7, 2007. Proposed Amendments to the Water Quality Control Plan - Los Angeles Region for the Machado Lake Trash TMDL.

Attachment A to Resolution No. R08-006. Adopted by Regional Board September 2, 2010. Proposed Amendment to the Water Quality Control Plan - Los Angeles Region to incorporate the Total Maximum Daily Load for Pesticides and PCBs in Machado Lake.

Attachment A to Resolution No. R10-008. May 5, 2011. Amendment to the Water Quality Control Plan - Los Angeles Region to Incorporate the Total Maximum Daily Load for Toxic Pollutants in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters.

Attachment A to Resolution No. R11-008. May 5, 2011. Amendment to the Water Quality Control Plan - Los Angeles Region to Incorporate the Total Maximum Daily Load for Toxic Pollutants in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters.

Attachment C to Resolution No. R12-007. June 7, 2012. Amendment to the Water Quality Control Plan - Los Angeles Region to revise the Los Angeles Harbor Bacteria TMDL (Inner Cabrillo Beach and Main Ship Channel).

Bay Area Stormwater Management Agencies Association. April 29, 2011. Bay Area Stormwater Management Agencies Association Feasibility/Infeasibility Criteria Report – NPDES Municipal Regional Permit Provisions C.3.c.i.(2)(b)(iv) and C.3.c.iii.(1).

Bureau of Engineering Prop O Bond Division. October 2013. Proposition O - Clean Water Bond Program; October 2013 Monthly Report. http://www.lapropo.org/.

Bureau of Engineering Prop O Bond Division. March 2014. Proposition O - Clean Water Bond Program; March 2014 Monthly Report. http://www.lapropo.org/.

California Environmental Protection Agency. Los Angeles Regional Water Quality Control Board. 2014. Basin Plan Amendments - TMDLs. http://www.waterboards.ca.gov/rwqcb4/water_issues/programs/tmdl/tmdl_list.shtml.

California Regional Water Quality Control Board. July 11, 2007. Trash Total Maximum Daily Load for Machado Lake in the Dominguez Channel Watershed.

California Regional Water Quality Control Board, Los Angeles Region. Revised Draft April 2008. Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL.

Caltrans. January 2009. BMP Pilot Study Guidance Manual (CTSW-RT-06-171.02.1). California Department of Transportation.

CASQA. 2003. California Stormwater Quality Association. *California Stormwater BMP Handbooks.* Four Handbooks: New Development and Redevelopment, Construction, Municipal, and Industrial/Commercial. www.cabmphandbooks.org.

CASQA. 2007. California Stormwater Quality Association. Municipal Stormwater Program Effectiveness Assessment Guidance.

CDM for City of Los Angeles Department of Public Works Bureau of Sanitation. October 11, 2006. Final Project Concept Report Rosecrans Recreation Center Stormwater Enhancements Proposition O Project. http://www.lapropo.org/sitefiles/docs/Concept_Reports/Rosecrans_FINALReport.pdf.

CDM for City of Los Angeles Department of Public Works Bureau of Sanitation. October 11, 2006. Project Concept Report Peck Park Canyon Proposition O Project. http://www.lapropo.org/sitefiles/docs/Concept_Reports/PeckPark_ConcptReport.pdf.

CDM for City of Los Angeles Department of Public Works Bureau of Sanitation. December 13, 2006. Final Project Concept Report Machado Lake Ecosystem Rehabilitation Project. http://www.lapropo.org/sitefiles/docs/Concept_Reports/Machado_CR.pdf.

City of Los Angeles. Environment LA Sanitation. Project Information Form. Provided by Alfredo Magallanes February 16, 2014.

City of Los Angeles. 2003, 2010, 2011. Los Angeles Harbor—Annual Assessment Report(s). City of LA, Department of Public Works, Bureau of Sanitation, Environmental Monitoring Division.

City of Los Angeles. November 18, 2013. Concept Memo #2: Existing and Potential Control Measures.

City of Los Angeles. Bureau of Street Services. 2014. Street Cleaning Section. http://bss.lacity.org/StreetMaintenance/scs.htm.

City of Los Angeles Department of Public Works Bureau of Engineering. July 2009. Machado Lake Ecosystem Rehabilitation Project Wilmington Drain Multi-Use Project Pre-Design Report Executive Summary. http://lapropo.org/sitefiles/Machado/executivesummary.pdf.

City of San Diego. Prepared by URS Corporation. May 31, 2011. Targeted Aggressive Street Sweeping Pilot Program Phase IV Speed Efficiency Study Final Report.

City of San Francisco. 2010. San Francisco Stormwater Design Guidelines. Appendix A: BMP Factsheets. http://www.sfwater.org/modules/showdocument.aspx?documentid=2778.

County of Los Angeles Department of Public Works Watershed Management Division. July 1, 2003. Dry Weather Treatment Feasibility Study.

County of Los Angeles Department of Public Works (LACDPW). April 2004. Dominguez Watershed Management Plan. Submitted by MEC Analytical Systems, Inc. http://ladpw.org/wmd/watershed/dc/DCMP/masterplan.cfm

County of Los Angeles Department of Public Works (LACDPW). 2006. Los Angeles County-Wide Structural BMP Prioritization Methodology: A Guidance Manual for Strategic Storm Water Quality Project Planning. 2006. Prepared for County of Los Angeles Department of Public Works, City of Los Angeles, and Heal the Bay by Geosyntec.

County of Los Angeles Department of Public Works (LACDPW). January 2009. County of Los Angeles Low Impact Development Standards Manual.

County of Los Angeles Department of Public Works (LACDPW). 2010a. Los Angeles County Watershed Model Configuration and Calibration – Part I: Hydrology. August 6, 2010. Submitted to Los Angeles County Department of Public Works by Tetra Tech.

County of Los Angeles Department of Public Works (LACDPW). 2010b. Los Angeles County Watershed Model Configuration and Calibration – Part II: Water Quality. August 6, 2010. Submitted to Los Angeles County Department of Public Works by Tetra Tech.

County of Los Angeles Department of Public Works (LACDPW). 2010c. The Los Angeles County Watershed Management Modeling System Loading Simulation Program in C++ User's Manual. October 1, 2010. Submitted to Los Angeles County Department of Public Works by Tetra Tech.

County of Los Angeles Department of Public Works (LACDPW). 2011a. Phase II Report: Development of the Framework for Watershed Scale Optimization Modeling. June 30, 2011. Submitted to Los Angeles County Department of Public Works by Tetra Tech.

County of Los Angeles Department of Public Works. September 12, 2011. 2011b. Multipollutant TMDL Implementation Plan for the County of Los Angeles Unincorporated Area of the Machado Lake Watershed.

County of Los Angeles Department of Public Works (LACDPW). 2013. The Los Angeles County Watershed Management Modeling System Regional Optimization User's Manual. March 19, 2013. Submitted to Los Angeles County Department of Public Works by Tetra Tech.

CWE. May 24, 2013. Vermont Avenue Median Stormwater Park. Prepared for Council for Watershed Health.

Fraley-McNeal, L., Schueler, T., Winer, R. 2007. National Pollutant Removal Performance Database - Version 3. Center for Watershed Protection, September 2007. http://www.cwp.org/online-watershed-library/doc_download/640-national-pollutant-removal-performance-database-version-3

Gateway Cities Council of Governments. 2013. Trash Implementation Meeting.

Geosyntec. 2008a. A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0). December 2008. Prepared for Heal the Bay, City of Los Angeles, and County of Los Angeles Department of Public Works by Geosyntec.

Geosyntec. 2008b. A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0) Technical Appendices. December 2008. Prepared for Heal the Bay, City of Los Angeles, and County of Los Angeles Department of Public Works by Geosyntec.

Hollywood Park Land Company, LLC. October 6, 2011. Standard Urban Stormwater Mitigation Plan and Low Impact Development for Hollywood Park. Prepared by Henrik Nazarian.

John L. Hunter & Associates, Richard Watson & Associates, CWE, and Kinnetic Laboratories. October 2010. Metals TMDL Implementation Plan for Reach 1 of the Los Angeles River and Compton Creek.

Leadership Committee of the Greater Los Angeles County Integrated Regional Water Management Region. July 2013. The Greater Los Angeles County Integrated Regional Water Management Plan. http://dpw.lacounty.gov/wmd/irwmp/index.cfm?fuseaction=TopDocListing&directory=2013_Public_Draft_IRWMP_Update&ttl=2013%20Public%20Draft%20IRWMP%20Update.

Los Angeles County Department of Public Works (LACDPW). 2002 – 2012. Municipal Stormwater Permit Unified Annual Report. 2002 – 2012. http://ladpw.org/wmd/NPDESRSA/AnnualReport/.

Los Angeles County Department of Public Works (LACDPW). 2002-2012. Los Angeles County Municipal Stormwater Monitoring Reports. http://ladpw.org/wmd/NPDES/report_directory.cfm.

Los Angeles County Department of Public Works (LACDPW). January 2006. Hydrology Manual.

Los Angeles County Department of Public Works (LACDPW). Dominguez Watershed. http://ladpw.org/wmd/watershed/dc/. Accessed on February 4, 2014.

Los Angeles County Flood Control District (LACFCD). 2012. Los Angeles County Clean Water, Clean Beaches Measure. http://www.lacountycleanwater.org/.

Los Angeles County Flood Control District (LACFCD). 2013. Machado Lake Nutrient TMDL Implementation Plan for the Los Angeles County Flood Control District.

Los Angeles County GIS Data Portal. 2013. http://egis3.lacounty.gov/dataportal.

Los Angeles County. Office of the Assessor. 2013. http://assessormap.co.la.ca.us/mapping/viewer.asp. Accessed December 9, 2013.

Los Angeles Regional Water Quality Control Board (LARWQCB). Adopted June 13, 1994. Water Quality Control Plan Los Angeles Region. *Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties*.

Los Angeles Regional Water Quality Control Board (LARWQCB). July 1, 2004. Resolution No. 2004-011. Amendment to the *Water Quality Control Plan for the Los Angeles Region* to Incorporate a Total Maximum Daily Load for Bacteria at Los Angeles Harbor (Inner Cabrillo Beach and Main Ship Channel).

Los Angeles Regional Water Quality Control Board (LARWQCB). June 7, 2007. Resolution No. R4-2007-006. Amendment to the *Water Quality Control Plan for the Los Angeles Region* to Incorporate a Total Maximum Daily Load for Trash in Machado Lake.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2007. 2006 CWA Section 303(d) List of Water Quality Limited Segments Requiring TMDLs. June 28, 2007. http://www.usbr.gov/lc/socal/reports/brineconcentrate/3Regs_part2.pdf.

Los Angeles Regional Water Quality Control Board (LARWQCB). May 1, 2008. Resolution No. R08-006. Amendment to the *Water Quality Control Plan for the Los Angeles Region* to Incorporate a Total Maximum Daily Load for Eutrophic, Algae, Ammonia, and Odors (Nutrients) for Machado Lake.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2010a. 2010 List of Impaired Surface Waters (The 303(d) List).

Los Angeles Regional Water Quality Control Board (LARWQCB). 2010b. Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants Total Maximum Daily Loads Draft. December 2010.

Los Angeles Regional Water Quality Control Board (LARWQCB). May 5, 2011. Resolution No. R11-008. Amendment to the *Water Quality Control Plan for the Los Angeles Region* to Incorporate a Total Maximum Daily Load for Toxic Pollutants in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters.

Los Angeles Regional Water Quality Control Board (LARWQCB). October 26, 2012. Response to Comments on the Tentative Order. *Minimum Control Matrix*. Accessed February 19, 2014. http://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/StormSewer/CommentLetters/E_MCM%20Matrix%2010-26-12%20Final.pdf.

Los Angeles Regional Water Quality Control Board (LARWQCB). 2013. General Required Information for Required Information for the Reasonable Assurance Analysis for Each Water Body-Combination Addressed by the Watershed Management Program. November 6, 2013.

Los Angeles Regional Water Quality Control Board (LARWQCB). February 6, 2014. Time Schedule Order No. R4-2014-0023. Requiring the City of Los Angeles (Inner Cabrillo Beach, Los Angeles Harbor) to Comply with Requirements Prescribed in Order No. R4-2012-0175 (NPDES Permit No. CAS004001.

Los Angeles River Upper Reach 2 Watershed Management Area (LAR UR2 WMA). January 2015. Los Angeles River Upper Reach 2 Watershe Management Area Revised Watershed Management Program (WMP) Plan. Submitted June 26, 2014, Revised January 27, 2015. Prepared by CWE.

Low Impact Development Center Inc. April 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies.

Lyons, J.M. and S. Birosik. 2007. Water Quality in the Dominguez Channel and Los Angeles/Long Beach Harbor Watershed Management Area under the Surface Water Ambient Monitoring Program (SWAMP) Fiscal Year 2002-2003. California Regional Water Quality Control Board, Los Angeles Region.

Machado Lake Ecosystem Rehabilitation Project and Wilmington Drain Mulit-Use Project Final Pre-Design Report, Appendix N, Draft Sediment Removal Plan. 2009. Prepared for City of Los Angeles, Department of Public Works and Bureau of Engineering. Prepared by CDM in association with Parsons.

Measure O Water Quality Improvement Projects for the Dominguez Channel Watershed. http://www.lapropo.org/sitefiles/dominguez.htm. Project pages for: Wilmington Drain Multi-Use Project, Machado Lake Ecosystem Rehabilitation Project, Rosecrans Recreation Center Stormwater Enhancements, and Peck Park Canyon.

Moran, Kelly. tdc Environmental. July 18, 2011. Memo: Brake Pad Copper Reduction - MRP Section C.13.c. Report 2011. http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/stormwater/MRP/2011_AR/BASMAA/A7-A12_2010-11_MRP_AR.pdf.

National Oceanic and Atmospheric Administration (NOAA). August 24, 1999. *United States and State of California v. Montrose Chemical Corp., et al., No. CV 90-3122-AAH (C.D.Cal.)*, Entered 08/24/1999. Amended Consent Decree (Settling Local Governmental Entities, e.g., LACSD).

NPDES Waste Discharge Requirements for Municipal Separate Storm Sewer System (MS4) Discharges within the County of Los Angeles, and the Incorporated Cities Therein, Except the City of Long Beach. 2001. State Water Resources Control Board; Los Angeles Region. NPDES Permit No. CAS004001; Order No. 01-182.

NPDES Waste Discharge Requirements for Municipal Separate Storm Sewer System (MS4) Discharges within the Coastal Watersheds of Los Angeles County, Except Those Discharges Originating from the City of Long Beach. 2012. State Water Resources Control Board; Los Angeles Region. NPDES Permit No. CAS004001; Order No. R4-2012-0175.

Port of Los Angeles (POLA). 2005. Mid-water column monitoring results, enhanced suite analyses. May and Sept. 2005-2008.

Port of Los Angeles (POLA) and City of Los Angeles Department of Public Works Bureau of Sanitation Watershed Protection Division. April 7, 2014. Inner Cabrillo Beach CB01 Compliance Station Pollution Prevention Plan. Prepared by Weston Solutions, Inc.

Port of Long Beach (POLB). 2006. Mid-water column monitoring results. Oct. 2006-2008.

Port of Long Beach (POLB)/Port of Los Angeles (POLA)/Weston Solutions. 2006. Characterization of Sediment Contaminant Flux in Inner and Outer Harbor Water Bodies –TMDL Implementation Support. Sampling and Analysis Plan, prepared for Port of Los Angeles and Port of Long Beach, by Weston Solutions.

Proposition 84 Application/Survey Preview. December 17, 2013. Century Boulevard LID Project. Submitted by the City of Inglewood.

Regional Water Quality Control Board (RWQCB). April 2008. Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL. Staff Report.

Regional Water Quality Control Board (RWQCB). September 2, 2010. Machado Lake Pesticides and PCBs TMDL. Staff Report.

RMC Water and Environmental. Opti, Database in response to the Greater Los Angeles County IRWMP. http://irwm.rmcwater.com/la/login.php.

RMC Water and Environmental and Geosyntec Consultants. November 2012. Greater Los Angeles County Integrated Regional Water Management South Bay Subregional Plan Draft. Section 4. http://dpw.lacounty.gov/wmd/irwmp/index.cfm?fuseaction=documents.

RMC Water and Environmental, Geosyntec Consultants, Dr. Ambrose, Richard, GreenInfo Network, et. al. 2012. The Greater Los Angeles County Open Space for Habitat and Recreation Plan. Prepared for the Greater Los Angeles County Integrated Regional Water Management Plan.

Southern California Coastal Water Research Project (SCCWRP). 2007. Atmospheric Deposition in LA/LB Harbor. Southern California Coastal Water Research Program presentation to Technical Advisory Committee, September 13, 2007.

Southern California Coastal Water Research Project (SCCWRP). 2007. Southern California Bight 2003 Regional Monitoring Program.

Southern California Coastal Water Research Project (SCCWRP). 2011. Southern California Bight 2008 Regional Monitoring Program.

Saviskas, Robert with the Los Angeles County West Vector and Vector-Borne Disease Control District. June 19, 2009. Rain Barrel Study and Analysis of Los Angeles County Public Works Low-Impact Development (LID) Ordinance Standards.

Stein, Eric D. and Ackerman, Drew. April 2007. Journal of the American Water Resources Association, Vol. 43, No. 2. Dry Weather Water Quality Loading in Arid, Urban Watershed of the Los Angeles Basin, California, USA.

Storm Water Solutions. 2013. Water Remediation Media. http://www.estormwater.com/water-remediation-media.

United States Environmental Protection Agency. 1999a. Storm Water Operation and Maintenance Fact Sheet: Catch Basin Cleaning. http://water.epa.gov/scitech/wastetech/upload/2002_06_28_mtb_catchbas.pdf.

United States Environmental Protection Agency. 1999b. Storm Water Technology Fact Sheet: Hydrodynamic Separators. http://water.epa.gov/scitech/wastetech/upload/2002_06_28_mtb_hydro.pdf.

United States Environmental Protection Agency. 2000. Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination System Program.

United States Environmental Protection Agency. Last updated April 3, 2012. National Menu of Stormwater Best Management Practices. http://cfpub.epa.gov/npdes/stormwater/menuofbmps/. Accessed February 25, 2014.

United States Environmental Protection Agency. 2013a. Green Homes: Conserving water. http://www.epa.gov/greenhomes/ConserveWater.htm.

United States Environmental Protection Agency. 2013b. Water: Class V Wells: Storm Water Drainage Wells. http://water.epa.gov/type/groundwater/uic/class5/types_stormwater.cfm.

United States Environmental Protection Agency. 2013c. Water: Low Impact Development (LID). http://water.epa.gov/polwaste/green/.

United States Environmental Protection Agency. Last updated February 3, 2014a. Environmental Indicators. http://www.epa.gov/reg3esd1/data/indicators.htm. Accessed February 24, 2014.

United States Environmental Protection Agency. Last Updated February 5, 2014b. Watershed Assessment, Tracking & Environmental Results. http://www.epa.gov/waters/ir/index.html.

Zeng, EY and D Tsukada, DW Diehl, J Peng, K Schiff, JA Noblet, KA Maruya. 2005. Distribution and Mass Inventory of Total Dichlorodiphenyldichloroethylene in the Water Column of the Southern California Bight. Environ. Sci. Technol. 39: 8170-76.

PAGE INTENTIONALLY LEFT BLANK