Long Beach Nearshore Watershed Management Program

A-8-1 Integrated Monitoring Program

Long Beach Nearshore Watershed Management Program Appendix 8

Integrated Monitoring Program Section 8.1

Inner Harbor, Outer Harbor, and eastern San Pedro Bay

INTEGRATED MONITORING PROGRAM FOR LONG BEACH INNER HARBOR, LONG BEACH OUTER HARBOR, AND EASTERN SAN PEDRO BAY

Prepared for the City of Long Beach

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ANCHOR QEA

Contents

INTEGRATED MONITORING PROGRAM FOR LONG BEACH INNER HARBOR, LONG BEACH OUTER HARBOR, AND EASTERN SAN PEDRO BAY

1 Introduction

This Integrated Monitoring Program (IMP) consists of receiving water monitoring, total maximum daily load (TMDL) compliance monitoring, non-stormwater outfall monitoring, new development/re-development effectiveness tracking, and regional study.

2 Waterbody-Pollutant Classification

Waterbody-pollutant combination has been prioritized and is summarized in Table 1. The highest priority water quality issues include all Category 1 waterbody-pollutant combinations due to their listing in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters (Harbor Toxics TMDL). These waterbody-pollutant combinations include copper, lead, zinc, total polycyclic aromatic hydrocarbons (PAHs), total dichlorodiphenyltrichloroethanes (DDTs), and total polychlorinated biphenyls (PCBs) in sediment for Inner Harbor, Outer Harbor, and eastern San Pedro Bay. All high priority pollutants in Long Beach Inner Harbor, Long Beach Outer Harbor, and eastern San Pedro Bay are included in a TMDL compliance regional monitoring program, which is conducted by the Regional Monitoring Coalition (RMC). The Harbor Toxics TMDL encouraged formation of a regional monitoring coalition for TMDL compliance monitoring. The City of Long Beach (City) has been actively involved in the RMC since its formation in 2013. The RMC's Coordinated Compliance Monitoring and Reporting Plan (CCMRP) was approved by the Regional Water Board on June 6, 2014. The RMC's first sediment sampling event was conducted in coordination with the Bight 2013 program. The first water and fish tissue sampling events were conducted in September 2014. Medium priority pollutants in Long Beach Inner Harbor, Long Beach Outer Harbor, and eastern San Pedro Bay are also included in the TMDL monitoring, except for Bis(2-ethylhexyl)phthalate in water, which will be monitored via receiving water monitoring.

Table 1. Water quality issue prioritization.

Waterbody	Highest Priority	High Priority			Medium Priority	
	Sediment	Water	Sediment	Fish	Water	Sediment
Long Beach Inner Harbor	Copper, lead, zinc, total PAHs, total DDTs, total PCBs	None	Mercury	Total chlordanes	Bis(2-ethylhexyl)phthalate, copper, mercury, zinc, chrysene, pyrene	None
Long Beach Outer Harbor	Copper, lead, zinc, total PAHs, total DDTs, total PCBs	None	None	None	Pyrene, bis(2-ethylhexyl)phthalate	Nickel
Eastern San Pedro Bay	Copper, lead, zinc, total PAHs, total DDTs, total PCBs	None	None	None	Pyrene, bis(2-ethylhexyl)phthalate	None

3 Monitoring Sites and Approach

Proposed monitoring locations for receiving water monitoring and TMDL compliance monitoring are summarized in Table 2.

3.1 Receiving Water Monitoring Sites

In coordination with the Harbor Toxics TMDL monitoring plan (i.e., CCMRP), one station was selected in Outer Long Beach Harbor (equivalent to CCMRP Station 16) and one station was selected in eastern San Pedro Bay (equivalent to CCMRP Station 19). Detailed methods are provided in the CCMRP. See Figure 1 for sample locations. For efficiency, it is recommended that the monitoring conducted to satisfy the requirements of the TMDL satisfies the receiving water monitoring requirements of the IMP. CCMRP monitoring results will be reviewed and incorporated into the IMP annual report by summary and reference only.

3.2 TMDL Monitoring Sites

The Harbor Toxics TMDL requires all 22 locations for monitoring (Figure 2). CCMRP Stations 1 through 11 are located within Port of Los Angeles waters, and CCMRP Stations 12-22 (see Figure 1) are located in Long Beach Inner Harbor, Long Beach Outer Harbor, and eastern San Pedro Bay. Detailed methods are provided in the CCMRP. For efficiency, it is recommended that the monitoring conducted to satisfy the requirements of the TMDL satisfies the receiving water monitoring requirements of the IMP. CCMRP monitoring results will be reviewed and incorporated into the IMP annual report by summary and reference only.

3.3 Stormwater Outfall Monitoring Site

Under the State's new Industrial General Permit, IGP (Order 2014-0057-DWQ), the Port of Long Beach is developing and leading a Compliance Group consisting of its maritime transportation facility tenants. To satisfy the requirements of the IGP, the Port proposes to monitor stormwater discharges from 22 sampling stations throughout the Harbor District (Figure 3). The Port of Long Beach Compliance group is required to sample twice per year (including 1 qualifying storm event [QSE] within the first half of each reporting year [July 1 to December 31] and 1 QSE within the second half of each reporting year [January 1 to June 30]). Samples from these stations will be submitted for total suspended solids (TSS), oil and grease (O&G), pH, metals (specifically, copper, lead and zinc), total DDTs, total PCBs, benzo(a)pyrene and chrysene. As such, no additional outfall discharges will be monitored as part of this IMP; rather, it is recommended that the monitoring conducted to satisfy the requirements of the IGP satisfies the stormwater outfall monitoring requirements of the IMP. IGP monitoring results will be reviewed and incorporated into the IMP annual report by summary and reference only.

Table 2. Monitoring site designation and monitoring function.

Site Name	Waterbody	Type of site	Location in WGS84	
			Latitude (N)	Longitude (W)
CCMRP Station 16	Outer Long Beach Harbor	Receiving Water/TMDL water, sediment, and fish	33.731449	-118.221000
CCMRP Station 19	Eastern San Pedro Bay	Receiving Water/TMDL water and sediment	33.736671	-118.131591
CCMRP Station 12	Inner Harbor Long Beach	TMDL water and sediment	33.768331	-118.228351
CCMRP Station 13	Inner Harbor Long Beach	TMDL water and sediment	33.75383222	-118.2163996
CCMRP Station 14	Inner Harbor Long Beach	TMDL water and sediment	33.74898245	-118.2308246
CCMRP Station 15	Inner Harbor Long Beach	TMDL water and sediment	33.74214303	-118.1994876
CCMRP Station 17	Outer Harbor Long Beach	TMDL water and sediment	33.72759372	-118.1860575
CCMRP Station 18	Eastern San Pedro Bay	TMDL water and sediment	33.75383222	-118.1813321
CCMRP Station 20	Eastern San Pedro Bay	TMDL water, sediment, and fish	33.72547972	-118.1573319
CCMRP Station 21	Los Angeles River Estuary	TMDL water and sediment	33.75644363	-118.1573319
CCMRP Station 22	Los Angeles River Estuary	TMDL water and sediment	33.761013	-118.202111

Latitude and longitude are in decimal degrees.

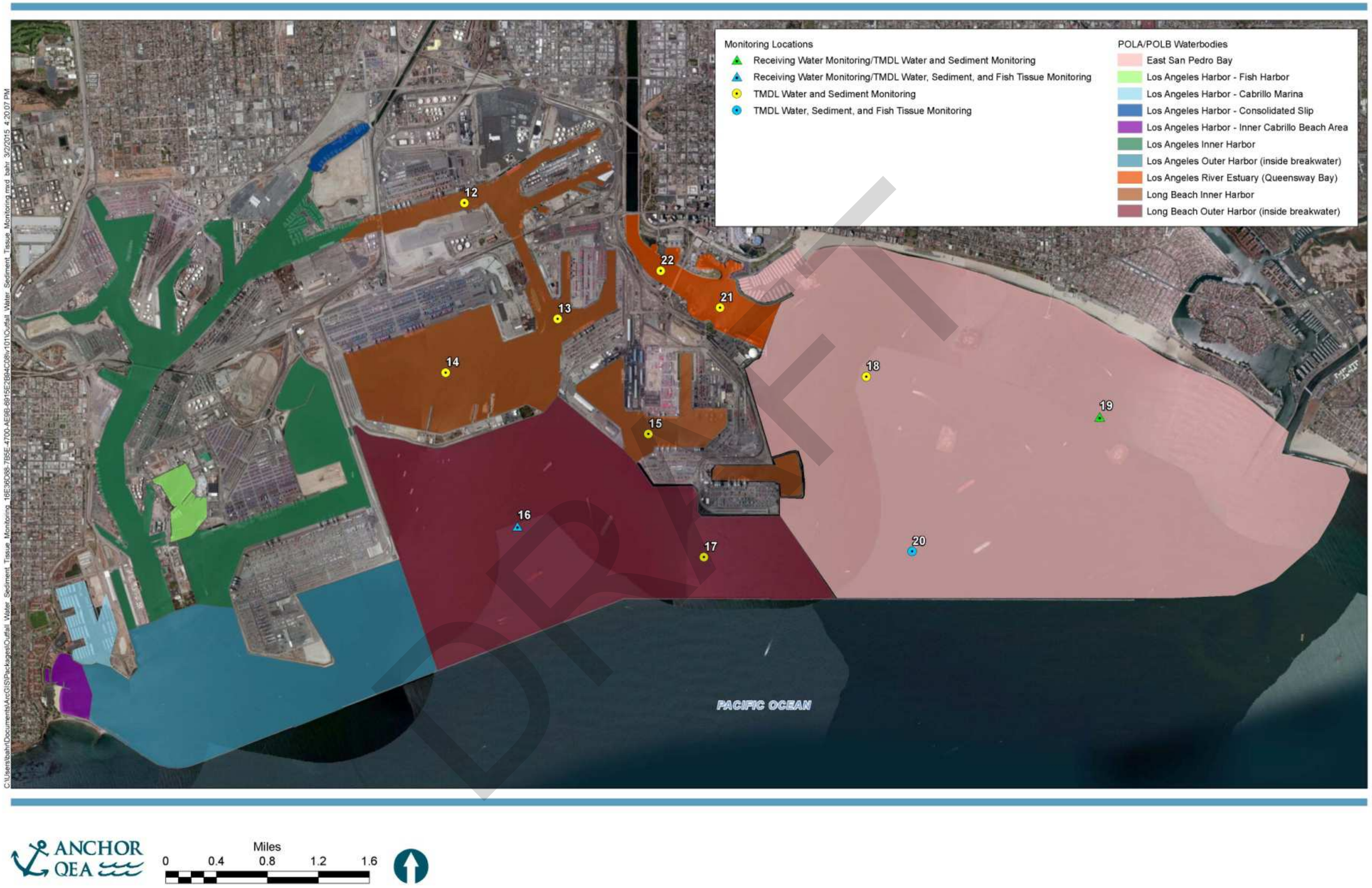

Figure 1. IMP monitoring sites in Long Beach Inner Harbor, Long Beach Outer Harbor, and eastern San Pedro Bay. Table 2 contains the coordinates of these sites.

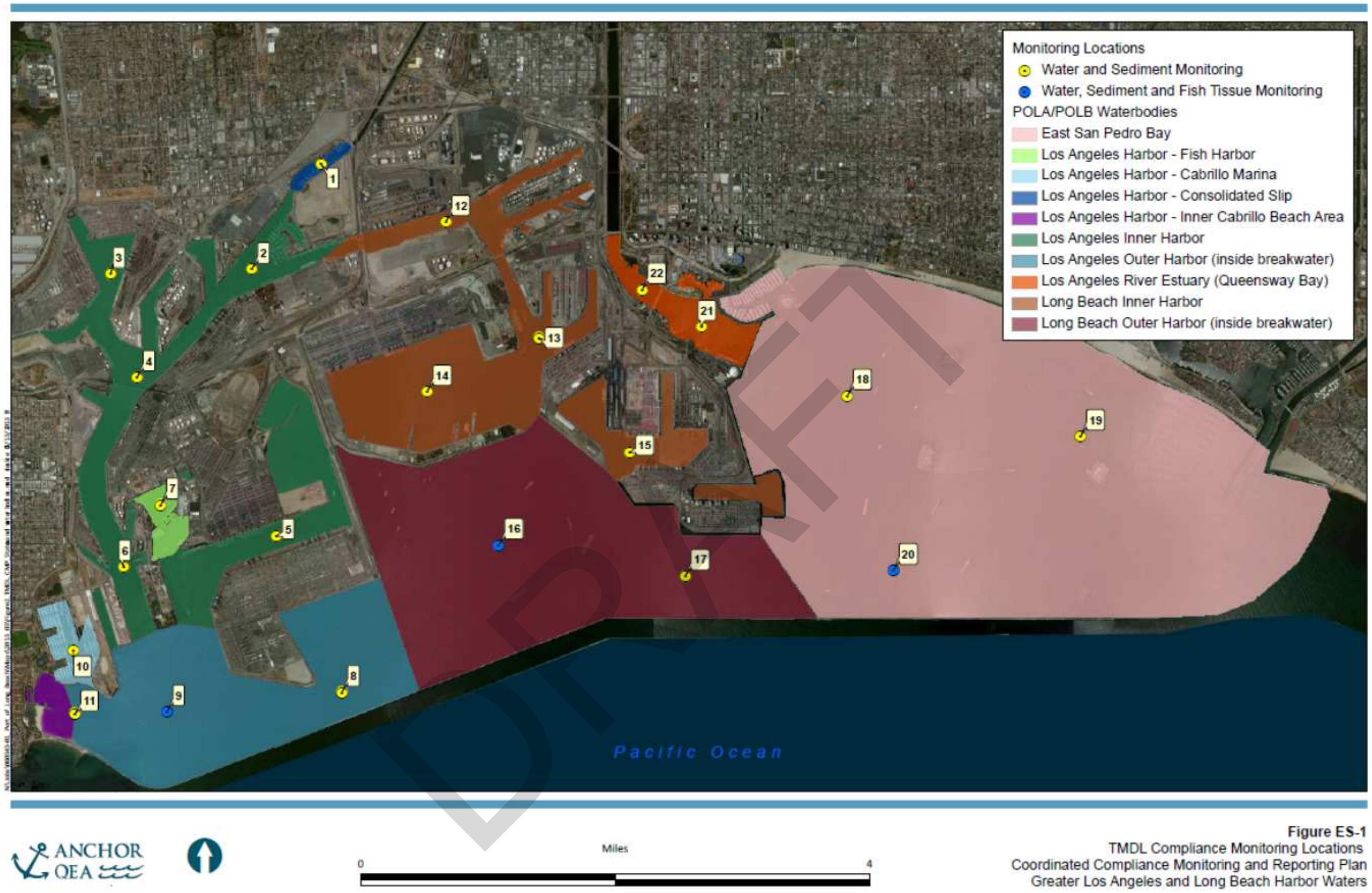

Figure 2. Harbor Toxics TMDL Coordinated Compliance Monitoring and Reporting Plan, CCMRP monitoring stations in Greater Los Angeles and Long Beach Harbor waters. Stations 12 through 22 are located within Long Beach Inner and Outer Harbor waters and eastern San Pedro Bay.

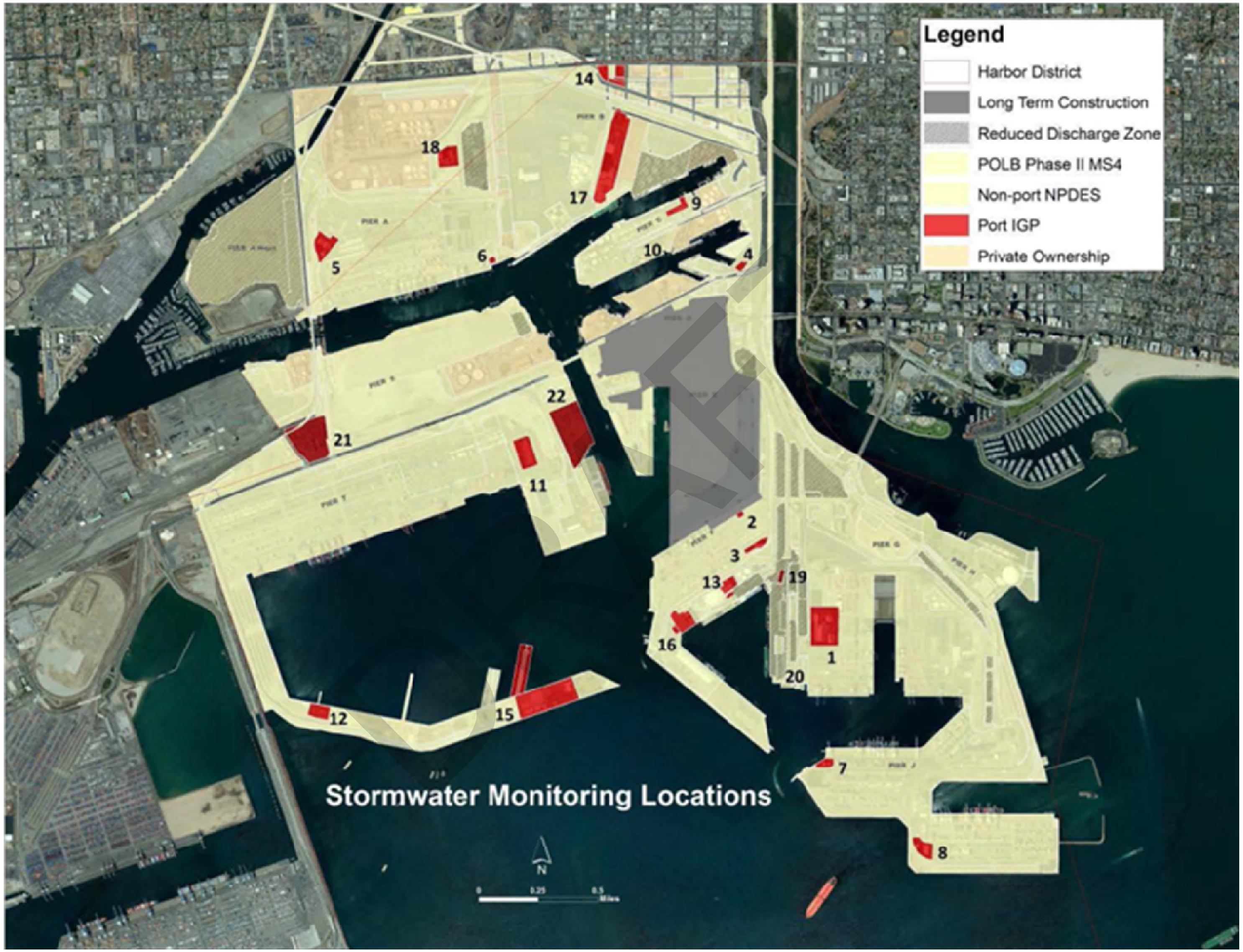

Figure 3. IGP monitoring stations in the Port of Long Beach.

3.3 Non-Stormwater Outfall Monitoring

The Port of Long Beach (Port) has developed an Illicit Discharge Detection and Elimination program to detect, investigate, and eliminate illicit discharges, including illegal dumping, into its system in accordance with the existing permit**.**

There are 224 stormwater outfalls throughout the Harbor District. All outfalls discharge to Inner or Outer Long Beach Harbor, with the exception of seven outfalls that discharge to the Los Angeles River Estuary. It should be noted that 15 of these outfalls that are located on Pier H and discharge into the Los Angeles River Estuary are not operated by the Port; these outfalls will be subject to the screening assessment process indicated above.

On a monthly basis, the Port visits all stormwater outfalls in the Harbor District on days with no precipitation in an effort to detect and eliminate unauthorized non-stormwater discharges (NSWDs). This is accomplished using a small vessel narrow enough to fit in between closely constructed piles and access outfalls located beneath wharf faces. Inspections are scheduled to coincide with the low tide. Notations of the following are made:

- Presence or absence of flow/moisture
- Presence or absence of stains
- Presence or absence of sludge
- Odor (if any)
- Other abnormal conditions

A detailed report is generated noting observations made at accessible outfalls and is submitted to the Port Environmental Planning Division. If evidence of ongoing potential illegal dumping or illicit connections to the storm drain system is noted, the Port Environmental Planning Division is immediately contacted.

3.4 New Development/Re-Development Effectiveness Tracking

The Monitoring and Reporting Program (MRP), Attachment E to the MS4 Permit requires that Permittees develop a New Development/Re-Development Effectiveness tracking program. The City has developed mechanisms for tracking information related to new and redevelopment projects that are subject to post-construction best management practice (BMP) requirements in Part VI.D.7 of the MS4 Permit.

3.5 Regional Studies

There are three large long-term regional monitoring programs that are conducted in the area inclusive of this IMP. The City's Harbor Department actively participates in two regional monitoring programs: the Southern California Bight (SCB) Regional Monitoring Program and the Biological Baseline Study. In addition, Heal the Bay manages the Beach Report.

3.5.1 Southern California Bight Regional Monitoring Program

The SCB is the approximate 400 miles of coastline from Point Conception in Santa Barbara County to Cabo Colnett in Ensenada, Mexico. The Southern California Coastal Water Research Project coordinates an extensive monitoring program within the SCB approximately every 5 years. The Bight program began in 1994, and data gathered during monitoring events have allowed for long-term tracking of benthic communities, fisheries, water quality, sediment chemistry and toxicity, and the general health of the SCB over time. This complex program incorporates multiple agencies and organizations, and as such, a series of guidance documents for field data collection, laboratory analyses, quality assurance, and data management have been created for each monitoring event.

The City's Harbor Department currently participates in the Bight monitoring programs. Since 2013, the sediment quality component of the Harbor Toxics TMDL has been integrated with the Bight monitoring program.

3.5.2 Biological Baseline Study

The City's Harbor Department currently participates in San Pedro Bay-wide Biological Baseline Studies in coordination with the Port of Los Angeles. This comprehensive regional program consists of studies to evaluate the area's physical and ecological characteristics, including kelp and eelgrass habitat, plankton, fish, and marine bird populations. The Biological Baseline Study is conducted approximately every 5 years.

4 Monitoring Schedule and Frequencies

Monitoring schedule and frequencies for the receiving water monitoring at CCMRP Stations 16 and 19 and the Harbor Toxics TMDL monitoring at CCMRP stations 12 through 22 are summarized in Table 3.

4.1 Receiving Water Monitoring Sites

Water column samples will be collected three times annually, two during wet weather events and one during a dry weather event, in order to coordinate with the RMC Harbor Toxics TMDL coordinated compliance monitoring. Two wet weather events instead of three wet weather events as specified in the MRP are deemed sufficient. This is because water column testing (physical parameters) at various depths performed in the TMDL monitoring according to the CCMRP will provide better data on mixing using total suspended solids (TSS). Besides two receiving water stations, an additional 20 TMDL CCMRP stations cover greater areas of receiving waters than typical nearshore monitoring for MS4 permits, minimizing potential water-based deployments for catching two wet weather events versus three wet weather events: and wet weather storms identified as greater than 0.25-inch precipitation targeting larger rain events that are likely to impact receiving water.

The first large storm of the season will be targeted as one of the two wet weather events and will have a predicted rainfall of at least 0.25 inch (0.64 centimeter) with a 70 percent probability of rainfall at least 24 hours prior to the event start time.

The first dry weather receiving water monitoring will start at two stations in the dry season of 2015, assuming the IMP is approved prior to the dry season. The first wet weather receiving water monitoring will start in the wet season of 2015-2016 assuming the IMP is approved prior to the wet season.

Aquatic toxicity testing will be conducted for all three (two wet and one dry weather) sampling events for the first year at each of CCMRP stations 16 and 19. If all toxicity tests from the three sampling events show no toxicity, aquatic toxicity tests will not be included in the following year.

4.2. TMDL Monitoring Sites

Sampling schedule and frequency are specified in the CCMRP. At stations 12 through 22, the schedule is designed for the next 10 years and segmented by season, where fall is defined as October 1 to December 31, winter is January 1 to March, spring is April 1 to June 30, and summer is July 1 to September 30. Water quality monitoring is to occur three times annually during two wet weather events and one dry weather event. The wet weather events will consist of two in winter, and the dry weather event will be in summer. Sediment quality monitoring will occur at every station two times every 5 years. The sampling is scheduled in summer during the years 2016, 2018, 2021, 2023, 2026, and 2028. Fish tissue sampling will occur at two stations (stations 16 and 20) biennially. The sampling is scheduled in summer during the years 2016, 2018, 2020, 2022, 2024, 2026, and 2028.

Table 3. Schedule for implementation of monitoring activities.

	Station	Type of monitoring	Dry 2015	Wet 2015/2016	Dry 2016	Wet 2016/2017	Dry 2017	Wet 2017/2018	Dry 2018
Receiving water/TMDL	CCMRP 16	Chemistry[1] and field measurements	1	2	1	2	1	2	1
		Aquatic toxicity[2]	1	2	1	2	1	2	1
	CCMRP 19	Chemistry[1] and field measurements	1	2	1	2	1	2	1
		Aquatic toxicity[2]	1	2	1	2	1	2	1
TMDL monitoring	CCMRP 12 - 22	Water column	1	2	1	2	1	2	1
		Sediment	0	0	1	0	0	0	1
		Fish tissue	0	0	1	0	0	0	1
Non-stormwater outfall	Outfalls	Inventory and screen	Ongoing[3]						
		Source ID[4]			Ongoing		Ongoing		Ongoing
		Monitoring[5]			TBD		TBD		TBD

[1] Table E-2 chemical analyses will be performed once during the first wet weather event and once during the first dry weather event. Parameters that exceed method detection limits and available water quality objectives will continue to be monitored along with all parameters included as Category 1, 2, or 3 waterbody-pollutant classifications for the subject waterbody. Wet and dry weather chemical parameters will be separately assessed for purposes of continued monitoring. All parameters classified as highest, high, and medium priority waterbody-pollutants in the waterbody will continue to be monitored during the permit cycle unless the parameters (primarily medium priority parameters) are shown to not be present at levels of concern on a consistent basis.

[2] If all toxicity tests from the three sampling events of the first year show no toxicity at a monitoring station, aquatic toxicity tests will not be included in the following year at that monitoring station.

[3] The Port developed and has been implementing an NSWD monitoring program. See Section 10.

[4] Source tracking and classification work depend upon the number of sites categorized as Suspect outfalls with evidence of significant flow.

[5] Monitoring will be implemented if significant dry weather flows are identified at discharge points that cannot be identified, are non-essential exempt flows, or are identified as illicit flows that are not yet controlled.

5 Chemical/Physical Parameters

Implementation of the IMP will be integrated with the Harbor Toxics TMDL compliance monitoring program. At a minimum, the IMP requires monitoring for the following parameters:

- Pollutants assigned a receiving water limitation derived from TMDL Waste Load Allocations
- Other pollutants identified on the Clean Water Act (CWA) Section 303(d) List for the receiving water or downstream receiving waters
- Aquatic toxicity

Flow will not be monitored . Suspended sediment concentration will not be monitored because Long Beach Harbor and San Pedro Bay are not listed on the CWA Section 303(d) List for sedimentation, siltation, or turbidity. TSS will be monitored because it is listed in the Harbor Toxics TMDL as a required analytical parameter to understand sedimentation sources.

The Harbor Toxics TMDL compliance monitoring program contains a set of analytical parameters that are required based on historical detections or known chemical sources to the marine habitat. The guidance for the IMP requires a greatly expanded list of parameters that have various relevancies to the marine environment. It is proposed that the expanded IMP analyte list (Table E-2) be implemented for the first wet and dry weather receiving water quality monitoring events at the two receiving water stations (i.e., CCMRP Stations 16 and 19). Results of initial wet weather and dry weather monitoring at these two sites will be used to determine necessity of specific analytes beyond the TMDL required analyte list. As specified in the MS4 Permit, if the parameter was not detected in the first event.

Table 4 lists the analytical parameters required as part of the Harbor Toxics TMDL compliance monitoring program and identifies the additional parameters required to be monitored during the first wet and dry weather monitoring events as part of this IMP.

Table 4. Parameters monitoring via receiving water monitoring and TMDL compliance monitoring.

Parameter group	**Parameter**	**TMDL monitoring**			**Additional receiving water monitoring**
		Water	**Sediment**	**Fish**	
Conventional Pollutants	Oil and grease				Required
	Total Phenols				Required
	Cyanide				Required
	pH				Required
	Temperature				Required[1]
	Dissolved Oxygen				Required[1]
	Lipids			Required	
Bacteria (Single Sample Limits)	Total coliform (marine waters)				Required[1]
	Enterococcus (marine waters)				Required[1]
	Fecal coliform (marine & fresh waters)				Required[1]
	E. coli (fresh waters)				Required[1]
General	Dissolved Phosphorus				Required[1]
	Total Phosphorus				Required[1]
	Turbidity				Required[1]
	Total Suspended Solids	Required	Required		
	Total Dissolved Solids		Required		Required[1]
	Volatile Suspended Solids				Required[1]
	Total Organic Carbon		Required		Required[1]
	Total Petroleum Hydrocarbon				Required[1]
	Biochemical Oxygen Demand				Required[1]
	Chemical Oxygen Demand				Required[1]
	Total Ammonia-Nitrogen				Required[1]
	Total Kieldahl Nitrogen				Required[1]
	Nitrate-Nitrite				Required[1]
	Alkalinity				Required[1]
	Specific Conductance				Required[1]
	Total Hardness				Required[1]
	MBAS				Required[1]

Parameter group	Parameter	TMDL monitoring			Additional receiving water monitoring
		Water	Sediment	Fish	
	Chloride				Required[1]
	Fluoride				Required[1]
	Methyl tertiary butyl ether (MTBE)				Required[1]
	Perchlorate				Required[1]
Metals	Aluminum				Required[1]
	Antimony				Required[1]
	Arsenic				Required[1]
	Beryllium				Required[1]
	Cadmium	Required	Required		
	Chromium (total)	Required	Required		
	Chromium (Hexavalent)				Required[1]
	Copper	Required	Required		
	Iron				Required[1]
	Lead	Required	Required		
	Mercury	Required	Required		
	Nickel				Required[1]
	Selenium				Required[1]
	Silver				Required[1]
	Thallium				Required[1]
	Zinc	Required	Required		
Semivolatile Organic Compounds	2-Chlorophenol				Required[1]
	4-Chloro-3-methylphenol				Required[1]
	2,4-Dichlorophenol				Required[1]
	2,4-Dimethylphenol				Required[1]
	2,4-Dinitrophenol				Required[1]
	2-Nitrophenol				Required[1]
	4-Nitrophenol				Required[1]
	Pentachlorophenol				Required[1]
	Phenol				Required[1]

Parameter group	Parameter	TMDL monitoring			Additional receiving water monitoring
		Water	Sediment	Fish	
	2,4,6-Trichlorophenol				Required[1]
	Acenaphthene		Required		
	Acenaphthylene				
	Anthracene		Required		
	Benzidine				Required[1]
	1,2 Benzanthracene				
	Benzo(a)pyrene		Required		
	Benzo[a]anthracene		Required		
	Benzo(e)pyrene		Required		
	Benzo(o,h,i)perylene				
	3,4 Benzoflouranthene				
	Benzo(k)flouranthene				
	Biphenyl		Required		
	Bis(2-Chloroethoxy) methane				Required[1]
	Bis(2-Chloroisopropyl) ether				Required[1]
	Bis(2-Chloroethyl) ether				Required[1]
	Bis(2-Ethylhexl) phthalate				Required[1]
	4-Bromophenyl phenyl ether				Required[1]
	Butyl benzyl phthalate				Required[1]
	2-Chloroethyl vinyl ether				Required[1]
	2-Chloronaphthalene				Required[1]
	4-Chlorophenyl phenyl ether				Required[1]
	Chrysene		Required		Required[1]
	Dibenzo(a.h)anthracene		Required		Required[1]
	1,3-Dichlorobenzene				Required[1]
	1,4-Dichlorobenzene				Required[1]
	1,2-Dichlorobenzene				Required[1]
	3,3-Dichlorobenzidine				Required[1]
	Diethyl phthalate				Required[1]

Parameter group	Parameter	TMDL monitoring			Additional receiving water monitoring
		Water	Sediment	Fish	
	Dimethyl phthalate				Required[1]
	di-n-Butyl phthalate				Required[1]
	2,4-Dinitrotoluene				Required[1]
	2,6-Dinitrotoluene				Required[1]
	4,6 Dinitro-2-methylphenol				Required[1]
	2,6- Dimetthylnapthalene		Required		
	1,2-Diphenylhydrazine				Required[1]
	di-n-Octylphthalate				Required[1]
	Fluoranthene		Required		Required[1]
	Fluorene		Required		Required[1]
	Hexachlorobenzene				Required[1]
	Hexachlorobutadiene				Required[1]
	Hexachloro-cyclopentadiene				Required[1]
	Hexachloroethane				Required[1]
	Indeno(1,2,3-cd)pyrene				Required[1]
	Isophorone				Required[1]
	1-Methylnapthalene		Required		
	2-Methylnapthalene		Required		
	1-Methylphenanthrene		Required		
	Naphthalene		Required		Required[1]
	Nitrobenzene				Required[1]
	N-Nitroso-dimethyl amine				Required[1]
	N-Nitroso-diphenyl amine				Required[1]
	N-Nitroso-di-n-propyl amine				Required[1]
	Phenanthrene		Required		Required[1]
	Perylene		Required		
	Pyrene		Required		Required[1]
	1,2,4-Trichlorobenzene				Required[1]
Chlorinated	Aldrin				Required[1]

Parameter group	Parameter	TMDL monitoring			Additional receiving water monitoring
		Water	Sediment	Fish	
Pesticides	alpha-BHC				Required[1]
	beta-BHC				Required[1]
	delta-BHC				Required[1]
	qamma-BHC (lindane)				Required[1]
	alpha-chlordane	Required	Required	Required	
	gamma-chlordane	Required	Required	Required	
	Oxychlordane		Required	Required	Required[1]
	cis-Nonachlor		Required	Required	Required[1]
	trans-Nonachlor		Required	Required	Required[1]
	Total Chlordane[2]		Required	Required	Required[1]
	2,4’-DDD	Required	Required	Required	
	2,4’-DDE	Required	Required	Required	
	2,4’DDT	Required	Required	Required	
	4 4'-DDD	Required	Required	Required	
	4,4'-DDE	Required	Required	Required	
	4,4'-DDT	Required	Required	Required	
	Dieldrin	Required	Required	Required	
	alpha-Endosulfan				Required[1]
	beta-Endosulfan				Required[1]
	Endosulfan sulfate				Required[1]
	Endrin				Required[1]
	Endrin aldehyde				Required[1]
	Heotachlor				Required[1]
	Heptachlor Epoxide				Required[1]
	Toxaphene	Required	Required	Required	
Polychlorinated Biphenyls (PCBs)[3]	Aroclor-1016				Required[1]
	Aroclor-1221				Required[1]
	Aroclor-1232				Required[1]
	Aroclor-1242				Required[1]
	Aroclor-1248				Required[1]

Parameter group	Parameter	TMDL monitoring			Additional receiving water monitoring
		Water	Sediment	Fish	
	Aroclor-1254				Required[1]
	Aroclor-1260				Required[1]
	CL3-PCB-18	Required	Required	Required	
	CL3-PCB-28	Required		Required	
	CL3-PCB-37	Required	Required	Required	
	CL4-PCB-44	Required	Required	Required	
	CL4-PCB-49	Required	Required	Required	
	CL4-PCB-52	Required	Required	Required	
	CL4-PCB-66	Required	Required	Required	
	CL4-PCB-70	Required	Required	Required	
	CL4-PCB-74	Required	Required	Required	
	CL4-PCB-77	Required	Required	Required	
	CL4-PCB-81	Required	Required	Required	
	CL5-PCB-87	Required	Required	Required	
	CL5-PCB-99	Required	Required	Required	
	CL5-PCB-101	Required	Required	Required	
	CL5-PCB-105	Required	Required	Required	
	CL5-PCB-110	Required	Required	Required	
	CL5-PCB-114	Required	Required	Required	
	CL5-PCB-118	Required	Required	Required	
	CL5-PCB-119	Required	Required	Required	
	CL5-PCB-123	Required	Required	Required	
	CL5-PCB-126	Required	Required	Required	
	CL6-PCB-128	Required	Required	Required	
	CL6-PCB-138	Required	Required	Required	
	CL6-PCB-149	Required	Required	Required	
	CL6-PCB-151	Required	Required	Required	

Parameter group	Parameter	TMDL monitoring			Additional receiving water monitoring
		Water	Sediment	Fish	
	CL6-PCB-153	Required	Required	Required	
	CL6-PCB-156	Required	Required	Required	
	CL6-PCB-157	Required	Required	Required	
	CL6-PCB-158	Required	Required	Required	
	CL6-PCB-167	Required	Required	Required	
	CL6-PCB-168	Required	Required	Required	
	CL6-PCB-169	Required	Required	Required	
	CL7-PCB-170	Required	Required	Required	
	CL7-PCB-177	Required	Required	Required	
	CL7-PCB-180	Required	Required	Required	
	CL7-PCB-183	Required	Required	Required	
	CL7-PCB-187	Required	Required	Required	
	CL7-PCB-189	Required	Required	Required	
	CL8-PCB-194	Required	Required	Required	
	CL8-PCB-201	Required	Required	Required	
	CL9-PCB-206	Required	Required	Required	
Organophosphate Pesticides	Atrazine				Required[1]
	Chlorpyrifos				Required[1]
	Cyanazine				Required[1]
	Diazinon				Required[1]
	Malathion				Required[1]
	Prometryn				Required[1]
	Simazine				Required[1]
Herbicides	2,4-D				Required[1]
	Glyphosate				Required[1]
	2,4,5-TP-SILVEX				Required[1]

Notes: 1) As specified in Order Number R4-2014-0024 Appendix D Part III Section B, monitoring must be conducted according to test procedures approved under 40 CFR Part 136 for the analysis of pollutants unless another test procedure is required under 40 CFR Subchapters N or O or is otherwise specified in this

Order for such pollutants [40 CFR Sections 122.41(j)(4) and 122.44(i)(1)(iv)]. 2) See the CCMRP for reporting limits of the analytical parameters required as part of the Harbor Toxics TMDL compliance monitoring program and Table E-2 of Attachment E to the MS4 Permit for minimum levels of the additional parameters required to be monitored during the first wet and dry weather monitoring events as part of this IMP.

1 Constituents required by Table E-2 are only required for the first year monitoring events. For following year sampling events, those required will depend on if they meet the ML.

2 Total chlordane is calculated using the following compounds: alpha-chlordane, gamma-chlordane, oxychlordane, cis-nonachlor, and trans-nonachlor.

3 PCB co-elutions will vary by instrument and column, and may increase reporting limits for some congeners.

6 Adaptive Management

The IMP will be reviewed on an annual basis to make any necessary adjustments to the monitoring sites, parameters, frequency of sampling, or sampling procedures. The IMP is intended to require modifications based upon annual monitoring results. Annual changes may include revisions in toxicity testing, parameters monitored at the receiving water monitoring sites, addition of new parameters to stormwater outfall sites, addition or relocation of monitoring sites, as well as a range of other program adjustments necessary to improve the ability of the program to monitor water quality improvements and identify major sources of contaminants in need of targeted control measures.

Waterbody-pollutant categories and the frequency of exceedance of available receiving water limitations are central to the monitoring approach. Pre-determined triggers will be used to determine if new parameters should be incorporated into the program or if monitoring of a parameter should be discontinued. Monitoring parameters will be adjusted based upon the following guidelines:

- Any parameter exceeding the minimum, appropriate water quality criteria listed in Appendix G during the wet and dry weather screening of Table E-2 parameters will be added to the monitoring list for the subject receiving water site and season.
- If a Table E-2 parameter exceeds receiving water criteria in two consecutive surveys, the parameter will be added to the monitoring list of the representative and associated upstream stormwater outfall monitoring site[s] for a minimum of 2 years.
- If monitoring results of a Table E-2 parameter that was added to a stormwater outfall monitoring site indicate the parameter is not detected in excess of the lowest applicable water quality criterion for 2 consecutive years, monitoring of that parameter at the stormwater outfall monitoring site will be discontinued.
- Pollutants in waterbody/classification 3 will be removed from the list of monitored parameters at a stormwater outfall monitoring site if they are not detected at levels that exceed the minimum, appropriate water quality criteria for a period of 2 consecutive years.

7 Aquatic Toxicity Testing and Toxicity Identification Evaluations

Aquatic toxicity testing includes the evaluation of receiving water samples for toxicity and may support the identification of compounds that elicit a toxic response. Once the toxicity is determined to be present and significant, the causative agent may be determined in a Toxicity Identification Evaluation (TIE) or other investigative action. After the causative agent(s) is identified a source analysis may be conducted to target BMPs to address the sources of toxicity. Receiving water samples are collected and analyzed twice per year in wet weather and once per year in dry weather and evaluated for toxicity. This section describes the testing program.

7.1 Sensitive Species Selection

Aquatic toxicity monitoring will be performed at receiving water monitoring stations CCMRP 16 and CCMRP 19, located in Long Beach Outer Harbor and East San Pedro Bay, respectively (Figure 2). Both stations are located in the marine environment. As described in the MRP, if samples are collected in receiving waters with salinity greater than or equal to 1 part per thousand (ppt), chronic toxicity testing will be conducted in accordance with test methods described in the *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (EPA/600/R-95/136; USEPA 1995). Acceptable marine toxicity tests and species identified in the MRP include:

- A static renewal toxicity test with the topsmelt*, Atherinops affinis (*Larval Survival and Growth Test Method 1006.01)
- A static non-renewal toxicity test with the purple sea urchin, *Strongylocentrotus purpuratus* (Fertilization Test Method 1008.0)
- A static non-renewal toxicity test with the giant kelp*, Macrocystis pyrifera* (Germination and Growth Test Method 1009.0)

All three test species were evaluated to determine the most appropriate test species for the evaluation of toxicity in marine receiving water samples. Wet weather conditions in the region generally persist for less than the chronic testing period for *A. affinis* (7 days); therefore, this test is not representative of conditions found in the receiving water. In addition, the chronic TIE for this species is limited by logistical constraints (e.g., daily renewals of test solution, volume requirements); therefore, only the acute TIE could be performed. Alternatively, chronic toxicity tests with *S. purpuratus* and *M. pyrifera* are much shorter in duration (40 minutes and 48 hours, respectively) and consistent with the relatively shorter exposure periods introduced during storm events. With the shorter duration, a TIE can be initiated much quicker, reducing the holding time and potential for loss of toxicity due to extended sample storage. In chronic toxicity tests, *S. purpuratus* have been shown to be sensitive to metals (Tellis et al. 2014[1]), which are a primary pollutant in urban runoff for wet and dry weather. *S. purpuratus* demonstrate more sensitivity to metals than *M. pyrifera* exposed in chronic toxicity tests (Anderson and Hunt 1988[2]). In addition, *S. purpuratus* can be field collected and held in the laboratory for an extended period of time, making them readily available for storm water testing. Based on these factors, toxicity testing will be conducted with *S. purpuratus*. Because of seasonality in gamete availability, an alternative echinoderm species (sand dollar, *Dendraster excentricus*) may be substituted for *S. purpuratus* if gravid urchins are unavailable, as described in Test Method 1008.0.

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[1] Tellis, M. S., Lauer, M. M., Nadella, S., Bianchini, A., and Wood, C. M., 2014. Sublethal mechanisms of Pb and Zn toxicity to the purple sea urchin (Strongylocentrotus purpuratus) during early development. Aquatic Toxicology,146, 220-229.

[2] Anderson, B.S., and Hunt, J.W., 1988. Bioassay methods for evaluating the toxicity of heavy metals, biocides and sewage effluent using microscopic stages of giant kelp Macrocystis pyrifera (Agardh): A preliminary report. Marine environmental research, 26:113 -134 Source: Marine environmental research (1988) volume: 26 issue: 2 page: 113 -134

7.2 Testing Period

The testing period for the chronic toxicity tests with *S. purpuratus* is 40 minutes, which is consistent with the relatively shorter exposure periods introduced during storm events. As previously discussed, the shorter duration of this test allows a TIE to be initiated quickly if necessary, reducing the holding time and potential for loss of toxicity due to extended sample storage. Chronic testing with *S. purpuratus* will be conducted in accordance with *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (USEPA 1995).

7.3 Toxicity Endpoint Assessment and Toxicity Identification Evaluation Triggers

The chronic toxicity test endpoint will be analyzed, per the MRP, using the U.S. Environmental Protection Agency's (USEPA's) Test of Significant Toxicity (TST) approach (USEPA 2010) as required in the MRP. The MRP specifies that the chronic in-stream waste concentration (IWC) is set at 100 percent receiving water for receiving water samples. TST passage or failure will be determined based on USEPA's TST Implementation Document (USEPA 2010) at a percent effect value equal to or greater than 50 percent at 100 percent receiving water as specified in the MRP. Although the TST approach requires only control and 100 percent receiving water sample, a full dilution series will be tested to estimate the degree of toxicity. This is because USEPA Region IX recently withdrew its approval of use of two concentrations of a control and an IWC (i.e., 100 percent receiving water) in lieu of the five concentrations plus a control when using the TST approach.[3] Therefore, use of a five dilution series plus a control is required for toxicity testing even when using the TST. Federal regulations prohibit any modification of a USEPA-approved CWA analytical method [40 C.F.R. §136.6(b)(3)].

A control and five concentrations will be tested (e.g., 100, 75, 50, 25, and 12.5 percent). In addition to the TST outcome (pass or fail), statistical analysis will be performed using the Comprehensive Environmental Toxicity Information System (CETIS). The statistical output will include the No Observed Effect Concentration (NOEC), Lowest Observed Effect Concentration (LOEC), and Median Effective Concentration (EC_{50}). These non-TST endpoints are currently used for USEPA approved toxicity test methods. These endpoints will be useful to validate and support the outcome of the TST. The TST outcome will provide only pass or fail and will provide no additional information. If there is concern over an outcome of a toxicity test, the non-TST endpoints will provide useful information to validate the TST outcome. In addition, toxicity monitoring results from the IMP can be compared to historical toxicity data in Long Beach Harbor water and eastern San Pedro Bay and to data from other toxicity monitoring programs using these non-TST endpoints in order to understand temporal and spatial trends.

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[3] USEPA Region IX February 11, 2015. A letter to Renee Spears at State Water Resources Control Board written by Eugenia McNaughton at USEPA Region IX. Previously, USEPA sent a letter approving a use of a control and an IWC as alternative test procedure (ATP) in lieu of multiple dilution series when using the TST to respond the request from the State Water Resource Control Board. However, USEPA in its February 11, 2015 letter, withdrew its approval. This letter also states that USEPA proposed a rulemaking to revise 40 CFR § 136 in order to limit authority of an approval of ATP only to Regional ATP Coordinator. If the rulemaking is completed, only a USEPA Regional ATP Coordinator will be allowed to approve an ATP and a permitting authority will be no longer allowed to approve an ATP.

A Toxicity Identification Evaluation (TIE) will be triggered to identify the cause of toxicity if fertilization endpoint demonstrates a percent effect value equal to or greater than 50 percent at the IWC.[4] TIE procedures will be initiated as soon as possible after the toxicity trigger threshold is observed to reduce the potential for loss of toxicity due to extended sample storage.

In cases where significant endpoint toxicity effects in excess of 50% are observed in the original sample, but the follow-up TIE baseline test is found to not be statistically significant, the cause of toxicity will be considered non-persistent, and no immediate follow-up testing will be required on the sample. However, future test results will be evaluated to determine if implementation of concurrent TIE treatments is needed to provide an opportunity to identify the cause of toxicity.

7.4 Toxicity Identification Evaluation Approach

The results of toxicity testing will be used to trigger further investigations to determine the cause of observed laboratory toxicity. The primary purpose of conducting TIEs is to support the identification of management actions that will result in the control of pollutants causing toxicity in receiving waters. Successful TIEs will direct monitoring at outfall sampling sites to inform management actions. As such, the goal of conducting TIEs is to identify pollutant(s) that should be sampled during outfall monitoring so that management actions can be identified to address the pollutant(s).

The TIE approach as described in *Methods for Aquatic Toxicity Identification* (USEPA 1991) is divided into three phases, although some elements of the first two phases are often combined. Each of the three phases is briefly summarized below:

- Phase I describes methods to characterize the physical/chemical nature of the constituents that cause toxicity. Such characteristics as solubility, volatility, and filterability are determined without specifically identifying the toxicants. Phase I results are intended as a first step in specifically identifying the toxicants, but the data generated can also be used to develop treatment methods to remove toxicity without specific identification of the toxicants.
- Phase II describes methods to specifically identify toxicants.
- Phase III describes methods to confirm the suspected toxicants.

A Phase I TIE will be conducted on samples that exceed the TIE trigger described in Section7.3. Water quality data will be reviewed to support evaluation of potential toxicants. A range of sample manipulations may be conducted as part of the TIE process. The most common manipulations are described in Table 5. Information from previous chemical testing and/or TIE efforts will be used to determine which of these (or other) sample manipulations are most likely to provide useful information for identification of primary toxicants. TIE methods will generally adhere to USEPA procedures documented in conducting TIEs (USEPA 1991, 1992, 1993a, 1993b).

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[4] Difference between mean control and mean IWC response, divided by the mean control response, multiplied by 100

Table 5. Phase I and II Toxicity Identification Evaluation Sample Treatments.

TIE Sample Treatment	Description
Baseline (no manipulation)	For comparing changes in toxicity in other manipulations and evaluating changes in toxicity during storage
Graduated pH test	pH is adjusted to determine if toxicity can be attributed to compounds whose toxicity is pH-dependent (e.g., ammonia, some trace metals)
Filtration test	Particulate-associated toxicants are physically removed by filtration
Aeration test	Sample is aerated to evaluate effects of volatile toxicants (e.g., organic solvents)
Ethylenediamine-Tetraacetic Acid (EDTA) addition test	A chelating compound; EDTA reduces toxicity caused by cationic metals
Sodium thiosulfate (STS) addition test	Reduces toxicity caused by oxidants (i.e., chlorine) and some trace metals
Piperonyl Butoxide (PBO) addition test	Reduces toxicity caused by organophosphate pesticides (i.e., diazinon, chlorpyrifos, malathion) and enhances toxicity caused by pyrethroids
Carboxylesterase addition	Removes toxicity caused by pyrethroids
Solid Phase Extraction (SPE) with C18 column	Removes non-polar organics
Methanol Eluate test	Methanol is used to elute the C18 column to recover toxicants and confirm toxicity

The City will identify the cause(s) of toxicity using a selection of treatments in Table 5, and if possible, using the results of water column chemistry analyses. After any initial assessments of the cause of toxicity, the information may be used during future events to modify the targeted treatments to more closely target the expected toxicant or class of toxicants. Moreover, if the toxicant or toxicant class is not initially identified, toxicity monitoring during subsequent events will confirm whether the toxicant is persistent or a short-term episodic occurrence.

As the primary goals of conducting TIEs is to identify pollutants for incorporation into outfall monitoring, narrowing the list of toxicants following Phase I TIEs via Phase II/III TIEs is not necessary if the toxicant class determined during the Phase I TIE is sufficient for 1) identifying additional pollutants for outfall monitoring; and/or 2) identifying control measures. Thus, if the specific pollutant(s) or classes of pollutants (e.g., metals) are identified, then sufficient information is available to incorporate the additional pollutants into outfall monitoring and to start implementation of control measures to target the additional pollutants.

Phase II TIEs may be utilized to identify specific constituents causing toxicity in a given sample if the results of Phase I TIE testing and a review of available chemistry data fail to provide information necessary to identify constituents that warrant additional monitoring activities or management actions to identify likely sources of the toxicants and lead to elimination of the sources of these contaminants. Phase III TIEs will be conducted, as necessary, following any Phase II TIEs.

TIEs will be considered inconclusive if 1) the toxicity is not persistent; and 2) the cause of toxicity cannot be attributed to a class of constituents (e.g., pesticides, metals) that can be targeted for monitoring.

The TIE is considered conclusive if:

- A combination of causes that act in a synergistic or additive manner are identified
- Toxicity can be removed with a treatment or combination of the TIE treatments
- Analysis of water quality data collected during the same event identifies the pollutant or analytical class of pollutants

7.5 Discharge Assessment

The City will prepare a brief Discharge Assessment Plan if TIEs conducted on consecutive sampling events are inconclusive. The discharge assessment will be conducted after consecutive inconclusive TIEs rather than after one because of inherit variability associated with the toxicity and TIE testing methods.

The Discharge Assessment Plan will consider the observed potential toxicants in the receiving water and associated urban runoff discharges, known species effect levels, and relevant exposure periods. The Discharge Assessment Plan will reexamine the following issues:

- Is additional receiving water toxicity monitoring necessary to better evaluate the spatial extent of receiving water toxicity?
- Should different test species be considered? If a species is proposed that is different than the species utilized when receiving water toxicity was observed, justification for the substitution will be provided.
- Is the number and location of monitoring sites suitable for understanding the observed receiving water toxicity?
- What program adjustments are necessary to facilitate a better understanding of the cause of toxicity? Examine the number of monitoring events to be conducted, a schedule for conducting the monitoring, and a process for evaluating the completion of the assessment monitoring.

The Discharge Assessment Plan will be submitted to Los Angeles Regional Water Board for comment within 60 days of receipt of notification of the second consecutive inconclusive result. If no comments are received within 30 days, it will be assumed that the approach is appropriate for the given situation and the Plan should be implemented within 90 days of submittal.

7.6 Follow Up on Toxicity Testing Results

The MRP indicates the following actions should be taken when a toxicant or class of toxicants is identified through a TIE:

1. Group members shall analyze for the toxicant(s) during the next scheduled sampling event in the discharge from the outfall(s) upstream of the receiving water location.

2. If the toxicant is present in the discharge from the outfall at levels above the applicable receiving water limitation, a toxicity reduction evaluation (TRE) will be performed for that toxicant.

The list of constituents monitored at outfalls identified in the IMP will be modified based on the results of the TIEs. Monitoring for those constituents will occur as soon as feasible following the completion of a successful TIE (i.e., the next monitoring event that is at least 45 days following the toxicity laboratory's report transmitting the results of a successful TIE).

The requirements of the TREs will be met as part of the adaptive management process in the WMPs rather than the IMP. The identification and implementation of control measures to address the causes of toxicity are tied to management of the stormwater program, not the IMP. It is expected that the requirements of the TREs will only be conducted for toxicants that are not already addressed by an existing Permit requirement (e.g., TMDLs) or existing or planned management actions.

8 Monitoring Methodology

8.1 Aquatic Toxicity Testing Method

During the first year of monitoring, chronic toxicity testing will be performed using *S. purpuratus*. Toxicity testing will be performed on a control and five concentrations (e.g., 100, 75, 50, 25, and 12.5 percent). Table 6 provides sample volumes necessary for toxicity tests (both wet and dry weather) as well as minimum volumes necessary to fulfill Phase I TIE testing if necessary. As detailed in the previous section, the fertilization endpoint will be assessed using the USEPA's TST procedure and CETIS to determine if there is a 50% difference between sample controls and the test waters and ultimately determine if further testing is necessary.

Table 6. Toxicity Test Volume Requirements for Aquatic Toxicity Testing

Test Organism	**Toxicity Test Type**	**Test Concentration**	**Volume Required for Initial Test (L)**	**Minimum Volume Required for TIE (L)[1]**
Marine Tests for Samples with Salinity ≥ 1.0 ppt				
Purple sea urchin (*Strongylocentrotus purpuratus*)	Fertilization test	0, 12.5, 25, 50, 75 and 100%	1	10

Notes:

The National Pollutant Discharge Elimination System permit targets a 36-hour holding time for initiation of testing but allows a maximum holding time of 72 hours if necessary.

1 Minimum volume for TIE is for Phase 1 only

8.2 Receiving Water monitoring

As specified in Appendix E – Monitoring and Reporting Program – Section IV.A.3, the IMP may be coordinated with other sampling programs to leverage resources. This section provides a summary of receiving water, sediment, and tissue monitoring methodology proposed for the City's IMP, which is based on the CCMRP that was developed to satisfy the Harbor Toxics TMDL compliance monitoring program. The CCMRP was approved by the Regional Board on June 6, 2014. Implementation of the CCMRP satisfies the TMDL compliance monitoring requirements.

As presented previously (see Section 4), the TMDL compliance monitoring program contains a subset of analytical parameters required, at a minimum, for the first wet and dry weather receiving water quality monitoring events. Implementation of the IMP will require these additional analytical parameters to be tested at the frequency specified in the permit.

8.2.1 Water

Receiving water quality monitoring consists of in situ measurements and the collection of water samples for chemical analyses.

8.2.1.1 In Situ Measurements

For each sampling event and at each station, water depth and in situ[5] water quality parameters (temperature, dissolved oxygen [DO], pH, and specific conductance [or salinity]) will be collected. Water quality parameters and water depth will be recorded on a field data sheet.

The water depth at each station should be recorded using a probe or lead line. Water quality will be measured in situ at the station by immersing a multi-parameter instrument[6] into the water at the same location where the water sample is collected. The instrument must equilibrate for at least 1 minute before collecting temperature, pH, conductivity, and/or salinity measurements, and at least 90 seconds before collecting DO measurements. Because DO takes the longest to stabilize, this parameter will be recorded after temperature, pH, and salinity. In situ measurements will follow Standard Operating Procedures (SOPs) identified in the Surface Water Ambient Monitoring Program (SWAMP; MPSL-DFG 2007). SOPs developed in support of the CCMRP may also be referenced. Water quality measurements will be collected at three depths during wet and dry weather events (surface, mid-water column, and bottom).

The MS4 Permit states that flow also be included as a parameter to be measured. At the point of a stormwater or dry weather discharge, it is appropriate to measure for flow. In these cases, flow measurements (i.e., the volume of water discharged per unit of time from a specific discharge point) may be used to calculate suspended sediment and pollutant loadings to a receiving waterbody. In contrast, at stations within a receiving waterbody, it is not appropriate to measure flow for two primary reasons:

- Tidal and wind currents (in bays and estuaries) or flows originating from upstream sources (in rivers and channels) will cause inaccurate flow measurements of the discharge after it mixes with receiving water.
- Mixing of the discharge with receiving water prevents calculations of loadings (i.e., the pollutant concentration multiplied by flow measurement) because the discharge and its suspended sediment and pollutant load is immediately diluted in the receiving water.

This IMP proposes to sample at locations within receiving waters. As such, flow will not be measured, because mixing and other hydrodynamic factors will confound the flow measurements and loading calculations.

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[5] Water quality parameter measurements may be taken in the laboratory immediately following sample collection if auto-samplers are used for sample collection or if weather conditions are unsuitable for field measurements.

[6] A multi-parameter instrument is preferred; however, multiple specific water quality parameter meters may also be used.

8.2.1.2 Grab Samples

Grab samples (i.e., instantaneous, not time- or flow-weighted composites) for analytical chemistry and bacteriological analyses will be taken only from the surface (upper 1 meter of water column) during wet and dry weather events. Multiple grab samples may be required at each station in order to provide sufficient water volume to complete all analyses required. Water samples will be collected with a grab sampler (e.g., Niskin or Van Dorn) that has been decontaminated prior to sample collection at each station. Sampling methods will generally conform to the USEPA's clean sampling methodology described in the SWAMP SOP (MPSL-DFG 2007). SOPs developed in support of the CCMRP may also be referenced.

Sample processing and handling for water chemistry will be conducted in accordance with guidance developed in the Quality Assurance Management Plan for the State of California's SWAMP (Pucket 2002). Aliquots for all required parameters will be taken directly from the grab sampler into appropriate containers or bottles. Water samples will be preserved, depending on the type of analysis, in the field in order to meet specified holding time. Water samples will be stored at less than 4°C until delivery to the appropriate analytical laboratory.

8.2.2 Sediment

Surface sediment samples will be collected at each station. Multiple grab samples may be required at each station in order to provide sufficient sediment volumes to complete all analyses required for the Sediment Quality Objective (SQO) Part 1 assessment (Bay et al. 2009). Sediment grabs will be evaluated for acceptance as outlined in the Bight Field Operations Manual, Section VIII (BCEC 2008).

Surface sediment grab sample procedures will be collected using a Van Veen sampler or similar sampling device as appropriate for the type of sediment sample being collected, as described in the Bight Field Operations Manual, Section VIII (BCEC 2008). SOPs developed in support of the CCMRP may also be referenced.

Sediment sample processing and handling for purposes of sediment chemical analyses, sediment toxicity, and benthic community assessment in support of the SQO Part 1 assessment will be performed in accordance with procedures specified in the Sediment Quality Assessment Draft Technical Support Manual (Bay et al. 2009) and the Bight Field Operations Manual (BCEC 2008). SOPs developed in support of the CCMRP may also be referenced. Sediment samples for chemistry and toxicity analyses will be stored at less than 4°C until delivery to the appropriate analytical laboratory. Benthic infauna samples will be stored in 10 percent buffered formalin in the short term and then subsequently transferred to 70 percent ethanol (or equivalent) for long-term storage.

8.2.3 Fish Tissue

Fish tissue samples will be collected and analyzed for chemical contaminants of concern. Sampling, processing, and testing methods will be carried out in accordance with Bight protocols (BCEC 2008, 2009). SOPs developed in support of the CCMRP may also be referenced. Necessary permits (e.g., scientific collection, incidental take) will be secured prior to fish collection. Applications and procedures for permits can be found online at the California Department of Fish and Wildlife (CDFW) website (CDFW 2013).

CDFW code section 1002 and Title 14 sections 650 and 670.7 requires a Scientific Collecting Permit to take, collect, capture, mark, or salvage, for scientific purposes, fish and invertebrates. CDFW section 2081(b) requires an Incidental Take Permit (ITP) for any species listed as threatened or endangered (T/E). Although none of the targeted species for this study are T/E species, it is possible that T/E species will be accidentally caught as by catch. An ITP is required for T/E species that are caught or handled in any way, even if they are returned to the ocean.

In addition, the permit holders must notify the local CDFW office prior to collection and submit a report of the animals taken under the permits within 30 days of the expiration date of the permits.

Composite samples of three fish species (white croaker, California halibut, and shiner surfperch) will be collected at two locations, one in eastern San Pedro Bay and one in Outer Long Beach Harbor.

When possible, fish will be collected using a semi-balloon, 7.6-meter headrope otter trawl following the methods in the Bight Field Operations Manual (BCEC 2008). If other methods need to be employed in the case that an otter trawl is not feasible (e.g., lampara net, beach seine, fish trap, or hook and line), SWAMP methods will be used (MPSL-DFG 2001). SOPs developed in support of the CCMRP may also be referenced.

Once the catch is onboard the vessel, the targeted species will be identified and separated for subsequent processing. At each station, 12 individuals of each fish species will be collected for further processing. There is currently no legal size limit for white croaker. An ocean fish contaminant survey was performed from 2002 to 2004 (NOAA 2007). In part, this survey sought to generate information on contaminants of concern for fish caught for sustenance in Southern California. Collection of white croaker for the Harbor Toxics TMDL study should be consistent with this survey, which recommended a minimum length of 160 millimeters (mm; total length). Collection of California halibut of legal size limit is preferred. The current regulations specify at least 22 inches (or 559 mm; total length) for California halibut (FGC 2012). Collection of adult shiner surfperch (i.e., second year age-class with a target length of 88 mm [Odenweller 1975]) is preferred. Additional individuals of the three target species and non-target species will be returned to the ocean as soon as possible to minimize loss. It should be noted that field personnel may encounter by catch species that are potentially harmful while sorting for targeted species. The Bight Field Operations Manual (BCEC 2008) and Fish Collection SOPs in Appendix A provide information on the safe handling of these organisms.

Each targeted fish kept will be tagged with a unique identification number and then measured for total length, fork length, and weight, and examined for gross pathology in accordance with guidance established in the Bight Field Operations Manual (BCEC 2008). Three composite samples per species per station will be created. A composite sample will be composed of four individuals; therefore, a total of 12 individuals per station are required. If more than 12 specimens are caught, then the 12 individuals best and most closely distributed about the 75th percentile of the length distribution of all individuals will be used for the composites. The selected 12 individual fish will then be arranged by size and the smallest four fish, the middle four fish, and the largest four fish within a species will be grouped for each composite to satisfy the 75 percent rule (the smallest individual in a composite is no less than 75 percent of the total length of the largest individual in a composite; USEPA 2000). This may permit data evaluation based on size class, if necessary. Skin-off fillets will be used for white croaker, California halibut, and shiner surfperch to be consistent with the *2002 – 2004 Southern California Coastal Marine Fish Contaminants Survey* (NOAA 2007). Dissection and compositing methods will be performed in the analytical laboratory in accordance with USEPA guidance (USEPA 2000).

Fish tissue will be analyzed for chemical parameters. Processing and preservation will be performed in accordance with the methods described in the Bight Field Operations Manual and Bioaccumulation Workplan (BCEC 2008, 2009). Fish will be processed in the field according to the steps below.

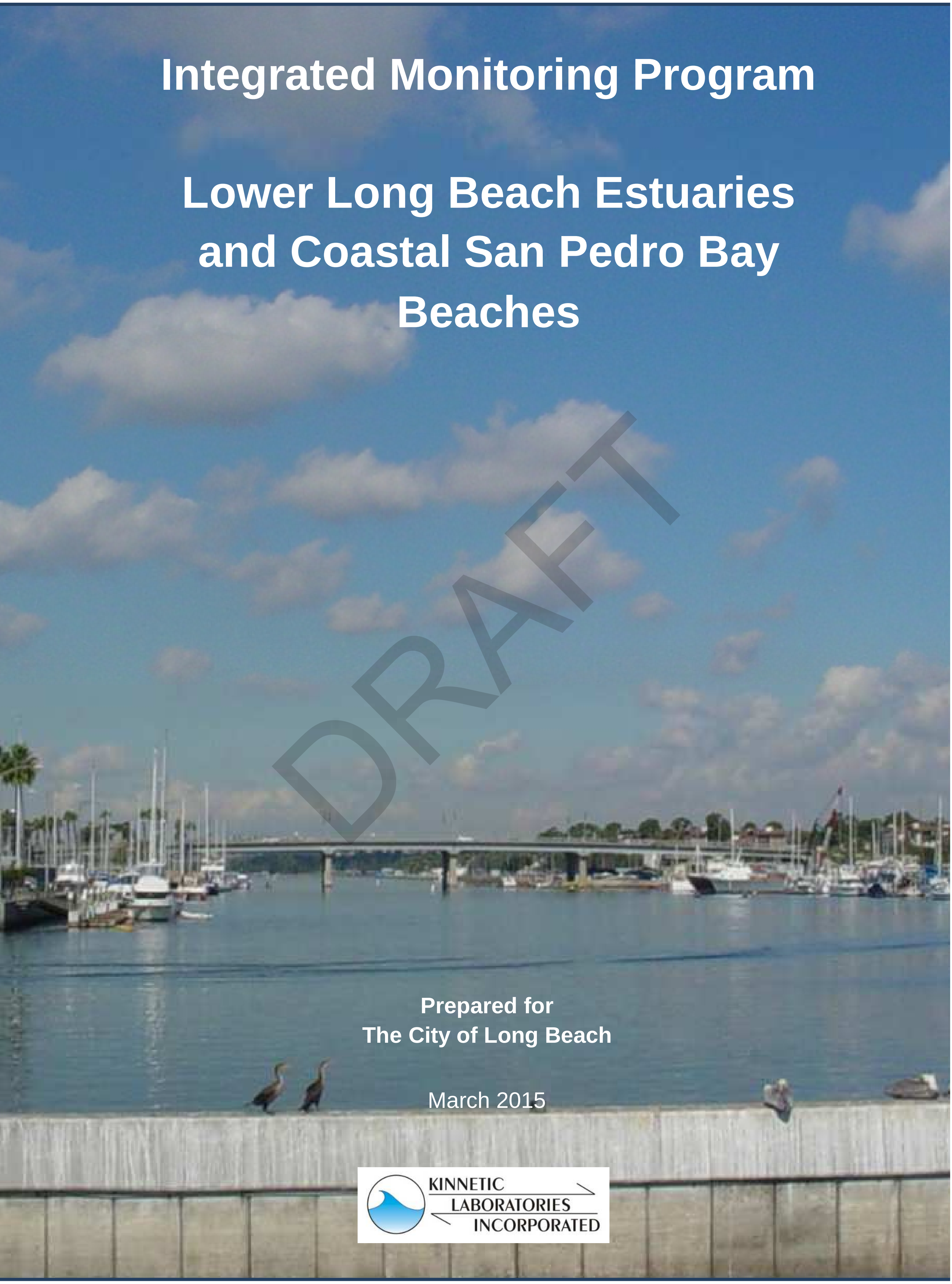
- Sacrifice fish and leave whole body intact.
- Blot fish dry and pack each fish in aluminum foil (shiny side out).
- Place each packed fish in a labeled, food-grade, resealable plastic bag and store on ice.
- Ship overnight to the analytical laboratory on wet or blue ice. If samples are held more than 24 hours, pack on dry ice.

Chain-of-custody forms will be maintained. Tissue compositing will be conducted by the analytical laboratory.

Long Beach Nearshore Watershed Management Program Appendix 8

Integrated Monitoring Program Section 8.2

Lower Long Beach Estuaries and Coastal San Pedro Bay Beaches



Integrated Monitoring Program

Lower Long Beach Estuaries and Coastal San Pedro Bay Beaches

Prepared for
The City of Long Beach

March 2015

KINNETIC
LABORATORIES
INCORPORATED

Contents

APPENDICES

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ACRONYMS

ALERT	Automatic Local Evaluation in Real Time
AMEL	Average Monthly Effluent Limitation
Basin Plan	*Water Quality Control Plan for the Coastal Watersheds of Los Angeles and Ventura Counties*
BMP	Best Management Practices
BPJ	Best Professional Judgment
BOD	Biochemical Oxygen Demand 5-day @ 20 °C
BRI	Benthic Response Index
CASQA	California Stormwater Quality Association
CCR	California Code of Regulations
CD	Compact Disc
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CIMP	Coordinated Integrated Monitoring Program
CL	Control Limit
COD	Chemical Oxygen Demand
CTR	California Toxics Rule
CV	Coefficient of Variation
CWA	Clean Water Act
CWC	California Water Code
CWP	Center for Watershed Protection
Discharger	Los Angeles County MS4 Permittees
DNQ	Detected But Not Quantified
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
EFA	Effective Filtration Area
EIA	Effective Impervious Area
ERL	Effects Range Low
ERM	Effects Range-Median
ELAP	California Department of Public Health Environmental Laboratory Accreditation Program
Facility	Los Angeles County MS4s
FEB	Fluorinated Ethylene Propylene
FIB	Fecal Indicator Bacteria
GIS	Geographical Information System
gpd	gallons per day
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
IC50	Concentration at which the organism is 50% inhibited
IC/ID	Illicit Connection and Illicit Discharge Elimination
IMP	Integrated Monitoring Program
IWC	In-Stream Waste Concentration

LA	Load Allocations
LACFCD	Los Angeles County Flood Control District
LARWQCB	Regional Water Quality Control Board, Los Angeles
LCC	Los Cerritos Channel
LID	Low Impact Development
LOEC	Lowest Observed Effect Concentration
MAL	Municipal Action Limits
MBAS	Methylene Blue Active Substances
MCM	Minimum Control Measure
mg/L	milligrams per Liter
MDEL	Maximum Daily Effluent Limitation
ME	Mass Emission
µg/L	micrograms per Liter
MDL	Method Detection Limit
MEC	Maximum Effluent Concentration
MGD	Million Gallons Per Day
ML	Minimum Level
MRP	Monitoring and Reporting Program
MS4	Municipal Separate Storm Sewer System
MTBE	Methyl tertiary-butyl ether
NAC	Non-Stormwater Action Levels
ND	Not Detected
NOEC	No Observable Effect Concentration
NPDES	National Pollutant Discharge Elimination System
NSW	Non-Stormwater
NTR	National Toxics Rule
Ocean Plan	Water Quality Control Plan for Ocean Waters of California
ORI	Outfall Reconnaissance Inventory
PCB	Polychlorinated Biphenyls
PWS	Primary Watershed Segment
PES	Polyester-reinforced polysulfone
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QPF	Quantified Precipitation Forecast
RAP	Reasonable Assurance Program
RIVPACS	River Invertebrate Prediction and Classification System
RBI	Relative Benthic Index
Regional Water Board	California Regional Water Quality Control Board, Los Angeles Region
RL	Reporting Limit
RPA	Reasonable Potential Analysis
RWL	Receiving Water Limitations
SIP	State Implementation Policy (Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California)

SMC	Stormwater Monitoring Coalition
SMR	Self-Monitoring Reports
SQO	Sediment Quality Objective
SSC	Suspended Sediment Concentration
State Water Board	California State Water Resources Control Board
SVOC	Semi-Volatile Organic Compound
SWAMP	State’s Water Ambient Monitoring Program
SWI	Sediment Water Interface
SWS	Secondary Watershed Segment
TAC	Test Acceptability Criteria
TIE	Toxicity Identification Evaluation
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TRE	Toxicity Reduction Evaluation
TSD	Technical Support Document
TSS	Total Suspended Solid
TST	Test of Significant Toxicity
TU_c	Chronic Toxicity Unit
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
WDR	Waste Discharge Requirements
WET	Whole Effluent Toxicity
WLA	Waste Load Allocations
WMA	Watershed Management Area
WMMS	Watershed Management Modeling System
WMP	Watershed Management Program
WQBELs	Water Quality-Based Effluent Limitations
WQS	Water Quality Standards
%	Percent

INTEGRATED MONITORING PROGRAM FOR THE CITY OF LONG BEACH BAY AND ESTUARINE WATERSHEDS
LOS CERRITOS CHANNEL, ALAMITOS BAY, SAN GABRIEL RIVER ESTUARY WATERSHEDS, AND SAN PEDRO BAY BEACHES

1 Introduction

An Integrated Monitoring Program (IMP) is required to be submitted either separately or as part of a Watershed Management Plan (WMP). The IMP is required to integrate requirements of the current City of Long Beach MS4 permit and Total Maximum Daily Load (TMDL) monitoring requirements. This plan was developed to address five primary objectives which include:

- Assess the chemical, physical, and biological impacts of discharges from the MS4s on receiving waters.
- Assess compliance with receiving water limitations and water quality-based effluent limitations (WQBELs) established to implement TMDL wet and dry weather load allocations
- Characterize pollutant loads in MS4 discharges.
- Identify sources of pollutants in MS4 discharges.
- Measure and improve the effectiveness of pollutant controls implemented under the new MS4 permits.

The approach presented in this IMP incorporates all objectives of the Monitoring and Reporting Program (MRP) but provides a customized approach to address the objectives identified in the MRP for Receiving Water and Outfall Monitoring based upon the unique characteristics of the following watersheds:

- The lower portions of the City that drain into the Los Cerritos Channel Estuary and Alamitos Bay areas.
- The small portion of the City that drains directly to San Pedro BayBeaches.
- The portions of the City that drain into the San Gabriel River Estuary.

A drainage map of the City of Long Beach Los Cerritos Channel Estuary and Alamitos Bay watershed is shown in Figure 1-1 along with sub-watershed drainages within the overall watershed area. Also shown in Figure 1-1 is a drainage map of the City of Long Beach drainages to the San Gabriel River Estuary, which is within the City and below the confluence of the San Gabriel River and Coyote Creek at the head of the estuary.

Figure 1-1. Map of City of Long Beach Watersheds Showing Sub-Watersheds Los Cerritos Channel Estuary, Alamitos Bay, and San Gabriel River Estuary.

The City of Long Beach is also participating in three other watershed programs that, together with this program, address all discharges from the City. A previous Coordinated Integrated Monitoring Program (CIMP) along with a WMP have been developed for the up-stream, freshwater portion of the Los Cerritos Channel (LCC) Watershed, which includes parts of the City of Long Beach but also includes other cities in the upper watershed. This upper LCC Watershed has a receiving water quality monitoring site at Stearns Street (LCC1). A short distance downstream, this water discharges to tidal waters of the Los Cerritos Channel Estuary. Another CIMP and WMP were developed for the Lower Los Angeles River Watershed, which includes drainages from the City of Long Beach and several upstream cities that drain to the Los Angeles River. Finally, a Lower San Gabriel River Watershed CIMP and WMP were prepared that cover the lower, freshwater portions of the San Gabriel River Watershed, which also complements the CIMP and WMP that cover the upper drainages to the San Gabriel River.

The watersheds covered by this present IMP are within the City. However, discharges from freshwater portion of the Los Cerritos Channel contribute the majority of flows into the Los Cerritos Channel estuary. As a result, the freshwater receiving water quality monitoring station located at Stearns Street (LCC1) will be treated as an outfall monitoring site for purposes of this IMP. Participating jurisdictions for the upstream freshwater watershed CIMP include the Cities of Long Beach, Bellflower, Cerritos, Downey, Lakewood, Paramount, Signal Hill, and the Los Angeles County Flood Control District. Likewise, receiving water monitoring sites at the lower end of the freshwater portions of the San Gabriel River and Coyote Creek will also be considered as outfall monitoring sites for purposes of the San Gabriel River Estuary. Participating jurisdictions for the Lower San Gabriel River CIMP include the Cities of Long Beach, Artesia, Bellflower, Cerritos, Diamond Bar, Downey, Hawaiian Gardens, La Mirada, Lakewood, Norwalk, Pico Rivera, Santa Fe Springs, Whittier, and the Los Angeles County Flood Control District. The City of Long Beach IMP will coordinate with each of the upstream watershed programs to share data and assure that appropriate water quality measurements are taken to meet common objectives for each program. External contributions of contaminants are limited to atmospheric deposition originating predominantly from major transportation corridors and facilities.

1.1 Monitoring Objectives

The MRPs established under the Los Angeles County[1] and the City of Long Beach[2] NPDES permits have equivalent requirements. The City of Long Beach bay and estuarine watersheds are located in areas covered by the City of Long Beach's permit, but the requirements differ only in terms of schedules. The City has prepared a WMP under the City NPDES Permit schedule. This IMP is required to incorporate the following elements and address the established objectives under each element.

- Receiving Water Monitoring (Wet and Dry Weather) (Part II.E.1 of the MRP)
    - Are receiving water limitations being met?
    - Are there trends in pollutant concentrations over time or during specified conditions?

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[1] Order No. R4-2012-0175, NPDES Permit No. CAS004001

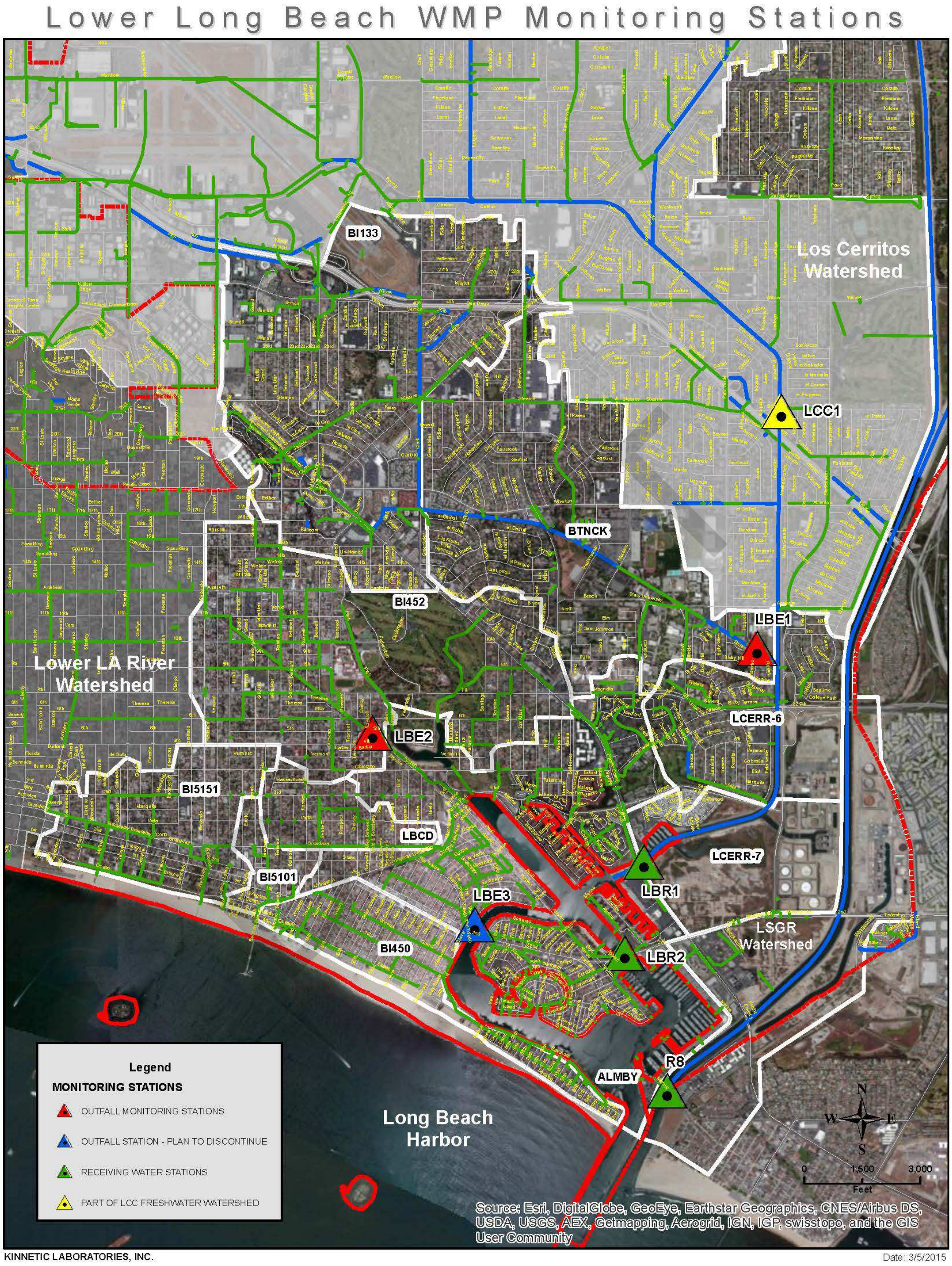
[2] Order No. R4-2014-0024, NPDES Permit No. CAS004003

  - Are designated beneficial uses fully supported as determined by water chemistry, aquatic toxicity, and bioassessment monitoring?
- Stormwater Outfall Monitoring (Part II.E. 2 of the MRP)
  - How does the quality of the permittee’s discharges compare to Municipal Action Limits (MALs)?
  - Are the permittee’s discharges in compliance with applicable stormwater WQBELs derived from TMDL WLAs?
  - Do the permittee’s discharges cause or contribute to an exceedance of receiving water limitations?
- Non-Stormwater Outfall Based Monitoring (Part II.E.3 of the MRP)
  - Are the permittee’s discharges in compliance with non-stormwater WQBELs derived from TMDL Waste Load Allocations (WLAs).
  - How does the quality of the permittee’s discharges compare to Non-Stormwater Action Levels?
  - Dose the permittee’s discharges cause or contribute to an exceedance of the receiving water limitations?
  - Does the permittee comply with the requirements of the Illicit Connection and Illegal Discharge Program?
- New Development/Re-Development Effectiveness Tracking (Part II.E.4 of the MRP)
  - Are the conditions established in building permits issued by the Permittee being met?
  - Are stormwater volumes associated with the design storm effectively retained on-site?
- Regional Studies
  - How does the permittee plan to participate in efforts to characterize the impact of the MS4 on receiving waters? Include participation in regional studies with the Southern California Stormwater Monitoring Coalition (SMC) and any special studies specified in TMDLs.

1.2 Monitoring Sites and Approach

The approach presented in this IMP incorporates all objectives of the MRP but provides a customized approach to address the objectives identified in the MRP for Stormwater Monitoring based upon the unique characteristics of the Lower Long Beach Estuaries and the small drainages from the City to the San Pedro Bay beaches. Monitoring sites selected for the Los Cerritos Channel Estuary and Alamitos Bay, and for the San Gabriel River Estuary are shown on Figure 1-2 and in Figure 1-3 for coastal beaches.

Historical water quality monitoring for the last fourteen years has been carried out at the Los Cerritos Channel site at Stearns Street (LCC1) and, in most cases, with consistent detection limits applicable to current receiving water limitations (RWLs). This site at the head of the Los Cerritos Channel Estuary captures all runoff from the Los Cerritos Channel freshwater watershed, including runoff from a large segment of the City of Long Beach. This site is also the compliance monitoring site for the Los Cerritos Channel Metals TMDL. This site is located about 100 feet downstream of a former United States Geological Survey (USGS) gaging station and effectively marks the downstream extent of freshwater influences within the Channel. During low tides, freshwater extends down to the end of the concrete-lined channel below Atherton Street. LCC1 marks the upper extent of tidal influence for all but the most extreme high tides. The portion of the Los Cerritos Channel listed as impaired for metals was identified



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 1-2. **Locations of Monitoring Sites in the Los Cerritos Channel Estuary and Alamitos Bay, and in the San Gabriel River Estuary.**

as the 2.1 mile freshwater portion above the tidal prism. EPA (2010) used data from 10 years of both wet and dry weather monitoring at LCC1 to establish the freshwater metals TMDL for the Los Cerritos Channel. Other historical monitoring sites (Figure 1-2) under the former City of Long Beach NPDES permit included a station in the intertidal channel on Bouton Creek near where water discharges to the Los Cerritos Channel Estuary below Stearns Street. Another historical monitoring site is the discharge of the Belmont Pump Station into Alamitos Bay. Monitoring sites to be used in this present IMP program are listed in Table 1-1 along with their location and their functions.

Table 1-1. Monitoring Site Designation and Monitoring Function.

Site Name	Site Description	Datum NAD83		Outfall Sites	Receiving Water Sites	Bacteria Monitoring
		Latitude (N)	Longitude (W)			
LCC1	LCC1 at Stearns Street	33.79540	118.10366	X		
LBE1	Bouton Creek @ LCC Estuary Channel	33.77855	118.10554	X		
LBE2	Termino Drain to Marine Stadium	33.77254	118.13826	X		
LBE3	Belmont Pump Station to Alamitos Bay	33.75892	118.12952	To be discontinued		
LBR1	Los Cerritos Estuary Channel @ E. PC Hwy Bridge	33.76341	118.11514		X	
LBR2	Alamitos Bay at 2nd Street Bridge	33.75692	118.11678		X	
R8	San Gabriel River at Marina Bridge	33.74719	118.11299		X	
B5	Coastal Beaches	33.76344	118.17829			X
B56	Coastal Beaches	33.76336	118.17352			X
B60	Coastal Beaches	33.76128	118.16188			X
B7	Coastal Beaches	33.75971	118.15454			X
B8	Coastal Beaches	33.75803	118.14909			X

Receiving Water and Outfall Monitoring for the City of Long Beach IMP are listed in Table 1-1 and illustrated in Figure 1-2. The Los Cerritos Channel LCC1 site is part of the Los Cerritos Channel freshwater CIMP and monitoring at this site will continue to be carried out by the LCC Watershed Group. However, data from this site will be important to the evaluation of estuarine receiving waters. The Bouton Creek outfall monitoring site will be continued. A new outfall monitoring site will be established on the Termino Drain that discharges into the far northwestern end of Marine Stadium. The main reason for monitoring the Termino Drain is that it formerly drained into the Colorado Lagoon, an area subject to a TMDL for chlordane, lead, zinc, PAHs, and toxicity in sediments, as well as for DDT, dieldrin, and PCBs in tissues. Sediments located near the site where this drain formerly discharged into Colorado Lagoon were among the most contaminated in the entire lagoon.

In addition, the City's Beach Bacterial monitoring program at all of the recreational beaches will continue on their scheduled frequency of once a week. However, the new permit will require more frequent monitoring on the City's coastal beaches west of the Pier (Figure 1-3) in San Pedro Bay because of the City of Long Beach Beaches and Los Angeles River Estuary Bacterial TMDL.

Finally, monitoring at the Belmont Pump Station outfall monitoring site will be discontinued for the present as there are now fourteen years of monitoring data for this site. The selection of monitoring stations was guided by previously existing data and by consideration of Sub-Basin areas and land use as discussed below.

Monitoring of outfalls into the San Gabriel River estuary will not be necessary as stormwater discharges into this estuary are from limited land areas or from wetlands. Discharges in this area of the estuary are dominated by power plant cooling water discharges into the estuary and by sanitary plant discharges from higher up in the San Gabriel River freshwater Watershed, as well as stromwater discharges from the upper freshwater watershed during storm events. Waters and sediments within this estuary are also being monitored, including the continuing San Gabriel River Regional Monitoring Program previously carried out by the Council for Watershed Health and now carried on by Aquatic Bioassay & Consulting Laboratories under a new five year contract.

Figure 1-3. Receiving Water Beach Bacterial Monitoring Sites West of Pier on Main Beach

1.2.1 Previously Available Data

A significant amount of data already exist for the Los Cerritos Channel, Alamitos Bay, and San Gabriel River estuaries as well as that of bacterial monitoring on the City's recreational beaches. These include data from both established monitoring programs as well as from special studies. The following sections provide a brief review of available data and comments on the results of these studies with respect to the design of this present stormwater monitoring program. This information provided the basis for decisions on the location of monitoring stations and the parameters to be monitored. Maps showing the locations of some of these sampling and monitoring sites are given in Appendix G along with data source references. A brief discussion of key findings is given below.

1.2.1.1 Los Cerritos Channel Estuary and Alamitos Bay

City of Long Beach NPDES Stormwater Monitoring Program and Beach Bacteria Monitoring. Data from three monitoring sites in the estuary (LCC1 at Stearns, Bouton Creek, and the Belmont Pump Station) are available for flow, chemical concentrations, toxicity, and contaminant load data for the past fourteen years of monitoring (Kinnetic Laboratories, 2000-2014). Of particular interest are results of a special study that tracked the freshwater plume from rain events through the estuary. Bioassay tests using the sea urchin fertilization test indicated that toxicity in these receiving waters was minimal during storm events. Another special study sampled and tested sediments within the Los Cerritos Channel Estuary and identified chlordane in sediments that exceeded Effects Range Median (ERM) screening values and a few other compounds such as metals and DDTs that exceeded the Effects Range Low (ERL) level (Long et al, 1995).

Another special study on bacterial sources along the City's main beach in San Pedro Bay (Kinnetic Laboratories, 2009) implicated the Los Angeles River plume driven by predominant diurnal winds from the west in periodic bacteria exceedances on this beach. Water quality surveys conducted to screen for potential human sources showed no evidence of human contributions using very low sample limits of detection (SLOD). Universal *Bacteriodales* measurements showed concentrations were low and comparable to numbers currently found in San Pablo Bay and San Francisco Bay (S. Wuertz, pers. comm.) In addition, no markers for adenoviruses or enterovirus were detected.

Finally, continuing analyses of the City of Long Beach's ongoing bacterial monitoring data for all of the City beaches (Kinnetic Laboratories, 2014a and214b) has shown a marked improvement (Table 1-2) over recent years in compliance with bacterial criteria, achieving high compliance during the summer dry season up to a maximum of 98.7% this past summer, and also marked improvement during the winter period which also is influenced by the number of winter storms. For the West Main Beach, summer 2014 compiance was 97.4 percent, and 90.0 percent overall compliance for the year including both wet and dry weather. These improvements have been directly related to dry weather (summer and winter) diversions of the Belmont and Appian Way Pump Stations, and major improvements to Colorado Lagoon that included bypassing the Termino Drain from the lagoon to Marine Stadium along with a dry weather diversion and a trash trap included in the project design. Three more dry weather diversions of drains to the main beach are being designed, including diversion of a 78-inch drain to the pump station at the mouth of the Los Angeles River.

Table 1-2. City of Long Beach Bacterial Criteria Compliance on Recreational Beaches.

ALL SITES SINGLE SAMPLE PERCENT COMPLIANCE		
Storm Year	**All Seasons**	**Summer Season**
2014	89%	99%
2013	89%	88%
2012	81%	91%
2011	70%	95%
2010	73%	81%
2009	73%	82%
2008	74%	74%
2007	68%	78%
2006	80%	67%

Colorado Lagoon Monitoring and Improvement Program. A water, sediment, and marine biological TMDL monitoring program is in place (Anchor, 2013 and 2014) and continuing in Colorado Lagoon following completion of major improvements. Preliminary data from Colorado Lagoon sediments show that sediment contamination is generally confined to the lagoon. Contaminants in sediment that exceed ERM values include lead and some other metals that have exceeded ERL values (cadmium, copper, mercury, zinc). Dieldrin, total DDTs, and total chlordanes are above ERM criteria amd PCBs are above ERL criteria. Plans are being developed for further remediation of remaining sediment. Bacterial concentrations at the Colorado Lagoon's beaches as measured by the City's beach monitoring program are minimal and have consistently met standards ever since completion of the low flow diversions and initial dredging.

Southern California Bight Studies (2003 and 2008). Sediment data from sampling stations in the Los Cerritos Channel Estuary and in Alamitos Bay have shown chlordane to exceed ERM levels and DDTs and some metals (copper, lead, and zinc) were shown to generally exceed ERL levels in sediments. Low sediment toxicity was found in Alamitos Bay and moderate toxicity in the Los Cerritos Channel Estuary as evaluated by Sediment Quality Objective (SQO) testing.

California Environmental Data Exchange Network (CEDEN) Database. Sediment data from a Regional Water Board special study indicated one station in the upper Los Cerritos Channel exceeded ERMs for chlordane, DDTs, zinc, and total PCBs and four metals above ERLs. The Statewide Stream Pollution Trends Study in the upper San Gabriel River Estuary (Site RA2) showed chlordane exceeded the ERM and metals (copper, zinc) and total DDTs exceeded ERLs.

1.2.2 San Gabriel River Estuary

San Gabriel River Regional Monitoring Program. The Council for Watershed Health and Aquatic Bioassay & Consulting Laboratories have conducted an ongoing monitoring program since 2007 and this program is to be continued by Aquatic Bioassay and Consulting Laboratories. This San Gabriel River Regional Monitoring Program has produced a dataset of Sediment Quality Objective (SQO) data for sediments in the estuary which includes toxicity using *Eohaustorius* (amphipod) and *Mytilus* (mussel) as test organisms. Sediment chemistry and benthic infauna are also part of the program. Water chemistry in the estuary is limited to conventional parameters by electronic probes along with bacterial analyses.

Except for Site RA2 near the top of the estuary, results for sediments show metals along with total DDTs exceeding ERL values. Sediment bioassays showed no toxicity for all years except for 2012 when toxicity was characterized as low to moderate. SQO evaluations showed unimpacted or likely unimpacted conclusions. SQOs reported in a Stream Pollution Trends Program Technical Report (2014), shows a five year average of moderate toxicity for Site RA2 and associated sediment chemistry tends to confirm this result. It also needs to be noted that water chemistry as required by the new MRP has not been part of this program.

Southern California Bight Studies (2003 and 2008). Sediment chemistry reported from seven sites along the San Gabriel River Estuary in 2003 showed only nickel (one site) and total DDTs above ERL levels and no toxicity was measured with *Eohaustorius* (amphipod). In 2008, no toxicity was measured using the amphipod test and low toxicity was measured for *Mytilus* (mussel) test.

CEDEN Database. DDTs and PCBs exceeded ERM levels at only one station located near the power plant.

1.2.3 Land Use and Sub-Basin Areas

Land uses for watersheds discharging to the Long Beach bay and estuarine areas are mapped in Figure 1-4 along with sub-watershed boundaries. Land use summary tables are given in Table 1-3 for the Los Cerritos Channel Estuary and Alamitos Bay watersheds and in Table 1-4 for the San Gabriel River Estuary watershed in the City of Long Beach.

Overall, the Los Cerritos Channel Estuary and Alamitos Bay watershed covers about 6,279 acres broken into ten sub-watersheds. Within the Los Ceritos Channel Estuary and Alamitos Bay watershed, single and multifamily residential land use is the largest category, comprising a total of approximately 46.4% of the total land area, with industrial use only 5.6% and commercial use only 5.8%. Transportation and secondary roads account for about 24.2% of the land use and institutional use accounts for about 10.2%. Bay and estuarine water comprise about 7.2% of the land use and include small boat harbors.

For the San Gabriel River Estuary watershed, single and multifamily residential comprises about 20% of the land use, with the largest category being industrial at 35.3% due mostly to power plant use. Transportation and secondary roads accounts for about 5.8% of land use and commercial for about 9.1%. Water comprises about 18.3% of the area and agricultural/vacant land including wetlands comprises about 11.4% of the area.

Monitoring sites selected for the Los Cerritos Channel Estuary are shown on Figure 1-2 and are listed in Table 1-1. The Bouton Creek monitoring station drains from Sub-Basin BTNCK and portions of B1133. The Sub-Basin BTNCK totals 1,047 acres and Sub-Basin B1133 totals 1,178 acres, two of the larger sub-basins. Both are high in residential use, somewhat above the overall average. Sub-Basin BTNCK is average in commercial use but Sub-Basin BTNCK is about double the average commercial use. Sub-Basin BTNCK is high in institutional use. Bouton Creek was chosen as part of the original City of Long Beach NPDES stormwater monitoring sites because of the size of the drainage basin and because it discharges directly into the Los Cerritos Channel Estuary.

The Termino Drain monitoring site drains Sub-Basin B1515. This Sub-Basin covers 378 acres and is about average in single family residential land use but very high in multifamily residential and higher than average in secondary road land use. The main reason for moving a monitoring site to the Termino Drain is because this drainage originally flowed through Colorado Lagoon, an area subject to a TMDL for chlordane, lead, PAHs, and toxicity in sediments and DDT, dieldrin, and PCBs in tissue. The City of Long Beach has now re-routed this drain around the lagoon along with other major lagoon improvements. However, the City wishes to verify that better management practices have now significantly improved water quality and effectively eliminated or reduced legacy contaminants from the watershed.

The Belmont Pump Station drains part of Sub-Basin ALMBY and discharges into Alamitos Bay. Originally, this site was selected due to bacterial exceedances on the nearby Alamitos Bay recreational beaches. Now, both this pump station and the nearby Appian Way Pump station discharges have dry weather diversions (summer dry and winter dry) to the sanitary system with marked improvement on compliance at these beaches with regard to bacterial criteria. Since fourteen years of monitoring data are available for this station, monitoring at this site will be discontinued.

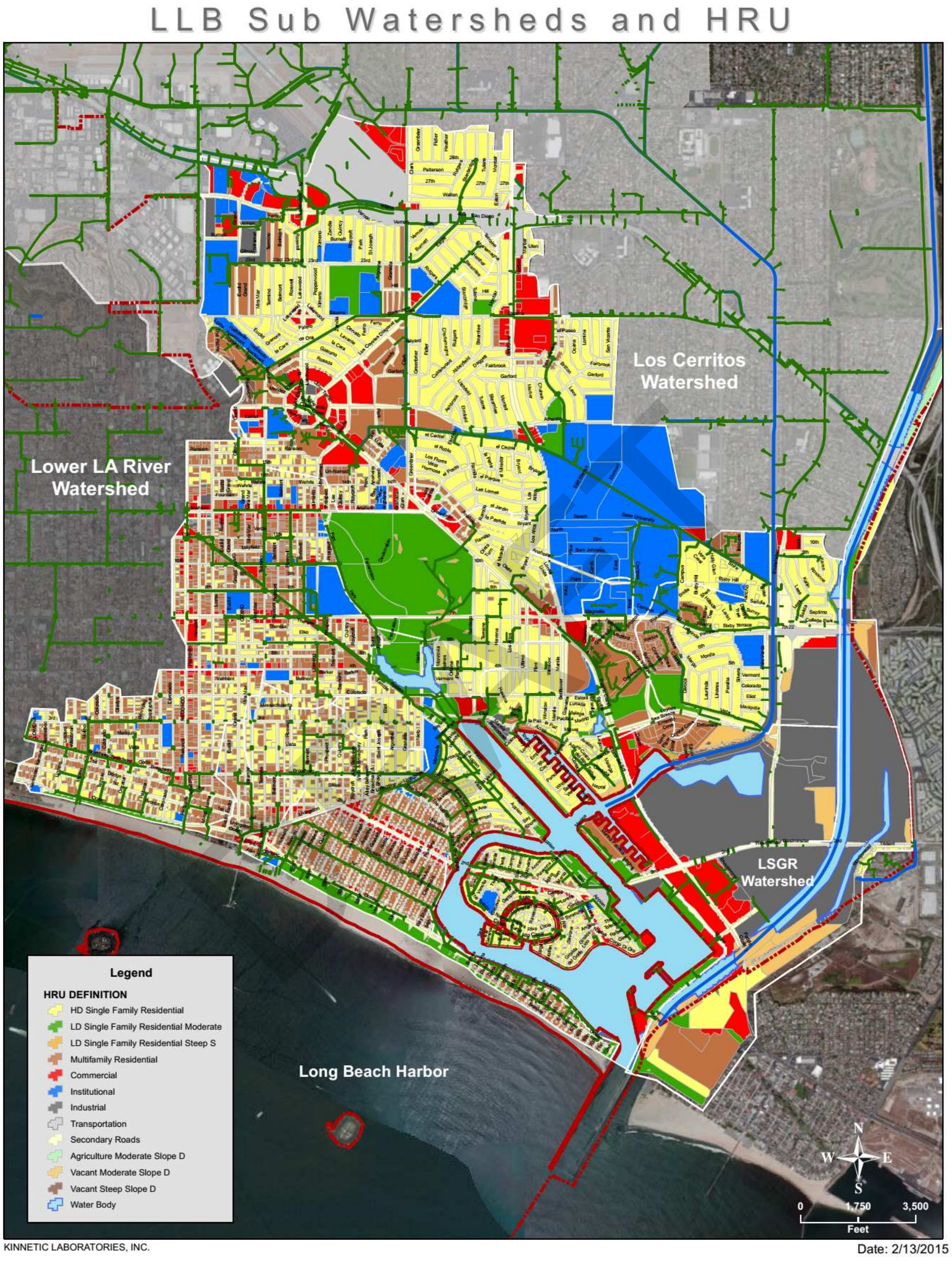


Figure 1-4. **Land Uses in Sub-Basins of Long Beach Bay and Estuary Watersheds.**

Table 1-3. Land Use Data and Areas for each Sub-Basin of the Los Cerritos and Alamitos Estuary Bay Watershed (HUC-12).

		Subwater Number/Acreage										
Land Use	***HRU CODE***	**BI515**	**BI452**	**BI133**	**BTNCK**	**LCERR-6**	**LCERR-7**	**ALMBY**	**BI450**	**BI5101**	**LBCD**	**TOTAL**
HD single family residential	1	74.1	199.9	292.2	357.5	140.0	0.7	301.6		14.3	63.1	1443.4
LD single family residential moderate	2	6.6	204.4	20.0	17.8	17.1	2.8	120.8	34.2			423.7
LD single family residential steep slope	3		4.3			0.6	1.8	4.1	0.4			11.2
Multifamily residential	4	150.9	226	157.8	35.7	42.3	25.2	189.7	133.6	34.2	37.4	1032.8
Commercial	5	15.6	55.4	123.3	58	11.3	13	71.9	11.4	3.4	0.8	364.1
Institutional	6	10.4	52	120.9	380.6	27.0		42.4	1.9	0.3	2.3	637.8
Industrial	7		3.8	30.1	1.3	80.3	223.3	13.6	0.8			353.2
Transportation	8			150.1	16.4	8.1		5.6				180.2
Secondary Roads	9	120.9	239.4	275.1	179.2	90.3	16	254.3	87.5	26.3	48.3	1337.3
Agriculture moderate slope	13					0.5						0.5
Vacant moderate slope	15			2.0		3.1	25.8	4.3				35.2
Vacant steep slope	19			6.2			2.1	0.2				8.5
Water	20					6.5	51	393.9	0.1			451.5
Total Acres		**378.5**	**985.2**	**1177.7**	**1046.5**	**427.1**	**361.7**	**1402.4**	**269.9**	**78.5**	**151.9**	**6279.4**
		Subwater Number / %										
HD single family residential	1	19.58	20.29	24.81	34.16	32.78	0.19	21.51		18.22	41.54	22.99
LD single family residential moderate	2	1.74	20.75	1.70	1.70	4.00	0.77	8.61	12.67			6.75
LD single family residential steep slope	3	0.00	0.44	0.00		0.14	0.50	0.29	0.15			0.18
Multifamily residential	4	39.87	22.94	13.40	3.41	9.90	6.97	13.53	49.50	43.57	24.62	16.45
Commercial	5	4.12	5.62	10.47	5.54	2.65	3.59	5.13	4.22	4.33	0.53	5.80
Institutional	6	2.75	5.28	10.27	36.37	6.32		3.02	0.70	0.38	1.51	10.16
Industrial	7	0.00	0.39	2.56	0.12	18.80	61.74	0.97	0.30			5.62
Transportation	8	0.00		12.75	1.57	1.90	0.00	0.40				2.87
Secondary Roads	9	31.94	24.30	23.36	17.12	21.14	4.42	18.13	32.42	33.50	31.80	21.30
Agriculture moderate slope	13					0.12		0.00				0.01
Vacant moderate slope	15			0.17		0.73	7.13	0.31				0.56
Vacant steep slope	19			0.53			0.58	0.01				0.14
Water	20					1.52	14.10	28.09	0.04			7.19
		100	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 1-4. Land Use and Area for San Gabriel River Estuary.

San Gabriel Estuary HRU Totals			
DEFINITION	*HRU CODE*	*ACRES*	*%*
HD single family residential	1	56	8.33%
LD single family residential moderate	2	22.2	3.30%
Multifamily residential	4	56.2	8.36%
Commercial	5	61.4	9.13%
Industrial	7	237.2	35.29%
Transportation	8	11.1	1.65%
Secondary Roads	9	28.4	4.22%
Agriculture moderate slope	13	9.6	1.43%
Vacant moderate slope	15	63.8	9.49%
Vacant steep slope	19	3.4	0.51%
Water	20	122.9	18.28%
TOTAL		**672.2**	**100%**

The City of Long Beach also has two small areas on the west side of the Los Angeles River one of which drains to the Dominguez Channel, and one other that may have some drainage to the Dominguez Channel (Figure 1-5). The upper area above Willow Street drains a small portion of freeway and about 40 acres of City of Long Beach residential land and goes to the Dominguez Channel. The right of way area of about 112 acres below this area down to Willow Street drains to the Los Angeles River.

The area below Willow Street (Figure 1-5) totals about 257 acres. In addition, there is about 58 acres of a utility corridor. Land use in this area includes a large area of institutional use (School, 77 acres) and Park land use (22 acres) along with Commercial (67 acres). The rest of the area in question consists of right of way and roads (91 acres). Field verification of dranages in this second area below Willow Street will be carried out to verify the direction of flows.

Since these two areas are small and both areas resemble land use that will be monitored by the Bouton Creek monitoring station and by the Termino Drain monitoring station, no monitoring is proposed for these two small drainages on the west side of the Los Angeles River at this time.

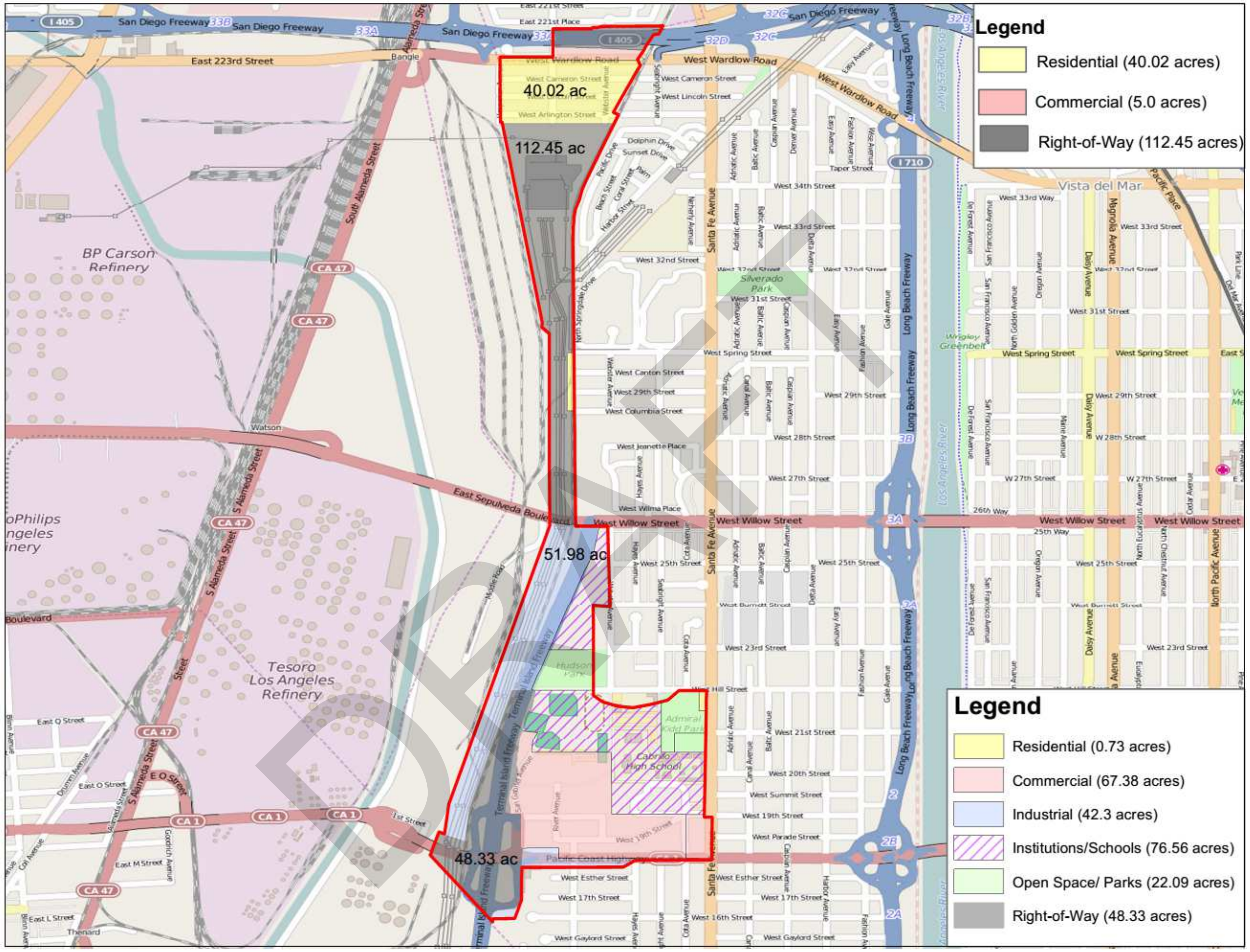


Figure 1-5. City of Long Beach Drainages to Dominguez Channel.

1.2.4 Receiving Water Monitoring

Receiving water monitoring stations are shown in Figure 1-2 for the Los Cerritos Channel Estuary, Alamitos Bay and for the San Gabriel River Estuary. These stations and their function are also described in Table 1-1.

Receiving water stations (Table 1-1) will be at Site LBR1 located at the Los Cerritos Channel Estuary at East Pacific Highway Bridge, and Site LBR2 located in Alamitos Bay at the Second Street Bridge. Wet and dry weather monitoring of receiving waters will be conducted at Site LBR2. Sediment monitoring for SQO parameters will be conducted at Site LBR1 near the base of the Los Cerritos Channel Estuary.

The receiving water station for the San Gabriel River Estuary will be at the historic Site R8 located at the Marina Bridge at the end of the estuary. This site is occupied by the ongoing San Gabriel River Monitoring Program for dry weather water and for sediment data. This program will augment these data by conducting wet weather monitoring at this site.

1.2.5 Non-Stormwater Outfall Monitoring

Non-Stormwater (NSW) Outfall Monitoring will be conducted throughout the major open channels of the Los Cerritos Channel Estuary, Alamitos Bay and in the San Gabriel River Estuary. Appendix E presents a list of major and minor outfalls within the estuarine study area, their size, and the location coordinates. Appendix E also includes a location map for each category of outfalls.

The City will first implement a screening process to determine which outfalls exhibit significant NSW discharges and those that do not require further investigations. These outfall screening data will be recorded on Outfall Reconnaissance Investigation (ORI) forms and in the associated database. The outfall

screening process will be implemented during the spring, summer, and fall months (dry weather periods) of 2015. Identification of obvious illicit discharges will be immediately addressed. Otherwise, the outfall screening process will be completed prior to starting source investigations.

In the case of outfalls discharging into an estuary or directly to San Pedro Bay, inspection methods will need to be modified somewhat as many of these discharges are intertidal in nature. For estuarine outfalls, inspections, flow estimates, and any water quality measurements may have to be taken at an upstream manhole or other suitable upstream site in the drainage as sampling a mixture of salt and freshwater of unknown proportions will not yield the desired information. Some upstream sampling sites may require partial street closures to access.

Outfalls with significant NSW flows will be identified on the basis of all three outfall screening surveys. Outfalls will be prioritized for source identification studies. Source investigations will then be conducted on prioritized outfalls, with 25% to be conducted by March 28, 2017 and 100% by March 28, 2019. Further monitoring will commence on significant NSW discharges comprised of either unknown or conditional exempt non-essential discharges, or illicit discharges that cannot be abated.

1.2.6 New Development/Re-Development Effectiveness Tracking

The City of Long Beach has developed mechanisms for tracking information related to new and re-development projects that are subject to post-construction Best Management Practice (BMP) requirements in Part VII.K.xi of the MS4 Permit.

1.2.7 Regional Studies

On behalf of the participating agencies, the Los Angeles County Flood Control District (LACFCD) will continue to provide financial and/or monitoring resources to the Southern California Stormwater Monitoring Coalition Regional Watershed Monitoring Program, also known as the Regionally Consistent and Integrated Freshwater Stream Bioassessment Monitoring Program (Bioassessment Program). The Bioassessment Program was initiated in 2009 and is structured to occur in cycles of five years. Sampling under the first cycle concluded in 2013. The next five-year cycle is scheduled to begin in 2015, with additional special study monitoring scheduled to occur in 2020.

Permittee representatives will also participate in the Southern California Stormwater Monitoring Coalition (SMC) meetings and assist in development and implementation of selected and appropriate regional studies designed to improve stormwater characterization and impact assessment.

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2 Overview of the Schedule and Sampling Frequencies for each IMP Element

The IMP will be implemented in a phased process. Existing monitoring at LCC1 will continue to be conducted, and the dry weather screening of major outfalls will be conducted. Implementation of new monitoring programs and modifications to the existing monitoring program at LCC1 will be implemented beginning July 1, 2015 or 90 days after the approval of the IMP, whichever is later.

Receiving Water Quality Monitoring

- For the Los Cerritos Channel Estuary and Alamitos Bay, monitoring will occur at one Receiving Water Quality Monitoring Site, LBR2, located in Alamitos Bay at 2nd Street Bridge. Three wet weather and two dry weather events will be monitored at this site each year with chemical and toxicity testing carried out.
- For the San Gabriel River, one receiving water site (R8) located at the Marina Bridge will be monitored. Four wet weather and two dry weather events will be monitored each year. Monitoring parameters at this San Gabriel River receiving water site will be limited to copper to meet TMDL requirements and dioxin along with total suspended solids (TSS), suspended sediment concentration (SCC), and hardness. These parameters will be monitored along with others as part of the ongoing San Gabriel River Regional Monitoring Program for dry weather.
- SQO testing will occur at both receiving water Stations LBR1 in Alamitos Bay at the East Pacific Coast Highway for the Los Cerritos Channel Estuary and Alamitos Bay and at Station R8 at the Marina Bridge for the San Gabriel River Estuary. This monitoring will be carried out at a frequency of twice every five years and will be scheduled, if possible, to coincide with the work in San Pedro Bay on the Harbor Toxics Program. The SQO testing at Station R8 is presently part of the San Gabriel River Regional Monitoring Program.
- Monitoring of the two dry weather events will start in July 2015 or 90 days after approval of the IMP, whichever is later. Wet season monitoring will follow during the 2015/2016 wet season pending timely approval of this IMP.
- For the Los Cerritos Channel and Alamitos Bay receiving water sites, water quality testing during the critical dry weather flows (July) and during the first significant storm event of the year will incorporate the water quality parameters listed in Table E-2 of the MRP. Water quality testing during the remaining two wet weather events and one dry weather event will incorporate all constituents identified in Table 3.3 (See Section 3) for the receiving waters.
- If Table E-2 constituents are not detected at the specified Method Detection Limit (MDL) for their respective test method or if the results are below the lowest applicable water quality objective and are not otherwise identified as being 303(d) listed or part of an ongoing TMDL, these analytes will not be further analyzed. In accordance with the minimum requirements established in the Permit MRP (page E-16), parameters exceeding the lowest applicable water quality objective will continue to be analyzed for the remainder of the Order at the respective receiving water monitoring station.– For the R8 receiving water site in the San Gabriel River estuary, if dioxins are not detected at the specified Method Detection Limit (MDL), the

permittee will remove this analyte from further sampling with the approval of the Regional Board. Although dioxin is 303(d) as a category 2C pollutant, it has not exceeded criteria in the past 5 years.

Outfall Stormwater Monitoring

- The LCC1 Station at Stearns Street is already installed and will be operated by the LCC Watershed group during the 2015/2016 wet season. Station LBE1 at Bouton Creek, which discharges into the Los Cerritos Channel Estuary, is a specially designed intertidal monitoring station that was also previously installed as part of the City of Long Beach's previous NPDES monitoring program. This station will also be prepared to start monitoring storm events under the current IMP during the 2015/2016 wet season. Station LBE2 located on the Termino Drain will need to be installed and can be operational for the 2015/2016 wet season pending timely approval of this IMP. Permanent equipment will not be installed at the two receiving water stations (LBR2 and R8), so monitoring of these sites can be done in the 2015/2016 wet season as well.
- When possible, outfall sampling will be conducted concurrently with stormwater monitoring at LCC1.
- Water quality testing at outfall sites will initially incorporate a list of general and conventional pollutants, *E. coli*, nutrients, and metals. A detailed list of analytes to be initially tested at outfall sites is addressed in Section 3.
- Additional water quality parameters listed in Table E-2 of the MRP may be incorporated based upon results of stormwater monitoring at the receiving water station LBR2. These constituents will be added to monitoring requirements at outfall sites once an analyte is detected in stormwater runoff at LBR2 during two consecutive stormwater monitoring events. Similarly, if analytes added at the outfall monitoring sites are not detected during two consecutive stormwater monitoring events, they will be removed from the required analytical list.

City Beach Bacterial Monitoring Program

- The City's Recreational Beach Monitoring Program may need to increase the frequency of bacterial indicator monitoring on City beaches located from the mouth of the Los Angeles River Estuary to the Belmont Pier from once a week to five times a week to comply with the City of Long Beach Beaches and Los Angeles River Estuary Bacterial TMDL. Because of the very good compliance record on these beaches, because of the extensive City of Long Beach program to install diversions (summer and winter dry weather), and because this intensive monitoring would require weekend and overtime work, it proposed herein to carry out bacterial monitoring on these San Pedro Bay beaches twice a week.

Non-Stormwater Outfall Monitoring Program

- Three initial surveys will be completed. The first will focus upon verification of outfalls as identified based upon available City and County GIS records, providing baseline photographic records, assessing flow, recording observations, and field water quality measurements. An inventory of outfalls above 12 inches in diameter will be created. The second and third screening surveys will include field water quality testing to assist in the identification and classification of the discharge.

- Information from the three initial surveys will be used to determine which outfalls have significant discharges and classify these outfalls for further investigation. Information from the three surveys such as flow rates of the discharge, flow rates in the channel, the nature of the channel-earthen or concrete, and land uses in the drainage area will be used collectively to determine significance.
- Outfalls with significant non-tidal flow will be classified for further investigation. Flow measurements, observations, field water quality tests and limited laboratory tests may be used to classify the remaining outfalls as either **Suspect Discharges**, **Potential Discharges** or **Unlikely Discharges** of concern. Clean outfalls with no evidence of discharges or odors during the initial surveys will be classified as **Unlikely** sources of non-stormwater discharges and will not require further investigation.
- Outfalls considered having the highest risk for illicit discharges or illegal flows will be classified as **Suspect Discharges.** This will require multiple lines of evidence indicative of potential illicit discharges or persistent high flows that represent significant receiving waters contributions.
- Outfalls considered to be **Suspect Discharges** will be further classified and ranked for further investigations designed to identify the sources of these discharges and to determine whether discharges are illicit, exempt, conditionally exempt, conditionally exempt but non-essential flows or unknown.
- Suspect outfalls determined to have exempt or conditionally exempt discharges will be identified in annual reports along with the measures taken to identify the sources.
- Suspect outfalls identified with conditionally exempt but non-essential flows or flows from unknown sources will first be subject to review to determine if suitable control measures can be implemented to eliminate the discharges.
- If discharges cannot be eliminated, they will be subjected to a periodic monitoring to document that sufficient measures are taken to control potential discharges of pollutants in the discharge.
- Source investigations for discharges from outfalls classified as suspect will be ongoing in order to meet the requirement that investigations are conducted for no less than 25% of the outfalls in the inventory by March 28, 2017 and 100% of the outfalls in the inventory by March 28, 2019.
- Outfalls classified as **Potential Discharges** will be reassessed during the permit.
- Outfalls with obvious illicit discharges will be immediately classified as such and investigated immediately.

Table 2-1. Schedule for Implementation of Monitoring Activities in the Los Cerritos Channel Estuary, Alamitos Bay, and the San Gabriel River Estuary.

Task	Dry 2015	Wet 2015-16	Dry 2016	Wet 2016-17	Dry 2017	Wet 2017-18	Dry 2018
Receiving Water							
LBR1 E. Pacific Coast Hwy Bridge							
SQO SedimentTesting[7]							
LBR2 Alamitos Bay, 2nd St. Bridge							
Chemistry[1]	2	3	2	3	2	3	2
Aquatic Toxicity	1	2	1	2	1	2	1
Bacterial Indicators (Marine)	2	3	2	3	2	3	2
R8 San Gabriel River at Marina Bridge							
Chemistry[1]	2	3	2	3	2	3	2
Aquatic Toxicity	1	2	1	2	1	2	1
Bacterial Indicators (Marine)	2	3	2	3	2	3	2
SQO Sediment Testing[7]							
San Pedro Bay/Coastal Beaches							
Bacterial Indicators (Marine)	2/week	2/week	2/week	2/week	2/week	2/week	2/week
Stormwater Outfalls							
LCC1 Stearns Street[5]	2	4	2	4	2	4	2
LBE1 Bouton Creek	2	3	2	3	2	3	2
LBE2 Termino Drain	2	3	2	3	2	3	2
Non-Stormwater Outfall							
Inventory & Screen[2]	3						
Source ID[3]	Ongoing		Ongoing		Ongoing		Ongoing
Monitoring[4]			2		2		2

1. Table E-2 chemical analyses will be performed once during the first wet weather event and once during the first critical dry weather monitoring event. Constituents that exceed MDLs and available water quality objectives will continue to be monitored along with all constituents included as Category 1, 2 or 3 water body/pollutant classifications for the subject water body. Wet and dry weather chemical constituents will be separately assessed for purposes of continued monitoring. All constituents classified as category 1, 2, and 3 water body/pollutant in the water body will continue to be monitored during the permit cycle unless the constituents (primarily category 3 constituents) are shown to not be present at levels of concern on a consistent basis.
2. Initial Inventory and Screening will be completed in three surveys before the end of 2016. One re-assessment of the Non-Stormwater Outfall Monitoring Program will be conducted prior to March 28, 2019.
3. Investigations designed to track and classify discharges will start during the 2016 dry season. Source tracking and classification work depend upon the number of sites categorized as Suspect outfalls with evidence of significant flow.
4. Monitoring will be implemented if significant dry weather flows are identified at discharge points that are cannot be identified, are non-essential exempt flows, or identified as illicit flows that are not yet controlled. These sites will be initially monitored twice a year in conjunction with dry weather monitoring of the receiving water site.
5. Monitoring at LCC1 will continue to be conducted by the Los Cerritos Channel Watershed Group not by this present program. However, data will be available for this site.
6. The fourth storm event is only for the purpose of fulfilling the TMDL requirements. Only metals, TSS, SSC, and hardness will be analyzed.
7. SOQ sediment testing will be done once every 2.5 years and will be scheduled the same as the Harbor Toxic Monitoring Progam if possible.

3 Chemical/Physical Parameters

Water quality priorities within the Los Cerritos Channel Estuary, Alamitos Bay, and San Gabriel River Estuary were established in accordance with Section C.5.a.ii of the Permit. The three Permit categories are defined as follows:

- **Category 1 (Highest Priority):** Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.
- **Category 2 (High Priority):** Pollutants for which data indicate water quality impairment in the receiving water according to the State's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
- **Category 3 (Medium Priority):** Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.

These Permit categories were intended to be specific to water bodies within the watershed.

Table 3-1 summarizes pollutants within each category. Colorado Lagoon has its own TMDL and monitoring plan now underway. However, the constituents are still pertinent to the Los Cerritos Channel Estuary as the Termino Drain has been diverted to the Marine Stadium and is the drainage suspected of the contamination within the Lagoon that resulted in the TMDL. An outfall monitoring site will be placed on the Termino Drain as part of this IMP.

The primary constituents of concern in the watershed are chlordane (sediment), DDT (tissue), dieldrin (tissue), lead (sediment), PCBs (fish tissue), PAHs (sediment), toxicity (sediment), and zinc (sediment), which are part of the Colorado lagoon TMDL. Total chlordane (sediment) is incorporated due to a 303(d) listing in the Los Cerritos Channel Estuary. Indicator bacteria are incorporated due to a 303(d) listing in Alamitos Bay. Permittees in the nearshore watershed as defined in the Harbor Toxics TMDL are separately contributing to monitoring requirements in the Harbor waters and the Los Angeles River Estuary. PCBs and PAHs are currently incorporated into the sampling requirements for the Long Beach outfall monitoring sites. Additional listings exist for minor exceedances of copper, lead, zinc, and bacteria criteria and these parameters will be included for outfall monitoring sites.

The primary constituent of concern in the San Gabriel River Estuary watershed is copper during dry weather conditions (Table 3-2). Copper is included as part of the San Gabriel River Metals and Selenium TMDL. Dissolved oxygen, dioxins, and nickel are incorporated due to 303(d) listings in the San Gabriel River Estuary. Permittees in the nearshore watershed (as defined by the Harbor Toxics TMDL) are separately contributing to monitoring requirements in the Harbor waters and the Los Angeles River Estuary. Additional listings exist for exceedances of arsenic, cyanide, lindane, MBAS, mercury, and PAH.

Table 3-1. Waterbody-Pollutant Categories for the Los Cerritos Channel Estuary, Alamitos Bay Estuary, San Pedro Beaches and Colorado Lagoon.

Category	Los Cerritos Channel Estuary	Alamitos Bay	San Pedro/ Coastal Beaches	Colorado Lagoon
1			Total coliform, *E. coli*, *enterococcus* [8]	Chlordane (sediment), dieldrin (tissue), DDT (tissue), lead (sediment), PAHs (sediment), PCBs (fish tissue), toxicity (sediment), zinc (sediment)
2	Total chlordane (sediment)[5,6,7]	Indicator bacteria		Indicator bacteria [9]
3	Dry Weather Copper [1,5,6] (water and sediment), 4,4-DDD[4,6] (sediment), *enterococcus*[2,6], fecal coliform[2,6], lead[1,5] (sediment), total coliform[2, 6], zinc[1,5,7] (sediment)	Dry Weather Copper [1,5,6] (water and sediment), 4,4-DDT[7,5] (sediment), *enterococcus*[2,6], fecal coliform[2,6], lead [1,5] (sediment), total coliform[2, 6], Total chlordane (sediment)[2,5,6], zinc[1,5] (sediment)		
	Wet Weather Dieldrin[1,6], *enterococcus*[2,6], fecal coliform[2,6], , malathion[3,6], total coliform[2, 6]	Wet Weather E*nterococcus*[6], fecal coliform[6], malathion[3,6], total coliform[2,6], toxaphene[1,6]		

1. Exceeds California Toxics Rule Saltwater.
2. Exceeds the Los Angeles Basin Plan.
3. Exceeds National Non-Priority Pollutant Aquatic Life Criteria for Saltwater.
4. Exceeds ERMs, SCCWRP Bight 2003 data.
5. SCCWRP Bight 2008 data.
6. City of Long Beach Stormwater Monitoring Reports 2002-2014.
7. Regional Water Board 4 Dominguez Channel Watershed Monitoring 2003-2005.
8. Will be monitored according to the Long Beach City Beaches and Los Angeles River Estuary Bacteria TMDL.
9. Listed in the 2010 303(d) list category 5, a water segment where standards are not met and a TMDL is required, but not yet completed.

Table 3-2. Waterbody-Pollutant Categories for the San Gabriel River Estuary.

Category	Constituents	
	Wet	**Dry**
1	Copper[1]	Copper[1]
2	Dissolved oxygen[2], dioxin (2,3,7,8-TCDD)[3], nickel[3]	
3	Arsenic[7], cyanide[5], indicator bacteria[6], lindane[4], MBAS[4], mercury[5], PAH[5], toxicity[5]	Alpha-endosulfan[4], diazinon[5]

1. Listed in the San Gabriel River Metals TMDL.
2. 303(d) Category 2B: Water Body-Pollutant Combination that is not a "pollutant" (i.e. Toxicity).
3. 303(d) Category 2C: Water Body-Pollutant Combination without exceedances in past 5 years.
4. Listed as a Catergory 3 pollutant in the Lower San Gabriel River CIMP.
5. Listed as a Catergory 2 pollutant in the Lower San Gabriel River CIMP.
6. Listed as a Catergory 2 pollutant in the Upper San Gabriel River CIMP.
7. In 2006 California updated the 303(d) list and removed the listings for arsenic for the San Gabriel River Estuary and silver for Coyote Creek.

Table 3-3 summarizes the constituents that will be monitored at the outfall and receiving water sites in the Los Cerritos Channel Estuary and Alamitos Bay and Table 3-4 summarizes the constituents that will be monitored at the Receiving Water site in the San Gabriel River Estuary. These constituents will serve as the core of the monitoring program. In addition, sections VI.C.1.e and VI.D.1.d of the MRP require that a comprehensive list of constituents is screened once during the first major storm event of the year and once during a period of critical dry weather flow. These screenings will be done for the Los Cerritos/Alamitos Bay estuary but not for the San Gabriel River estuary site R8. Results of this analytical screening process will determine which constituents need to be analyzed at the LCC/Alamitos Bay outfall sites for the remainder of the five-year cycle of the permit.

Table 3-3. Summary of Constituents to be Monitored on a Regular Basis at the Outfall Sites and the Receiving Water Sites in the Los Cerritos Channel Estuary and Alamitos Bay and on Coastal Beaches.

CLASS OF MEASUREMENTS	OUTFALL SITES		RECEIVING WATER SITES	RECEIVING WATER SITES	RECEIVING WATER SEDIMENTS	SAN PEDRO BEACHES
	Wet[4]	Dry	Wet	Dry	Dry	Wet and Dry
Flow	3	2				
Field Measurements pH, dissolved oxygen, temperature, and specific conductivity	3	2	3	2		
MRP Table E-2 Constituents[1] (other than those specifically listed below)	1	1	1	1		
Aquatic Toxicity[3]			2	1		
General and Conventional Pollutants (Table 3-3) (All <u>except</u> total phenols, turbidity, BOD_5, MTBE, and perchlorate, chloride and fluoride)	3	2	3	2		
Microbiological Constituents (Table 3-4) Total & Fecal Coliform, *Enterococcus*	3	2	3	2		2/week
Nutrients (Table 3-5) - none required						
Organochlorine Pesticides and PCBs (Table 3-7) Chlordane[2], Dieldrin, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT	3	2	3	2		
Metals (Table 3-6) Ag, Al, As, Cd, Cu, Hg, Ni, Pb, Zn	3	2	3	2		
Organophosphate Pesticides (Table 3-8) Malathion	3	2	3	2		
Semivolatile Organic Compounds (Table 3-9)	3	2	3	2		
Sediment Quality Objectives (SQO) **Sediment chemistry, Sediment toxicity, benthic infauna**					1[4]	

1. All Table E-2 constituents will be measured during the first major storm event of the season and the critical, low flow dry weather event (July) during the first year of the IMP.
2. Chlordane components are based upon sum of chlordane-alpha, chlordane-gamma, nonachlor-alpha, nonachlor-gamma, and oxychlordane consistent with the Harbor Toxics TMDL.
3. Aquatic toxicity at outfall sites may be triggered by toxicity at receiving water sites in Alamitos Bay.
4. Phase 1 Sediment Quality Objectives will be monitored once every 2 to 2.5 years and will be coordinated with similar monitoring being conducted in Habor waters.

Table 3-4. Summary of Constituents to be Monitored on a Regular Basis for the Receiving Water Site in the San Gabriel River Estuary[1].

CLASS OF MEASUREMENTS	RECEIVING WATER SITE		RECEIVING WATER SEDIMENTS
	Wet	Dry	Dry
Flow			
Field Measurements pH, dissolved oxygen, temperature, and specific conductivity	4	2	
MRP Table E-2 Constituents (other than those specifically listed below)			
Aquatic Toxicity			
General and Conventional Pollutants (Table 3-3) (All <u>except</u> alkalinity and TSS)	4	2	
Microbiological Constituents (Table 3-4) Total and Fecal Coliform,and *Enterococcus*			
Nutrients (Table 3-5)			
Organochlorine Pesticides and PCBs (Table 3-7) Dioxin	3	2	
Metals (Table 3-6) Cu	4	2	
Organophosphate Pesticides[4] (Table 3-8)			
Semivolatile Organic Compounds (Table 3-9) PAHs			
Sediment Quality Objectives (SQO) Sediment chemistry, Sediment toxicity, benthic infauna			1[2]

1. Only field measurements, alkalinity, TSS, copper and dioxin will be monitored at R8.
2. Dry Weather monitoring and Sediment Quality Objective monitoring in San Gabriel River Estuary to be done by San Gabriel River Regional Monitoring Program. SQO monitoring will be once every 2.5 years.

If a parameter is not detected above the Method Detection Limit (MDL) for its respective test method *<u>or</u>* the result is below the lowest applicable water quality objective and is not otherwise identified as a basic monitoring requirement, a TMDL analyte or a 303(d) listing, it need not be further analyzed. If a parameter is detected exceeding the lowest applicable water quality objective during either the wet or dry weather screening then the parameter shall be analyzed for the remainder of the Order at the receiving water monitoring station where it was detected during the respective conditions (wet or dry).

Analytical tests will be reconsidered at least once during each permit cycle in order to assess the appropriateness of maintaining the analyte or suite of analyses in the testing requirements. Water quality criteria, analytical methods, analytical results consistently near detection limits, updated information with respect to sources or many other additional factors may contribute to factors may warrant reconsideration of the analyte. If an analyte listed in Table E-2 (Attachment E of the Permit) is not detected at levels of concern during two consecutive monitoring events representing the same seasonal conditions, the City will submit a request to the Regional Board to remove the analyte from future sampling. This does not include constituents that are part of basic monitoring requirements. In order to avoid bias due to seasonal build-up/wash off, this evaluation would be limited to the comparisons of the first major storm of the season rather than data associated with consecutive events from the same season.

Constituents requiring screening are listed in Table E-2 of the MRP. These constituents are further broken out by major analytical groups in Table 3-5 through Table 3-11 below. Analytical requirements for the program are broken out by analytical test requirements since many are associated with an analytical test suite. This is most evident with the semivolatile organic compounds analyzed by EPA Method 625. Although this section identifies recommended methods for each analyte, many of the target constituents can be addressed by alternative methods. Use of alternative analytical methods may be preferable in cases where a larger suite of target analytes can be tested and still enable meeting minimum levels (MLs) established for each analyte. Selection of analytical methods is intended to be performance-based to allow laboratories flexibility to utilize methods that meet or exceed MLs listed in the MRP. As an example, the following tables (Table 3-5 and Table 3-6) list separate EPA methods for organochlorine pesticides and Aroclors, organophosphate pesticides and semivolatile organic compounds. Some laboratories choose to use EPA Method 625 for all of these test requirements. This approach is acceptable as long as the method meets the MLs listed in Table E-2 of the MRP and meet data quality objectives consistent with the State's Surface Water Ambient Monitoring Program (SWAMP), but other laboratories will use separate test protocol for organophosphate pesticides. Regional data suggest that rainfall and flows in major watersheds are least in July. As such, critical low flow monitoring will be conducted in July.

A table listing available Water Quality Objectives is provided in Appendix I. This table includes criteria for both freshwaters and for saltwaters and will be the basis for evalutions of the levels present in these waters of contaminants of concern.

3.1 General and Conventional Pollutants

Most of the general and conventional pollutants listed in Table 3-5 will continue to be analyzed as part of the base monitoring requirements for both receiving water and outfall sampling. These constituents are common contaminants in stormwater from urban environments. Some, such as turbidity, are redundant and best used as surrogates under special studies. Turbidity is often used as a surrogate for suspended solids but requires calibration to the source material. Turbidity measurements are recognized to lack comparability due to differences in equipment as well as the differences between static and dynamic measurements (Anderson 2005 - USGS National Field Manual for Collection of Water Quality Data, Chapter 6.7). Total suspended solids (TSS) and suspended sediment concentrations (SSC) directly examine particles associated with water samples and do not suffer from the problems associated with measuring turbidity. An integral part of the pollutant reduction strategy involves the reduction of discharged solids from the MS4, therefore both TSS and SSC will be monitored. Since SSC sampling protocols are not met by the automatic stormwater samplers designed to measure pollutants, SSC analysis will be done on a subsample of the composite samples. Rigorous subsampling protocols will be utilized in order to assure representative samples that can be related directly to the chemical results. The SSC sample analyses will add information to the current TSS analyses being run.

Other pollutants in this group have been previously analyzed in stormwater and dry weather discharges into the Los Cerritos Channel from LCC1 and the LBE1 Bouton Creek site since 2000 and have not been detected. As an example, total phenols have never exceeded the ML of 0.1 mg/L in this watershed. MTBE and cyanide were analyzed during the first three years of the City of Long Beach Stormwater Monitoring Program. MTBE was only detected in 1 out of 11 samples and cyanide was never detected. Although perchlorate has not been analyzed in stormwater in the LCC watershed, industrial activities likely to result in perchlorate discharges do not exist in the watershed. Perchlorate will be screened at the outfall sites during the initial surveys but this contaminant is not expected to require continued analysis at any monitoring site.

In summary, sufficient evidence exists to eliminate total phenols, cyanide, turbidity and MTBE from further analysis. Perchlorate will be incorporated in the initial screening since it has not been tested but it is not expected that continued testing will be required. Most other constituents included in this list are common contaminants in stormwater runoff and will continue to be analyzed. Analysis of chloride and fluoride may be analyzed as needed to assist in differentiating potable water and groundwater sources during source tracking programs for the non-stormwater outfall monitoring program but will not be included in monitoring conducted for wet/dry weather receiving water monitoring or for monitoring of the outfall monitoring sites.

Table 3-5. Conventional Constituents, Analytical Methods, and Quantitation Limits.

CONSTITUENTS		**Target Reporting Limits**
Conventional Pollutants	**Method**	**mg/L**
Oil and Grease	EPA1664	5
Total Petroleum Hydrocarbon	EPA 418.1	5
Total Suspended Solids	EPA 160.2	1
Suspended Sediment Concentration	ASTM D3977-97 (Method C)	0.5
Total Dissolved Solids	EPA 160.1	1
Volatile Suspended Solids	EPA 160.4	1
Total Organic Carbon	EPA 415.1	1
Biochemical Oxygen Demand	SM 5210B EPA 405.1	3
Chemical Oxygen Demand	EPA 410.1	4
Alkalinity	EPA 310.1	5
Specific Conductance	EPA 120.1	1 umho
Total Hardness	EPA 130.2	1
MBAS	EPA 425.1	0.02
Chloride	EPA300.0	2
Fluoride	EPA300.0	0.1
Perchlorate	EPA314.0	4 ug/L
Sulfate	EPA375.2	2
Field Measurements	**Method**	**mg/L**
pH-field instrumentation	EPA 150.1	0 – 14
Temperature-field	In-situ	N/A
Dissolved Oxygen- field [1]	In-situ	Sensitivity to 5 mg/L

[1] Dissolved Oxygen will only be measured during dry weather surveys.

3.2 Microbiological Constituents

All microbiological constituents used as fecal indicator bacteria (FIB) will continue to be monitored at the outfall and receiving water monitoring sites. Bacteria used as fecal indicators in marine waters will continue to be analyzed during wet and dry weather surveys because they discharge to estuarine waters. Table 3-6 provides both upper and lower quantification limits for each FIB which was established to assure that quantifiable results are obtained. Upper quantitation limits are provided to assure that FIBs are quantified.

The City's Recreational Beach Monitoring Program proposes to increase the frequency of bacterial indicator monitoring on City beaches located from the mouth of the Los Angeles River Estuary to the Belmont Pier from once a week to twice a week. Because of the very good compliance record on these beaches, the City would rather continue to spend resources on prevention measures and feel that this frequency of twice a week is sufficient to monitor the compliance on these beaches.

Table 3-6. Microbiological Constituents, Analytical Methods, and Quantitation Limits.

BACTERIA[1]	Method	Lower Limits MPN/100ml	Upper Limits MPN/100ml
Total coliform	SM 9221B	<20	>2,400,000
Fecal coliform	SM 9221E	<20	>2,400,000
Enterococcus	SM 9230B/C	<20	>2,400,000

[1] Microbiological constituents will vary based upon sampling point. Total and fecal coliform and *enterococcus* will be measured only in marine waters or at locations where either the discharge point or receiving water body will impact marine waters.

3.3 Nutrients

Nutrients (Table 3-7) are also considered as part of the base requirements for the monitoring program. These will be analyzed as part of the Table E-2 screening requirements during the first major storm event of the year and a critical dry weather sampling event at the outfall sites. Nutrients have not been identified as exceeding any applicable RWL to date and are therefore not scheduled to be sampled as part of the ongoing program unless required based upon the initial screening. The current monitoring plan calls for separate analysis of nitrate-N and nitrite-N. Concentrations of nitrite-N have typically been low at the previous outfall monitoring sites within the estuaries. If data indicates that concentrations of nitrite-N remain minimal, these analytes will be combined into one analytical procedure that quantifies both nitrate-N and nitrite-N at the same time.

Table 3-7. Nutrients, Analytical Methods, and Quantitation Limits.

CONSTITUENTS	Method	Reporting Limit (mg/L)
Total Kjeldahl Nitrogen (TKN)[1]	EPA 351.1	0.50
Nitrate as Nitrogen (NO_3-N)[1,2]	EPA 300.0	0.10
Nitrite as Nitrogen (NO_2-N)[1,2]	EPA 300.0	0.05
Total Nitrogen[1]	calculation	NA
Ammonia as Nitrogen (NH_3-N)	EPA 350.1	0.10
Total Phosphorus	SM 4500-P E or F	0.1
Dissolved Phosphorus	SM 4500-P E or F	0.1

1. Total Nitrogen is the sum of TKN, nitrate, and nitrite.
2. Nitrate –N and Nitrite-N may be analyzed together using EPA 300

3.4 Total and Dissolved Trace Metals

A total of 16 trace metals are listed in Table E-2 of the MRP. Analytical methods and reporting limits for these elements are summarized in Table 3-8. Most metals will be analyzed by EPA Method 1620 using ICP-MS to provide appropriate detection limits. Hexavalent chromium and mercury both require alternative methods. Neither hexavalent chromium or mercury are commonly analyzed as part of stormwater programs. Hexavalent chromium has been analyzed at LACFCD's mass emission monitoring sites in both the Los Angeles River (S10) and the San Gabriel River (S14) for the past eight to ten years and has not been detected. Mercury has been detected at some mass emission monitoring sites but detections are not common at any sites. Analytical methods and detection limits used for the monitoring have been consistent with those required in Table E-2 of the MRP.

Measurement of mercury is generally not considered to be appropriate in flow-weighted composite samples taken with autosamplers due to its volatility. This becomes more of an issue when sampling is conducted near the limits of a peristaltic pump. Automatic stormwater samplers are not suitable for sampling stormwater at low detection limits (0.5 to 5 nanograms/liter). Grab samples will be taken for analysis of mercury in order to augment composite samples, which will be analyzed by EPA method 245.1. These grab samples will be analyzed by Method 1631E since this method is less subject to interferences and will be collected at the same time that monitoring crews pull other grab samples required by the monitoring program. Additional QAQC will be employed to support the extremely low detection limits required by the program.

Table 3-8. Metals, Analytical Methods, and Quantitation Limits.

METALS	METHODS		REPORTING LIMIT
	FRESHWATER	SALTWATER	*ug/L*
Aluminum	EPA200.8	EPA1620	100
Antimony	EPA200.8	EPA1620	0.5
Arsenic	EPA200.8	EPA1620	0.5
Beryllium	EPA200.8	EPA1620	0.5
Cadmium	EPA200.8	EPA1620	0.25
Chromium (total)	EPA200.8	EPA1620	0.5
Chromium (Hexavalent)	EPA218.6	EPA218.6	5
Copper	EPA200.8	EPA1620	0.5
Iron	EPA200.8	EPA1620	25
Lead	EPA200.8	EPA1620	0.5
Mercury	EPA245.1	EPA 7470A	0.2
Mercury (Low level)	1631E	EPA1631E	0.0005
Nickel	EPA200.8	EPA1620	1
Selenium	EPA200.8	EPA1620	1
Silver	EPA200.8	EPA1620	0.25
Thallium	EPA200.8	EPA1620	0.5
Zinc	EPA200.8	EPA1620	1

3.5 Organochlorine Pesticides and PCBs

Although organochlorine pesticides (OC pesticides) and PCBs are not commonly present in stormwater sampled at previous outfall monitoring stations in the estuary, they have periodically been detected at low concentrations. The analytical methods and detection limits for these compounds are summarized in

Table 3-9. These compounds are specified in Table E-2 of the MRP. The MRP suggests that detection of any of these analytes in excess of the ML and/or applicable criteria will require continuation of the analysis through the period of the permit. Since this could be attributable to analytical issues, we have recommended more frequent reevaluation (refer to Section 3).

Since the OC pesticides are part of an analytical suite, detection of one compound would necessitate continuation of the entire suite. However, this would not require continuation of PCB analyses if they are not detected in the early storm event and critical dry weather monitoring event. Monitoring for

PCBs will be reported as the summation of Aroclors and a minimum of 50 congeners, using EPA Method 8270 without the use of High Resolution Mass Spectrometry for routine monitoring.

Table 3-9. Chlorinated Pesticides and PCB, Analytical Methods, and Quantitation Limits.

CHLORINATED PESTICIDES	**METHOD**	**REPORTING LIMIT μg/L**
Aldrin	EPA 608, 8081A	0.005
alpha-BHC	EPA 608, 8081A	0.01
beta-BHC	EPA 608, 8081A	0.005
delta-BHC	EPA 608, 8081A	0.005
gamma-BHC (lindane)	EPA 608, 8081A	0.02
alpha-chlordane	EPA 608, 8081A	0.1
gamma-chlordane	EPA 608, 8081A	0.1
Nonachlor-alpha	EPA 608, 8081A	0.1
Nonachlor-gamma	EPA 608, 8081A	0.1
Oxychlordane	EPA 608, 8081A	0.1
4,4'-DDD	EPA 608, 8081A	0.05
4,4'-DDE	EPA 608, 8081A	0.05
4,4'-DDT	EPA 608, 8081A	0.01
Dieldrin	EPA 608, 8081A	0.01
alpha-Endosulfan	EPA 608, 8081A	0.02
beta-Endosulfan	EPA 608, 8081A	0.01
Endosulfan sulfate	EPA 608, 8081A	0.05
Endrin	EPA 608, 8081A	0.01
Endrin aldehyde	EPA 608, 8081A	0.01
Heptachlor	EPA 608, 8081A	0.01
Heptachlor Epoxide	EPA 608, 8081A	0.01
Toxaphene	EPA 608, 8081A	0.5
POLYCHLORINATED BIPHENYLS		
PCBs[1] (Reported as the summation)	EPA Method 8270	0.005
Aroclor-1248	EPA 608,EPA 8082	0.5
Aroclor-1254	EPA 608,EPA 8082	0.5
Aroclor-1260	EPA 608,EPA 8082	0.5

[1] Monitoring for PCBs will be reported as the summation of aroclors and a minimum of 50 congeners for routine monitoring. 54 PCB congeners include: 8, 18, 28, 31, 33, 37, 44, 49, 52, 56, 60, 66, 70, 74, 77, 81, 87, 95, 97, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 132, 138, 141, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 174, 177, 180, 183, 187, 189, 194, 195, 201, 203, 206, and 209. These include all 41 congeners analyzed in the SCCWRP Bight Program and dominant congeners used to identify the aroclors. List of aroclors and congeners were obtained from Table C8 in the State's Surface Water Ambient Monitoring Program's Quality Assurance Program Plan.

3.6 Organophosphate Pesticides and Herbicides

Organophosphate pesticides, triamine pesticides and herbicides list in Table E-2 of the MRP are summarized in Table 3-10. Due to the fact that diazinon and chlorpyrifos are no longer available for residential use, these constituents are now rarely detected. When detected, concentrations rarely exceed available water quality criteria for protection of aquatic life. Malathion, however, remains a common constituent in stormwater runoff but this pesticide is not as toxic as other organophosphate pesticides.

Two compounds in this list, atrazine and simazine, are not organophosphate pesticides but can be analyzed by EPA Method 8141a. Both are triazine herbicides which are used for control of broadleaf weeds. Based upon historical data, herbicides such as these and the three additional separately listed compounds are unlikely to require continued analysis after completion of initial screening of Table E-2 constituents. Alternative analytical methods may be considered and used as long as the established reporting limits can be met.

Table 3-10. Organophosphate Pesticides and Herbicides, Analytical Methods, and Quantitation Limits.

ORGANOPHOSPHATE PESTICIDES	METHOD	REPORTING LIMIT µg/L
Atrazine	EPA507, 8141A	1
Chlorpyrifos	EPA8141A	0.05
Cyanazine	EPA8141A	1
Diazinon	EPA8141A	0.01
Malathion	EPA8141A	1
Prometryn	EPA8141A	1
Simazine	EPA8141A	1
HERBICIDES		
Glyphosate	EPA547	5
2,4-D	EPA515.3	0.02
2,4,5-TP-SILVEX	EPA515.3	0.2

3.7 Semivolatile Organic Compounds (Acid, Base/Neutral)

Semivolatile organic compounds (SVOCs) from Table E-2 of the MRP are listed in Table 3-11 below. Acids consist mostly of phenolic compounds which are uncommon in stormwater samples. Base/neutral compounds include polynuclear aromatic hydrocarbons (PAHs) and phthalates. SVOCs were only measured during the first two years of the City of Long Beach Stormwater Monitoring Program. Very few analytes were detected and those that were detected were typically less than 10 times the reporting limit. Phthalates were among the most common SVOCs detected and are 303(d) listed based upon measurements taken over ten years ago. Phthalates have been historically a common laboratory contaminant due to the significant use of plastic in laboratories but they are also a common environmental contaminant for the same reason.

Table 3-11. Semivolatile Organic Compounds, Analytical Methods, and Quantitation Limits.

SEMIVOLATILE ORGANIC COMPOUNDS	METHOD	REPORTING LIMIT
ACIDS		**µg/L**
2-Chlorophenol	EPA625	2
4-Chloro-3-methylphenol	EPA625	1
2,4-Dichlorophenol	EPA625	1
2,4-Dimethylphenol	EPA625	2
2,4-Dinitrophenol	EPA625	5
2-Nitrophenol	EPA625	10
4-Nitrophenol	EPA625	5
Pentachlorophenol	EPA625	2
Phenol	EPA625	1
2,4,6-Trichlorophenol	EPA625	10
BASE/NEUTRAL		µg/L
Acenaphthene	EPA625	1
Acenaphthylene	EPA625	2
Anthracene	EPA625	2
Benzidine	EPA625	5
1,2 Benzanthracene	EPA625	5
Benzo(a)pyrene	EPA625	2
Benzo(g,h,i)perylene	EPA625	5
3,4 Benzofluoranthene	EPA625	10
Benzo(k)fluoranthene	EPA625	2
Bis(2-Chloroethoxy) methane	EPA625	5
Bis(2-Chloroisopropyl) ether	EPA625	2
Bis(2-Chloroethyl) ether	EPA625	1
Bis(2-Ethylhexl) phthalate	EPA625	5
4-Bromophenyl phenyl ether	EPA625	5
Butyl benzyl phthalate	EPA625	10
2-Chloroethyl vinyl ether	EPA625	1
2-Chloronaphthalene	EPA625	10
4-Chlorophenyl phenyl ether	EPA625	5
Chrysene	EPA625	5
Dibenzo(a,h)anthracene	EPA625	0.1
1,3-Dichlorobenzene	EPA625	1
1,4-Dichlorobenzene	EPA625	1
1,2-Dichlorobenzene	EPA625	1
3,3-Dichlorobenzidine	EPA625	5
Diethyl phthalate	EPA625	2
Dimethyl phthalate	EPA625	2
di-n-Butyl phthalate	EPA625	10
2,4-Dinitrotoluene	EPA625	5
2,6-Dinitrotoluene	EPA625	5
4,6 Dinitro-2-methylphenol	EPA625	5

SEMIVOLATILE ORGANIC COMPOUNDS	METHOD	REPORTING LIMIT
1,2-Diphenylhydrazine	EPA625	1
di-n-Octyl phthalate	EPA625	10
Fluoranthene	EPA625	0.05
Fluorene	EPA625	0.1
Hexachlorobenzene	EPA625	1
Hexachlorobutadiene	EPA625	1
Hexachloro-cyclopentadiene	EPA625	5
Hexachloroethane	EPA625	1
Indeno(1,2,3-cd)pyrene	EPA625	0.05
Isophorone	EPA625	1
Naphthalene	EPA625	0.2
Nitrobenzene	EPA625	1
N-Nitroso-dimethyl amine	EPA625	5
N-Nitroso-diphenyl amine	EPA625	1
N-Nitroso-di-n-propyl amine	EPA625	5
Phenanthrene	EPA625	0.05
Pyrene	EPA625	0.05
1,2,4-Trichlorobenzene	EPA625	1

3.8 Marine Sediment Analyte List, Methods, and Required Reporting Limits

Chemical Analyses of sediments from the estuaries will need to be analyzed as part of the Sediment Quality Objective test protocols described below in Section 4. Table 3-12 provides a list of analytes, analytical methods, and reporting limits for use in the analyses of these marine sediments for the SQO testing of estuarine sediments.

Table 3-12. Analytes, Analytical Methods, and Target Quantitation Limits for Marine Sediments.

ANALYTE	METHOD	UNITS	REPORTING LIMIT
CONVENTIONALS			
Total Solids	SM2540 B	%	0.1
Total Organic Carbon	EPA 9060A	%	0.01
Grain Size	ASTM D 422	%	1.0
METALS			
Arsenic	EPA 6020	mg/kg	0.1
Cadmium	EPA 6020	mg/kg	0.1
Chromium	EPA 6020	mg/kg	0.1
Copper	EPA 6020	mg/kg	0.1
Lead	EPA 6020	mg/kg	0.1
Mercury	EPA 7471A	mg/kg	0.03
Nickel	EPA 6020	mg/kg	0.1
Selenium	EPA 6020	mg/kg	0.1
Silver	EPA 6020	mg/kg	0.1
Zinc	EPA 6020	mg/kg	1.0

ANALYTE	METHOD	UNITS	REPORTING LIMIT
CHLORINATED PESTICIDES			
2,4' DDD	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
2,4' DDE	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
2,4' DDT	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
4,4' DDD	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
4,4' DDE	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
4,4' DDT	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Total DDT	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Aldrin	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
BHC-alpha	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
BHC-beta	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
BHC-delta	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
BHC-gamma (Lindane)	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Chlordane-alpha	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Chlordane-gamma	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Oxychlordane	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Dieldrin	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Endosulfan sulfate	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Endosulfan I	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Endosulfan II	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Endrin	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Endrin aldeyde	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Endrin ketone	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Heptachlor	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Heptachlor epoxide	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Methoxychlor	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
Toxaphene	EPA 8081A/ 8270C (SIM)	µg/kg	20
trans-Nonachlor	EPA 8081A/ 8270C (SIM)	µg/kg	1.0
PCB CONGENERS			
PCB congeners of: 003, 005, 008, 015, 018, 027, 028, 029, 031, 033, 037, 044, 049, 052, 056, 060, 066, 070, 074, 077, 081, 087, 095, 097, 099, 101, 105, 110, 114, 118, 119, 123, 126, 128, 137 138, 141, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 174, 180, 183, 187, 189, 194, 195, 200, 201, 203, 206 and 209.	EPA 8270C (SIM)	µg/kg	0.5

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4 Aquatic Toxicity Testing and Toxicity Identification Evaluations

Aquatic toxicity testing supports the identification of BMPs to address sources of toxicity in urban runoff. Monitoring begins in the receiving water and the information gained is used to identify constituents for monitoring at outfalls to support the identification of pollutants that need to be addressed in the WMP.

The receiving waters for the Los Cerritos Channel Estuary and Alamitos Bay Estuary are salt water, so suitable marine toxicity test species must be selected. If toxicity is measured in these marine receiving and if the follow up TIEs do not identify the contaminant(s) causing the toxicity, then toxicity must be measured at the stormwater outfalls being monitored. In this case, the stormwater samples must be salted up to all the bioassay tests to be conducted with the same marine test species.

The sub-sections below describe the detailed process for conducting aquatic toxicity monitoring, evaluating results, and the technical and logistical rationale. Control measures and management actions to address confirmed toxicity caused by urban runoff are addressed by the WMP, either via currently identified management actions or those that are identified via adaptive management of the WMP.

4.1 Sensitive Species Selection

The Permit MRP (page E-29) states that sensitivity screening to select the most sensitive test species should be conducted unless "a sensitive test species has already been determined, or if there is prior knowledge of potential toxicant(s) and a test species is sensitive to such toxicant(s), then monitoring shall be conducted using only that test species." The receiving waters for the Los Cerritos Channel Estuary and Alamitos Bay Estuary are salt water so suitable toxicity test species must be selected.

Samples collected in receiving waters with salinity equal to or greater than 1 ppt or from outfalls discharging to receiving waters with salinity that is equal to or greater than 1 ppt, should be tested using the most sensitive test species in accordance with *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms (EPA/600/R-95/136, 1995).* The marine and estuarine test species identified in the MRP are:

- A static renewal toxicity test with the topsmelt, *Atherinops affinis* (Larval Survival and Growth Test Method).
- A static non-renewal toxicity test with the purple sea urchin, *Strongylocentrotus purpuratus* (Fertilization Test Method).
- A static non-renewal toxicity test with the giant kelp, *Macrocystis pyrifera* (Germination and Growth Test Method).

In addition to the three species identified in the MRP, the red abalone, *Haliotis rufescens (H. rufescens*) larval development test was also considered given the extensive use of this test in this region.

Although all the species mentioned have been demonstrated as sensitive to a wide variety of toxicants and have been subject to numerous inter- and intra-laboratory testing using standardized toxicants, two species: *Macrocystis pyrifera* (*M. pyrifera*) and *Atherinops affinis* (*A. affinis*); have limitations when used to assess the toxicity of stormwater compared to the sea urchin fertilization test and the red abalone larval development test.

The method for *M. pyrifera* is a 48-hour chronic toxicity test that measures the percent zoospore germination and the length of the gametophyte germ tube. Although the test may be sensitive to herbicides, fungicides, and treatment plant effluent, the use of *M. pyrifera* as a test species for stormwater monitoring may not be ideal. Obtaining sporophylls for stormwater testing could also be a limiting factor for selecting this test. Collection of *M. pyrifera* sporophylls from the field is necessary prior to initiating the test and the target holding time for any receiving water or stormwater sample is 36 hours; however, 72 hours is the maximum time a sample may be held prior to test initiation. During the dry season, meeting the 36-72 hour holding time will be achievable; however, field collection during wet weather may be delayed beyond the maximum holding time due to heavy seas and inaccessible collection sites. In addition, collection of *M. pyrifera* sporophylls during the storm season may include increased safety risks that can be avoided by selection of a different species.

The *A. affinis* test measures the survival and growth test of a larval fish over seven days. At the end of seven days of exposure to a suspected toxicant, the number of surviving fish are recorded, along with their weights, and compared to those exposed to non-contaminated seawater. Positive characteristics of the *A. affinis* chronic test include the ability to purchase test organisms from commercial suppliers as well as being one of the few indigenous test species that may be used to test undiluted stormwater by the addition of artificial sea salts to within the range of marine receiving waters. Unfortunately, the tolerance of *A. affinis* to chemicals in artificial sea salts may also explain their lack of sensitivity to changes in water quality compared to other test organisms such as the sea urchin or red abalone. Further, there are concerns with the comparability of conducting a seven-day exposure test when most rain events do not occur over a seven-day period.

The *Strongylocentrotus purpuratus* (*S. purpuratus*) fertilization test measures the ability of *S. purpuratus* sperm to fertilize an egg when exposed to a suspected toxicant. The *S. purpuratus* fertilization has been selected as a chronic toxicity test organism in previous MS4 permits and has been used to assess ambient receiving water toxicity, sediment porewater toxicity, as well as stormwater toxicity. The *S. purpuratus* fertilization test is also among the most sensitive test species to metals. The adult test organisms may be purchased and held in the lab prior to fertilization, and the sample volume necessary to conduct the test is small with respect to the other suggested tests. The minimal exposure period (20 minutes) allows for a large number of tests to be conducted over a short period of time and permits the testing of toxicants that may lose their potency over long periods of time.

The *Haliotis rufescens* (*H. rufescens*) larval development test measures the percent of abnormal shell development in larvae exposed to toxic samples for 48 hours. The *H. rufescens* is commonly used to test treatment plant effluent, but has had limited use in stormwater compared to the *S. purpuratus* fertilization test. The advantages of the red abalone test include a sensitive endpoint, the ability to purchase abalone from commercial suppliers, hold test organisms prior to spawning, and the low variability in results compared to other species (e.g., *S. purpuratus* fertilization test). Thus, though not listed as a potential test species for use in stormwater monitoring in the MS4 permit, it was considered as a potentially sensitive species for the purposes of selecting the most sensitive species.

Due to the limitations of the giant kelp germination and growth test and the topsmelt survival and growth test, in addition to not being particularly sensitive to the constituents identified as problematic in stormwater, these tests are not considered particularly helpful in supporting the identification of pollutants of concern.

Based on the sensitivity, smaller test volume requirements, their ability to be housed in the laboratory prior to testing, and shorter exposure times, the *S. purpuratus* fertilization test and the red abalone development test will be considered during sensitive species selection to measure toxicity in marine and estuarine environments. Based on historical data of the sensitivity of the *S. purpuratus* and *H. rufescens* tests, and the limiting factors associated with the *A. affinis* and *M. pyrifera tests*, the sensitive species test for marine and estuarine species will be conducted with the sea urchin and red abalone tests. Species screening was determined to be appropriate for these two species (as opposed to selecting just one) as testing conducted within the region with both species have shown varying sensitivity. Thus, it is appropriate to test both to determine sensitivity at a given site. After the screening testing is completed, monitoring will be conducted with the most-sensitive species.

If testing of freshwater from outfall samples should become necessary, salting up required for freshwater testing will limit the highest concentration that can be tested with the sea urchin to about 60% to 63.8% as brine must be used. For the red abalone development test, solid standard salts may be added so this test does not have this limitation.

4.2 Testing Period

The following describes the testing periods to assess toxicity in samples collected in the Long Beach bay and estuaries watershed and in the San Gabriel River Estuary Watershed during dry and wet weather conditions. Testing of marine receiving waters will be carried out using the two species, the Sea Urchin (*S. purpuratus*) fertilization test and Red Abalone (*H. rufescens*) larval development tests. These same test organisms will be used if required for upstream outfall discharge testing if necessary by using standard salting up procedures. Thus toxicity testing of marine receiving waters and of stormwater outfall discharges will be carried out in accordance with *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms (EPA/600/R-95/136, 1995)*.

4.3 Toxicity Endpoint Assessment and Toxicity Identification Evaluation Triggers

Per the MRP, toxicity test endpoints will be analyzed, using the Test of Significant Toxicity (TST) t-test approach specified by the USEPA (USEPA, 2010). The Permit specifies that the chronic in-stream waste concentration (IWC) is set at 100% receiving water for receiving water samples and 100% effluent for outfall samples. Using the TST approach, a t-value is calculated for a test result and compared with a critical t-value from USEPA's TST Implementation Document (USEPA, 2010). Follow-up triggers are generally based on the Permit specified statistical assessment as described below.

With chronic toxicity testing on fresh water samples using the sea urchin (*Strongylocentrotus*), the highest concentration of a fresh water stormwater sample that can be tested after the addition of brine is approximately 66% freshwater. Thus an approximate 2 TU_c reduction in survival or reproduction needs to be observed between the sample and laboratory control that is statistically significant, for a toxicity identification evaluation (TIE) to be performed.

TIE procedures will be initiated as soon as possible after the toxicity trigger threshold is observed to reduce the potential for loss of toxicity due to extended sample storage. If the cause of toxicity is readily apparent or is caused by pathogen related mortality or epibiont interference with the test, the result will be rejected, if necessary, a modified testing procedure will be developed for future testing.

In cases where significant endpoint toxicity effects greater than 50% are observed in the original sample, but the follow-up TIE positive control "signal" is found to not be statistically significant, the cause of toxicity will be considered non-persistent. No immediate follow-up testing is required on the sample. However, future test results will be evaluated to determine if implementation of concurrent TIE treatments are needed to provide an opportunity to identify the cause of toxicity.

4.4 Toxicity Identification Evaluation Approach

The results of toxicity testing will be used to trigger further investigations to determine the cause of observed laboratory toxicity. The primary purpose of conducting TIEs is to support the identification of management actions that will result in the removal of pollutants causing toxicity in receiving waters. Successful TIEs will direct monitoring at outfall sampling sites to inform management actions. As such, the goal of conducting TIEs is to identify pollutant(s) that should be sampled during outfall monitoring so that management actions can be identified to address the pollutant(s).

The TIE approach as described in USEPA's 1991 Methods for Aquatic Toxicity Identification is divided into three phases although some elements of the first two phases are often combined. Each of the three phases is briefly summarized below:

- Phase I utilizes methods to characterize the physical/chemical nature of the constituents, which cause toxicity. Such characteristics as solubility, volatility and filterability are determined without specifically identifying the toxicants. Phase I results are intended as a first step in specifically identifying the toxicants but the data generated can also be used to develop treatment methods to remove toxicity without specific identification of the toxicants.
- Phase II utilizes methods to specifically identify toxicants.
- Phase III utilizes methods to confirm the suspected toxicants.

A Phase I TIE will be conducted on samples that exceed a TIE trigger described in Section 4.3. Water quality data will be reviewed to future support evaluation of potential toxicants. A range of sample manipulations may be conducted as part of the TIE process. The most common manipulations are described in Table 4-1. Information from previous chemical testing and/or TIE efforts will be used to determine which of these (or other) sample manipulations are most likely to provide useful information for identification of primary toxicants. TIE methods will generally adhere to USEPA procedures documented in conducting TIEs (USEPA, 1991, 1992, 1993a-b).

Table 4-1. Phase I and II Toxicity Identification Evaluation Sample Manipulations.

TIE Sample Manipulation	Expected Response
pH Adjustment (pH 7 and 8.5)	Alters toxicity in pH sensitive compounds (i.e., ammonia and some trace metals)
Filtration or centrifugation*	Removes particulates and associated toxicants
Ethylenediamine-Tetraacetic Acid (EDTA) or Cation Exchange Column*	Chelates trace metals, particularly divalent cationic metals
Sodium thiosulfate (STS) addition	Reduces toxicants attributable to oxidants (i.e., chlorine) and some trace metals
Piperonyl Butoxide (PBO)*	Reduces toxicity from organophosphate pesticides such as diazinon, chlorpyrifos and malathion, and enhances pyrethroid toxicity
Carboxylesterase addition(1)	Hydrolyzes pyrethroids
Temperature adjustments(2)	Pyrethroids become more toxic when test temperatures are decreased
Solid Phase Extraction (SPE) with C18 column*	Removes non-polar organics (including pesticides) and some relatively non-polar metal chelates
Sequential Solvent Extraction of C18 column	Further resolution of SPE-extracted compounds for chemical analyses
No Manipulation*	Baseline test for comparing the relative effectiveness of other manipulations

* Denotes treatments that will be conducted during the initiation of toxicity monitoring, but may be revised as the program is implemented. These treatments were recommended for initial stormwater testing in Appendix E (Toxicity Testing Tool for Stormwater Discharges) of the State Water Resources Control Board's June 2012 Public Review Draft "Policy for Toxicity Assessment and Control".

1 Carboxylesterase addition has been used in recent studies to help identify pyrethroid-associated toxicity (Wheelock et al., 2004; Weston and Amweg, 2007). However, this treatment is experimental in nature and should be used along with other pyrethroid-targeted TIE treatments (e.g., PBO addition).

2 Temperature adjustments are another recent manipulation used to evaluate pyrethroid-associated toxicity. Lower temperatures increase the lethality of pyrethroid pesticides. (Harwood, You and Lydy, 2009)

The City of Long Beach will identify the cause(s) of toxicity using a selection of treatments in Table 4-1 and, if possible, using the results of water column chemistry analyses. After any initial assessments of the cause of toxicity, the information may be used during future events to modify the targeted treatments to more closely target the expected toxicant or class of toxicants. Moreover, if the toxicant or toxicant class is not initially identified, toxicity monitoring during subsequent events will confirm if the toxicant is persistent or a short-term episodic occurrence.

As the primary goals of conducting TIEs is to identify pollutants for incorporation into outfall monitoring, narrowing the list of toxicants following Phase I TIEs via Phase II/III TIEs is not necessary if the toxicant class determined during the Phase I TIE is sufficient for 1) identifying additional pollutants for outfall monitoring and/or 2) identifying control measures. Thus, if the specific pollutant(s) or classes of pollutants (e.g., metals that are analyzed via EPA Method 200.8) are identified then sufficient information is available to incorporate the additional pollutants into outfall monitoring and to start implementation of control measures to target the additional pollutants.

Phase II TIEs may be utilized to identify specific constituents causing toxicity in a given sample if the results of Phase I TIE testing and a review of available chemistry data fails to provide information necessary to identify constituents that warrant additional monitoring activities or management actions to identify likely sources of the toxicants and lead to elimination of the sources of these contaminants. Phase III TIEs will be conducted following any Phase II TIEs.

For the purposes of determining whether a TIE is inconclusive, TIEs will be considered inconclusive if:

- The toxicity is persistent (i.e., observed in the baseline), and
- The cause of toxicity cannot be attributed to a class of constituents (e.g., insecticides, metals, etc.) that can be targeted for monitoring.

If (1) a combination of causes that act in a synergistic or additive manner are identified; (2) the toxicity can be removed with a treatment or via a combination of the TIE treatments; or (3) the analysis of water quality data collected during the same event identify the pollutant or analytical class of pollutants, the result of a TIE is considered conclusive.

Note that the MRP (page E-30) allows a TIE Prioritization Metric (as described in Appendix E of the Stormwater Monitoring Coalition's Model Monitoring Program) for use in ranking sites for TIEs. However, as the extent to which TIEs will be conducted is unknown, prioritization cannot be conducted at this time. However, prioritization may be utilized in the future based on the results of toxicity monitoring and an approach to prioritization will be developed through the CIMP adaptive management process and will be described in future versions of the CIMP.

4.5 Follow Up on Toxicity Testing Results

The suggested approach is that If the results of TIEs are inconclusive, a toxicity test conducted during the same conditions (i.e., wet or dry weather), using the same test species, will be conducted at applicable upstream outfalls as soon as feasible (i.e., the next monitoring event that is at least 45 days following the toxicity laboratory's report transmitting the results of an inconclusive TIE). The same TIE evaluation triggers and TIE approach presented in Section 4.3 and 4.4, respectively will be followed based on the results of the outfall sample.

The MRP (page E-30) indicates the following actions should be taken when a toxicant or class of toxicants is identified through a TIE:

1. The toxicant(s) should be analyzed during the next scheduled sampling event in the discharge from the outfall(s) upstream of the receiving water location.
2. If the toxicant is present in the discharge from the outfall at levels above the applicable receiving water limitation, a toxicity reduction evaluation (TRE) will be performed for that toxicant.

The list of constituents monitored at outfalls identified in the IMP will be modified based on the results of the TIEs. Similarly, upon completion of a successful dry weather TIE, additional constituents identified in the TIE will be added to monitoring requirements at outfalls with significant non-stormwater flows. Monitoring for those constituents will occur as soon as feasible following the completion of a successful

TIE (i.e., the next monitoring event that is at least 45 days following the toxicity laboratory's report transmitting the results of a successful TIE).

The requirements of the TREs will be met as part of the adaptive management process in the WMPs rather than the IMP. The identification and implementation of control measures to address the causes of toxicity are tied to management of the stormwater program, not the IMP. It is expected that the requirements of TREs will only be conducted for toxicants that are not already addressed by an existing Permit requirement (i.e., TMDLs) or existing or planned management actions.

The Water Boards' TMDL Roundtable is currently evaluating options to streamline and consistently respond to urban-use pesticide impairment listings throughout the State including a statewide urban-use pesticide TMDL modeled after the San Francisco Bay Area Urban Creeks Pesticides TMDL. In addition to toxicity testing, statewide efforts will be monitored to study these pesticides being discussed by the California Stormwater Quality Association (CASQA) Pesticides sub-committee and other Regional Water Boards. The toxicity approach is subject to modifications based on discussions with the Regional Board.

4.6 Summary of Aquatic Toxicity Monitoring

The approach to conducting aquatic toxicity monitoring as described in the previous sections is summarized in detail in Figure 4.1. The intent of the approach is to identify the cause of toxicity observed in receiving water to the extent possible with the toxicity testing tools available, thereby directing outfall monitoring for the pollutants causing toxicity with the ultimate goal of supporting the development and implementation of management actions.

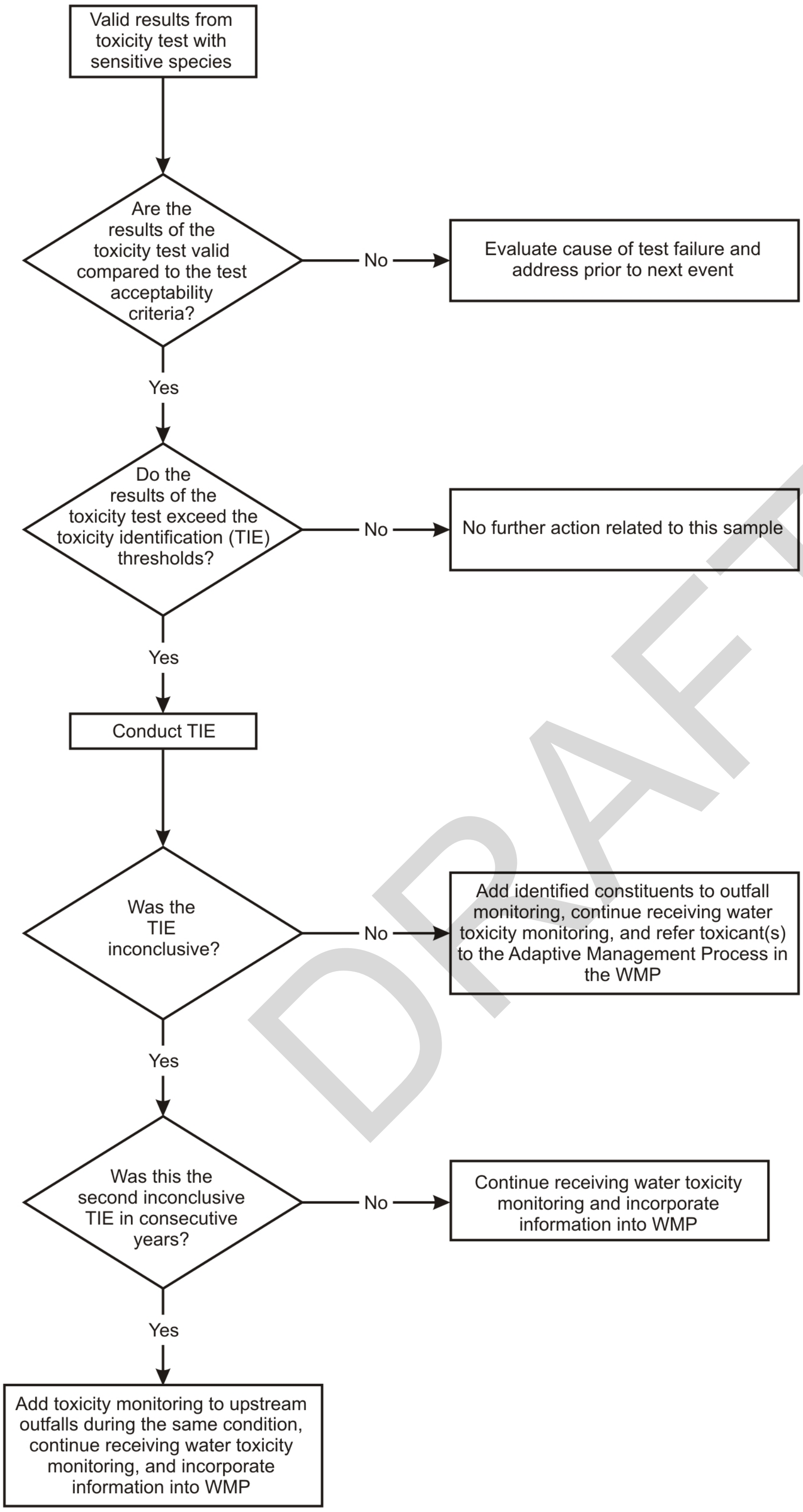

Figure 4.1. Detailed Aquatic Toxicity Assessment Process.

4.7 Receiving Water Sediment Monitoring, Sediment Quality Objectives

4.7.1 Overview of SQO Procedure

From Section 1.2.1 above that briefly summarizes previous data in the Los Cerritos Estuary and Alamitos Bay, chlordane is 303d listed, although a TMDL is not in place. Data from several sources show that chlordane in sediments exceeds the ERM marine water guidance level within this estuary and DDTs generally only exceeds ERL levels. At only one station near the power plant, DDTs and PCBs exceed ERMs. Generally, current data indicates that marine waters within this estuary are not toxic, though a few instances in the Bight 2008 dataset, some toxicity was measured at one sampling point.

Because chlordane concentrations above ERM values are widespread in sediments in this Estuary along with other contaminants at lower levels, this sediment contamination will not go away soon due to increased stormwater WMP practices. It is therefore important to determine whether the estuarine sediments are not significantly impacted to warrant a TMDL and further actions.

Therefore, SQO testing will be conducted at the receiving water Site LBR1 located at the Los Cerritos Channel Estuary at the East Pacific Coast Highway Bridge. This method is designed to evaluate whether these estuarine sediments show any significant impairments. Guidance for this SQO approach is contained in the SWRCB's Water Quality Control Plan for Enclosed Bays and Estuaries – Part I Sediment Quality (2009a). SQOs have been developed for contaminants of concern in bays and estuaries in California based on an approach that incorporates multiple lines of evidence (MLOE; Bay et al. 2014). These MLOEs include sediment chemistry, sediment toxicity, and benthic community composition. It is proposed that this SQO method for the evaluation of sediment quality be used at the LBR1 receiving water site in the Los Cerritos Estuary. Where practical, the timing of SQO monitoring will be coordinated with SQO monitoringnow being carried out in San Pedro Bay as part of the Harbor Toxics TMDL. Similar work is also now being done at the San Gabriel River Estuary receiving water Site R8 located at the Marina Bridge near the mouth of the San Gabriel River. This latter work is also part of a continuing program at multiple sites in the receiving waters up the San Gabriel River Estuary as part of the ongoing San Gabriel River Regional Monitoring program.

Evaluation of sediments follows the following path:

- **Sediment Chemistry Line of Evidence**. The chemistry LOE requires chemical analysis of a suite of constituents. Two indices are used to interpret the results: the California Logistic Regression Model (CA LRM) and the Coordinated Compliance Monitoring and Reporting Plan Chemical Score Index (CSI). Results produced by these indices are subsequently used to produce a single score representing the chemistry LOE.
- **Sediment Toxicity LOE.** The toxicity LOE requires two toxicity tests: acute amphipod survival and a sub-lethal test (i.e., bivalve embryo development). The results of each test are compared to classification ranges (nontoxic, low toxicity, moderate toxicity, or high toxicity) and assigned a corresponding score. The two test scores are integrated to produce a single score for the toxicity LOE.
- **Benthic Community LOE**. The benthic community LOE is comprised of enumerating and identifying organisms to species level (when possible) and evaluating results based on four

indices: the Index of Biotic Integrity (IBI), the Relative Benthic Index (RBI), the Benthic Response Index (BRI), and the River Invertebrate Prediction and Classification System (RIVPACS). The four indices are weighted together to provide an overall score for the benthic community LOE.

- **Integration of MLOEs**. First, integration of MLOEs aids in determining two broad effects categories. The chemistry and toxicity LOEs are evaluated together to determine the potential for chemically-mediated effects; likewise, the toxicity and benthic community LOEs are combined to determine the severity of biological effects. Finally, integration of the two effects categories results in an overall station assessment in which the station is placed into one of six impact categories (Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted, Clearly Impacted, or Inconclusive).

4.7.2 Sampling and Analyses Methods

Chemistry. Sediment chemistry is one of three essential lines of evidence (LOE) required for the SQO Part 1 , which helps determines the type of chemical exposure and its potential for producing adverse biological effects. Determination of the chemistry LOE is comprised of two main components: 1) measurement of a suite of constituents and 2) interpretation of the results using two indices of chemical exposure: CA CLR and CSI (Bay et al. 2014). Sediment samples will be analyzed for total organic carbon (TOC), grain size, total solids, metals, organochlorine pesticides, and PCBs.

Toxicity. Toxicity tests will be conducted in accordance with Sediment Quality Assessment Technical Support Manual (Bay et al. 2014). Two sediment toxicity tests, including an acute amphipod survival and a chronic, sub-lethal test are required for the assessment (Bay et al. 2014). For consistency and comparability with the Bight program and over time, the *Eohaustorius estuarius* amphipod toxicity test should be used for compliance monitoring. *E. estuarius* has been historically used during Bight Monitoring in 1998, 2003, and 2008 (Bay et al. 2014) and Ports Biological Baseline Monitoring in 2008 (SAIC, 2010). The continued use of this species as part of future monitoring events will allow for the greatest data comparability over time. However, due to the intolerance of *E. estuarius* for sediment with a high percent of clay, alternative species accepted by the SQO guidance (e.g., *Leptocheirus plumulosus*) should be considered in areas expected to have a high percent of fines.

The chronic, sublethal toxicity test that should be conducted as part of an SQO assessment in the Los Angeles/Long Beach Harbor Complex is the mussel (*Mytilus galloprovincialis*) sediment-water interface test. Recent Bight monitoring in 2008 employed the SWI test and, continued use of this test will provide the best data comparability between previous and future sampling events. In accordance with the original intent of the SWI test design (Anderson et al. 1996), *M. galloprovincialis* larvae should be exposed to intact cores. In contrast, homogenized sediment was used in the Bight 2008 testing program. The use of intact cores instead of homogenized sediment will reduce the potential for confounding effects of ammonia and sulfides found in deeper sediment, while still testing for the toxic effects of chemicals fluxing from sediment to overlying water.

A description of these toxicity test methods specified under the SQO policy is provided in Chapter 4 of the Sediment Quality Assessment Draft Technical Support Manual (Bay et al. 2014). Specifically, Chapter

4 provides guidance on sample preparation, organism acclimation, test methods, QA/QC procedures, and data analysis and interpretation (Bay et al. 2014).

Benthic Community. The third essential LOE for sediment quality assessment is the composition of the benthic community. The benthic LOE is a direct measure of the effect that sediment contaminant exposure has on the benthic biota of California's bays and estuaries. Determination of the benthic LOE is based on four measures of benthic community condition: 1) IBI, 2) RBI, 3) BRI, and 4) RIVPACS (Bay et al. 2014). Benthic community analyses will be conducted in accordance with Sediment Quality Assessment Technical Support Manual (Bay et al. 2014). Chapter 5 of the Sediment Quality Assessment Technical Support Manual (Bay et al. 2014) details recommended laboratory procedures for the processing of benthic infauna samples and subsequent data analysis necessary for the SQO Part 1 assessment. Methods are included in the SOP: Benthic Infauna Field Sampling and Biological Laboratory Protocols (Appendix H).

Sediment Quality Objective Assessment. The SQO assessment incorporates the MLOE described above (chemistry, toxicity, and benthic community) to develop final station assessments. SQO assessment should be conducted in accordance with the Water Quality Control Plan (SWRCB, 2009) and the Technical Support Manual (Bay et al. 2014). The calculation of the toxicity LOE is straightforward, as described in the Technical Support Manual. Consequently, only supplemental guidance is provided here for the chemistry and benthic LOEs.

Chemistry LOE. Calculation of the chemistry LOE should follow methods described in the Water Quality Control Plan (SWRCB 2009) and the Technical Support Manual (Bay et al. 2014). Specific attention should be given to guidance on the summing of total high molecular weight PAHs, low molecular weight PAHs, total PCBs, and total DDTs; guidance on using the specific chemical constituents in each class to sum, managing non-detects, and applying a multiplication factor as part of the total PCB concentration estimate should be strictly followed.

For individual analytes with a non-detect result, an estimated concentration represented by half the detection limit should be consistently used. Using this method will ensure consistency across all monitoring events. This stipulation does not apply to non-detect results used in a sum (as previously described). While there are other ways that non-detects can be estimated (i.e., non-detect equals detection limit), the recommended method is in agreement with the Technical Support Manual (Bay et al. 2014).

Calculations may be performed using various tools, including a calculator, Microsoft Excel®, or programming languages (i.e., Interactive Data Language [IDL]). SCCWRP has also developed a data integration tool in Microsoft Excel® (Data Integration Tool v5.4) for calculating each LOE and the final MLOE. The current version is available on the Sediment Quality Assessment Tools page of the SCCWRP website (SCCWRP 2014). It should be noted that this tool is currently under revision.

Benthic LOE. Calculation of the benthic LOE should follow methods described in the Water Quality Control Plan (SWRCB 2009) and the Technical Support Manual (Bay et al. 2014). As part of this calculation, data should be prepared and benthic indices calculated in accordance with this manual. The preparation of data for benthic indices calculations is a critical step that has significant impacts on the results and SQO outcome. The Technical Support Manual (Bay et al. 2014) describes most key steps required to prepare data prior to benthic indices calculations. In addition, the Technical Support Manual states that data should be prepared by identifying each taxon to the appropriate level "in keeping with the benthic macrofauna species list for the relevant habitat." While a seemingly uncomplicated task, to address this data requirement in full, the following steps should be taken to ensure consistency with SCCWRP data assessment tools, as it will allow for the most comprehensive quality control.

Species collected from within the Los Angeles/Long Beach Harbor Complex should be compared to the "Benthic Lookup" worksheet found within the Data Integration Tool v5.4 Excel file (Bay et al. 2014). Species should be matched to corresponding names within this species list, and if no corresponding species exists, species should be matched to the next lowest taxonomic level (genus, family, order, class, or phylum). Species may be identified to the nearest taxonomic level using the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) Taxonomic Toolbox available at http://www.scamit.org/taxontools/.

Species not matching a corresponding species or the next lowest taxonomic level should be checked to ascertain that the species name is the most recently accepted name for that organism. For example, *Caesia perpinguis* (Hinds 1844) should be recorded as *Nassarius perpinguis*. The most recently accepted species names will be checked.

If benthic species or taxon do not match any taxon provided in the Benthic Lookup worksheet, they should be excluded from benthic indices calculations entirely (i.e., their names should be removed from the species listed at that station), until revision of the Data Integration Tool v5.4 is complete, which will allow for the ability to include some species that may not be on the list, but are in fact marine benthic invertebrates.

Upon conversion of species names to the lowest taxonomic level, duplicate, triplicate, or more taxon results should be compiled into one taxon result with one corresponding abundance. For example, if the abundance data show two organisms identified as *Lineus bilineatus* (which can be converted to the family Lineidae, as it is the lowest matching taxonomic level) and four organisms identified as Lineidae, then there should be one line item for Lineidae with a total of six organisms (SCCWRP, 2012).

Within the Benthic Lookup worksheet found within the Data Integration Tool v5.4 Excel file, there is a species level column that indicates whether or not a species should be dropped. SCCWRP states that "when present, 'Drop' in this column indicates that abundances of this taxon are included in index calculations, but it is not included for counting numbers of taxa because lower taxonomic level entries in this taxon are also present" (SCCWRP 2009). It is critical that programming language or user-designed spreadsheets used to calculate benthic indices incorporate this 'Drop' instruction.

The supplemental data preparation steps previously described must be followed such that QC checks can be conducted on the numerical results of the indices using the SCCWRP Data Integration Tool v5.4, assuming initial indices calculations were performed using a programming language such as IDL, SAS® software, or separate Excel file. In addition, if species are not matched to the Benthic Lookup worksheet when they should be, the match between observed and expected species could be reduced, which would affect the RIVPACS score and could also have an impact on the result of other benthic indices due the inclusion of total number of taxa or subclasses of taxa (i.e., molluscs) in the calculation of these indices. If species are included in the data analyses when they do not match the species list, the scores of the benthic indices could be impacted, which could potentially affect the benthic LOE outcome.

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5 Receiving and Outfall Water Quality Monitoring (Wet and Dry Weather)

For the Los Cerritos, Alamitos Bay, and San Gabriel River estuaries, receiving water sampling will be in the open estuarine waters. These samples are to be taken as soon as possible, but probably within 24 hours after a storm event. These samples will be taken at Site LBR2 in Alamitos Bay and at R8 in the San Gabriel River Estuary.

Receiving water water quality will be assessed by grab samples collected at a depth of approximately 3 feet below the surface. Outfall sampling will be conducting using automated flow-composited water sampling equipment installed at Sites LBE1 at Bouton Creek and LBE2 at the Termino Drain.

5.1 Sampling Frequency and Mobilization Requirements

Outfall and receiving water quality monitoring will be performed three times a year during the wet season and two times a year during dry weather conditions. A fourth wet event will be required for Site R8 in the San Gabriel River Estuary but will involve only copper and conventional analytes to satisfy the copper TMDL.

For the Los Cerritos Channel and Alamitos Bay, screening for Table E-2 constituents listed in the MRP will be conducted during the first significant storm of the year and during a critically dry weather period. Large sampling volumes are required to incorporate all analytical tests and associated QA/QC needed for Table E-2 constituents, bioassay tests and to provide sufficient volumes should TIEs be required. Due to these requirements, mobilization criteria for the wet weather events must be well planned.

Mobilization of field crews will typically start when there is both a 70% probability of rainfall within 24 hours of the arrival of a predicted storm event and Quantitative Precipitation Forecasts (QPFs) indicate that a minimum of 0.25 inches will occur within a 24-hour time period. Due to the importance of the first storm event of the year, crews will be mobilized to prepare the site (or sites) for monitoring 24 hours in advance of any events with at least a 50% probability of rainfall and QPFs of at least 0.20 inches within a 24-hour time period. If weather forecast for the first storm of the season indicate development of a condition known as a "cut-off low"[3], partial field teams may initially be deployed to prepare stations since such conditions create highly unpredictable situations that have the potential to suddenly move onshore with higher than expected rainfall. Full mobilization will require an upgrade in the local forecast to a predicted rainfall of at least 0.25 inches with a minimum probability of 70% within 12 hours of the event. For the purposes of this IMP, weather forecasts and QPFs provided by the Los Angeles/Oxnard National Weather Service and the California Nevada River Forecast Center will be used to assess whether mobilization criteria are met.

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[3] A closed upper-level low which has become completely displaced (cut off) from basic westerly current, and moves independently of that current. Cutoff lows may remain nearly stationary for days, or on occasion may move westward opposite to the prevailing flow aloft (i.e., retrogression).

Once the screening phase has been completed for Table E-2 constituents, storm events will be considered suitable for monitoring given a minimum of 72 hours (3 days) with cumulative rainfall of less than 0.1 inches within the watershed. Evaluation of antecedent rainfall conditions will initially be based upon Los Angeles County ALERT (Automatic Local Evaluation in Real Time) stations and rain gauges within or near the Los Cerritos Channel Watershed and rainfall measured at LCC1. The rain gauge located at Signal Hill City Hall (#335) will serve as the primary site for evaluation of antecedent conditions. The rain gauge installed at the outfall monitoring sites will also be used to evaluate antecedent conditions. Assessment of antecedent conditions will be based upon average rainfall measured at sites located within the watershed boundaries and that are known to be fully operable. Once crews are mobilized for a storm event, rainfall must exceed a minimum of 0.25 inches and provide sufficient rainfall to meet project objectives. The four storm events to be sampled at the R8 receiving water site are only intended to address the requirements of the copper TMDL in the San Gabriel River Estuary along with Dioxin. At this site, a minimum rainfall event of 0.25 inches would be expected to fulfill sampling requirements for the TMDL constituents and provide a representative flow-composite sample due to the fact that the watershed is highly impervious.

Two monitoring events are required during dry weather conditions. Based upon existing information, dry weather monitoring at the outfall sites will be conducted once in late spring/early summer (May to June) and again towards the end of the dry season in September/October. This will be consistent with historical dry weather sampling conducted under the City of Long Beach NPDES Permit. During the dry season, the only restriction on sampling will be that total rainfall over the 72-hour time period preceding the sampling event does not exceed 0.1 inches. In practice, rainfall is very rare during the summer months. With the exception of unusual periods when hurricanes developing off of Baja California cause some precipitation to spin north, rainfall events are very infrequent.

5.2 Sampling Constituents

For the Los Cerritos Channel and Alamitos Bay, with minor exceptions, chemical analyses are scheduled to be conducted for all analytes listed in Table 3-5 through Table 3-11 during the first significant rainfall of the season and again during a period of critical low flow. Chemical constituents not detected in excess of their respective MDLs or that do not exceed available water quality standards will be considered for removal during subsequent surveys. Adjustments to the list of analytical tests will be assessed separately for wet and dry weather sampling requirements. Since the initial screening event may be followed too quickly for the data to be received and fully evaluated, the field team must be prepared to collect water samples for the testing the full set of Table E-2 constituents during the second sampling event.

Most of the general and conventional pollutants listed in Table 3-5 will continue to be analyzed as part of the base monitoring requirements for continued monitoring for receiving and outfall waters. The only pollutants considered for elimination will be cyanide, total phenols, perchlorate, and MTBE. Analysis of chloride and fluoride will continue to be used to assist in the interpretation of potential potable water sources during in association with the non-stormwater screening program. In addition, microbiological constituents (Table 3-6), nutrients (Table 3-7), chlordane compounds (

Table 3-9), and metals (Table 3-8) will continue to be part of the ongoing monitoring.

From Section 4 above, two sensitive toxicity testing species have been selected for initial testing of the marine receiving water. These are the sea urchin (*S. purpuratus*) and the red abalone (*H. rufescens*) fertilization and development tests. These test species will also be used as necessary for outfall samples by salting up these outfall samples to accommodate these marine species.

As noted in the previous section, it has been determined that Table 5-1 provides sample volumes necessary for toxicity tests (both wet and dry weather) as well as minimum volumes necessary to fulfill Phase I TIE testing if necessary. As detailed in the previous section, the sublethal endpoints will be assessed using EPA's TST procedure to determine if there is a statistically significant 50% difference between sample controls and the test waters and ultimately determine if further testing is necessary.

Table 5-1. Toxicity Test Volume Requirements for Aquatic Toxicity Testing as part of the Long Beach Estuaries Stormwater Monitoring Program.

Test Organism	Toxicity Test Type	Test Concentration	Volume Required for Initial Screen (L)	Minimum Volume Required for TIE (L)[1]
Tests for Marine Water or Salted-Up Stormwater				
Sea Urchin (*S. purpuratus*)	Fertilization and larvae development	100% only	1.5	10
Red Abalone (*H. rufescens*)	Larval development	100% only	2.0	10
SampleQualityTests Water	--	--	1.0	--
Total volume required per Test event			2.5	a

[1] Minimum volume for the TIE is for Phase 1 characterization testing only. The additional volume collected for potential TIE testing can be held in refrigeration (4°C in the dark, no head space) and shipped to the laboratory at a later date if needed.

Note: The NPDES permit targets a 36-hr holding time for initiation of testing but allows a maximum holding time of 72-hr if necessary.

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6 Non-Stormwater (NSW) Outfall Monitoring for Los Cerritos Channel, Alamitos Bay, and San Gabriel River Estuaries

Detailed objectives of the screening and monitoring process (Section IX.A, page E-20 of the MRP) include the following:

1. Develop criteria or other means to ensure that all outfalls with significant non-stormwater discharges are identified and assessed during the term of this Order.

2. For outfalls determined to have significant non-stormwater flow, determine whether flows are the result of illicit connections/illicit discharges (IC/IDs), authorized or conditionally exempt non-stormwater flows, natural flows, or from unknown sources.

3. Refer information related to identified IC/IDs to the IC/ID Elimination Program (Part V8I.D of the Order) for appropriate action.

4. Based on existing screening or monitoring data or other institutional knowledge, assess the impact of non-stormwater discharges (other than identified IC/IDs) on the receiving water.

5. Prioritize monitoring of outfalls considering the potential threat to the receiving water and applicable TMDL compliance schedules.

6. Conduct monitoring or assess existing monitoring data to determine the impact of non-stormwater discharges on the receiving water.

7. Conduct monitoring or other investigations to identify the source of pollutants in non-stormwater discharges.

8. Use results of the screening process to evaluate the conditionally exempt non-storm water discharges identified in Parts IV.B.2 of this Order and take appropriate actions pursuant to Part IV.B.3 of this Order for those discharges that have been found to be a source of pollutants. Any future reclassification shall occur per the conditions in Parts IV.B.3 of this Order.

9. Maximize the use of Permittee resources by integrating the screening and monitoring process into existing or planned CIMP efforts.

Ultimately, the NSW program is intended to establish a process for identifying outfalls that serve as potential sources of contaminants. Sites where initial screening indicates the potential for discharges of a magnitude considered to have the potential to cause or contribute to exceedances of receiving water limitations will require further efforts to classify the discharges and determine appropriate actions.

In cases where flow or other factors show evidence of potential discharges of concern, the program will take further action to determine if the flows are illicit, exempt, conditionally exempt, conditionally exempt but non-essential, or if the source(s) of the discharge cannot be identified (unknown). Illicit discharges require immediate action and, if they cannot be eliminated, monitoring will be implemented until such time that the illicit discharge can be eliminated. Discharges classified as conditionally exempt but non-essential or unknown also require ongoing monitoring.

The following sections summarize the elements of the program and processes to ultimately eliminate major sources of non-stormwater discharges.

6.1 Non-Stormwater Outfall Screening and Monitoring Program

An outline of the NSW Outfall Screening Monitoring Program and a general timeline is shown in Table 6-1. The NSW Outfall Screening and Monitoring Program will consist of a screening phase designed to initially classify outfalls into one of three categories. Three screening surveys will be conducted starting in the Spring of 2015, Summer of 2015, and Fall (Winter-Dry Weather) 2015 to identify outfalls or other discharges that are considered to be significant and persistent sources of non-stormwater flow to either open channels or receiving waters.

The initial survey will focus on completing an inventory of all outfalls (refer to Appendix E) to receiving waters. Outfalls greater than 12-inches in diameter (or equivalent) will be photographed and documented. All minor outfalls[4] (outfalls less than 36-inches in diameter or equivalent) without evidence of the presence of industrial activities will be maintained in the database but will be considered as not requiring any further action.

If while in the process of conducting any of the site inspections, the inspection team encounters a transitory discharge, such as a liquid or oil spill, the problem will be immediately referred to the appropriate local jurisdiction for clean-up or response. If it is not readily apparent which jurisdictional authority has responsibility, the discharge will be reported to the City technical committee chair.

For the present case of outfalls discharging into an estuary or directly to San Pedro Bay, inspection methods will need to be modified somewhat as many of these discharges are intertidal in nature. Indeed, the City of Long Beach's existing Bouton Creek stormwater monitoring station has been specially designed to operate in this intertidal creek. Thus for estuarine outfalls, inspections, flow estimates, and any water quality measurements may have to be taken at an upstream manhole or other suitable upstream site in the drainage as sampling a mixture of salt and freshwater of unknown proportions will not yield the desired information. Some of these upstream sampling sites may require partial street closures. For other facilities or for the Port of Long Beach, coordination with operations may be required.

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[4] Minor municipal separate storm sewer outfall (or ''minor outfall'') means a municipal separate storm sewer outfall that discharges from a single pipe with an inside diameter of less than 36 inches or its equivalent (discharge from a single conveyance other than circular pipe which is associated with a drainage area of less than 50 acres); or for MS4s that receive stormwater from lands zoned for industrial activity (based on comprehensive zoning plans or the equivalent), an outfall that discharges from a single pipe with an inside diameter of less than 12 inches or from its equivalent (discharge from other than a circular pipe associated with a drainage area of 2 acres or less)

Table 6-1. Outline of the NSW Outfall Screening and Monitoring Program.

Element	Description	Timing of Completion
1. Outfall Screening	Because data required to implement the NSW Outfall Program are not available, the Permittees will implement a screening process to determine which outfalls exhibit significant NSW discharges and those that do not require further investigation. Data will be recorded on Outfall Reconnaissance Investigation (ORI) forms and in the associated database.	The Outfall Screening process will be implemented in the spring, summer, and fall (Winter-Dry Weather) of 2015. Identification of obvious illicit discharges will be immediately addressed. Otherwise, the Outfall Screening process will be completed prior to starting source investigations.
2. Identification of outfalls with significant NSW discharge (Part IX.C of the MRP)	Data from the Outfall Screening process will be used to categorize MS4 outfalls on the basis of discharge flow rates, field water quality and physical observations.	Concurrent with Outfall Screening December, 28, 2016.
3. Inventory of Outfalls with NSW discharges (Part IX.D of the MRP)	Develop an inventory of all major MS4 outfalls, identify outfalls with known NSW discharges and identify outfalls with no flow requiring no further assessment.	Concurrent with Outfall Screening December 28, 2016.
4. Prioritized source investigation (Part IX.E of the MRP)	Use the data collected during the Outfall Screening process to further prioritize outfalls for source investigations.	Prioritization for Source Investigation will be occur after completion of Outfall Screening
5. Identify sources of significant NSW discharges (Part IX.F of the MRP)	For outfalls exhibiting significant NSW discharges, Permittees will perform source investigations per the established prioritization.	Complete source investigations for 25% of the outfalls with significant NSW discharges by March, 28, 2017 and 100% by March 28, 2019
6. Monitoring NSW discharges exceeding criteria (Part IX.G of the MRP)	Monitor outfalls determined to convey significant NSW discharges comprised of either unknown or conditionally exempt non-essential discharges, or illicit discharges that cannot be abated.	Monitoring will commence within 90 days of completing the source investigations

Information from all three screening surveys will be consolidated to assist in the identification and ranking of outfalls considered to have significant NSW discharges. Multiple lines of evidence will be considered when assessing the significance of a discharge. Data from the field screening program such as flow measurements, general observations and *in-situ* water quality information will be given primary consideration but land uses within the drainage area will also be considered.

A combination of field observations, flow measurements and field water quality measurements collected during the screening surveys will be used to classify outfalls into one of the following three categories that will determine further actions (Figure 6-1).

1. **Suspect Discharge** – Outfalls with persistent high flows during at least two out of three visits and with high severity on one or more physical indicators (odors, oil deposits, etc.). Outfalls in this category require prioritization and further investigation.

2. **Potential Discharge** - Flowing or non-flowing outfalls with presence of two or more physical indicators. Outfalls in this category are considered to be low priority but will be continue to be monitored periodically to determine if the sites are subject to less frequent, discharges or determine if actions can be taken to reduce or eliminate the factors that lead to the site being considered a potential source of contaminants.

3. **Unlikely Discharge** - Non-flowing outfalls with no physical indicators of an illicit discharge. Outfalls within this classification would be not be subject to any further screening.

Initial screening activities will emphasize use of field water quality instrumentation and/or simple field test kits to assist in classifying discharges. Based upon initial data, collection of water samples for limited laboratory testing may be incorporated into the program as requirements for more complex, accurate and scientifically supportable data become necessary to characterize non-stormwater discharges and provide scientifically supportable data to track the source of these discharges.

As an example, the Center for Watershed Protection and Pitt (2004) provide an evaluation of twelve analytes for assistance in determining the source of NSW discharges (Table 6-2). Three of the analytes can be measured with *in-situ* instrumentation. Others can be analyzed relatively inexpensively by use of field test kits or can be analyzed in an ELAP-certified laboratory. In addition, three to five of the listed tests are often considered sufficient to screen for illicit discharges. Ammonia, MBAS, fluoride (assuming tap water is fluorinated), and potassium are considered to confidently differentiate between sewage, wash water, tap water, and industrial wastes. Incorporation of *in-situ* measurement of temperature, pH, TDS/salinity, turbidity and dissolved oxygen can further assist in characterizing and tracking the source(s) of an NSW discharge.

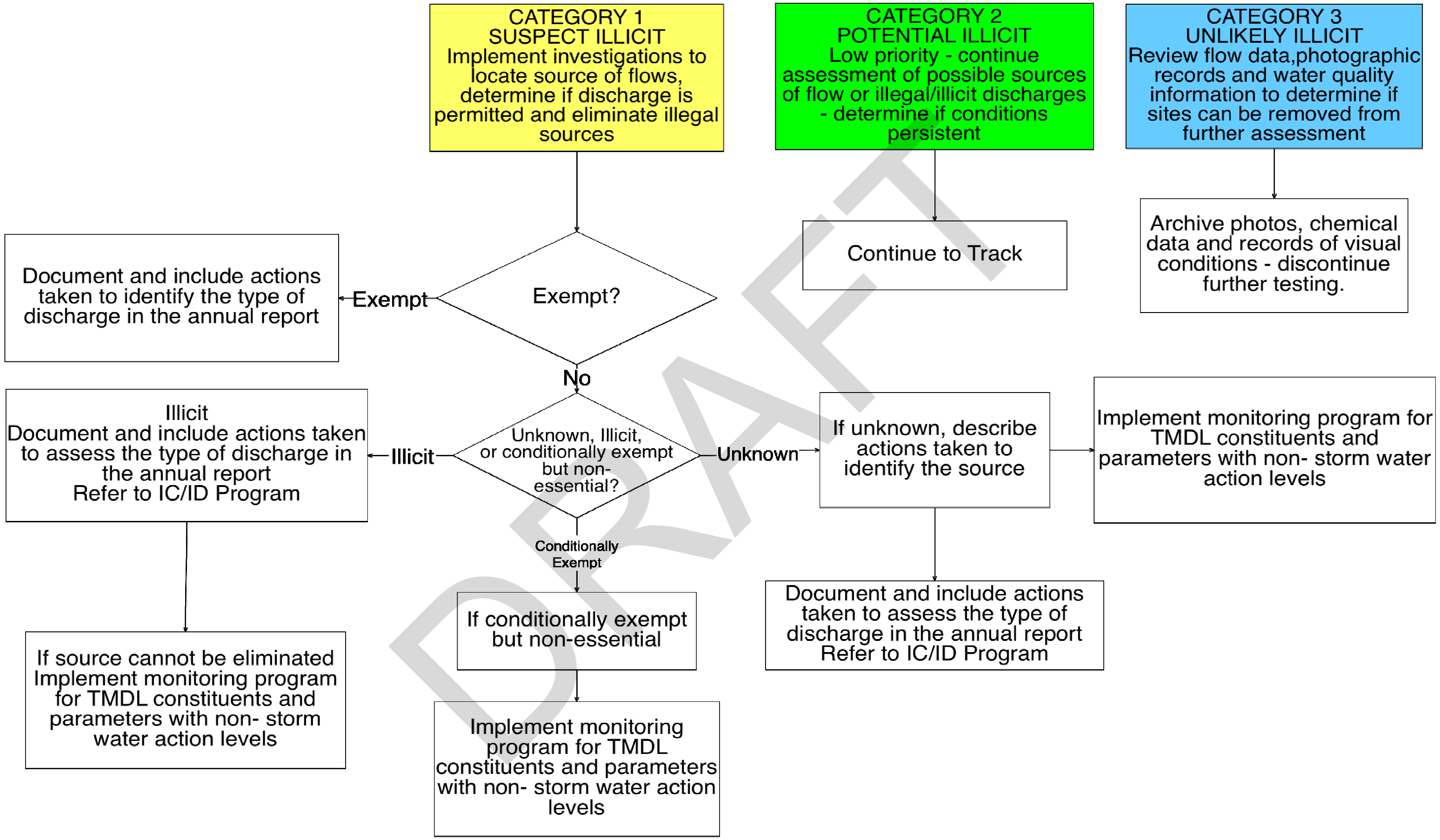

Figure 6-1. **Flow Diagram of NSW Outfall Program after Classifying Outfalls during Initial Screening.**

Table 6-2. Potential Indicator Parameters for Identification of Sources of NSW Discharges.

Indicator Parameters	
Ammonia	E. coli
Boron	Fluoride
Chlorine	Hardness
Color	pH - Field
Conductivity-Field	Potassium
Detergents – Surfactants (MBAS or fluorescence)	Turbidity

Based upon CWP and Pitt 2004. Illicit Discharge Detection and Elimination A Guidance Manual for Program Development and Technical Assessments

6.1.1 Identification of Outfalls with Significant Non-Stormwater Discharges

Existing monitoring data or institutional knowledge (Objective 4) are not available to allow identification of outfalls with significant NSW discharges. The screening program is necessary to collect information necessary to identify outfalls with potentially significant NSW discharges. The outfall screening includes collection of information necessary to provide an accurate inventory of the major outfalls, assess flow from each outfall and in the receiving waters, determine the general characteristics of the receiving waters (e.g. is flow present, does the flow from the outfall represent a large proportion of the flow, is it an earthen or lined channel), and record general observations indicative of possible illicit discharges. The initial screening survey(s) will also be used to refine the inventory information required in Section 6.1.2.

The outfall screening process will be initiated in the Spring of 2015 dry weather time period and be ongoing in order to meet the schedule for completion of 25% of the source identification work by March, 28, 2017. Once the screening process is completed, the Permittee are required to identify MS4 outfalls with “significant” NSW discharges. The MRP (Section IX.C.1) indicates that significant NSW discharges may be determined based upon one or more of the following characteristics:

a. Discharges from major outfalls subject to dry weather TMDLs.

b. Discharges for which existing monitoring data exceeds Non-Stormwater Action Levels (NALs) identified in Attachment G of the Order.

c. Non-stormwater discharges that have caused or have the potential to cause overtopping of downstream diversions.

d. Discharges exceeding a proposed threshold discharge rate as determined by the Permittee.

e. Discharges with the largest pollutant loading into the receiving waters.

f. Other characteristics as determined by the Discharger and incorporated within their screening program plan.

Most of these characteristics are either unlikely to differentiate significant NSW discharges or the information will not be available when the screening process is completed. Multiple lines of evidence derived from flow measurements, observations and *in-situ* water quality information recorded on the ORI forms used during the screening process will be used to determine “significant” NSW discharges and appropriately rank sites for source investigations. The relative magnitude of the discharges, persistence of the flow, visual and physical characteristics recorded at each site, and land uses associated with the drainage may also be considered. Characteristics of the receiving waters (flow, channel characteristics – hard or soft-bottom, etc.) at the discharge location will also be considered when determining the relative significance of NSW discharges. The most important consideration is whether the discharge has the potential to cause or contribute to exceedance of receiving water quality limitations. Factors that provide the best insight with respect to these impacts will receive the greatest weight when establishing the list of “significant” NSW discharges.

6.1.2 Inventory of MS4 Outfalls with Non-Stormwater Discharges

Part VII.A of the MRP requires that the IMP plan(s) include a map(s) and/or database of the MS4 that includes the elements listed in Table 6-3. A database of the MS4 outfalls within the LCC, Alamitos Bay, and San Gabriel watersheds of the City of Long Beach has been assembled for submission with this IMP. However, field verifications and outfall inspections are to be started during the period of Spring to Fall 2015 and be ongoing with the results reported by December 28, 2016. The planned schedule of performance is given in Table 6-3 for each of the required elements of this program.

Elements requiring further development include completing the descriptive MS4 database and performing the three outfall inspections events in the coming dry-weather periods of 2015. Other items include the Effective Impervious Area determination, information on the length of open channels and underground pipes equal to or greater than 18 inches, and the drainage areas associated with each outfall. Sub-basins used for the WMMS model are currently associated with each outfall within that sub-basin. If an outfall is identified as a significant source of NSW discharges, drainage areas for each targeted outfall will be refined and updated in the database. Additional information such as documenting presence of significant NSW discharges, links to a database documenting water quality measurements at sites with significant NSW discharges will be updated annually and submitted with the IMP annual report.

Table 6-3. Basic Database and Mapping Information for the Watershed.

Database Element	Status	
	Complete	Schedule
1. Surface water bodies within the Permittee(s) jurisdiction	X	
2. Sub-watershed (HUC 12) boundaries	X	
3. Land use overlay	X	
4. Effective Impervious Area (EIA) overlay (if available)		Will provide if available
5. Jurisdictional boundaries	X	
6. The location and length of all open channel and underground pipes 18 inches in diameter or greater (with the exception of catch basin connector pipes)		Mar. 28, 2016
7. The location of all dry weather diversions	X	
8. The location of all major MS4 outfalls within the Permittee's jurisdictional boundary. Each major outfall shall be assigned an alphanumeric identifier, which must be noted on the map	X[2]	
9. Notation of outfalls with significant non-stormwater discharges (to be updated annually)		Dec. 28, 2016
10. Storm drain outfall catchment areas for each major outfall within the Permittee(s) jurisdiction		Mar. 28, 2016
11. Each mapped MS4 outfall shall be linked to a database containing descriptive and monitoring data associated with the outfall. The data shall include:[4]		Mar. 28, 2016
a. Ownership		X
b. Coordinates		X
c. Physical description		X
d. Photographs of the outfall, where possible to provide baseline information to track operation and maintenance needs over time		X
e. Determination of whether the outfall conveys significant non-stormwater discharges		X
f. Stormwater and non-stormwater monitoring data		X

1. Locations are identified but the length of all open channel and underground pipes are not fully documented.
2. Attributes in the shapefile contain a Unique ID for all outfalls greater than 12" in diameter.
3. Catchments for each outfall are included as the area of the subbasins associated with each outfall. Several outfalls may drain these subbasins. Data will be developed as needed to resolve the drainage areas specific to each outfall.
4. Efforts are ongoing to define ownership and maintenance responsibility. As data become available, information regarding the conveyance of NSW and associated water quality data will be added to the database. Information will be updated based upon the three screening surveys.

As a component of the inventory and screening process, Permittees are required to document the physical attributes of MS4 outfalls determined to have significant non-stormwater discharges. Table 6-4 summarizes the minimum physical attributes required to be recorded and linked to the outfall database. These data will be maintained using the ORI field form and associated database (Appendix D) developed by CWP and Pitt (2004). Data entry can be accomplished by completing the ORI form while conducting the screening survey. Current forms are shown in the Appendix D but may be modified as the parameters and database are modified to provide different information more relevant to the NSW program.

Table 6-4. Minimum Physical Attributes Recorded during the Outfall Screening Process.

Database Element
a. Date and time of last visual observation or inspection
b. Outfall alpha-numeric identifier
c. Description of outfall structure including size (e.g., diameter and shape)
d. Description of receiving water at the point of discharge (e.g., natural, soft-bottom with armored sides, trapezoidal, concrete channel)
e. Latitude/longitude coordinates
f. Nearest street address
g. Parking, access, and safety considerations
h. Photographs of outfall condition
i. Photographs of significant non-stormwater discharge (or indicators of discharge) unless safety considerations preclude obtaining photographs
j. Estimation of discharge rate
k. All diversions either upstream or downstream of the outfall
l. Observations regarding discharge characteristics such as turbidity, odor, color, presence of debris, floatables, or characteristics that could aid in pollutant source identification
m. Observations regarding the receiving water such as flow, channel type, hard/soft bottom. (added minimum attribute.

6.1.3 Prioritized Source Identification

After completion of the initial reconnaissance survey and the two additional screening surveys, sites will be ranked based upon both initial flow observations from the reconnaissance inventory and the classifications assigned during each of the screening surveys. Source investigations will be scheduled to be conducted at sites categorized as potential illicit discharges.

The MRP (IX.E.1) states that prioritization of source investigations should be based upon the following items in order of importance.

a. Outfalls discharging directly to receiving waters with WQBELs or receiving water limitations in the TMDL provisions for which final compliance deadlines have passed.

b. All major outfalls and other outfalls that discharge to a receiving water subject to a TMDL shall be prioritized according to TMDL compliance schedules.

c. Outfalls for which monitoring data exist and indicate recurring exceedances of one or more of the Action Levels identified in Attachment G of this Order.

d. All other major outfalls identified to have significant non-stormwater discharges.

Additional information from the screening process will be used to refine priorities. Sites with evidence of higher, more frequent flow, presence of odors or stains will be assigned higher priorities for source investigations.

6.1.4 Identify Source(s) of Significant Non-Stormwater Discharges

The screening and source identification component of the program is intended to identify the source or sources of contaminants contributing to an NSW discharge. The prioritized list of major outfalls with significant NSW discharges will be used to direct investigations starting with outfalls deemed to present the greatest risk to the receiving water body.

The Order requires the City to develop a source identification schedule based on the prioritized list of outfalls exhibiting significant NSW discharges. Source investigations will be conducted for no less than 25% of the outfalls in the inventory by March 28, 2017 and 100% of the outfalls in the inventory by March 28, 2019.

Part IX.A.2 of the MRP requires Permittees to classify the source investigation results into one of four endpoints: illicit connections/illicit discharges (IC/IDs), authorized or conditionally exempt non-stormwater flows, natural flows, or from unknown sources. If source investigations indicate the source is illicit or unknown, the Permittee will document actions to eliminate the discharge and implement monitoring if the discharge cannot be eliminated.

If the source of a discharge is found to be attributable to natural flows or authorized conditionally exempt NSW discharge, the Permittee must identify the basis for the determination (natural flows) and identify the NPDES permitted discharger. If the source is found to be a conditionally exempt but non-essential discharge, monitoring is required to determine whether the discharge should remain conditionally exempt or be prohibited.

Source investigations will be conducted using a variety of different approaches depending upon the initial screening results, land use within the area drained by the discharge point, and the availability of drainage maps. Any additional water quality sampling will emphasize analysis of simple indicators, most of which can be either taken to a laboratory or analyzed in the field using field test kits. Such testing would only be conducted as needed to differentiate major sources of flows or to assist in assessing mixed sources rather than detailed characterization of the discharge. Investigations may include:

- Tracking of dry weather flows from the location where they are first observed in an upstream direction along the conveyance system.

- Collection of additional water samples for analysis of NSW indicators for assistance in differentiating major categories of discharges such as tap water, groundwater, wash waters and industrial wastewaters.
- Compiling and reviewing available resources including past monitoring and investigation data, land use/MS4 maps, aerial photography, existing NPDES discharge permits and property ownership information.

If source tracking efforts indicate that the discharge originates from a jurisdiction upstream of the boundaries of the estuary watershed, the appropriate jurisdiction and the Regional Board will be notified in writing of the discharge within 30 days of the determination. All existing information regarding documentation and characterization of the data, contribution determination efforts, and efforts taken to identify its source will be included.

Investigations will be concluded if authorized, natural, or essential conditionally exempt flows are found to be the source of the discharge. If the discharge is determined to be due to non-essential conditionally exempt, illicit, or unknown discharges, further investigations will be considered to assess whether the discharge can be eliminated. Alternatively, if the discharges are either non-essential conditionally exempt or of an unknown source, additional investigations may be conducted to demonstrate that it is not causing or contributing to receiving water impairments.

6.1.5 Monitor Non-Stormwater Discharges Exceeding Criteria

As required in the MRP (Part II.D.4), outfalls with significant NSW discharges that remain unaddressed after source identification will be monitored. The objectives of the non-stormwater outfall based monitoring program include the following:

a. Determine whether a Permittee's discharge is in compliance with applicable NSW WQBELs derived from TMDL WLAs,

b. Determine whether a Permittee's discharge exceeds NSW action levels, as described in Attachment G of the Order,

c. Determine whether a Permittee's discharge contributes to or causes an exceedance of receiving water limitations,

d. Assist a Permittee in identifying illicit discharges as described in Part VI.D.10 of the Order.

e. Characterize the discharge's quantity, and quality and annual pollutant load if applicable.

After completion of source investigations, outfalls found to convey NSW discharges that could not be abated and were identified as illicit, conditionally exempt but non-essential or unknown will be monitored. Monitoring will be initiated within 90 days of completing the source investigations or as soon as the first scheduled dry weather survey. Conducting NSW monitoring at the same time as receiving water dry weather monitoring will be more cost effective and allow evaluation of whether the NSW discharges are causing or contributing to any observed exceedances of water quality objectives in the receiving water.

Monitoring of NSW discharges is expected to undergo substantial changes from year to year as the result of ongoing actions taken to control or eliminate these discharges. As NSW discharges are addressed, monitoring of the discharges will no longer be required. In addition, if monitoring demonstrates that discharges do not exceed any WQBELs, non-stormwater action levels, or water quality standards for pollutants identified on the 303(d) list after the first year, monitoring of the pollutants meeting all receiving water limitations will be no longer be necessary. Due to potential frequent adjustments in the number and location of outfalls requiring monitoring and pollutants requiring monitoring, the annual IMP report is expected to communicate adjustments in the number and locations of monitored discharges, pollutants being monitored and justifications for any adjustments.

6.1.5.1 Monitoring Parameters and Frequency

The MRP (Section IX.G.1) specifies the minimum parameters for monitoring of NSW discharges. Determination of monitoring parameters at each site requires consideration of a number of factors applicable to each site. Monitoring parameters will include:

a. Flow,

b. Pollutants assigned a WQBEL or receiving water limitation to implement TMDL Provisions for the respective receiving water, as identified in Attachments L - R of the Order,

c. Other pollutants identified on the CWA section 303(d) List for the receiving water or downstream receiving waters,

d. Pollutants identified in a TIE conducted in response to observed aquatic toxicity during dry weather at the nearest downstream receiving water monitoring station (LBR2 and R8) during the last sample event or where the TIE conducted on the receiving water sample was inconclusive, aquatic toxicity testing will be conductd at the upstream outfall site(s). If the discharge exhibits aquatic toxicity, then a TIE shall be conducted,

e. Other parameters in Table E-2 identified as exceeding the lowest applicable water quality objective at LBR2 and R8 (the nearest downstream receiving water station) per Part VI.A.

The MRP (Part IX.G.2-5) specifies the following monitoring frequency for NSW outfall monitoring:

- For outfalls subject to a dry weather TMDL, the monitoring frequency shall be per the approved TMDL monitoring plan or as otherwise specified in the TMDL or as specified in an approved CIMP.
- For outfalls not subject to dry weather TMDLs, approximately quarterly for first year.
- Monitoring can be eliminated or reduced to twice per year, beginning in the second year of monitoring if pollutant concentrations measured during the first year do not exceed WQBELs, NALs or water quality standards for pollutants identified on the 303(d) List.

- Following one year of monitoring, the Discharger may submit a written request to the Executive Officer of the Los Angeles Regional Water Board to reduce or eliminate monitoring of specified pollutants, based on an evaluation of the monitoring data.

While a monitoring frequency of four times per year is specified in the Permit, it is inconsistent with the dry weather receiving water monitoring requirements. The receiving water monitoring requires two dry weather monitoring events per year. Additionally, during the term of the current Permit, outfalls are required to be screened at least once and those with significant NSW discharges will be subject to a source investigation. As a result, the City proposes that NSW outfall monitoring events be conducted twice per year. The NSW outfall monitoring events will be coordinated with the dry weather receiving water monitoring events to provide better opportunities to determine if the NSW discharges are causing or contributing to any observed exceedances of water quality objectives in the receiving water.

Any monitoring required will be performed using grab samples (refer to Appendix F for field sampling procedures) rather than automated samplers. Bacteria, which are expected to be the limiting factor at many sites during dry weather, require collection by grab methods and delivery to the laboratory within 6 hours. Based upon the much reduced variability experienced in measurements of dry weather flows associated with ongoing monitoring programs, measured concentrations of other analytes are not expected to vary significantly over a 24-hour period.

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7 New Development /Redevelopment Effectiveness Tracking

The City of Long Beach will maintain an electronic database to track qualifying new development and re-development projects that are subject to the Planning and Land Development Progrms of Part VII.J of Order N0. R4 2014-0024. The electronic databases contain the information listed in Table 7-1 that includes details about the project and the design of onsite and offsite best management practices, as well as descriptions of the required information.

To promote consistency across watersheds and facilitate future planning and research within the watershed, all watersheds are subscribing to MS4Front, a web-based software system designed to streamline record keeping for MS4 permits and assists with annual reporting. Cities have concluded that although it is a sophisicated management tool, it is flexible and relatively easy to use. The tracking programs will be converted to MS4Front.

Table 7-1. Information Required in the New Development/Re-Development Tracking Database.

	Required Information	Description
General Site Information	Project Name and Developer Name	Brief name of project and developer information (e.g. name, address, and phone number).
	Project Location and Map	Coordinates and map of the project location. The map should be linked to the GIS storm-drain map required in part VII.A of the Permit.
	Documentation of issuance of requirements to the developer	Date that the project developer was issued the Permit requirements for the project (e.g. conditions of approval).
	Date of Certificate of Occupancy	Date that the Certificate of Occupancy was issued.
On-site BMP Sizing Information	85th percentile storm event (inches per 24 hours)	85th percentile storm depth for the project location calculated using the Analysis of 85th Percentile 24-hour Rainfall Depths Within the County of Los Angeles.
	95th percentile storm event (inches per 24 hours)	95th percentile storm depth for the project location calculated using the *Analysis of 85th Percentile 24-hour Rainfall Depths Within the County of Los Angeles*. Only applies if the project drains directly to a natural drainage system[5] and is subject to hydromodification control measures.
	Project design storm (inches per 24 hours)	The design storm for each BMP as calculated using the Analysis of 85th Percentile 24-hour Rainfall Depths Within the County of Los Angeles.
	Projects design volume (gallons or MGD)	The design storm volume (design storm multiplied by tributary area and runoff coefficient) for each BMP.
	Percent of design storm volume to be retained on site	The percentage of the design volume which on-site BMPs will retain.
	Other design criteria required to meet hydromodification requirements for projects that directly drain to natural water bodies	Information relevant to determine if the project meets hydromodification requirements as described in the Permit e.g., peak flow and velocity in natural water body, peak flow from project area in mitigated and unmitigated condition, etc.). Only applies if the project drains directly to a natural drainage system.
	One -year, one-hour storm intensity as depicted on the most recently issued isohyetal map published by the Los Angeles County Hydrologist for flow-through BMPs	If flow-through BMPs (e.g., sand filters, media filters) for water quality are used at the project, provide the one-year, one-hour storm intensity at the project site from the most recent isohyetal map issued by LA County.
Off-site BMP Information	Location and maps of off-site mitigation, groundwater replenishment, or retrofit sites	If any off-site mitigation is used, provide locations and maps linked to the GIS storm-drain map required in part VII.A of the Permit.
	Design volume for water quality mitigation treatment BMPs	The calculated design volume, If water quality mitigation is required.
	Percent of design storm volume to be infiltrated at an off-site mitigation or groundwater replenishment project site	The percentage of the design volume which off-site mitigation or groundwater replenishment will retain.
	Percent of design storm volume to be retained or treated with biofiltration at an off-site retrofit project	The percentage of the design volume which off-site biofiltration will retain or treat.

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[5] A natural drainage system is defined as a drainage system that has not been improved (e.g., channelized or armored). The clearing or dredging of a natural drainage system does not cause the system to be classified as an improved drainage system.

8 Reporting

Reporting will normally consist of Annual IMP Reports and semi-annual data reports. Discharge Assessment Plans will only be submitted if TIEs are found to produce inconsistent results during two consecutive tests. These include the following reports:

Annual IMP Reports

Annual IMP monitoring reports are required to be submitted to the Regional Water Board Executive Officer by December 15th of each year in the form of three compact disks (CDs). The reporting period will cover July 1 through June 30. The annual reporting process is intended to meet the following objectives.

Summary information allowing the Regional Board to assess:

a. Each Permittee's participation in one or more Watershed Management Programs.
b. The impact of each Permittee(s) stormwater and non-stormwater discharges on the receiving water.
c. Each Permittee's compliance with receiving water limitations, numeric water quality-based effluent limitations, and non-stormwater action levels.
d. The effectiveness of each Permittee(s) control measures in reducing discharges of pollutants from the MS4 to receiving waters.
e. Whether the quality of MS4 discharges and the health of receiving waters is improving, staying the same, or declining as a result watershed management program efforts, and/or TMDL implementation measures, or other Minimum Control Measures.
f. Whether changes in water quality can be attributed to pollutant controls imposed on new development, re-development, or retrofit projects.

Data Submittals

Analytical data reports are required to be submitted to the Regional Board on a semi-annual basis in accordance with the Southern California Municipal Storm Water Monitoring Coalition's Standardized Data Transfer Formats. These reports are required to be subject to verification and validation prior to submittal. They are to cover monitoring periods of July 1 through December 31 for the mid-year report and January 1- June 30 for the end of year report. These data reports should summarize:

- Exceedances of applicable WQBELs, receiving water limitations, or any available interim action levels or other aquatic toxicity thresholds.
- Basic information regarding sampling dates, locations, or other pertinent documentation.

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APPENDIX A

AUTOMATED STORMWATER MONITORING EQUIPMENT

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1 Automated Stormwater Monitoring Equipment

Monitoring of stormwater runoff at the receiving water/TMDL site and Watershed Segmentation monitoring sites will require use of automated stormwater sampling equipment. This section addresses equipment and sampling procedures that will be used for LCC1, PWS and SWS sites.

Flow-weighted and time-weighted sampling will generally require similar equipment. Similar equipment will be necessary regardless of the selected sampling approach. Time-weighted composite samples simply allow for more mobile installations that do not require flow meters, rain gauges, solar panels, or communication equipment. In lieu of communications equipment, such sites require added field personnel to monitor and track performance of the equipment along with added sensors to trigger the equipment to initiate the sampling.

For purposes of this CIMP, it is assumed that all sites requiring collection of flow-weighted composite samples will be established as "permanent" or "long-term" sites with appropriate security to protect the equipment and intake structures from debris coming down the stream or vandalism. As noted, collection of time-weighted samples will be utilize the same types of autosamplers and composite containers but will not include flow meters, rain gauges and telecommunication packages. Monitoring stations designed to take time-weighted composite samples will require sensors to detect initial flows and trigger the sampler. This will allow for use of smaller security enclosures that can temporally be secured at a site or, if necessary, equipment can be deployed in a manhole.

Fixed monitoring sites will utilize automated stormwater sampling stations that incorporate an autosampler (American Sigma or Isco), a datalogger/flow module to monitor flow and pace the autosampler, a rain gauge to monitor and record local rainfall, and telecommunications to allow for remote monitoring and control of each site. Sites without access to AC power will be powered by deep-cycle marine batteries. Sites without direct access to AC power will utilize solar panels to provide the energy needed to maintain the charge on two deep cycle batteries used to power the autosampler, flow meter and datalogger. Providing reliable telecommunications for real-time access to data and to provide command and control functionality has greatly improved efficiency and contributed to improved stormwater data.

Both types of automated stormwater monitoring systems considered for this monitoring program use peristaltic pumping systems. When appropriate measures are taken, it has been demonstrated that these types of systems are capable of collecting blanks that are uncontaminated and high quality, reproducible data using detection limits appropriate to water quality criteria. In order to accomplish this, extreme care must be taken to avoid introduction of contaminants.

Requirements include:

- Assuring that all materials coming into contact with the samples are intrinsically low in trace metals and do not adsorb/absorb metals or other target.

- Materials coming into contact with the sample water are subjected to intensive cleaning using standardized protocol and subjected to systematic blanking to demonstrate and document that blanking standards are met.
- All cleaned sampling equipment and bottles are appropriately tracked so that blanking data can be associated with all component deployed in the field.
- Samples are collected, processed and transported taking care to avoid contamination from field personnel or their gear, and
- Laboratory analysis is conducted in a filtered air environment using ultrapure reagents.

Table 2-1 of the USGS National Field Manual (http://pubs.water.usgs.gov/twri9A/) provides a summary of acceptable materials for use sampling organic and inorganic constituents. The stormwater monitoring stations will primarily utilize 20-L borosilicate glass media bottles for the composite samples, FEP tubing for the sample hose and either 316 SS or Teflon-coated intake strainers. Ten (10) liter borosilicate glass media bottles will be considered for sites where required sample volumes are low and lower sample volumes are acceptable. The peristaltic hose is a silicone-base material that is necessary for operation of the autosamplers. The peristaltic hose can be as source of silica which is not a target compound.

Although the technical limitations of autosamplers are often cited, they still provide the most practical method for collecting representative samples of stormwater runoff for characterization of water quality and have been heavily utilized for this purpose for the past 20 years. The alternative, manual sampling, is generally not practical for collection of flow-weighted composite samples from a large number of sites or for sampling events that occur over an extended period of time. Despite the known drawbacks, autosamplers combined with accurate flow metering remain the most common and appropriate tool for monitoring stormwater runoff.

1.1 Sampler Intake Strainer, Intake Tubing and Flexible Pump Tubing

Intake strainers will be used to prevent small rocks and debris from being drawn into the intake tubing and causing blockages or damage to the pump and peristaltic pump tubing. Strainers will be constructed of a combination of Teflon and 316 stainless or simply stainless steel. The low profile version is typically preferred to provide greater ability to sample shallow flows. Although high grade stainless steel intake strainers are not likely to impact trace metal measurements, it is preferable to use strainers coated with a fluoropolymer coating. If the stainless steel intake is not coated, the strainer will not be subjected to cleaning with acids. Cleaning will be limited to warm tap water, laboratory detergents and MilliQ water rinses.

Tubing comprised of 100% FEP (Fluorinated Ethylene Propylene) will be used for the intake tubing. Several alternative fluoropolymer products are available but 3/8" ID solid FEP tubing has the chemical characteristics suitable for sampling metals and organics at low levels and appropriate physical characteristics. The rigidity of FEP tubing provides resistance to collapse at high head differentials but still is manageable for tight configurations.

The peristaltic hose used in autosamplers is a medical-grade silicon product. The specifications for the peristaltic pump hoses used in these samplers are unique to the samplers. It is very important that hose specified and provided by the manufacturers of the autosamplers be used. Minor differences in the peristaltic hose can cause major deterioration in performance of the samplers. Use of generic peristaltic pump hose from other sources can lead to problems with the ability to calibrate the samplers and maintain intake velocities of greater than 2.5 feet per second with higher lift requirements.

The peristaltic hose is connected to the FEP tubing and fed through the pump head leaving the minimum amount necessary to feed the peristaltic pump hose into the top of the composite bottle. The composite container will always have a lid to prevent dust from settling in the container.

1.2 Composite Containers

The composite containers used for monitoring must be demonstrated to be free of contaminants of interest at the desired levels (USEPA 1996). Containers constructed of fluoropolymers (FEP, PTFE), conventional or linear polyethylene, polycarbonate, polysulfone, polypropylene, or ultrapure quartz are considered optimal for metals but borosilicate glass has been shown to be suitable for both trace metals and organics at limits appropriate to EPA water quality criteria. High capacity borosilicate media bottles (20-liters or ~5-gallons) are preferred for storm monitoring since they can be cleaned and suitably blanked for analysis of both metals and organic compounds. The transparency of the bottles is also a useful feature when subsampling and cleaning the containers for reuse.

Figure 1. Composite Bottle with Label and installed Tubing inside Brute® Container.

These large media bottles are designed for stoppers and thus do not come with lids. Suitable closure mechanisms must be fabricated for use during sampling, transport and storage of clean bottles. The preferred closure mechanism is a Teflon® stopper fitted with a Viton® O-ring (2 3/8" - I.D. x 23/4"-O.D.) that seals the lid against the media bottle. A polypropylene clamp (Figure 2) is used to seal the Teflon® stopper and O-ring to the rim of the composite sample bottle. Two polypropylene bolts with wing-nuts are used to maintain pressure on the seal or to assist in removal of the lid.

Every composite bottle requires one solid lid for use in protecting the bottle during storage and transport. A minimum of one Teflon® stopper should be available for each monitoring site during storm events. Each field sampling crew should have additional stoppers with holes ("sampling stopper") that would be available if a sampling stopper is accidentally contaminated during bottle changes or original installations.

Figure 2. Composite bottle showing bottle bag used for transport and lifting.

The holes in the sampling stoppers should be minimally larger than the external diameter of the peristaltic hose. If a tight fit exists, the pressure created when water is pumped into the bottle will cause the hose to be ejected and the sampling event will to be abandoned.

Transporting composite bottles is best accomplished by use of 10-gallon Brute® containers to both protect them from breakage and simplify handling. They also provide additional capacity for ice while transporting full bottles to the laboratory or subsampling site.

Bottle bags (Figure 2) are also useful in allowing full bottles to be handled easier and reduce the need to contact the bottles near the neck. They are important for both minimizing the need to handle the neck of the bottle and are also an important Health and Safety issue. The empty bottles weigh 15 pounds and they hold another 40 pounds of water when full. These can be very slippery and difficult to handle when removing them from the autosamplers. Bags can be easily fabricated out of square-mesh nylon netting with nylon straps for handles. Use of bottle bags allows two people to lift a full bottle out of the ice in the autosampler and place it in a Brute® container. Whether empty or full, suitable restraints should be provided whenever the 20-L composite bottles and Brute® containers are being transported.

1.3 Flow Monitoring

Retrieval of flow-weighted stormwater samplers requires the ability to accurately measure flow over the full range of conditions that occur at the monitoring site. The ability to accurately measure flow at an outfall site should be carefully considered during the initial site selection process. Hydraulic characteristics necessary to allow for accurate flow measurement include a relatively straight and uniform length of pipe or channel without major confluences or other features that would disrupt establishment of uniform flow conditions. The actual measurement site should be located sufficiently downstream from inflows to the drainage system to achieve well-mixed conditions across the channel. Ideally, the flow sensor and sample collection inlet should be placed a minimum of five pipe diameters upstream and ten pipe diameters downstream of any confluence to minimize turbulence and ensure well-mixed flow. The latest edition of the *Isco Open Channel Flow Measurement Handbook* (Walkowiak 2008) is an invaluable resource to assist in selection of the most appropriate approach for flow measurements and information on the constraints of each method.

The existing mass emission site has an established flow rating curve (Stage-Flow relationships) that only requires measurement of water level to estimate flow. Additional sites requiring flow monitoring are expected to utilize area-velocity sensors that use Doppler-based sensors to measure the velocity of water in the conveyance, a pressure sensor to measure water depth, and information regarding channel dimensions to allow for real-time flow measurements to pace the autosamplers.

1.4 Rainfall Gauges

Electronic tipping bucket rain gauges will be installed at each fixed monitoring location to provide improved assessment of rainfall in the smaller drainages. Use of a localized rain gauge provides better representation of conditions at the site. A variety of quality instruments are available but all require substantial maintenance to ensure maintenance of high data quality.

Tipping bucket rain gauges with standard 8-inch diameter cones will be used at each site. These provide 1 tip per 0.01” of rain and have an accuracy of ± 2% up to 2"/hr. The accuracy of tipping bucket rain gauges can be impacted by very intense rainfall events but errors are more commonly due to poor installation.

Continuous data records will be maintained throughout the wet season with data being output and recorded for each tip of the bucket. The rainfall data is downloaded at the same rate as the flow and stormwater monitoring events.

1.5 Power

Stormwater monitoring equipment can generally be powered by battery or standard 120VAC. If 120VAC power is unavailable, external, sealed deep-cycle marine batteries will be used to power the monitoring site. Even systems with access to 120VAC will be equipped with batteries that can provide backup power in case of power outages during an event. All batteries will be placed in plastic marine battery cases to isolate the terminals and wiring. A second battery will be provided at each site to support the telecommunication packages. Sites relying on battery power will also be equipped with a solar panel to assure that a full charge is available when needed for a storm event.

1.6 Telecommunication for System Command/Control and Data Access

The ability to remotely communicate with the monitoring equipment has been shown to provide efficient and representative sampling of stormwater runoff. Remote communication facilitates preparation of stations for storm events and making last minute adjustments to sampling criteria based upon the most recent forecasts. Communication with the sites also reduces the number of field visits by monitoring personnel. Remote two-way communication with monitoring sites allows the project manager (storm control) to make informed decisions during the storm as to the best allocations of human resources among sampling sites. By remotely monitoring the status of each monitoring site, the manager can more accurately estimate when composite bottles will fill and direct field crews to the site to avoid disruptions in the sampling. Real time access to flow, sampling and rainfall data also provides important information for determining when sampling should be terminated and crews directed to collect and process the samples. Increases in both efficiency and sample quality make two-way communication with monitoring stations a necessity for most monitoring programs.

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APPENDIX B

CLEANING AND BLANKING PROTOCOL

FOR

EQUIPMENT AND SUPPLIES USED IN COLLECTION OF FLOW OR TIME-WEIGHTED COMPOSITES

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CLEANING PROTOCOL FOR:

20-L Borosilicate Glass Composite Bottles (Media Bottles) and Closures

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the procedures for the cleaning of 20-liter composite sample bottles and the related equipment necessary to complete the task. The purpose of these procedures is to ensure that the sample bottles are contaminant-free and to ensure the safety of the personnel performing this procedure.

2.0 APPLICATION

This SOP applies to all laboratory activities that comprise the cleaning of 20-liter composite sample bottles and stoppers.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The cleaning of 20-liter composite-sample bottles and associated equipment involves hazardous materials. Skin contact with all materials and solutions should be minimized by wearing appropriate personal protective equipment (PPE) including: chemical-resistant gloves, laboratory coats, chemical-resistant aprons, and goggles. To ensure that you are aware of the hazards involved, the material safety data sheets (MSDSs) for nitric acid and laboratory detergents should be reviewed before beginning any of these procedures.

Note: Preparations should be made to contain and neutralize any spillage of acid. Be aware of the location of absorbent, neutralizing, and containment materials in the bottle cleaning area.

4.0 DEFINITIONS

4.1 **Composite sample bottle** - 20 liter borosilicate glass bottle that is used with autosamplers to collect a stormwater composite sample.

4.2 **Stopper** - a Teflon® cap used to seal the composite sample bottle (either solid, or drilled with holes for the silicon inlet tubing).

4.3 **O-Ring** - Viton O-ring 23/8"- I.D. x 23/4"- O.D. that is located around the base of stopper.

4.4 **Clamp** - Polypropylene clamp, 2 bolts, and wing nuts specifically designed to fasten the stopper and the O-ring to the rim of the composite sample bottle.

4.5 **De-ionized (DI) water -** commercial de-ionized water (12-13 Megohm/cm)

4.6 **Laboratory Detergent** - 2% solution of Contrad 70® or Micro-90® detergent

5.0 EQUIPMENT

5.1 Instrumentation:

1) Peristaltic pump with a protocol-cleaned sub-sampling hose setup

5.2 Reagents:

1) ACS Reagent Grade nitric acid in a 2 Normal solution (2N HNO_3)

2) Contrad 70® non-phosphate laboratory detergent

3) Contrad 70® anti-foaming agent

4) Micro-90® non-phosphate laboratory detergent

5) Baking soda or equivalent to neutralize acid

6) pH paper

5.3 Apparatus:

1) Bottle Rolling Rack
2) DI Rinse Rack
3) Yellow Neutralization Drip Bucket
4) Neutralization Tank

5.4 Documentation:

The status of each composite sample bottle must be tracked. Bottles should be washed in batches of 10, 20, or 30 and the status of each batch must be made apparent to all personnel by posting a large status label (including the start date) with each batch. This will ensure that all required soak times have been attained and that each bottle was subjected to the proper cleaning procedures. Information on each batch of bottles cleaned (including bottle number, QA batch, date cleaning started, date finished, date blanked, and cleaning technicians) should be entered in the **Bottle Cleaning Log Sheet**.

6.0 CLEANING PROCEDURES

Care must be taken to ensure that no contaminants are introduced at any point during this procedure. If the wash is not performed with this in mind, the possibility for the introduction of contaminants (i.e., from dust, dirty sub-sampling tubing tips, dirty fingers/gloves, automobile emissions, etc.) is increased significantly.

6.1 Teflon® Bottle Stoppers with Holes and Field Extras:

To be performed whenever required for field use.

1) Wash with laboratory detergent using a clean all-plastic brush.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N nitric acid squirt bottle.

5) Rinse thoroughly (minimum of three times) with DI water.

6) Allow to dry in a dust-free environment.

7) Store in two sealed clean Ziploc® bags.

6.2 NPS 20 liter composite sample bottle Cleaning:

6.2.1 Preliminary Bottle Cleaning:

Bottles should undergo a preliminary rinse with tap water as soon as possible after they are available. This includes dumping any remaining stormwater into a sanitary drain and rinsing the bottles and stoppers. This prevents material from adhering to the interior surface of the bottle.

6.2.2 **<u>48 Hour Soak:</u>** Place the bottle to be cleaned into a secondary containment bucket. Prepare a 2% solution of laboratory detergent with tap water directly in the bottle. Note: Since laboratory detergent is a foaming solution, add 3/4 of the tap water first, add the detergent, then add the rest of the water. Should excessive foam be generated, a few drops of Contrad 70® anti-foaming agent may be added. **Make sure that the bottle is filled to the rim and scrub the rim with an all-plastic scrub brush.** Scrub a Teflon® stopper with 2% solution of laboratory detergent and place stopper over the full bottle so overflowing happens. This will allow both the stopper and the bottle to soak for 48 hours. After the 48 hour soak, this solution may be may be retained for reuse (i.e., siphoned into other dirty bottles) or it can be poured off into a sanitary drain.

6.2.3 Teflon® Bottle Stopper and O-ring Cleaning:

This procedure should be performed prior to the bottle washing process so that the stopper can follow the bottle through the acid wash.

1) Rinse thoroughly (minimum of three times) with tap water.

2) Rinse thoroughly (minimum of three times) with DI water.

3) Store temporarily in a similarly cleaned

6.2.4 **Tap Water Rinse:** Tap water rinses detergent better than DI water. Flush upside down bottle with tap water for 20 sec. Rinse each bottle 3 times with tap water being careful not to contaminate the clean surfaces.

6.2.5 **DI Rinse:** Rinse the top and neck of the bottles with DI water using a squirt bottle and then rinse upside down for three minutes on the DI rinse rack for bottles. Make sure to tip bottles from side to side for a more thorough rinsing. Allow 1-2 minutes for the bottles to drain as much as possible. Rinse each stopper with DI water squirt bottle 3 times (being careful not to touch the clean surfaces).

6.2.6 **Acid Wash:** Note that it is important to Wash the bottle with 2N nitric acid according to the following procedure:

1) Place the empty bottle near the 2N nitric acid carboy and peristaltic pump. The location should be able to safely contain a spill if the 20L bottle breaks.
2) Pump acid into the bottle using the peristaltic pump fitted with a protocol-cleaned sub-sampling hose setup
3) Fill the bottle slightly more than half full.
4) Place a protocol-cleaned solid Teflon® stopper (with a properly seated O-ring) (Refer to Section 6.2.3 above) on the bottle and clamp it securely.
5) **Carefully** lift and place the bottle on the roller rack and check for leakage from the stopper. Neutralize any spillage. Often small leaks can be corrected by a slight tightening of the clamp. Roll the bottles for twenty minutes.
6) Pump the acid into another bottle for rolling or back into the 2N nitric acid carboy.

6.2.7 **DI Rinse for Sub-sampling Hose**: After use, the sub-sampling hose setup should be rinsed by pumping 1-2 gallons of DI water through the hoses and into a neutralization tank. Carefully rinse the outside of the hose to remove any acid that may be on the exterior of the hose. pH paper should be used to insure that the fluid in and on the hose is 6.8 or higher. Continue rinsing until your reach neutral pH. Store hose in a clean, large plastic bag between uses. Dispose of rinsate in accordance with all federal, state, and local regulations

6.2.8 **DI Rinse for Bottles**: Allow the bottles to drain into a yellow neutralization bucket for at least 1 minute. Place four bottles at a time on the DI rinse rack and rinse for 5 minutes. Move bottles around to ensure complete and thorough rinsing. Rinse the outside of the bottle with tap water. Allow bottles to drain for 2 minutes.

6.2.9 **DI Rinse for Stoppers**: Rinse caps thoroughly 3 times over neutralization tank. Place on a clean surface where the clean side of the stopper will not be contaminated.

6.3 **Storage:** Clamp a stopper (one that went through the entire cleaning procedure) on the bottle. Properly label the bottle as to the date cleaned and by whom and place on the bottle storage rack or in a secondary containment bucket in a safe area. Also, fill out the **Bottle Cleaning Log Sheet**.

7.0 QUALITY ASSURANCE REQUIREMENTS

7.1 The NPS 20 liter sample bottles must be evaluated ("blanked") for contaminants after they have completed the decontamination procedure. The analytical laboratory performing the evaluation should supply Milli-Q® water that is used as a blanking rinsate, and sample bottles for the appropriate constituents of concern. This evaluation will be accomplished by randomly blanking 10% of the washed bottles, or 1 bottle per batch (whichever is greater) and having the blanking rinsate analyzed by the laboratory for the appropriate constituents.

7.2 If any of the bottles fail the analyses (concentration of any analytes are at or above the limit of detection), all of the bottles from that batch must be decontaminated. Again, 10% of these bottles must be subjected to the blanking process as described-above.

7.3 If results of the evaluation process show that the bottles are not contaminant-free, the cleaning procedure must be re-evaluated. Consult with the Quality Assurance/Quality Control Officer to determine the source of contamination.

CLEANING PROTOCOL FOR:

Miscellaneous Laboratory Equipment used for Cleaning and Blanking

1.0 SCOPE

This Standard Operating Procedure describes the procedures for cleaning the miscellaneous items necessary to complete the tasks of cleaning 20- liter composite sample bottles and hoses. The purpose of these procedures is to ensure that the items are contaminant-free and to ensure the safety of the personnel performing this procedure.

2.0 APPLICATION

This SOP applies to all laboratory activities that comprise the cleaning of ancillary items necessary to complete the tasks of cleaning 20 liter composite sample bottles and NPS hoses.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The cleaning of the following items may involve contact with hazardous materials. Skin contact with all materials and solutions should be minimized by wearing appropriate personal protective equipment (PPE) including: chemically-resistant protective gloves, laboratory coats, chemically-resistant aprons, and goggles. In addition, to ensure that you are aware of the hazards involved and of any new revisions to the procedure, the material safety data sheets (MSDSs) for nitric acid and the laboratory detergent should be reviewed before beginning any of these procedures.

4.0 DEFINITIONS

4.1 Polyethylene Squirt Bottles - ½ and 1 liter squirt bottles for washing and/or rinsing with DI water or nitric acid.

4.2 Polycarbonate and Polyethylene De-ionized Water Jugs - For holding DI water.

4.3 Polyethylene Bucket - For holding tap water, DI water or detergent solutions during hose washing procedures.

4.4 Four-inch Teflon® Connector - For connecting two lengths of silicon peristaltic tubing together.

4.5 Four-inch Silicon Connector - For connecting two lengths of Teflon® hose together.

4.6 Orange Polypropylene Hose Caps - For placing over the ends of clean Teflon® hose to prevent contamination.

4.7 De-ionized (DI) water - Commercial de-ionized water

4.8 Laboratory Detergent - 2% solution of Contrad 70® or Micro-90® detergent.

5.0 EQUIPMENT

5.1 Instrumentation: Not applicable.

5.2 Reagents:

1) ACS Reagent Grade nitric acid as a 2 Normal solution (2N HNO_3)

2) Micro-90® non-phosphate laboratory detergent

3) Contrad 70® non-phosphate laboratory detergent

4) Contrad 70® anti-foaming agent.

5) pH paper or pH meter

6) Baking soda ($NaHCO_3$) or equivalent to neutralize acid

5.3 Apparatus:

1) Clean polyethylene squirt bottles.

2) Clean polyethylene trays or 2000 ml glass beakers.

3) Neutralization Tank

5.4 Documentation:

Label each squirt bottle, DI jug, storage container holding clean items, etc. as to the date each was cleaned and the initials of the cleaning technician.

6.0 CLEANING PROCEDURES

Care must be taken to ensure that no contaminants are introduced at any point during these procedures. If the wash is not performed with this in mind, the possibility for the introduction of contaminants (i.e., from dirty sinks, dirty counter tops, dirty fingers/gloves, dirty hose ends, etc.) is increased significantly.

Rinsing properly is essential to ensure proper cleaning. This is done by squirting the liquid over the item to be cleaned in a top-down fashion, letting the water flow off completely **<u>before</u>** applying the next rinse. Rinse the item in this fashion **<u>a minimum</u>** of three times. **Numerous rinses of relatively small volumes are <u>much better</u> than one or two rinses of higher volume.** Be aware of handling: use clean gloves (it is best if they have gone through the same prior wash as the item to be rinsed) and rinse off the fingers prior to grasping the item to be cleaned. Try to grasp the item in a slightly different place between rinses so ones fingers do not cover a portion of the item throughout the rinses.

6.1 Polyethylene Squirt Bottles:

1) Soak in a 2% solution of laboratory detergent in a protocol-cleaned bucket for 48 hours.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N (10%) nitric acid.

5) Rinse thoroughly (minimum of three times) with DI water. Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations.

6.2 Polycarbonate and Polyethylene DI Water Jugs:

1) Fill to the rim with a 2% solution of laboratory detergent, cap the jug, and let soak for 48 hours. Wash cap with an all-plastic scrub brush after soak.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N (10%) nitric acid.

5) Rinse thoroughly (minimum of three times) with DI water. Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations.

6.3 Polyethylene Bucket:

1) Fill to the rim with a 2% solution of laboratory detergent and let soak for 48 hours.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N (10%) nitric acid squirt bottle.

5) Rinse thoroughly (minimum of three times) with DI water. Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations. **Label as to the date cleaned and initial.**

6.4 Four-inch Teflon® and Silicon Hose Connectors and Orange Polypropylene Hose Caps. The purpose of the four-inch sections of Teflon® and silicon hose is to connect longer lengths of each type of hose together during the hose cleaning procedures. The orange polypropylene hose caps are for the ends of cleaned FEP hoses to prevent contamination prior to use in the field or laboratory.

1) Using a 2% solution of laboratory detergent, soak the four-inch sections of FEP hose, silicon tubing, and orange caps for 48 hours.

2) Rinse thoroughly with tap water (minimum of three rinses).

3) Rinse thoroughly with DI water (minimum of three rinses).

4) Using a squirt bottle filled with 2N (10%) HNO3, thoroughly rinse the interior and exterior of the connectors and caps thoroughly OR, roll/agitate them in a shallow layer of 2N (10%) HNO3 in a laboratory detergent cleaned glass beaker or other appropriate, clean container for a more thorough washing.

5) Thoroughly rinse connectors and caps with DI water (minimum of three rinses). Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations. Keep clean connectors and caps in a similarly cleaned (or certified clean) widemouth glass jar or detergent-cleaned resealable bag and **label as clean, date cleaned, and initial**.

NPS 20-Liter Bottle Subsampling Procedure

1.0 Scope

This Standard Operating Procedure (SOP) describes the procedures for the compositing and sub-sampling of non-point source (NPS) 20 liter sample bottles. The purpose of these procedures is to ensure that the sub-samples taken are representative of the entire water sample in the 20-L bottle (or bottles). In order to prevent confusion, it should be noted that in other KLI SOPs relating to 20-L bottles they are referred to as "composite" bottles because they are a composite of many small samples taken over the course of a storm; in this SOP the use of "compositing" generally refers to the calculated combining of more than one of these 20-L "composite" bottles.

2.0 Application

This SOP applies to all laboratory activities that comprise the compositing and sub-sampling of NPS 20 liter sample bottles.

3.0 Health and Safety Considerations

The compositing and sub-sampling of NPS 20 liter sample bottles may involve contact with contaminated water. Skin contact with sampled water should be minimized by wearing appropriate protective gloves, clothing, and safety glasses. Avoid hand-face contact during the compositing and sub-sampling procedures. Wash hands with soap and warm water after work is completed.

4.0 Definitions

4.1 **20 liter sample bottle:** 20 liter borosilicate glass bottle that is used to collect multiple samples over the course of a storm (a composite sample).

4.2 **Large-capacity stirrer**: Electric motorized "plate" that supports a 20 liter bottle and facilitates the mixing of sample water within the bottle by means of spinning a pre-cleaned magnetic stir-bar which is introduced into the bottle.

4.3 **Stir-bar**: Teflon-coated magnetic "bar" approximately 2-3 inches in length which is introduced into a 20 liter bottle and is spun by the stirrer, thereby creating a vortex in the bottle and mixing the sample. Pre-cleaned using cleaning protocols provided in KLI SOP for *Cleaning Procedures for Miscellaneous Items Related to NPS Sampling*.

4.4 **Sub-sampling hose**: Two ~3-foot lengths of Teflon tubing connected by a ~2-foot length of silicon tubing. Pre-cleaned using cleaning protocols provided in SOP for *Teflon Sample Hose and Silicon Peristaltic Tubing Cleaning Procedures*. Used with a peristaltic pump to transfer sample water from the 20-L sample bottle to sample analyte containers.

4.6 **Volume-to-Sample Ratio (VSR):** A number that represents the volume of water that will flow past the flow-meter before a sample is taken (usually in liters but can also be in kilo-cubic feet for river deployments). For example, if the VSR is 1000 it means that every time 1000 liters passes the flow-meter the sampler collects a sample (1000 liters of flow per 1 sample taken). Note: The VSR indicates when a sample should be taken and is NOT an indication of the sample size.

5.0 EQUIPMENT

5.1 Instrumentation: Not applicable

5.2 Reagents: Not applicable.

5.3 Apparatus

1) Large capacity stirrer.

2) Stir bar.

3) Sub-sampling hose.

4) Peristaltic pump.

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APPENDIX C

QUALITY ASSURANCE/QUALITY CONTROL

1. Quality Assurance/Quality Control

Elements of a Quality Assurance and Quality Control (QA/QC) Plan have been incorporated into the CIMP in order to detail critical activities conducted to assure that both chemical and physical measurements meet the standard of quality needed to evaluate measurements at levels relevant to applicable water quality criteria. With many different monitoring programs being implemented within the region, comparability should remain of the primary goals of the QA/QC monitoring program. The Intergovernmental Task Force on Monitoring Water Quality (ITFM, 1995) defines comparability as the “characteristics that allow information from many sources to be of definable or equivalent quality so that it can be used to address program objectives not necessarily related to those for which the data were collected.”

One important aspect of comparability is the use of analytical laboratories that are accredited under a program such as the National Environmental Laboratory Accreditation Program (NELAP), California’s Environmental Laboratory Accreditation Program (ELAP) or a well-qualified research laboratory. In addition, the laboratory should be a participant in a laboratory proficiency and intercalibration program. Laboratories have not been selected for this program but participation in the Stormwater Monitoring Coalition’s (SMC) intercalibration program will be a primary consideration. Unfortunately, the SMC has not fully completed implementation of a program the full range of analyses included in the MRP Table E-2 list.

Evaluation of data quality will be based upon protocols provided in the *National Functional Guidelines for Inorganic Superfund Data Review (USEPA540-R-10-011)* (USEPA 2010), *National Functional Guidelines for Superfund Organic Methods Data Review (EPA540/R-08-01),* and the *Guidance on the Documentation and Evaluation of Trace Metals Data Collected for Clean Water Act Compliance Monitoring (EPA/821/B/95/002)* (USEPA 1996).

The sections that follow address activities associated with both field sampling and laboratory analyses. Quality assurance activities start with procedures designed to assure that errors introduced in the field sampling and subsampling processes are minimized. Field QA/QC samples are collected and used to evaluate potential contamination and sampling error introduced into a sample prior to its submittal to the analytical laboratory. Laboratory QA/QC activities are used to provide information needed to assess potential laboratory contamination, analytical precision and accuracy, and representativeness.

1.1.1 Sample Handling, Containers and Holding Times.

Table **1** provides a summary of the types of sample volumes, container types, preservation and holding times for each analytical method. Analytical methods requiring the same preservation and container types may be transferred to the laboratory in one container in order to minimize handling prior to transfer to the laboratory.

Table 1. Constituents, Sample Container, Preservation and Holding Times.

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Conventionals							
pH	150.1	15 minutes		glass or PE	none	+/- 0.1	std. units
Oil and Grease	1664A	28 days	1 L	Glass	HCl	5	mg/L
TPH	418.1	28 days	1 L	Glass	HCl	5	mg/L
Total Phenols	420.1	28 days	500mL-1 L	Glass	H_sSO_4	5	mg/L
Cyanide	SM4500-CN-E	14 days	500 mL	HDPE	NaOH	0.003	mg/L
Turbidity	SM2130B	48 hours	100-250mL	Glass	4-6°C	1	NTU
TSS	160.2	7 days	1 L	HDPE	4-6°C	4	mg/L
SSC[1]	ASTMD3977B	7 days	1 L	HDPE	4-6°C	4	mg/L
TDS	160.1	7 days	1 L	HDPE	4-6°C	1	mg/L
VSS	160.4	7 days	1 L	HDPE	4-6°C	1	mg/L
TOC; DOC	415.1	28 days	250 mL	glass	4°C and HCl or H_2SO_4 to pH<2	1	mg/L
BOD_5	SM5210B	48 hours	600mL-1L	HDPE	4-6°C	3	mg/L
COD	410.1	28 days	20-250 mL	Glass	H_sSO_4	4	mg/L
Alkalinity	SM 2320B	Filter ASAP, 14 days	100-250 mL	HDPE	4-6°C	1	mg/L
Conductivity	SM 2510	28 days	100-250 mL	HDPE	4°C; filter if hold time >24 hours	1	µmho/cm
Hardness	130.2	6 months	100-250 mL	HDPE	and HNO_3 or H_2SO_4 to pH<2	1	mg/L
MBAS	425.1	48 hours	250-500 mL	HDPE	4-6°C	0.02	mg/L
Chloride	300	28 days	250-500 mL	HDPE	4-6°C	2	mg/L
Fluoride	300	28 days	250-500 mL	HDPE	4-6°C	0.1	mg/L
Perchlorate	314.0	28 days	100-250 mL	HDPE	4-6°C	4	µg/L
Volatile Organics							
MTBE	624	14 days	3 40mL VOA	Glass	HCl	1	µg/L
Sulfate	375.2	28 days	250-500 mL	HDPE	4-6°C	2	mg/L

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Bacteria							
Total Coliform	SM9221B	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
Fecal Coliform	SM9221B	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
Enterococcus	SM9230B or C	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
E. coli	SM 9223 COLt	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
Nutrients							
TKN	351.1	28 days	500mL-1L	Amber glass	H_sSO_4	0.5	mg/L
Nitrate-N	300	48 hours	50-125mL	HDPE	4-6°C	0.1	mg/L
Nitrite-N	300	48 hours	50-125mL	HDPE	4-6°C	0.05	mg/L
Total Nitrogen	Calculation					NA	mg/L
Ammonia-N	350.1	28 days	500mL-1L	Amber glass	H_sSO_4	0.1	mg/L
Total Phosphorus	SM4500-P,EorF	28 days	100-250 mL	glass	H_sSO_4	0.1	mg/L
Dissolved Phosphorus	SM4500-P,EorF	28 days	100-250 mL	glass	4-6°C	0.1	mg/L
Organic Compounds (pesticides and herbicides)							
Organochlorine Pesticides & PCBs[1]	608 & 8270	7days:40days	1L	Amber glass	4-6°C	0.005-0.5	µg/L
Organophosphate Pesticides	507	14days	1L	Amber glass	$Na_sS_2O_3$ 4-6°C	0.01-1	µg/L
Glyphosate	547	14days	250mL	Amber glass	$Na_sS_2O_3$ 4-6°C	5	µg/L
Chlorinated Acids	515.3	14days	250mL	Amber glass	$Na_sS_2O_3$ 4-6°C		
2,4-D						0.02	µg/L
2,4,5-TP-Silvex						0.2	µg/L
Semivolatile Organic Compounds	625;8270D	7days;40days	1L	Amber glass	4-6°C	0.05-10	µg/L

Metals (Total)

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Aluminum	1620	6 months to analysis	250 to500 mL	HDPE	4°C and HNO_3 to pH<2	100	µg/L
Antimony	1620					0.5	µg/L
Arsenic	1620					0.5	µg/L
Beryllium	1620					0.5	µg/L
Cadmium	1620					0.25	µg/L
Chromium (Total)	1620					0.5	µg/L
Copper	1620					0.5	µg/L
Iron	1620					25	µg/L
Lead	1620					0.5	µg/L
Nickel	1620					1	µg/L
Selenium	1620					1	µg/L
Silver	1620					0.25	µg/L
Thallium	1620					0.5	µg/L
Zinc	1620					1	µg/L
Chromium (Hexavalent)	218.6	24 hours	250 ml	HDPE	4°C	5	µg/L
Mercury	1631E	28 days	250 ml	Glass or Teflon	4°C and HNO3 to pH<2	0.0005	µg/L

Abbreviations

TSS=Total Suspended Solids
SSC=Suspended Sediment Concentration
TDS=Total Dissolved Solids

TPH=Total Petroleum Hydrocarbons
VSS=Volatile Suspended Solids
TOC=Total Organic Carbon

BOD_5=Five-day Biochemical Oxygen Demand
COD=Chemical Oxygen Demand
MBAS=Methylene Blue Active Substances

MTBE= Methyl Tertiary Butyl Ether
TKN=Total Kjeldahl Nitrogen
PCBs=Polychlorinated Biphenyls

[1] Monitoring for PCBs will be reported as the summation of aroclors and a minimum of 50 congeners. 54 PCB congeners include: 8, 18, 28, 31, 33, 37, 44, 49, 52, 56, 60, 66, 70, 74, 77, 81, 87, 95, 97, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 132, 138, 141, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 174, 177, 180, 183, 187, 189, 194, 195, 201, 203, 206, and 209. These include all 41 congeners analyzed in the SCCWRP Bight Program and dominant congeners used to identify the aroclor

1.1.2 Precision, Bias, Accuracy, Representativeness, Completeness, and Comparability

The overall quality of analytical measurements is assessed through evaluation of precision, accuracy/bias, representativeness, comparability and completeness. Precision and accuracy/bias are measured quantitatively. Representativeness and comparability are both assessed qualitatively. Completeness is assessed in both quantitative and qualitative terms. The following sections examine how these measures are typically applied.

1.1.2.1 Precision

Precision provides an assessment of mutual agreement between repeated measurements. These measurements apply to field duplicates, laboratory duplicates, matrix spike duplicates, and laboratory control sample duplicates. Monitoring of precision through the process allows for the evaluation of the consistency of field sampling and laboratory analyses.

The Relative Percent Difference (RPD) will be used to evaluate precision based upon duplicate samples. The RPD is calculated for each pair of data is calculated as:

$$RPD=[(x_1-x_2)*100]/[(x_1+x_2)/2]$$

Where:

x_1=concentration or value of sample 1 of the pair

x_2=concentration or value of sample 2 of the pair

In the case of matrix spike/spike duplicate, RPDs are compared with measurement quality objectives (MQOs) established for the program. MQOs will be established to be consistent with the most current SWAMP objectives in the SWAMP Quality Assurance Project Plan (2008) including the most recent updates as well as consultations with the laboratories performing the analyses. In the case of laboratory or field duplicates, values can often be near or below the established reporting limits. The most current SWAMP guidelines rely upon matrix spike/spike duplicate analyses for organic compounds instead of using laboratory duplicates since one or both values are often below detection limits or are near the detection limits. In such cases, RPDs do not provide useful information.

1.1.2.2 Bias

Bias is the systematic inherent in a method or caused by some artifact or idiosyncrasy of the measurement system. Bias may be either positive or negative and can emanate from a number of different points in the process. Although both positive and negative biases may exist concurrently in the same sample, the net bias is all that can be reasonably addressed in this project. Bias is preferably measured through analysis of spiked samples so that matrix effects are incorporated.

1.1.2.3 Accuracy

Accuracy is a measure of the closeness of a measurement or the average of a number of measurements to the true value. Accuracy includes of a combination of random error as measured by precision and systematic error as measured by bias. An assessment of the accuracy of measurements is based on determining the percent difference between measured values and known or “true” values applied to surrogates, Matrix Spikes (MS), Laboratory Control Samples (LCS) and Standard Reference Materials (SRM). Surrogates and matrix spikes evaluate matrix interferences on analytical performance, while laboratory control samples, standard reference materials and blank spikes (BS) evaluate analytical performance in the absence of matrix effects.

Assessment of the accuracy of measurements is based upon determining the difference between measured values and the true value. This is assessed primarily through analysis of spike recoveries or certified value ranges for SRMs. Spike recoveries are calculated as Percent Recovery according to the following formula:

$$\text{Percent Recovery} = [(t-x)/\alpha]*100\%$$

Where:

t=total concentration found in the spiked sample

x=original concentration in sample prior to spiking, and

α=actual spike concentration added to the sample

1.1.2.4 Representativeness, Comparability and Completeness

Representativeness is the degree to which data accurately and precisely represents the natural environment. For stormwater runoff, representativeness is first evaluated based upon the automated flow-composite sample and the associated hydrograph. To be considered as representative, the autosampler must have effectively triggered to capture initial runoff from the pavement and the composite sample should:

- be comprised of a minimum number of aliquots over the course of the storm event,
- effectively represent the period of peak flow,
- contain flow-weighted aliquots from over 80% of the total runoff volume, and
- demonstrate little or no evidence of “stacking”.

Stacking occurs when the sampling volume is set too low and commands back up in the memory of an autosampler causing it to continuously cycle until it catches up with the accumulation of total flow measured by the stormwater monitoring station.

Representativeness is also assessed through the process of splitting or subsampling 20 L composite bottles into individual sample containers being sent to the laboratory. The first subsamples removed from the composite bottle should have the same composition as the last. Subsampling should be conducted in accordance with guidance in the subsampling SOP. This SOP is based upon use of large laboratory magnetic stir plate, an autosampler, and precleaned subsampling hoses to minimize variability. Sample splitting can introduce a substantial amount of error especially if significant quantities of coarse sediments (greater than 250 µm) represent as significant fraction of the suspended sediments. Use of a USGS Teflon churns or Decaport cone splitter may also be used but would require development of a separate SOP.

Comparability is the measure of confidence with which one dataset can be compared to another. The use of standardized methods of chemical analysis and field sampling and processing are ways of insuring comparability. Application of consistent sampling and processing procedures is necessary for assuring comparability among data sets. Thorough documentation of these procedures, quality assurance activities and a written assessment of data validation and quality are necessary to provide others with the basic elements to evaluate comparability.

Completeness is a measure of the percentage of the data judged valid after comparison with specific validation criteria. This includes data lost through accidental breakage of sample containers or other activities that result in irreparable loss of samples. Implementation of standardized Chain-of-Custody procedures which track samples as they are transferred between custodians is one method of maintaining a high level of completeness.

A high level of completeness is essential to all phases of this study due to the limited number of samples. Of course, the overall goal is to obtain completeness of 100%, however, a realistic data quality indicator of 95% insures an adequate level of data return.

1.1.3 Laboratory Quality Assurance/Quality Control

The quality of analytical data is dependent on the ways in which samples are collected, handled and analyzed. Data Quality Objectives provide the standards against which the data are compared to determine if they meet the quality necessary to be used to address program objectives. Data will be subjected to a thorough verification and validation process designed to evaluate project data quality and determine whether data require qualification.

The three major categories of QA/QC checks are accuracy, precision, and contamination were discussed in the previous section. As a minimum, the laboratory will incorporate analysis of method blanks, and matrix spike/spike duplicates with each analytical batch. Laboratory duplicates will be analyzed for analytical tests where matrix spike/spike duplicate are not analyzed. Use of Certified Reference Materials (CRM) or Standard Reference Materials (SRM) is also recommended as these allow assessment of long term performance of the analytical methods so that representativeness can be assessed. Laboratories often use an internal CRM that is analyzed with each batch to evaluate any potential long-term shift in performance of the analytical procedures. Recommended minimum quality control samples will be based upon SWAMP QAPP (2008) and the associated 2013 Quality Control and Sample Handling Tables for water (http://www.swrcb.ca.gov/water_issues/programs/swamp/mqo.shtml).

1.1.4 Field QA/QC

1.1.4.1 Blanks

A thorough system of blanking is an essential element of monitoring. Much of the blanking processes are performed well in advance of the actual monitoring in order to demonstrate that all equipment expected to contact water is free of contaminants at the detection limits established for the program. Equipment components are cleaned in batches. Subsamples from each cleaning batch are rinsed with Type 1 laboratory blank water and submitted to the laboratory for analysis. If hits are encountered in any cleaning batch, the entire batch is put back through the cleaning and blanking process until satisfactory results are obtained. If contaminants are measured in the blanks, it is often prudent to reexamine the cleaning processes and equipment or materials used in the cleaning process. Equipment requiring blanks and the frequency of blanks is summarized below and in Table 2.

Table 2. Summary of Blanking Requirements for Field Equipment.

System Component	Blanking Frequency
Intake Hose	One per batch
Peristaltic Pump Hose	One per batch[1] or 10% for batches greater than 10
Composite Bottles	One per batch or 10% for batches greater than 10
Subsampling Pump Hose	One per batch or 10% for batches greater than 10
Laboratory Sample Containers	2% of the lot[2] or batch, minimum of one
Capsule Filter Blank[3]	One per batch or 10% for batches greater than 10
Churn/Cone Splitter[4]	When field cleaning is performed, process one blank per session

[1] A batch is a group of samples that are cleaned at the same time and in the same manner.

[2] If decontaminated bottles are sent directly from the manufacturer, the batch would be the lot designated by the manufacturer in their testing of the bottles.

[3] If filtration is performed in the laboratory, the capsule filter blanks would be considered part of laboratory QA/QC.

[4] This is applicable to use of a churn or cone splitter to subsample flow-weighted composite samples into individual containers. Splitting may be performed by the sampling team in a protected, clean area or by the laboratory.

1.1.4.2 Field Duplicates

Composite subsampling duplicates associated with flow-weighted composite samples are often referred to as field duplicates but, in fact, they are subsampling replicates. These replicates help assess combined variability associated with subsampling from the composite container and variability associated with the analytical process. They are evaluated against the same criteria as used for laboratory duplicates.

1.1.5 Equipment Cleaning, Blanking and Tracking

Sample collection, handling, and processing materials can contribute and/or sorb trace elements within the time scales typical for collection, processing and analysis of runoff samples. Sampling artifacts are especially important when measured concentrations that are at or near analytical detection limits (Horowitz 1997). Therefore, great care is required to collect and process samples in a manner that will minimize potential contamination and variability in the sampling process (Breault and Granato 2000).

Sampling conducted to measure dissolved metals and other trace contaminants at levels relevant to EPA water quality criteria requires documentation that all sampling equipment is free of contamination and that the processes used to obtain and handle samples do not introduce contamination. This requires documentation that methods used to collect, process and analyze the samples do not introduce contamination. Documentation for the CIMP includes written procedures provided in Appendix B for cleaning all components of the sampling system, blanking processes necessary to verify that system components and sample handling are not introducing contamination, and a system of tracking deployment of protocol-cleaned equipment in the field as described in this section.

All composite containers and equipment used for sample collection in the field and/or sample storage in the laboratory will be decontaminated and cleaned prior to use. These include the FEP tubing, Teflon® lids, strainers and hoses/fittings that are used in the subsampling process (USGS 1993). Personnel assigned to clean and handle the equipment are thoroughly trained and familiar with the cleaning, blanking, and tracking procedures. In addition, all field sampling staff will be trained to be familiar with these processes so that they have a better understanding of the importance of using clean sampling procedures and the effort required to eliminate sources of contamination.

Sample contamination has long been considered one of the most significant problems associated with measurement of dissolved metals and may be accentuated with use of High Resolution Mass Spectroscopy (HRMS) methods for trace levels of organic constituents at levels three orders of magnitude lower than conventional GCMS methods. One of the major elements of QA/QC documentation is establishing that clean sampling procedures are used throughout the process and that all equipment used to collect and process the water samples are free of contamination.

Cleaning protocols are consistent with ASTM (2008) standard D5088 – 02 that covers cleaning of sampling equipment and sample bottles. The generalized cleaning process is based upon a series of washings that typically start with tap water with a phosphate-free detergent, a tap water rinse, soaking in a 10% solution of reagent grade nitric acid, and a final series of rinses with ASTM Type 1 water. Detailed procedures for decontamination of sampling equipment are provided in Appendix A. In addition, Appendix G of the most recent Caltrans Stormwater Monitoring Guidance Manual (Caltrans, 2013) provides alternative cleaning procedure that incorporate use of methylene chloride to remove potential organic contaminants. Experience indicates that this step can be eliminated and still result in blanking data suitable for most target organic contaminants. Addition of this cleaning step or a comparable step to address organic contaminants may be necessary if satisfactory equipment blanks cannot be attained. Significant issues exist with respect to use of methylene chloride. This chemical is highly toxic, must be handled and disposed as a hazardous waste and is difficult to fully remove from the 20-L media bottles used as composite containers.

In order to account for any contamination introduced by sampling containers, blanks must be collected for composite bottles and laboratory bottles used for sample storage for trace contaminants. A sampling container blank is prepared by filling a clean container with blank water and measuring the concentrations of selected constituents (typically metals and other trace contaminants for composite bottles and metals analysis only for metals storage bottles). Blanking of the 20-L composite bottles will be performed by using the minimum amount of blank water necessary for the selected analytical tests. This is typically requires one to two liters. The bottle is capped and then manipulated to assure that all surfaces up to the neck of the bottle are rinsed. The water is then be allowed to sit for a minimum of one hour before decanting the rinse water into sample containers. In order to provide adequate control, media bottles are labelled and tracked. All media bottles cleaned and blanked in one batch are tracked to allow for recall if laboratory analyses reveal any contamination. Further tracking is required in the field to document where bottles from each cleaning batch are used and to assist in tracking of any contamination that might be detected after bottles have been deployed since laboratory turnaround in the middle of the storm season may require use of decontaminated bottles prior to receiving the results of the blank analyses.

Selected constituents for blanking will be dependent upon the list of contaminants with reasonable potential to be present at levels that could impact sample results. Minimum parameters used for blank analyses will include total recoverable trace metals, TDS, TOC and nutrients. Analysis of total metals will allow for detection of any residual metal contamination which will be of concern for all sampling. Nutrients, particularly nitrogen compounds, will assure that residual nitrogen from acid cleaning has been fully removed. TDS and TOC are useful for accessing presence of any residual contaminants. Additional blanking may be added when sampling other constituents with ultra-low analytical methods. These blanks may be submitted "blind" to the laboratory by field personnel or prepared internally by the laboratory.

Certified pre-cleaned QC-grade laboratory containers can be used. These bottles are cleaned using acceptable protocol for the intended analysis and tracked by lots. They come with standard certification forms that document the concentration to which the bottles are considered "contaminant-free" but these concentrations are not typically suitable for program reporting limits required for measurement of dissolved metals. Manufacturers may provide an option of certification to specific limits required by a project but it is preferable to purchase the QC bottles that are tracked by lot and conduct internal blanking studies. Lots not meeting project requirements should be returned to the manufacturer and exchanged for containers from another lot. At least 2% of the bottles in any "lot" or "batch" should be blanked at the program detection limits with a minimum frequency of one bottle per batch. A batch is considered to be a group of samples that are cleaned at the same time and in the same manner; or, if decontaminated bottles are sent directly from the manufacturer, the batch would be the lot designated by the manufacturer in their testing of the bottles. Cleaned bottles are stored in a clean area with lids properly secured.

Subsampling hoses consist of a length of peristaltic hose with short lengths of FEP tubing attached to each end. These are required to be cleaned inside and out since the FEP tubing is immersed in the composite bottle during the subsampling process. Once cleaned, the ends of the subsampling hoses are bagged. All hoses associated with the batch are then stored in large zip-lock containers labeled to identify the cleaning batch. Blanking of subsampling hoses is conducted as part of the composite bottle blanking process. A clean subsampling hose is used to decant blank water from the 20-L composite bottles into clean laboratory containers. Detection of any contaminants in the bottle blanks therefore requires that the subsampling hoses also are subjected another decontamination process. After cleaning, the subsampling hoses should only be handled while wearing clean, powder-free nitrile gloves.

APPENDIX D

NON-STORMWATER IC/ID AND OUTFALL TRACKING

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Operation Procedures

Illicit Discharge Detection & Elimination: Initial Outfall Screening

Purpose:	This provides a basic checklist for field crews conducting initial survey of storm drainage system outfalls for use in identification of illicit discharges

Reference: Brown et al., *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments,* Center for Watershed Protection, Ellicott City, 2004.

Planning Considerations:

☐ Employees should have reviewed and understand the information presented in Chapter 11 of the reference manual
☐ Inspections are to occur during dry weather (no runoff producing precipitation in last 72 hours)
☐ Conduct inspections with at least two staff per crew
☐ Conduct inspections during low groundwater (if appropriate).
☐ Complete ***Site Info section on Outfall Reconnaissance Inventory Form*** before leaving the office. Additional forms should be available for undocumented outfalls

Field Methods:

☐ Ensure outfall is accessible.
☐ Inspect outfall only if safe to do so.
☐ Characterize the outfall by recording information on the ***LCC Outfall Reconnaissance Inventory Form.***
☐ Photograph the outfall with a digital camera (use dry erase board to identify outfall).
☐ Enter flow information on form if dry weather flow is present and ***easily*** obtained. If not, provide rough estimate of flow.
☐ Document clean, dry outfalls for potential elimination during future screening programs.
☐ Water samples will not be collected during the initial survey. In-situ measurements of temperature, conductivity, and pH should be taken if significant flow is present.
☐ Do not enter private property without permission.
☐ Photograph each site with the site identification written on the dry erase board.

Equipment List:

1. System map
2. Outfall Reconnaissance Inventory Forms
3. City identification or business cards
4. Digital camera (spare batteries)
5. Cell phone
6. GPS unit
7. Clip board and pencils
8. Dry erase board and pens
9. Hand Mirror
10. Flashlight (spare batteries)
11. Disposable gloves
12. Folding wood ruler or comparable
13. Temperature, Conductivity probe
14. pH probe/strips
15. ***Ammonia test strips***
16. ***Ten1-liter (polyethylene) sample bottles***
17. Watch with second hand
18. Calculator
19. Hand sanitizer
20. Safety vests
21. First aid kit
22. ***Cooler***
23. Permanent marker

Bolded, italicized items will only be needed for later surveys. No water quality samples will be taken for laboratory analysis during the first survey.

LOWER LONG BEACH ESTUARIES OUTFALL RECONNAISSANCE INVENTORY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Subbasin:		Outfall ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours:	Last 48 hours:	
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	
Land Use in Drainage Area (Check all that apply): ☐ Industrial ☐ Ultra-Urban Residential ☐ Suburban Residential ☐ Commercial		☐ Open Space ☐ Institutional Other: ____ Known Industries: _______________________________________	
Notes (e.g.., origin of outfall, if known):			

Section 2: Outfall Description

LOCATION	**MATERIAL**	**SHAPE**	**DIMENSIONS (IN.)**	**SUBMERGED**
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: __________	☐ Circular ☐ Single ☐ Elliptical ☐ Double ☐ Box ☐ Triple ☐ Other: _____ ☐ Other: _____	Diameter/Dimensions: ______________________	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: _____	☐ Trapezoid ☐ Parabolic ☐ Other: _____	Depth: _____ Top Width: _____ Bottom Width: _____	▨
☐ **In-Stream**	**(applicable when collecting samples)**			
Flow Present?	☐ Yes ☐ No ***If No, Skip to Section 5***			
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial			

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		**RESULT**	**UNIT**	**EQUIPMENT**
☐Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐Flow #2	Flow depth		In	Tape measure
	Flow width	_____' _____"	Ft, In	Tape measure
	Measured length	_____' _____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Meter
pH			pH Units	Meter
Ammonia			mg/L	Test strip

Lower Long Beach Estuaries Outfall Reconnaissance Inventory Field Sheet

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☐ No *(If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☐ Yes ☐ No *(If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Outfall Characterization

☐ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1. Sample for the lab?	☐ Yes	☐ No			
2. If yes, collected from:	☐ Flow	☐ Pool			
3. Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type:	☐ OBM	☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

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APPENDIX E

MAJOR AND MINOR OUTFALLS IN THE LOWER LONG BEACH ESTUARIES

(Los Ceritos Channel, Alamitos Bay and San Gabriel River Estuaries)

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Major Outfalls (>36 inches) in the Lower Long Beach Estuaries

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
SAN GABRIEL RIVER	33.75782	-118.09867	SAN GABRIEL RIVER / S/O 2ND ST	UNK (HEADWALL)	-264		ACTV
SAN GABRIEL RIVER	33.74893	-118.11026	SAN GABRIEL RIVER /	UNK (HEADWALL)	-267		ACTV
SAN GABRIEL RIVER	33.74903	-118.11011	SAN GABRIEL RIVER /	UNK (HEADWALL)	-268		ACTV
SAN GABRIEL RIVER	33.74663	-118.11280	MARINA DR / SAN GABRIEL RIVER	UNK (HEADWALL)	-269		ACTV
SAN GABRIEL RIVER	33.74484	-118.11355	SAN GABRIEL RIVER / S/O MARINA DR	UNK (HEADWALL)	-270		ACTV
ALAMITOS BAY	33.74508	-118.11685	OCEAN BLVD / 72ND PL	UNK (HEADWALL)	-309		ACTV
BOUTON CREEK	33.78582	-118.12016	BOUTON CREEK DR / EARL WARREN DR	UNKNOWN	-368		ACTV
LOS CERRITOS CHANNEL	33.77954	-118.10340	STUDEBAKER RD / 9TH ST	36'' DISCHARGE	72-T12	36	ACTV
ALAMITOS BAY	33.75574	-118.11234	ALAMITOS BAY / BASIN NO. 3	36'' DISCHARGE	25-S05	36	ACTV
LOS CERRITOS CHANNEL	33.76718	-118.12503	5517 CHINA PT	36'' DISCHARGE	-166	36	ACTV
BOUTON CREEK	33.78774	-118.12747	ATHERTON ST / TULANE AVE	36'' DISCHARGE	-376	36	ACTV
BEACH	33.75890	-118.14808	39TH PL / ALLIN ST	39" DISCHARGE	-113	39	ACTV
ALAMITOS BAY	33.75261	-118.10891	ALAMITOS BAY / BASIN NO. 3	39'' DISCHARGE	-149	39	ACTV
LOS CERRITOS CHANNEL	33.76607	-118.12162	5950 WATERFRONT PL	39'' DISCHARGE	-168	39	ACTV
LOS CERRITOS CHANNEL	33.77454	-118.10396	LOS CERRITOS CHANNEL / 7TH ST	39'' DISCHARGE	-177	39	ACTV
SIMS POND	33.76884	-118.11812	357 SEVILLE WAY	39" DISCHARGE	-398	39	ACTV
ALAMITOS BAY	33.75887	-118.12950	201 BAY SHORE AVE	5-8" DISCHARGE	-163	40	ACTV
LOS CERRITOS CHANNEL	33.76456	-118.11996	6138 CORSICA CIR	42'' DISCHARGE	83-R8	42	ACTV
LOS CERRITOS CHANNEL	33.77759	-118.10388	6491 BIXBY HILL RD	42'' DISCHARGE	4-T11	42	ACTV
LOS CERRITOS CHANNEL	33.76275	-118.11532	6264 PACIFIC COAST HWY	42'' DISCHARGE	16-S07	42	ACTV
BOUTON CREEK	33.78148	-118.11156	6251 STATE UNIVERSITY DR	42" DISCHARGE	-420	42	ACTV
COLORADO LAGOON	33.77172	-118.13193	MONROVIA AVE / 4TH ST	48'' DISCHARGE	51-Q10	48	ACTV
LOS CERRITOS CHANNEL	33.77477	-118.10343	LOS CERRITOS CHANNEL / 7TH ST	48'' DISCHARGE	35-T11	48	ACTV
COLORADO LAGOON	33.77192	-118.13684	PARK AVE / 4TH ST	48" DISCHARGE	66-P10	48	ABND
SAN GABRIEL RIVER	33.77495	-118.09825	6930 SEPTIMO ST	48'' DISCHARGE	-263	48	ACTV
BOUTON CREEK	33.78624	-118.12100	BOUTON CREEK / E/O BELLFLOWER BLVD	48'' DISCHARGE	-369	48	ACTV
BIXBY GOLF COURSE POND	33.76955	-118.11662	6180 BIXBY VILLAGE DR	48" DISCHARGE	-401	48	ACTV
BEACH	33.76244	-118.16156	OCEAN BLVD / MOLINO AVE	51'' DISCHARGE	44-L7	51	ACTV
BEACH	33.75993	-118.15079	36TH PL / OCEAN BLVD	54" DISCHARGE	2-M6	54	ACTV
COLORADO LAGOON	33.77335	-118.13257	6TH ST / NIETO AVE	54'' DISCHARGE	9-Q10	54	ACTV
LOS CERRITOS CHANNEL	33.76755	-118.10450	LOS CERRITOS CHANNEL FC / LOYNES DR	60'' DISCHARGE	29-T09	60	ACTV
LOS CERRITOS CHANNEL	33.76753	-118.12492	SPINNAKER BAY DR / ELIOT ST	60'' DISCHARGE	-167	60	ACTV
COLORADO LAGOON	33.77273	-118.13635	6TH ST / ALLEY E/O PARK AVE	63'' DISCHARGE	6-P10	63	ACTV
LOS CERRITOS CHANNEL	33.76350	-118.11578	LOS CERRITOS CHANNEL / COSTA DEL SOL	64" DISCHARGE	5-S07	64	ACTV

Major Outfalls (>36 inches) in the Lower Long Beach Estuaries Con'd.

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
BOUTON CREEK	33.78698	-118.13803	4645 PACIFIC COAST HWY	69" DISCHARGE	-412	69	ACTV
MARINE STADIUM	33.76775	-118.12992	PAOLI WAY / MARINA PARK LN	72" DISCHARGE	15-Q8	72	ABND
BOUTON CREEK	33.78785	-118.12858	ATHERTON ST / LITCHFIELD AVE	72'' DISCHARGE	-377	72	ACTV
LOS CERRITOS CHANNEL	33.78127	-118.10342	STUDEBKAER RD / ANAHEIM RD	81'' DISCHARGE	-178	81	ACTV
ALAMITOS BAY	33.75368	-118.13080	5437 OCEAN BLVD	1-36" & 2-30" & 1-6" DISCHARGE	-161	36	ACTV
MARINE STADIUM	33.76765	-118.12983	PAOLI WAY / MARINA PARK LN	108" DISCHARGE	-22	108	ACTV
BOUTON CREEK	33.80229	-118.13412	CLARK AVE / VERNON ST	120'' DISCHARGE	-392	120	ACTV
BOUTON CREEK	33.79526	-118.13415	5090 LOS COYOTES DIA	132'' DISCHARGE	-387	132	ACTV

Minor Outfalls (12-36 inches) in the Lower Long Beach WMP

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
RIVO ALTO CANAL	33.75273	-118.12346	219 RIVO ALTO CAN	12'' DISCHARGE	62-R4D	12	ACTV
LOS CERRITOS CHANNEL	33.76571	-118.10314	STUDEBAKER RD / LOYNES DR	12" DISCHARGE	8-T08	12	ACTV
RIVO ALTO CANAL	33.75290	-118.12348	218 RIVO ALTO CAN	12'' DISCHARGE	69-R4D	12	ACTV
RIVO ALTO CANAL	33.75568	-118.12460	RIVO ALTO CAN /	12" DISCHARGE	-135	12	ACTV
RIVO ALTO CANAL	33.75562	-118.12352	89 RIVO ALTO CAN	12" DISCHARGE	-136	12	ACTV
RIVO ALTO CANAL	33.75559	-118.12338	93 RIVO ALTO CAN	12'' DISCHARGE	-137	12	ACTV
RIVO ALTO CANAL	33.75542	-118.12343	129 RIVO ALTO CAN	12" DISCHARGE	-140	12	ACTV
RIVO ALTO CANAL	33.75516	-118.12242	118 RIVO ALTO CAN	12" DISCHARGE	-141	12	ACTV
ALAMITOS BAY	33.75085	-118.11345	225 MARINA DR	12'' DISCHARGE	-143	12	ACTV
LOS CERRITOS CHANNEL	33.76840	-118.10419	6238 MARIQUITA ST	12'' DISCHARGE	-169	12	ACTV
LOS CERRITOS CHANNEL	33.76956	-118.10407	6333 ELIOT ST	12'' DISCHARGE	-170	12	ACTV
LOS CERRITOS CHANNEL	33.77030	-118.10407	6333 COLORADO ST	12'' DISCHARGE	-172	12	ACTV
LOS CERRITOS CHANNEL	33.77104	-118.10407	6333 VERMONT ST	12'' DISCHARGE	-173	12	ACTV
LOS CERRITOS CHANNEL	33.77180	-118.10404	LOS CERRITOS CHANNEL / 5TH ST	12'' DISCHARGE	-174	12	ACTV
BOUTON CREEK	33.78682	-118.12262	BOUTON CREEK / BELLFLOWER BLVD	12'' DISCHARGE	-370	12	ACTV
CHANNEL W/O CLARK AVE	33.79654	-118.13413	2209 CLARK AVE	12'' DISCHARGE	-388	12	ACTV
MARINE STADIUM	33.76044	-118.11976	MARINE STADIUM / MARINA DR	15'' DISCHARGE	100-R6	15	ACTV
MARINE STADIUM	33.76779	-118.12786	BOATHOUSE LN / ELIOT ST	15'' DISCHARGE	27-Q9	15	ACTV
ALAMITOS BAY	33.75271	-118.11806	97 VISTA DEL GOLFO	15'' DISCHARGE	8-R4A	15	ACTV
RIVO ALTO CANAL	33.75338	-118.12150	171 RIVO ALTO CAN	15" DISCHARGE	18-R4A	15	ACTV
ALAMITOS BAY	33.74832	-118.11547	205 MARINA DR	15'' DISCHARGE	-114	15	ACTV
ALAMITOS BAY	33.74950	-118.11560	205 MARINA DR	15'' DISCHARGE	-115	15	ACTV

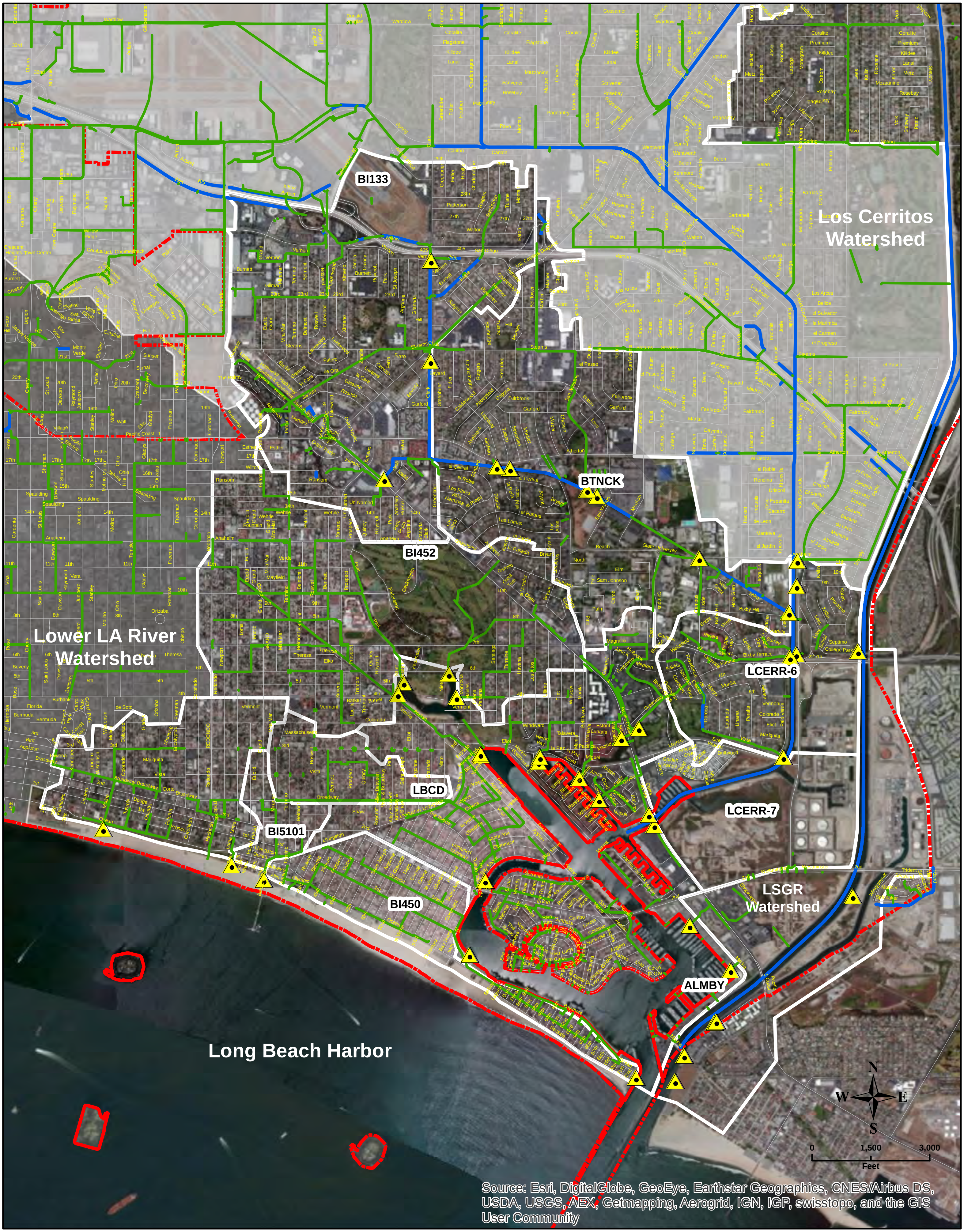
Minor Outfalls (12-36 inches) in the Lower Long Beach Estuaries Con'd.

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
ALAMITOS BAY	33.74794	-118.11538	205 MARINA DR	15'' DISCHARGE	-116	15	ACTV
ALAMITOS BAY	33.74825	-118.11497	205 MARINA DR	15'' DISCHARGE	-117	15	ACTV
ALAMITOS BAY	33.74806	-118.11412	ALAMITOS BAY / BASIN NO. 1	15'' DISCHARGE	-118	15	ACTV
ALAMITOS BAY	33.74875	-118.11339	ALAMITOS BAY / BASIN NO. 1	15'' DISCHARGE	-119	15	ACTV
ALAMITOS BAY	33.74923	-118.11286	ALAMITOS BAY / BASIN NO. 1	15'' DISCHARGE	-120	15	ACTV
SAN GABRIEL RIVER	33.74752	-118.11344	MARINA DR / SAN GABRIEL RIVER	15'' DISCHARGE	-121	15	ACTV
SAN GABRIEL RIVER	33.74790	-118.11308	MARINA DR / SAN GABRIEL RIVER	15'' DISCHARGE	-122	15	ACTV
ALAMITOS BAY	33.75078	-118.11322	225 MARINA DR	15'' DISCHARGE	-144	15	ACTV
ALAMITOS BAY	33.75100	-118.11293	225 MARINA DR	15'' DISCHARGE	-145	15	ACTV
ALAMITOS BAY	33.75100	-118.11033	ALAMITOS BAY / BASIN NO. 2	15'' DISCHARGE	-147	15	ACTV
ALAMITOS BAY	33.75168	-118.10920	ALAMITOS BAY / BASIN NO. 2	15'' DISCHARGE	-148	15	ACTV
ALAMITOS BAY	33.75314	-118.10952	ALAMITOS BAY / BASIN NO. 3	15'' DISCHARGE	-150	15	ACTV
ALAMITOS BAY	33.75231	-118.11430	APPIAN WAY / LIDO LN	15'' DISCHARGE	-151	15	ACTV
ALAMITOS BAY	33.75477	-118.11127	ALAMITOS BAY / BASIN NO. 3	15'' DISCHARGE	-152	15	ACTV
ALAMITOS BAY	33.75323	-118.11474	6201 APPIAN WAY	15'' DISCHARGE	-155	15	ACTV
ALAMITOS BAY	33.75423	-118.11585	APPIAN WAY / THE TOLEDO	15'' DISCHARGE	-156	15	ACTV
ALAMITOS BAY	33.75450	-118.11614	APPIAN WAY / THE TOLEDO	15'' DISCHARGE	-157	15	ACTV
ALAMITOS BAY	33.75517	-118.11688	APPIAN WAY / SAVONA WK	15'' DISCHARGE	-158	15	ACTV
ALAMITOS BAY	33.75587	-118.11654	APPIAN WAY / 2ND ST	15'' DISCHARGE	-159	15	ACTV
ALAMITOS BAY	33.75368	-118.13080	5437 OCEAN BLVD	1-36" & 2-30" & 1-6" DISCHARGE	-161	30	ACTV
ALAMITOS BAY	33.75656	-118.11713	2ND ST / MARINE STADIUM	2-24" & 2-18" & 1-6" DISCHARGE	-164	18	ACTV
ALAMITOS BAY	33.75656	-118.11713	2ND ST / MARINE STADIUM	2-24" & 2-18" & 1-6" DISCHARGE	-164	24	ACTV
MARINE STADIUM	33.75837	-118.11754	MARINA DR / MARINE STADIUM	15'' DISCHARGE	-165	15	ACTV
LOS CERRITOS CHANNEL	33.77107	-118.10338	LOS CERRITOS CHANNEL /	15'' DISCHARGE	-175	15	ACTV
BOUTON CREEK	33.78749	-118.12493	1492 BRYANT DR	15'' DISCHARGE	-375	15	ACTV
BOUTON CREEK	33.78778	-118.12785	1495 LA PERLA AVE	15'' DISCHARGE	-378	15	ACTV
CHANNEL W/O CLARK AVE	33.79793	-118.13412	2244 CLARK AVE	15'' DISCHARGE	-391	15	ACTV
ALAMITOS BAY	33.75258	-118.12711	5575 CORSO DI NAPOLI	16'' DISCHARGE	-123	16	ACTV
CHANNEL W/O CLARK AVE	33.79262	-118.13416	CLARK AVE / GARFORD ST	16'' DISCHARGE	-384	16	ACTV
LOS CERRITOS CHANNEL	33.77606	-118.10395	6499 SADDLE RD	18'' DISCHARGE	15-T11	18	ACTV
LOS CERRITOS CHANNEL	33.78239	-118.10337	1229 STUDEBAKER RD	18'' DISCHARGE	26-T13	18	ACTV
ALAMITOS BAY	33.75588	-118.11248	ALAMITOS BAY / BASIN NO. 3	18'' DISCHARGE	-153	18	ACTV
LOS CERRITOS CHANNEL	33.76929	-118.10336	LOS CERRITOS CHANNEL /	18'' DISCHARGE	-171	18	ACTV
BOUTON CREEK	33.77832	-118.10534	881 RANCHO DR	18'' DISCHARGE	-362	18	ACTV

Minor Outfalls (12-36 inches) in the Lower Long Beach Estuaries Con'd.

LOCATION	LATITUDE	LONGITUDE	PHYSICAL LOCATION OF OUTFALL	SIZE AND TYPE	FEATURE ID	SIZE, INCHES	STATUS
BOUTON CREEK	33.77867	-118.10603	6451 SHIRE WAY	18'' DISCHARGE	-363	18	ACTV
BOUTON CREEK DR	33.78056	-118.10976	940 HOLLY GLEN DR	18'' DISCHARGE	-367	18	ACTV
BOUTON CREEK	33.78731	-118.12397	1490 BRYANT DR E	18'' DISCHARGE	-374	18	ACTV
BOUTON CREEK	33.78798	-118.12985	1620 ELMFIELD AVE	18'' DISCHARGE	-379	18	ACTV
BOUTON CREEK	33.78798	-118.12990	1601 ELMFIELD AVE	18'' DISCHARGE	-380	18	ACTV
CHANNEL W/O CLARK AVE	33.79214	-118.13416	CLARK AVE / GARFORD AVE	18'' DISCHARGE	-383	18	ACTV
CHANNEL W/O CLARK AVE	33.79432	-118.13415	2102 CLARK AVE	18'' DISCHARGE	-385	18	ACTV
CHANNEL W/O CLARK AVE	33.79456	-118.13415	5002 LOS COYOTES DIA	18'' DISCHARGE	-386	18	ACTV
CHANNEL W/O CLARK AVE	33.79662	-118.13413	2200 CLARK AVE	18'' DISCHARGE	-389	18	ACTV
CHANNEL W/O CLARK AVE	33.79665	-118.13413	2200 CLARK AVE	18'' DISCHARGE	-390	18	ACTV
MARINE STADIUM	33.76081	-118.11975	MARINE STADIUM / MARINA DR	21" DISCHARGE	98-R6	21	ACTV
ALAMITOS BAY	33.76012	-118.12445	371 BAY SHORE AVE	21'' DISCHARGE	6-R6	21	ACTV
348 CALLE MARSEILLE	33.76851	-118.11845	SIMS POND	21" DISCHARGE	-397	21	ACTV
LOS CERRITOS CHANNEL	33.77720	-118.10340	LOS CERRITOS CHANNEL / BOUTON CREEK	24'' DISCHARGE	13-T11	24	ACTV
LOS CERRITOS CHANNEL	33.77398	-118.10338	LOS CERRITOS CHANNEL / 7TH ST	24'' DISCHARGE	2-T10	24	ACTV
LOS CERRITOS CHANNEL	33.77193	-118.10340	LOS CERRITOS CHANNEL /	24'' DISCHARGE	-176	24	ACTV
BOUTON CREEK	33.78831	-118.13326	5101 EL CEDRAL ST	24'' DISCHARGE	-381	24	ACTV
6180 BIXBY VILLAGE DR	33.76943	-118.11675	BIXBY GOLF COURSE POND	24" DISCHARGE	-400	24	ACTV
LOS CERRITOS CHANNEL	33.77513	-118.10395	LOS CERRITOS CHANNEL / SURREY DR	27'' DISCHARGE	57-T11	27	ACTV
LOS CERRITOS CHANNEL	33.78135	-118.10380	ANAHEIM RD / STUDEBAKER RD	27'' DISCHARGE	21-T12	27	ACTV
ALAMITOS BAY	33.75690	-118.11599	2ND ST / MARINE STADIUM	27" DISCHARGE	35-S06	27	ACTV
ALAMITOS BAY	33.75093	-118.11045	ALAMITOS BAY / BASIN NO. 2	27'' DISCHARGE	-146	27	ACTV
BOUTON CREEK	33.78003	-118.10871	910 HOLLY GLEN DR	27'' DISCHARGE	-366	27	ACTV
LOS CERRITOS CHANNEL	33.78147	-118.10386	ANAHEIM RD / STUDEBKAER RD	29'' DISCHARGE	26-T12	29	ACTV
BEACH	33.76035	-118.15274	OCENA BLVD / REDONDO AVE	30" DISCHARGE	11-M6	30	ACTV
LOS CERRITOS CHANNEL	33.76746	-118.10473	LOS CERRITOS CHANNEL / LOYNES DR	30'' DISCHARGE	6-T08	30	ACTV
ALAMITOS BAY	33.75998	-118.12841	261 BAY SHORE AVE	30" DISCHARGE	-162	30	ACTV
BOUTON CREEK	33.77973	-118.10810	BOUTON CREEK / PALO VERDE AVE	30'' DISCHARGE	-365	30	ACTV
BOUTON CREEK	33.78702	-118.12318	1720 BELLFLOWER BLVD	30'' DISCHARGE	-371	30	ACTV
BOUTON CREEK	33.78720	-118.12367	BOUTON CREEK / BELLFLOWER BLVD	30'' DISCHARGE	-372	30	ACTV
BOUTON CREEK	33.78701	-118.12315	BOUTON CREEK / BELLFLOWER BLVD	30'' DISCHARGE	-373	30	ACTV
BOUTON CREEK	33.78837	-118.13392	1661 GREENBRIER RD	30'' DISCHARGE	-382	30	ACTV
ALAMITOS BAY	33.75812	-118.12886	5425 SORRENTO DR	4-16" DISCHARGE	-395	16	ACTV
356 SEVILLE WAY	33.76888	-118.11786	SIMS POND	30" DISCHARGE	-399	30	ACTV

Lower Long Beach WMP Major Outfalls

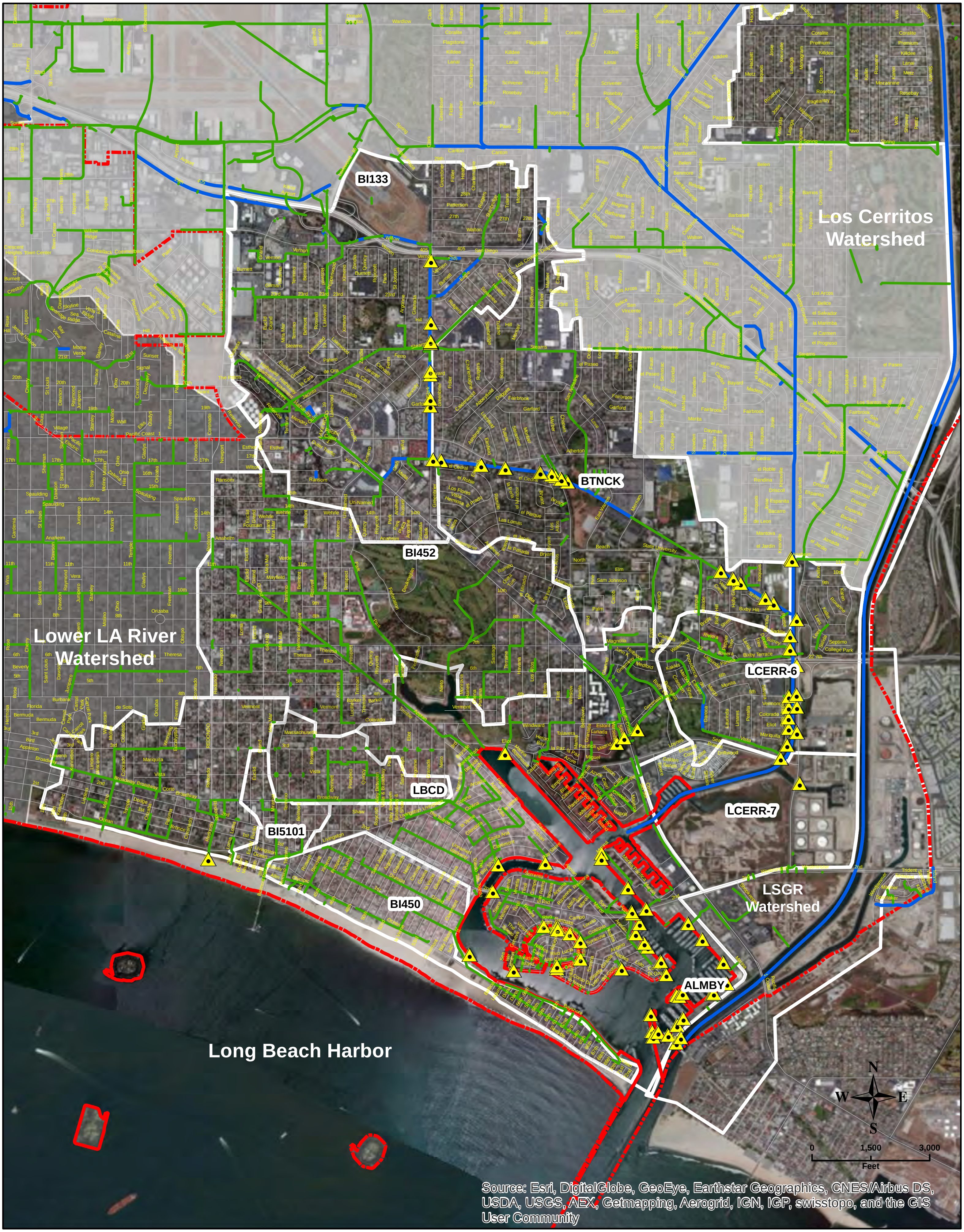


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

KINNETIC LABORATORIES, INC.

Date: 3/5/2015

Lower Long Beach WMP Minor Outfalls



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

KINNETIC LABORATORIES, INC.

Date: 3/5/2015

APPENDIX F

GENERAL FIELD SAMPLING PROCEDURES

FOR

COMPOSITE AND GRAB SAMPLES

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GENERAL FIELD SAMPLING PROCEDURE FOR:

Composite Samples

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the procedures for the compositing and sub-sampling of non-point source (NPS) "composite" sample bottles. The purpose of these procedures is to ensure that the sub-samples taken are representative of the entire water sample in the "composite" bottle (or bottles). In order to prevent confusion, it should be noted that the bottles are referred to as "composite" bottles because they are a composite of many small samples taken over the course of a storm; in this SOP the use of "compositing" generally refers to the calculated combining of more than one of these "composite" bottles.

2.0 APPLICATION

This SOP applies to all laboratory activities that comprise the compositing and sub-sampling of NPS composite sample bottles.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The compositing and sub-sampling of composite sample bottles may involve contact with contaminated water. Skin contact with sampled water should be minimized by wearing appropriate protective gloves, clothing, and safety glasses. Avoid hand-face contact during the compositing and sub-sampling procedures. Wash hands with soap and warm water after work is completed.

4.0 DEFINITIONS

4.1 **"Composite" sample bottle:** A borosilicate glass bottle that is used to collect multiple samples over the course of a storm (a composite sample).

4.2 **Large-capacity stirrer:** Electric motorized "plate" that supports composite bottle and facilitates the mixing of sample water within the bottle by means of spinning a pre-cleaned magnetic stir-bar which is introduced into the bottle.

4.3 **Stir-bar:** Pre-cleaned teflon-coated magnetic "bar" approximately 2-3 inches in length which is introduced into a composite bottle and is spun by the stirrer, thereby creating a vortex in the bottle and mixing the sample.

4.4 **Sub-sampling hose:** Two pre-cleaned ~3-foot lengths of Teflon tubing connected by a ~2-foot length of silicon tubing. Used with a peristaltic pump to transfer sample water from the composite sample bottle to sample analyte containers.

4.5 **Volume-to-Sample Ratio (VSR):** A number that represents the volume of water that will flow past the flow-meter before a sample is taken (usually in liters but can also be in kilo-cubic feet for river deployments). For example, if the VSR is 1000 it means that every time 1000 liters passes the flow-meter the sampler collects a sample (1000 liters of flow per 1 sample taken). Note: The VSR indicates when a sample should be taken and is NOT an indication of the sample size.

5.0 EQUIPMENT

5.1 Instrumentation: Not applicable

5.2 Reagents: Not applicable.

5.3 Apparatus:

1) Large capacity stirrer.
2) Stir bar.
3) Sub-sampling hose.
4) Peristaltic pump.

5.4 Documentation: Information from the field logbook should include the volume-to-sample ratio for each composite sample bottle, each bottle's ID number, and the time of the last sample taken at a particular sampling site (for purposes of holding times). Previous documentation should exist for the cleaning batch numbers for the 20-L bottles and the sub-sampling hoses.

6.0 COMPOSITING AND SUB-SAMPLING PROCEDURES

Compositing sample water prior to sub-sampling may be necessary if more than one composite sample bottle was filled (or partially filled) during the course of a storm at a particular sampling site. Care must be taken to ensure that no contaminants are introduced at any point during this procedure. If the compositing is not performed with this in mind, the possibility for the introduction of contaminants (i.e., from dust, dirty sub-sampling hose tips, dirty fingers/gloves, engine emissions, etc.) is increased significantly.

6.1 Determining the Fraction of Each Sample Bottle to be Composited: This is essential to producing a composite that is representative of the entire storm sampled and is not biased/weighted toward the first part of the storm (Bottle 1) or the last part of the storm (last bottle). In general, either the bottles have been sampled using the same volume-to-sample ratio (VSR), OR the VSR has been increased for the Bottle 2 in order to prevent over-filling of another bottle; this happens when the amount of rainfall and resulting runoff volume was underestimated.

6.1.1 Consult the field logbook and confirm that the bottles are from the same sampling station. Inspect the bottles' "ID" tags and confirm that the volume-to-sample ratio (VSR) numbers are the same as in the logbook.

6.1.2 If both bottles have the same VSR then equal parts of each sample should be mixed.

6.1.3 If the VSR of Bottle 2 is double that of Bottle 1 then 2-parts from Bottle 2 should be mixed with 1-part from Bottle 1. This is because Bottle 1 is, in a sense, twice as concentrated as Bottle 2, having sampled half as much flow per sample aliquot.

6.1.4 If there are more than two bottles to composite simply follow the rules above but apply it to all three bottles. For example, if Bottles 1, 2, and 3 had VSRs of 100, 200, and 400, respectively, then the composite would be composed of 4-parts from Bottle 3, 2-parts from Bottle 2, and 1-part from Bottle 1.

6.1.5 Volume-to-Sample Ratios are typically multiples of each other and are rarely fractions of each other. This is simply to make compositing bottles with different VSRs easier.

6.1.6 Rarely does an instance occur in which the VSR of Bottle 1 is HIGHER than that of Bottle 2. The only reason for this would be if the runoff was grossly overestimated and "Sample Control" instructed a field crew to pull Bottle 1 early and lower the VSR for Bottle 2.

6.2 **Determining Water Volume Needed and the Fate of Any Excess Water:** Compositing multiple composite bottles can often be done using only those bottles, or may require "dirtying" or "sacrificing" a clean composite bottle. The different reasons are described below.

6.2.1 **Determine sample volume needed:** The minimum volume of sample water needed for filling the numerous sample analyte containers must be known, or calculated on the spot. This is done by simply adding up the volumes of all sample containers to be filled. If there is not enough sample water (after compositing) to fill all the containers then consult with the project manager to determine what the order of priority is for the analyses (i.e., in what order to fill the containers). It is also useful to know the absolute minimum sample volumes needed by the laboratory to perform each analysis; some sample containers may not need to be filled completely.

6.2.2 **Determine if excess water is to be saved:** If the composite bottles are mostly full then it is likely that much of the sample water will be left over from the sub-sampling process. In this case it is sometimes prudent to save the left over sample water (on ice) for several days in case problems occur with the laboratory and more water is needed. Always check with the project manager on this point because it may require dirtying (sacrificing) a clean composite bottle to make the composite in. If any excess water is not to be saved then compositing can always be done in the existing composite sample bottles: while being homogenized on a stir plate the excess sample water is simply discarded (pumped out in a calculated fashion), making room for the final composite.

6.2.3 **Plan on making as large a composite as possible:** If, for example, only 8 liters of sample water are needed but there is enough water to make a higher volume composite then it is prudent to do so. This is to account for any accidental spills and, if required, to the save enough excess water for possible re-analysis. There generally will never be a need to make a composite greater than a single 20-L composite bottle.

6.2.4 **If only one composite bottle exists from a station:** Simply follow the procedures for sub-sampling into numerous sample containers described in Section 6.5.

6.3 **Compositing Without Saving Excess Water:** This procedure also applies to instances in which there may not be excess water. For the sake of clarity an example will be used to explain the following steps. In this example three 20-L composite bottles are involved in creating a composite: Bottle 1 has 20 liters of sample water and was filled at a Volume to Sample Ratio (VSR) of 100; Bottle 2 has 20 liters and a VSR of 200; Bottle 3 has 20 liters and a VSR of 400. Sample water will be composited in Bottle 3. Most bottles have 1 liter graduations; if some don't then sample depth must be used to figure the fraction of water to be transferred.

6.3.1 Carefully place Bottle 3 on a large spin plate and gently drop a pre-cleaned stir-bar into the bottle and adjust the speed of the spin plate to optimize the mixing of the sample water throughout the bottle. The speed at which the stir-bar is spun should be adjusted so that even mixing is achieved. Speeds that are too fast will create a large vortex within the composite bottle that can actually concentrate heavier particles and should be avoided. Settling on a particular speed is based on a subjective visual assessment of what speed produces the most even, random mixing throughout the composite bottle.

6.3.2 Install a pre-cleaned sub-sampling hose into a peristaltic pump. Carefully remove the plastic cover which protects the approximately 18 inches of its exterior surface which has been cleaned. Insert this end into Bottle 3. Uncap the other end of the sub-sampling hose and ready it over a waste bucket.

6.3.3 While being mixed on the stir plate pump 10 liters into the waste bucket, leaving 10 liters in Bottle 3. This is best performed by two people. One person is responsible for filling the waste bucket and one person is responsible for moving the intake tubing up and down in the water column of the composite sample and controlling the pump. Based on experimental evidence, this up and down movement of the intake helps obtain (or, in this case discard) a more representative sample. This is because there can still be some stratification of heavier particles in the sample bottle despite the mixing created by the stirrer. The up and down movement of the intake tubing should be limited to 80-90 percent of the water depth and should never touch the bottom of the sample bottle.

6.3.4 Remove Bottle 3 from the stir plate and replace with Bottle 2 and insert a new stir-bar and mix as described in Section 6.3.1. Keeping the sub-sampling hose clean (avoid setting it down or bumping it into objects), insert the intake end into Bottle 2. Using the methods described in Section 6.3.3 pump only 5 liters from Bottle 2 into Bottle 3, making a total of 15 liters. **NEVER INSERT THE "DIRTY" EFFLUENT END OF THE HOSE INTO ANY BOTTLE.**

6.3.5 Repeat the actions in Section 6.3.4 with Bottle 1, pumping only 2.5 liters of Bottle 1 into Bottle 3, making a total of 17.5 liters of composited water.

6.3.6 Note that this process cannot generate any excess composite water because there is none left from Bottle 3 that has not been contaminated in the waste bucket.

6.4 **Compositing While Also Saving Excess Water:** This is identical to the procedures described in Section 6.3 with one difference: the first 10 liters of Bottle 3 is pumped into a clean 20-L bottle instead of into a waste bucket. This "dirties" a fourth bottle but ensures that excess sample water can be kept and composited again, if desired.

6.5 **Sub-sampling Composited Water into Sample Containers:** This is the final stage in successfully filling a suite of sample analyte containers with composited water that is representative of an entire sampling event.

6.5.1 Place the composite bottle containing the composited water on the stir plate and achieve proper mixing.

6.5.2 Uncap and arrange all the sample containers to be filled in such a way that they can be easily filled. Due to the vibration of the peristaltic pump on the sub-sampling hose it takes a very steady hand to efficiently guide the stream of sample water into the containers. **NEVER INSERT THE "DIRTY" EFFLUENT END OF THE HOSE INTO THE SAMPLE CONTAINERS.** It is often necessary to steady the sample containers with a second hand so they do not fall over.

7.0 PERSONNEL

Only personnel that have been trained in the use of the proper safety equipment, as per the are allowed to complete this task. . The Laboratory Supervisor is responsible for training personnel in the proper procedures in composite sample bottle, teflon sample hose and silicon peristaltic tubing, and stir bar cleaning.

8.0 QUALITY ASSURANCE REQUIREMENTS

The composite sample bottles and sub-sampling hoses must have been evaluated ("blanked") for contaminants after their initial decontamination procedure.

GENERAL FIELD SAMPLING PROCEDURE FOR:

Grab Samples

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the procedures involved in the discrete manual sampling (grab sampling) of storm water for a nonpoint source (NPS) monitoring program. The purpose of these procedures is to ensure contaminant free samples, and to ensure the safety of the personnel involved.

2.0 DEFINITIONS

2.1 **Sample Containers** – any EPA or laboratory specified clean container that is used to collect sample water.

2.2 **Grab Pole** – used to obtain grabs from locations where it is impossible or too dangerous (fast current, storm drain pipe, etc.) to manually obtain a sample.

3.0 PERSONNEL

Only personnel that have been trained in the use of the proper safety equipment are allowed to complete this task. Training needs to include the proper sampling techniques and station hazards that will be encountered while performing this task. The Project Manager is responsible for training personnel in these procedures.

4.0 EQUIPMENT

4.1 **Instrumentation** – see section 12.0 Physical Parameters

4.2 **Reagents** – preservatives will be supplied by the laboratory that supplies the sample bottles. Usually, the preservative is a concentrated acid (HNO_3, H_2SO_4, HCl or other).

4.3 **Apparatus** – a telescoping grab pole with a bottle holding device secured to one end. The bottle holding device is made of plastic and Velcro. It is designed to hold in place sample bottles of various sizes and types.

4.4 **Documentation** – time, date, location, number of containers and type of grab (whether for chemical analysis or physical parameters) must be noted in the station log book for that station.

5.0 PROCEDURES

Grab sampling methods will be discussed for the following analytes:

Metals and Total Cyanide

Oil and Grease

Fecal Coliform and Fecal Streptococci

Volatile Organic and Aromatic Compounds (VOA's)

Organic Compounds (Pesticides, PAHs, PCBs, SVOCs, etc.)

Physical Parameters

6.0 GRAB SAMPLING TECHNIQUES

6.1 Grab sampling may be conducted at any time during the storm event, depending upon the specific project requirements. The type of grab study might vary as the storm season progresses and the scope requirements deem necessary. These might include:

6.1.1 **Discrete Grabs** – Taken once during the storm event at a predetermined time, usually at peak flow.

6.1.2 **Persistent Grabs** – A schedule of discrete grabs which continue through the end of the storm to show a rate of change over time.

6.1.3 **First Flush** – A type of discrete grab to be taken within the first thirty minutes of the storm event.

For the majority of grab sample studies, discrete grabs will be required. Grabs will be taken on the rising hydrocurve of the storm event and as close to peak stage as is feasible. The times of these grabs will be decided by the Storm Control and/or Shift Leader and will be relayed to the field crews.

6.2 Depending upon then type of analyte being sampled, the technique may vary but all sampling **MUST** follow these general rules to minimize contamination:

6.2.1 Grab bottles are to be filled as near to the intake as is safely possible.

6.2.2 When unable to obtain a sample near the intake, take one as near to the center of flow as possible or in an area of sufficient velocity to ensure good mixing

6.2.3 The field personnel taking grab samples must be standing downstream from the sample bottle when filling.

6.2.4 The mouth of the bottle must be facing into the current.

6.2.5 Raise and lower the bottle through the water column so the sample is not biased with only one level sampled.

6.2.6 Manhole sites and inaccessible stream sites are best sampled with a grab pole.

7.0 METALS AND TOTAL CYANIDE

Samples to be analyzed for metals and cyanide are grabbed in a plastic or Teflon® container. Metals and total cyanide will require a preservative in the container (see Section 4.2). These grabs require extra care so as to not overfill the container and spill out any of the preservative, or allow the preservative to come into contact with the skin.

Metals sample bottles contain an acid preservative (HNO_3) and total cyanide sample bottles contain a base ($NaOH$) for a preservative. When the grab container is being filled manually, the level of water can be watched so the container is not overfilled. When the sample cannot be taken by hand and must be taken with a grab pole, the filling becomes a bit more difficult. Lower the container with the grab pole and watch for escaping air bubbles when submerged. Pull the sample bottle out frequently to check the water level accumulated and quit filling when that level has reached the "shoulder" of the bottle. Be sure **NOT TO OVERFILL THE SAMPLE BOTTLE**; this would spill the preservative compromising the sample and possibly endangering the person sampling.

8.0 OIL AND GREASE

Oil and grease samples are very similar to metals in that the bottles contain preservative and **MUST NOT BE OVERFILLED**. Oil and grease analysis requires that the sample be taken in glass containers, usually amber and usually in duplicate (in case of breakage). Fill these containers in the same exact way as mentioned above for metals analysis.

9.0 FECAL COLIFORM AND FECAL STREPTOCOCCI

Fecal coliform and fecal streptococci are usually grabbed in bacteria bottles or urine analysis cups. They contain a residual chlorine removal preservative tablet and should be filled to the sample container fill line when sampling. Wear protective gloves so that there is no skin contact with the interior of the container. The main precaution is not to contaminate the sample when opening the cup. Fill each cup completely and secure the cap.

10.0 VOLATILE ORGANIC AND AROMATIC COMPOUNDS (VOA'S)

Collecting water for Volatile Organic Compounds (VOA) requires extreme care. VOA's volatilize (enter the gaseous phase very quickly), thus, sample vials are designed to prevent this. These vials will leave no headspace (air bubbles) in a properly filled container because they have a septa cap , thereby minimizing loss of analyte to the atmosphere.

To fill a VOA vial, lower it into the water column and allow it to **FILL UP COMPLETELY** (until a water dome is formed over the top of the vial). VOA's must be preserved with HCl so take extra care not to spill any of this preservative. Very carefully place the septa cap onto the vial so no air is introduced, start with the cap tilted to one side and gently lower it until it is seated onto the threads of the vial and secure. Make sure there is no air in the vial by inverting the sample. If air bubbles show, a new sample must be taken using a new vial and the bad container and sample must be returned to the lab for proper disposal. **See Section 13.0 for additional precautions to be taken with VOA vials.**

11.0 ORGANIC COMPOUNDS (PESTICIDES, PAHs, PCBs, SVOCS, etc.)

Organic compound samples are collected in glass containers, usually amber. These samples generally do not require preservatives but should be filled in the same way as those collected for metals, and oil and grease analyses.

12.0 PHYSICAL PARAMETERS

Each time a station is visited during a storm event, certain physical parameters must be measured. Generally, at a minimum, pH and temperature are measured. Follow the instructions that are included with the field instrumentation used for the best results. There are many different brands of meters that require different techniques.

Take the measurements as close to the grab sampling point as possible while keeping safety a priority. A grab sample may be taken and analyzed somewhere more convenient and safe than the stream edge. Remember that the analysis on a grab sample should be performed “as soon as possible” to ensure as accurate measurements (pH, temperature, etc.) as possible. Record all results in the log book for that station and be sure to write in the units of measurement.

13.0 QUALITY CONTROL LIMITS

Grab sample containers must come from a reputable distributor and be certified clean for the analyte to be sampled. They must also be properly preserved and labeled prior to sampling. Transport the bottles in clean coolers accompanied with any required paperwork or instructions.

Immediately upon completion of sampling, return the sample bottles to a clean cooler and ice them down to 4°C. Recheck to be certain that all the information on the label is correct (date, time, location, analysis, preservative, etc.). Fill out the required paperwork and station log book sheets and transfer the samples to a predetermined pick-up location for the Analytical Laboratory.

13.1 For some storm sampling events, different Quality Assurance and Quality Controls (QA/QC) will be implemented. These will include:

13.1.1 Field Duplicates – Additional set of sample bottles grabbed at the same location and time as the actual sample. This sample may be given its own mock station identification and be submitted to the Analytical Laboratory blind.

13.1.2 Field Blanks – This is a full set of sample bottles (usually minus TSS and turbidity) containing reagent grade analyte free water provided by the Analytical Laboratory that will be doing the analysis. These samples are poured by hand from clean bottles containing the blank water into a labeled sample container. These sample bottles may be given a mock station identification and submitted blind as well.

13.1.3 Trip Blanks – Usually required for very sensitive samples (VOA’s). The Analytical Laboratory will provide sample bottles already filled with reagent grade analyte free water that will make the full “trip” from the lab, out into the field and back into the lab. **THESE CONTAINERS ARE NOT TO BE OPENED**.

Trip blanks are only analyzed if contamination is suspected. If analyzed and contamination is found, they usually warrant further investigation and subsequent sampling.

13.1.4 **Matrix Spiking and Lab Replicates** – These analyses can usually be taken from a sample bottle already sent into the field and do not require extra bottles, however, extra volume may be required at these stations.

13.2 While performing or preparing for grab sampling, be sure that no “outside” contamination will occur:

13.2.1 No engines are running in the general vicinity of sampling.

13.2.2 Sample containers are clean and intact.

13.2.3 Sample containers are properly labeled and meet bottle requirements for that analyte (size, type, preservative, type of cap liners, etc.).

13.2.4 Sample techniques are proper and safe.

13.3 **Volatile Organic and Aromatic Compounds (VOA’s)** – require very special handling.

13.3.1 VOA vials are very fragile. Protect with adequate foam packing material.

13.3.2 VOA bottles should have no headspace (see Section 10.0). This means that they are subject to freezing. **Prevent direct contact of VOA vial with ice by using additional packaging.**

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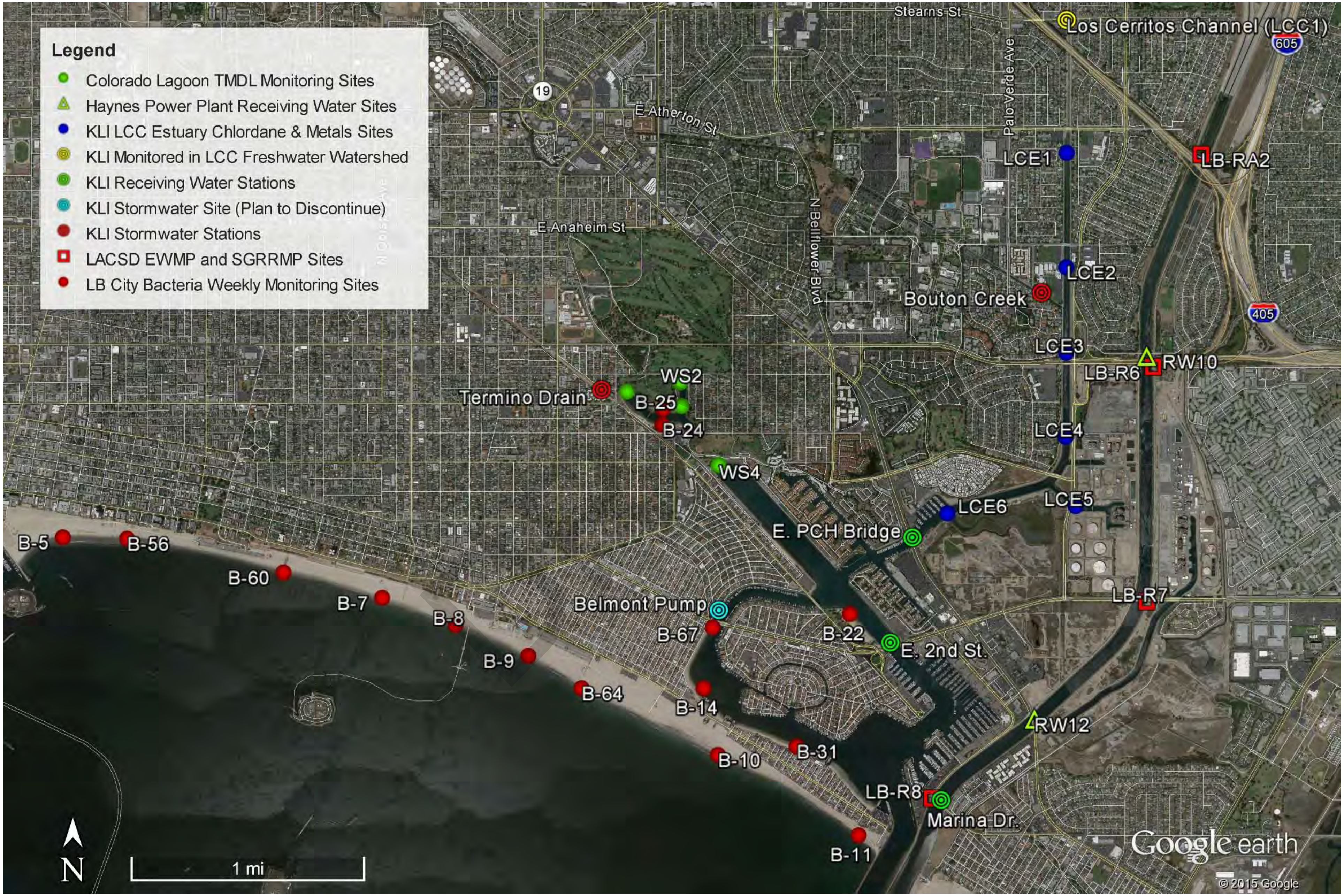
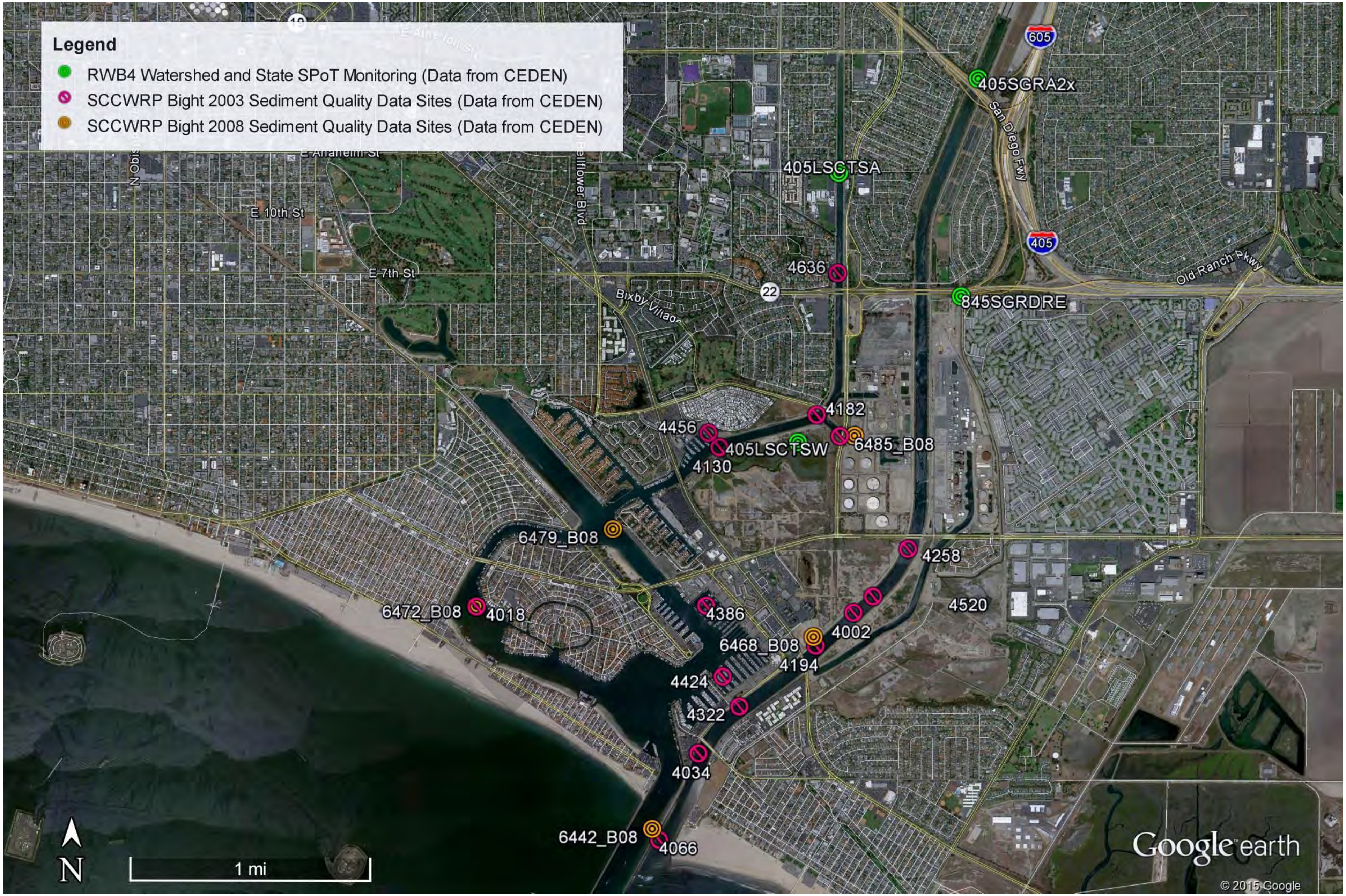
APPENDIX G

REGIONAL DATA SOURCES

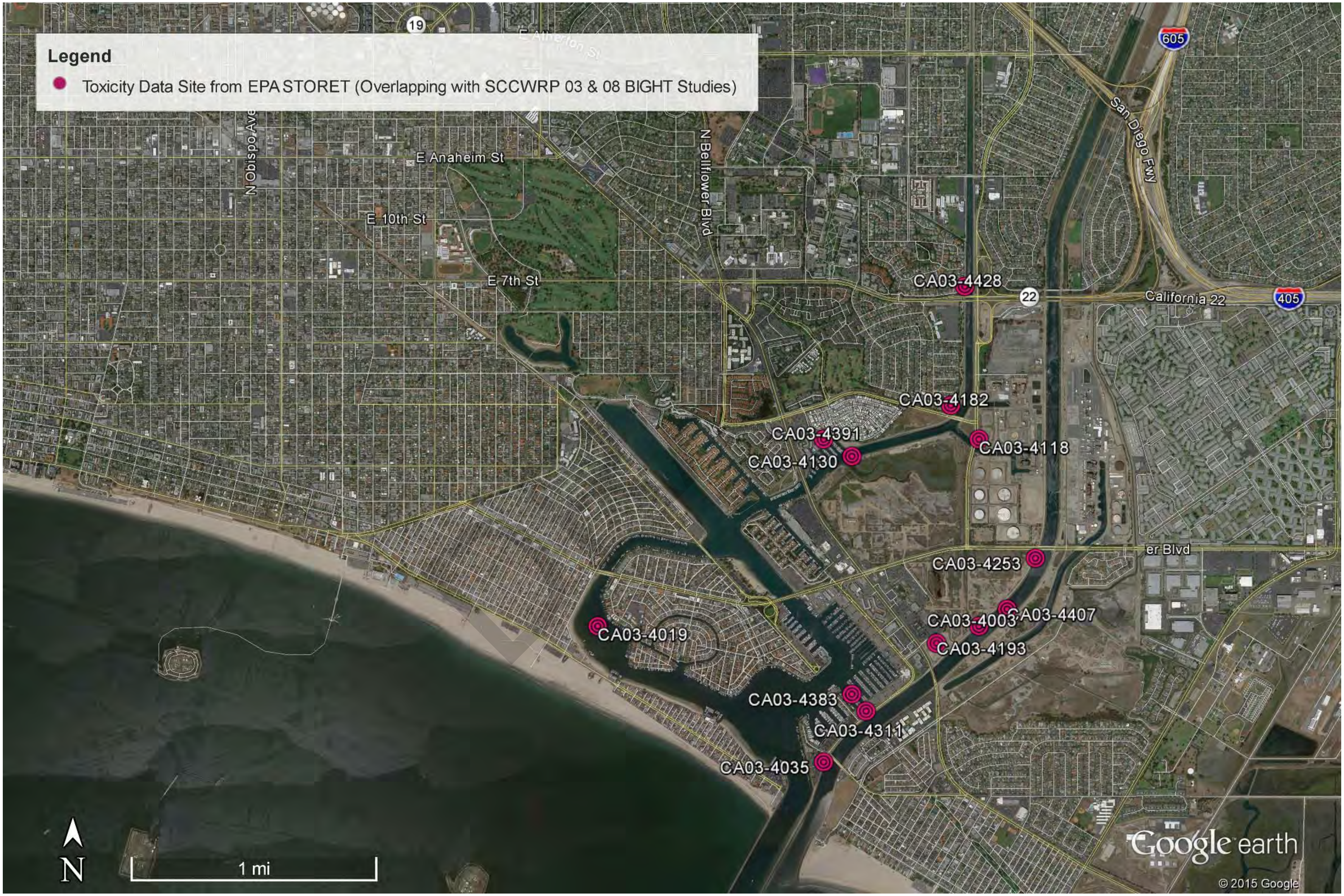
Station Map 1

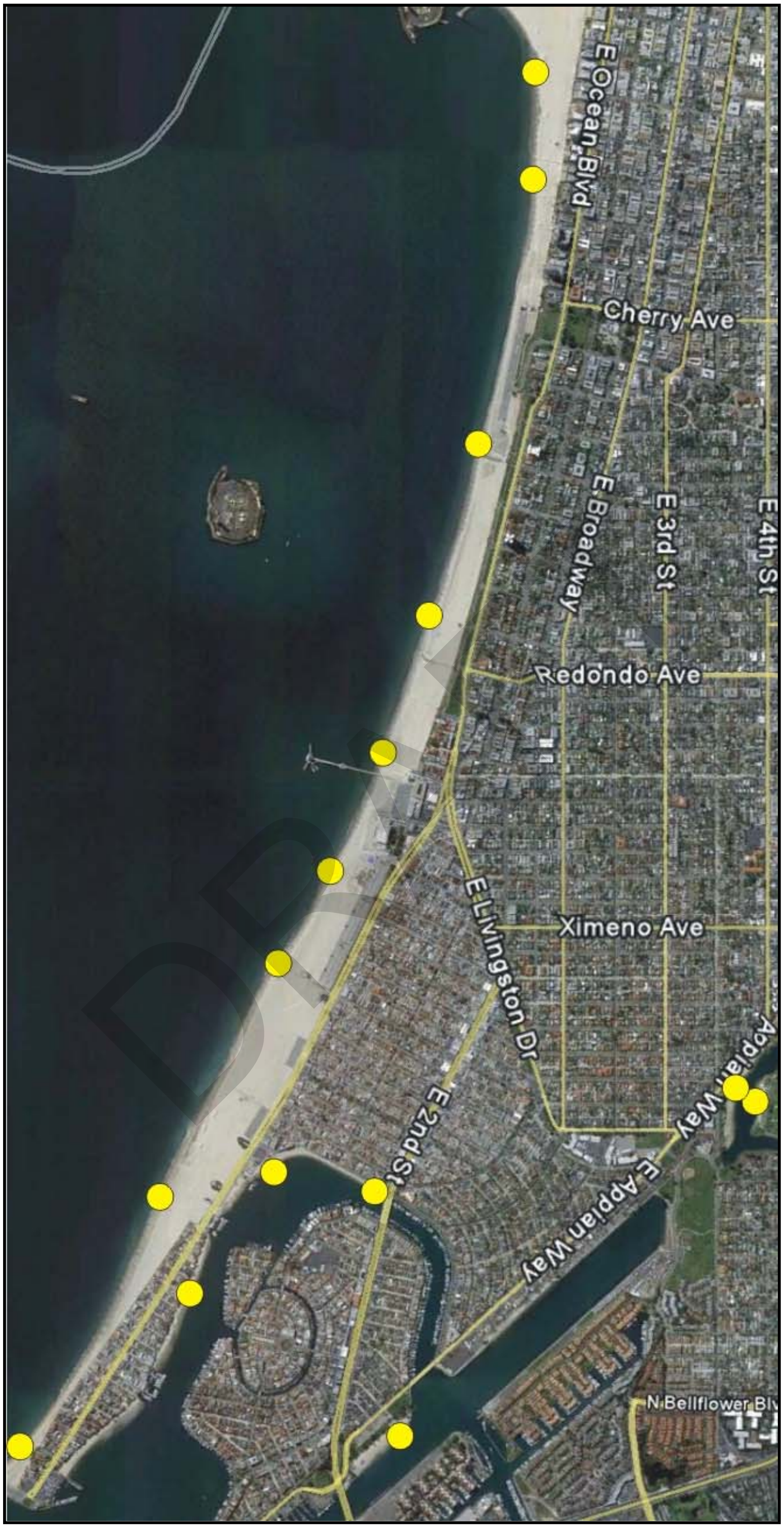


Station Map 2



Station Map 3





City of Long Beach Indicator Bacteria Monitoring Locations

LCC, AB, SGR Estuary Station Locations, Chemistry and Toxicity Data References, and Web Links

The Southern California Coastal Water Research Project (SCCWRP) 2003 Bight Data	http://www.sccwrp.org/Data/SearchAndMapData/DataCatalog/Bight03Survey.aspx
The Southern California Coastal Water Research Project (SCCWRP) 2008 Bight Data	http://www.sccwrp.org/Data/SearchAndMapData/DataCatalog/Bight08Survey.aspx
City of Long Beach Stormwater Management Final Monitoring Reports & Shoreline Bacteria Data	http://www.longbeach.gov/pw/stormwater_management/reports.asp
1999-2000 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2000. City of Long Beach Stormwater Monitoring Report 1999-2000 NPDES Permit No. CAS004003 (CI 8052), July, 2000 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28563
2000-2001 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2001. City of Long Beach Stormwater Monitoring Report 2000-2001 NPDES Permit No. CAS004003 (CI 8052), July, 2001 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28564
2001-2002 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2002. City of Long Beach Stormwater Monitoring Report 2001-2002 NPDES Permit No. CAS004003 (CI 8052), July, 2002 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28565
2002-2003 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2003. City of Long Beach Stormwater Monitoring Report 2002-2003 NPDES Permit No. CAS004003 (CI 8052), July, 2003 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28566
2003-2004 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2004. City of Long Beach Stormwater Monitoring Report 2003-2004 NPDES Permit No. CAS004003 (CI 8052), July, 2004 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28571
2004-2005 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2005. City of Long Beach Stormwater Monitoring Report 2004-2005 NPDES Permit No. CAS004003 (CI 8052), July, 2005 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28567
2005-2006 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2006. City of Long Beach Stormwater Monitoring Report 2005-2006 NPDES Permit No. CAS004003 (CI 8052), July, 2006 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28568
2006-2007 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2007. City of Long Beach Stormwater Monitoring Report 2006-2007 NPDES Permit No. CAS004003 (CI 8052), July, 2007 http://www.longbeach.gov/civica/filebank/blobdload.asp?BlobID=28569
2007-2008 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2008. City of Long Beach Stormwater Monitoring Report 2007-2008 NPDES Permit No. CAS004003 (CI 8052), July, 2008.
2008-2009 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2009. City of Long Beach Stormwater Monitoring Report 2008-2009 NPDES Permit No. CAS004003 (CI 8052), July, 2009. Appendix C - Los Cerritos Channel Chordane and Metals Sediment Survey.pdf
2009-2010 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2010. City of Long Beach Stormwater Monitoring Report 2009-2010 NPDES Permit No. CAS004003 (CI 8052), July, 2010
2010-2011 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2011. City of Long Beach Stormwater Monitoring Report 2010-2011 NPDES Permit No. CAS004003 (CI 8052), July, 2011
2011-2012 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2012. City of Long Beach Stormwater Monitoring Report 2011-2012 NPDES Permit No. CAS004003 (CI 8052), July, 2012
2012-2013 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2013. City of Long Beach Stormwater Monitoring Report 2012-2013 NPDES Permit No. CAS004003 (CI 8052), July, 2013
2013-2014 City of Long Beach Stormwater Final Report	Kinnetic Laboratories, Inc. 2014. City of Long Beach Stormwater Monitoring Report 2013-2014 NPDES Permit No. CAS004003 (CI 8052), July, 2014
City of Long Beach Weekly Shoreline Bacteria Data	http://www.longbeach.gov/health/eh/water/water_samples.asp
Bay Protection and Toxic Cleanup Program (BPTCP) Region 4 Data and Station Locations	http://www.swrcb.ca.gov/water_issues/programs/bptcp/data.shtml
Los Angeles County Sanitation District	LACSD EWMP Data Request file (xls), from the Los Angeles County Sanitation District (LACSD) NPDES Monitoring Database for the San Gabriel River, 12/22/2012. Only data pertinent to the Long Beach Water Reclamation Plant receiving water in the lower San Gabriel River Estuary.

San Gabriel River Regional Monitoring Program Annual Reports	
San Gabriel River Regional Water Monitoring Program 2007 Annual Report	Aquatic Bioassay & Consulting Laboratories. 2008. San Gabriel River Regional Monitoring Program Annual Report - 2007, Sept. 2008 http://watershedhealth.org/Files/document/449_SGRRMP%202007%20Report.pdf
San Gabriel River Regional Water Monitoring Program 2008 Annual Report	Aquatic Bioassay & Consulting Laboratories. 2009. San Gabriel River Regional Monitoring Program Annual Report - 2008, Sept. 2009 http://watershedhealth.org/Files/document/531_SGR%20annual%20report%202008%20_14.pdf
San Gabriel River Regional Water Monitoring Program 2009 Annual Report	Aquatic Bioassay & Consulting Laboratories. 2010. San Gabriel River Regional Monitoring Program Annual Report - 2009 http://watershedhealth.org/Files/document/606_SGR_annual_report_2009%20(FINAL).pdf
San Gabriel River Regional Water Monitoring Program 2010 Annual Report	Council for Watershed Health and Aquatic Bioassay & Consulting Laboratories. 2011. San Gabriel River Regional Monitoring Program Annual Report - 2010 http://watershedhealth.org/Files/document/773_SGR_annual_report_2010.pdf
San Gabriel River Regional Water Monitoring Program 2011 Annual Report	Council for Watershed Health and Aquatic Bioassay & Consulting Laboratories. 2012. San Gabriel River Regional Monitoring Program Annual Report - 2011 http://watershedhealth.org/Files/document/797_SGRRMP_2011_Rpt[2].pdf
San Gabriel River Regional Water Monitoring Program 2012 Annual Report	Council for Watershed Health and Aquatic Bioassay & Consulting Laboratories. 2013. San Gabriel River Regional Monitoring Program Annual Report - 2012 http://www.watershedhealth.org/Files/document/868_SGRRMP_2012_Final%20Draft.pdf
City of LA Department of Water and Power Haynes Generating Station NPDES Permit	http://www.waterboards.ca.gov/water_issues/programs/tmdl/records/region_4/2008/ref2735.pdf
CLADWP Haynes PS Receiving Water Data 2003 - 2004	http://www.waterboards.ca.gov/water_issues/programs/tmdl/records/region_4/2008/ref2734.xls
California Environmental Data Exchange Network (CEDEN)	http://www.ceden.us/AdvancedQueryTool
EPAs My WATERS Mapper Site	http://watersgeo.epa.gov/mwm/?layer=305B&feature=CAR4051600020000229163853&extraLayers=null

APPENDIX H

BENTHIC INFAUNA FIELD SAMPLING

AND

BIOLOGICAL LABORATORY PROTOCOLS

VEEN GRAB – OPERATION AND SAMPLE COLLECTION

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the operation and collection of sediment samples with a Van Veen or Ponar grab. Various models of these grabs are available to the scientific community; this SOP refers to a modified Van Veen (sometimes referred to as a Young grab) which is equipped with a stabilizing frame and to the smaller hand operated Ponar grab. The purpose of this SOP is to ensure the proper operation and collection of samples and decontamination procedures used during the collection of samples for scientific analyses and to ensure the safety of personnel involved. Some procedures presented in this SOP (e.g. solvent cleaning) may not apply to all programs and will need to be addressed in the project specific sampling plan.

2.0 APPLICATION

This SOP applies to the collection of all sediment samples with either a Van Veen or Ponar grab including samples destined for physical, chemical, geological, and biological analyses.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Proper safety procedures should be followed for the lifting, deployment, and retrieval of all gear, including the Van Veen grab. Proper hand signals should be used to direct the hydraulics operator at all times. In addition, the grab should be secured when not in use. The modified Van Veen grab is heavy (~200 lbs) when loaded with sediment and requires mechanical or hydraulic lifting when being deployed or retrieved whereas the small petite Ponar is only 25 lbs and may be manually deployed and retrieved and does not require a grab stand.

The grab stand should be tied down securely to the boat; the grab can then be tied to the stand. When underway, the scissor arms of the grab should be tied to one side of the frame so that they do not swing or become damaged with the rolling motion of the survey vessel.

The scissor mechanism of the grab is a potential hazard; care should be taken when cocking and cleaning the grab to avoid accidents. Also, the jaws of the grab come together with some force because of the weight of the grab. Avoid placing your fingers or hands between the jaws of the grab. Should the grab trip in air because of a sudden slacking of the line, the grab will drop some distance. Avoid getting under the grab or any other suspended equipment. The use of protective grip gloves is recommended while working with this grab. Also, when utilizing overhead lifting with an A-frame, boom, or davit, personnel should wear hard hats and safety glasses.

Decontamination chemicals/solvents and sample preservatives are hazardous substances and should be handled with caution. Protective gloves and safety glasses should be worn while using these substances. The Material Safety Data Sheets for each material should be reviewed for specific safety information. Solvent waste must be collected in approved, labeled containers and disposed of properly. Proper handling of solvents and/or sample preservatives including gloves, safety glasses, and respiratory protection if necessary should follow the guidelines specified in the KLI's Chemical Hygiene/Hazardous Communication Program and Respiratory Protection Training Program. Since the previous sampling efforts in the area have determined that the sediment contaminant concentrations are at or near background levels, no chemical solvents will be utilized on this program. Cleaning of the grab for chemical analyses will utilize a dilute Alconox solution per Army Corps of Engineers dredge material sampling guidelines.

4.0 DEFINITIONS

N/A

5.0 EQUIPMENT

The Van Veen grab and associated sampling utensils (scoops, spoons, etc.) are constructed of stainless steel and are generally coated with Teflon or similar coating (Kynar or Halar). This coating allows for the collection of sediments uncontaminated by trace metals and allows for easy cleaning for organic contaminants such as oil and grease.

The grab itself consists of two halves which make up a semi-circular bucket when the grab is in the closed position. These halves are joined together by a hinge; the pin through this hinge is secured to the frame which supports the grab. The top of each half of the grab consists of a hinged door. These doors are lifted to view and subsample the grab's contents. They are usually secured with small cams or wing nuts on each door corner.

The grab mechanism consists of a scissor-like arrangement. When the grab is open (cocked), the scissors are in the collapsed position. The grab is held open in this position by the use of pins and hooks on the scissor arms. When the grab is in the closed (tripped) position, the scissors are in the extended position. The grab line is attached to the top of the scissor arrangement with a shackle and swivel.

The Van Veen frame provides stability during sampling and facilitates deployment and retrieval of the grab. The frame consists of a circular base with a four-cornered vertical frame extending upward from it. The grab rests within this frame, secured by the center pin as noted above. The line which suspends the grab (hauling line) feeds through a hole in the top of the frame and is attached to a swivel which is shackled to the grab line. This swivel allows the grab (and frame) to rotate without kinking the hauling line.

The grab is deployed in the cocked position with tension on the line. When this tension is released as the grab hits the sea floor, the hook and pin arrangement is released. When tension is again exerted on the line, the scissor arms are pulled into the upright position. This causes the grab halves to close, enclosing the sediment sample inside.

The grab generally is used with a wooden grab stand, which serves as a platform on which to perform cleaning, sampling, and cocking operations. This stand is open so that discarded sediment may be released into a pan placed below the grab. Also, a catch pan for solvents is placed under the grab stand during solvent rinsing, if applicable, to allow proper collection and disposal of the solvent waste.

6.0 PROCEDURE

6.1 GRAB DECONTAMINATION

Decontamination of the Van Veen grab must be performed directly prior to the collection of chemistry samples. For physical, geological, or biological sample collection, it is unnecessary to decontaminate the grab other than a thorough wash to remove sediment particles. As per the 2013 *Dredged Material Evaluation and Disposal Procedures* produced by the Dredged Material Management Office, U.S. Army Corps of Engineers, Seattle District, the grab will undergo a site water rinse, Alconox wash, site water rinse, and triple DI rinse prior to use on chemistry samples. When washing or rinsing the grab, it is important to clean all surfaces which come into contact with the sample. This includes the inner surfaces of the bucket, including the inner portions of the hinged lids.

In areas where no surface sheen or contamination is visible, the sampler is subject to the following general decontamination procedures prior to each deployment at a station as follows: These procedures should be used as general guidelines for decontamination of the Van Veen grab and associated sediment sampling utensils. Since no significant sediment contamination is expected, no other cleaning agents will be necessary for decontamination. If an obvious contaminant is present at site or on the grab, the rinsate solution used to decontaminate the grab must be contained and kept for proper disposal. All other equipment rinsate solutions, including Alconox solutions, should be disposed of as close as possible to original grab location since Alconox is water soluble, biodegradable and has been approved for environmental use by the U.S Department of Agriculture.

If other solvents or acids were to be used for decontamination, proper disposal, containment, and personal protective equipment protocols must be utilized. When rinsing the grab with solvents or acid, a basin is placed below the grab for collection of the waste; this waste material is subsequently transferred to a waste container. Separate containers and catchment basins should be utilized for solvent and acid waste material. In areas where a surface sheen or slick is visible or there is visible oil on the grab, the grab should be wiped clean and subject to detergent washing prior to following the above steps. This includes a detergent wash between each drop of the equipment (i.e., replicate drop) if a surface slick is present.

6.2 SAMPLE COLLECTION

6.2.1 Cocking of the Van Veen Grab

After decontamination of the grab, the grab must be cocked. The doors are first secured, using the cams or wing nuts provided, in the closed position. The grab is cocked by pulling the scissor arms into the collapsed position and engaging each of the two hooks over the pin on the opposite arm. There must be tension on the grab line in order to maintain this cocked position.

6.2.2 Deployment and Retrieval of the Van Veen Grab

The Van Veen grab is deployed using a crab block, winch, capstan, or other hydraulic hauling system. A smaller grab such as the petite Ponar may be lowered and retrieved by hand. The boat deck wash hose should be used during deployment and retrieval of the grab if a visible surface sheen is seen to keep it away from the grab as it enters and exits the water.

To deploy the grab, any slack in the line is first removed in order to keep the grab in the cocked position. The grab is then lifted above the rail and swung free of the boat. The line is then lowered to the bottom until it goes slack. At this time, haul back on the line is commenced.

The grab is retrieved by hauling back on the line at a rate of approximately 1 m/s. When the grab nears the surface, the haul back is slowed. The grab is brought up until it clears the rail and is then brought inboard and placed on the grab stand. The grab should be in the closed (tripped) position; the bucket should be closed and the scissors should be in the extended position.

6.2.3 Determination of Grab Success

This type of bottom grab is utilized to obtain samples of minimally disturbed bottom sediment. Visual inspection of each grab is necessary to determine adequacy of each cast. Successful grabs must have adequate penetration and water overlying the sediment surface. Unsuccessful grabs are discarded. Over penetration of the grab may also be a reason to discard the sample if sediment has pushed through the top of the grab or the sediment surface appears disturbed.

Proper penetration is dependent upon the sediment type (substrate) as well as the volume of sample required. For most sampling programs, the top 2-cm of sediment is collected for chemical and physical analysis. Infaunal (benthic) samples usually require the entire grab. Because of the semi-circular construction of the grab, the surface volume of top 2-cm sediment obtainable is dependent upon the depth of penetration of the grab. The greater the penetration, the greater the volume of the sample. Therefore, if a large volume of sediment is necessary from each replicate (or drop of the grab); penetration must be deep enough to provide that volume. Grab penetration may be controlled to a certain degree by weighting the grab or by installation of a bottom baffle plate to control over penetration in extremely soft sediments.

Overlying water should remain in each grab upon retrieval. The presence of this water indicates that the grab was completely closed upon retrieval, thereby excluding sources of potential contamination. In addition, the overlying water protects the sample from physical disturbance during grab retrieval.

6.2.4 Collection of Sediments from the Grab

Sediments are collected from each successful grab as dictated by program protocols. Samples are collected through the hinged doors on the top of the grab. Overlying water is removed from the grab by siphoning through a precleaned Teflon hose using a siphon bulb or allowed to slowly drain. If necessary this Teflon hose is subject to the decontamination procedure as outlined in Section 6.1.

Chemistry samples are removed from the grab prior to the removal of any other type of sample to avoid potential contamination. Samples for Volatile Organic Aromatics (VOA) should be removed from the grab immediately after the overlying water has been siphoned off (i.e., prior to the removal of other chemistry samples). After chemistry samples have been removed, other sample types are taken from the grab. These may include sediment grain size, total organic carbon, mineralogy, microbiology, or toxicity samples. Infaunal samples require a dedicated grab; it is typical to take an entire grab for infaunal analysis.

Chemistry samples are removed from the grab with stainless steel, Teflon or similar coated sampling utensils that have been decontaminated according to procedures outlined in Section 6.1. The top 10 cm of sediment will be utilized for chemical analyses. Sediments taken for chemistry or toxicology are taken away from the surfaces of the grab (i.e., no sediments that have been in contact with the grab surfaces should be used for chemical or toxicological analysis).

6.3 DISCARD OF THE REMAINING SEDIMENT

After all samples have been obtained from the grab, the remaining sediment is discarded. An open basin is placed beneath the grab on the grab stand. The grab jaws are opened by collapsing the scissor mechanism. This allows the sediment to drop out into the basin. The grab is rinsed with seawater from the boat's seawater system to remove all residual sediment. If the sediment is not contaminated and required to be retained, the remaining sediment may be disposed of on-site at the sampling location. The grab is then subject to decontamination procedures as outlined in Section 6.1 and prepared for another drop.

6.4 VAN VEEN MAINTENANCE

The Van Veen grab should be inspected periodically for wear and tear on the scissor mechanism, the doors, the hinge pins, and the Teflon coating. Door wing nuts or cams may need to be replaced. In addition, the line, shackles, and swivel suspending the grab when in operation should be visually inspected to ensure safe operation.

The Teflon, Halar, or Kynar coating of the grab often becomes worn when a grab is subject to heavy use. Re-coating of the grab must be done periodically to ensure adequate coverage of all metal portions of the grab that might come into contact with the sediments.

The center shaft of the grab may be greased periodically to ensure smooth operation. A silicone lubricant approved by program chemists should be used in order to avoid hydrocarbon or other organic contamination of the sediment samples obtained with the grab.

7.0 PERSONNEL

Only personnel that have been trained in the use of the Van Veen grab and in the proper handling of hazardous materials are allowed to complete this task. Training of personnel in the proper handling of the Van Veen grab may take place on a survey vessel under the direction of the crew leader. Training of personnel in safety procedures and handling of hazardous materials must be performed according to KLI=s Safety Program.

8.0 QUALITY ASSURANCE REQUIREMENTS

Decontamination of the Van Veen grab may be checked by performing an equipment rinsate blank where appropriate for chemical analysis. A rinsate blank is obtained by pouring reagent grade deionized water over the inner grab surface and collecting the water into a sample container. The rinsate water may then be analyzed for the contaminants of concern. Collection and analysis of equipment rinsate blanks will vary depending on specific program requirements.

9.0 REFERENCE DOCUMENTS

- KLI’s Chemical Hygiene/Hazardous Communication Training Program
- KLI’s Respiratory Protection Training Program
- MSDSs for solvents and sample preservatives depending on specific program requirements.

VESSEL OPERATIONS FOR VIBRACORE AND VAN VEEN GRABS

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the operation of Kinnetic Laboratories Inc. (KLI) research vessels with a hydraulic A-frame, other sampling platforms (i.e., barges and small boasts), vibracore and related equipment, and Van Veen grab used for sediment sample collection. The purpose of this SOP is to establish the proper operating procedures, thus ensuring the safety of personnel involved.

2.0 APPLICATION

This SOP applies to KLI research vessels used in conjunction with vibracoring and a Van Veen grab for the collection of samples.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Proper safety procedures should be followed for the lifting, deployment, and retrieval of all equipment and gear when using a KLI research vessel to do so.

ALL PERSONNEL ARE REQUIRED TO REVIEW AND SIGN THE SPECIFIC PROJECT SITE SAFETY PLAN

- No alcohol or drug use during or prior to while working on any boat. If you are taking a prescription or over-the-counter medication that may effect your ability to perform some duty, you must notify the captain as soon as possible

NO ILLICIT DRUGS OR ALCOHOL ON BOARD AT ANY TIME – "ZERO TOLERANCE"

- Smoking prohibited
- Move carefully and cautiously. "Unexpected" vessel movement or slippery conditions can result in serious injuries. Each crew is one "hand," that is, one hand for the work of the boat, one hand for yourself. Use handholds and get help rather than risk injury. Wearing grip gloves while working is recommended.
- Wear U.S. Coast Guard approved work vests, float coat, or exposure suit in a closed fashion in skiffs, small boats, or launches unless in an enclosed cabin or cockpit or wherever there is a drowning hazard.
- Never stand under stressed rigging. Do not walk on or straddle rope. Never stand on a loop of line.
- Learn the location and operation of all fire extinguishers.
- Wear appropriate steel-toe boots or shoes.
- Learn the location, access and operation of thru-hull valves and shaft boxes.

- Do not obstruct passageways with gear.
- Learn the location of the first aid kit.
- Do not jump between vessel and docs. Decks can be slippery.
- Use extreme caution when accessing the engine room while the engine is running. Belts, shafts, voltages, and high temperatures are all considerations when entering the engine room.
- Avoid wearing loose clothing or rain gear near winches, tie back long hair.
- Wear safety glasses when appropriate.
- Beware of dangerous or unknown marine organisms on deck.
- If defective or damaged equipment is noticed, report it immediately.
- Do not discharge oil or oily waste overboard. Control and clean-up all spills of fuel, oil or hazardous materials immediately. Wash down area with soap when appropriate and collect wash and rinsate for disposal. No discharges of hazardous materials are allowed.
- Hard hats should be worn whenever heavy objects are being handled by the winch and A-frame.
- Use nonconducting tag lines (without knots in the end) to control a suspended load. Adequate tag lines must be available.
- Stay where the operator can see you.
- Hooks must have safety latches.
- Regular inspection of a winch. Make sure the line wraps smoothly on the drum and has no kinks.
- Proper hand signals should be used to direct the winch operator at all times.
- All shackles will be safety wired.
- Be aware of pinch points and cable spurs.
- Work requiring the use of the vessel will not take place during inclement weather.

4.0 DEFINITIONS

N/A

5.0 EQUIPMENT

KLI research vessels are equipped with full electronics (including Differential GPS), hydraulic A-frame and winches, and with marine sampling equipment for field studies within harbors and inshore coastal waters. The winch cable spools up to the block at the apex of the A-frame and terminates at a chain bridal connection to the vibracore head. All vibracore equipment (generator, speed controller, power cords) or Van Veen grab equipment (grab stand) will be situated on the deck of the vessel.

6.0 PROCEDURE

This procedure outlines the general course of action related to the use of KLI research vessels, vibracore and related equipment, and a Van Veen grab for the purpose of sample collection. All Health and Safety considerations mentioned in Section 3 apply to these procedures.

6.1 KLI RESEARCH VESSEL VIBRACORING

Motoring to sample locations will be done with great care. All equipment and supplies will be secured to avoid shifting and unsafe weight transfer while underway. All vibracore connections will be protected by wrapping with electrical tape. This will prevent water from entering the connection, causing a short within the system.

Once the vessel has reached its destination, it will be positioned on the sampling location and anchored to keep from moving laterally. Once the vessel is anchored on location, the vibracore head will be positioned on the deck using the winch. Care will be taken to keep the work surface area orderly and free of obstructions. The core tube will then be inserted into the clamp and tightened into place. Once the vibracore setup is complete, the operator will carefully lift the vibracore using the winch until it is standing vertical. The vibracore will then be carefully lowered into the water. When bottom is reached, the circuit breaker on the generator will be turned on, the generator will be started and the vibratory mechanism in the vibracore head will be started by pushing the start button on the speed controller and lowered carefully in the sediment.

After the target depth is reached, the vibracore will be stopped by pushing the stop button on the speed controller, turning off the circuit breaker and shutting the generator off. The vibracore will then be carefully pulled out of the sediment. If the pullout is difficult the tube will be vibrated out so that undue strain is not placed on the vessel and equipment. Once out of the sediment, the vibracore will be carefully maneuvered onto the deck and the core tube removed. The tube will be capped, taped, and marked with its proper sample location identification. Care should be taken when lifting and manipulating the core tube, as it will be heavy. After having removed the core, the vibracore will be placed back on deck and secured for transit. Equipment, gear and sample core will be properly secured on the deck before departing for the next location.

6.2 KLI RESEARCH VESSEL SAMPLING USING A VAN VEEN GRAB

Please see SOP: Operation and Collection of Sediment Samples with a Van Veen Grab.

7.0 PERSONNEL

Personnel will be trained onsite.

8.0 REFERENCE DOCUMENTS

Project Specified Site Safety Plan

SOP: Operation and Collection of Sediment Samples with a Van Veen Grab.

OTTER TRAWL SAMPLING PROCEDURES

1.0 SCOPE

1.1 INTRODUCTION

Otter trawls are used for collection of demersal fishes and epibenthic invertebrates for varying purposes. As examples, animals may be collected to assess epibenthic community structure or to provide tissue for chemical analyses to assess bioaccumulation. An otter trawl is a long conical net, with otter boards (doors) on either side of the large opening, towed at the end of long bridle lines. As the net is towed, the boards are forced away from the centerline of the net, stretching the opening. The top of the large net opening is fitted with floats and the bottom of the opening is fitted with chain or a lead line to keep the net open.

1.2 DESCRIPTION

KLI owns and uses three sizes of Marinovich Otter Trawl: 10 foot head rope, 16-foot head rope, and a 25-foot head rope. Each net requires the same type of components, although they are scaled to an appropriate size. The smallest is appropriate for hand hauling and small skiff operations.

2.0 APPLICATION

The descriptions and methods in this SOP apply to all otter trawls that KLI owns as of this writing.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Safety is a concern during the deployment of nets, as with the deployment of any lines from the deck of a moving vessel. Special care must be observed during deployment and retrieval to ensure crew members do not become entangled in the bridles or the net. The force of the water on the moving net is tremendous and can easily pull an entangled individual overboard, where it is possible for the individual to become further entangled and drown. Work gloves, float vests and hard hats should be worn during deployment and retrieval of the net. Gloves should also be worn at all times especially when handling fish with sharp spines and lines from the trawl.

Caution: Formalin is a health hazard and a suspected carcinogen, and may cause blindness if splashed in eyes. Wear chemical-proof gloves and protective goggles and avoid breathing vapors.

4.0 DEFINITIONS

Otter Boards: Weighted wooden doors attached to the large front opening of the net to apply spreading force while net is towed through the water.

Bridals: Long lines (2) each attached on one end to a door, and joined on the other end at a swivel.

Swivel: Device allowing free rotation of the towing cable relative to the bridals of the trawl.

Otter Trawl: Conical net with a large rectangular opening at the fore end, and a small closable end aft.

Cod-end: A special piece of netting, usually of a finer mesh than the rest of the net, at the small aft end of the net where animal collect during towing.

Spreader Bar: A bar approximately 1 m long attached between the bridals at the end near the swivel to prevent the bridals from winding around one another during towing.

5.0 EQUIPMENT

Each of the devices defined in the section above is a necessary component of the otter trawl. Among the otter trawls that KLI owns the three sizes (10-foot, 16-foot, and 25-foot head rope) differ only in net size, door dimension, and bridal length. All the same components are required for each size of net.

6.0 PROCEDURE

6.1 FIELD SAMPLING

The otter trawl is deployed from the rear deck of the towing vessel. Although the smaller nets may be towed in shallow water by a small boat (e.g., a whaler), the nets are generally towed from a larger boat with a wire spool and winch mounted on deck (e.g., R/V PROPHESY or larger). The net, with boards and bridals attached is laid on the deck, so that it may be deployed over the stern with the float line at top and the chain or lead line at bottom. The cod-end is tied closed with several wraps of a 1/4-inch line and a double hitch.

The net is deployed over the stern, cod-end first, as the vessel slowly moves forward. A crew member on either side of the vessel guides the trawl until the boards are ready to be released. Holding the bridals, the boards are lowered into the water taking care they do not flip over and close the net. As the boards enter the water, the bridles are held to allow the water to force them away from the centerline of the net. As the net opens, the bridles are released and finally, the whole trawl is lowered into the water on the cable.

The trawl should be towed into the prevailing current at approximately 2.5 kts. The requirements of many sampling programs override this preference. A minimum scope (length of tow cable:depth of water) of 3:1 should be maintained at all times while towing, and as much as 5:1 is preferable, especially in deeper waters. The vessel must maintain forward progress during all times the trawl is in the water, both to ensure the catch remains in the net, and to avoid entanglement of the net in the screw of the vessel.

6.2 HANDLING OF CATCH

Trawling can result in the collection of large numbers of live fish and invertebrates. Stress during capture and subsequent handling may be a significant source of mortality in some species. Handling procedures will be designed to minimize stress. It is intended that the majority of the catch will be returned to the water live, thus, the catch will be quickly placed in water-filled buckets or totes as soon as the net is recovered. Towing time will be kept short to minimize crushing, bruising, or suffocating fish caught in the cod end. Fish will be handled with smooth rubber gloves or bare wet hands to minimize damage to the mucus coating on the outside of the fish.

6.3 LENGTH MEASUREMENTS

Length will be measured on all fish captured in the trawl. Maximum standard (total) length will be measured from the most anterior part of the fish to the tip of the tail for fish without forked tails. Fork length will be measured from the most anterior portion of the fish to the tip of the median caudal fin ray for salmonids or other fish with forked tails. Where numerous fish of a given species and size group are taken in a single haul, a minimum of 20 randomly selected fish from each cohort will be measured and the total number of that cohort will be counted. Fish identifications and lengths will be recorded on a Trawl I Fish Catch Record form.

Invertebrates in the trawl catch may be counted by species and released, or preserved for laboratory identification and enumeration. For abundant invertebrate groups, representative samples may be preserved for later measurements to characterize size groupings present.

6.4 PRESERVATION

Fish and invertebrates to be retained will be preserved in a buffered formalin and seawater solution.

7.0 PERSONNEL

A minimum of two crew members and a skipper are required to perform otter trawls. When large numbers of fish are to be processed, more crew are helpful. Each crew member must read this SOP, as well as sections of the KLI Safety Manual regarding vessel safety.

All personnel involved should be trained in basic ecological field techniques. The field crew leader should have experience with the sampling gear and sampling design that are to be utilized. At least one member of the crew should be familiar with any piece of sampling gear used. For trawling, field personnel must be trained in basic field sampling techniques and identification of fish and invertebrates.

8.0 QUALITY ASSURANCE REQUIREMENTS

Logs must be maintained for all the time the trawl is in the water, indicating the time of deployment, the time the trawl reaches the bottom, the duration of towing, the vessel speed, and the GPS positions of the beginning and end of trawls.

Depending on the requirements of a given study, project-specific data sheets will be produced. These will include accounting of all relevant individuals caught (e.g., all individuals of all species and their standard lengths for community analysis; numbers, sex, standard lengths of target species for bioaccumulation collections).

All logs and data sheets must be completely filled in by the end of the work day and signed by the vessel=s skipper or task leader. All appropriate chains of custody must be maintained and samples preserved as appropriate and described in the SOP dealing with the task at hand.

9.0 REFERENCE DOCUMENTS

Mearns, A.J. and H.H. Stubbs. 1974. Comparison of otter trawls used in southern California coastal surveys. Southern California Coastal Water Research Project. Report TM 213.

Puget Sound Estuary Program (PSEP). 1990. Recommended Guidelines for Sampling Soft-Bottom Demersal Fishes by Beach Seine and Trawl in Puget Sound, Appendix B, Net Plans for Standard and Alternate Beach Seines and Trawls. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington, and Puget Sound Water Quality Authority, Olympia, Washington.

FIELD INFAUNA SAMPLE PROCESSING

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the field processing of infaunal samples. Infaunal samples are generally collected with a Van Veen grab, but may be taken by variety of other methods such as Smith-MacIntyre grab, box corers, hand corers, or by divers. These samples must be handled carefully to avoid damaging the infaunal specimens; broken or damaged specimens are extremely difficult to systematically identify. The purpose of this SOP is to ensure the proper field processing and preservation of infauna samples prior to their arrival at the infauna sorting laboratory. This SOP does not cover the actual collection of samples as it has been assumed that the samples have already been properly collected as outlined by methods described in other SOPs.

2.0 APPLICATION

This SOP applies to the field processing and preservation of all infauna taxonomic samples that have been collected from subtidal, intertidal, or wetland areas.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Formalin and alcohol used in the preservation of infaunal samples are extremely hazardous substances. Protective gloves, safety glasses, and an apron or other protective clothing should be worn while using either of these chemicals. In addition, respirators should be worn when handling an open container, pouring, or transferring formalin or formalin preserved samples from one container to another (e.g., from a stock container to a dispensing carboy

4.0 EQUIPMENT AND SUPPLIES

As noted above, infaunal samples are collected with the use of bottom grabs such as the Van Veen sampler. Additional equipment needed for the collection and processing of infaunal samples includes sieves (1.0, 0.5-mm mesh size), a seawater hose system, a squirt bottles filled with seawater, funnels, siphon hose (non-Teflon is acceptable), forceps, and sample containers.

5.0 INFAUNAL SAMPLE COLLECTION AND PROCESSING

Infaunal samples are quantitative in nature and include the entire contents of a dedicated grab. Upon retrieval of the grab, the overlying water is siphoned off through a 1.0 or 0.5-mm mesh sieve depending on project requirements in order to retain any animals that are in the liquid layer of the sample. After removal of the overlying water, the sediment is transferred from the grab to a basin for processing.

Sediment from the basin is then sieved through the 1.0 or 0.5-mm sieve using one of two techniques. The objective of this sieving procedure is to remove the bulk of the sediment in a gentle but thorough manner so that remaining animals (and sediment) can be adequately preserved. If the sediment is fine enough to be easily washed through the sieve with a gentle stream of water from the wash hose, this method is used to sieve the entire sample. Small portions of the grab may be washed in the sieve at one time to ensure careful handling and avoid damaging the specimens.

In some cases, however, a large amount of heavy sediments (e.g., clay) or terrestrial or algal debris will make this sieving process difficult. In this instance, the sample is sieved by repeatedly dipping the sieve into a shallow container of water, taking care not to allow any water to flow over the top of the sieve. This dipping technique acts to suction some of the silt and finer sediments through the bottom of the sieve, thereby freeing up the specimens for adequate preservation and reducing the bulk of the sample. Again, small portions of the sample may be added to the sieve at one time to facilitate the sieving process.

After the sieving process is complete, the animals and sediment remaining on the sieve are transferred to a plastic jar. A gentle stream of wash water and/or seawater in a squirt bottle are used to facilitate this transfer. A funnel is placed in the mouth of the sample jar to ensure that no animals are lost during this transfer. Forceps may be used to gently pull adhering animals or debris from the mesh so that they also may be transferred to the sample container. After sieving, the sieve is visually inspected to ensure that all animals have been included in the sample. This inspection also reduces potential risk of cross-contamination between samples.

Samples are preserved using a 10% solution of buffered formalin in seawater. Formalin is a 37% formaldehyde solution which must be buffered with borax to eliminate decalcification of the calcareous portions of animals in the sample. Formalin is a carcinogen and respiratory irritant and should be handled with extreme caution. See the Material Safety Data Sheets and SOP regarding the use and handling of formalin, including emergency response to overexposure.

Samples are labeled with all pertinent information required by project protocols. Internal labels of durable, waterproof paper are generally used to identify infaunal samples. Refer to project protocols for further information regarding labeling procedures.

PRESERVATION OF BIOLOGICAL SAMPLES

1.0 SCOPE

This Standard Operating Procedure (SOP) document describes the procedures involved in the use of propylene phenoxytol and formaldehyde in relaxing, fixing and preservation of biological samples. The purpose of these procedures is to ensure the proper preservation of samples and the safety of the personnel involved.

2.0 APPLICATION

This SOP applies to all field and laboratory activities involving the relaxing, fixing and preservation of biological samples.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The relaxing, fixing and preservation of biological samples may involve contact with hazardous materials. Skin contact with all materials and solutions should be minimized by wearing appropriate chemically-resistant protective gloves, laboratory coats, chemically-resistant aprons and goggles. Respiratory protection against hazardous vapors can be accomplished using the proper respirator and cartridge combination. In addition, the MSDS's for propylene phenoxytol, formaldehyde, and alcohol (ethanol and/or isopropanol) need to be reviewed before beginning, to ensure that you are aware of the hazards involved and of any new revisions.

4.0 DEFINITIONS

N/A

5.0 EQUIPMENT

5.1 INSTRUMENTATION

- Respirator fitted with organic or formaldehyde cartridge
- Chemically resistant PPE – gloves, apron, rain gear, goggles

5.2 REAGENTS

- Propylene phenoxytol
- 37% Formaldehyde (full strength buffered w/borax)
- Alcohol (70% ethanol and/or 70% isopropanol)

5.3 APPARATUS

- Sieve - specific size is project-related

- Squirt bottles - for alcohol and seawater
- Spoon and forceps - for handling sample

6.0 PROCEDURE

With all appropriate safety equipment on, access is now possible to the propylene phenoxytol in the safety cabinet, and the 37% formaldehyde solution stored in labeled containers with appropriately sized over packs. Benthic organisms need to be relaxed with an addition of propylene phenoxytol for a minimum of 2 hours and up to 8 hours before fixing samples with formaldehyde. Check with task leader as to amount of propylene phenoxytol to use, as it depends on sample size and type. RESPIRATOR MUST BE WORN ON OPENING OF FORMALDEHYDE OVER PACK, as there is usually a buildup of gaseous vapors inside. Add enough concentrated buffered formaldehyde to sample container to produce an approximately 10% solution upon addition of site or tap water.

Samples need to be transferred to 70% alcohol (ethanol for most samples, isopropanol for larger organisms such as fish) within 48 to 96 hours and in no case later than 7 days. When transferring samples you need all the required safety equipment again. Pour off the formaldehyde solution, rinse three times with seawater and dispose of in the waste formaldehyde drum.

Finally, preserve the samples with a 70% alcohol solution.

7.0 PERSONNEL

Only personnel that have been trained in the use of the proper safety equipment, as per the KLI Chemical Hygiene/Hazardous Communication Training Program are allowed to complete this task. Training needs to include proper use and fitting of respiratory protective equipment as per the KLI Respiratory Protection Training Program. The Laboratory Supervisor is responsible for training personnel in the proper procedures in sample fixing and preservation.

8.0 REFERENCE DOCUMENTS

- MSDS's for propylene phenoxytol, formaldehyde, ethanol and isopropanol.
- KLI's Chemical Hygiene/Hazardous Communication Training Program.
- KLI's Respiratory Protection Training Program.

LABORATORY – BENTHIC SORTING & BIOMASS PROCESSING

1.0 SCOPE

This Standard Operating Procedure (SOP) document describes the procedures involved in the benthic sample sorting and wet weight biomass process. The purpose of these procedures is to ensure the proper sorting and handling of organisms from field collected samples as well as biomass measurements of the sorted groups.

2.0 APPLICATION

This SOP applies to all laboratory activities involving the sorting and weighing of benthic organisms from benthic biological samples.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The process of sorting biological samples will involve contact with potentially hazardous substances, reasonable caution should be exercised. The Material Safety Data Sheets (MSDS) for alcohol (ethanol and /or isopropanol) should be reviewed before beginning the sorting process to ensure that you are aware of the hazards involved and of any new revisions that may be available. The sorting lab should be adequately ventilated at all times during the sorting process to prevent the buildup of harmful or irritating vapors.

4.0 DEFINITIONS

N/A

5.0 EQUIPMENT

5.1 INSTRUMENTS AND SUPPLIES

- Stereo dissecting microscopes (10- to 40 -power) (one per sorter)
- Analytical balance (good to 0.01 gm wet weight)
- Alcohol (70% ethanol and/or 70% isopropanol)
- Jewelers forceps, spoons, eye droppers, petri dishes, and scissors
- Sieves (appropriate to project)
- Squirt bottles (for alcohol)
- Label paper (Right in the Rain©)
- Nytex screen and watch

6.0 PROCEDURE

6.1 SORTING

Prior to beginning the sorting process the appropriate MSDS=s should be consulted. The primary technique used to sort organisms from sediment starts with placing approximately one teaspoon of the sample into a petri dish and using a pair of forceps to sort through the sample in a methodical manner removing each organism that is present. This process is to be performed using a dissecting microscope and repeated if necessary until all organisms are removed from each spoonful. Only one person should sort each sample from beginning to end. All organisms should be sorted into five major taxonomic categories or groups: Annelida, Arthropoda, Mollusca, Echinodermata, and combined miscellaneous phyla. All sorted organisms will be placed into their respective group screw cap vials with 70 percent alcohol. The appropriate internal sample tracking information label will be placed into each vial. Each label will include the pertinent field information as well as the name of each sorter doing the sorting.

6.2 BIOMASS

Biomass estimates for the major taxonomic groups should be made prior to the identifications. The weights should be estimated to the nearest 0.01 gm wet weight and recorded in the laboratory on separate biomass data sheets. All fragments encountered during sorting should be weighed with their respective group. Each taxonomic group will be air-dried on absorbent paper for a period of one minute prior to weighing. The organisms will be placed on a tarred weighing Nytex screen and allowed to air-dry for one minute. The weight of the group is then subtracted from the weight of the screen to obtain the biomass estimate that is recorded.

7.0 PERSONNEL

Only personnel that have been trained in the sorting and biomass process will handle sample sorting and wet weight biomass determination. The Laboratory Supervisor is responsible for training personnel in the proper sorting and biomass methodologies to be used. The QA/QC officer will determine which samples have not been adequately sorted and weighed and require corrective action.

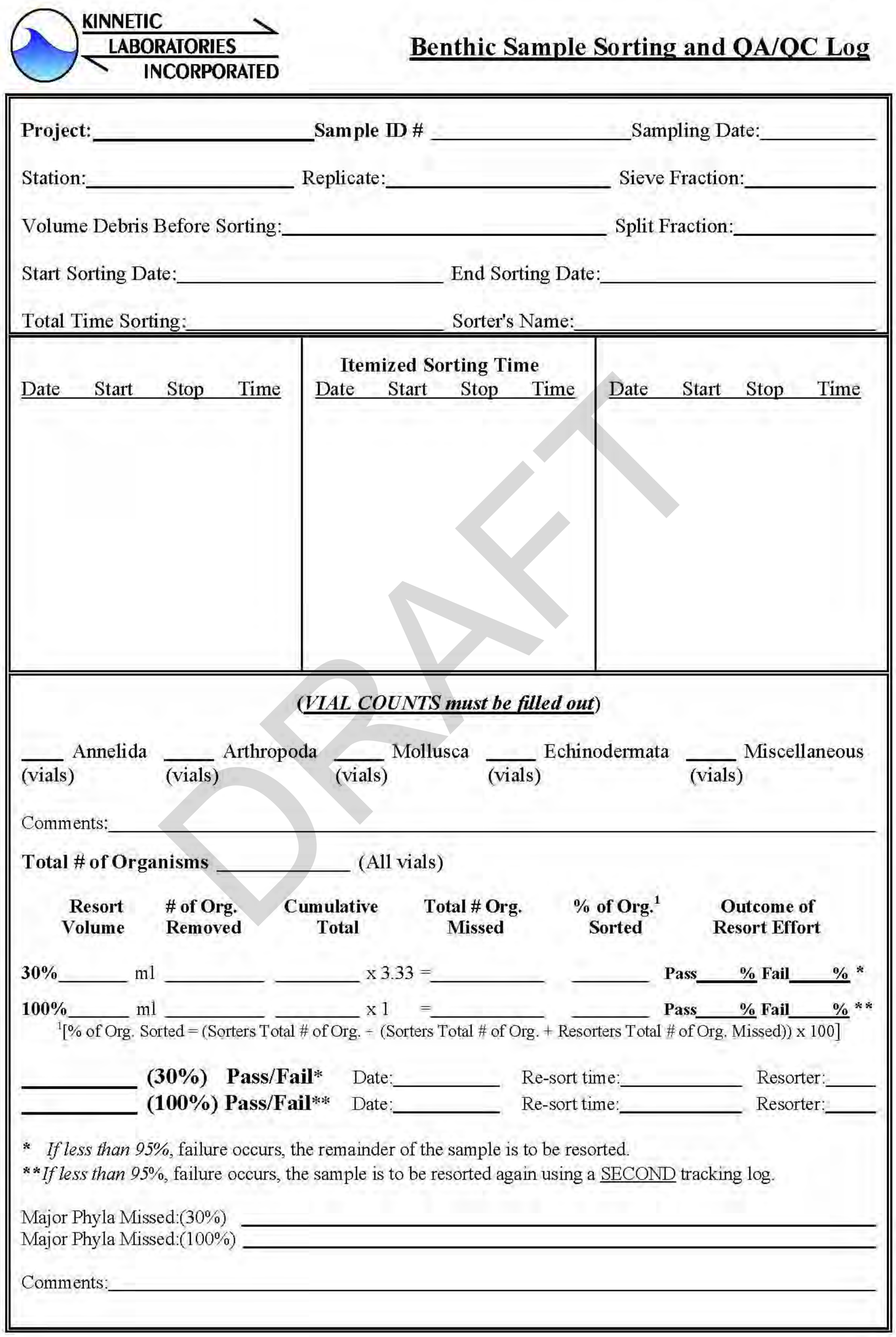
8.0 QUALITY ASSURANCE REQUIREMENTS

All sorted samples will be resorted a minimum of 30 percent by a person different from the original sorter of the sample. Any sample not passing the initial 30 percent resort will be completely resorted over again by a person other than the person performing the original sorting of the sample. Records of this process are recorded for each resorted sample and kept on file.

9.0 REFERENCE DOCUMENTS

- Benthic Sample Sorting and QA/QC Log
- Taxonomic Identification Chain of Custody Record
- Sample Tracking and Sorting Worksheet

ATTACHMENT A
Benthic Sample Sorting and QC/QC Log



KINNETIC LABORATORIES INCORPORATED

Benthic Sample Sorting and QA/QC Log

Project:______________________ **Sample ID #** ____________________ Sampling Date:__________

Station:_____________________ Replicate:______________________ Sieve Fraction:___________

Volume Debris Before Sorting:__________________________ Split Fraction:___________

Start Sorting Date:_____________________ End Sorting Date:______________________

Total Time Sorting:_____________________ Sorter's Name:______________________

				Itemized Sorting Time							
Date	Start	Stop	Time	Date	Start	Stop	Time	Date	Start	Stop	Time

(***VIAL COUNTS must be filled out***)

____ Annelida (vials) _____ Arthropoda (vials) _____ Mollusca (vials) _____ Echinodermata (vials) _____ Miscellaneous (vials)

Comments:____

Total # of Organisms ____________ (All vials)

Resort Volume	**# of Org. Removed**	**Cumulative Total**	**Total # Org. Missed**	**% of Org.[1] Sorted**	**Outcome of Resort Effort**
30%______ ml	__________	_________ x 3.33 =	___________	________	**Pass____% Fail____%** *
100%______ ml	__________	_________ x 1 =	___________	________	**Pass____% Fail____%** **

[1] [% of Org. Sorted = (Sorters Total # of Org. ÷ (Sorters Total # of Org. + Resorters Total # of Org. Missed)) x 100]

__________ **(30%) Pass/Fail*** Date:__________ Re-sort time:____________ Resorter:_____
__________ **(100%) Pass/Fail**** Date:__________ Re-sort time:____________ Resorter:_____

* *If less than 95%*, failure occurs, the remainder of the sample is to be resorted.
***If less than 95%*, failure occurs, the sample is to be resorted again using a SECOND tracking log.

Major Phyla Missed:(30%) ______________________________________
Major Phyla Missed:(100%) ______________________________________

Comments:____

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APPENDIX I

TABLE OF AVAILABLE WATER QUALITY OBJECTIVES (FRESHWATER AND SALTWATER)

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Freshwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	LA Basin Plan			California Toxics Rule		California Fish and Game		UC Davis	
	Instantaneous Single Sample	Acute Max. Level	30-day Average	Acute CMC	Chronic CCC	Acute CMC	Chronic CCC	Acute CMC	Chronic CCC
Analyte Group									
Conventionals (mg/L unless noted)									
Oil and Grease									
Total Phenols									
Cyanide		0.15		22	5.2				
pH (pH Units)		6.5 - 8.5							
Temperature		≤20°F of Ambient							
Dissolved Oxygen		≥5							
Total Ammonia (as N)[1]									
Bacteria (MPN/100 ml) [2]									
Enterococcus	104		35						
Fecal Coliform	400		200						
Total Coliform	10000		1000						
Ratio of Fecal to Total Coliform	FC/TC≥0.1 & TC>1000								
General (mg/L unless noted)									
Dissolved Phosphorus									
Total Phosphorus									
Turbidity (NTUs)									
Total Suspended Solids									
Total Dissolved Solids									
Volatile Suspended Solids									
Total Organic Carbon									
Total Petroleum H}'drocarbon									
Biochemical Oxygen Demand									
Chemical Oxygen Demand									
Total Ammonia-NitroQen									
Total Kjeldahl Nitrogen									
Nitrate-Nitrite		10							
Nitrite		1							
Alkalinity									
Specific Conductance (umho/cm)									
Total Hardness									
MBAS		0.5							
Chloride									
Fluoride		2							
Methyl tertiary butyl ether (MTBE}		0.013							
Perchlorate (ug/L)		6							
Dissolved Metals (µg/L) [3]									
Aluminum									
Antimony									
Arsenic				340	150				
Beryllium									
Cadmium				4.3	2.2				
Chromium (total)									
Chromium (Hexavalent)				16	11				
Copper				13	9				
Iron									
Lead				65	2.5				
Mercury									
Nickel				470	52				
Selenium									
Silver				3.4					
Thallium									
Zinc				120	120				
Total Metals (µg/L)									
Aluminum		1000							
Antimony		6							
Arsenic		10							
Beryllium		4							

Freshwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	LA Basin Plan			California Toxics Rule		California Fish and Game		UC Davis	
Analyte Group	Instantaneous Single Sample	Acute Max. Level	30-day Average	Acute CMC	Chronic CCC	Acute CMC	Chronic CCC	Acute CMC	Chronic CCC
Cadmium		5							
Chromium (total)		50							
Chromium (Hexavalent)									
Copper									
Iron									
Lead		100							
Mercury		2							
Nickel		100							
Selenium		50		20	5				
Silver									
Thallium		2							
Zinc									
***Semivolatile Organic Compounds* (ug/L)**									
Acids									
2-Chlorophenol									
4-Chloro-3-methylphenol									
2,4-Dichlorophenol									
2,4-Dimethylphenol									
2,4-Dinitrophenol									
2-Nitrophenol									
4-Nitrophenol									
Pentachlorophenol		1		19	15				
Phenol									
2,4,6-Trichlorophenol									
Base/Neutral									
Acenaphthene									
Acenaphthylene									
Anthracene									
Benzidine									
1,2 Benzanthracene									
Benzo(a)pyrene		0.2							
Benzo(g,h,i)perylene									
3,4 Benzoflouranthene									
Benzo(k)flouranthene									
Bis(2-Chloroethoxy) methane									
Bis(2-Chloroisopropyl) ether									
Bis(2-Chloroethyl) ether									
Bis(2-Ethylhexl) phthalate									
4-Bromophenyl phenyl ether									
Butyl benzyl phthalate									
2-Chloroethyl vinyl ether									
2-Chloronaphthalene									
4-Chlorophenyl phenyl ether									
Chrysene									
Dibenzo(a,h)anthracene									
1,3-Dichlorobenzene									
1,4-Dichlorobenzene		5							
1,2-Dichlorobenzene		600							
3,3-Dichlorobenzidine									
Diethyl phthalate									
Dimethyl phthalate									
di-n-Butyl phthalate									
2,4-Dinitrotoluene									
2,6-Di nitrotoluene									
4 ,6 Dinitro-2-methylphenol									
1,2-Diphenylhydrazine									
di-n-Octyl phthalate									
Fluoranthene									
Fluorene									

Freshwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	LA Basin Plan			**California Toxics Rule**		**California Fish and Game**		**UC Davis**	
Analyte Group	**Instantaneous Single Sample**	**Acute Max. Level**	**30-day Average**	**Acute CMC**	**Chronic CCC**	**Acute CMC**	**Chronic CCC**	**Acute CMC**	**Chronic CCC**
Hexachlorobenzene		1							
Hexachlorobutadiene									
Hexachloro-cyclopentadiene		50							
Hexachloroethane									
Indeno_{1,2,3-cd)pyrene									
Isophorone									
Naphthalene									
Nitrobenzene									
N-Nitroso-dimethyl amine									
N-Nitroso-diphenyl amine									
N-Nitroso-di-n-propyl amine									
Phenanthrene									
Pyrene									
1,2,4-Trichlorobenzene		5							
Aroclors (µg/L)									
Aroclor-1016									
Aroclor-1221									
Aroclor-1232 .									
Aroclor-1242									
Aroclor-1248									
Aroclor-1254									
Aroclor-1260									
PCBs (Total)		0.5			0.014				
Chlorinated Pesticides **(µg/L)**									
Aldrin				3					
alpha-BHC									
beta-BHC									
delta-BHC									
gamma-BHC (lindane)		0.2		0.95					
alpha-chlordane									
gamma-chlordane									
4 4'-DDD									
4,4'-DDE									
4,4'-DDT				1.1	0.001				
Dieldrin				0.24	0.056				
alpha-Endosulfan				0.22	0.056				
beta-Endosulfan				0.22	0.056				
Endosulfan sulfate									
Endrin		2		0.086	0.036				
Endrin aldehyde									
Heptachlor		0.01		0.52	0.0038				
Heptachlor Epoxide		0.01		0.52	0.0038				
Toxaphene		3		0.73	0.0002				
Methoxychlor		30							
Mirex									0.001
Total Chlordane		0.1		2.4	0.0043				
Organophosphates **(µg/L)**									
Atrazine		1							
Chlorpyrifos						0.02	0.014	0.01	0.01
Cyanazine									
Diazinon						0.16	0.1	0.2	0.07
Malathion						0.43	0.1	0.17	0.028
Prometryn									
Simazine		4							
Herbicides **(ug/L)**									
2,4-D		70							
Glyphosate		700							
2,4,5-TP-SILVEX		50							

Freshwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	LA Basin Plan			California Toxics Rule		California Fish and Game		UC Davis	
Analyte Group	**Instantaneous Single Sample**	**Acute Max. Level**	**30-day Average**	**Acute CMC**	**Chronic CCC**	**Acute CMC**	**Chronic CCC**	**Acute CMC**	**Chronic CCC**
***Pyrethroids* (ng/L)**									
Bifenthrin		3						4	0.6
Cyfluthrin		2						0.3	0.05
Cypermethrin								1	0.2
L-Cyhalothrin								1	0.5
Permethrin								10	2
Total Deltamethrin/Tralomethrin									
Total Esfenvalerate/Fenvalerate									

1. The one-hour average ammonia-N criterion applicable to storm events is pH dependent. The 30-day ammonia-N criterion applicable to dry weather is both temperature and pH dependent.
2. Saltwater bacteria standards
3. CTR freshwater dissolved metals are hardness dependent. The values listed here are computed for a hardness of 50 mg/L.
   CTR freshwater dissolved cadmium and lead coefficients for conversion of total recoverable to dissolved criteria are also hardness dependent.

General

- Minimum Level (ML) is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed.
- Criteria continuous concentration (CCC) equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.
- Criteria maximum concentration (CMC) equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects.

California Toxics Rule

- CTR freshwater dissolved metals are hardness dependant. The values listed here are computed for a hardness of 50 mg/L.
- CTR freshwater dissolved cadmium and lead conversion coefficients for total to dissolved are also hardness dependent.
- CTR freshwater and saltwater dissolved metal criteria are "CCC" except for silver which are "CMC".
- CTR freshwater and saltwater organics are "CCC" except for aldrin and gamma-BHC which are "CMC".

LA Basin Plan, 2013

Bacteria are instantaneous or single sample criteria.

LA Basin Plan contains Title 22 Drinking Water standards

Ammonia listed is Acute 1-hour average objective for waters not designated COLD and/or MIGR and is pH dependent. The value listed is for a pH of 7.5. Chronic criteria are applied to Dry Weather results and are pH and temperature dependent

California Fish and Game - Siepmann and Finlayson, 2000, Siepmann & Slater 1998 (malathion)

All values are "CMC" criteria. CMCs are considered acute criteria.

UC Davis - Werner and Oram, 2008, Palumbo, et al. 2012 (for orthophosphates), and Fojut, et al. 2012 (for pyrethroids)

Saltwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	California Toxics Rule		California Fish and Game		UC Davis	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Analyte Group	CMC	CCC	CMC	CCC	CMC	CCC
Conventionals (mg/L unless noted)						
Oil and Grease						
Total Phenols						
Cyanide	1	1				
pH (pH Units)						
Temperature						
Dissolved Oxygen						
Total Ammonia (as N)						
Bacteria (MPN/100 ml)						
Enterococcus						
Fecal Coliform						
Total Coliform						
Ratio of Fecal to Total Coliform						
General (mg/L unless noted)						
Dissolved Phosphorus						
Total Phosphorus						
Turbidity (NTUs)						
Total Suspended Solids						
Total Dissolved Solids						
Volatile Suspended Solids						
Total Organic Carbon						
Total Petroleum Hydrocarbon						
Biochemical Oxygen Demand						
Chemical Oxygen Demand						
Total Ammonia-NitroQen						
Total Kjeldahl Nitrogen						
Nitrate-Nitrite						
Nitrite						
Alkalinity						
Specific Conductance (umho/cm)						
Total Hardness						
MBAS						
Chloride						
Fluoride						
Methyl tertiary butyl ether (MTBE}						
Perchlorate (ug/L)						
Dissolved Metals (µg/L)						
Aluminum						
Antimony						
Arsenic	69	36				
Beryllium						
Cadmium	42	9.3				
Chromium (total)						
Chromium (Hexavalent)	1100	50				
Copper	4.8	3.1				
Iron						
Lead	210	8.1				
Mercury						
Nickel	74	8.2				
Selenium	290	71				
Silver	1.9	-				
Thallium						
Zinc	90	81				

Saltwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	California Toxics Rule		California Fish and Game		UC Davis	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Analyte Group	CMC	CCC	CMC	CCC	CMC	CCC
Total Metals (* µg/L*)						
Aluminum						
Antimony						
Arsenic						
Beryllium						
Cadmium						
Chromium (total)						
Chromium (Hexavalent)						
Copper						
Iron						
Lead						
Mercury						
Nickel						
Selenium						
Silver						
Thallium						
Zinc						
***Semivolatile Organic Compounds* (ug/L)**						
Acids						
2-Chlorophenol						
4-Chloro-3-methylphenol						
2,4-Dichlorophenol						
2,4-Dimethylphenol						
2,4-Dinitrophenol						
2-Nitrophenol						
4-Nitrophenol						
Pentachlorophenol	13	7.9				
Phenol						
2,4,6-Trichlorophenol						
Base/Neutral						
Acenaphthene						
Acenaphthylene						
Anthracene						
Benzidine						
1,2 Benzanthracene						
Benzo(a)pyrene						
Benzo(g,h,i)perylene						
3,4 Benzoflouranthene						
Benzo(k)flouranthene						
Bis(2-Chloroethoxy) methane						
Bis(2-Chloroisopropyl) ether						
Bis(2-Chloroethyl) ether						
Bis(2-Ethylhexl) phthalate						
4-Bromophenyl phenylether						
Butyl benzyl phthalate						
2-Chloroethyl vinylether						
2-Chloronaphthalene						
4-Chlorophenyl phenylether						
Chrysene						
Dibenzo(a,h)anthracene						
1,3-Dichlorobenzene						
1,4-Dichlorobenzene						
1,2-Dichlorobenzene						

Saltwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	California Toxics Rule		California Fish and Game		UC Davis	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Analyte Group	CMC	CCC	CMC	CCC	CMC	CCC
3,3-Dichlorobenzidine						
Diethyl phthalate						
Dimethyl phthalate						
di-n-Butyl phthalate						
2,4-Dinitrotoluene						
2,6-Dinitrotoluene						
4,6 Dinitro-2-methylphenol						
1,2-Diphenylhydrazine						
di-n-Octyl phthalate						
Fluoranthene						
Fluorene						
Hexachlorobenzene						
Hexachlorobutadiene						
Hexachloro-cyclopentadiene						
Hexachloroethane						
Indeno_{1,2,3-cd)pyrene						
Isophorone						
Naphthalene						
Nitrobenzene						
N-Nitroso-dimethylamine						
N-Nitroso-diphenylamine						
N-Nitroso-di-n-propylamine						
Phenanthrene						
Pyrene						
1,2,4-Trichlorobenzene						
Aroclors (µg/L)						
Aroclor-1016						
Aroclor-1221						
Aroclor-1232 .						
Aroclor-1242						
Aroclor-1248						
Aroclor-1254						
Aroclor-1260						
PCBs (Total)		0.03				
***Chlorinated Pesticides* (µg/L)**						
Aldrin	1.3					
alpha-BHC						
beta-BHC						
delta-BHC						
gamma-BHC (lindane)	0.16					
alpha-chlordane						
gamma-chlordane						
Total Chlordane	0.09	0.004				
4 4'-DDD						
4,4'-DDE						
4,4'-DDT	0.13	0.001				
Dieldrin	0.71	0.0019				
alpha-Endosulfan	0.034	0.0087				
beta-Endosulfan	0.034	0.0087				
Endosulfan sulfate						
Endrin	0.037	0.0023				
Endrin aldehyde						
Heptachlor	0.053	0.0036				

Saltwater Benchmarks and Guidelines Used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.

	California Toxics Rule		California Fish and Game		UC Davis	
Analyte Group	**Acute CMC**	**Chronic CCC**	**Acute CMC**	**Chronic CCC**	**Acute CMC**	**Chronic CCC**
Heptachlor Epoxide	0.053	0.0036				
Toxaphene	0.21	0.0002				
Methoxychlor						
Mirex					0.001	
Organophosphates **(µg/L)**						
Atrazine						
Chlorpyrifos			0.02	0.009	0.011	0.0056
Cyanazine						
Diazinon						
Malathion			0.34	0.1	0.17	0.028
Prometryn						
Simazine						
Herbicides **(ug/L)**						
2,4-D						
Glyphosate						
2,4,5-TP-SILVEX						
Pyrethroids **(ng/L)**						
Bifenthrin					4	0.6
Cyfluthrin					0.3	0.05
Cypermethrin					1	0.2
L-Cyhalothrin					1	0.5
Permethrin					10	2
Total Deltamethrin/Tralomethrin						
Total Esfenvalerate/Fenvalerate						

General

- Criteria continuous concentration (CCC) equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.
- Criteria maximum concentration (CMC) equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects.

California Toxics Rule

- CTR freshwater and saltwater dissolved metal criteria are except for silver which are .
- CTR freshwater and saltwater organics are except for aldrin and gamma-BHC which are .

California Fish and Game - Siepmann and Finlayson, 2000, Siepmann & Slater 1998 (malathion)

All values are criteria. CMCs are considered acute criteria.

UC Davis - Werner and Oram, 2008.

Sediment Screening Values for Selected Analytes

Analyte Name	Units	NOAA Screening[1]		Human RSLs[2]		Human CHHSLs[3]	
		Salt ERL	**Salt ERM**	**Residential**	**Industrial**	**Residential**	**Commercial/ Industrial**
Arsenic	mg/kg	8.2	70	0.39	1.6	0.07	0.24
Cadmium	mg/kg	1.2	9.6	70	800	1.7	7.5
Chromium	mg/kg	81	370			100,000	1,000,000
Copper	mg/kg	34	270	3,100	41,000	3,000	38,000
Lead	mg/kg	46.7	218	400	800	18	180
Mercury	mg/kg	0.15	0.71	10	43	1,600	16,000
Nickel	mg/kg	20.9	51.6	1,500	20,000	150	3,500
Selenium	mg/kg			390	5,100	380	4,800
Silver	mg/kg	1	3.7	390	5,100	380	4,800
Zinc	mg/kg	150	410	23,000	310,000	23,000	100,000
1-Methylnaphthalene	µg/kg			22,000	99,000		
2-Methylnaphthalene	µg/kg	70	670	310,000	4,100,000		
Acenaphthene	µg/kg	16	500	3,400,000	33,000,000		
Acenaphthylene	µg/kg	44	640				
Anthracene	µg/kg	85.3	1100	17,000,000	170,000,000		
Benzo (a) Anthracene	µg/kg	261	1600	150	2100		
Benzo (a) Pyrene	µg/kg	430	1600	15	210	38	130
Benzo (b) Fluoranthene	µg/kg			150	2100		
Benzo (k) Fluoranthene	µg/kg			1500	21,000		
Biphenyl	µg/kg						
Chrysene	µg/kg	384	2800	15,000	210,000		
Dibenz (a,h) Anthracene	µg/kg	63.4	260	15	210		
Fluoranthene	µg/kg	600	5100	2,300,000	22,000,000		
Fluorene	µg/kg	19	540	2,300,000	22,000,000		
Indeno (1,2,3-c,d) Pyrene	µg/kg			150	2100		
Naphthalene	µg/kg	160	2100	3600	18,000		
Phenanthrene	µg/kg	240	1500				
Pyrene	µg/kg	665	2600	1,700,000	17,000,000		
Total Low Weight PAHs	µg/kg	552	3160				
Total High Weight PAHs	µg/kg	1700	9600				
Total PAHs[4]	µg/kg	4022	44792				
Benzyl butyl phthalate	µg/kg			260,000	910,000		
bis-(2-Ethylhexyl)phthalate	µg/kg			35,000	120,000		
Diethyl phthalate	µg/kg			49,000,000	490,000,000		
Di-n-butyl phthalate	µg/kg			6,100,000	62,000,000		
2,4,6-Trichlorophenol	µg/kg			44,000	160,000		
2,4-Dichlorophenol	µg/kg			180,000	1,800,000		
2,4-Dimethylphenol	µg/kg			1,200,000	12,000,000		
2,4-Dinitrophenol	µg/kg			120,000	1,200,000		
2-Chlorophenol	µg/kg			390,000	5,100,000		
Pentachlorophenol	µg/kg			890	2,700	4,400	13,000
Phenol	µg/kg			18,000,000	180,000,000		
4,4'-DDD	µg/kg	2	20	2,000	7,200	2,300	9,000
4,4'-DDE	µg/kg	2.2	27	1,400	5,100	1,600	6,300
4,4'-DDT	µg/kg	1	7	1,700	7,000	1,600	6,300
Total DDT	µg/kg	1.58	46.1				
Aldrin	µg/kg			29	100	33	130
Chlordane	µg/kg			1,600	6,500	430	1,700
Cis-nonachlor	µg/kg						

Sediment Screening Values for Selected Analytes

Analyte Name	Units	NOAA Screening[1]		Human RSLs[2]		Human CHHSLs[3]	
		Salt ERL	Salt ERM	Residential	Industrial	Residential	Commercial/ Industrial
DCPA (Dacthal)	µg/kg	0.02	8	610,000	6,200,000		
Dieldrin	µg/kg			30	110	35	130
Endosulfan I	µg/kg			370,000	3,700,000		
Endrin	µg/kg			180,000	1,800,000	21,000	230,000
Heptachlor	µg/kg			110	380	130	520
Heptachlor Epoxide	µg/kg			53	190		
Methoxychlor	µg/kg			310,000	3,100,000	340,000	3,800,000
Mirex	µg/kg			27	96	31	120
Toxaphene	µg/kg			440	1600	460	1,800
PCB077	µg/kg			34	110		
PCB081	µg/kg			11	38		
PCB105	µg/kg			110	380		
PCB114	µg/kg			110	380		
PCB118	µg/kg			110	380		
PCB123	µg/kg			110	380		
PCB126	µg/kg			0.034	0.11		
PCB156	µg/kg			110	380		
PCB157	µg/kg			110	380		
PCB167	µg/kg			110	380		
PCB169	µg/kg			0.11	0.38		
PCB170	µg/kg			30	99		
PCB180	µg/kg			300	990		
PCB189	µg/kg			110	380		
Total PCB Congeners	µg/kg	22.7	180			89	300

1. Effects Range Low (ERL) and Effects Range Median (ERM) sediment quality objectives from Long *et al.* (1995).
2. Regional Screening Levels for Chemical Contaminants at Superfund Sites" (USEPA Region 9, 2010).
3. California Human Health Screening Levels for Soil (Cal/EPA, 2005).