COUNTY OF LOS ANGELES

DEPARTMENT OF PUBLIC WORKS

"To Enrich Lives Through Effective and Caring Service"

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IN REPLY PLEASE
REFER TO FILE: WM-7

June 26, 2014

Mr. Samuel Unger, P.E.
Executive Officer
California Regional Water Quality
Control Board – Los Angeles Region
320 West 4th Street, Suite 200
Los Angeles, California 90013

Attention Ms. Renee Purdy

Dear Mr. Unger:

SUBMITTAL OF ENHANCED WATERSHED MANAGEMENT PROGRAM WORK PLAN AND COORDINATED INTEGRATED MONITORING PROGRAM PLAN FOR THE MARINA DEL REY ENHANCED WATERSHED MANAGEMENT PROGRAM GROUP

The County of Los Angeles, Los Angeles County Flood Control District, Cities of Los Angeles and Culver City, collectively the Marina del Rey Enhanced Watershed Management Program (EWMP) Group, are submitting the enclosed EWMP Work Plan and Coordinated Integrated Monitoring Program (CIMP) Plan. The Marina del Rey EWMP Group is submitting these documents to fulfill the requirements of Order No. R4-2012-0175 Municipal Separate Storm Sewer System (MS4) Permit.

The enclosed EWMP Work Plan fulfills the requirements identified in Section VI.C.4.c.iv of the MS4 Permit and the enclosed CIMP Plan fulfills the requirements identified in Attachment E Sections IV.C.4 of the MS4 Permit.

If you have any questions, please contact me at (626) 458-4300 or ghildeb@dpw.lacounty.gov or your staff may contact Mr. Bruce Hamamoto at (626) 458-5918 or bhamamo@dpw.lacounty.gov.

Very truly yours,

GAIL FARBER
Director of Public Works

GARY HILDEBRAND
Assistant Deputy Director
Watershed Management Division

MR:ba
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Enc.

cc: City of Los Angeles
City of Culver City

Marina del Rey
Enhanced Watershed Management Program
Work Plan

Prepared For:

Marina del Rey Enhanced Watershed Management Agencies

County of Los Angeles
Los Angeles County Flood Control District
City of Los Angeles
City of Culver City

June 28, 2014

Marina del Rey Enhanced Watershed Management Program

Work Plan

Prepared For:

Marina del Rey Enhanced Watershed Management Agencies

County of Los Angeles
Los Angeles County Flood Control District
City of Los Angeles
City of Culver City

Prepared By:

Weston Solutions, Inc.
5817 Dryden Place, Suite 101
Carlsbad, California 92008

June 28, 2014

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LIST OF ACRONYMS

AVS	acid volatile sulfide
BMP	best management practice
BSS	City of Los Angeles Bureau of Street Services
Caltrans	California Department of Transportation
CCC	criterion continuous concentration
CEM	cost effectiveness metric
CEQA	California Environmental Quality Act
CIMP	Coordinated Integrated Monitoring Program
CM	control measure
CMP	Coordinated Monitoring Plan
CMC	criterion maximum concentration
CNG	compressed natural gas
County	County of Los Angeles
CTR	California Toxics Rule
CWA	Clean Water Act
CWP	Center of Watershed Protection
DDT	dichlorodiphenyltrichloroethane
EF	Effectiveness Factor
EMC	event mean concentration
ER	efficiency ratio
ER-L	effects range low
EWMP	Enhanced Watershed Management Program
FCG	fish contaminant goal
GIS	Geographic Information System
GPM	gallons per minute
HRU	Hydrologic Response Unit
IC/ID	illegal connection/illicit discharge
IP	Implementation Plan
LACDBH	Los Angeles County Department of Beaches and Harbors
LACFCD	Los Angeles County Flood Control District
LADPW	Los Angeles County Department of Public Works
LARWQCB	Los Angeles Regional Water Quality Control Board
LCC	life cycle cost
LFD	low flow diversion
LID	Low Impact Development
LPG	liquefied petroleum gas
LSPC	Loading Simulation Program in C++
MCM	Minimum Control Measure
MDL	method detection limit
MdR	Marina del Rey
MdRH	Marina del Rey Harbor
MPN	most probable number
MS4	Municipal Separate Storm Sewer System
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPRP	National Pollutant Removal Performance
NPSS	non-point source study
NPV	net present value
O&M	operations and maintenance

OEHHA	Office of Environmental Healy Hazard Assessment
p,p'-DDE	p,p'-dichlorodiphenyldichloroethylene
PCB	polychlorinated biphenyl
PIPP	Public Information and Participation Programs
PVS	Palos Verdes Shelf
RAA	Reasonable Assurance Analysis
RMD	Los Angeles County Road Maintenance Division
RV	recreational vehicle
RWL	Receiving Water Limitation
SEM	simultaneously extracted metals
SMBRC	Santa Monica Bay Restoration Commission
SOL	Summation of Loads
SPS	Site Priority Score
SUSMP	Standard Urban Stormwater Mitigation Plan
TAC	Technical Advisory Committee
TMDL	Total Maximum Daily Load
TSO	Time Schedule Order
TSS	total suspended solids
UV	ultraviolet
Weston	Weston Solutions, Inc.
WLA	waste load allocation
WMA	Watershed Management Area
WMMS	Watershed Management Modeling System
WQBEL	water quality based effluent limitations

1.0 INTRODUCTION

The Marina del Rey (MdR) watershed is a small sub-watershed located in the larger, Santa Monica Bay watershed. The Marina del Rey Harbor (MdRH) was officially opened in 1965 and is the world's largest man-made small craft harbor. The tributary area served by an MS4 that drains to MdRH is approximately 1,409 acres and consists of portions of the cities of Culver City, Los Angeles, as well as portions of the unincorporated County of Los Angeles (County). The MdR Watershed Management Area (WMA) is one of the smallest WMAs in the County of Los Angeles, but it is also one of the most important and active watersheds.

The MdR watershed has the one of the most aggressive Total Maximum Daily Load (TMDL) schedules for both Toxics and Bacteria and often leads the way in TMDL implementation for the rest of the County.

The extensive ongoing efforts of the County, Los Angeles County Flood Control District (LACFCD), and the cities of Culver City and Los Angeles to improve water quality in the MdR watershed include conducting activities and implementing best management practices (BMPs) to help reduce pollutants from stormwater runoff from the watershed to the harbor. Over the past 10 years, the responsible agencies in the MdR watershed have spent tens of millions of dollars in special studies, low-flow diversions, non-structural BMPs, structural BMPs, and monitoring efforts.

The water quality in the harbor has significantly improved due to the cooperative efforts of the the County, the LACFCD, and the cities of Culver City and Los Angeles (collectively known as the MdR Enhanced Watershed Management Program [EWMP] agencies). The MdR EWMP agencies look forward to working with interested stakeholders and the Regional Board to further improve water quality in the watershed.

1.1 Enhanced Watershed Management Plan Overview

On December 28, 2012, the Los Angeles Regional Water Quality Control Board (LARWQCB) adopted the National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System Permit (MS4 Permit). This new MS4 Permit establishes the waste discharge requirement for stormwater and non-stormwater discharges within the watersheds of Los Angeles County. The MS4 Permit includes provisions that allow Permittees to voluntarily choose to implement an Enhanced Watershed Management Program (EWMP).

The EWMP for the Marina del Rey (MdR) watershed is a collaborative effort of the EWMP agencies, comprised of the County of Los Angeles (County), Los Angeles County Flood Control District (LACFCD), and the cities of Los Angeles and Culver City. Development of the MdR EWMP in accordance with the MS4 Permit includes incorporating the following steps into the work plan:

1. Identification of water quality priorities, including evaluation of existing water quality conditions, classification of pollutants, assessment of known and suspected pollutant sources in the watershed and prioritization of water quality issues in the watershed.
2. Characterization of existing and potential control measures within the watershed

3. Addressing the approach to incorporate reasonable assurance analysis (RAA) in the optimization of MdR watershed control measures.

For the purposes of the MdR EWMP, the MdR watershed management area (WMA) is approximately 1,409 acres and consists of portions of the cities of Culver City and Los Angeles, as well as unincorporated County areas. The MdR EWMP will cover the areas owned by the MS4 Permittees within the watershed (Figure 1). The WMA does not include the area adjacent to the Ballona Wetlands because the area is owned by the State of California (State) and does not include the California Department of Transportation (Caltrans) right-of-way areas because these agencies are not members of the MdR EWMP Agencies. The WMA also does not include the water areas within the MdR watershed because they are considered non-point sources and are not covered by the MS4 Permit.

Figure 1. Marina del Rey Watershed Jurisdictional Boundaries

1.2 MdR Watershed Land Use and Drainage Characteristics

The MdR watershed is bordered by the Santa Monica Bay Watershed to the west and the Ballona Creek Watershed to the north and east. The MdR harbor is open to the Santa Monica Bay through the main channel and shares a common breakwater with Ballona Creek. The MdR watershed consists of four subwatersheds, referred to as Subwatersheds 1 to 4 (Figure 1). Table 2 summarizes the MdR watershed acreage by subwatershed.

The MdRH is an active harbor for pleasure craft, consisting of the main channel and eight basins (A to H). Basins A, B, C, G, and H are known as the Front Basins. Basins D, E, and F are known as the Back Basins and are located in Subwatershed 1. The MdR watershed also includes the Venice Canals and the tributary area to the Ballona Lagoons, which discharge to the MdRH, near the exit to the Santa Monica Bay (Subwatershed 2). The Caltrans right of way areas which are located mainly within the City of Los Angeles in Subwatersheds 1 and 4, and the portions of the Ballona Wetland (49.3 acres) located on State land in Subwatershed 1 are outside the boundaries of the MdR EWMP MS4 Permit area.

Figure 2. MdR Land Use and Subwatersheds

Table 1. Summary of Marina del Rey Subwatershed Acreage

Agency	EWMP MS4 Permittee	Sub-watershed 1 (Acres)	Sub-watershed 2 (Acres)	Sub-watershed 3 (Acres)	Sub-watershed 4 (Acres)	EWMP Watershed (Acres)	% EWMP Watershed Area
City of Los Angeles	Yes	32.9	278.1	70.5	589.8	971.3	69%
County of Los Angeles	Yes	336.2	46.8	0.0	12.7	395.7	28%
City of Culver City	Yes	0.0	0.0	0.0	42.2	42.2	3%
Los Angeles County Flood Control District	Yes	N/A	N/A	N/A	N/A	N/A	N/A
Area of EWMP Agencies		**369.1**	**324.9**	**70.5**	**644.7**	**1409**	**100%**
Caltrans	No	5.4	0.0	0.0	26.4	31.8	NA
State of California (Ballona Wetland)	No	49.3	0.0	0.0	0.0	49.3	NA
MdRH Watershed Area		**423.8**	**324.9**	**70.5**	**671.1**	**1490**	-

The following land uses are found in the MdR watershed:

- The MdRH land area in Subwatershed 1 (369.1 acres) is almost entirely composed of unincorporated County land and has many small drains that discharge into all the basins. The MdR Small Drain Survey, completed for the Los Angeles County Department of Beaches and Harbors (LACDBH, 2004), identified approximately 724 small outfalls that discharge directly into MdRH, the majority of which serve the individual parcels and small roads among the basins. The remaining drains are located in the streets surrounding the basins. The City of Los Angeles, Caltrans, and the City of Culver City are not responsible for any outlets that drain directly to the harbor. The LACFCD owns 20 storm drain outlets and two storm drain inlets that flow into the Oxford Basin. No MS4 Permittee was assigned responsibility for four storm drain outlets. LACDBH is responsible for approximately 700 storm drain outlets associated with leased parcel sites.
- Subwatershed 2 (approximately 324.9 acres) does not drain into the MdRH Front or Back Basins but drains into the Venice Canal and the Ballona Lagoon, which discharge into the MdRH main channel mouth.
- Boone Olive Pump Plant serves Subwatershed 3, a tributary area of 70.5 acres that lies entirely within the boundaries of the City of Los Angeles. The pump station discharges into Basin E.
- Subwatershed 4 lies mainly within the jurisdiction of the City of Los Angeles and the City of Culver City and totals approximately 644.7 acres (excluding Caltrans areas). Its corresponding runoff discharges into the Oxford Basin, a stormwater retention basin occupying approximately 10 acres within the County. Situated north of the Back Basins, Oxford Basin is operated by the LACFCD. It drains into Basin E through two tide gates and storm drain piping.

Table 2 presents the land use acreages by subwatershed and
Table 3 shows the land use acreages by jurisdiction.

Table 2. Land Use Acreages by Subwatershed (Acres)

Land Use Class	Subwatershed Acreage*				Total
	1	2	3	4	
Single Family Residential	1.8	45.8	22.9	167.2	237.7
Multi-Family Residential	137.1	131.8	21.1	96.3	386.3
Institutional/Public Facilities	8.0	10.1	2.6	67.2	87.9
Commercial and Services	120.0	22.8	1.6	124.2	268.6
Industrial/Mixed with Industrial	0.2	0.2	0.3	27	27.7
Transportation/Road ROW	38.2	83.3	22.0	153.8	297.3
Developed Recreation/Marina Parking	41.6	0.7	0	1.9	44.2
Beach	8.2	0	0	0	8.2
Water**	6.4	30.3	0	7.1	43.8
Vacant	7.6	0	0	0	7.6
Total	369.1	325	70.5	644.7	1409

*Acreage excludes Caltrans and State owned land (Ballona Wetland) not in EWMP Area

**Marina Boat Area and MdRH Water not included in "Water" class acreage provided here. Water class includes Ballona Lagoon (14.4 ac), Venice Canals (15.9), Oxford Basin (7.1 ac), and Ballona Shoreline and other water (6.4 ac)

Table 3. Land Use Acreages by EWMP Agency Jurisdiction

Land Use Class	EWMP Agencies Jurisdictional Areas (Acres)*			
	City of Culver City	City of Los Angeles	County of Los Angeles	Total
Single Family Residential	6.8	230.6	0.3	237.7
Multi-Family Residential	0	229.4	156.9	386.3
Institutional/Public Facilities	0	83.7	4.2	87.9
Commercial and Services	24.3	122.3	122.0	268.6
Industrial/Mixed with Industrial	0	27.7		27.7
Transportation/Road ROW	11.1	246.4	39.8	297.3
Developed Recreation/Marina Parking	0	0.9	43.3	44.2
Beach	0	0	8.2	8.2
Water**	0	30.3	13.5	43.8
Vacant	0	0	7.6	7.6
Total	42.2	971.3	395.7	1409

*Acreage excludes Caltrans and State-owned land (Ballona Wetland) not in EWMP Area.

**Marina Boat Area and MdRH Water not included in "Water" class acreage provided here. Water class includes Ballona Lagoon (14.4 ac), Venice Canals (15.9), Oxford Basin (7.1 ac), and Ballona Shoreline and other water (6.4 ac)

2.0 REGULATORY BACKGROUND

2.1 Section 303(d) List 2010

The federal Clean Water Act (CWA), Section §303(d), requires states to identify waters that do not meet applicable water quality standards despite the treatment of point sources by the minimum required levels of pollution control technology. States are required not only to identify these "water quality limited segments" but also to prioritize such waters for the purpose of developing Total Maximum Daily Loads (TMDLs). A TMDL is defined as the "sum of the individual waste load allocations (WLAs) for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2), such that the capacity of the waterbody to assimilate constituent loads (the loading capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (USEPA, 2000).

The §303(d) list was last updated in 2010 and identified a number of constituents for the MdRH Back Basins and harbor Beach (Table 4).

Table 4. Summary of Section 303(d) Listings

Water Body	Constituent	Final Listing Decision
Marina del Rey Harbor - Back Basins	Chlordane (tissue and sediment)	List on §303(d) list (being addressed by USEPA-approved TMDL)
	Copper (sediment)	List on §303(d) list (being addressed by USEPA-approved TMDL)
	DDT* (tissue)	Do Not Delist from §303(d) list (TMDL required list)
	Dieldrin* (tissue)	Do Not Delist from §303(d) list (TMDL required list)
	Fish Consumption Advisory	List on §303(d) list (being addressed by USEPA-approved TMDL)
	Indicator Bacteria	List on §303(d) list (being addressed by USEPA-approved TMDL)
	Lead (sediment)	List on §303(d) list (being addressed by USEPA-approved TMDL)
	PCBs (tissue and sediment)	List on §303(d) list (being addressed by USEPA-approved TMDL)
	Sediment toxicity	Do Not Delist from §303(d) list (being addressed with USEPA-approved TMDL)
	Zinc (sediment)	List on §303(d) list (being addressed by USEPA-approved TMDL)
Marina del Rey Harbor Mother's Beach	Indicator Bacteria	List on §303(d) list (being addressed by USEPA-approved TMDL)

*USEPA-approved TMDL has made a finding of non-impairment for this constituent.

2.2 Existing TMDLs Summary

The Marina del Rey watershed is subject to three TMDLs; the Santa Monica Bay Nearshore Debris TMDL (Debris TMDL), the Marina del Rey Harbor Mother's Beach and Back Basin Bacteria TMDL (Bacteria TMDL), and the Toxic Pollutants in Marina del Rey Harbor (MdRH) TMDL (Toxics TMDL). Each of these TMDLs is briefly summarized below. The Toxics TMDL supersedes the EPA established Santa Monica Bay DDTs and PCBs TMDL. The compliance schedules for the applicable TMDLs are represented in Table 5. The Ballona Creek Wetlands TMDL for Sediment and Invasive Exotic Vegetation has been established for the neighboring Ballona Creek Wetlands, which is not included in the MdR WMA.

Table 5. TMDL Compliance Schedules

<table>
<tr><th>TMDL</th><th>Matrix</th><th>Parameters</th><th>Goal</th><th>Date</th></tr>
<tr><td rowspan="5">Marina del Rey Harbor Toxic Pollutants TMDL</td><td>Harbor Water</td><td>Dissolved Copper (from boats)</td><td>Meet LAs</td><td>3/22/2024</td></tr>
<tr><td rowspan="2">Harbor sediments (Back Basins)</td><td rowspan="4">Copper, lead, zinc, chlordane, PCBs, DDTs, p'p-DDE</td><td>Interim Sediment Allocations</td><td>3/22/2016</td></tr>
<tr><td>Final Compliance</td><td>3/22/2018</td></tr>
<tr><td rowspan="2">Harbor sediments (Front Basins)</td><td>Interim Sediment Allocations</td><td>3/22/2019</td></tr>
<tr><td>Final Compliance</td><td>3/22/2021</td></tr>
<tr><td rowspan="2">Marina del Rey Mother's Beach and Back Basins Bacteria TMDL</td><td>Harbor Water</td><td rowspan="2">Total coliform, Fecal coliform, Enterococcus</td><td>Compliance with allowable exceedance days for summer and winter dry weather</td><td>3/18/2007</td></tr>
<tr><td>Harbor Water</td><td>Compliance with allowable exceedance days for wet weather and geometric mean targets</td><td>7/15/2021</td></tr>
<tr><td rowspan="5">Santa Monica Bay Nearshore and Offshore Debris TMDL</td><td colspan="2" rowspan="5">Trash</td><td>20% reduction</td><td>3/20/2016</td></tr>
<tr><td>40% reduction</td><td>3/20/2017</td></tr>
<tr><td>60% reduction</td><td>3/20/2018</td></tr>
<tr><td>80% reduction</td><td>3/20/2019</td></tr>
<tr><td>100% reduction</td><td>3/20/2020</td></tr>
</table>

2.2.1 Santa Monica Bay Nearshore Debris TMDL

The Debris TMDL was adopted by the LARWQCB on November 4, 2010 (Resolution No. R10-010 and became effective upon adoption by the U.S. Environmental Protection Agency (USEPA) on March 20, 2012. Responsible agencies identified for the Debris TMDL include, among others, the County, the City of Culver City, and the City of Los Angeles. The Debris TMDL established numeric targets and waste load allocations of zero discharge of trash and plastic pellets to waterbodies within the Santa Monica Bay WMA, which includes MdRH. The trash WLA applicable to the MS4 permittees shall be complied with through the Ballona Creek Trash TMDL (Resolution No. R08-007).

2.2.2 Bacteria TMDL

The Bacteria TMDL was originally adopted by the LARWCQB on August 7, 2003 (Resolution No. 2003-012) and became effective on March 18, 2004 upon approval by the USEPA. The Bacteria TMDL was revised by the LARWQCB on June 7, 2012 (Resolution No. R12-007). The responsible agencies identified for the Bacteria TMDL include the County, LACFCD, City of Los Angeles, the City of Culver City, and CalTrans.

The Bacteria TMDL established numeric bacterial compliance targets based on the acceptable health risk for marine recreational waters as defined by the USEPA. The numeric targets are expressed as both single sample limits and rolling 30-day geometric means (Table 6).

Table 6. Bacteria TMDL Numeric Targets

Indicator	Rolling 30-Day Geometric Mean Limit	Single Sample Limit
Total coliform	1,000 MPN/100 mL	1,000 MPN/100 ml if fecal > 10% of total, or 10,000 MPN/100 mL**
Fecal coliform	200 MPN/100 mL	400 MPN/100 mL
Enterococcus	35 MPN/100 mL	104 MPN/100 mL

*The geometric mean is calculated weekly as a rolling geometric mean using 5 or more samples, for 6 week periods starting all calculation weeks on Sunday.
** Total coliform single sample limit of 10,000 most probable number (MPN) decreases to 1,000 when the fecal coliform value is greater than 10% of total coliform value.

The TMDL WLAs are expressed as allowable exceedance days, or the number of days on which sampling results can surpass the numeric targets and WLAs. The geometric mean targets may not be exceeded at any time. For the single sample targets, allowable exceedance days are specified by three defined seasons (summer dry, winter dry, and wet weather) and vary by monitoring site. Each season has its own compliance dates, requirements, and limits, as presented on Table 7.

Table 7. Bacteria TMDL Seasons

Compliance Season	Compliance Season Dates	Allowable Exceedance Days/Year	Compliance Deadline
Geometric Mean	Year-round	0 days/year	July 15, 2021
Summer dry	April 1–October 31	0 days/year (daily and weekly sampling)	March 18, 2007
Winter dry	November 1–March 31	9 days/year (daily sampling)	March 18, 2007
		2 days/year (weekly sampling)	
Wet weather	Rain event ≥ 0.1 inches at LAX rain gauge, and 3 days following the end of the rain event	17 days/year (daily sampling)*	July 15, 2021
		3 days/year (weekly sampling)*	

*Wet weather allowable exceedance days for MDRH-9 are 8 days/year for daily sampling and 1 day/year for week sampling.

2.2.3 Toxics TMDL Summary

The Regional Board adopted the Toxics TMDL on October 6, 2005 (Resolution No. 2005-012). The Toxics TMDL was approved by USEPA and became effective on March 22, 2006. The Toxics TMDL originally addressed certain metals and organics in the Back Basins of MdRH (Basins D, E, and F). The Toxics TMDL was amended in 2014 to include the Front Basins of MdRH (Basins A, B, C, G and H). The metals addressed by the TMDL are copper, lead, and zinc, while Chlordane, total polychlorinated biphenyls (PCBs), p,p’-dichlorodiphenyldichloroethylene (p,p’-DDE) and total dichlorodiphenyltrichloroethanes (DDTs) are the targeted organic constituents. The responsible agencies identified for the Toxics TMDL include the County, LACFCD, City of Los Angeles, City of Culver City, and Caltrans. The Toxics TMDL compliance schedule is included in Table 5.

2.2.3.1 Sediment Numeric Targets

The Toxics TMDL established sediment numeric targets using the effects range low (ER-L) (Long et al., 1995) guidelines for copper, lead, zinc, chlordane, total DDTs, and p,p'-DDE. The sediment numeric target for total PCBs in sediments was selected to protect human health from consumption of contaminated fish (Table 8).

Table 8. Toxics TMDL Sediment Numeric Targets

Constituent	Numeric Target for Sediment
Chlordane	0.5 µg/kg
Total PCBs	3.2 µg/kg
Total DDTs	1.58 µg/kg
p-p'-DDE	2.2 µg/kg
Copper	34 mg/kg
Lead	46.7 mg/kg
Zinc	150 mg/kg

2.2.3.2 Water Column Numeric Targets

The Toxics TMDL established a final numeric target for PCBs in the water column using the California Toxics Rule (CTR) criterion for the protection of human health from the consumption of aquatic organisms. A numeric target for dissolved copper in the water column was also established based on the CTR Criterion Maximum Concentration (CMC) and Criterion Continuous Concentration (CCC) (Table 9).

Table 9. Toxics TMDL Water Column Numeric Targets

TMDL Phase	Numeric Target (µg/L)
Total PCBs	0.00017*
Dissolved copper	Acute – 4.8/Chronic – 3.1

*Receiving water quality samples shall be collected monthly and analyzed for total PCBs at detection limits that are at or below the minimum levels. The minimum levels are those published by the State Water Resources Control Board in Appendix 4 of the Policy for the Implementation of Toxic Standards for Inland Surface Water, Enclosed Bays, and Estuaries of California, March 2, 2000. Special emphasis should be placed on achieving detection limits that will allow evaluation relative to the CTR standards.

2.2.3.3 Fish Tissue Numeric Targets

The Toxics TMDL fish tissue numeric target of 3.6 µg/kg for total PCBs is the Office of Environmental Health Hazard Assessment (OEHHA) Fish Contaminant Goal (FCG).

2.2.3.4 Sediment Waste Load Allocations

Loading capacity was estimated based on annual average total suspended solids (TSS) loads into MdRH under the assumption that the finer sediments transport the majority of constituents. The Toxics TMDL for sediment was calculated based on the estimated loading capacity and the numeric sediments targets (Table 10). The sediment load allocation is the same as the numeric target.

Table 10. Toxics TMDL Numeric Targets and Loading Capacity

Metals	Numeric Target (Load Allocation) ERL(mg/kg)	TMDL Loading Capacity(kg/year)
Copper	34	2.88
Lead	46.7	3.95
Zinc	150	12.69
Organics	**ERL (µg/kg)**	**Proposed TMDL (g/year)**
Chlordane	0.5	0.04
PCBs	22.7	1.92
Total DDTs	1.58	0.13
p-p'-DDE	2.2	0.19

2.2.3.5 Water Column Load Allocations

The load allocation for dissolved copper from boats is a reduction of 85% from the baseline copper load from boats of 3,609 kg/year.

2.2.3.6 Stormwater Waste Load Allocations

WLAs for stormwater are also included in the Toxics TMDL for each of the Permittees (Table 11).

Table 11. Toxics TMDL Stormwater Waste Load Allocations

Permittees	Copper (kg/year)	Lead (kg/year)	Zinc (kg/year)	Chlordane (g/year)	Total PCBs (g/year)	Total DDT (g/year)	p'p-DDE (g/year)
MS4	2.26	3.10	9.96	0.0332	1.51	0.10	0.15
Caltrans	0.036	0.05	0.16	0.0005	0.024	0.0017	0.0024
General construction	0.23	0.32	1.02	0.0034	0.16	0.011	0.015
General industrial	0.012	0.016	0.053	0.0002	0.008	0.0006	0.0008
Total	**2.54**	**3.49**	**11.2**	**0.04**	**1.70**	**0.12**	**0.16**

3.0 DATA EVALUATION AND WATER QUALITY PRIORITIZATION

3.1 Approach to Data Compilation and Analysis

In accordance with the MS4 Permit, existing water quality conditions were characterized using data from relevant studies and monitoring completed within the past 10 years. Table 12 provides a summary of the data and studies used in the evaluation.

Table 12. Summary of Data and Studies Used in the Evaluation

Report	Parameters	Stormwater / MS4	Harbor Water	Sediment	Sediment Cores	Fish Tissue
Toxics TMDL Monitoring (2010-2013)	Organics	x	-	x	-	x
	Metals	x	x	x	-	-
	Conventional	x	-	x	-	-
	Toxicity	-	-	x	-	-
Storm Borne Sediment Monitoring (2011)	Organics	x	-	-	-	-
	Metals	x	-	-	-	-
	Conventional	x	-	-	-	-
Special Study – Low Detection Limits (2011)	Organics	x	-	x	-	-
Special Study - Partitioning Coefficient (2011)	Organics	x	-	x	-	-
	Metals	x	x	x	-	-
	Conventional	x	x	x	-	-
MdRH Annual Reports (2002-2007)	Organics	-	-	x	-	-
	Metals	-	-	x	-	-
	Conventional	-	x	-	-	-
	Bacteria	-	x	-	-	-
MdRH Sediment Characterization Study (2008)	Organics	-	-	x	x	-
	Metals	-	-	x	x	-
	Conventional	-	x	x	-	-
	Toxicity	-	-	x	-	-
Oxford Basin Study (2010)	Organics	-	x	x	x	-
	Metals	-	x	x	x	-
	Conventional	-	x	x	x	-
	Bacteria	-	x	x	-	-
Bight '03 (2003)	Organics	-	-	x	-	-
	Metals	-	-	x	-	-
	Conventional	-	-	x	-	-
	Toxicity	-	-	x	-	-
Bight '08 (2008)	Organics	-	-	x	-	-
	Metals	-	-	x	-	-
	Conventional	-	-	x	-	-
	Toxicity	-	-	x	-	-
Section 2.2.9– Bacteria TMDL Monitoring (2007-2013)	Bacteria	-	x	-	-	-
Nonpoint Source Bacteria Study (2006)	Bacteria	x	x	x	-	-

3.2 Summary of Findings by Matrix

3.2.1 Stormwater

Stormwater monitoring was conducted as part of the Toxics TMDL coordinated monitoring plan at five stations (Figure 3).

A total of 23 storms were monitored in accordance with the Toxics TMDL Coordinated Monitoring Plan (CMP) during the 3-year period (2010 to 2013). Two special studies and one pilot study were also conducted: the Partitioning Coefficient Special Study, the Low Detection Limit (LDL) Special Study, and the storm borne sediment pilot study. Because the Toxics TMDL targets for stormwater are sediment based, it is not feasible to make an assessment of water quality exceedances based on water column data. For this report, the data were compared to the CTR water column criteria to provide a general sense of the water quality conditions in the stormwater to help guide the prioritization of water quality issues. Key findings include:

- Dissolved copper and dissolved zinc frequently exceeded the CTR CMC in Toxics TMDL monitoring, whereas dissolved lead rarely exceeded the CTR CMC (one sample exceeded at CTR CMC at MdR-C-2 on 3/8/2013).
- Partitioning Coefficient Study results for copper in stormwater showed that concentrations were above background levels and may be contributing to copper in the MdRH.
- Chlordane was not detected in any of the Toxics TMDL monitoring samples above the Method Detection Limit (MDL). The MDLs were below the CTR CMC for acute toxicity for freshwater (2.4 μg/L). Low Detection Limit Special Study results for chlordane in stormwater achieved lower MDLs. The low MDL results confirmed that chlordane levels were below the applicable criterion.
- Total PCBs were not detected above the MDL for the first two monitoring years of Toxics TMDL monitoring, and at only two events at all stations during the third year. The field trip blank also had total PCB results above the MDL for each of those events.
- Low Detection Limit Special Study results for total PCBs achieved lower MDLs. The results showed that all samples exceeded the harbor water numeric target of 0.00017 μg/L by a factor of at least 12.

Figure 3. TMDL Monitoring Locations

3.2.2 Harbor Water

Water quality samples have been collected in MdRH for more than 25 years as part of the Annual Report Monitoring for MdRH (ABC 2001 to 2008). Samples were analyzed for indicator bacteria and physical parameters (e.g., temperature, salinity, dissolved oxygen). Monitoring under the Bacteria TMDL began in 2007, with more frequent sampling and observational data collection. In addition, a bacteria non-point source special study was conducted in 2006. In 2010, copper, lead, zinc, total PCBs, and chlordane were added to the list of constituents and monitored monthly as part of the Toxics TMDL CMP.

Dissolved copper concentrations in the water column exceeded the Toxics TMDL numeric target (4.8 µg/L) at all stations during all years, with the exception of MdRH-F-4 and MdRH-F-5 in 2011. Concentrations were comparable within the Front and Back Basins, particularly between stations MdRH-B-1, MdRH-B-2, MdRH-F-1, and MdRH-F-2 (Basin D, Basin E, Basin A, and Basin B, respectively). The Partitioning Coefficient Special Study collected samples at the same stations as the Toxics TMDL monitoring at surface, mid-depth, and at-depth. The results showed that copper concentrations were higher near the surface and lowest at the deepest sample depths.

There were no exceedances of the Toxics TMDL water column PCB numeric target for the Toxics TMDL monitoring. However, as part of the LDL Special Study, lower MDLs were achieved and it was determined that all samples collected as part of the LDL study exceeded the final Toxics TMDL numeric target of 0.00017 µg/L by at least a factor of 12. The highest concentrations were observed in Basin F.

Chlordane results exceeded the saltwater CTR CMC for one sample, MdRH-B-1 in October 2011. Chlordane was also analyzed as part of the LDL Special Study, and lower MDLs were achieved (0.028 ng/L). Only one result was above the CTR for Human Health; however, the trip blank associated with the sample also had a detection greater than the CTR for Human Health. These results are therefore qualified due to the results of the field blank analysis.

Bacteria TMDL monitoring began in 2007 with monitoring of nine compliance stations and five ambient stations. In 2009 monitoring at the ambient stations was discontinued. The Bacteria TMDL requires daily or weekly monitoring at the nine compliance stations within the MdRH, along with samples collected at depth at four stations. Historical bacteria data are also available from monitoring conducted prior to 2007 as part of the MdRH Annual Monitoring conducted by the LACDBH. A Non-Point Source Study was conducted in 2006 to assess potential sources of bacteria from within the MdRH. The findings of the study showed that birds were a likely source of bacteria to the MdRH.

The Bacteria TMDL is split into three seasons: summer dry, winter dry, and wet weather. Data were analyzed and presented for each season. The highest proportion of exceedance days from the Bacteria TMDL monitoring during dry weather occurred at stations MdRH-5 and MdRH-7. Historically, the greatest proportion of exceedance days during summer dry was at MdRH-5 and MdRH-6 (MdRH-7 was not monitored prior to 2007). Of interest to note is that during winter dry weather, the highest proportion of exceedance days occurs at stations MdRH-1, MdRH-2, and MdRH-3, which are different from those most often exceeding during summer dry. Monitoring is no longer conducted at MdRH-10, MdRH-11, MdRH-12, MdRH-13, or MdRH-14.

Observational data are collected as part of the Bacteria TMDL monitoring, and those data were assessed for patterns relating to the observed indicator bacteria concentrations. A slight correlation was observed between the animal and/or bird observation data and indicator bacteria results, with slightly higher concentrations of indicator bacteria occurring when the number of birds and/or animals observed was higher.

3.2.3 Sediment

Annual chemistry sediment monitoring has been conducted by the LACDBH for more than 25 years at 20 monitoring stations within the MdRH. In addition to the annual monitoring program, which ended in 2007, Bight '03, Bight '08, the Oxford Basin Special Study (2010), the MdRH Sediment Characterization Study (2008), the Toxics TMDL Monitoring (2010-present) and two special studies have been conducted.

In addition to the chemistry monitoring that has been conducted, toxicity and benthic infauna monitoring have also been conducted as part of Bight '03, Bight '08, the MdRH Sediment Characterization Study (2008), and Toxics TMDL Monitoring (2010 to present). It is important to assess the chemistry along with the toxicity and biological data to gain a broader understanding of the impacts of chemistry results in the environment. During Bight '08, acid-volatile sulfide (AVS) and simultaneously extracted metals (SEM) analyses was conducted, as well as analysis of total organic carbon. These additional chemistry parameters allowed an assessment of the bioavailability of metals in the samples.

The Bight '08 monitoring results included AVS:SEM analyses. The bioavailability analysis of the results showed that although these divalent metals occur at high concentrations within the MdRH, they are not likely bioavailable due to the high levels of sulfides and carbon also present in the sediments.

Toxicity results for the Bight '08 support the AVS:SEM analyses, which indicated non-toxic levels at three of the five stations, low toxicity at one of the five stations, and moderate toxicity at one station. The Toxics TMDL monitoring toxicity results were also low for *E. estuarius* and *M. galloprovincialis;* however, *L. plumulosus* chronic testing showed toxicity to the sediments. The causes of the toxicity are not clear, although they do not appear to be due to metals.

Metals concentrations within the MdRH are higher in the basins and main channel adjacent to the basins. The spatial pattern of these analytes is presented in Figure 4 through Figure 6. All available data are presented in the figures. The maps are intended to provide a visual presentation of the results, and should not be used for predictive purposes.

Copper concentrations in MdRH are highest in the Back Basins (Basin D, E, and F) along the back of Basin G and in the middle portion of Basin B (Figure 4).

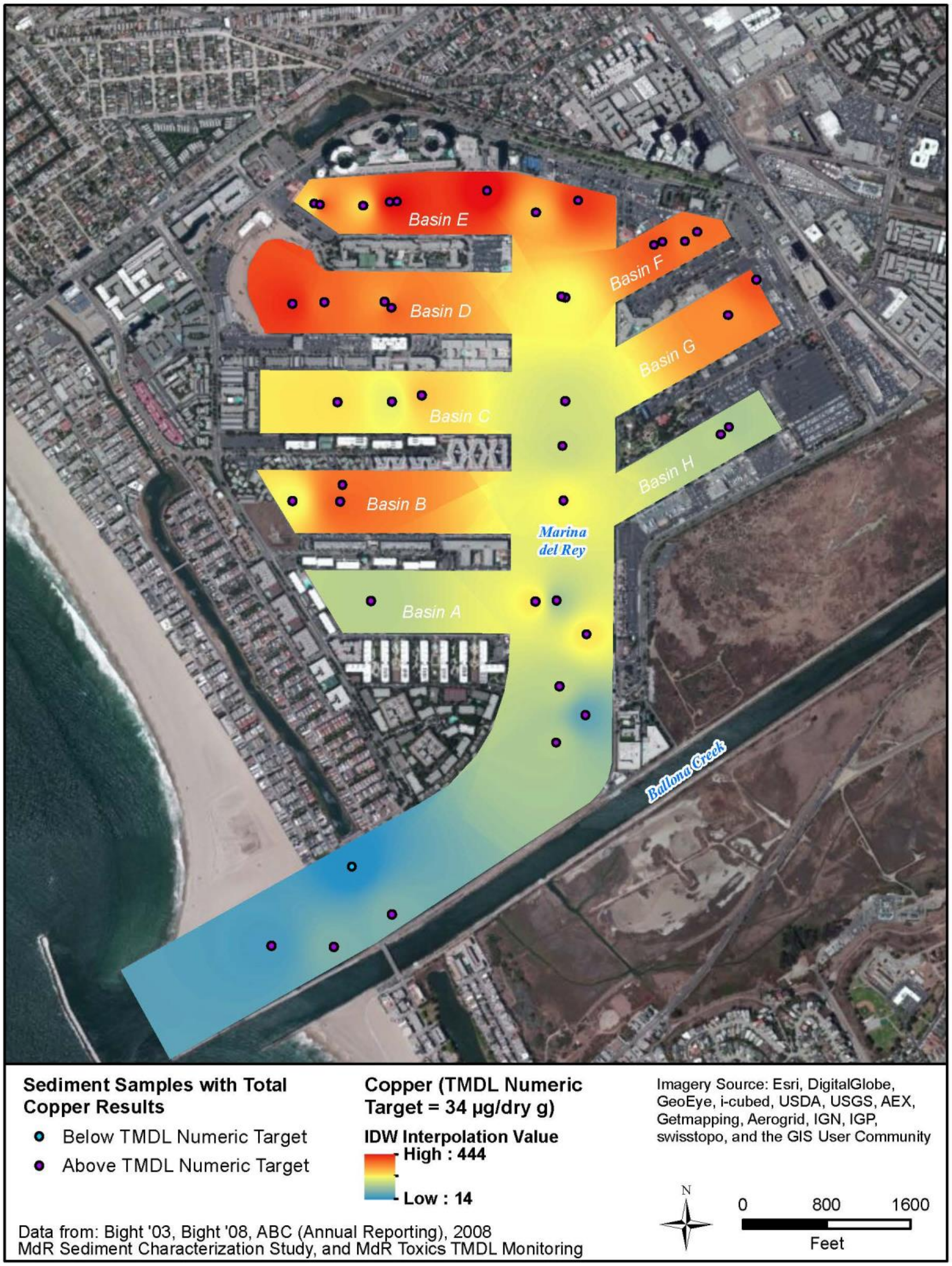


Figure 4. Marina del Rey Harbor Sediment Copper Concentrations, 2002 to 2013

Lead concentrations are highest in Basin B, the main channel toward the harbor entrance, and in some samples collected near the entrance to the MdRH (Figure 5).

Figure 5. Marina del Rey Harbor Sediment Lead Concentrations, 2002 to 2013

Zinc concentrations followed a similar spatial pattern when compared to the copper concentrations, with the highest concentrations in Basin E, the back of Basin D, and Basin B (Figure 6).

Figure 6. Marina del Rey Harbor Sediment Zinc Concentrations, 2002 to 2013

Total PCBs (Aroclors and congeners separately), DDTs, and p,p'-DDE were also assessed for spatial patterns within the MdRH. Figure 7 and Figure 8 illustrate the concentrations. Bight monitoring data, along with the 2008 Sediment Characterization data, used a sum of PCB congeners to calculate total PCBs. The Toxics TMDL monitoring uses a sum of Aroclors to calculate total PCBs. These two methods are not directly comparable; in fact, the total PCB results can be quite different. Therefore, the results are presented on two separate maps (Figure 7 and Figure 8). The concentrations of Aroclor total PCBs were highest in Basin C and Basin E; however, samples exceeded the TMDL numeric target throughout the MdRH.

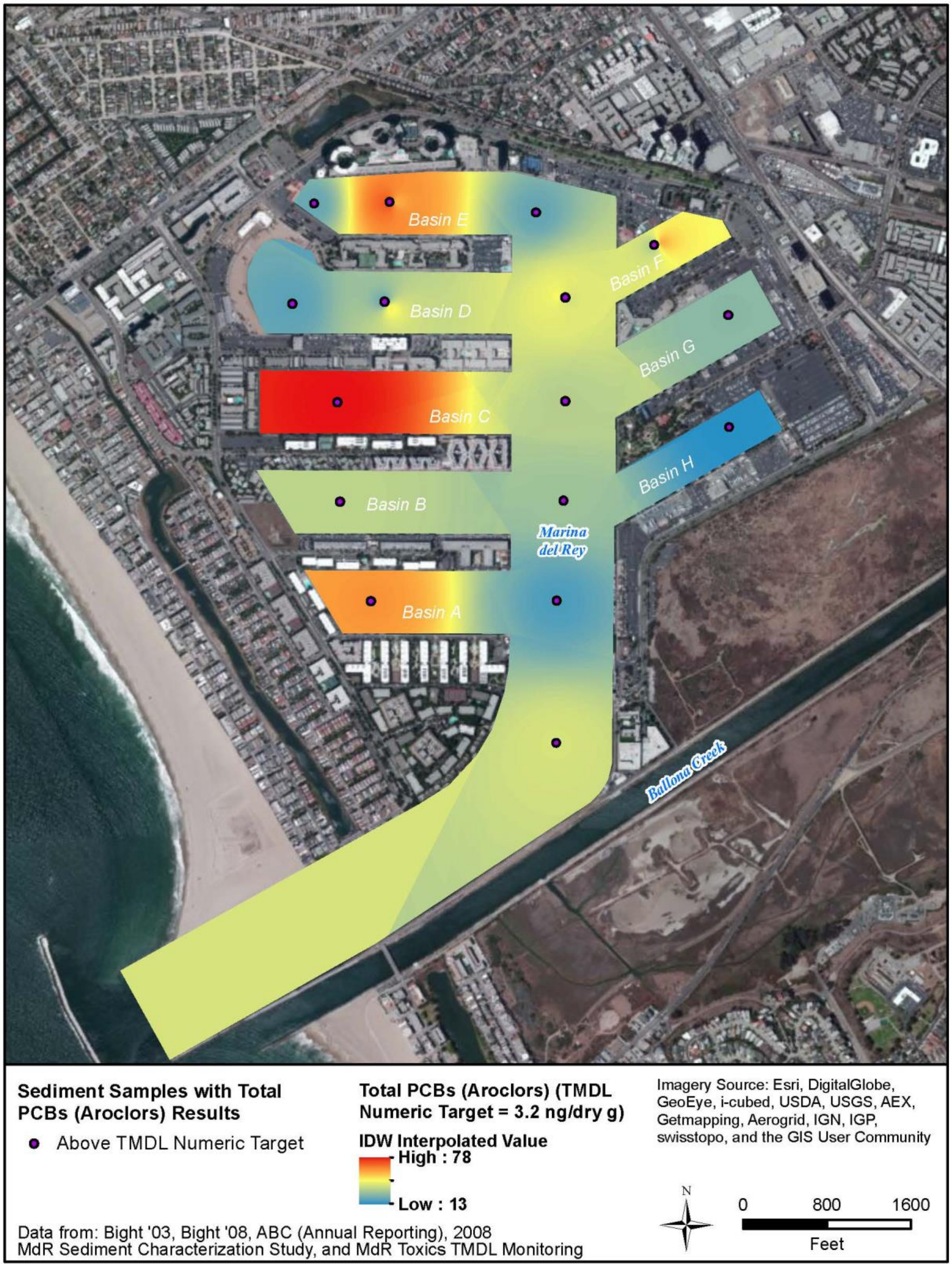


Figure 7. Marina del Rey Harbor Sediment Total PCB (Aroclor) Concentrations, 2002 to 2013

Congener total PCB concentrations were highest in the main channel between Basins D and F, in Basin E, and at the back of Basin C. Some higher concentrations were also detected near the mouth of the harbor in the main channel; however, several samples near the mouth of the MdRH were below the TMDL numeric target, so the sediments are likely heterogeneous.

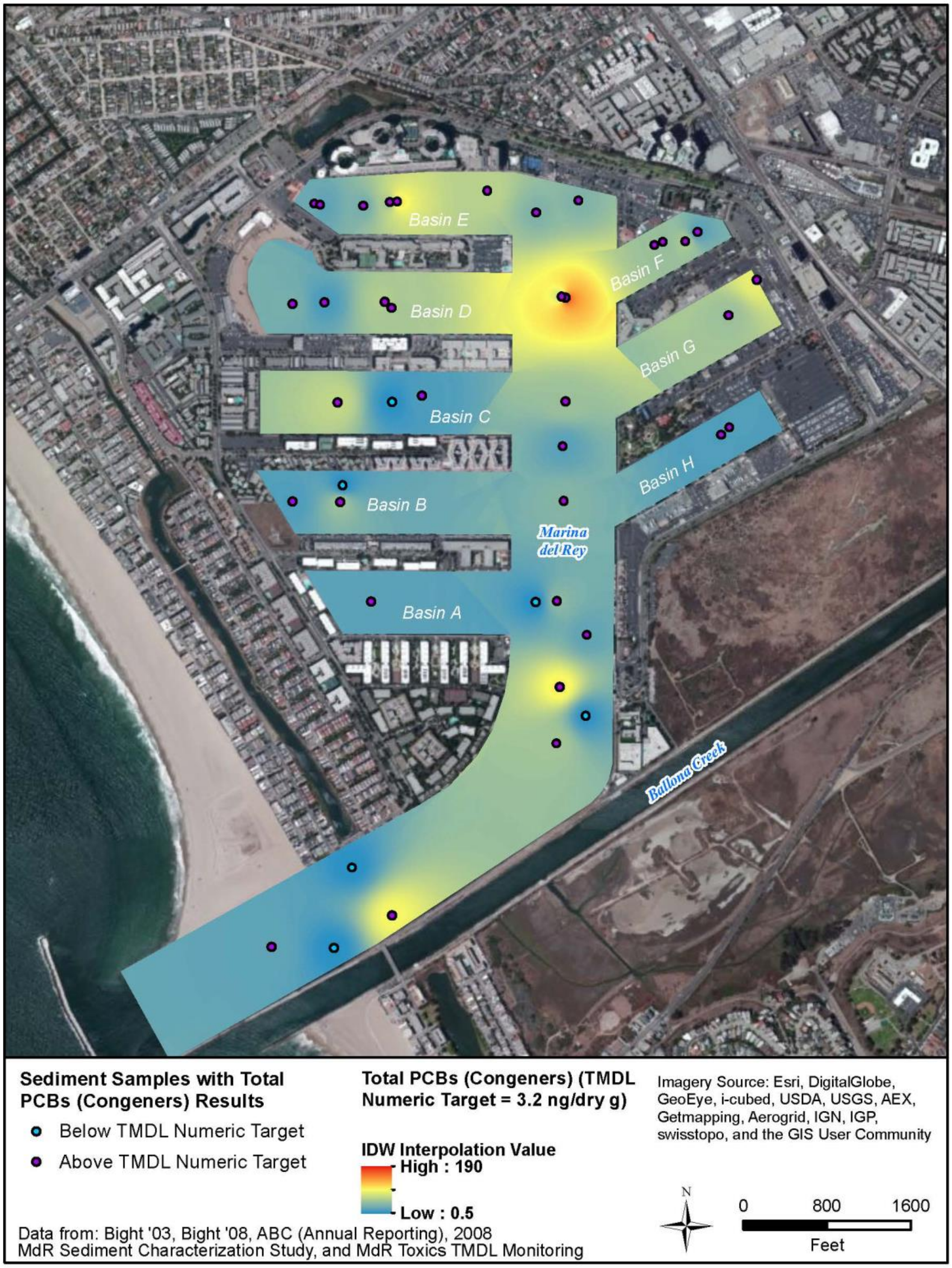


Figure 8. Marina del Rey Harbor Sediment Total PCB (Congener) Concentrations, 2002 to 2013

Total DDTs are presented in Figure 9. The highest single results were from the main channel near the mouth of the harbor and Basin E. Results were also high throughout the main channel and into Basins F and G.

Figure 9. Marina del Rey Harbor Sediment Total DDT Concentrations, 2002 to 2013

Finally, p,p'-DDE results are presented in Figure 10 and follow a pattern similar to that observed for total DDTs. The highest concentrations were in Basin E, Basin G, and near the mouth of MdRH.

Figure 10. Marina del Rey Harbor Sediment p,p'DDE Concentrations, 2002 to 2013

3.3 Summary of Findings by Constituent

Copper – Sediment and harbor water copper concentrations are highest in Basin D, Basin E, and to some extent in Basins B and C; and do not meet Toxics TMDL numeric targets. Stormwater is likely contributing to the harbor water concentrations in these locations, as well as paint with copper additives leaching from boat hulls in the MdRH water. However, preliminary AVS:SEM analyses indicate that copper may not be causing toxicity in the sediments. The MS4 waste load allocations for copper are not currently met.

Lead – Sediment concentrations of lead are highest near the mouth of the MdRH, in Basins A, and B, and to some extent, in Basin G. Sediments do not currently meet Toxics TMDL numeric targets. Stormwater runoff concentrations of dissolved lead are low, although storm borne sediment analysis of stormwater runoff shows that high levels of lead can be found associated with suspended sediments in stormwater runoff. However, the storm borne sediment analysis was only based on one event in 2011 and may not be representative of the annual load.

Zinc – The sediment concentrations of zinc follow a pattern similar to that of copper (highest concentrations in Basins D and E, and to a lesser extent in Basins B and C) and can also be found at high levels in stormwater runoff and storm borne sediment samples. However, the storm borne sediment analysis was only based on one event in 2011 and may not be representative of the annual load. Currently, the zinc concentrations in sediment do not meet Toxics TMDL numeric targets. Preliminary AVS:SEM analyses indicate that zinc is not likely causing toxicity in the sediments. The MS4 waste load allocations for zinc are not currently met.

Total PCBs – Sediment PCB concentrations are highest in the back basins, particularly Basin E and do not currently meet Toxics TMDL numeric targets. Fish tissue concentrations for total PCBs do not currently meet Toxics TMDL numeric targets. Both stormwater and harbor water samples collected as part of the Toxics TMDL CMP monitoring are below MDLs for all samples collected, but the MDLs are above the Toxics TMDL numeric target. The Low Detection Limit (LDL) study results, which achieved MDLs below the TMDL numeric targets, show that neither stormwater nor harbor water meet the Toxics TMDL numeric target. During the storm borne sediment monitoring, PCBs were also at high levels at MdR-5 (which drains into Basin E). However, the storm borne sediment analysis was only based on one event in 2011 and may not be representative of the annual load.

Total DDTs – DDTs were recently added to the TMDL; therefore monitoring as part of the Toxics TMDL has not been conducted. However, assessment of historical sediment data in the MdRH show that DDTs have been found in levels higher than the Toxics TMDL numeric target. Historic samples of DDT in Oxford Basin have also been above the Toxics TMDL numeric target.

p,p'-DDE – p,p'-DDE was recently added to the TMDL, and follows the same spatial patterns as total DDTs. The Toxics TMDL numeric targets are not currently met for p-p'DDE.

Chlordane – Sediment monitoring conducted as part of the Toxics TMDL CMP resulted in non-detected results for chlordane for all samples. However, the MDL used in the analysis is above the Toxics TMDL numeric target. Historical sediment samples collected in the MdRH such as those collected for the 2008 Sediment Study, Bight '03, and Bight '08, have found chlordane at levels above the Toxics TMDL numeric target. The highest concentrations occurred near the mouth of the MdRH. Stormwater, harbor water, and the initial special studies analyses also resulted in non-detected results for chlordane for all samples. Re-analysis of stormwater and harbor water as part of the Low Detection Limit Study resulted in low detections of chlordane. Methods for estimating total chlordane may vary between studies, and cause discrepancies in the estimation of total chlordane. Findings regarding the sources and amounts of chlordane present in the MdRH remain inconclusive.

Bacteria – Bacteria TMDL monitoring has been conducted in the MdRH since 2007 at nine locations. The TMDL has three compliance seasons, summer dry, winter dry, and wet weather. Currently, the MdRH is not consistently meeting the single sample or geometric mean sample Bacteria TMDL allowable exceedance day targets. The highest proportion of exceedance days occurs at MdRH-5 and MdRH-7 (Basin E). However, during winter dry weather the highest proportion of exceedance days occurs at MdRH-1, MdRH-2, and MdRH-3 (Basin D at Marina Beach). Historical source identification studies have pointed toward birds as the greatest contributor to bacteria concentrations in the MdRH.

4.0 WATER BODY- POLLUTANT CLASSIFICATION

In accordance with the MS4 Permit, Section VI.C.5.a, water-body pollutant combinations were classified into one of the following three categories (Table 13):

1. Category 1 (Highest Priority) – Pollutants with receiving water limitation or water-quality-based effluent limits (WQBEL) as established in Part V1.E and Attachments L through R of the MS4 Permit.

2. Category 2 (High Priority) – Pollutants in the receiving water that are listed as §303(d) and for which MS4 discharges may be causing or contributing to the impairment.

3. Category 3 (Medium Priority) – Pollutants with insufficient data to list as §303(d) but which exceed receiving water limitations contained in the MS4 Permit and for which MS4 discharges may be causing or contributing to the exceedance.

4.1 MdR WMA Pollutant Classification

Category 1 (highest priority) pollutants are defined by the MS4 Permit as those constituents that have been addressed with receiving water limitations or WQBELS established through a TMDL. The Toxics TMDL, as described in Section 2.2.3, establishes waste load allocations for chlordane, total PCBs, total DDTs, p-p'-DDE, copper, lead and zinc. In addition, the TMDL establishes numeric targets for dissolved copper and total PCBs in the water column in MdRH. As a result of the establishment of the TMDL for these constituents, they are classified in accordance with the MS4 Permit as Category 1 pollutants for MdRH (Table 13).

The Bacteria TMDL as described in Section 2.2.2 established numeric bacterial compliance targets for fecal coliform, *Enterococcus*, and total coliform in MdRH. As a result of the TMDL, these constituents are classified in accordance with the MS4 Permit as Category 1 pollutants for MdR (Table 13).

Table 13. Waterbody – Pollutant Classification

Waterbody	Pollutant	Classification
Marina del Rey Harbor	Dissolved Copper	Category 1
	Copper	Category 1
	Lead	Category 1
	Zinc	Category 1
	Total PCBs	Category 1
	Total DDTs	Category 1
	p,p'-DDE	Category 1
	Chlordane	Category 1
	Fecal coliform	Category 1
	Enterococcus	Category 1
	Total coliform	Category 1
Ballona Lagoon/ Venice Canal	None known	None

Ballona Lagoon is the only waterbody other than MdRH that falls within the MdR WMA. However, there are no available data concerning the receiving water or discharges to the receiving water. Category 2 constituents are defined in the MS4 Permit as pollutants in the receiving water that are listed as §303(d) and for which MS4 discharges may be causing or contributing to the impairment. Dieldrin is a §303(d) listed constituent for MdRH (Table 4), however the EPA made a finding of non-impairment for this constituent so it will not be considered a Category 2 pollutant.

Category 3 constituents are those pollutants with insufficient data to list as §303(d) but which exceed receiving water limitations contained in the MS4 Permit and for which MS4 discharges may be causing or contributing to the exceedance. The data evaluation did not result in any constituents being classified as a Category 3 constituent.

5.0 POLLUTANT SOURCE ASSESSMENT

A pollutant source assessment was carried out to identify potential sources of Category 1 to 3 pollutants.

5.1 Harbor-Based Sources

Likely sources of bacteria, copper, lead, zinc, total PCBs, total DDTs, p,p'-DDE, and total chlordane that have been identified within the MdRH include the following:

- **Boats**: Several studies attributed the higher metal concentrations found in the main channel and in the mouths of each Back Basin as being sourced from maritime activities. Anti-fouling, copper-based hull paint was specifically identified as a source of higher copper in the MdRH. This source is being addressed through the revised Toxics TMDL.
- **Legacy Sediments**: Several studies have characterized the unconsolidated and consolidated sediments of the harbor and found higher concentrations of metals, PCBs, chlordane, and DDT. Disturbance of these sediments could cause re-suspension in the water column and transport to other areas of the MdRH.
- **Boone Olive Pump Station**: During wet weather, this site was identified as a source of fecal indicator bacteria contributing to higher bacterial loads to Basin E.
- **Oxford Basin**: This water body was identified as a potential source of metals and bacteria in a number of studies conducted prior to the installation of dry weather diversions. Assessment within Oxford Basin in 2010 during dry and wet weather suggested that Oxford Basin was not a significant contributor of pollutants (particularly metals). Dry-weather bacteria contributions from Oxford Basin appear to have decreased with the construction of the dry-weather diversions. The Oxford Basin Low Flow Diversion (LFD) came online in January 2009 and the Washington and Thatcher LFD in December 2006. Further Best Management Practices (BMP) evaluation may be required to assess the effectiveness of the diversions. During wet weather, Oxford Basin has been found to contribute to bacteria concentrations in Basin E. Oxford Basin is currently undergoing a restoration, which will potentially improve water quality in Oxford Basin.
- **Natural Sources**: Birds have been found to be a significant source of fecal indicator bacteria to MdRH. Within the unincorporated areas of the county the impact of this natural source can be limited through structural BMPs such as bird controls, nonstructural BMPs, and bird waste management programs.

5.2 Watershed-Based Sources

Likely sources of bacteria, copper, lead, zinc, total PCBs, total DDTs, p,p'-DDE, and total chlordane from the watershed to the MdRH include the following:

- **Stormwater Runoff**: Stormwater monitoring conducted under the Toxics TMDL has shown that copper, lead, and zinc are being transported into the MdRH during storm events. Storm borne sediment monitoring has shown that chlordane and PCBs are transported by suspended sediment in stormwater. However, the storm borne sediment analysis was only based on one event in 2011 and may not be representative of the annual load.
- **Residential Contributions**: Use of certain building materials can contribute loads of copper and zinc (from structures such as roofing materials, gutters, and fencing) through urban runoff. Non-stormwater discharges such as over-irrigation and wash water can provide a transport mechanism for pollutants and provide a reservoir for bacteria growth and/or regrowth in soils and the MS4. Control of these sources may include structural solutions, such as aggressive street and parking

lot sweeping, covering and containing trash, proper recycling of yard waste, controlled/reduced pesticide and fertilizer applications, and additional nonstructural solutions, such as targeted educational and enforcement programs for irrigation and washing activities and/or facilities.

- **Commercial Contributions**: Certain commercial practices, including poorly managed restaurant wash-down and trash storage, can impact water quality. These facilities may also attract birds, and their waste may contribute to bacterial concentrations in MdRH. Management actions could include targeted trash inspection programs to correct pollutant loading activities, education to improve housekeeping and trash containment and cover activities, and bird exclusion devices.
- **Atmospheric Deposition**: Atmospheric deposition of metals has been found to be a significant source of copper (brake pads) and zinc (brake pads and tires). Improvements to loads from these sources can be achieved through true source control activities, such as the Brake Pad Partnership and product substitution and structural solutions, such as targeted aggressive street and parking lot sweeping.
- **Anthropogenic Fecal Sources**: Fecal sources can include poorly contained pet waste, bird attractants (e.g., open trash receptacles), and public restrooms. Another key anthropogenic source may be the illegal dumping of boat waste into the harbor. Solutions may include outreach regarding pet waste, RV waste and boat waste disposal, enforcement programs, trash inspection programs, targeted restaurant inspections, and containment of wash-down water used for restroom facility cleaning.

5.3 Summary of Sources per Contaminant

Multiple monitoring programs and special studies have sought to assess conditions in the MdRH. This section presents the interrelationship of the findings of these multiple studies in terms of constituents, potential sources, and potential data gaps.

A summary of the identified constituent sources from key studies is presented on Table 14.

Table 14. Key Study Findings – Attributed Sources

Study	Bacteria	Metals	Chlordane, PCBs, and DDTs
Bacteria TMDL Non-Point Source Study	Oxford Basin, birds, and some anthropogenic sources	Not tested	Not tested
MdRH Mother's Beach and Back Basins Bacteria Indicator TMDL Compliance Study	Birds and some anthropogenic sources	Not tested	Not tested
MdRH Annual Reports	Oxford Basin	Copper based boat hull paint, legacy sediments, and stormwater runoff	Boat hull paint, legacy sediments, and stormwater runoff
MdRH Sediment Characterization Study	Not tested	Boats, legacy sediments, and stormwater runoff	Boat hull paint, legacy sediments, and stormwater runoff
Oxford Basin Sediment and Water Quality	Natural levels observed	Low concentrations observed	Low concentrations observed
Bight '03	Not tested	Boats, legacy sediments	Boats, legacy sediments
Bight '08	Not tested	Boats, legacy sediments	Boats, legacy sediments
Toxics TMDL Monitoring	Not tested	Boats, legacy sediments, residential contributions, commercial contributions, and stormwater runoff	Boats, legacy sediments, and stormwater runoff
Toxics TMDL Special Studies	Not tested	Boats, legacy sediments, residential contributions, commercial contributions, and stormwater runoff	Boats, legacy sediments, and stormwater runoff

5.3.1.1 Chlordane, PCBs, and DDTs

The pesticide chlordane was widely used for food crops and lawn care until 1978 when use was limited to termite control. In 1988 chlordane use was banned in the United States. Assessment of sediment in MdRH found concentrations of chlordane to be highest in the main channel, near the mouth of the harbor.

Before DDT was banned in 1972, large DDT releases occurred during agriculture or vector control applications. Emissions could also have resulted during production, transport, and disposal. DDT was released to surface waters for vector control or as a result of dry and wet deposition from the atmosphere or direct gas transfer. DDTs can be released to the soil during spraying operations from direct or indirect releases during manufacturing, formulation, storage, or disposal. Another potential source of DDT contamination in sediment is the Palos Verdes Shelf (PVS), because contaminated sediment near an outfall can act as a source of contamination to a distant part of a water body. Fish exposed to the PVS sediments may bioaccumulate PCBs and DDTs, and when captured in the MdRH, have high levels of these pollutants although there is a potential that this exposure may not have occurred in the MdRH. DDT and its metabolites may be transported from one medium to another by the processes of solubilization, adsorption, remobilization, bioaccumulation, and volatilization. It can also be transported by currents, winds, and diffusion.

From 1947 to 1983, Montrose Chemical Corporation manufactured DDT at its plant near Torrance, CA. The plant discharged wastewater containing the now-banned pesticide into Los Angeles sewers that emptied into the Pacific Ocean off White Point on the PVS. The DDT manufacturing process also resulted in groundwater and surface soil contamination on and near the Montrose plant property. It is estimated that more than 800 to 1,000 tons of DDT were discharged between the late 1950s and the early 1970s. Several other industries also discharged PCBs into the Los Angeles sewer system that ended up on the PVS by way of outfall pipes. The PVS site is defined by the large area of DDT- and PCB-contaminated sediment on the ocean floor. The contaminated sediment deposit is thin, 2 inches to 2 feet thick, and covers several square miles. The most contaminated sediment is buried under a layer of cleaner sediment whose surface concentrations of DDT and PCB have dropped over time.

Prior to the use of copper and tributyltin as anti-fouling paints, PCBs were used in boat hull paint. It is possible that historical contamination from boat hulls may be contributing to high levels of PCBs in the Back Basins.

5.3.1.2 Metals

The results of most sediment studies conducted in the MdRH found copper and zinc concentrations to be highest in the Back Basins. Lead concentrations were highest in the main channel. The sources of these metal were generally identified as maritime activities (e.g., hull leachate), discharge from storm drains into the receiving water, and atmospheric deposition.

The Oxford Basin Sediment and Water Quality Characterization (Weston, 2010a) provided insights into the potential for the Oxford Basin to act as a reservoir and potential source for contaminated sediments entering Basin E. The results of the study indicated low concentrations of metals, except chromium and lead, suggesting that resuspension of sediments in Oxford Basin is not likely to be a source of metals in Basin E.

5.3.1.3 Fecal Indicator Bacteria

Water quality has been comprehensively assessed throughout the MdRH as special studies and as part of continuous monitoring programs. As a result of these studies, a number of constituent sources have been identified.

Assessments of bacterial contributions to Basin E were consistent among the majority of projects, with the Oxford Basin and Boone Olive Pump Station identified as a source of bacterial loads during wet weather. The most recent study did not indicate that Oxford Basin was a predominant contributor to bacteria concentrations in Basin E during dry-weather flows (the Oxford Basin Sediment and Water Quality Characterization [Weston, 2010a]). This study was undertaken after the installation of a dry-weather diversion into the Oxford Basin.

In the bacterial source identification study (Weston, 2007), birds were identified as a key contributor throughout MdRH and management actions targeting this source were recommended (Figure 11). Anthropogenic sources and transport mechanisms included boat-related maintenance activities, trash and food waste, washing activities (restaurants, restrooms, parking areas, and buildings), landscaping, and the MS4. Another key factor in the presence of bacteria within MDRH is the limited flow through the marina waters. This lack of circulation increases the potential for bacterial reservoirs to inhabit locations such as pier supports and boat hulls. These locations are also prone to limited ultraviolet (UV) penetration and subsequently allow increased microbial longevity.

Bacterial concentrations in sediments were found to be very low in all studies, suggesting that marina sediments do not act as a significant reservoir of fecal indicator bacteria.

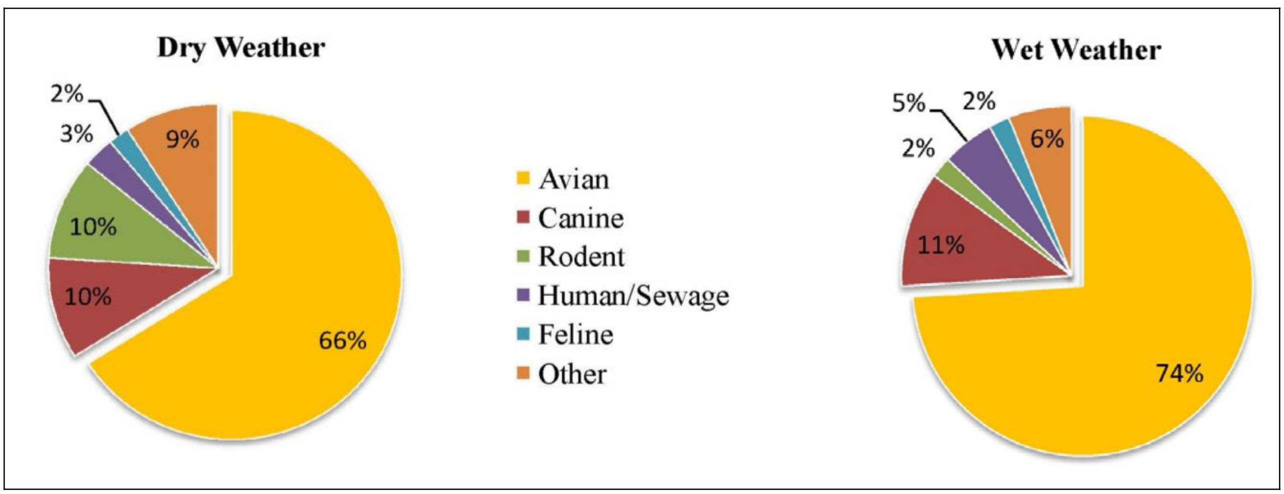


Figure 11. Ribotyping Results for Wet Weather and Dry Weather (Weston, 2007)

5.4 Prioritized Sources

Based on the source assessment, the issues within the MdR watershed were prioritized and sequenced in accordance with section VI.C.5.a.iv of the MS4 Permit (Table 15). As specified in the MS4 Permit, the highest priority is assigned to those pollutants with TMDLs according to the following criteria:

a. Controlling pollutants for which there are established WQBELS, or receiving water limitation with interim or final compliance deadlines within the current MS4 Permit term, or whose TMDL deadlines have passed without achieving the limitations,
b. Controlling pollutants for which there are established WQBELs or receiving water limitations with compliance deadlines (interim or final) between September 6, 2012 and October 25, 2017.

The second highest priorities are established for pollutants for which receiving water limitations are exceeded, or impairment is implicated as a result of discharges from the MS4. For purposes of the prioritization, third priority will be attributed to controlling pollutants with TMDL compliance dates beyond the term of the MS4 Permit.

Table 15. Prioritized Sources

Priority	Waterbody	Pollutant	Priority Sources*	Compliance Deadlines
1a	MdRH Back Basins	Bacteria (dry weather)	Birds, anthropogenic sources	March 18, 2007 final Summer and Winter dry.
1b	MdRH Back Basins	Copper	Boats, residential, stormwater runoff	March 22, 2016 interim sediment allocations met. Final compliance March 22, 2018.
		Lead	Legacy sediment, stormwater runoff (suspended sediment)	March 22, 2016 interim sediment allocations met. Final compliance March 22, 2018.
		Zinc	Commercial contributions, stormwater runoff	March 22, 2016 interim sediment allocations met. Final compliance March 22, 2018.
		PCBs	Legacy sediment, boats, stormwater runoff (suspended sediment)	March 22, 2016 interim sediment allocations met. Final compliance March 22, 2018.
		DDTs	Legacy sediment, stormwater runoff	March 22, 2016 interim sediment allocations met. Final compliance March 22, 2018.
		p,p'-DDE	Legacy sediment, stormwater runoff	March 22, 2016 interim sediment allocations met. Final compliance March 22, 2018.
		Chlordane	Legacy sediment, stormwater runoff (suspended sediment)	March 22, 2016 interim sediment allocations met. Final compliance March 22, 2018.

Table 15. Prioritized Sources

Priority	Waterbody	Pollutant	Priority Sources*	Compliance Deadlines
3	MdRH Back Basins	Bacteria (wet weather)	Birds, stormwater runoff, anthropogenic sources	July 15, 2021 final wet weather and geometric mean.
	MdRH Front Basins	Copper	Boats, residential, stormwater runoff	March 22, 2019 interim sediment allocations met. Final compliance March 22, 2021.
		Lead	Legacy sediment, stormwater runoff (suspended sediment)	March 22, 2019 interim sediment allocations met. Final compliance March 22, 2021.
		Zinc	Commercial contributions, stormwater runoff	March 22, 2019 interim sediment allocations met. Final compliance March 22, 2021.
		PCBs	Legacy sediment, boats, stormwater runoff (suspended sediment)	March 22, 2019 interim sediment allocations met. Final compliance March 22, 2021.
		DDTs	Legacy sediment, stormwater runoff	March 22, 2019 interim sediment allocations met. Final compliance March 22, 2021.
		p,p'-DDE	Legacy sediment, stormwater runoff	March 22, 2019 interim sediment allocations met. Final compliance March 22, 2021.
		Chlordane	Legacy sediment, stormwater runoff (suspended sediment)	March 22, 2019 interim sediment allocations met. Final compliance March 22, 2021.

*Although stormwater is not a primary source of pollutants it is a conveyance mechanism and is treated as a point source for purposes of the Toxicity TMDL.

6.0 STRUCTURAL AND NON-STRUCTURAL CONTROL MEASURES

The development of the MdR EWMP requires the identification of optimal combination of control measures necessary and sufficient to meet WQBELs and Receiving Water Limitations (RWLs) set in the MdR Bacteria TMDL, Toxics TMDL (modified in 2014), and 2012 MS4 Permit, thus, reducing the impact of stormwater and non-stormwater runoff on receiving water quality.

BMPs are generally classified as structural and non-structural or institutional BMPs. Structural BMPs can be further categorized into distributed and centralized. Minimum Control Measures (MCMs) are a subset of non-structural BMPs. These are classified as planning, enforcement and inspection, monitoring, source control, and Public Information and Participation Programs (PIPP) (i.e. education, outreach, and incentives).

The purpose of this section is to summarize structural and non-structural BMPs already in effect, planned BMPs that are not yet online, customization measures to improve existing BMPs, as well as potential new structural and non-structural BMP opportunities within the MdR area under the jurisdiction of the MdR EWMP agencies. The information presented in this section was compiled from the various Notice of Intents (NOIs), Time Schedule Orders (TSOs), MdR Bacteria and Toxics Implementation Plans , and information submitted directly by the MdR EWMP agencies for the purpose of this EWMP development.

The BMPs are listed in Table 16, Structural BMPs, and Table 17 Non-Structural BMPs. The tables list the control measures with their general types, date implemented, status, responsible agency, and a descriptive summary, followed by proposed potential customization to improve the existing BMPs, which will be further developed in the EWMP process. The locations of the existing structural control measures, when applicable, are shown in Figure 12.

Participating agencies are continuing to implement the MCMs required under the 2001 MS4 Permit. Applicable new MCMs will be implemented by the time the EWMP is approved by the Regional Board.

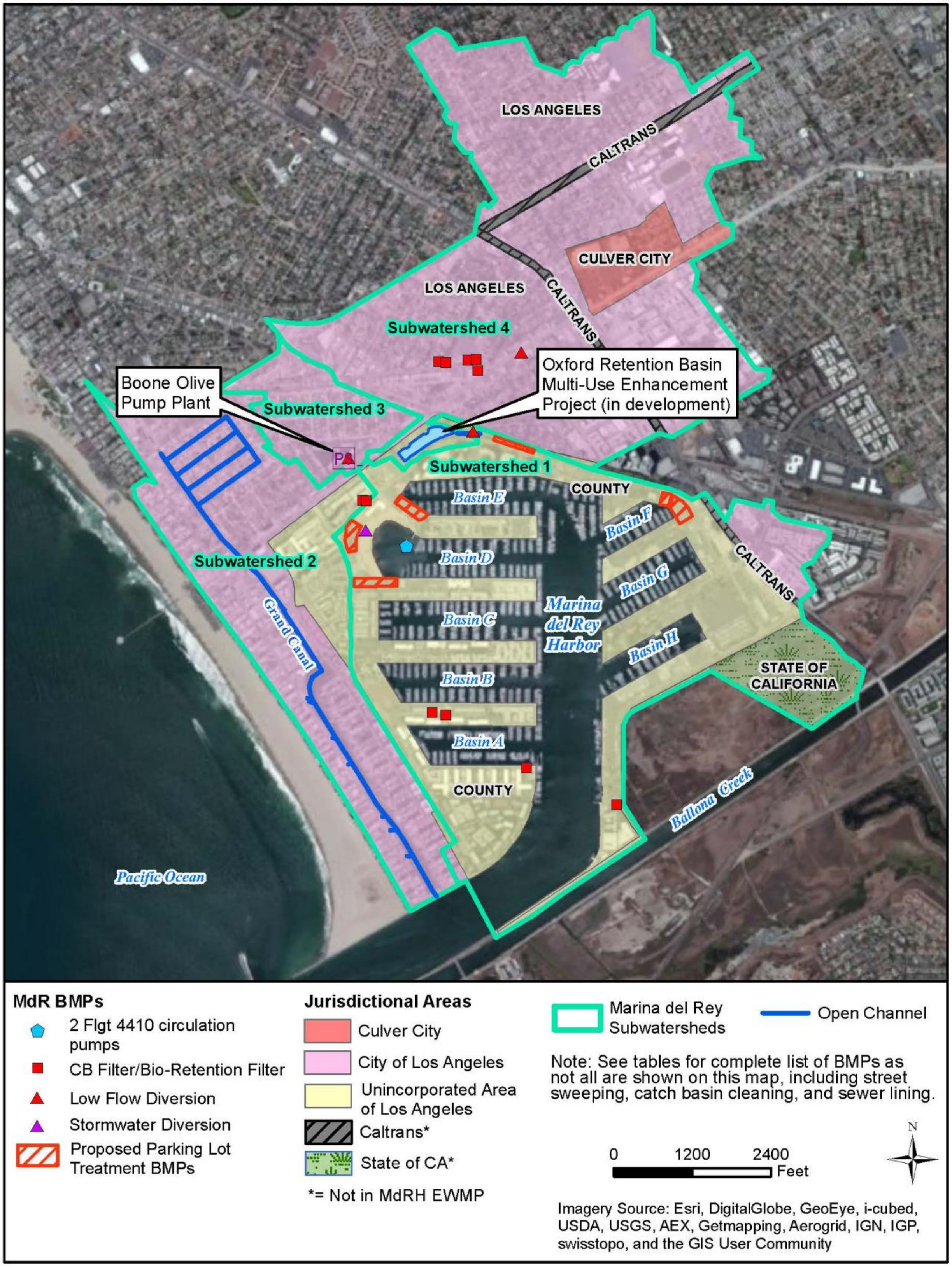


Figure 12. Existing Structural Control Measures within MdRH Boundaries

Table 16. List of Existing and Proposed Structural BMPs in the EWMP Agencies Jurisdictions Areas

Project "Title" // Descriptive Title	BMP Type	Status	Date	Agency	Location	Description	Potential Customization
Marina Beach Water Quality Improvement Project – Phase I	Mechanical Circulation Device	Complete	10/2006	County, LACDBH	Basin D / Mother's Beach	Two subsurface water circulators (2 Flygt 4410 circulation pumps) with 55-inch-diameter banana propellers were installed in Basin D just offshore from Marina Beach, attached under a special dock at Parcel No. 91. The circulators pump water toward the beach face at a rate of 60,000 gallons per minute (GPM) (30,000 GPM each).	
Marina Beach Water Quality Improvement Project – Phase II	Stormwater Diversion	Complete	8/2007	County, LACDBH	Basin D / Mother's Beach	A stormwater collection system was constructed to redirect all stormwater sheet flows from impervious areas currently draining into Marina Mothers' Beach and Back Basin D into Basin C.	Water Quality BMP can be added to downstream end of diversion pipe to improve Basin C
Tree Wells (5)	Bio-Retention Filter (Filterra)	Complete	1/2007	LACFCD	West and East side of Garfield Ave West and East side of Coeur D'Alene Abbot Kinney	Five bioretention filters were installed upstream of Project No. 5243 as an additional measure to prevent pollutants from entering Back Basin E. Each has a footprint of 6.5 ft by 4 ft to collect and treat dry weather runoff and stormwater serving three subdrainage areas of 0.3, 14.1, and 16.5 acres, a total of 30.9 acres.	
Project 3874, 5243, 3872	Low Flow Diversion	Complete	3/2007	LACFCD	539 Washington St. 3874 Boone-Olive Pump Station 3872 Oxford Pump Station	Three low flow diversions (92,000, 20,000 and 288,000 gal/day) were installed at three locations to divert dry-weather non-stormwater urban runoff to a sanitary sewer flowing into Hyperion Treatment Plant, to comply with the MdRH Dry Weather Bacteria TMDL. The diversions serve 61, 310, and 148 acres, respectively.	Form a low-flow diversion task force to recommend management actions that optimize operations for the MdRH. Implement a pilot project to test new technologies for low-flow diversion monitoring to better operate the system and characterize the sources of dry weather flows.
Sewer and Manhole Lining		Complete	1993	County, City of Los Angeles	Surrounding Basins D, E, and F	Existing sewers in MdRH have been lined since 1993 to reduce Stormwater Sewer Overflows. Since 2007, the County has lined and rehabilitated 11 miles of sewer lines and 208 manholes in the MdRH watershed.	
Catch Basin Retrofit		Complete / In Development	2011	County, City of Los Angeles, City of Culver City	Across MdRH	In the City of Los Angeles area, 293 catch basins have been retrofitted with trash screens (103 City-owned and 190 LACFCD-owned catch basins with trash screens). Catch basin cleaning has been conducted at a typical frequency of at least 3 to 4 times/year. The City of Culver City has retrofitted four catch basins with full capture devices. The County plans to retrofit 40 catch basins in the MdR with full-capture devices.	
Parking Lot Retrofits		In Development	Yearly until 2017	County	Parking Lots 5, 7, 9, and Library	The retrofitting of three parking lots and the library facility in MdR is underway based on the multi-pollutant implementation plan developed in 2011 for MdR. The retrofitting will incorporate various BMPs such as bioretention planters, biofiltration systems, porous pavement, and rain barrels. The goal of these parking lot projects is to treat runoff coming from the County facilities before it enters the harbor.	Implement a pilot study to assess the effectiveness of the retrofitted parking lots in reducing contaminants loads from their respective drainage areas and propose potential customizations to improve performance if deemed necessary.
Oxford Retention Basin Multi-Use Enhancement Project		In Development	Fall 2015	County, LACFCD	Oxford Retention Basin	This project, scheduled to begin construction in 2014, is designed to enhance flood protection, reduce runoff pollution, and significantly improve the quality of plant and wildlife habitat within the facility, as well as its aesthetic appeal. Diseased trees and non-native plants will be replaced with native, more drought-tolerant species. The project will also provide new recreational and safety amenities, including a walking path, observation areas, wildlife-friendly lighting, and more attractive tubular fencing. The project will improve water quality by increasing circulation and dissolved oxygen levels of the water in the basin by constructing a circulation berm.	Implement a monitoring program to assess the impact of the project on the receiving water quality.
Tree Wells		Proposed / In Development	Within 60 months of TSO adoption	City of Los Angeles, LACFCD	To Be Decided	Tree wells were proposed in the Time Schedule Order (TSO) Request for MdRH Bacteria TMDL. LACFCD is constructing seven bioretention areas on Admiralty as part of Oxford Basin Project.	
Green Streets		To Be Assessed				MdR is highly urbanized with the potential for implementation of green streets practices across its four subwatersheds.	Green streets will be assessed as a regional BMP through the assessment of the execution of a series of distributed BMPs across the various jurisdictions and subwatersheds in the MdR watershed to capture the 85th percentile, 24-hour storm event.
Ballona Lagoon and Venice Canals		To Be Assessed				The canals service Subwatershed 2, South of Washington Blvd and Venice Beach, from Ballona Grand Canal (East) to the West Canal then discharging at the MdRH mouth as shown in Figure 12. They are generally surrounded by residential areas with habitat protection buffer strips on both banks.	
Boone Olive Pump Station		To Be Assessed				The pump station is located at 581 Washington Street, Venice, CA 90291. It services the flows from Subwatershed 3.	

Table 17. List of Existing and Proposed Non-Structural BMPs in the Marina del Rey Harbor EWMP Agencies Jurisdictions Areas

Project "Title" // Descriptive Title	BMP Type 1	BMP Type 2	Status	Regulatory Driver	Date	Agency	Description	Potential Customizations
PLANNING								
Marina del Rey Bacteria TMDL Implementation Plan (MDRWRA, 2007)	Planning	Compliance	Complete	Bacteria TMDL	01/2007	County, Multiple	The plan includes procedures, plans, programs, and actions to be carried out through the MdR watershed in order to reduce bacteria concentrations at this impaired water body to comply with the Bacteria TMDL requirements.	The 2012 MS4 Permit allows Permittees to voluntarily choose to implement an Enhanced Watershed Management Program (EWMP), which includes prioritization of water-quality issues; identification of implementation strategies, CMs, and BMP to meet pertinent standards; integrated water-quality monitoring; and opportunity for stakeholder input, using integrated planning, to comprehensively evaluate opportunities to implement multi-benefit regional projects to improve water quality. These projects may also achieve other benefits such as flood protection, water supply enhancement, recreational opportunities, and wildlife habitat enhancement.
Marina del Rey Multi-Pollutants Implementation Plan (LADPW, 2012)	Planning	Compliance	Complete	Toxics TMDL, Trash TMDL	03/2011	County	The plan includes procedures, plans, programs, and actions to be carried out through the unincorporated area of MdR watershed in order to reduce toxics and bacteria concentrations at this impaired water body to comply with the Toxics and Bacteria TMDL requirements.	
Marina del Rey Toxics Implementation Plan (City of Los Angeles, 2011)	Planning	Compliance	Complete	Toxics TMDL	03/2011	City of Los Angeles, Multiple	The plan includes procedures, plans, programs, and actions to be carried out through the MdR watershed within the City of Los Angeles, Caltrans and City of Culver City boundaries in order to reduce bacteria concentrations at this impaired water body to comply with the Toxics TMDL requirements.	
ENFORCEMENT								
Illegal Connection/ Illicit Discharge (IC/ID) Program	Enforcement	IC/ID	Existing/ Ongoing	MS4 Permit	2001 - present	LACFCD County, City of Los Angeles, City of Culver City	This program involves coordination of multiple departments to cease and eliminate pollution by IC/IDs to the stormwater system. The County has an active education, response, and enforcement program. The data are tracked for the County region and for the County's Road Maintenance Division (RMD), as part of its annual pre-storm season drainage inspection program. The cities of Los Angeles and Culver City have citywide programs that have also been implemented in MdR watershed.	
Construction Inspections Industrial/Commercial Facility Inspections	Enforcement	Inspections (w/ Education)	Ongoing	MS4 Permit		County, City of Los Angeles, City of Culver City	Los Angeles County MS4 Permit Program has been implemented in MdR watershed as part of a citywide and county wide program. The City of Culver City has a citywide program that has also been implemented in the MdR watershed.	
Restaurant Inspections	Enforcement	Inspections (w/ Education)	Ongoing	MS4 Permit	2004	County, City of Los Angeles	Annual inspections target restaurants as a potential source of food waste. This program identifies facilities lacking minimum stormwater BMPs and housekeeping practices - for waste disposal, grease containers, mop sinks, and other housekeeping activities.	
Low Impact Development (LID) ordinance	Enforcement	Ordinance	Existing	MS4 Permit	Jan 2009 May 2012 In Development	County, City of Los Angeles, City of Culver City	The City of Los Angeles is currently amending sections of the LID Ordinance, as well as its Stormwater and Urban Runoff Pollution Control Ordinance (L.A.M.C. Chapter VI, Article 4.4) to meet all the MS4 Permit requirements. The County adopted a revised LID ordinance on November 12, 2013 to meet all MS4 Permit requirements. Based on a communication with the City of Culver City staff, an ordinance is being developed based on the existing ones for the County and the City of Los Angeles; it is expected to be in effect by December 2014.	

Table 17. List of Existing and Proposed Non-Structural BMPs in the Marina del Rey Harbor EWMP Agencies Jurisdictions Areas

Project "Title" // Descriptive Title	BMP Type 1	BMP Type 2	Status	Regulatory Driver	Date	Agency	Description	Potential Customizations
Green Street Policy	Enforcement	Ordinance	Existing	MS4 Permit	Jul 2011 In Development	County, City of Los Angeles, City of Culver City	The City of Los Angeles and the County have adopted a Green Street Policy that is in compliance with the requirements of the MS4 Permit for its portion in the watershed. Based on a communication with the City of Culver City staff, an ordinance is being developed based on the existing ones for the County and the City of Los Angeles; it is expected to be in effect by December 2014.	
Standard Urban Stormwater Mitigation Plan (SUSMP)	Enforcement	Ordinance	Existing	MS4 Permit	Ongoing	City of Los Angeles	The City of Los Angeles has several projects in MdR Watershed as part of its implementation of the Citywide SUSMP program	
SOURCE CONTROL								
Brake Pad Partnership	Source Control	Alternative Product	Complete	MS4 Permit, Toxics TMDL	2010	Multiple	MdRH Agencies have supported the Brake Pad Partnership and the adoption process of SB 346 (adopted in 2010) through monetary contributions, in-kind technical services, and committee memberships. Caltrans, in conjunction with the State Board, contributed close to $1,000,000 to research on impacts of brake pads to surface waters. The Brake Pad Partnership is an example of true source control that will remove copper brake pads from the market, and therefore, a source of loading to the environment. SB346 requires that brake pads contain no more than 5% copper by weight by 2021 and no more than 0.5% copper by weight by 2025.	
Trash Removal and Control	Source Control		Proposed	Trash TMDL		City of Los Angeles, County, City of Culver City	The Santa Monica Bay Debris TMDL requires responsible parties to reduce their trash contribution to the Santa Monica Bay by 10% each year for a period of 10 years with the goal of zero trash to waterbodies. The County and City of Los Angeles have achieved every yearly milestone, solely through the implementation of structural measures without having to take credit for implemented institutional measures that are also resulting in a reduction of trash. Other programs are implemented by other entities for trash control. For example, the City of Los Angeles Bureau of Street Services (BSS) offers a reward for information resulting in the identification of persons committing an act of illegal dumping.	

Table 17. List of Existing and Proposed Non-Structural BMPs in the Marina del Rey Harbor EWMP Agencies Jurisdictions Areas

Project "Title" // Descriptive Title	BMP Type 1	BMP Type 2	Status	Regulatory Driver	Date	Agency	Description	Potential Customizations
MAINTENANCE								
Street Sweeping	Maintenance	Maintenance	Ongoing	Toxics TMDL, Trash TMDL, Bacteria TMDL	2008	County, Multiple	County: Streets are swept 2x/week Mondays and Thursday. Parking lots are swept at least 2 times/week and up to 6 times/week. Ten sweepers are used in MdRH, 4 vacuum and 6 mechanical stationed with the RMD-3 fleet. One of each is compressed natural gas (CNG) powered versus liquefied petroleum gas (LPG) powered. Lot 15: 6x/week (winter); daily (summer), Lots 11, 13 and 16: 4x/week. City of Los Angeles / Caltrans: Bureau of Street Services (BSS) conducts sweeping: 130 mechanical broom sweepers, 100 operators, weekly sweeping for posted streets and monthly sweeping for arterial streets. Has a delegated maintenance agreement with Caltrans to sweep Venice and Lincoln/Pacific Coast Highway. The City of Culver City has a street sweeping program that includes weekly sweeping of street in its portion of MdRH. Current schedule is side Streets – Monday and Tuesday 8:00 AM to 12:00 PM, Washington Boulevard – Monday through Friday 4:00 AM to 6:00 AM. The City of Los Angeles BSS currently sweeps approximately 63 curb miles (some swept weekly and some swept monthly) located within the City of Los Angeles' portion of MdRH. Maintenance responsibility of Lincoln Boulevard (State Route 1) and Venice Boulevard (State Route 187) has been delegated to the City of Los Angeles by a Delegated Maintenance Agreement. Caltrans will be working closely with the City of Los Angeles to achieve optimal maintenance performance that includes sweeping, trash pickup, and drainage cleanup.	
Catch Basin Cleaning	Maintenance	Maintenance	Ongoing	Toxics TMDL, Trash TMDL, Bacteria TMDL	2011	City of Los Angeles, County, City of Culver City	The City of Los Angeles catch basin cleaning occurs at a typical frequency of 3 to 4 times per year, targeting trash. Within the County area, catch basins are be cleaned quarterly, semi-annually or every year depending on the prioritization of each catch basin. The City of Culver City cleaning occurs three times per year.	
County Beaches - Sanitation Program	Maintenance	Maintenance	Ongoing	MS4 Permit, Bacteria TMDL		County	County staff "sanitizes" the beach 7 days a week, provided the sand is not wet. A tractor with rake and screen system is used to collect trash and turn off the beach sand. This process removes solids and debris and allows the sun to "sanitize" the sand during the day. Operations are between 5 am and 1:30 pm daily.	
PUBLIC INFORMATION AND PARTICIPATION PROGRAM								
Billboard Educational Campaign	PIPP	Outreach, Education	Complete	MS4 Permit, Toxics TMDL	Feb 2012		This program was a countywide, 8-week billboard campaign designed to promote protective waste management practices. A used motor oil educational advertisement was displayed on 20 billboards throughout the County.	

Table 17. List of Existing and Proposed Non-Structural BMPs in the Marina del Rey Harbor EWMP Agencies Jurisdictions Areas

Project "Title" // Descriptive Title	BMP Type 1	BMP Type 2	Status	Regulatory Driver	Date	Agency	Description	Potential Customizations
Boating Clean and Green Campaign	PIPP	Outreach, Incentive	Ongoing	Toxics TMDL, Bacteria TMDL	Apr 1997	County	This statewide educational and outreach program is designed to educate boaters about environmentally sound boating practices. The County held a focus group session to bring boaters together to openly share observations on boater behavior and motivations as they relate to water pollution. The boaters shared their observations on what is needed to better enforce current boater regulations as well as what visual messages would be most effective in influencing boater behavior. Based on the results of the Boater Focus Group, the County started the "Boaters Help Keep Marina del Rey and Santa Monica Bay Clean" campaign. A series of posters were created and posted at strategic sites in the harbor.	
Dock Walker Training	PIPP	Education, Outreach	Ongoing	Bacteria TMDL		LACDBH	This program consists of volunteers who inspire and educate boaters and other recreators to be safe and environmentally sound while boating in California. Through this program, general boater educational materials were developed.	
Clean LA	PIPP	Education, Outreach	Ongoing	Bacteria and Toxics TMDLs	2002	County	County of Los Angeles portal to a number of award-winning programs that help residents, businesses, and government keep the County clean and sustainable.	
School Outreach	PIPP	Education, Outreach	Ongoing	MS4 Permit, Bacteria TMDL, Toxics TMDL, Trash TMDL		City of Los Angeles, LACFCD	Los Angeles County MS4 Permit and MdRH Bacteria TMDL Implementation Plan Programs: This program includes making targeted phone calls to all public and private K-12 schools within the MdRH to notify them of the availability of environmental education programs offered by the LACFCD and City of Los Angeles, emphasizing to school administrators that these programs comply with State curriculum standards and provide opportunities to fulfill service-learning requirements.	
Clean Marinas Program	PIPP	Outreach, Incentive	Ongoing	Bacteria TMDL, Trash TMDL	Apr 2006	County	This program is a partnership among private marina owners, government marina operators, and yacht clubs that was developed to provide clean facilities to the boating community.	
Smart Gardening	PIPP	Education, Outreach, Incentive	Ongoing	Toxics TMDL, Bacteria TMDL		County	This program targets businesses, schools, and homeowners through outreach and education materials for water-wise gardening. Topics covered include drought-tolerant plants and native plants, irrigation methods and associated water use/savings, irrigation management, and structural BMPs (i.e., rain barrels, cisterns, green roofs). The program includes educational workshops, training events, and the design/build of demonstration gardens targeting local residences and businesses. The County operates 12 Learning Centers throughout the County. They are equipped with educational and demonstration materials designed for program workshops. Each is landscaped with various backyard and drought-tolerant plants. Some of the centers also include grass recycling demonstrations. The County is partnering with the University of California Cooperative Extension "Master Gardeners" volunteers from the community. The volunteers are trained to promote environmentally responsible and sustainable horticultural practices in the home, community, and school landscapes by conducting workshops and demonstrations; speaking to community groups; educating teachers and parents at school gardens; and answering gardening questions at fairs and farmers markets as well as staffing email and phone helplines.	

7.0 CONTROL MEASURE PERFORMANCE ANALYSIS

Although the performance of any given BMP is difficult to predict without a detailed evaluation of design and site characteristics, monitoring program, and analysis methodology, there are many studies that may provide some useful generalizations for BMP efficiencies. Numerous studies, national resources, and methodologies that focus on the assessment of BMP performance and selection process were reviewed in the development of this, and the following, sections. These resources include the International BMP Database studies and guidelines, the National Pollutant Removal Performance Database, as well as studies and guidance documents performed across the nation.

The first subsection (7.1) provides a summary of the considerations associated with the process of BMP performance assessment and affecting the comparisons between BMP-type application and among different BMP types. The next subsection (7.2) presents the efficiency calculation methods used in the comparison with their limitations, followed by (7.3) the compilation of available BMP performance analysis studies and databases results and the generation of BMP performance efficiencies using readily available reported data for Southern California and (4) comparison of the BMP performance data from the compiled and calculated information. This information will be used in the generation of a non-quantitative effectiveness and performance comparison matrix for the various BMP strategies, in accordance with the following sections.

7.1 Terms Definition

To describe the level of treatment achieved and how well a device, system, or practice meets its goals, three terms are usually employed: (a) performance, (b) effectiveness, and (c) efficiency. These terms are defined, respectively, as a measure of how well a BMP system (a) meets its goals for stormwater that the BMP is designed to treat, (b) meets its goals in relation to all stormwater flows, (c) removes pollutants.

The focus of this control measure performance analysis is to determine the efficiency of various BMP types, through a quantitative percent removal metric, noting that efficiency does not capture all the aspects relating to performance and effectiveness, but allows evaluation of the ability of a BMP to meet any regulatory goals based on percent removal.

Performance and effectiveness metrics can be generated by developing a ranking matrix comparing non-quantitative measures such as volume reduction benefit, operations and maintenance (O&M) needs, failure potential, sensitivity to site conditions, applicability for a certain land use, potential for thermal increases, and groundwater contamination.

7.2 Factors Affecting Performance Comparison

The performance, efficiency, and effectiveness of a structural BMP, where, generally, inflow and outflow of a treatment type BMP can be monitored, varies by design differences, operational and maintenance approaches, pollutant, different input concentrations, storm characteristics (such as rainfall amount, rainfall density, antecedent weather), and age.

Structural BMP performance is dependent on many design and site-specific details. Specific characteristics of regional climate, soil type, BMP-specific engineering details, or maintenance programs, even if reported, cannot be accurately incorporated in the quantitative assessment and comparison of a single BMP type or across the different BMP types.

It is equally important to consider the size and land use of the contributing drainage area; which is directly related to the pollutant loading and initial concentrations generated by a storm event. With most BMPs, efficiency decreases with smaller influent concentration. If the inflow pollutant concentration is very low, a low or negative removal percentage can be recorded because limited performance potential can be achieved by the BMP. In addition, stormwater quality varies during a storm event, from event to event at the same site, and between sites of the same land use. In addition, as the concentration approaches its analytical detection limit, the effect of the variability of laboratory techniques becomes more significant. For high influent concentrations, a negative efficiency may be due to resuspension of pollutants, a change in pH that dissolved precipitated or sorbed pollutants, or erosion of the basin side.

Another important factor affecting the reported or actual performance of a BMP lies in the associated monitored storm event characteristics. For example, studies with few or no major storm events may report low removal efficiencies because both influent and effluent concentrations were low. In addition, a large number of storms must be monitored to statistically discern a difference in performance among BMPs.

In addition, note that different programs collect different analytes at different frequencies. Even when studies are similar, inconsistencies in sampling and assessment methods can yield widely different efficiencies. For example, several categories of BMPs can be effective at reducing the overall runoff volume, hence the associated pollutants loads, which would not be accounted for if only concentrations are being monitored.

The statistical analysis results comparing performance efficiencies of different BMP types should be examined with an understanding of the caveats associated with the data limitations. Whereas the use of BMPs is continuously increasing in Southern California and across the nation, and the monitoring and reporting requirements are increasing, the number of monitoring studies is still limited. In many cases, reported monitoring information is just used for compliance purposes and not further analyzed for BMP efficiency information. Across the various BMP categories, the range of data regarding concentrations, loads, or percent removal for a particular pollutant is generally high, resulting in a large difference between the lowest and highest removal efficiencies. The greater the range, the less confidence there is in the median and average removal efficiency.

Finally, the effect of infiltration and the resulting volume reduction cannot be ignored when comparing BMPs. A higher concentration in the effluent of a BMP with high infiltration compared to another similar BMP with limited or no infiltration is not indicative of a lower performance because the former is associated with lower loads from lower flows, thus yielding higher efficiency.

7.3 Analysis and Results

The efficiency of stormwater structural BMPs can be evaluated in a number of ways (the listing and description of these methods are beyond the scope of this document). The two most common computation methods are event mean concentration (EMC) efficiency ratio (ER) and mass balance or loads summation, where pollutant removal efficiency, usually represented as a percentage, specifically refers to the pollutant reduction from the inflow to the outflow of a system. As a general rule, the concentration-based technique often results in slightly lower performance efficiencies than the load-based technique.

7.3.1 EMC Efficiency Ratio

The ER is defined as the percent reduction of the average inflow and outflow EMC of pollutants over a period of time.

$$ER = \frac{Average\ EMC_{inflow} - Average\ EMC_{outflow}}{Average\ EMC_{inflow}}$$

This method weights EMCs from all storms regardless of their magnitude such that a high concentration, high volume event (higher loads) has weight equal to a low concentration, low volume (lower loads) event. Thus, "cleaner" watersheds record lower performances (the logarithmic data transformation generally minimizes the difference between EMC and mass balance calculations). It also does not account for storage capacity. Also, using this method, efficiency can vary depending on whether efficiency was based on average EMCs or an average of efficiency of each storm event.

7.3.2 Summation of Loads

The Summation of Loads (SOL) approach defines efficiency as the ratio of the summation of all incoming loads to the summation of all outflow loads, where loads are calculated as the product of the EMC by the corresponding volume.

$$SOL = \frac{Sum\ \ Loads_{inflow} - Sum\ Loads_{outflow}}{Sum\ Loads_{inflow}}$$

This method assumes that the removal of a constituent of concern is most relevant over an entire period of analysis, such as yearly. Generally, a small number of large storms dominate efficiency. In this method, some data points without a corresponding inflow or outflow flow volume cannot be used. This is not the case for the ER method because it is volume independent.

7.3.3 International BMP Database

The International BMP Database (WERF et al., 2013) was used to calculate BMP performance percentages for the toxic metals copper, lead, and zinc, in addition to fecal coliform and total suspended solids (TSS). For each BMP type, every BMP site concentration and/or volume was averaged and/or summed for every storm event, for each reported pollutant inflow and outflow concentration/inflow and outflow volume. The ER and SOL were then calculated using these averages as percentage change values. The process was performed on data filtered on the national level (USA), California State level (CA), and Southern California (SOCAL) using San Diego, Orange, Los Angeles, Ventura, and Riverside counties. The number of events used, resulting mean, median, minimum, maximum, first quartile, and third quartiles, for each BMP category, for the USA, CA, and SOCAL are compared in Table 18. This analysis is based on pollutant reduction and does not consider volume reduction. The BMP database publications reported that normally-dry vegetated BMPs (filter strips, vegetated swales, bioretention, and grass lined detention basins) appear to have substantial potential for volume reduction on a long-term basis, on the order of 30 percent (%) for filter strips and grass-lined detention basins, 40% for grass swales, and greater than 50% for bioretention with underdrains. Bioretention facilities without underdrains would be expected to provide greater volume reduction.

Table 18. Structural BMP Efficiency Potential Comparison for TSS

BMP CATEGORY	Region	N	Efficiency Ratio - ER - Percent Concentration Reduction						Sum of Loads - SOL - Percent Load Reduction					
			Avg	Min	Q1 25%	Med	Q3 75%	Max	Avg	Min	Q1 25%	Med	Q3 75%	Max
BIORETENTION														
Biofilter - Grass Strip	CAL	235	66	-281	55	91	100	100	80	-38	78	96	100	100
	SOCAL	104	60	-281	53	100	100	100	82	-38	76	98	100	100
	USA	392	46	-2,683	52	85	100	100	84	-38	83	98	100	100
Biofilter - Grass Swale	CAL	59	21	-1,700	46	74	100	100	74	-162	78	89	100	100
	SOCAL	59	21	-1,700	46	74	100	100	74	-162	78	89	100	100
	USA	222	-34	-2,125	-29	39	80	100	48	-295	51	82	95	100
Biofilter - Wetland Vegetation Swale	USA	43	-15	-440	-86	50	100	100	.	.	.	.	.	.
Bioretention	USA	330	-1063	-350,777	61	91	99	100	57	-1200	84	97	100	100
NPRP* - Grass and Dry Swale	USA	15		18	69	81	87	99		18	69	81	87	99
NPRP* Bioretention Filter	USA	10		-100	15	59	74	98		-100	15	59	74	98
FILTRATION														
Filter - Other Media	CAL	18	36	-62	10	40	56	100	36	-62	10	40	56	100
	SOCAL	18	36	-62	10	40	56	100	36	-62	10	40	56	100
	USA	92	22	-4,700	57	89	100	100	56	-1853	59	96	100	100
Filter - Peat Mixed With Sand	CAL	19	82	13	71	98	100	100	82	13	71	98	100	100
	SOCAL	19	82	13	71	98	100	100	82	13	71	98	100	100
	USA	19	82	13	71	98	100	100	82	13	71	98	100	100
Filter - Sand	CAL	140	67	-1,590	81	92	97	100	80	-122	81	92	97	100
	SOCAL	87	81	-122	81	92	97	100	80	-122	81	92	97	100
	USA	376	65	-1,590	70	88	98	100	78	-125	80	91	96	100
NPRP* - Organic and Sand	USA	18								8	80	86	92	98

Table 18. Structural BMP Efficiency Potential Comparison for TSS (Continued)

BMP CATEGORY	Region	N	Efficiency Ratio - ER - Percent Concentration Reduction						Sum of Loads - SOL - Percent Load Reduction					
			Avg	Min	Q1 25%	Med	Q3 75%	Max	Avg	Min	Q1 25%	Med	Q3 75%	Max
INFILTRATION														
Infiltration (Percolation) Trench	USA	36	100	100	100	100	100	100	.	.	.	.	.	.
Infiltration Basin	CAL	13	80	17	64	91	97	100	.	.	.	.	.	.
	SOCAL	13	92	55	92	96	99	100	95	88	94	96	98	100
	USA	53	-391	-12,763	55	87	99	100	.	.	.	.	.	.
Porous Pavement - Porous Asphalt	USA	12	80	-19	78	93	98	100	.	.	.	.	.	.
NPRP* - No underdrain	USA	4								0	62	89	96	97
DETENTION AND SETTLING														
Detention - Underground Vault, Tank or Pipe(s)	USA	21	26	-128	-31	18	100	100	21	0	0	19	46	46
Detention Basin (Dry) - Concrete or Lined Tank and/or Basin With Open Surface	CAL	13	5	-279	-27	45	75	90	5	-279	-27	45	75	90
	SOCAL	13	5	-279	-27	45	75	90	5	-279	-27	45	75	90
	USA	46	65	-279	67	92	100	100	11	-279	-27	56	76	90
Detention Basin (Dry) - Surface Grass-Lined Basin That Empties Out After A Storm	CAL	63	63	-282	63	76	83	100	69	-266	75	84	91	100
	SOCAL	63	63	-282	63	76	83	100	69	-266	75	84	91	100
	USA	332	32	-2,220	39	72	100	100	-5	-4,583	45	74	90	100
NPRP* - Dry Pond	USA	10								-1	18	49	71	90
Retention Pond (Wet) - Surface Pond With a Permanent Pool	CAL	54	-361	-5,056	-281	0	95	100	95	85	94	97	98	100
	SOCAL	13	64	0	33	75	88	98	93	85	91	95	95	98
	USA	911	15	-8,600	66	93	100	100	-4	-8,600	67	90	99	100
NPRP* - Wet Pond	USA	46								-33	60	80	88	99
Wetland - Basin With Open Water Surfaces	CAL	8	.	.	.	.	.	.	.	.	.	.	.	.
	SOCAL	8	79	17	70	91	96	98	.	.	.	.	.	.
	USA	331	44	-1,000	45	77	94	100	40	-351	24	66	90	100

Table 18. Structural BMP Efficiency Potential Comparison for TSS (Continued)

BMP CATEGORY	Region	N	Efficiency Ratio - ER - Percent Concentration Reduction						Sum of Loads - SOL - Percent Load Reduction					
			Avg	Min	Q1 25%	Med	Q3 75%	Max	Avg	Min	Q1 25%	Med	Q3 75%	Max
Wetland - Basin Without Open Water (Wetland Meadow Type)	USA	3	57	50	50	59	62	62	.	.	.	.	.	.
Wetland - Channel With Wetland Bottom	USA	213	-7,440	-1,533,923	0	64	100	100	-30006	-1,591,712	50	80	96	100
NPRP* - Wetland	USA	40								-100	46	72	86	100
MANUFACTURED DEVICE														
Manufactured Device	CAL	90	4	-1298	-2	43	75	100	2	-1298	1	65	94	100
	SOCAL	65	-17	-1298	-25	33	67	100	-56	-1298	-16	15	81	99
	USA	1044	43	-1506	19	62	92	100	34	-1298	8	55	87	100
COMPOSITE														
Composite	USA	268	-38	-17963	63	92	100	100	-205	-11394	81	94	100	100

*NPRP Database Percent TSS Removal: Whenever possible SOL were used; when more than one method was used to calculate pollutant removal in a specific BMP study, SOL were entered into the database rather than ER. Averages were not reported.

National level = USA, California State level = CAL, and Southern California = SOCAL.

7.3.4 National Pollutant Removal Performance Database

The National Pollutant Removal Performance (NPRP) Database was developed by the Center for Watershed Protection (CWP, 2007). It includes a total of 166 studies published through 2006. The data were statistically analyzed to derive the mean and quartile removal values for the major groups of stormwater BMPs for copper, zinc, bacteria, and TSS among others. The data did not include lead. Whenever possible, SOL were used. When more than one method was used to calculate pollutant removal in a specific BMP study, SOL were entered into the database rather than ER. Averages were not reported. The NPRP efficiencies for TSS are summarized in Table 18.

In selecting a BMP performance efficiency assumption, the 75-percentile removal efficiency should be used, rather than the median. Use of the median may lead to design standards that aim to the middle range of performance, and thus to BMPs showing a mediocre performance. The number of storm events, and the average, median, minimum, maximum, first quartile, and third quartile results for each BMP category are listed in Table 18 for the data obtained from the BMP Database for Southern California, California, and the USA, as well as the NPRP database. Figure 13 was generated as an example to demonstrate the wide range of variability in TSS removal efficiencies in the following areas: (1) among the methods used to calculate efficiencies, (2) among the different BMP categories, and (3) and among the different storm events, even with the exclusion of outliers. The figure presents a comparison of the efficiencies calculated for Southern California BMP applications, using both ER and SOL.

As expected, manufactured devices display the highest level of variability due to the variety of devices used. The variability is also relatively high for detention ponds, and bioretention strips and swales. Minimum values often include negative efficiencies, which may be the result of a natural process, or a design or operational flaw. In general, filters and infiltration basins showed the best efficiencies, in addition to biofiltration (grass strips and grass swales), followed by grass lined detention ponds and retention ponds.

An assessment of the statistical analysis performed and comparisons of efficiencies developed for different regions and using different methods, presented in Table 18, will be conducted in order to select "best-suited" efficiency values. The values thus may be used in the BMP evaluation and selection process with minimum or controlled risk. A stochastic two-stage modeling approach might be developed, if found necessary, to manage risk of non-compliance, with a specified confidence level.

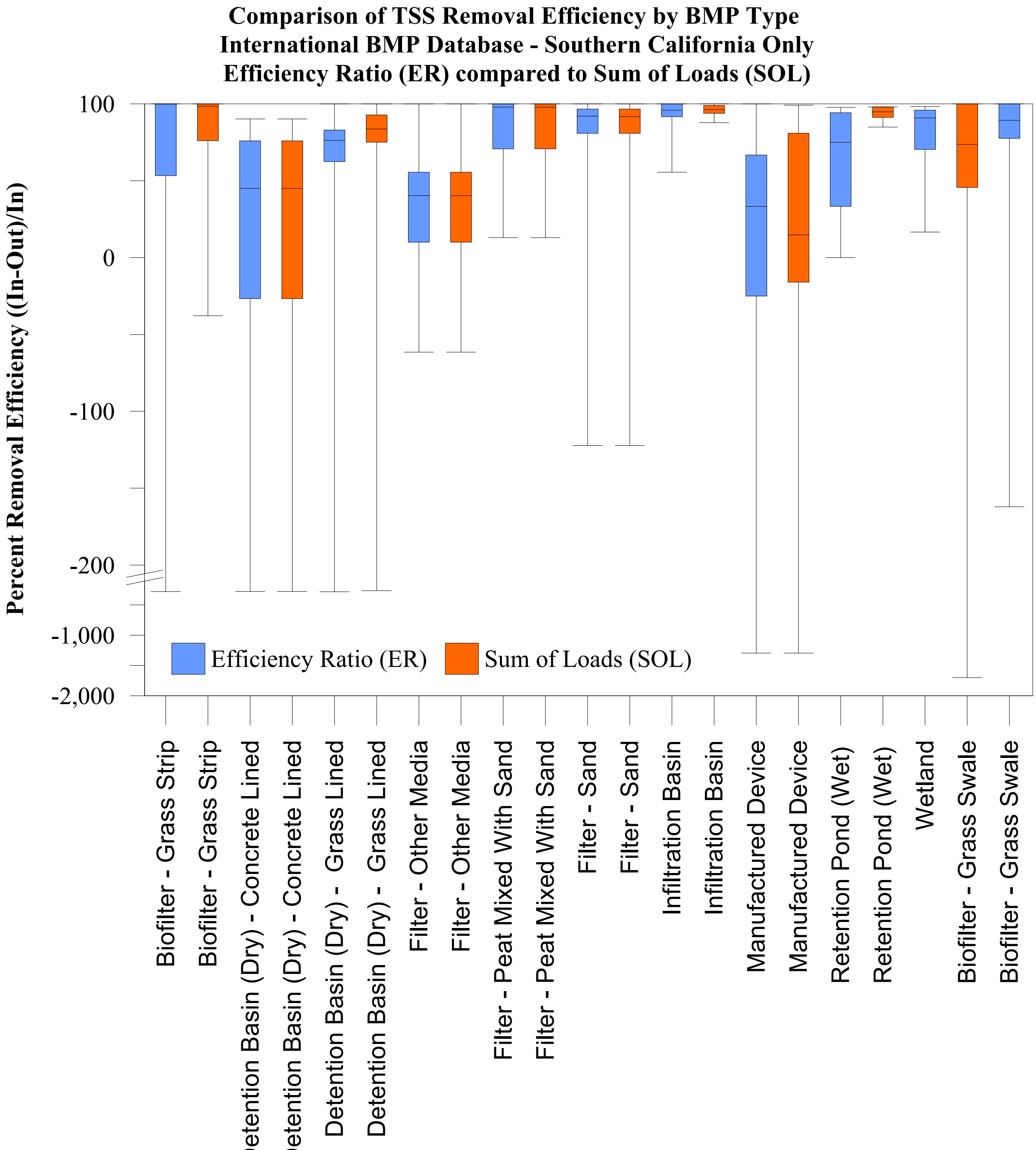


Figure 13. Comparison of BMP Efficiencies for Southern California (BMP Database)

7.3.5 BMP Performance and Effectiveness Matrix

A composite average rating score, Effectiveness Factor (EF), will be developed to rank different BMPs based on a multitude of factors affecting the performance and effectiveness of a BMP, as previously discussed. The scores will be assigned quantitative values, such as -10 through 10, with 10 being the score for the highest positive aspect and -10 the score of the highest negative aspect of a certain BMP. The scores will be based on the qualitative evaluation of the effectiveness of BMPs in the context of MdR. Such qualitative analysis will include factors such as volume reduction, beautification potential, land needs, associated cost and risk. The BMP specific efficiency estimates, ER or SOL, will be weighted by the site-specific composite scores, resulting in the EF. The EF will be used to rank the BMP types with the highest EF associated with the relatively best performance and effectiveness.

A Cost Effectiveness Metric (CEM) ($/mass reduction/year and/or $/volume reduction/year) will be developed using the following factors: (1) estimated load removal potential of a certain strategy, efficiency measure, in terms of volume reduction/year and mass reduction/year; (2) Capital Cost ($); (3) Life Cycle Cost, ($/Year); and/or (4) Cost associated with drainage areas ($/Acre). LID designs, such as rain barrels and roof gardens, will be used in the comparison of various control measure strategy scenarios.

7.3.6 Evaluation of Nonstructural BMPs

The direct impact of Non-structural non-treatment type BMPs such as aggressive street sweeping, true source control, enhanced inspections, bird exclusion devices, runoff reduction programs cannot be easily quantified with efficiency metrics and require innovative methods to measure effectiveness that are not determined through a comparison of inflow and outflow. However, some studies have attempted to quantify the benefits of nonstructural control measures. Supporting evidence and studies do exist, however, justifying the load reduction apportionment for various nonstructural programs that may be implemented within the MdR watershed. Recent pilot studies conducted in Southern California provide a basis for estimated load reductions. In this section, a conservative approach was adopted to quantifying the efficiency of nonstructural control measures. It is expected that the estimates of potential reductions presented in this section will be increased based on current and future studies for toxics.

When targeted at the actual pollutant source, studies have shown nonstructural solutions, such as operational source controls, to be very effective at removing the source and therefore reducing concentrations and/or loads to below regulatory requirements, with the added benefit of being highly cost effective. The recently approved legislation reducing the concentration of copper in brake pads in California was achieved through the Brake Pad Partnership that provided scientific data on the impact of copper from brake pads on water quality in urban areas. This true source control approach will significantly reduce copper concentrations in most urbanized watersheds, including MdR.

The City of San Diego performed a street sweeping pilot study (Weston, 2010b) to assess the effectiveness of various street and parking lot sweeping strategies. The study demonstrated that aggressive street sweeping was effective in reducing metals and pesticide loading and, to a lesser extent, bacteria. The Multi-Pollutant Implementation Plan for the Unincorporated Area of MdRH (LADPW, 2012) used this study to develop a potential mass-based load reduction efficiency, presented in Table 19.

Table 19. Summary of Nonstructural Control Measures Effectiveness

Nonstructural Program (targeted source)	**Range of Potential Load Reductions**			
	Metals – Minimum	**Metals – Maximum**	**Bacteria – Minimum**	**Bacteria – Maximum**
Sweeping (Streets/Parking Lots)	13%	15%	8.5%	9.5%
Birds	–	–	7%	10%
Parking garage structures	3%	6%	3%	6%
Restaurants	1%	4%	1%	4%
MS4 catchment/sewage	1%	3%	1%	3%
Runoff reduction	1%	2%	1%	2%
Buildings and construction	1%	2%	–	1%
Pet waste	–	–	1%	2%
Boating community	–	1%	–	1%
Total	**20%**	**33%**	**22.5%**	**38.5%**

The estimated effectiveness of nonstructural BMPs for bacteria is based on the Bacteria Non-point Source Study (NPSS) conducted for MdRH (Weston, 2007). The study showed that avian sources represented 74% of the wet-weather bacterial sources and 66% of the dry-weather bacterial sources. If the current bird waste management program was expanded to more aggressively target the recreational areas along the waterfront through a combination of pollutant removal (street sweeping) and long-term bird deterrence, it is conservatively estimated that 10% to 15% of this source may be reduced. This type of program could potentially result in a 7% to 10% reduction in bacterial load. The study also found that canines represent 11% of the wet-weather source and 10% of the dry-weather source of bacterial loading. If an aggressive dog waste management program was implemented across MdRH, it is conservatively estimated that 10% to 20% of this source could be removed. This type of program is estimated to achieve an approximate reduction of 2% to 3% of the bacterial load reduction. In addition to birds and canines, the study found that parking lot wash down activities were the cause for highest bacterial concentrations measured during the study; thus targeting parking garages would likely result in comparable reduction in bacterial and metals loading. Operational source control measures that reduce urban runoff from sources, such as over-irrigation and washing activities, will therefore address both toxic constituents and bacteria by addressing the transport mechanism for these pollutants. This type of program could potentially result in a 3% to 6% pollutant load reduction.

The NPSS collected spot samples from five instances of irrigation runoff, two of which were collected at the entry point to the MS4. Given the freshwater source, runoff from over-irrigation is not a pollutant unto itself, but rather a transport mechanism for other pollutants. A runoff reduction program was given a greater potential for load reduction than buildings and construction sources, pet waste, and the boating community because of the higher potential frequency of occurrence and the opportunity to leverage programs to encourage implementation of BMPs (e.g., cisterns, rain barrels, and green roofs). This type of program could potentially result in a 1% to 2% pollutant load reduction.

The MdR Toxics TMDL assumed that nonstructural BMPs would be able to reduce loads by 30% (LARWQCB, 2005). Based on the estimates presented in the Multi-Pollutant Implementation Plan for the Unincorporated Area (LADPW, 2012), as summarized above and presented in Table 19, the estimated total reductions that could be achieved from nonstructural BMPs is approximately 33%; however, the plan used a conservative load reduction of 25%. For the purposes of the MdR EWMP, a more conservative percent reduction (such as 10% or 15%) may be assumed and modified based on the adaptive management process of BMPs observed performance, evaluation and customization.

8.0 APPROACH FOR CUSTOMIZING EXISTING CONTROL MEASURES AND IDENTIFYING ADDITIONAL CONTROL MEASURES

This section presents an approach for identifying and evaluating new, regional, or decentralized control measures or potential customization and/or retrofits of existing control measures to manage wet weather runoff caused by existing and new development and/or redevelopment.

In accordance with this approach, the MdR EWMP will assess the feasibility of implementing Regional BMPs across the MdR watershed. The EWMP will build on the previous TMDL implementation plans; reevaluate the proposed watershed control measures; identify additional regional projects to maximize capture of all non-stormwater runoff and stormwater from the 85th percentile, 24-hour storm event; and identify additional watershed control measures for those areas in the watershed that cannot be addressed by a regional project while considering opportunities to maximize multi-benefit solutions regarding flood control, water quality, and aesthetics, where possible including public and private facilities.

The primary step in the identification of additional runoff control measures is a needs assessment. The purpose of the needs assessment is to quantify the type, quantity, and quality of runoff that may require control.

The first step in the analysis involves the estimation of runoff volume generated in the watershed. This may be performed by a multitude of methods such as Modified Rational Method calculations, trend analysis based on existing monitoring data, or watershed modeling using the Watershed Management Modeling System (WMMS). One or several of these techniques may be used to estimate the volume of runoff that will be generated by an 85th percentile, 24-hour storm event for the whole watershed, the subwatersheds, and/or at parcel level.

The second step in the needs assessment is the water quality analysis. This component consists of estimating the TSS and associated pollutants loads, bioavailable or otherwise, that are generated in the watershed by the corresponding runoff volumes. The loads may be extrapolated from existing monitoring information in the watershed or using the WMMS-estimated volume results.

Based on the estimated volumes and corresponding pollutants loads characterization, the runoff volume and/or contaminant loads reductions will be quantified. Comparison of these numbers with the TMDLs, taking into account the existing control measures, will allow assessment of the need for additional control measures.

After it has been established that additional runoff control measures are necessary to address compliance, alternatives, structural, non-structural, and combinations of both types of control measures can be generated as customization and/or retrofits of existing measures or as new ones, based on site-specific considerations. Existing control measures that do not address or partially address the water quality priorities and have proven to present challenges will be evaluated for elimination or customization in order to modify their function and/or increase their effectiveness. This process will include the qualitative evaluation of non-structural minimum control measures (MCMs), such as public outreach material and industrial inspection frequency, using tools such as surveys of the knowledge base of agency stormwater staff. Factors such as cost, poor performance, difficult maintenance, resources intensiveness, and redundancy will be taken into consideration.

A comprehensive evaluation will be conducted to evaluate a variety of treatment strategies for their ability to meet reductions in WLAs; minimize bacteria exceedances for drainage areas in the MdR watershed; and provide multiuse benefits, which include flood control protection, recreational enhancements, and stormwater reuse, when possible.

In addition to structural measures, reductions in runoff using source control BMPs will be evaluated (e.g., smart irrigation systems, drip irrigations systems, drought tolerant landscaping, ordinance enforcement, and public education and/or outreach programs). This collective approach will provide a long-term solution for TMDL compliance in the MdR watershed. The nonstructural programs may consist of expansions of existing programs or may be based on applicable data available or TMDL compliance recommendations proposed in other reports and special studies.

The analysis will consider a multitude of factors involved in the assessment of structural BMPs, including geology, hydrology, land use, watershed characteristics, drainage area, runoff characteristics, BMP types and combinations, BMP performance, and associated costs.

Geographic Information System (GIS) analysis will be used to assist as a site selection tool, with focus on the availability of public parcels. Only sites within a public ROW or on publicly owned land will be considered during the identification process.

A BMP optimization matrix will be developed as a comparison tool of different individual BMP type functionality, with the greatest focus put on their multi-pollutants and multi-benefits potential. A similar assessment matrix will be generated for calculated and compiled performance efficiencies for different BMP types. A Life Cycle Cost estimation will be prepared for each BMP type and a corresponding dollar value will be estimated per unit pollutant load reduction and unit volume reduction as an additional means to compare the different BMPs. Using these optimization matrices, similar measures will be calculated for a combination of systems of BMPs in series, on-site and/or regional, and online and/or offline alternatives.

8.1 Example Regional BMPs

Opportunities for Regional BMPs will be evaluated within and across subwatersheds, with focus on the multi-benefits potential for capture and reuse of wet weather flows corresponding to the 85^{th} percentile, 24-hour storm events, for variable drainage areas.

Availability of public land will be the first criteria directing the location identification and BMP type selection process. GIS analysis will be used to assist as a site selection tool to identify potential public parcels.

Where large public areas are available (and applicable), including parks, feasibility of using these spaces as capture and reuse Regional BMPs will be evaluated with the corresponding drainage area identified.

Soil investigations performed as part of the County's Parking Lot 5 Project in MdR shows a groundwater depth around 5 feet near MdRH. However, soil investigations from the County's Parking Lot 7 Project East of Oxford Basin demonstrate a groundwater depth close to 20 feet, which provides infiltration BMP opportunities in the upstream area of the MdR watershed.

In the highly urbanized areas, as is the case for a majority of watersheds in the Los Angeles Region, where public land is not available, the potential for the capture and reuse of wet weather runoff may be evaluated for underground storage facilities and green streets application. This might be applicable for areas in Subwatershed 4, under the jurisdiction of the City of Los Angeles. The network of storm drain and catch basin in these residential and commercial areas would be evaluated for locations where underground capture is maximized. Green streets should be designed in conjunction with the evaluations and captured water would be used to maintain the green streets.

In addition, existing infrastructure will be assessed for potential modifications to maximize their benefits as potential Regional BMPs. Examples of these include Boone Olive Pump Plant in Subwatershed 3, under the jurisdiction of the City of Los Angeles, and Venice Canals and Ballona Lagoon in Subwatershed 2, under the jurisdiction of the City of Los Angeles and the County.

8.2 Regional BMP Selection Tool

The MdR EWMP will propose measures aimed at targeting multi-pollutants on a regional scale. A composite ranking matrix will be generated to prioritize areas of concern based on their contributions to the total watershed contaminant loads. Individual projects will be assigned a relative priority, based on priority sources, number of priority pollutants, opportunity to transport to marina waters, and/or opportunities for bacterial regrowth, as determined from past special studies and reports. Generally, pollutant sources that contributed both bacterial and toxic pollutants will be given priority over sources that contributed to a single type of pollutant. Also, a higher priority will be given to projects building upon existing programs. Each structural solution will identify the BMP type, goal, description, targeted pollutant and audience, assessment, and potential methods of measure for effectiveness assessment. Source identification studies, code modification evaluations, and other baseline projects will also be given higher priority.

This section provides guidance on factors that should be considered when selecting BMPs for existing, new development, or redevelopment projects. BMP selection involves many factors such as physical site characteristics, water quality objectives, multi-benefits potential, aesthetics, safety, maintenance requirements, and cost that provide opportunities for BMPs or constrain BMP selection. Typically, there is not a single answer but rather multiple solutions ranging from stand-alone BMPs to treatment trains that combine multiple BMPs to achieve water quality objectives as well as other benefits such as flood control and recreation. A BMP selection decision tree is presented in Figure 14.

It is important to start the following discussion by noting that in the highly urbanized setting of MdR, the availability of public land will be a determining factor in the feasibility of implementation of a structural BMP. Another very important factor is the fact that the MdR watershed is characterized by a high groundwater table and strong tidal influence which decrease in the North Eastern direction in the watershed. Regional BMPs however are not limited to infiltration BMPs. A collection of distributed BMPs, such as green streets, to capture the 85^{th} percentile, 24-hour storm event would qualify as a Regional BMP.

Five geological and hydrological characteristics were identified as important in determining the feasibility of BMP scenarios in terms of BMP type and site selection evaluation. These characteristics are depth to bedrock, type of bedrock, soil characteristics, depth to water table, and land use. In addition, other factors affecting the implementation of a control measure include compatibility with the surrounding area, health and safety, maintenance considerations, cost feasibility, and performance and risk analysis. The factors are further discussed below. Existing maps of these five characteristics, when applicable, will be used whenever possible, along with GIS modeling and aerial photography and/or remote sensing to assist in BMP site and type selection. The integration of surface and subsurface information to map such parameters will provide more data that are directly relevant in the decision-making process of urban and county planners, engineers and developers, and geotechnical investigators.

1. Type of and Depth to Bedrock—Bedrock that is commonly fractured, such as shallow dolomite or limestone, is highly susceptible to contamination. The fractures provide direct and rapid pathways for contaminants to reach the water table. Groundwater within sandstone formations is less susceptible because sandstone contains fewer well-connected fractures. Soil and sediment overlying bedrock slows seepage to the water table. A greater depth to bedrock increases groundwater protection. The depth-to-bedrock value limits capabilities and activities on the surface.

2. Soil Type—Soils are classified by the Natural Resource Conservation Service into the four Hydrologic Soils Groups, A, B, C and D, where As, are generally the deepest, have the smallest runoff potential, and highest infiltration rate and Ds generally have the greatest runoff potential and lowest infiltration rate and include soils with a permanent high water table, soils with high swelling potential, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. Soils A and B are well-suited for infiltration-based BMPs such as rain gardens, permeable pavement systems, sand filter, grass swales, and buffers, often without the need for an underdrain system.

3. Depth to the water table—Shallow groundwater may limit the ability to infiltrate runoff. In addition, groundwater quality protection is an issue that should be considered for infiltration-based BMPs. For example, infiltration BMPs should be avoided for land uses that involve storage or use of materials that have the potential to contaminate groundwater underlying a site, such as runoff from fueling stations or materials storage areas. In addition, the deeper the groundwater table, the better the opportunity for contaminants to be filtered or to degrade before arriving at the water table.

4. Land Use—The land use cover identifies potential areas where regional and decentralized BMP implementation might be feasible. In addition, it allows the quantification of the degree of urbanization and imperviousness, both important factors affecting BMP type and location selection. Space constraints are frequently cited as feasibility issues for BMPs, especially for high-density, lot-line-to-lot-line development and redevelopment sites, where there is a limited amount of publicly operated land available to implement the larger scale projects that would be necessary to capture and/or reuse runoff. The primary focus will be to identify opportunities to retrofit existing conveyance systems, parks, and other recreational areas with water quality protection measures.

5. Existing Utilities—Utilities are frequently located below ground, which coincides with the feasible locations for stormwater BMPs. Typically, water and sewer piping, natural gas lines, and telephone and electrical conduits are located in the public ROW and on individual parcels. BMPs will require modification to fit into the limited available space without disrupting existing utilities, or utilities will require relocation for BMP installation.

6. Compatibility with Surroundings—Stormwater quality areas can add interest and diversity to a site, serving multiple purposes. Gardens, plazas, rooftops, and parking lots can become amenities and provide visual interest while performing stormwater quality functions and reinforcing urban design goals for the neighborhood and community. The integration of BMPs and associated landforms, walls, landscape, and materials can reflect the standards and patterns of a neighborhood and help to create lively, safe, and pedestrian-oriented districts. The quality and appearance of stormwater quality facilities should reflect the surrounding land use type, the immediate context, and the proximity of the site to important civic spaces. The standard of design and construction should maintain and enhance property values without compromising function. In addition, construction staging should be sited in a way to minimize the effect of construction mobilization and noise to adjacent tenants

7. Health and Safety—Stormwater quality facilities must be designed and maintained in a manner that does not pose health or safety hazards to the public. The potential for nuisances, odors, and prolonged soggy conditions should be evaluated for BMPs, especially in areas with high pedestrian traffic or visibility. Urban areas are heavily populated, which adds to safety concerns when considering potential BMPs such as ponds, wetlands, and surface sand filters. Open surface systems may require additional measures such as fencing to ensure public safety and reduce vandalism. Often the only feasible location for BMPs in developed areas is underground, which presents more complex maintenance issues that trigger worker safety requirements. The installation of subsurface BMPs may require maintenance activities to be performed in confined spaces. Confined spaces have specific entry requirements to ensure safety that would need to be followed each time BMPs are inspected or maintained.

8. Maintenance—BMPs can be more effectively maintained when they are designed to allow easy access for inspection and maintenance and to take into consideration property ownership, easements, visibility from easily accessible points, slope, vehicle access, and other factors. Clear, legally-binding written agreements assigning maintenance responsibilities and committing adequate funds for maintenance are also critical. Maintenance requirements must be carefully planned and implemented when access to subsurface BMPs is limited to manhole openings or requires the removal of grates and panels. Subsurface BMPs may be considered confined spaces and require additional measures to ensure safe access for inspection or maintenance. As a result of these potential restrictions and/or additional measures, BMP technologies that require maintenance on an annual or semiannual basis are often preferred to those requiring more frequent maintenance. Difficulty in performing the maintenance (increased level of effort) can increase the cost of the required maintenance.

9. Watershed Characteristics—The contributing drainage area is an important consideration both on the site level and at the regional level. On the site level, there must be a practical minimum size for certain BMPs related to the ability to drain and treat the associated runoff over the required drain time. On the regional level, there must be a limit on the maximum drainage area for a regional facility to assure adequate treatment of rainfall events. In addition, in a highly urbanized setting, small drainage areas and undefined outfalls limit the number of treatment strategies that can be used to treat stormwater runoff.

10. BMP Categories—BMPs can be categorized based on their functionality (storage versus conveyance) and design strategy (stand-alone versus in series; online versus offline). Storage-based BMPs provide volume reduction benefits and include bioretention and/or rain gardens, extended detention or dry basins, sand and/or media filters, constructed wetland ponds, retention or wet ponds, and permeable pavement systems. Conveyance-based BMPs include grass swales, grass buffers, constructed wetlands channels,

and other BMPs that improve quality and reduce volume but only provide incidental storage. Ideally, a combination of conveyance-based and storage-based BMPs can be used to allow the implementation of multiple benefits BMPs. Given the natural variability of the volume, rate and quality of stormwater runoff, and the variability in BMP performance, using multiple practices in a treatment train that links together complementary processes can expand the range of pollutants that can be treated and increase the overall efficiency of the system for pollutant removal and provide system redundancy; also, the land requirements for a combined facility are lower than for two separate facilities. In addition, BMPs may be designed to be online such that all of the off-site runoff from the upstream watershed and site runoff is intercepted and treated by the BMP. Locating BMPs offline requires that all on-site catchment areas flow though a BMP prior to combining with flows from the upstream off-site watershed.

11. BMP Performance—BMP performance evaluation is not required for Regional BMPs, except to the extent that they capture the 24-hour 85th percentile storm. Performance of various BMPs depends on numerous factors, such as BMP type, design, site, storm characteristics, monitoring methodology, performance measures, and pollutant loadings. A comparison of available performance data is presented in Section 7.3.5 above. It is important to note that a wide range of reported effectiveness data exist that varies widely between and among different BMPs.

12. Cost Estimates—Cost effectiveness is an essential component in BMP planning and selection, especially with the stricter regulations and leaner budgets imposed on stormwater management programs. Life cycle cost (LCC), which refers to all costs that occur during the economic life of a project, should be optimized. Generally, the components of the LCC for a constructed facility include construction, engineering and permitting, contingency, land acquisition, routine operation and maintenance, and major rehabilitation costs minus salvage value. It is also recommended that the cost of administering a stormwater management program be included as a long-term cost for BMPs. One method to assess and compare the LCC of various BMPs is to use the net present value (NPV) of the whole life costs of the BMP(s) implemented, the average annual mass of pollutant removed, and the average annual volume of surface runoff reduced to compute a unit cost per pound of pollutant or cubic feet of runoff removed over the economic life of the BMP.

13. Risk Assessment—A risk assessment will be conducted for the selected BMP systems by evaluating estimated reduction efficiencies, treatment capacity, whether or not a BMP can be integrated with other BMPs, likelihood of failure, and ease of adaptive customization.

14. Other Factors—California Environmental Quality Act (CEQA) environmental consideration not listed above include cultural resources, greenhouse gas emissions, and air quality and traffic will be preliminarily assessed for potentially significant impact to identify permitting and potential mitigation requirements at this early assessment phase

The diagram presented in Figure 14 depicts the iterative multi-stage nature of the BMP selection process necessary to ensure the optimal BMP strategies combinations are selected while accounting for the complex relational dynamics between the different BMP selection considerations, such as cost, risk, and effectiveness.

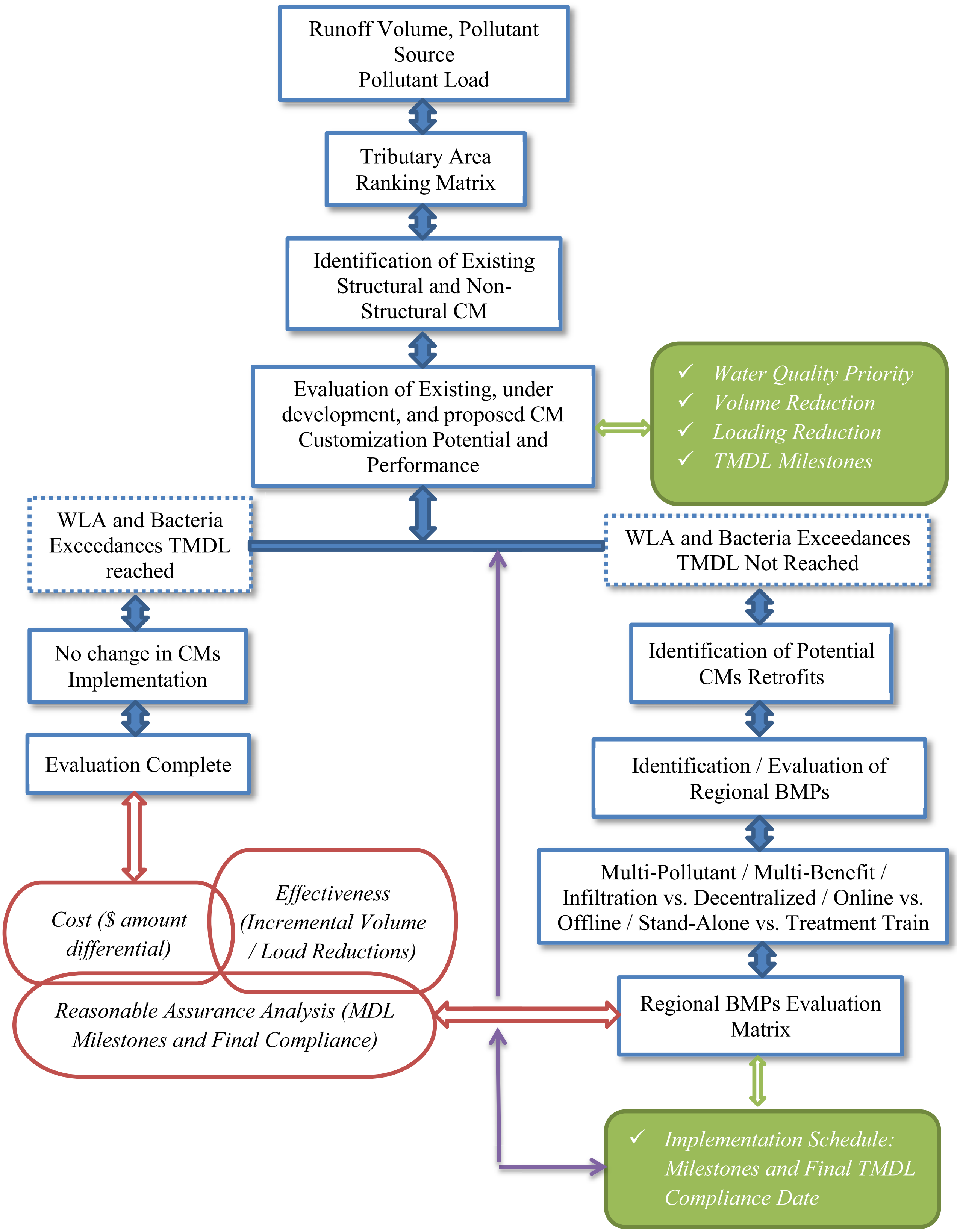


Figure 14. Conceptual Diagram of EWMP BMPs Selection Decision Tree

9.0 REASONABLE ASSURANCE ANALYSIS

A key element of the MdR EWMP will be the Reasonable Assurance Analysis (RAA). The purpose of the RAA is to quantitatively demonstrate that the proposed control measures designed in the EWMP will "achieve applicable WQBELs and/or RWLs with compliance deadlines during the Permit term" (Section C.5.b.iv.(5) of the 2012 MS4 Permit). The RAA requires the development of a modeling process to support the selection of BMPs as well as an adaptive customization and scheduling process to demonstrate and address compliance with the MS4 Permit. The RAA for the MdR watershed will comply with RAA guidelines provided by the LARWQCB to the extent practicable and applicable to the watershed.

The following sections describe the modeling tool selection justification and model configuration processes. They also describe the BMP adaptive selection methodology, including selection of BMP types and evaluation of their effectiveness, their pollutant removal potential, location optimization, and risk evaluation and cost minimization, as well as implementation scheduling to address conformity with compliance milestones.

9.1 Modeling Tool Selection

The MdR EWMP agencies have selected the Los Angeles County WMMS as the model to be used for the development of the MdR EWMP, as allowed by the corresponding MS4 Permit.

WMMS is a computer-based decision support system developed by LACFCD for all major watersheds within the County to simulate hydrologic and pollutant generation and transport processes. The model results help identify cost-effective pollution reduction measures to address urban runoff and stormwater quality issues and TMDL implementation planning. WMMS provides a tool for future planning of multi-benefit projects involving water quality, flood control, water conservation, and open space development.

The WMMS expands on the USEPA watershed and BMP selection optimization models, Loading Simulation Program in C++ (LSPC) and the System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN) model.

WMMS will be used for the MdR watershed to support the estimated current loadings and the required load reductions that will be used to set targets and/or goals for selected BMPs and watershed management strategies, and to demonstrate that the activities and control measures identified and selected in the MdR EWMP will achieve applicable WQBELs and/or RWLs. The MdR watershed is a highly urbanized area with a typically uniform distribution of land use, soil types, and imperviousness. The groundwater table across the watershed is variable with deeper levels at the northeastern boundary. These characteristics make the MdR watershed different from other larger watersheds. The modeling tool will be used to the extent applicable for the watershed, in conjunction with other spreadsheet analysis.

WMMS conforms to the modeling system selection criteria set by the LARWQCB–led RAA committee to ensure that an RAA is performed in the process of developing the MdR EWMP. WMMS has the following capabilities: (1) provides a dynamic, continuous, long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system; (2) accounts for rainfall and runoff for urban and natural watershed systems; (3) represents variability in pollutant loadings, based on land use, soil hydrologic group, and slope; (4) follows a BMP process based approach; and (5) can function as a decision support system to evaluate BMP performance, risk, and cost.

9.2 WMMS Model Configuration

The WMMS was calibrated for all major watersheds within the County to simulate hydrologic and pollutant generation and transport processes. Therefore, it incorporates watershed-specific initial default input values of the calibration parameters, which may need to be modified based on more recently available data to be consistent with the current watershed conditions.

The input information that will potentially be verified and updated in the WMMS input files includes land use, precipitation, imperviousness, drainage characteristics, and land use load allocations. The model will subsequently be recalibrated and validated using the most recent monitoring information, collected as part of the Coordinated Monitoring Plans for the MdR watershed.

WMMS was calibrated for a total of eight watersheds, one of which is the Ballona Creek watershed. For the MdR EWMP watershed area, WMMS was calibrated based on monitoring information for the Ballona Creek watershed, a total of 130 square miles, segmented into seven subwatersheds based on the drainage network. The Ballona Creek watershed is adjacent to the MdR watershed and possesses similar characteristics; therefore, the current calibrated model incorporates an accurate representation of the MdR watershed. This similarity will be verified in the current effort, and the relevant adjustments will be performed as deemed necessary.

The application of WMMS to simulate the MdR watershed runoff and pollutant transport will require the adaptation of the model to the MdR watershed. This adaptation involves multiple steps, including the segmentation of watershed, the configuration of key model components (i.e., soils, land use representation, meteorological data), the model calibration and validation (for hydrology, sediment, and pollutants), and multiple scenario model simulation. These steps are discussed below.

9.2.1 Segmentation

The segmentation of MdR watershed into smaller discrete subwatersheds in WMMS for modeling and analysis will be investigated. In WMMS, subwatershed segmentation is based primarily on drainage networks, such as engineered storm drain and stream networks, and secondly on the topography, the flow, and the location of water quality monitoring stations, as well as the consistency of hydrologic factors, land use consistency, and existing hydrologic boundaries. Based on the specific objective of the simulation runs to be performed, the sensitivity of the model to segmentation in the MdR watershed will be shown. Objectives include model calibration, jurisdictional loading assessment, and storm runoff volumes evaluation. For example, the potential of modifying the MdR subwatershed boundaries assigned in WMMS will be evaluated to allow the model to generate runoff volumes and pollutant loadings representing the various MdR Subwatershed 1, 2, 3, and 4, as well as jurisdictional boundaries of the MdR EWMP agencies within each subwatershed modeled. Where monitoring information is not available, such as in the case of Subwatershed 2, the most representative subwatershed calibration or an average of the various subwatersheds will be used.

9.2.2 Drainage Characteristics

WMMS incorporates a GIS layer containing flow directions for all subwatersheds. Subwatershed routing will be scrutinized to ensure that flow routing is accurately represented within and between subwatersheds of the MdR watershed. The highest resolution will be used, depending on the data availability and the feasibility of implementation. Using the highest resolution might be of significance for the assessment of the runoff in the Front Basins, which were included in the revised TMDL. In addition, the drainage network for the MdR watershed will be updated for the analysis to ensure that the most current infrastructure is represented in the model and accounted for during the BMP selection process. Point sources and hydromodifications will also be identified and incorporated in the simulation process.

9.2.3 Landuse/Imperviousness

WMMS assigns imperviousness based on land use categories. Imperviousness is then used as a basis to distribute hydrologic and water quality parameters. Land use will be updated based on information provided by the EWMP agencies. In addition, it will be updated based on GIS and aerial imagery to account for redevelopment, new developments, and public structures, such as previously marked vacant land use areas. The combination of land use, soils, and slope influence, used by WMMS to assign Hydrologic Response Units (HRUs) provides a sound physical basis for refining and differentiating the representation of vacant land. For that reason, this land use category might need to be refined to better represent the physical variability and variations in an area's hydrologic response to weather. The highest spatial resolution will be used based on the most recent available information from a variety of spatial data sources to create composite land use and imperviousness maps.

9.2.4 Land Use Based Loadings

To capture the pollutant loading of sources, WMMS is set up to include a suite of land uses that represent a variety of pollutant sources, forming the basis for the representation of pollutant generation and accumulation and the resulting pollutant runoff and delivery to receiving waterbodies. Pollutant loading in WMMS is correlated with the HRUs defined within the model.

9.2.5 Meteorological Data

Rainfall-runoff processes for each subwatershed are driven by precipitation data. The most recent rainfall time-series data with the highest applicable time resolution from the most representative station for the MdR watershed will be updated into WMMS, as provided by the EWMP agencies. Original rainfall data included in the formal model calibration extend from 1987 to 2006. Evapotranspiration and other meteorological factors (such as wind speed and air temperature), which were processed and evaluated during the formal development of WMMS, are not anticipated to be modified in this effort.

9.2.6 Watershed Boundaries

The potential for modifying the MdR subwatershed boundaries assigned in WMMS will be evaluated to allow the model to generate runoff volumes and pollutant loadings within the respective set boundaries. These boundaries will be defined and assessed based on different objectives, including BMP site selection. As an example, multiple runs representing the various jurisdictional boundaries of the EWMP agencies entities within each subwatershed modeled will be evaluated for runoff volumes and pollutant loadings, through the use of the corresponding land use types and areas.

9.2.7 Recalibration and Validation

Model calibration and validation is a critical step that will be performed prior to model application to ensure as accurate as possible a representation of the physical system, with allowed confidence level criteria, summarized in Table 20.

Calibration refers to the adjustment or fine-tuning of modeling parameters to reproduce observations on the basis of field monitoring data. The simulation and calibration of the hydrologic and water quality components of the watershed model will be performed to obtain physically realistic model predictions by selecting parameter values that reflect the unique characteristics of the watersheds represented, in this case, MdR. Spatial and temporal aspects will be evaluated through the calibration process using the representative monitoring stations and associated drainage areas and events. Where monitoring information is not available, weighted area averaged calibration parameters will be used.

The calibration of WMMS for the MdR watershed and subwatersheds will be an iterative process of parameter evaluation and refinement as a result of comparing simulated and observed values of interest. It is required for parameters that cannot be deterministically and uniquely evaluated from topographic, climatic, physical, and chemical characteristics of the watershed and compounds of interest. The hydrologic calibration will be based on the available years of simulation to evaluate parameters under a variety of climatic conditions and produce the best overall agreement between simulated and observed values throughout the calibration period. Calibration might include, as applicable and feasible, a time series comparison of daily, monthly, seasonal, and annual values, and individual storm events. Composite comparisons (e.g., average monthly stream flow values over the period of record) might also be made for a proper calibration of hydrologic parameters.

The second step following hydrologic calibration will be sediment calibration. Considering that several of the pollutants of concern in the MdR watershed are assumed to be transported as sorbed to sediment (TSS), accurate sediment simulation is an important step in water quality modeling. TSS calibration will be performed using the most recent monitoring information for TSS within the MdR watershed. The water quality calibration for the pollutants of concern will follow the TSS calibration. The objective of the water quality calibration is to select water quality parameters that adequately represent the loading generation capabilities for the different modeled HRUs for a wide range of storm intensities specific to the MdR watershed.

The third step following hydrologic and sediment parameter calibration is pollutant modeling calibration. The removal of sediment-associated water quality constituents is simulated by multiplying the mass of sediment (tons/acre/time interval) washed off in runoff by a washoff potency factor (POTFW) (pollutant quantity/ton), the amount of a pollutant that is associated with a ton of sediment for a land segment. Different POTFW parameter values exist for copper, lead, zinc, DDT, and PCB by land use. For this calibration, a potency factor analysis will be performed using available storm sampling data. To estimate the potency factors, mass- and flow-weighted concentrations will be used to calculate the ratio between the metals and the sediment by land use. The derived values will then be compared to previously estimated potency factors during the initial WMMS calibration, and these factors will be updated if needed.

9.2.8 Model Simulation Calibration Criteria

As noted previously, the application of WMMS for the MdR watershed was based on its calibration using the Ballona Creek hydrology and quality monitoring data. Because new monitoring data exist for the MdR watershed, the model will be recalibrated using the MdR-specific information, in conjunction with the other updated information discussed in the previous subsections. The acceptable model calibration criteria are listed in Table 20, as provided by the RAA Technical Advisory Committee (TAC) sub-committee to ensure the calibrated model properly assesses all the model parameters and modeling conditions that can affect model results.

Table 20. Model Calibration Criteria

Model Parameters	% Difference Between Simulated and Observed Values		
	Very Good	Good	Fair
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

9.3 BMP Selection Methodology

The MdR watershed is very different from the other Los Angeles watersheds because it is small and highly urbanized, with a large portion of the lower watershed within a high groundwater and tidally influenced former estuary. A combination of regional, decentralized, and institutional BMPs, including LID filtration, street sweeping, and storm water reuse, will be required to address attainment of the stormwater volume and pollutant loading reductions necessary for compliance.

A hierarchical, iterative, risk-based optimization process will be used for the identification, evaluation, and selection of a suite of control measures and corresponding implementation plans. The identification and evaluation of potential control measures will be based on multiple factors in two categories, functional performance goals and drainage area location and pollutant reduction prioritization. This section discusses these factors.

9.3.1 Control Measures Effectiveness Potential

Using a statistical quantification of a concentration or load-based percent efficiency metric to represent the performance of a BMP system does not reflect the variability of its effectiveness in real-world conditions. A composite average rating score, Effectiveness Potential (EP), will be developed to account for the compounded nature of the many factors affecting the performance and effectiveness of a BMP strategy.

A weighted value of the compounded BMP system efficiency estimates, which will be selected using the empirical databases analyzed and presented in Section 7, will be calculated. In addition, the efficiency associated with a BMP system will be weighted by a score generated using a quantitative ranking matrix. This matrix will account for non-quantifiable factors such as the potential for a management strategy to generate multiple benefits, including volume reduction, multiple pollutant removal, ability to be implemented on public land, and ease of operation and maintenance in the context of MdR. The MdR Multi-pollutant Implementation Plan provides a list of BMPs applicable to the MdR watershed along with qualitative descriptions of some of their requirements. A summary is presented in Table 21. This table will be verified and modified and a version of it will be used as the basis for further analysis of potential BMPs.

The BMP strategy-specific efficiency estimates, weighted by the site-specific composite scores, result in the EP. The EP will be used to rank the BMP types. The highest EP will be associated with the relatively best performance and effectiveness.

An additional third weighting process, involving a drainage area and pollutant prioritization mechanism, will be considered in the evaluation and selection process. This process is discussed in the following sections.

9.3.1.1 Pollutant Removal

Concentration and mass based pollutant removal efficiency values for various BMP types, are presented in Section 7.0 of this document. Removal of pollutants varies widely among and across different BMPs and is a factor of drainage area, land use, storm characteristics, design, and operational considerations. Therefore, the estimated efficiencies extend over a wide range of values, including negative estimates. Studies with negative efficiencies (the BMP acted as a source, not a sink for pollution) will be included in the EP development process because they reflect operational conditions, such as natural processes or construction and operational related issues, which can create a system that is not providing its expected pollutant removal. Alternatively, if negative efficiencies were not included, efficiencies could be discounted to account for failed systems that occur operationally. This inclusion may be achieved by decreasing the confidence level when selecting the efficiency measures to be used in the calculations.

Table 21. Example Review of Site Specific Best Management Practices as Presented in the Multi-Pollutants Implementation Plan (LADPW, 2012)

Best Management Practices	Scoping			Evaluation: Controlling Factors		Evaluation: Additional Factors								Final Selection				
	Bacteria Removal Efficiency (%)	Configuration	Effective Life[1,3] (yrs)	Water Quantity Reduction	Applicable in Areas with High Groundwater Table	Applicable in Areas with High Groundwater Table Using Modifications or Underdrains	Area Required for BMP[1,5]	Independent of Natural Underlying Soils	Maintenance Requirements	Subsurface	Surface	Training	Viability in Urbanized Areas	Additional Benefits[7]	Capital Costs	Construction Timeline	Public Acceptance	No Safety Concerns
<u>THIS TABLE HAS BEEN IMPORTED AS AN EXAMPLE FROM THE MdR MULTI-POLLUTANT IMPLEMENTATION PLAN; THE NUMBERS AND SOURCES IN THIS TABLE WILL BE VERIFIED AND MODIFIED AS NEEDED FOR THE PURPOSE OF THE EWMP DEVELOPMENT.</u>																		
Detention and Retention Practices																		
Detention Tanks and Vaults	NA[1]	Offline	50–100	✓		✓	0.5–1%	✓	Frequent Cleanout	✓		Mod.	✓		Mod. - High	Mod. - High	✓	
Dry/Wet Ponds	70–88[2]	Both	20–50	✓	✓		10–20%	✓	Annual Inspection		✓	Low		✓	Mod.	Mod.	✓	
Extended Detention Basins	78	Both	--	✓			--		Biannual Inspection		✓	Low			Mod. - High	Mod.		
Wetlands and Shallow Marsh Systems	78[2]	Both	20–50		✓		10%		Annual Inspection		✓	Low		✓	Mod. - High	Mod. - High	✓	
Filtration Practices																		
Green Roofs	70–90[3]	Offline	--	✓	✓		NA	✓	Biannual Inspection		✓	Low	✓	✓	Mod. - High	Mod.	✓	✓
Filtration and Disinfection Facilities	70–90[3]	Both	--		✓		NA	✓	Frequent Inspection		✓	High	✓		High	Mod. - High		✓
Organic Media Filters	90[1]	Offline	5–20		✓		2–3%	✓	Annual Media Removal	✓	✓	Low	✓		High	Mod.	✓	✓
Surface Sand Filters	70–90[3]	Offline	5–20		✓		2–3%	✓	Biannual Media Removal		✓	Low			Mod.	Mod.		
Underground Sand Filters	70–90[3]	Offline	5–20		✓	✓	2–3%	✓	Annual Media Removal	✓		Mod.	✓		High	Mod.	✓	✓
Infiltration Practices																		
Bioretention[8]	70–90[3]	Both	5–20	✓		✓	4–10%	✓[6]	Mowing / Plants	✓	✓	Low	✓	✓	Mod.	Low	✓	✓
Infiltration Basin	75–98[1]	Offline	5–10	✓			2–4%		Mowing / Sediment Removal		✓	Low		✓	Mod.	Mod. - High	✓	
Infiltration Trench	75–98[1]	Both	10–15	✓		✓	2–4%		Biannual Inspection		✓	Mod.	✓		Mod. - High	Mod.		✓
Porous Pavements																		
Porous Pavements	NA[1,3]	NA	15–20	✓		✓	NA	✓[6]	Biannual Vacuum	✓	✓	Low	✓		Mod. - High	Mod. - High	✓	✓
Proprietary Devices																		
Cartridge Filters	50–80[1]	Offline	--		✓		<1%	✓	Frequent Cleanout	✓		Mod.	✓		Mod.	Low	✓	✓
Catch Basin Inserts	40–70[4]	In-line	--		✓		None	✓	Frequent Cleanout	✓		Low	✓		Low	Low	✓	✓
Hydrodynamic Devices	40–70	Both	--		✓		None	✓	Periodic Cleanout	✓		Low	✓		Mod.	Low	✓	✓
Proprietary Biotreatment Devices	Up to 96	Offline	--		✓		--	✓	Periodic Cleanout	✓	✓	Mod.	✓	✓	Mod.	Low	✓	✓
Low Flow Diversions to Sanitary Sewers	100	In-line	--		✓		None	✓	Periodic Cleanout	✓		Mod.	✓		High	Mod. - High	✓	✓
Stormwater Storage																		
Cisterns	70–90[3]	Both	--	✓	✓		4%	✓	Biannual Inspection	✓	✓	Low	✓	✓	Low - Mod.	Low	✓	✓
Rain Barrels	70–90[3]	Both	--	✓	✓		4%	✓	Biannual Inspection		✓	Low	✓	✓	Low	Low	✓	✓
On-Site Storage and Reuse	70–90[3]	Offline	--	✓	✓	✓	--	✓	Biannual Inspection	✓	✓	High	✓	✓	High	Mod. - High	✓	✓
Vegetated Swales																		
Vegetated Swales	25–50	In-line	5–20	✓	✓	✓	10–20%		Mowing		✓	Low	✓	✓	Low	Low	✓	

Notes: **<u>THIS TABLE HAS BEEN IMPORTED AS AN EXAMPLE FROM THE MdR MULTI-POLLUTANT IMPLEMENTATION PLAN (LADPW, 2012); THE NUMBERS IN THIS TABLE WILL BE VERIFIED AND MODIFIED AS NEEDED FOR THE PURPOSE OF THE EWMP DEVELOPMENT.</u>**

[1] U.S. Department of Transportation – Federal Highway Administration: Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring

[2] Green Country Stormwater Alliance – National Pollutant Removal Performance Database, Version 3

[3] Neponset River Watershed Association – Fact Sheet: The Wetlands Act & TMDLs

[4] Assumes regular maintenance, occasional removal of accumulated materials, and removal of any clogged media.

[5] Expressed as a percent of the total drainage area; can be modified to accommodate urban conditions.

[6] When equipped with an underdrain system.

[7] Recreational, wildlife habitat, aesthetics, etc.

[8] Bioretention systems may include raised planters and flow-through planter boxes that act as LID filtration devices.

9.3.1.2 Minimum Control Measures/Institutional BMPs

Institutional BMPs will be evaluated. These include street sweeping (mechanism and frequency) and trash removal, as well as education and enforcement. Multiple scenarios of institutional control measure efficiencies will be incorporated into the analysis through the different associated EPs based on the relevant available studies, as discussed in Section 7.0. The scheduling scenarios will also be considered in the selection and implementation of the institutional BMPs. Participating agencies are continuing to implement the MCMs required under the 2001 MS4 Permit. Applicable new MCMs will be implemented by the time the EWMP is approved by the Regional Board

9.3.1.3 Volume Reduction

BMPs that promote infiltration and/or that incorporate evapotranspiration have the potential to reduce the volume of runoff generated. Volume reduction control measures have many benefits in terms of hydrology, sediment washoff, and pollutant mobilization. Groundwater elevation information throughout the MdR watershed will be necessary to evaluate the potential implementation of large infiltration BMPs. Based on a communication with the City of Los Angeles in December 2013, it is observed that inland areas of the watershed are characterized by a groundwater table deeper than 20 feet.

9.3.1.4 Operational Conditions

Efficiencies need to be adjusted based on operational conditions. Where possible, efficiencies will be adjusted for surface water and groundwater interactions, along with geology and soil types (e.g., slope, seeps, floodplain). Management conditions, including the operation and maintenance of the BMP, design and construction supervision, and/or upland land use change will also impact efficiencies. If maintenance is neglected, a BMP may become impaired, no longer providing its functions as designed. Proper maintenance of outlet structures, flow splitters, and clean-out gates is critical to achieving the designed efficiency of a stormwater BMP. As an example, in a scenario where a BMP whose performance depends on the underlying groundwater table is selected for a site with a high groundwater table, the BMP's efficiency will be reduced to represent the overall conditions that will govern the performance of the BMP.

The efficiency estimates summarized in Section 7.0 include negative numbers that represent situations of natural or man-caused impairment of a BMP. These negative numbers will not be excluded from the statistical analysis of efficiencies.

9.3.1.5 Public Land Availability

Individual BMPs require surface area footprints based on their expected design-based water volume and water quality load reduction. In highly urbanized areas where limited public land and ROW are available, BMPs with high acreage requirements are of limited applicability and may contribute a significant added cost to an otherwise optimal management strategy.

9.3.1.6 Existing and Proposed BMPs

The performance of existing BMPs will be evaluated depending on the availability of quantitative and/or qualitative information. The associated load reductions will be subtracted from the model load estimation to be included in the analysis of the additional required BMPs. Load reductions associated with proposed BMPs will be similarly incorporated. When possible, the type and location of these BMPs that are not yet in their planning phase will be reassessed.

9.3.2 Control Measures Location Prioritization

Currently, there are several water quality monitoring stations located throughout the MdR watershed. Section 3.0 of the MdR EWMP Work Plan provides a summary of water quality information from different efforts relevant to MdR, including the results from the monitoring stations in MdRH, pursuant to the MdR TMDL Monitoring Plan. For each monitoring site, a pollutant-specific weighting factor may be generated from the number of exceedances and/or the percent exceedances for each pollutant, using the available MdR monitoring data. A composite weighting factor may be obtained, for a specific site or drainage area as the product or summation of its corresponding pollutant weighting factors. The resulting monitoring site-specific factors are associated with the drainage area corresponding to that monitoring site. A high factor signifies a potential for high pollutant loadings. Adjusting the composite weighing factors by their corresponding drainage area acreage will assign a Site Priority Score (SPS) to that drainage area. This score will help identify what kind of treatment capacity is necessary and how it might be optimally distributed upstream of an assessment point. A large area with low factors might have a lower score than a smaller area with relatively high pollutant factors.

9.3.3 Cost and Risk Optimization

Various BMPs can be associated with specific cost and risk factors based on the strategy adopted in their implementation. These factors will be incorporated in the evaluation and selection process of the runoff management strategies. The estimation of a CEM in terms of $/mass reduction/year and/or $/volume reduction/year, and/or $/drainage acre might provide some insight in the BMP selection process. The optimal volume and/or pollutant loading reduction contribution of a certain BMP strategy, in conjunction with the best value, will be selected, taking into consideration the risk associated with the design storm selection. Nonstructural BMPs will also be included in the analysis.

WMMS includes cost-effectiveness curves derived for various management levels, as achieved pollutant percent load reductions with associated cost for representative BMPs. These curves are subwatershed-specific. They represent the highest pollutant reduction benefit at the minimum associated cost. The curves estimate a maximum cost beyond which there is no load reduction benefit. A curve represents an optimized set of BMP sizes and locations in a watershed or subwatershed. The curves are specific to the physiographic features of the watershed, which are classified as management categories in the model. A degree of practice, defined as risk tolerance, or allowable Exceedances, or TMDL attainment, may be set in the model to simulate uncertainty. In the BMP selection process, a set desired degree of practice is specified based on the existing pollutant loadings information. For this degree of practice, an optimal management level is determined for various management categories.

An analysis will be performed for the critical condition storm event to ensure an adequate representation of the potential runoff volumes and pollutant loadings. This storm will be used for the selection and design of the mitigation measures for the distributed BMPs with a to-be-selected conservative risk level to address compliance. Baseline flow rates/runoff volumes may be based on one of the 90th percentile of long term estimated/modeled flow rates or other established hydrologic critical condition in the applicable TMDL. Appendix B of the Toxics TMDL, defines the average deposition over 10 years as the critical conditions (not 90th percentile wet year). The 90th percentile wet day year will be used for compliance with the Bacteria TMDL for MdR.

Regional BMPs will be designed to capture the 85th percentile 24-hour storm event corresponding to the drainage area to the BMP. The uncertainty analysis will help demonstrate the model sensitivity of the system to the optimization objective, in terms of the stringency of the water quality attainment target.

Current/baseline pollutant loading will based on relevant subwatershed data and the best available representative land use and pollutant loading data collected within the last 10 years. These baseline pollutant loadings will be assessed and reported considering variability in pollutant loading at a spatial and temporal (including critical and average condition) scale consistent with that used in the MdR TMDLs and in the approved monitoring plan.

The SUSTAIN model will be used as part of the optimization framework for the BMP assessment and selection. SUSTAIN allows for the development, evaluation, and selection of optimal BMP combinations at various watershed scales on the basis of cost and effectiveness. It helps identify cost-effective BMP placement and selection strategies based on a pre-determined list of feasible sites and applicable BMP types and size ranges. This module uses evolutionary optimization techniques to search for cost-effective BMPs that meet user-defined decision criteria. Efficiency frontier curves assist in the selection of the optimal combination of BMPs and treatment thresholds to comply with the TMDL requirements using the most effective approach and associated cost.

The risk analysis in the framework of SUSTAIN lies in the identification of the optimal cost/risk solutions in achieving the required pollutant removal, while optimizing the BMP implementation schedule.

Cost estimates will be developed at the level of detail necessary for planning and strategy development for TMDL implementation of projects and programs in the MdR watershed. Project-specific cost estimates will be developed for individual nonstructural and structural projects. For example, the cost of a nonstructural program may consist of a 1-year initial pilot study cost, including project startup and assessment, and if applicable, ongoing O&M costs. Implementation costs for structural BMP conceptual design projects will include engineering design, permitting, construction, building materials, and O&M.

9.4 Implementation Schedule Methodology

The implementation schedule for the structural and institutional BMP strategies will be based on the corresponding MdR TMDL load reduction schedule. A phased approach will be used, in which compliance is to be achieved in an incremental percentage of the watershed through preset compliance milestones, and the minimum load reduction is to be achieved by the milestone date with the final date being 2021. New and/or modifications to the existing TMDL will be incorporated into the implementation schedule, if applicable. Interim milestones and dates to address adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L – R will be identified. BMPs must be implemented within time frame that is consistent with the most critical/closest deadline to address the gradual phasing of percent load reductions over the course of the implementation schedule. For areas to be addressed through retention of the runoff volume from the 85th percentile, 24-hour storm, volume reductions over time shall be related to the interim and final milestones.

For institutional BMPs, the programs expected to deliver the greatest value, highest pollutant reduction potential at minimum cost, will be considered first. All programs may be assumed to be stand-alone, with the understanding that they may include synergies providing for a more efficient implementation of similar programs. Considering each program as a stand-alone ensures a more conservative approach.

For structural BMPs, the programs corresponding to the highest SPS, described earlier, will be evaluated for implementation earliest in the implementation schedule timeline. In general, these programs will correspond to the relatively larger drainage area with the relatively higher associated multi-pollutant loading potential. BMP performance will be taken into account.

Considerations such as funding availability cannot be ignored during this prioritization process. The schedule will include establishing the time frame for BMP planning, design, construction, and assessment. The assessment of the implemented control measures will be performed at regular time intervals by evaluating the pollutant concentrations and loads measured and estimated at the various existing and proposed monitoring stations across the MdR watershed and in accordance with the Coordinated Integrated Monitoring Plan (CIMP) being generated for the MdR watershed. When load reductions at a monitoring station are not expected to be reached within the compliance timeframe, as projected by the modeling results, selection of BMPs, and set schedule, the proposed BMPs corresponding to the flows represented by the monitoring station will be reassessed in terms of expected performance and implementation schedule.

9.5 Results Presentation

The model output will include a series of summary tables and graphs for the different modeled scenarios performed for the risk analysis. These outputs are summarized in Table 22. For the various analyzed storm events and for the various defined land uses and drainage areas, the outputs include the following: (1) existing runoff and pollutant loadings and (2) load reduction required to meet TMDL requirements. The data can then be used to generate hydrographs and pollutographs for the different scenarios simulated as a requirement of the uncertainty analysis.

An example output presentation is provided in Figure 15. The figure presents a summary of the net cost and pollutant reduction as a function of the proposed implementation schedule from the MdR Multi-Pollutant Implementation Plan developed for the County (LADPW, 2012). These costs and pollutant reduction estimates are based on the proposed structural and institutional measures required to reach the load reduction TMDL milestone for the limiting pollutant, in this case zinc. Similar figures may be developed for a variety of storm scenarios to evaluate the effectiveness of the selected measures under the associated runoff volumes and pollutant loadings, as part of the RAA.

Table 22. Summary of WMMS Model Outputs

Model Output	Output Content
Current/Existing Pollutant Loadings	Current pollutant loadings at each subwatershed and each land use
Load Reduction Output	Pollutant load reduction at each subwatershed for each BMP scenario in dry and wet weather conditions Time series plot of pollutant load reduction for each BMP scenario at compliance points
Surface Runoff Output	Surface runoff at each subwatershed for each BMP scenario in dry and wet weather conditions Percent reduction at each subwatershed for each BMP scenario
Hydrographs and Pollutographs	Flow hydrographs at compliance points for each BMP scenario Pollutographs at compliance points for each BMP scenario
BMP Performance Summary	Load comparison with and without BMP and graphs for each BMP scenario BMP storage distribution for each BMP scenario

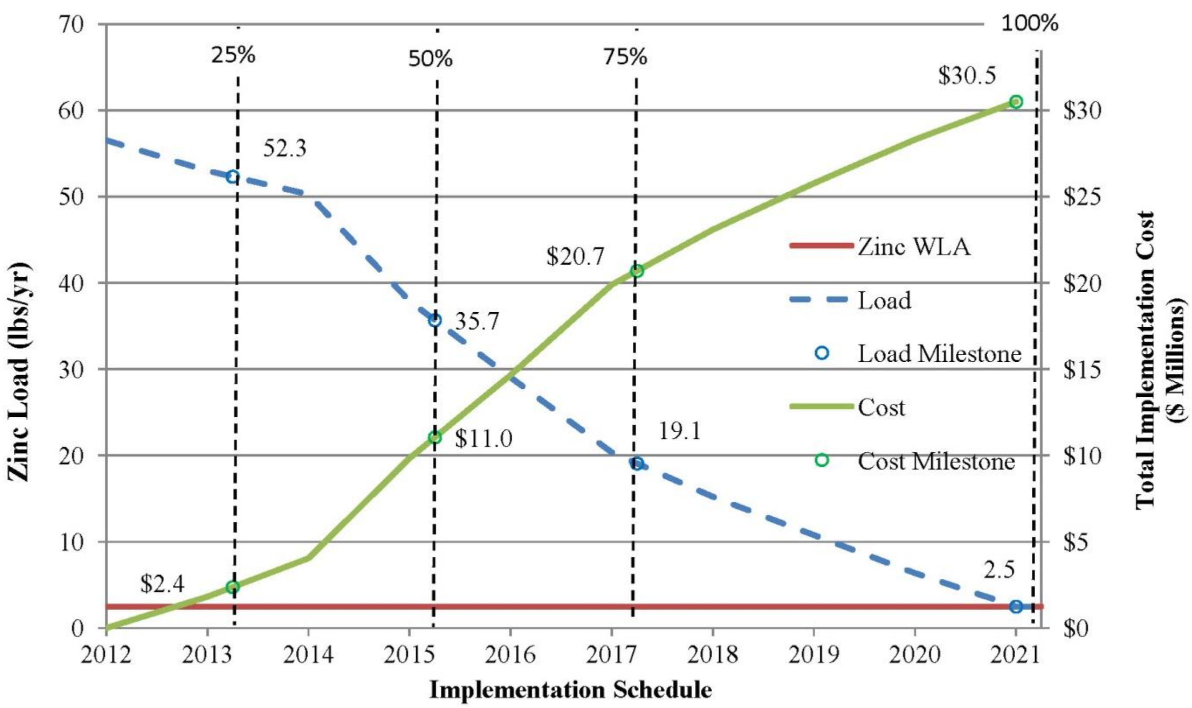


Figure 15. Example of Estimated Load Reductions and Annual Spending Projected to Achieve the Zinc Waste Load Allocation (LADPW, 2012)

10.0 MdR EWMP COMPLETION SCHEDULE

After the submittal of the EWMP Final Work Plan to the Regional Board, due June 28, and in consultation with the MdR EWMP agencies, the EWMP Plan development will proceed and will implement all aspects of the Final Work Plan, providing technical memorandums, a Draft EWMP Plan and a Final EWMP Plan that meet all requirements of Section VI.C. of the MS4 Permit. Multiple sub-tasks will be performed ending in completion of the Final Final EWMP Plan. These items are summarized below and in Figure 16 .

Item 1. Finalize Approach to Addressing USEPA TMDLs, 303(d) Listings, and Other Exceedances of Receiving Water Limitations:

A technical memorandum will be developed to address permit requirements related to USEPA TMDLs, §303(d) listings, and other exceedances of receiving water limitations. As part of this sub-task interim numeric milestones and compliance schedules for the Ballona Wetlands TMDLs for Sediments and Invasive Exotic Vegetation, for the Santa Monica Bay TMDLs for DDTs and PCBs will be developed, as well as for the §303(d) listed and non-§303(d) listed receiving water limitations exceedances not addressed in a TMDL in the watershed. The Draft Memorandum will be provided as electronic files by August 29, 2014.

Item 2. – List of Regional Projects and Initial Screening

Potential locations for regional projects to retain (i) all non-stormwater and (ii) all stormwater runoff of the volume equivalent to the 85th percentile, 24-hour storm event for the drainage area tributary to the project will be identified. A preliminary list of the regional projects for initial screening based on the Final EWMP Work Plan approach will be developed and presented in a draft memorandum for review by the EWMP agencies by September 30, 2014. Based upon feedback preliminary soils analysis and testing as well as an initial environmental study of up to three of the proposed regional project sites to support the feasibility analysis will be performed.

Regulatory issues, environmental permits and other requirements for implementing the proposed project sites will be reviewed and the feasibility of constructing the identified projects, including the rough cost estimates, will be assessed to develop a recommended final list. Analysis and results from this sub-task will be presented in the draft memorandum delivered under Sub-task 4.3 Watershed Control Measures and Reasonable Assurance Analysis.

Based upon feedback from EWMP agencies, preliminary soils analysis and testing as well as an initial environmental study of each proposed regional project site to support the feasibility analysis may be conducted.

Item 3 – Watershed Control Measures Performance

Following the process identified in the EWMP Work Plan, the modeling tool will be updated to represent hydrology, hydraulics, stormwater quality, non-stormwater quality, and receiving water quality before and after implementation of watershed control measures.

The performance of the implemented BMPs will be evaluated through quantitative analysis, qualitative assessment, or modeling to demonstrate that the identified control measures will achieve applicable WQBELs and/or RWLs.

Item 4 – Develop Project Schedules and Cost Estimates

Based on the selected watershed control measures, cost estimates for implementing the proposed watershed control measures will be developed. The cost analysis will include any necessary planning, design, permits, construction, operation and maintenance, energy, waste removal, post construction monitoring, and right of way acquisition. Schedules and sequencing for each of the proposed watershed control measures will also be prepared. The sequencing will be based on the approach outlined in the EWMP Work Plan. The schedules will account for:

- TMDL Compliance Schedules, Water Quality Priority categories, and proposed milestones
- The implementation period and milestones during the current Permit term will be differentiated from the future implementation period beyond the current Permit term. A higher level of detail regarding cost and schedule will be provided for watershed control measures scheduled for implementation during the current and next permit term. For control measures scheduled after the next permit term, a generic sequencing and schedule will be provided.
- The schedules will identify the responsibilities for each individual Permittee
- The project schedules will include planning, design, permits, right of way acquisition, construction, operation and maintenance, energy, waste removal, and post-construction monitoring. Realistic constructions durations will be proposed for each project including preconstruction activities such as bid, ware, notice to proceed, move in, construction sub activities depending on the Scope of Work, construction completion, and post construction monitoring, among other considerations that may be applicable during the completion of this sub-task.
- A reasonable time frame will be recommended to initiate projects, nonstructural solutions, and programs during the timeframes based on WESTON's best professional judgment of the requirements for each project.

The financial strategies to implement the EWMP will also be provided to the EWMP agencies and may include such measures as grant funding opportunities and stormwater taxes. Suggested strategies will be based on information gained from each of the EWMP agencies, as well as available known public funding options. The strategies will be presented as general recommendations and not include grant applications or other documentation necessary to fund the EWMP.

The Draft Memorandum will be delivered for review by February 13, 2015.

Item 5 – Draft EWMP Plan

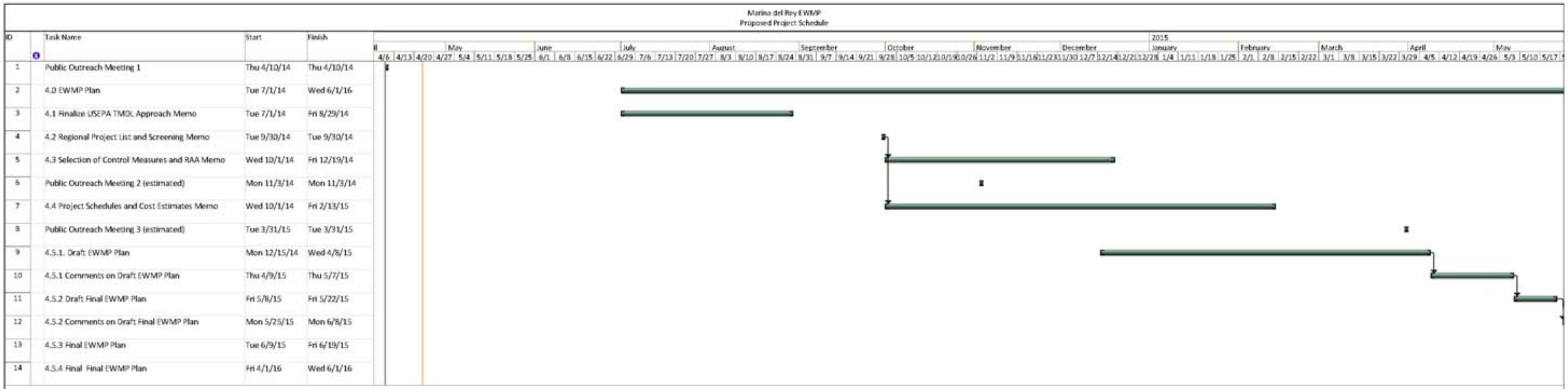
Finally, the deliverables from previously completed tasks will be incorporated to develop a draft and final EWMP plan. Weston will develop milestones and compliance schedules into the EWMP to measure progress toward addressing the highest water-quality priorities and achieving applicable WQBELs and/or RWLs in the shortest time as possible taking into account technological, operation, and economic factors.

The Draft EWMP Plan will be submitted to the MdR EWMP agencies by April 8, 2015. After the agency review, it is assumed that comments will be received by May 7, 2015, and incorporated into a Revised

Draft EWMP Plan by May 22, 2015. After one more revision iteration, a Draft Final EWMP Plan and a Final Final EWMP Plan will be submitted to the EWMP agencies by June 19, 2015 for submission to the Regional Board by June 28, 2015.

Public Outreach Meetings

Local stakeholders will be engaged in the EWMP development process through three workshops/meetings. The first meeting took place on April 10th, 2014 and included an overview of the EWMP process and milestones (Work Plan, CIMP, and EWMP). The second meeting will occur in the Fall of 2014 and the third meeting will likely occur in Winter 2014 or Spring 2015.



ID	Task Name	Start	Finish
1	Public Outreach Meeting 1	Thu 4/10/14	Thu 4/10/14
2	4.0 EWMP Plan	Tue 7/1/14	Wed 6/1/16
3	4.1 Finalize USEPA TMDL Approach Memo	Tue 7/1/14	Fri 8/29/14
4	4.2 Regional Project List and Screening Memo	Tue 9/30/14	Tue 9/30/14
5	4.3 Selection of Control Measures and RAA Memo	Wed 10/1/14	Fri 12/19/14
6	Public Outreach Meeting 2 (estimated)	Mon 11/3/14	Mon 11/3/14
7	4.4 Project Schedules and Cost Estimates Memo	Wed 10/1/14	Fri 2/13/15
8	Public Outreach Meeting 3 (estimated)	Tue 3/31/15	Tue 3/31/15
9	4.5.1. Draft EWMP Plan	Mon 12/15/14	Wed 4/8/15
10	4.5.1 Comments on Draft EWMP Plan	Thu 4/9/15	Thu 5/7/15
11	4.5.2 Draft Final EWMP Plan	Fri 5/8/15	Fri 5/22/15
12	4.5.2 Comments on Draft Final EWMP Plan	Mon 5/25/15	Mon 6/8/15
13	4.5.3 Final EWMP Plan	Tue 6/9/15	Fri 6/19/15
14	4.5.4 Final Final EWMP Plan	Fri 4/1/16	Wed 6/1/16

Figure 16. MdR EWMP Gant Chart Schedule

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