LOS CERRITOS CHANNEL
WATERSHED GROUP

Los Cerritos Channel

Coordinated Integrated Monitoring Program

Participants:

Bellflower
Cerritos
Downey
Lakewood
Long Beach
Paramount
Signal Hill
Los Angeles County Flood Control District

Prepared by:

KINNETIC LABORATORIES INCORPORATED

June 27, 2014

Page Intentionally Left Blank

Contents

APPENDICES

LIST OF FIGURES

LIST OF TABLES

1.1

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
CCR	California Code of Regulations
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
Discharger	Los Angeles County MS4 Permittees
DNQ	Detected But Not Quantified
EFA	Effective Filtration Area
ELAP	California Department of Public Health Environmental Laboratory Accreditation Program
Facility	Los Angeles County MS4s
FIB	Fecal Indicator Bacteria
GIS	Geographical Information System
gpd	gallons per day
HUC	Hydrologic Unit Code
IC50	Concentration at which the organism is 50% inhibited
IC/ID	Illicit Connection and Illicit Discharge Elimination
LA	Load Allocations
LARWQCB	Regional Water Quality Control Board, Los Angeles
LID	Low Impact Development
LOEC	Lowest Observed Effect Concentration
MAL	Municipal Action Limits
MCM	Minimum Control Measure
mg/L	milligrams per Liter
MDEL	Maximum Daily Effluent Limitation
µg/L	micrograms per Liter
MEC	Maximum Effluent Concentration
MGD	Million Gallons Per Day
ML	Minimum Level
MRP	Monitoring and Reporting Program

MS4	Municipal Separate Storm Sewer System
ND	Not Detected
NOEC	No Observable Effect Concentration
NPDES	National Pollutant Discharge Elimination System
NTR	National Toxics Rule
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
Ocean Plan	Water Quality Control Plan for Ocean Waters of California
ORI	Outfall Reconnaissance Inventory
PWS	Primary Watershed Segment
PES	Polyester-reinforced polysulfone
RAP	Reasonable Assurance Program
Regional Water Board	California Regional Water Quality Control Board, Los Angeles Region
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)
SMR	Self-Monitoring Reports
SQO	Sediment Quality Objective
SSC	Suspended Sediment Concentration
State Water Board	California State Water Resources Control Board
SWS	Secondary Watershed Segment
TAC	Test Acceptability Criteria
TIE	Toxicity Identification Evaluation
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TRE	Toxicity Reduction Evaluation
TSD	Technical Support Document
TSS	Total Suspended Solid
TU_c	Chronic Toxicity Unit
USEPA	United States Environmental Protection Agency
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

Page Intentionally Left Blank

COORDINATED INTEGRATED MONITORING PROGRAM FOR THE LOS CERRITOS CHANNEL WATERSHED GROUP

1. Introduction

A Coordinated Integrated Monitoring Program (CIMP) is required to be submitted either separately or as part of a Watershed Management Plan (WMP). The CIMP is required to integrate requirements of the current Los Angeles County MS4 Permit, the City of Long Beach MS4 permit and 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 CIMP incorporates all objectives of the MRP but provides a customized approach to address the objectives identified in the MRP for Stormwater Outfall Monitoring based upon the unique characteristics of the Los Cerritos Channel (LCC) watershed. Unlike other Watershed Management Groups (WMGs) in Los Angeles County, the LCC watershed does not receive flow from other WMGs. External contributions of contaminants are limited to atmospheric deposition originating predominantly from major transportation corridors and facilities.

Figure 1-1 provides a summary of all jurisdictions that are participating in both the Watershed Management Plan (WMP) and the CIMP. The Los Angeles County Flood Control District includes the entire area addressed by the Los Cerritos Channel WMP and CIMP.

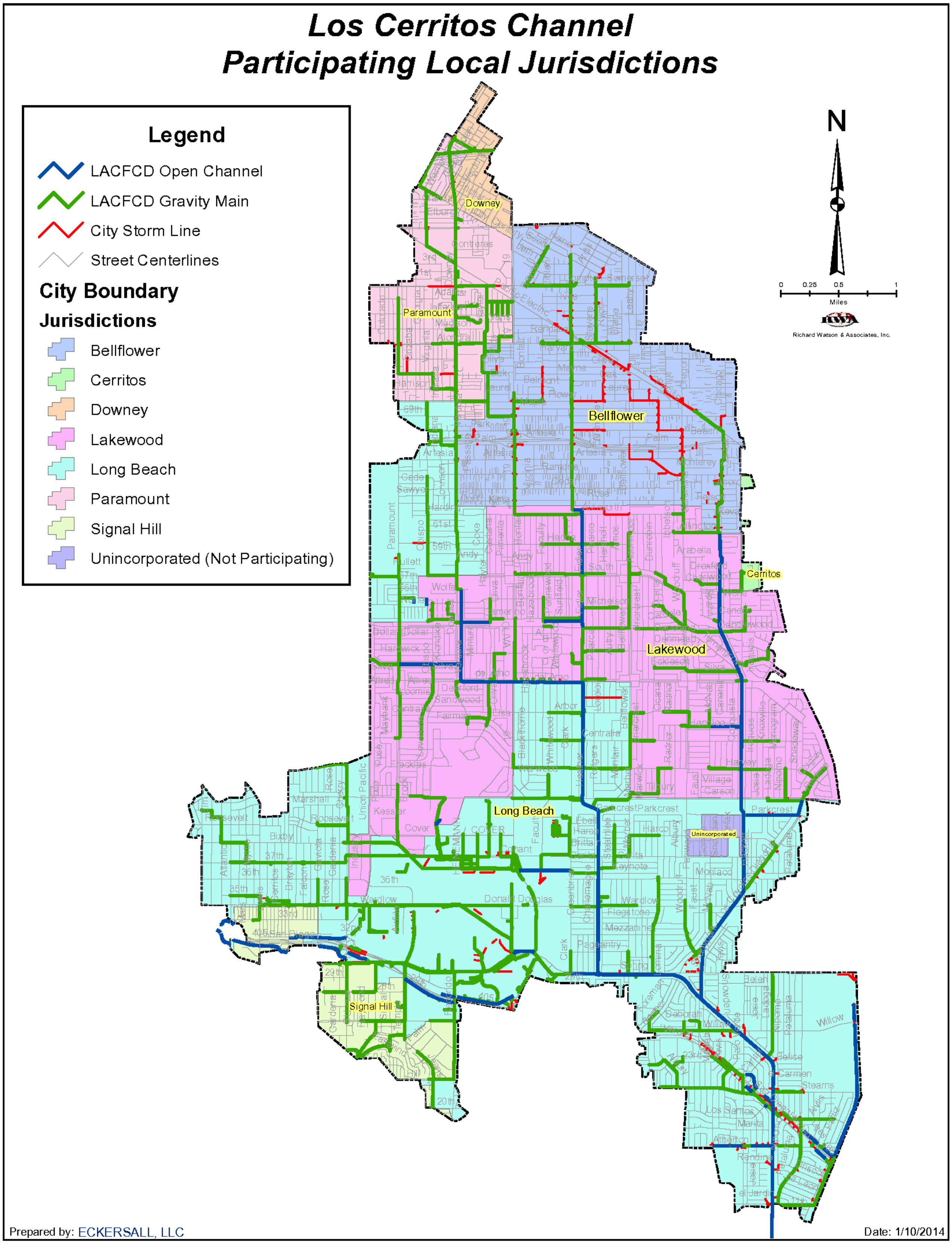


Figure 1-1. Jurisdictions Participating in the WMP and CIMP.

1.1 Monitoring Objectives

The Permit Monitoring and Reporting Program (MRP) for Los Angeles County[1] and the City of Long Beach[2] have equivalent requirements. The Los Cerritos Channel watershed is located in areas covered by both permits but the requirements differ only in terms of schedules. The City of Long Beach opted to participate in the WMP and CIMP being developed under the Los Angeles County Permit schedule but the major elements and primary objectives listed below are identical. The CIMP 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?
  - 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 permittees' discharges compare to Municipal Action Limits (MALs)?
  - Are the permittees' discharges in compliance with applicable stormwater WQBELs derived from TMDL WLAs?
  - Do the permittees' discharges cause or contribute to an exceedance of the receiving water limitations?
- Non-Stormwater Outfall Based Monitoring (Part II.E.3 of the MRP)
  - Are the permittees' discharges in compliance with non-stormwater WQBELs derived from TMDL WLAs.
  - How does the quality of the permittees' discharges compare to Non-Stormwater Action Levels?
  - Do the permittees' discharges cause or contribute to an exceedance of the receiving water limitations?
  - Do the permittees 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 Permittees being met?
  - Are stormwater volumes associated with the design storm effectively retained on-site?
- Regional Studies
  - How do the permittees 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] Order No. R4-2012-0175, NPDES Permit No. CAS004001

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

1.2 Monitoring Sites and Approach

The approach presented in this CIMP incorporates all objectives of the MRP but provides a customized approach to address the objectives identified in the MRP for Stormwater Outfall Monitoring based upon the unique characteristics of the Los Cerritos Channel (LCC) watershed. Unlike other Watershed Management Groups (WMGs) in Los Angeles County, the LCC watershed does not receive flow from other WMGs. External contributions of contaminants are limited to atmospheric deposition originating predominantly from major transportation corridors and facilities.

1.2.1 Receiving Water

Receiving water quality monitoring will be conducted at the historic Los Cerritos Channel site at Stearns Street (LLAR1). Originally, this location was considered a mass emission monitoring site for the City's stormwater program since it captures runoff stormwater that originates from a large segment of the City. This site is also the compliance monitoring site for TMDL monitoring. This site is located about 100 feet downstream of a former gaging station (Figure 1-2) and effectively marks the downstream extent of freshwater influences within the Channel. During low tides, freshwater extends down to the end of the concrete-line channel below Atherton St. 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 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 the LCC1 to establish the freshwater metals TMDL for the Los Cerritos Channel. This site now has a record of stormwater and dry weather water quality measurements that extend back for 13 years using consistent methods and, in most cases, consistent detection limits applicable to current receiving water limitations (RWLs).

1.2.2 Primary Watershed Segmentation (PWS) Monitoring

Stormwater outfall monitoring in the LCC watershed will be addressed by partitioning the watershed into segments that correspond to those used in the Los Cerritos Metals TMDLs to develop a model for estimating flow and pollutant loads. This allows the modeling information to be used to assist in directing sampling efforts to target areas of the watershed believed to contribute the greater loads and verify the accuracy of the model. If the monitoring program identifies a segment of the watershed as contributing significantly higher pollutants loads than the segments, then further monitoring will be conducted to further identify and isolate the source. This forensic monitoring would further partition the watershed by monitoring of Secondary Watershed Segmentation (SWS) using more portable sampling stations.

PWS sampling is intended to assist in determining whether the permittee's discharges are causing or contributing to exceedance of receiving water limitations, assess whether the permittee's discharges are in compliance with applicable WQBELs derived from TMDL WLAs and with applicable action limits. The Los Cerritos Channel watershed is highly divided with a number of separate channels contributing flow. In practice, no clear distinction exists between the end of the storm drain system and the start of tributaries or receiving waters. Restricting monitoring sites to locations considered to be "outfall" sites would limit sampling to much smaller catchments that are intended to be representative of land use throughout the LCC watershed. This monitoring approach was not considered to be an effective strategy for identification of the major sources of contaminants and would provide limited assistance in directing effective implementation of control measures in this watershed.

Primary Watershed Segment (PWS) sites (Figure 1-2) were selected based upon:

- LSPC modeling results from the LCC Metals TMDL (U.S. EPA 2010),
- land use characteristics within the watershed, and
- the ability to isolate major portions of the watershed.

The LSPC model was used to simulate flows and metals concentrations in Los Cerritos Channel during development of the LCC Metals TMDLs. An updated version of the LSPC serves as the basis for the Los Angeles County Watershed Management Modeling System (WMMS). The model divided the watershed into 10 sub-basins (Figure 1-2) and developed loading estimates (Figure 1-3) for each of the sub-basins. The LSPC model results provided the primary guidance for selection of appropriate watershed monitoring sites. Site selection first considered sub-basins that the model identified as the most significant sources of metals. Potential sites were considered at locations near the downstream edge of each sub-basin and where runoff from each sub-basin could be effectively isolated. Land use information for within each sub-basin was then examined to determine dominant land uses within each segment and assure that all major land uses would be effectively sampled. Lastly, sites were selected to effectively represent a large proportion of the watershed and yet avoid large disparities in the sizes of each segment such that pollutant or sediment delivery ratios[3] would not vary substantially among monitoring sites.

Sites selected as PWS sites include SB4, SB10, SB8 and SB9 (Figure 1-2; Table 1-2). Each of these isolates significant proportions of their respective sub-basins (4, 10, 8 and 9). Together, these monitoring locations allow 68% of the entire watershed to be monitored. Once implemented, pollutant loading rates for each of the PWS sites can be compared to loads measured at the downstream receiving water site (LCC1) in order to assess potential discrepancy in load contributions and determine if further implementation of control measures is warranted

SB4 is located in the Los Cerritos Channel just west of Lakewood Blvd and adjacent to the Long Beach Daugherty Airport. This site will effectively sample runoff from sub-basin 4. LSPC modeling indicated that this segment may be a significant source of both copper and zinc (Figure 1-3). Land use in this segment of the watershed (Table 1-1) is dominated equally by the Airport (classified as mixed urban in the model) and industrial land use. This segment represents approximately 13% of the entire LCC watershed.

SB10 is located in the Palo Verde Channel and will collect runoff from the sub-basin 10. This segment of the watershed is comprised largely of low density residential neighborhoods (Table 1-1) and represents 19% of the entire LCC watershed. The LSPC model predicted that this portion of the watershed would

[3] The delivery ratio of pollutant loads can be defined as the ratio of the discharged pollutant load delivered to the point of interest divided by the mass of pollutants generated at the source.

produce moderate loads of copper, lead and zinc. This watershed is somewhat unique in its relatively large size (3403 acres) and having more than 77 percent residential land use (71% low density and 6.3% high density residential land use). Monitoring of this sub-basin is considered to be useful in validating the modeling results and providing improved estimates of trace metal loads from residential areas.

Sub-basins 8 and 9 are located in northern portion of the watershed (Figure 1-2) draining portions of Bellflower, Downey, Lakewood, Long Beach, and Paramount. LSPC modeling indicated that these two sub-basins would likely yield some of the highest loads of metals (Figure 1-3). Initial modeling indicated that sub-basin 9 was expected to have higher loads of copper, lead and zinc than most other areas. The model projected that copper and lead loading would be elevated in sub-basin 8 but this region was expected to produce slightly lower levels of zinc. Land uses in both sub-basins are predominantly residential with substantial amounts of commercial activities (Table 1-1). Together, these two sub-basins comprise over a third of the LCC watershed. Monitoring sites are located near the bottom of each of these sub-basins. SB8 is located in the Clark Channel just north of the Lakewood Civic Center and SB9 is located in the Del Amo Channel near Clark Avenue.

Monitoring at these four PWS sites will form the backbone of the program. This program allows for an adaptive process that enables resources to be focused on confirming modeling results and portions of the watershed that are significant sources of contaminants and flow. Wet weather monitoring at the LCC1 receiving water monitoring site and the four PWS sites will be used to evaluate if one or more of these segments is contributing excessive loads of key pollutants.

Potential Secondary Watershed Segment (SWS) sites for forensic monitoring have been identified within each of the four sub-basins (Figure 1-2). SWS sites are identified by the name of the sub-basin monitoring site followed by a hyphen and a sequential number for each added site. For example, potential SWS sites in sub-basin 4 are identified as SB4-1 and SB4-2.

Where possible, these sites are positioned at locations that further dissect the sub-basins. In sub-basin 4, tentative SWS sites effectively divide the sub-basin into two areas of comparable size. SWS sites isolate major, but unequal branches of the drainages within both sub-basins 8 and 9. Sub-basin 10 has a more linear configuration that required locating potential SWS sites at two locations along the length of the sub-basin. These are sites where further monitoring would be conducted if one of more of the sub-basins is identified as having high pollutant loading rates. It is not anticipated that all secondary sampling locations will require sampling and it is possible that none will require further sampling.

Any sampling initiated at these SWS sites would be conducted with temporary installations designed to allow for installation within one day. Monitoring at these sites would utilize 24-hour, time-based sampling triggered by flow. Sampling would be conducted concurrently with sampling of the long-term sub-basin watershed sites (PWS sites) and the receiving water monitoring site (LCC1).

SWS sites will utilize time-based monitoring methods to aid in isolating areas that may be contributing excessive concentrations of contaminants. If monitoring data indicate that one of the two SWS sites has elevated concentrations of any contaminant of concern, additional upstream monitoring sites will be selected based upon the configuration of the upstream storm drains and land use. Monitoring equipment used for the paired secondary stations would then be relocated upstream in the targeted segment to better isolate potential sources.

1.2.3 Non-Stormwater Outfall Monitoring

Non-Stormwater Outfall Based Monitoring will be conducted throughout the major open channels of the Los Cerritos Channel Watershed. Initially, all pipes exceeding 12 inches in diameter and discharging either directly into the Los Cerritos Channel receiving water or into any of the open channels will be identified in the first screening survey. By the end of 2014, the database will be refined to determine which of the 12-inch to 36-inch pipes include discharges from areas with industrial land uses. Discharge pipes less than 36 inches and determined not to incorporate runoff from industrial land use areas will be excluded from further surveys. After completing an inventory of the outfalls, two more screening surveys will be conducted by the end of 2014 to document sites with persistent and significant non-stormwater flows. Subsequently, the source ID program will utilize an array of different methods to assist in determining whether flows are the result of illicit connections/illicit discharges (IC/IDs), authorized or conditionally exempt non-stormwater flows, natural flows or unknown. These may include available drainage maps, information on existing dewatering permits or industrial discharges, and a combination of field tests and limited laboratory testing.

1.2.4 New Development/Re-Development Effectiveness Tracking

Participating agencies have developed mechanisms for tracking information related to new and re-development projects that are subject to post-construction best management practice requirements in Part VI.D.7 of the MS4 Permit.

1.2.5 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 2014.

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.

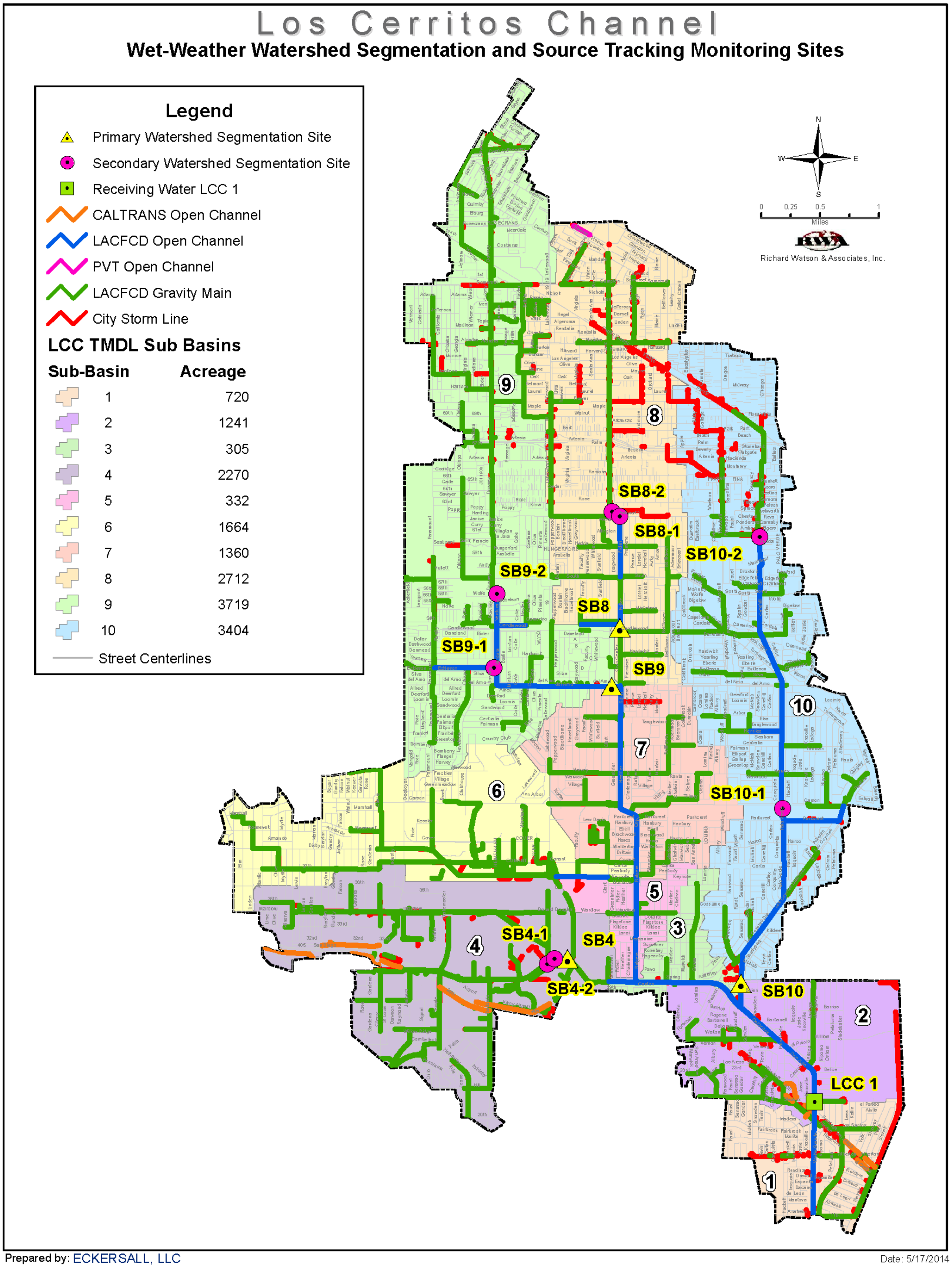
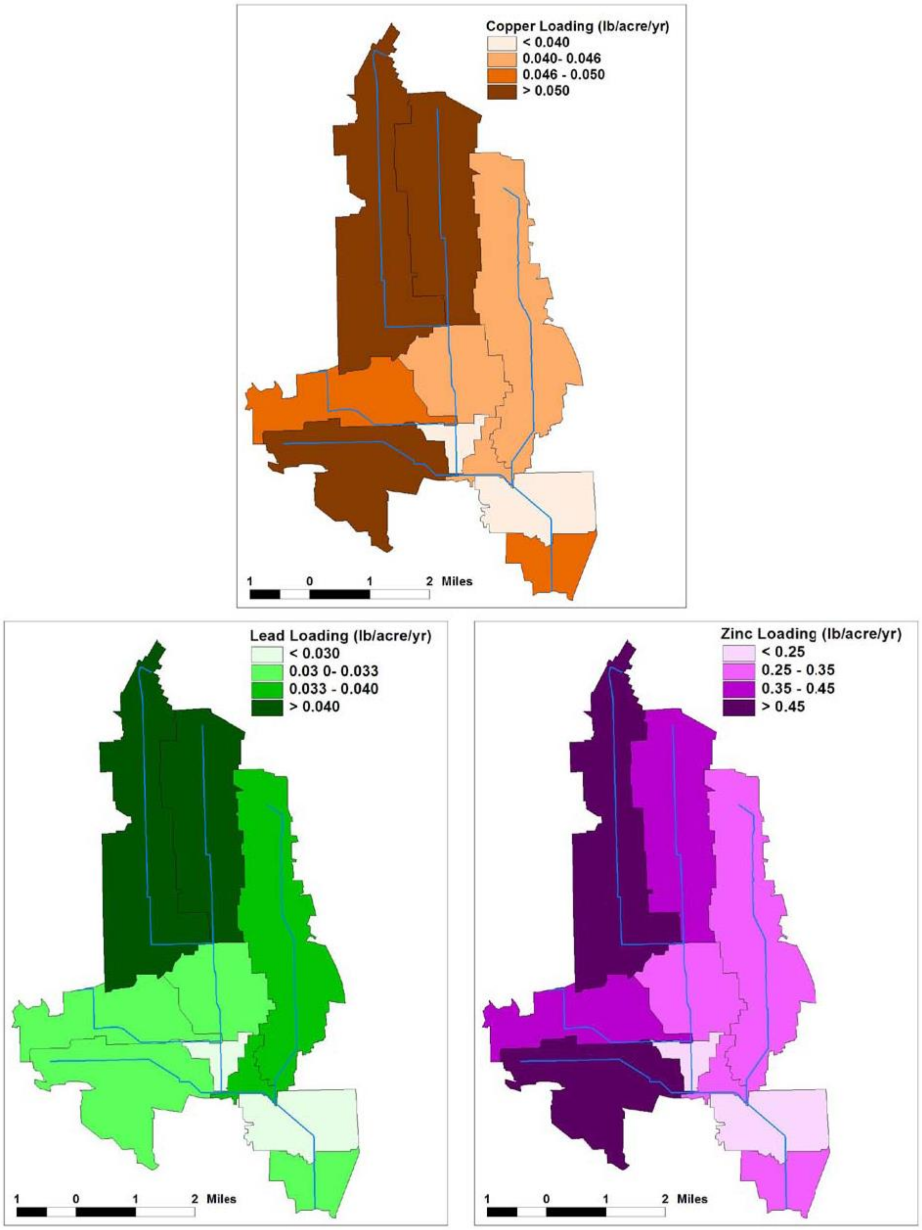


Figure 1-2. Locations of Potential Wet Weather Monitoring Sites in the Los Cerritos Channel Watershed.



Source: EPA 2010. Los Cerritos Channel Metals TMDL.

Figure 1-3. Estimated Concentrations of Metals from each Sub-basin of the Los Cerritos Channel Watershed.

Table 1-1. Summary of Land Use Associated with Monitored Segments of the Los Cerritos Channel Watershed.

Land Use	SUB-BASIN NUMBER/ACREAGE				
	4	8	9	10	TOTAL[2]
Agriculture	0	37.3	42.4	50	129.7
Commercial	352.5	506.8	709.9	371.9	1941.1
Industrial	705.8[1]	124.9	499.8	59	1389.5
HD Residential	40	371.3	490.5	212.7	1114.5
LD Residential	276.1	1,597.5	1,782.8	2,415.6	6072
Mixed Urban	752.8	13.6	120.2	142.4	1029
Open	143.5	60.4	63.9	151.5	419.3
Total Acres	2,271	2,712	3,710	3,403	12,096
		Total Watershed Acres			**17,716**
	SUB-BASIN NUMBER/%				
Land Cover	4	8	9	10	-
Agriculture	0.0	1.4	1.1	1.5	0.7
Commercial	15.5	18.7	19.1	10.9	11.0
Industrial	31.1	4.6	13.5	1.7	7.8
HD Residential	1.8	13.7	13.2	6.3	6.3
LD Residential	12.2	58.9	48.1	71.0	34.3
Mixed Urban	33.2	0.5	3.2	4.2	5.8
Open	6.3	2.2	1.7	4.5	2.4
Total %	13	15	21	19	68

HD= High Density, LD= Low Density

[1] Bolded values indicate major land uses present in each sub-basin.

[2] Land use composition for all 10 sub-basins can be accessed in the Los Cerritos Channel Metals TMDLs (EPA 2010)

Table 1-2. Monitoring Site Designation and Monitoring Function.

Site Name	Site Description	Datum NAD83		Type of Site			
				Receiving Water	TMDL	WATERSHED	
		Latitude (N)	Longitude (W)			Primary	Secondary[1]
LCC1	Stearns Street	33.79538	118.10361	**X**	**X**	**X**	
SB4	Sub-basin 4 – Spring St. Drain	33.81306	118.13953		**X**	**X**	
SB8	Sub-basin 8 – Clark Drain	33.85384	118.13226		**X**	**X**	
SB9	Sub-basin 9 – Del Amo/Downey	33.84682	118.13370		**X**	**X**	
SB10	Sub-basin 10 – Palo Verde	33.81044	118.11430		**X**	**X**	
SB4-1	Northern Sub-basin[1]	33.81316	118.14235				**X**
SB4-2	Southern Sub-basin[1]	33.81288	118.14249				**X**
SB8-1	North Clark Channel[1]	33.86848	118.13355				**X**
SB8-2	West Clark Channel[1]	33.86783	118.13225				**X**
SB9-1	West Downey Channel[1]	33.84908	118.15978				**X**
SB9-2	North Downey Channel[1]	33.85844	118.15046				**X**
SB10-1	North Palo Verde Channel[1]	33.86546	118.11160				**X**
SB10-2	Mid Palo Verde Channel	33.83210	118.10836				**X**

[1] These locations are ***tentative*** sites and will be further evaluated as part of the adaptive management of the CIMP. Monitoring at secondary sites will be dependent upon the monitoring results at each of the Primary Watershed Sites.

11

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

The CIMP will be implemented in a phased process (Table 2-1). Existing monitoring at LCC1 continues to be conducted, and the dry weather screening of major outfalls has commenced. 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 CIMP, whichever is later.

Receiving Water Quality Monitoring

- Monitoring will occur at one Receiving Water Quality Monitoring Site, LCC1, which will also serve as the LCC Metals TMDL compliance site.
- Monitoring will be conducted during two dry weather and three wet weather events. Although the LCC Metals TMDL calls for monitoring during four storm events, monitoring of three events is considered suitable to address the objectives of both programs. This allows alignment of monitoring the Receiving Water and Stormwater Outfall Monitoring requirements of the Permit with TMDL Monitoring. Alignment of these monitoring requirements allows for a more efficient and cost effective program.
- Monitoring of the two dry weather flows will start in July 1, 2015 or 90 days after approval of the CIMP, whichever is later. Wet season monitoring will follow for three storm events during the 2015/16 wet season.
- Water quality testing during the critical dry weather flows (July) and during the first significant storm event of the year will incorporate the entire list of 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 listed under water body/pollutant classifications 1, 2 and 3 (See Section 3) for the Los Cerritos Channel receiving waters. In summary, these include all constituents with existing TMDLS, those that are 303(d) listed or with sufficient data to warrant listing and constituents with a recent history or exceedances of relevant water quality criteria.
- 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 is not otherwise identified as being 303(d)-listed or part of an ongoing TMDL, the analyte will not be further analyzed. In accordance with the minimum requirements established in the Permit Monitoring and Reporting Program (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 receiving water monitoring station.
- The Aquatic Toxicity Testing program will be initiated during the 2015 dry weather season at LCC1. Aquatic Toxicity Testing will be conducted during one dry weather monitoring event when critical low flow conditions are expected and during two storm events including the first major storm of the year.

Primary Watershed Segmentation (PWS) Stormwater Monitoring

- Two PWS sites, SB4 and SB10, will be installed and ready for monitoring during the 2015/16 wet season. SB9 will be installed and prepared to monitor storm events during the 2016/17 wet season. SB8 will be installed in preparation for the subsequent season (2017/18) and will complete the planned array of four PWS sites.
- When possible, PWS sampling will be conducted concurrently with stormwater monitoring at LCC1. This will result in three monitored stormwater events for each PWS site as they are installed and ready for collection of flow-rated composite samples.
- Water quality testing at PWS 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 PWS sites is addressed in Section 3.1 This set of constituents assures that all Category 1, 2, and 3 analytes and ancillary information needed to interpret the data are part of the initial testing. The only exception will be enterococcus which is only included at PWS sites that would discharge to marine or estuarine waters. Enterococcus was only included due to the fact that the LCC1 receiving water/mass emission site is located in an area adjacent to estuarine/marine waters.
- 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, LCC1. These constituents will be added to monitoring requirements at PWS sites once an analyte is detected in stormwater runoff at LCC1 during two consecutive stormwater monitoring events. Similarly, if analytes added the PWS monitoring are not detected at PWS sites during two consecutive stormwater monitoring events, they will be removed from the required analytical list.
- Once a minimum of two seasons of wet weather monitoring data (six events) are available from a PWS site, data will be evaluated to determine if forensic monitoring is necessary to assist in source tracking and identifying upstream sources of key pollutants. Forensic monitoring would be conducted by further dividing the watershed with Secondary Watershed Segmentation (SWS) sites. Potential SWS sites have been identified for each of the four PWS sites but these sites will only be used if water quality constituents measured at the PWS sites are sufficiently elevated to warrant implementation of forensic monitoring.
- Sampling would be performed with temporary, mobile stormwater sampling stations used to take time-based composite samples and would focus on the specific analytes of concern as well as any appropriate ancillary data. Source tracking would be triggered if running averages measured at a PWS site exceeds Municipal Action Limits (MALs; Attachment G of the MRP) by more than 20% any analytes that have limits and that are required to be sampled at the PWS sites. Similarly, forensic sampling would also be conducted if the running average pollutant loading rates for Category 1 or 2 pollutants are found to exceed those measured at LCC1 (the Los Cerritos Channel receiving water/TMDL monitoring site) by more than 25%.

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 expand 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 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 contributions to the receiving waters.
- 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 be 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 program 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 December 2015 and 100% of the outfalls in the inventory by December 2017.
- Outfalls classified as **Potential Discharges** will 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 Watershed.

Task	Dry 2014	Dry 2015	Wet 2015-16	Dry 2016	Wet 2016-17	Dry 2017	Wet 2017-18	Dry 2018
Receiving Water/TMDL								
LCC1 Stearns St.	Note 6							
Chemistry[1]		2	3	2	3	2	3	2
Aquatic Toxicity		1	2	1	2	1	2	1
Primary Watershed Segments								
SB10			3		3		3	
SB4			3		3		3	
SB8							3	
SB9					3		3	
Secondary Watershed Segments[2]								
SBX-1					3		3	
SBX-2					3		3	
Non-Stormwater Outfall								
Inventory & Screen[3]	3							
Source ID[4]		Ongoing		Ongoing		Ongoing		Ongoing
Monitoring[5]				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 locations of Secondary Watershed Segmentation (SWS) sites have been selected for each Primary Watershed Segment (PWS). Implementation of monitoring at SWS site will be dependent upon results of monitoring at PWS sites (e.g. exceedance of action limits).
3. Initial Inventory and Screening will be completed in three surveys before the end of 2014. One re-assessment of the Non-Stormwater Outfall Monitoring Program will be conducted prior to December 2017.
4. Investigations designed to track and classify discharges will start during the 2015 dry season. 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 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.
6. Monitoring at LCC1 will continue to be conducted in accordance with the existing permit until the CIMP is approved.

3 Chemical/Physical Parameters

Section 2 of the Watershed Management Plan provides a detailed analysis of water quality priorities within the Los Cerritos Channel Watershed. Water quality priorities were established in accordance with Section C.5.a.ii of the Permit. The three Permit categories are defined as:

- **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.E and Attachments L through R of the Order.
- **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 but, in the case of the Los Cerritos Channel, data are limited to a single point in the watershed. Table 3-1 summarizes pollutants within each category.

Table 3-1. Waterbody-Pollutant Categories for the Los Cerritos Channel Watershed.

Category	Constituents
1	copper, lead, zinc, DDT, chlordane, PCBs, PAHs
2	ammonia, bis(2)ethylhexylphthalate, *E. coli*, pH
3	MBAS, enterococcus

The primary constituents of concern in the watershed are copper, lead and zinc which are part of the Los Cerritos Channel Metals TMDLs. Chlordane, DDTs, PCBs and PAHs are incorporated due to a 303(d) listing for chlordane in sediments downstream in the tidal portion of the channel and the Harbor Toxics TMDL for which the Los Cerritos Channel is considered part of the nearshore watershed[4]. Permittees in

[4] As recognized by the footnote in Attachment K-4 of the Permit, the Cities of Bellflower, Cerritos, Downey, Lakewood, Long Beach, Paramount, Signal Hill, and the LACFCD have entered into an Amended Consent Decree with the United States and the State of California, including the Regional Board, pursuant to which the Regional Board has released the aforementioned entities from responsibility for toxic pollutants in the Dominguez Channel and the Greater Los Angeles and Long Beach Harbors. Accordingly, no inference should be drawn from the submission of this CIMP or from any action or implementation taken pursuant to it that the aforementioned entities are obligated to implement the Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants TMDL, including this CIMP or any of the TMDL's other obligations or plans, or that the aforementioned entities have waived any rights under the Amended Consent Decree.

the nearshore watershed are separately contributing to monitoring requirements in the Harbor waters and the Los Angeles River Estuary. Therefore DDTs, PCBs and PAHs are not currently incorporated into the sampling requirements for the ME and PWS monitoring sites. Two other constituents, ammonia and pH, are 303(d) listed due to dry weather flows where extremely shallow flows cause a daily cycle of pH and result in calculated ammonia water quality criteria to be exceeded despite extremely low concentrations. Additional listings exist for minor exceedances of MBAS criteria and exceedance of coliform and enterococcus bacteria. Enterococcus bacteria are limited to LCC1 since this site discharges to an estuarine environment.

Table 3-2 summarizes the constituents that will be monitoring at the ME and PWS sites. 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 low flow. Results of this analytical screening process will determine which constituents need to be analyzed at the mass emission site for the remainder of the five-year cycle of the permit.

If a parameter is not detected above the Method Detection Limit (MDL) for its respective test method *or* 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 (2017) 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 is not detected at levels of concern during two consecutive monitoring events representing the same seasonal conditions, the analysis will be removed from the sampling requirements until being subject to reconsideration during the next five year Permit cycle. 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 consecutive events from the same season.

Constituents requiring screening are listed in Table E-2 of the Monitoring and Reporting Program. These constituents are further broken out by major analytical groups in Table 3-3 through Table 3-9below.

Table 3-2. **Summary of Constituents to be Monitored on a Regular Basis at the Mass Emission Site (LCC1) and the Primary Watershed Segmentation (PWS) Sites.**

CLASS OF MEASUREMENTS	MASS EMISSION SITE (LCC1)		PRIMARY WATERSHED SEGMENTATION (PWS) SITES
	Wet	Dry	Wet
Flow	3	2	3
Field Measurements (dissolved oxygen, pH, temperature, and specific conductivity)	3	2	3
MRP Table E-2 Constituents[1] (other than those specifically listed below)	1	1	
Aquatic Toxicity	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
Microbiological Constituents (Table 3-4)			
E.coli, Total & Fecal Coliform, enterococcus[3]	3	2	
E.coli			3
Nutrients (Table 3-5) - none required			
Organochlorine Pesticides and PCBs (Table 3-7)			
Chlordane[2]	3	2	
Metals (Table 3-6)			
Cu, Pb, & Zn	3	2	3
Organophosphate Pesticides[4] (Table 3-8) - none required			
Semivolatile Organic Compounds (Table 3-9**)**			
bis(2)ethylhexylphthalate	3	2	

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 CIMP.
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. Analysis of all Fecal Indicator Bacteria (FIBs) will only be included for LCC1 that discharges directly to the Los Cerritos Channel Estuary. Enterococcus will not be analyzed at PWS sites since they do not discharge to marine or estuarine waters.
4. No organophosphate pesticides are required as part of the baseline program.

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 3-7 and Table 3-8) 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.

The critical dry weather event is defined as the period when historical in-stream flow records are the lowest or during the historically driest month. Point measurements of dry weather flows taken in Los Cerritos Channel between 2000 and 2014 have been relatively uniform between May and September of each year, but base flows have decreased to approximately 0.5 cfs in recent years. Rainfall during the summer dry season is minimal and only briefly impacts flows in the channel. As a result, it is expected that critical dry weather flow testing could be performed anytime between May and September. Nevertheless, regional data suggest that rainfall and flows in major watersheds (Los Angeles River and San Gabriel River watersheds) are least in July. As such, critical low flow monitoring will be conducted in July.

A more accurate assessment of critical dry weather flow conditions will be completed and available by the end of the 2014 dry season. Flumes equipped with stilling wells, pressure sensors and data loggers will be constructed and installed throughout the watershed for a period of 6-8 weeks. The work is part of a State-funded Proposition 84 study[5] intended to provide detailed, continuous records of water level, flow and temperature at each site for the duration of the deployment. Four of flumes will be located at sites selected as PWS sites for this CIMP. These data will be used to determine if flow diminishes over the course of a few weeks or exhibits diurnal fluctuations as expected. Concurrent water samples will also be taken over three 24-hour time periods to analyze trace metals (especially copper, lead, and zinc) and nutrient loading. If differences are noted, forensic work will be conducted to identify and mitigate the source the discharges. Although this work is not part of the CIMP, the results of this program will be utilized to refine the "critical dry weather flow period" and to help provide guidance with respect to segments most likely to contribute higher loads of metals during dry weather conditions.

---

[5] Gateway Water Management Authority Agreement No. 12-423-550. Los Cerritos Channel Watershed Segmentation and Low Impact Development (LID) Project

3.1 General and Conventional Pollutants

Most of the general and conventional pollutants listed in Table 3-3 will continue to be analyzed as part of the base monitoring requirements for both receiving water and PWS/SWS 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 and suspended sediment concentrations directly examine particles associated with water samples and don't suffer from the problems associated with measuring turbidity.

Other pollutants in this group have been tested in samples from LCC1 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 has 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 receiving water site (LCC1) 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 recoverable phenolic compounds, 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 PWS/SWS monitoring sites.

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

CONSTITUENTS CONVENTIONAL POLLUTANTS	METHOD	Target Reporting Limits mg/L
Oil and Grease	EPA1664	5
Total Petroleum Hydrocarbon	EPA 418.1	5
Total Suspended Solids	EPA 160.2	1
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
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 four microbiological constituents used as fecal indicator bacteria (FIB) will continue to be monitored at the LCC1 Receiving Water monitoring site. Bacteria used as fecal indicators in marine waters will continue to be analyzed during wet and dry weather surveys due to being situated just above the Los Cerritos Channel Estuary. Only *E. coli* will be monitored at the four primary watershed segment sites since these are each located in freshwater portion of the watershed. Table 3-4 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.

Table 3-4. Microbiological Constituents, Analytical Methods and Quantitation Limits.

BACTERIA[1]	Method	Lower Limits MPN/100ml	Upper Limits MPN/100ml
Total coliform (marine waters)	SM 9221B	<20	>2,400,000
Fecal coliform (marine waters)	SM 9221E	<20	>2,400,000
Enterococcus (marine waters)	SM 9230B/C	<20	>2,400,000
E. coli (fresh waters)	SM 9221E/ Colilert-QT	<10	>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. *E. coli* will be analyzed at sites within the freshwater portion of the watershed.

3.3 Nutrients

Nutrients (Table 3-5) 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 both the receiving water site (LCC1). 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. 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 3-5. Nutrients, analytical methods, and quantitation limits

CONSTITUENT	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 3-6. Most metals will be analyzed by EPA Method 200.8 using ICP-MS to provide appropriate detection limits. Hexavalent chromium and mercury both require alternative methods. Neither hexavalent chromium nor mercury is 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. 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 the volatility. This becomes more of an issue when sampling is conducted near the limits of a peristaltic pump. Despite the known issues, autosamplers have been used to take samples of stormwater runoff throughout the country and analysis of both total and dissolved mercury are required for both stormwater and dry weather compliance monitoring locations within both the Los Angeles and San Gabriel Rivers. If mercury is detected in flow-rated composite samples, it is likely that alternative sampling and analytical methods may be warranted in order to better assess the problem.

Table 3-6. Metals Analytical Methods, and Quantitation Limits.

METALS (Dissolved & Total)	METHOD	Reporting Limit *ug/L*
Aluminum	EPA200.8	100
Antimony	EPA200.8	0.5
Arsenic	EPA200.8	0.5
Beryllium	EPA200.8	0.5
Cadmium	EPA200.8	0.25
Chromium (total)	EPA200.8	0.5
Chromium (Hexavalent)	EPA218.6	5
Copper	EPA200.8	0.5
Iron	EPA200.8	25
Lead	EPA200.8	0.5
Mercury	EPA245.1	0.2
Nickel	EPA200.8	1
Selenium	EPA200.8	1
Silver	EPA200.8	0.25
Thallium	EPA200.8	0.5
Zinc	EPA200.8	1

3.5 Organochlorine Pesticides and PCBs

Although organochlorine pesticides (OC pesticides) and PCBs are not commonly present in stormwater sampled at LCC1, they have periodically been detected at low concentrations. The analytical methods and detection limits for these compounds are summarized in Table 3-7. 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 analysis of PCBs analyses if they are not detected in the early storm event and critical dry weather monitoring event.

Table 3-7. Chlorinated Pesticides and PCB Analytical Methods, and Quantitation Limits

CHLORINATED PESTICIDES	METHOD	Reporting Limit ug/*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
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		
Aroclor-1016	EPA 608,EPA 8082	0.5
Aroclor-1221	EPA 608,EPA 8082	0.5
Aroclor-1232	EPA 608,EPA 8082	0.5
Aroclor-1242	EPA 608,EPA 8082	0.5
Aroclor-1248	EPA 608,EPA 8082	0.5
Aroclor-1254	EPA 608,EPA 8082	0.5
Aroclor-1260	EPA 608,EPA 8082	0.5

3.6 Organophosphate Pesticides and Herbicides

Organophosphate pesticides, triamine pesticides and herbicides list in Table E-2 of the MRP are summarized in Table 3-8. 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 ambient 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 3-8. Organophosphate Pesticides and Herbicides Analytical Methods, and Quantitation Limits

ORGANOPHOSPHATE PESTICIDES	METHOD	Reporting Limit ug/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 from Table E-2 of the MRP are listed in **Error! Reference source not ound.**Table 3-9 below. Acids consist mostly of phenolic compounds which are uncommon in stormwater samples. Base/neutrals include polynuclear aromatic hydrocarbons (PAHs) and phthalates. Semivolatile organic compounds 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 semivolatile organic compounds 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 3-9. **Semivolatile Organic Compounds, Analytical Methods, and Quantification Limits.,**

SEMIVOLATILE ORGANIC COMPOUNDS	METHOD	Reporting Limit
ACIDS		**ug/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		ug/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

4 Aquatic Toxicity Testing and Toxicity Identification Evaluations

Aquatic toxicity testing supports the identification of best management practices (BMPs) to address sources of toxicity in urban runoff. The following outlines the approach for conducting aquatic toxicity monitoring and evaluating results. 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.

The generalized approach to conducting aquatic toxicity monitoring is presented in Figure 4-1, which describes an evaluation process for each sample collected as part of routine sampling conducted twice per year in wet weather and once per year in dry weather. 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 sub-sections below describe the process and its technical and logistical rationale.

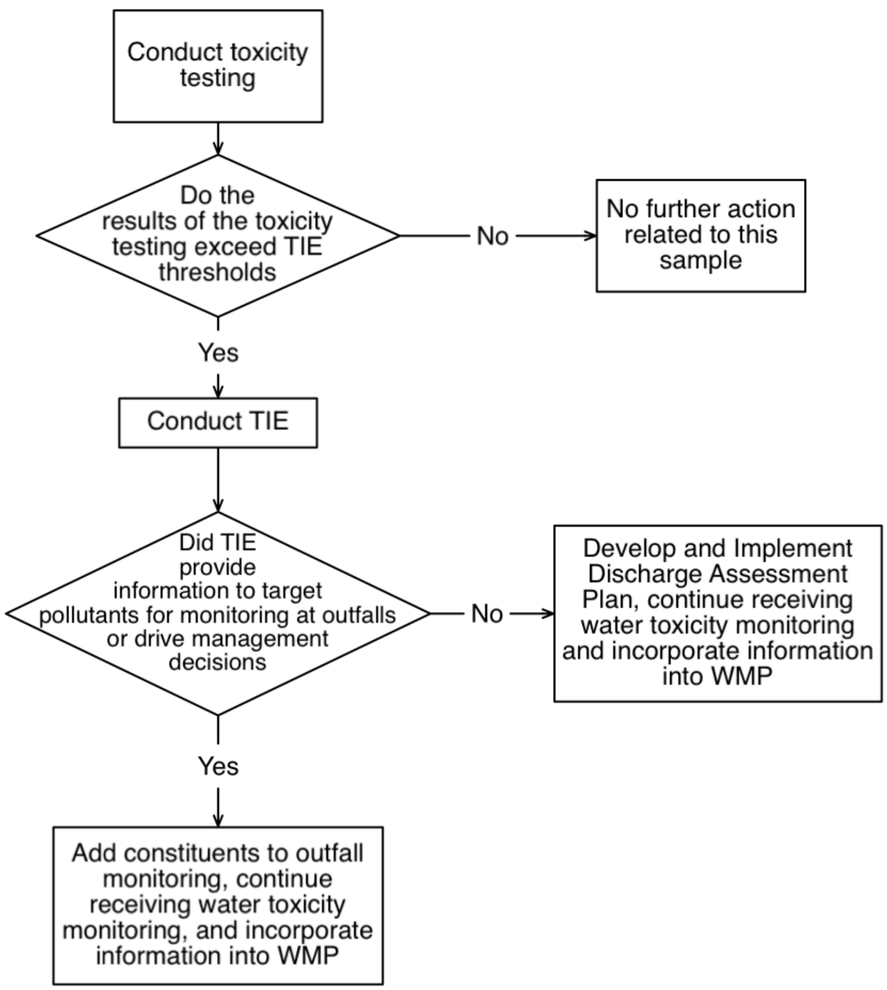


Figure 4-1. Generalized Aquatic Toxicity Assessment Process

4.1 Sensitive Species Selection

The Permit Monitoring and Reporting Program (MRP) (page E-32) 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." Previous relevant studies conducted in the watershed should be considered. Such studies may have been completed via previous MS4 sampling, wastewater NPDES sampling, or special studies conducted within the watershed.

As described in the MRP (page E-31), if samples are collected in receiving waters with salinity less than 1 part per thousand (ppt), or from outfalls discharging to receiving waters with salinity less than 1 ppt, toxicity tests should be conducted on the most sensitive test species in accordance with species and short-term test methods in *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (EPA/821/R-02/013, 2002; Table IA, 40 CFR Part 136). Salinities of both dry and wet weather discharges from the Los Cerritos Channel are considered to meet the freshwater criteria. During extreme high tides, salinity at the LCC1 receiving water monitoring site can exceed 1 ppt but dry weather sampling is always scheduled to avoid these extremes. The freshwater test species identified in the MRP are:

- A static renewal toxicity test with the fathead minnow, *Pimephales promelas* (Larval Survival and Growth Test Method 1000.04).
- A static renewal toxicity test with the daphnid, *Ceriodaphnia dubia* (Survival and Reproduction Test Method 1002.05).
- A static renewal toxicity test with the green alga, *Selenastrum capricornutum* (also named *Raphidocelis subcapitata*) (Growth Test Method 1003.0).

The three test species were evaluated to determine if either a sensitive test species had already been determined, or if there is prior knowledge of potential toxicant(s) and a test species is sensitive to such toxicant(s). In reviewing the available data in the Los Angeles River, Los Cerritos Channel, and the San Gabriel River watersheds, organophosphate pesticides and/or metals have been identified as problematic and are generally considered the primary aquatic life toxicants of concern found in urban runoff. Pyrethroid pesticides are known to be present in urban runoff and potentially contribute to toxicity in these waters. Tests specific to pyrethroid pesticides are simply less common. Given the knowledge of the presence of these potential toxicants in the watershed, the sensitivities of each of the three species were considered to evaluate which is the most sensitive to the potential toxicants in the watersheds.

Ceriodaphnia dubia has been reported as a sensitive test species for historical and current use pesticides and metals, and studies indicate that it is more sensitive to the toxicants of concern than *P. promelas* or *S. capricornutum*. In its aquatic life copper criteria document, the USEPA reports greater sensitivity of *C. dubia* to copper (species mean acute value of 5.93 µg/l) compared to *Pimephales promelas* (species mean acute value of 69.93 µg/l; EPA, 2007). *C. dubia's* relatively higher sensitive to metals is common across multiple metals. Researchers at the University of California, Davis also reviewed available species sensitivity values in developing pesticide criteria for the Central Valley Regional Water Quality Control Board. The UC Davis researchers reported higher sensitivity of *C. dubia* to diazinon and bifenthrin (species mean acute value of 0.34 µg/l and 0.105 µg/l) compared to *P. promelas* (species mean acute value of 7804 µg/l and 0.405 µg/l; Palumbo et al., 2010a, b). Additionally, a study of the City of Stockton urban stormwater runoff found acute and chronic toxicity to *C. dubia*, with no toxicity to *S. capricornutum* or *P. promelas* (Lee and Lee, 2001). The toxicity was attributed to organophosphate pesticides, indicating a higher sensitivity of *C. dubia* compared to *S. capricornutum* or *P. promelas*. *P. promelas* is generally less sensitive to metals and pesticides but has been found to be more sensitive to ammonia than *C. dubia*. However, as ammonia is not typically a constituent of concern for urban runoff and ammonia is not consistently observed above the toxic thresholds in the watershed, *P. promelas* is not considered a particularly sensitive species for evaluating the impacts of urban runoff in receiving waters in the watershed.

Selenastrum capricornutum is a species that is sensitive to herbicides; however, while sometimes present in urban runoff, measured concentrations are typically very low. Herbicides have not been identified as a potential toxicant in the watershed. *S. capricornutum* is also not considered the most sensitive species as it is not sensitive to either pyrethroids or organophosphate pesticides and is not as sensitive to metals as *C. dubia*. The *S. capricornutum* growth test can also be affected by high concentrations of suspended and dissolved solids, color and pH extremes, which can interfere with the determination of sample toxicity. As a result, it is common to manipulate the sample by centrifugation and filtration to remove solids in order to conduct the test. This process may affect the toxicity of the sample. In a study of urban highway stormwater runoff (Kayhanian et. al, 2008), the green alga response to the stormwater samples was more variable than both the *C. dubia* and the *P. promelas* and in some cases the alga growth was considered to be potentially enhanced due to the presence of stimulatory nutrients.

As *C. dubia* is identified as the most sensitive to known potential toxicant(s) typically found in receiving waters and urban runoff in the freshwater potions of the watershed and has demonstrated toxicity in programs within the watershed (CWH and ABC Laboratories, 2013), *C. dubia* is selected as the most sensitive species. The species also has the advantage of being easily maintained in in-house mass cultures. The simplicity of the test, the ease of interpreting results, and the smaller volume necessary to run the test, make the test a valuable screening tool. The ease of sample collection and higher sensitivity will support assessing the presence of ambient receiving water toxicity or long term effects of toxic stormwater over time. As such, toxicity testing will be conducted using *C. dubia*.

An alternative species of water fleas, *Daphnia magna*, may be used if the water being tested has elevated hardness. *C. dubia* test organisms are typically cultured in moderately hard waters (80-100 mg/L CaCO3) and can have increased sensitivity to elevated water hardness greater than 400 mg/L CaCO3), which is beyond their typical habitat range. Because of this, *Daphnia magna* may be substituted in instances where hardness in site waters exceeds 400 mg/L ($CaCO_3$). *Daphnia magna* is more tolerant to high hardness levels and is a suitable substitution for *C. dubia* in these instances (Cowgill and Milazzo, 1990).

4.2 Testing Period

As wet weather conditions in the region generally persist for less than the acute and chronic testing periods (typically 48 hours and 7 days, respectively), the shorter of the two testing methods, in the case of *C. dubia* acute testing measuring survival, will be used for wet weather toxicity testing. Because storm events are short duration, chronic tests performed on wet weather samples are not representative of the conditions found in the receiving water. Acute toxicity tests are consistent with the relatively shorter exposure periods of species in the watershed to potential toxicants introduced by urban runoff during storm events. Acute testing to assess survival endpoints will be conducted in accordance with *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (EPA, 2002b).

Chronic toxicity tests will be used to assess both survival and reproductive/growth endpoints for *C. dubia* in dry weather samples. Chronic testing will be conducted on undiluted samples in accordance with *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (USEPA, 2002a).

4.3 Toxicity Endpoint Assessment and Toxicity Identification Evaluation Triggers

Acute and chronic toxicity test endpoints will be analyzed, per the MRP, 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.

For acute *C. dubia* toxicity testing, if a statistically significant 50% difference in mortality is observed between the sample and laboratory control, a toxicity identification evaluation (TIE) will be performed. TIE procedures are discussed in detail in the following section. Experience conducting TIEs in receiving waters in the region supports using a 50% mortality trigger to provide a reasonable opportunity for a successful TIE. During TMDL monitoring in the Calleguas Creek Watershed (CCW) in 2003 and 2004, TIEs were initiated on samples exceeding the 50% threshold (the majority of which displayed 100% mortality). In that study, toxicity degraded in approximately 40% of the samples on which TIE procedures were conducted making the TIE unsuccessful (and effectively useless in pinpointing specific toxicants). Similar degradation of toxicity has been noted in tests conducted on stormwater samples from the Los Cerritos Channel mass emission monitoring site (LCC!). The Los Angeles Regional Water Quality Control Board approved monitoring program for the CCW Toxicity TMDL utilizes a 50% threshold for TIE initiation. Additionally, a 50% mortality threshold is utilized in the Ventura County MS4 Permit.

For chronic *C. dubia* toxicity testing, a TIE will be performed if a statistically significant 50% difference in mortality is observed between the sample and laboratory control. If a statistically significant 50% difference is observed in a sub-lethal endpoint between the sample and laboratory control, a confirmatory sample will be collected from the receiving water within two weeks of obtaining the results of the initial sample. If a statistically significant 50% difference in mortality or sub-lethal endpoint is again observed between the sample and laboratory control on the confirmatory sample, a TIE will 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 in excess of 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 Section4.4. 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)	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

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 Watershed Group 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.

TIEs will be considered inconclusive if 1) the toxicity is persistent (i.e., observed in the positive control), and 2) the cause of toxicity cannot be attributed to a class of constituents (e.g., insecticides, metals, etc.) 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

Note that the MRP (page E-33) 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. Information is currently not available to determine whether a prioritization metric will be warranted. If toxicity results indicate the need for development of a prioritization metric, a strategy will be developed and structured through the WMP adaptive management process. The suggested prioritization approach will be developed through the CIMP adaptive management process described in the CIMP annual report.

4.5 Discharge Assessment

The Watershed Management Group 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 above known species effect levels and the relevant exposure periods compared to the duration of the observed toxicity. 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 their impacts to 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.

4.6 Follow Up on Toxicity Testing Results

The MRP (page E-33) indicates the following actions should be taken when a toxicant or class of toxicants is identified through a TIE:

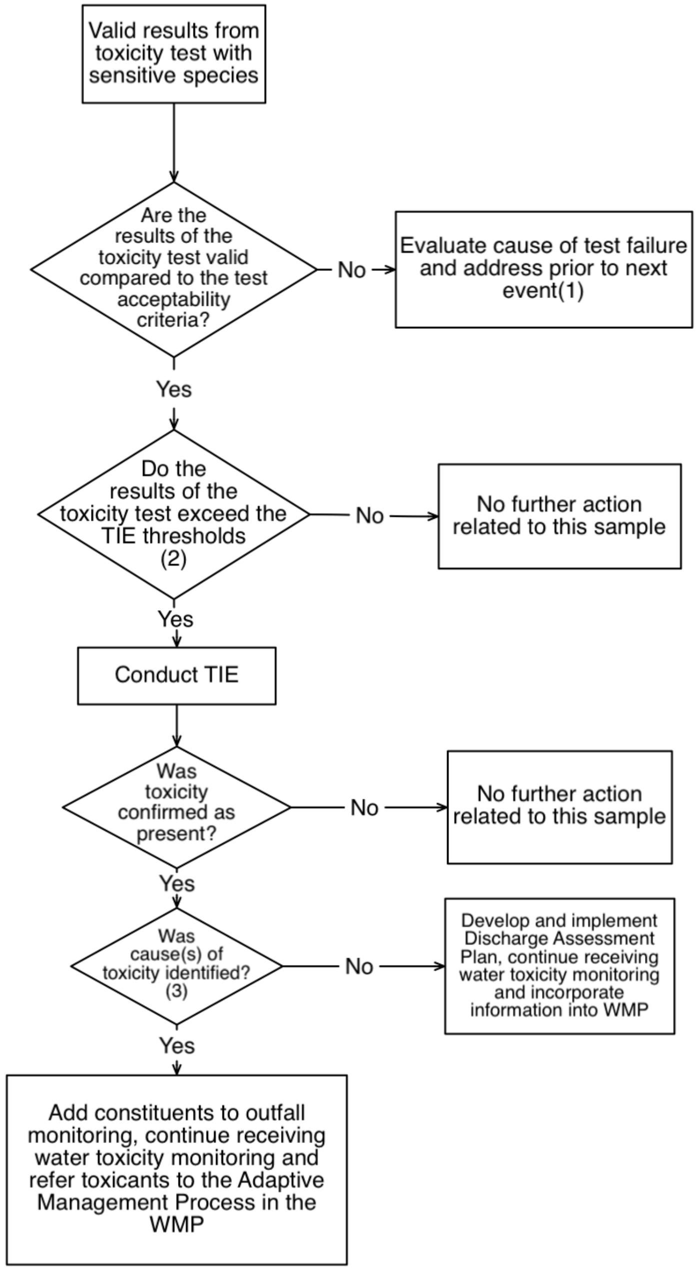
1. Group Members shall analyze for the toxicant(s) during the next scheduled sampling event in the discharge from the outfall(s) upstream of the receiving water location.
2. If the toxicant is present in the discharge from the outfall at levels above the applicable receiving water limitation, a toxicity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

The list of constituents monitored at outfalls identified in the CIMP 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 CIMP. The identification and implementation of control measures to address the causes of toxicity are tied to management of the stormwater program, not the CIMP. 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.

4.7 Summary of Aquatic Toxicity Monitoring

The approach to conducting aquatic toxicity monitoring as described in the previous sections is summarized in detail in Figure 4-2. 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.



1. **Test failure includes pathogen or epibiont interference which should be addressed prior to the next toxicity sampling event.**
2. **The TIE threshold is >50% mortality in an acute (wet weather) or chronic (dry weather) sample. If a >50% effect in a sub-lethal endpoint for a chronic test is observed a follow up sample will be initiated within two weeks of the completion of the initial sample collection. If the follow up sample exhibits a greater than 50% effect, a TIE will be initiated.**
3. **The goal of conducting the Phase I TIE is to identify the cause of toxicity so that outfall monitoring can incorporate the toxicant(s) into the list of constituents monitored during outfall monitoring. Thus, if the specific toxicant(s) or the analytical classes of toxicants (i.e., metals that are analyzed via EPA Method 200.8) are identified, sufficient information is available to inform the addition of pollutants to the list of pollutants monitoring during outfall monitoring.**

Figure 4-2. Detailed Aquatic Toxicity Assessment Process

5 Receiving Water Quality Monitoring (Wet and Dry Weather)

Receiving water quality monitoring will primarily be conducted with automated stormwater monitoring equipment detailed in Appendix A. Water samples for bacteria, oil and grease, , petroleum hydrocarbons, and volatile organic compounds must be collected separately as grab samples. Appendix A also discussed manual collection of water samples when required. This section addresses both the equipment and protocol used for collection of flow-weighted and time-weighted composite samples. Figure 1-2 will serve as the Receiving Water and TMDL compliance monitoring location for the Los Cerritos Channel. The monitoring equipment provides continuous records of rainfall at this site as well as flow during storm events. This site monitors and records all flows exceeding 18 cfs. Flow estimates are based upon a rating curve established for a former gaging station located approximately 100 feet upstream.

During dry weather monitoring, manual flow measurements are required to obtain instantaneous estimates of flow rates. Measurements are taken at a position where flow is relative uniform over a distance of 10 to 20 feet. Measurements are taken to determine to average width of the flowing water and the depth of water at the center of the flow. Water velocities are recorded by the time required for particles to travel a measured distance along the channel. The velocity of water flow is multiplied by the cross-sectional area of the channel to estimate flow. Since the channel approximates a triangular form, the cross-sectional area of the flowing water is calculated as ½ of the depth at the center of the channel multiplied by the width of flowing water. Dry weather flows have averaged approximately 0.5 cfs during the past five years.

5.1 Sampling Frequency and Mobilization Requirements

Monitoring of receiving water quality will be performed three times a year during the wet season and two times a year during dry weather conditions. 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 initial wet weather events will differ from subsequent events.

Mobilization of field crews will typically start when a 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 forecasts for the first storm of the season indicate development of a condition known as a “cut-off low”[6], 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 CIMP, weather forecasts and Quantitative Precipitation Forecasts (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.

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 of rainfall 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 LCC1 will serve as the secondary site if the primary site is inoperable or unavailable. As the Primary Watershed Segmentation (PWS) sites come on line, these 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. Due to anticipated reductions in required stormwater volumes, monitoring of subsequent storm events will be based upon weather forecasts predicting rainfall of 0.25 inches at probability of at least 70% within 24 hours of the predicted event. Once crews are mobilized for a storm event, rainfall must exceed a minimum of 0.25 inches and provide sufficient rainfall to project objectives. One of the three storm events to be sampled at the LCC1 Receiving Water Monitoring Site is only intended to address the requirements of the metals TMDL. At this site, a minimum rainfall event of 0.15 to 0.25 inches would be expected 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. There has been no indication that seasonal trends exist with respect to dry weather flows in the Los Cerritos Channel Watershed but data from the ongoing Proposition 84 study will provide information to evaluate if seasonality in flow exists in different areas of the watershed. Based upon existing information, dry weather monitoring at the LCC1 Receiving Water Monitoring Site 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

[6] 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).

precipitation to spin north, rainfall events are very infrequent. When practical, dry weather monitoring will be conducted during periods with less than 0.1 inches of rain occur over the previous week.

5.2 Sampling Constituents

With minor exceptions, chemical analyses are scheduled to be conducted for all analytes listed in Table 3-3 through Table 3-9 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 Method Detection Limits (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 3-3 will continue to be analyzed as part of the base monitoring requirements for continued monitoring for both receiving waters and for the metals TMDL. 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 3-4), nutrients (Table 3-5), chlordane compounds listed in Table 3-7 and TMDL metals (Table 3-6) will continue to be part of the ongoing monitoring at LLC1.

As noted in the previous section, it has been determined that adequate data exist to determine which of the three freshwater species are considered to be most sensitive during both storm events and dry weather periods. Available literature and local data indicate that the most sensitive bioassay test species is *Ceriodaphnia dubia*. The prior section on Aquatic Toxicity Testing and TIEs goes into detail as to species selection and the overall approach recommended for measuring toxicity in the receiving waters and strategies to eliminate any sources of toxicity. During wet weather conditions, bioassay tests will be performed based upon exposure to 100 percent test waters over a 48-hour time period since this time exposure is deemed to be more consistent with the duration of typical storm events. Since exposure times during the dry season are much long, dry weather testing will utilize 7-day chronic toxicity tests that assess both survival and reproductive endpoints for *C. dubia*. Chronic testing will also be conducted on 100 percent undiluted samples. 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 should be is necessary.

Table 5-1. Toxicity Test Volume Requirements for Aquatic Toxicity Testing as part of the Los Cerritos Channel Coordinated Integrated Monitoring Program.

Test Organism	**Toxicity Test Type**	**Test Concentration**	**Volume Required for Initial Screen (L)**	**Minimum Volume Required for TIE (L)[1]**
Freshwater Tests for Samples with Salinity < 1.0 ppt				
Daphnid Water Flea (Ceriodaphnia dubia)	48-Hour Acute Survival 7-day Chronic Survival and Reproduction	100% only	1.5	10
Sample Receipt Water Quality	--	--	1.0	--
Total volume required per event for samples with salinity < 1.0 ppt;			2.5	a

[1] Minimum volumes for TIE are 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.

6 Primary Watershed Segmentation (PWS) Sites

6.1 Sampling Frequency and Mobilization Requirements

The sampling frequency and mobilization requirements for the stormwater outfall sites will be consistent with monitoring conducted at the LCC1. A total of three storm events will be monitored at each site once they are installed. Monitoring will be concurrent with LCC1 monitoring in order to allow for comparison of pollutant loading rates associated with each segment relative to ultimate pollutant loads measured at the LCC1 site.

6.2 PWS Sampling Constituents

Constituents monitored at each PWS site will include all TMDL constituents as well as general and conventional constituents necessary to assist in evaluation of the data (Table 6-1). Constituents included in the MAL list and monitored at the outfall sites will be included in an annual MAL Assessment Report reported as part of the Annual Report. The MAL Assessment Report will summarize the monitoring data in comparison to the applicable MALs, and identify those subwatersheds where the running average concentrations of these constituents exceed the MALs by twenty percent or more.

Table 6-1. Constituents Monitored at Primary Watershed Segment (PWS) Sites.

CONSTITUENTS CONVENTIONAL POLLUTANTS	METHOD	TARGET REPORTING LIMITS mg/L
Total Suspended Solids	EPA 160.2	1
Total Dissolved Solids	EPA 160.1	1
Volatile Suspended Solids	EPA 160.4	1
Total Organic Carbon	EPA 415.1	1
Chemical Oxygen Demand	EPA 410.1	4
Alkalinity	EPA 310.1	5
Specific Conductance	EPA 120.1	1
Total Hardness	EPA 130.2	1
MBAS	EPA 425.1	0.02
Chloride	EPA300.0	2
Fluoride	EPA300.0	0.1
METALS (Dissolved & Total)	**METHOD**	**ug/L**
Copper	EPA200.8	0.5
Lead	EPA200.8	0.5
Zinc	EPA200.8	1

7 Secondary Watershed Segmentation (SWS) Sites (Wet Weather)

Secondary Watershed Segmentation (SWS) sites will be monitored with portable equipment that will be used to assist in tracking sources of constituents found to be elevated at one of the Primary Watershed Segmentation sites. The portable monitoring stations will consist of a battery powered autosamplers triggered by sensors installed in the channel to detect the start of flow. Once triggered, the samplers will take time-weighted samples for a 24-hour period. The autosamplers will be set to take 200 mL samples every 15 minutes while is present in the channel. All sample composite bottles and materials contacting the water will be identical to those used for each of the "permanent" or fixed monitoring sites.

SWS sites are expected to be deployed above PWS sites where specific contaminants are found to be elevated. Tentative locations (Figure 1-2) have been established at sites in each subwatershed should PWS monitoring data indicate that forensic monitoring is necessary to further isolate areas contributing excessive pollutant loads. The selected sites further segment the subwatersheds into two areas and are designed to be monitored concurrently with the SWS site. Pre-selection of candidate SWS sites was intended to facilitate implementation of forensic monitoring by clearly identifying the next step if conditions are met that trigger further testing.

SWS monitoring will be triggered if the running average of any MAL constituent is exceeded by 20 percent or if the running average of MAL or TMDL constituents at a PWS site exceeds the running average at other PWS sites by more than 20 percent. SWS sites would focus on monitoring the specific constituent of concern and any additional data necessary to help interpret the results. For example, if the constituent of concern is a trace metal, monitoring at SWS sites would include both TSS and hardness.

8 Non-Stormwater (NSW) Outfall Monitoring

Detailed objectives of the screening and monitoring process (Section IX.A, page E-23 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 VI.D.10 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-stormwater discharges identified in Parts III.A.2 and III.A.3 of the Order and take appropriate actions pursuant to Part III.A.4.d of the Order for those discharges that have been found to be a source of pollutants. Any future reclassification will occur per the conditions in Parts III.A.2 or III.A.6 of the 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, if any.

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.

8.1 Non-Stormwater Outfall Screening and Monitoring Program

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 summer of 2014 to identify outfalls or other discharges that are considered to be significant and persistent sources of non-stormwater flow to either the 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[7] (outfalls less than 36-inches in diameter or equivalent) without

[7] 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)

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 WMG technical committee chair.

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 8-1):

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. 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. The Center for Watershed Protection and Pitt (2004) provide an evaluation of twelve analytes for assistance in determining the source of NSW discharges (Table 8-2). 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.

Table 8-1. 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 is currently being implemented. 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, 2014 with Annual CIMP Report
3. Inventory of Outfalls with NSW discharge (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, 2014 with Annual CIMP Report
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 December 28, 2015 and 100% by December 28, 2017
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

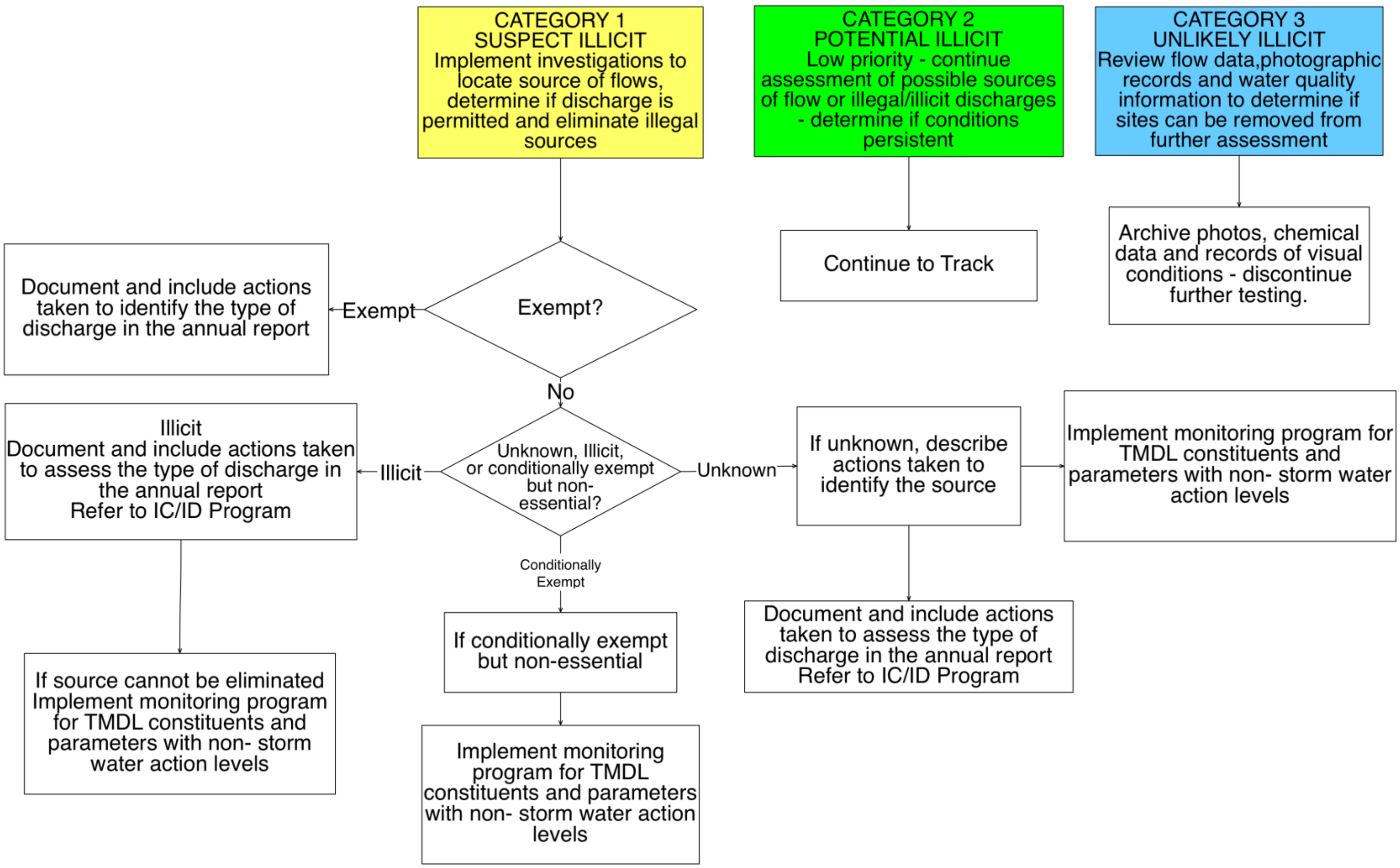


Figure 8-1. Flow Diagram of NSW Outfall Program after Classifying Outfalls during Initial Screening.

Table 8-2. 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

8.1.1 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 8.1.2.

The outfall screening process has already been initiated in order to meet the established schedule for completion of 25% of the source identification work. Once the screening process is completed Permittees 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.

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 Outfall Reconnaissance Investigation (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.

8.1.2 Inventory of MS4 Outfalls with Non-Stormwater Discharges

Part VII.A of the MRP requires that the CIMP plan(s) include a map(s) and/or database of the MS4 that includes the elements listed in Table 8-3. Most required elements are complete and being submitted with this CIMP. Elements requiring further development include the Effective Impervious Area, 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. Subbasins used for the WMMS model are currently associated with each outfall within that subbasin. 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 CIMP annual report.

Table 8-3. 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)	X[1]	
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)	X	ongoing
10. Storm drain outfall catchment areas for each major outfall within the Permittee(s) jurisdiction	X[3]	ongoing
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]		
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		ongoing
f. Stormwater and non-stormwater monitoring data		ongoing

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 8-4 summarizes the minimum physical attributes required to be recorded and linked to the outfall database.

These data will be maintained using the Outfall Reconnaissance Inventory (ORI) field form and associated database (Appendix C) 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 8-4. 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.

8.1.3 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.

8.1.4 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 WMG 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 December 2015 and 100% of the outfalls in the inventory by December 2017.

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 NWS 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 LCC WMP, 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.

8.1.5 Monitor Non-Stormwater Discharges Exceeding Criteria

As required in the MRP (Part II.3.3), 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.

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 CIMP report is expected to communicate adjustments in the number and locations of monitored discharges, pollutants being monitored and justifications for any adjustments.

8.1.5.1 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 (LCC1) during the last sample event or, where the TIE conducted on the receiving water sample was inconclusive, aquatic toxicity. 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 LCC1 (the nearest downstream receiving water station) per Part VI.D.1.d.

The MRP (Part IX.G.2-4) 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.

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 LCC WMG recommends 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 A 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.

9 New Development/Re-Development Effectiveness Tracking

Each of the cities in the watershed will maintain an electronic database to track qualifying new development and re-development projects that are subject to the Planning and Land Development Programs of Part VI.D.7 of Order No. R4 2012- 0175 and Part VII.J of Order No. R4 2014-0024. The electronic databases contain the information listed in Table 9-1 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 the watershed and facilitate future planning and research within the watershed, all of the cities within the watershed are subscribing to MS4Front, a web-based software system designed to streamline record keeping for MS4 permits and assists with annual reporting. The cities concluded that although it is a sophisticated management tool, it is flexible and relatively easy to use. The existing tracking programs will be converted to MS4Front.

Table 9-1. 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[8] 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.

[8] 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.

10 Reporting

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

Annual CIMP Reports

Annual CIMP 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 (CD). 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.

Discharge Assessment Plan

A Discharge Assessment Plan is applicable only if TIEs are conducted during two consecutive events and the results are inclusive for each. A 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 TIE 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.

11 References

American Public Health Association. 1992. Standard Methods for the Examination of Water and Wastewater, 18th ed. American Public Health Association, Washington DC.

American Public Health Association. 1995. Standard Methods for the Examination of Water and Wastewater, 19th ed. American Public Health Association, Washington DC.

Bonin, Jennifer L. and Timothy P. Wilson (2006). Organic Compounds, Trace Elements, Suspended Sediment, and Field Characteristics at the Heads-of-Tide of the Raritan, Passaic, Hackensack, Rahway, and Elizabeth Rivers, New Jersey, 2000-03,Prepared in cooperation with the New Jersey Department of Environmental Protection. Data Series 123. U.S. Geological Survey.

Center for Watershed Protection and R. Pitt . 2004. Illicit Discharge Detection and Elimination A Guidance Manual for Program Development and Technical Assessments. Center for Watershed Protection and University of Alabama. EPA Agreement X-82907801-0 Brown, E., D. Caraco,

Clark, S. E., C. Y. S. Siu, et al. 2009. "Peristaltic Pump Autosamplers for Solids Measurement in Stormwater Runoff." Water Environment Research 81: 192-200.

Council for Watershed Health (CWH) and ABC Laboratories, Inc., 2013. 2011 San Gabriel River Regional Monitoring Program, 2011 Annual Report.

Cowgill, U.M. and D.P. Milazzo. 1990. The sensitivity of two cladocerans to water quality variables, salinity and hardness. Arch. Hydrobiol. 120:185–196.

Gilbreath, A. N., Pearce, S. P. and McKee, L. J. (2012). Monitoring and Results for El Cerrito Rain Gardens. Contribution No. 683. San Francisco Estuary Institute, Richmond, California.

Gilinsky, Ellen (2009). TMDL Guidance Memo No. 09-2001. Guidance for monitoring of point sources for TMDL development using low-level PCB method 1668. Commonwealth of Virginia Department of Environmental Quality, Water Division.

Harwood, A.D, J. You, and M.J. Lydy. 2009. Temperature as a toxicity identification evaluation tool for pyrethroid insecticides: toxicokinetic confirmation. Environmental Toxicology and Chemistry 28(5):1051-1058

Horowitz, A.J. 1995. The use of suspended sediment and associated trace elements. in Water quality studies: Wallingford, Oxfordshire, IAHS Press, IAHS Special Publication no. 4, 58 p.

Kayhanian, M., C. Stransky, S. Bay, S. Lau, M.K. Stenstrom. 2008. Toxicity of urban highway runoff with respect to storm duration. Science of the Total Environment 389:109-128.

Lalor, M. 1994. Assessment of Non-Stormwater Discharges to Storm Drainage Systems in Residential and Commercial Land Use Areas. Ph.D. Thesis. Vanderbilt University Department of Environmental and Water Resources Engineering. Nashville, TN.

Lee, G. F. and A. Jones-Lee. “Review of the City of Stockton Urban Stormwater Runoff Aquatic Life Toxicity Studies Conducted by the CVRWQCB, DeltaKeeper and the University of California, Davis, Aquatic Toxicology Laboratory between 1994 and 2000,” Report to the Central Valley Regional Water Quality Control Board, G. Fred Lee & Associates, El Macero, CA, October (2001).

Levin, M.A., J.R. Fischer and V.J. Cabelli. 1975. Membrane Filtration Technique for Enumeration of Enterococci in Marine Waters. Applied Microbiology 30: 66-71.

Los Angeles Regional Water Quality Control Board, Los Angeles (LARWQCB). 2012 Waste Discharge Requirements for Municipal Separate Storm Sewer System Discharges within the Coastal Watersheds of Los Angeles County except those discharges originating from the City of Long Beach. Order No. R4-2012-0175, NPDES Permit No. CAS004001

Los Angeles Regional Water Quality Control Board, Los Angeles (LARWQCB). 2014 Waste Discharge Requirements for Municipal Separate Storm Sewer System Discharges from the City of Long Beach. Order No. R4-2014-0024, NPDES Permit No. CAS004003

Mahler, B.J., P.C. Van Metre, J.T. Wilson, A.L Guilfoyle and M.W. Sunvison 2006. Concentrations, loads, and yields of particle-associated contaminants in urban creeks, Austin, Texas, 1999–2004: U.S. Geological Survey Scientific Investigations Report 2006–5262, 107 p.

McCarty, Harry B., J. Schofield, K. Miller, R. N. Brent, P. Van Hoof, and B. Eadie. 2004. Results of the Lake Michigan Mass Balance Study:Polychlorinated Biphenyls and trans-Nonachlor Data Report. Prepared for US EPA Great Lakes National Program, EPA 905 R-01-011.

Messer, J.W. and A.P. Dufour. 1997. Method 1600: Membrane Filter Test Method for Enterococci in Water. US EPA Office of Water, Washington, DC. EPA-821-R-97_004.

Messer, J.W. and A.P. Dufour. 1998. A Rapid, Specific Membrane Filtration Procedure for Enumeration of Enterococci in Recreational Water. Appl. Environ. Microbiol. 64: 678-680.

Palumbo, A., Fojut, T., Brander, S., and Tjerdeema, R. 2010b. Water Quality Criteria Report for Bifenthrin. Prepared for the Central Valley Regional Water Quality Control Board by the Department of Environmental Toxicology, University of California, Davis. March.

Palumbo, A., Fojut, T., TenBrook, P. and Tjerdeema, R. 2010a. Water Quality Criteria Report for Diazinon. Prepared for the Central Valley Regional Water Quality Control Board by the Department of Environmental Toxicology, University of California, Davis. March.

Pitt, R. et al. 1993. A User’s Guide for the Assessment of Non-Stormwater Dischargers Into Separate Storm Drainage Systems. EPA/600-R-92-238. Risk Reduction Engineering Laboratory, USEPA. Cincinnati, OH.

Rantz, S.E and others. 1982. Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge. Geological Survey Water-Supply Paper 2175.

Stenstrom, Michael K., I.H. (Mel) Suffet and Victor Vasquez. 2009. Final Data Evaluation Report, Field Studies for the Development of Total Maximum Daily Loads for Organochlorine Pesticides and Polychlorinated Biphenyls in Three Los Angeles Count Lakes. Institute of the Environment, UCLA. Report to Los Angeles Regional Water Quality Control Board, March 15, 2009.

Texas Commission on Environmental Quality (TCEQ). 2012. Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Method. RG415

U.S. Geological Survey (1997) Protocols for Cleaning a Teflon Cone Splitter to Produce Contaminant-Free Subsamples for Subsequent Determinations of Trace Elements: OFFICE OF WATER QUALITY TECHNICAL MEMORANDUM 97.03 http://water.usgs.gov/admin/memo/QW/qw97.03.html

U.S. Geological Survey (1998) Change in Nitric Acid Preservative for Trace Element Samples: OFFICE OF WATER QUALITY TECHNICAL MEMORANDUM 98.06: http://water.usgs.gov/admin/memo/QW/qw98.06.html

United States Environmental Protection Agency (EPA). 1991. Methods for Aquatic Toxicity Identification Evaluations: Phase I. Toxicity Characterization Procedures. 2nd Edition. EPA-600-6-91-003. National Effluent Toxicity Assessment Center, Duluth, MN.

United States Environmental Protection Agency (EPA). 1992. Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I. EPA/600/6-91/005F. May 1992. National Effluent Toxicity Assessment Center, Duluth, MN.

United States Environmental Protection Agency (EPA). 1993a. Methods for Aquatic Toxicity Identification Evaluations- Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity. EPA-600-R-92-080. National Effluent Toxicity Assessment Center, Duluth, MN.

United States Environmental Protection Agency (EPA). 1993b. Methods for Aquatic Toxicity Identification Evaluations- Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity. EPA-600-R-92-081. National Effluent Toxicity Assessment Center, Duluth, MN.

United States Environmental Protection Agency (EPA). 1996. The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion. EPA823-B-96-007, June 1996

United States Environmental Protection Agency (EPA). 1996. Guidance on the Documentation and Evaluation of Trace Metals Data Collected for Clean Water Act Compliance Monitoring - Draft. Office of Water, Office of Science and Technology, E. A. D. (4303), M. S. SW and D. Washington.

United States Environmental Protection Agency (EPA). 1996. "Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels."

United States Environmental Protection Agency (EPA). 2002a United States Environmental Protection Agency (EPA). 2002a. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. Fourth Edition. October. EPA-821-R-02-013.

United States Environmental Protection Agency (EPA). 2002b. Methods for Measuring the Acute Toxicity of Effluent and Receiving Waters to Freshwater and Marine Organisms. Fifth Edition. October. EPA-821-R-02-012.

United States Environmental Protection Agency (EPA). 2007. Aquatic Life Ambient Freshwater Quality Criteria – Copper. February. EPA-822-R-07-001.

United States Environmental Protection Agency (EPA). 2010. National Pollutant Discharge Elimination System Test of Significant Toxicity Technical Document. EPA/833-R-10-004, U.S. Environmental Protection Agency, Office of Environmental Management, Washington,

United States Environmental Protection Agency (EPA). 2010. Los Cerritos Channel Total Daily Maximum Loads for Metals. 17 March 2010.

United States Geological Services (USGS) 2011. National Field Manual for the collection of Water-Quality Data. (TWRI Book 9), Chauncey Anderson 2005. Chapter 6.7. http://water.usgs.gov/owq/FieldManual/Chapter6/6.7_contents.html

Walkowiak, D. K., Ed. (2008). Isco Open Channel Flow Measurement Handbook.

Weston, D.P. and E.L. Amweg. 2007. Whole sediment toxicity identification evaluation tools for pyrethroid insecticides: II. Esterase addition. Environmental Toxicology and Chemistry 26:2397-2404.

Wheelock, C., Miller, J., Miller, M., Gee, S., Shan, G. and Hammock, B. 2004. Development of Toxicity Identification Evaluation (TIE) procedures for pyrethroid detection using esterase activity. Environmental Toxicology and Chemistry 23:2699-2708.

Wilson, Timothy P. 2006. Results of Cross-Channel Monitoring During the Lower Passaic River Environmental Dredging Pilot Program on the Lower Passaic River, December 1 to 12, 2005. USGS Report, West Trenton, New Jersey

APPENDIX A

AUTOMATED STORMWATER MONITORING EQUIPMENT

Page intentionally left blank

1 Automated Stormwater Monitoring Equipment

Monitoring of stormwater runoff at the Mass Emission (ME) sites and Stormwater Outfall 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 require similar equipment with minor exceptions at upstream, stormwater outfall monitoring sites. 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.

Page Intentionally Left Blank

APPENDIX B

CLEANING AND BLANKING PROTOCOL

FOR

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

Page Intentionally left Blank

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 **48 Hour Soak:** 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.

Page Intentionally left Blank

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

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	608	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 and Dissolved)

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Aluminum	200.8	If practical, filter immediately after subsampling. Otherwise filter in laboratory for dissolved fraction and preserve not more than 24 hours after subsampling; 6 months to analysis	250 to500 mL	HDPE	4°C and HNO_3 to pH<2	100	µg/L
Antimony	200.8					0.5	µg/L
Arsenic	200.8					0.5	µg/L
Beryllium	200.8					0.5	µg/L
Cadmium	200.8					0.25	µg/L
Chromium (Total)	200.8					0.5	µg/L
Copper	200.8					0.5	µg/L
Iron	200.8					25	µg/L
Lead	200.8					0.5	µg/L
Nickel	200.8					1	µg/L
Selenium	200.8					1	µg/L
Silver	200.8					0.25	µg/L
Thallium	200.8					0.5	µg/L
Zinc	200.8					1	µg/L
Chromium (Hexavalent)	218.6	Filter as above 24 hours	250 ml	HDPE	4°C	5	µg/L
Mercury	245.1	Filter as above 28 days	250 ml	Glass or Teflon	4°C and HNO_3 to pH<2	0.2	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

1.1.2 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

Page Intentionally Left Blank

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.

Los Cerritos Channel 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 ☐ Elliptical ☐ Box ☐ Other: _____	☐ Single ☐ Double ☐ Triple ☐ 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

Los Cerritos Channel 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)?

Page Intentionally Left Blank

APPENDIX E

MAJOR AND MINOR OUTFALLS TO THE LOS CERRITOS CHANNEL WATERSHED

Major Outfalls (=>36 inches) in the Los Cerritos Channel Watershed

LDISCHARGE POINT	DESCRIPTION	DISCHARGE POINT LATITUDE	DISCHARGE POINT LONGITUDE	OWNER	SIDE (R/L)	DISTANCE FROM CHANNEL STARTING POINT (km)	JURISDICTION	MODEL SUB WATERSHED	UNIQUE ID	PHOTO UNIQUE ID	CHANNEL UNIQUE ID
CLARK CHANNEL											
N. Charlemagne Ave/E. Pageantry St	36" Discharge	33.81315	-118.12997	Long Beach	R	1.925	Long Beach	BI9A-5	BI9A-5-001		CC-0.273
N. Rutgers Ave/E. Pageantry St	36" Discharge	33.81317	-118.12970	Long Beach	L	1.927	Long Beach	BI9A-5	BI9A-5-002		CC-0.275
N Charlemagne Ave/E. Mezzanine Way	72" Discharge	33.81519	-118.12998	Long Beach	R	2.141	Long Beach	BI9A-5	BI9A-5-003		CC-0.494
N Rutgers Ave/E. Mezzanine Way	54" Discharge	33.81519	-118.12971	Long Beach	L	2.152	Long Beach	BI9A-5	BI9A-5-004		CC-0.507
3343 Rutgers Ave/E. Wardlow Rd	36" Discharge	33.81791	-118.12970	UNK	L	2.449	Long Beach	BI9A-5	BI9A-5-005		CC-0.793
N. Charlemagne Ave/E. Wardlow Rd	42" Discharge	33.81870	-118.12997	LACFCD	R	2.528	Long Beach	BI9A-5	BI9A-5-006		CC-0.877B
N. Rutgers Ave/E. Wardlow Rd	42" Discharge	33.81869	-118.12971	LACFCD	L	2.528	Long Beach	BI9A-5	BI9A-5-007		CC-0.877A
N. Charlemagne/E. Monlaco Rd	150" Discharge	33.82273	-118.12977	LACFCD	R	2.993	Long Beach	BI9A-5	BI9A-5-015		CC-1.342
N. Rutgers Ave/E. Keynote St	63" Discharge	33.82355	-118.12967	LACFCD	L	3.070	Long Beach	BI9A-4	BI9A-4-001		CC-1.419
E. Conant St/N. Charlemagne Ave	39" Discharge	33.82505	-118.12990	LACFCD	R	3.238	Long Beach	BI9A-4	BI9A-4-002		CC-1.586
Carson St/N. Bellflower Blvd	63" Discharge	33.83124	-118.13056	LACFCD	L	3.960	Long Beach	BI9A-4	BI9A-4-007		CC-2.309

Carson St/N. Greenbrier Rd	48" Discharge	33.83215	-118.13235	LACFCD	R	4.164	Long Beach	BI9A-4	BI9A-4-008		CC-2.512
Carson St/N. Greenbrier Rd	45" Discharge	33.83233	-118.13233	LACFCD	R	4.206	Long Beach	BI9A-4	BI9A-4-011		CC-2.555
Harvey Way/N. Greenbrier Rd	51" Discharge	33.83612	-118.13233	LACFCD	R	4.599	Long Beach	BI9A-4	BI9A-4-016		CC-2.948
Harvey Way/Heather Rd	81" Discharge	33.83613	-118.13205	LACFCD	L	4.602	Long Beach	BI9A-4	BI9A-4-017		CC-2.950
E. Centralia St/N. Greenbrier Rd	42" Discharge	33.83954	-118.13225	LACFCD	R	4.976	Long Beach	BI9A-3	BI9A-3-001		CC-3.324A
E. Centralia St/Heather Rd	42" Discharge	33.83951	-118.13206	LACFCD	L	4.976	Long Beach	BI9A-3	BI9A-3-002		CC-3.324B
E. Arbor Rd/Clark Ave	36" Discharge	33.84300	-118.13226	LACFCD	R	5.348	Long Beach	BI9A-3	BI9A-3-007		CC-3.696
E. Arbor Rd/Clark Ave	39" Discharge	33.84297	-118.13225	LACFCD	R	5.357	Long Beach	BI9A-3	BI9A-3-008		CC-3.705
4763 Fidler Ave/Del Amo Blvd	36" Discharge	33.84500	-118.13203	Long Beach	L	5.586	Long Beach	BI9A-3	BI9A-3-011		CC-3.934
Del Amo Blvd/Fidler Ave	138" Discharge	33.84697	-118.13223	LACFCD	C	5.807	Lakewood	BI9A-3	BI9A-3-014		CC-4.155
Civic Center/Clark Ave	36" Discharge	33.84922	-118.13228	LACFCD	R	6.052	Lakewood	BI9A-2	BI9A-2-002		CC-4.413
Candlewood St/Fidler Ave	57" Discharge	33.85360	-118.13219	LACFCD	L	6.521	Lakewood	BI9A-2	BI9A-2-009		CC-4.882
Candlewood St/Fidler Ave	126" Discharge	33.85379	-118.13221	LACFCD		6.586	Lakewood	BI9A-1	BI9A-1-002		CC-4.916
Candlewood St/Clark Ave	72" Discharge	33.85442	-118.13226	LACFCD	R	6.625	Lakewood	BI9A-1	BI9A-1-003		CC-4.986
5443 Fidler Ave/Michelson St	36" Discharge	33.85618	-118.13213	LACFCD	L	6.818	Lakewood	BI9A-1	BI9A-1-008	BI9A-1-007	CC-5.179
Clark Ave/Michelson St	126" Discharge	33.85684	-118.13225	LACFCD		6.889	Lakewood	BI9A-1	BI9A-1-010		CC-5.250
South St/Fidler Ave	39" Discharge	33.86017	-118.13219	LACFCD	L	7.255	Lakewood	BI9A-1	BI9A-1-013		CC-5.616A

South St/Dagwood Ave	57" Discharge	33.86017	-118.13232	LACFCD	R	7.255	Lakewood	BI9A-1	BI9A-1-014		CC-5.616B
											CC-5.652
South St/Dagwood Ave	132" Discharge	33.86046	-118.13225	LACFCD	C	7.290	Lakewood	BI9A-1	BI9A-1-017		CC-5.651
Hedda St/Fidler Ave	39" Discharge	33.86411	-118.13232	LACFCD	L	7.696	Lakewood	BI9A-1	BI9A-1-018		CC-6.057B
Hedda St/Fidler Ave	39" Discharge	33.86409	-118.13234	LACFCD	R	7.696	Lakewood	BI9A-1	BI9A-1-019		CC-6.057A
Ashworth St/Fidler Ave	75" Discharge	33.86780	-118.13235	LACFCD	R	8.109	Lakewood	BI9A-1	BI9A-1-022		CC-6.469
Ashworth St/Fidler Ave	132" Discharge	33.86836	-118.13233	Lakewood	L	8.162	Lakewood	BI9A-1	BI9A-1-025		CC-6.522
Clark Ave/Ashworth St	87" Discharge	33.86848	-118.13355	LACFCD		8.282	Lakewood	BI9A-1	BI9A-1-026		CC-6.643
DEL AMO CHANNEL											
Del Amo Blvd/Whitewood Ave	36" Discharge	33.84696	-118.13552	UNK	L	0.286	Lakewood	BI9B-2	BI9B-2-003	BI9B-2-003	DAC-0.331
Del Amo Blvd/Faculty Ave	36" Discharge	33.84696	-118.13695	LACFCD	L	0.421	Lakewood	BI9B-2	BI9B-2-004	BI9B-2-004	DAC-0.466
Del Amo Blvd/Graywood Ave	42" Discharge	33.84698	-118.13783	LACFCD	L	0.508	Lakewood	BI9B-2	BI9B-2-005	BI9B-2-005	DAC-0.554
Del Amo Blvd/Graywood Ave	36" Discharge	33.84699	-118.13797	LACFCD	L	0.516	Lakewood	BI9B-2	BI9B-2-006	BI9B-2-005	DAC-0.561
Del Amo Blvd/Hazelbrook Ave	36" Discharge	33.84694	-118.19539	LACFCD	L	0.664	Lakewood	BI9B-2	BI9B-2-010	BI9B-2-010	DAC-0.709
Del Amo Blvd/Blackthorne Ave	36" Discharge	33.84697	-118.14041	LACFCD	R	0.737	Lakewood	BI9B-2	BI9B-2-011	BI9B-2-011	DAC-0.782

Del Amo Blvd/N. Blackthorne Ave	18" Discharge	33.84698	-118.14024	LACFCD	L	0.7388	Lakewood	BI9B-2	BI9B-2-012		DAC-0.784
Del Amo Blvd/N. Pepperwood Ave	36" Discharge	33.84699	-118.14126	LACFCD	L	0.820	Lakewood	BI9B-2	BI9B-2-014	BI9B-2-014	DAC-0.865
Del Amo Blvd/Lakewood Blvd	36" Discharge	33.84701	-118.14200	LACFCD	L	0.902	Lakewood	BI9B-2	BI9B-2-016	BI9B-2-016	DAC-0.947
Del Amo Blvd/Lakewood Blvd	45" Discharge	33.84699	-118.14226	LACFCD	L	0.917	Lakewood	BI9B-2	BI9B-2-018	BI9B-2-018	DAC-0.963
Del Amo Blvd/Lakewood Blvd	36" Discharge	33.84700	-118.14255	UNK	L	1.960	Lakewood	BI9B-2	BI9B-2-020	BI9B-2-020	DAC-1.004
Del Amo Blvd/Hayter Ave	48" Discharge	33.84702	-118.14598	LACFCD	L	1.253	Lakewood	BI9B-2	BI9B-2-024	BI9B-2-024	DAC-1.253
Del Amo Blvd/Hayter Ave	45" Discharge	33.84684	-118.14629	LACFCD	R	1.289	Lakewood	BI9B-2	BI9B-2-027	BI9B-2-027	DAC-1.334B
Del Amo Blvd/Downey Ave	48" Discharge	33.84703	-118.15051	LACFCD	R	1.666	Lakewood	BI9B-2	BI9B-2-029	BI9B-2-029	DAC-1.711
Downey Ave/Eckleson St	114" Discharge	33.84884	-118.15047	LACFCD		1.911	Lakewood	BI9B-2	BI9B-2-032		DAC-1.911
DOWNEY CHANNEL											
Candlewood St/Downey Ave	42" Discharge	33.853717	-118.150524	UNK	R	0.551	Lakewood	BI447A	BI447A-003	BI447A-003	DNC-0.5514
Candlewood St/Downey Ave	42" Discharge	33.854243	-118.150513	UNK	R	0.609	Lakewood	BI447A	BI447A-005	BI447-005	DNC-0.6093
Candlewood St/Downey Ave	42" Discharge	33.854297	-118.150527	Lakewood	R	0.618	Lakewood	BI447A	BI447A-006	BI447A-006	DNC-0.618
Candlewood St/Downey Ave	72" Discharge	33.854368	-118.150421	Lakewood	L	0.624	Lakewood	BI447A	BI447A-007	BI447A-007	DNC-0.624
Saint Pancratius Pl/Verdura Ave	117" Discharge	33.858402	-118.150459	Lakewood	L	1.072	Lakewood	BI447A	BI447A-008		DNC-1.072B

Saint Pancratius Pl/Verdura Ave	117" Discharge	33.858405	-118.15051	Lakewood	R	1.072	Lakewood	BI447A	BI447A-009		DNC-1.072A
Candlewood St/Downey Ave	72" Discharge	33.854382	-118.15029	Lakewood		0.633	Lakewood	BI447A	BI447A-010		DNC-0.796
Obispo Ave/Eckleson St	36" Discharge	33.849078	-118.154687	LACFCD	R	2.332	Lakewood	BI9B-1	BI9B-1-004		DNC-2.332
Obispo Ave/Eckleson St	60" Discharge	33.849074	-118.154747	LACFCD	R	2.336	Lakewood	BI9B-1	BI9B-1-005		DNC-2.336
Obispo Ave/Eckleson St	36" Discharge	33.849083	-118.154825	UNK	R	2.347	Lakewood	BI9B-1	BI9B-1-006		DNC-2.347
Obispo Ave/Eckleson St	48" Discharge	33.849183	-118.154825	UNK	L	2.347	Lakewood	BI9B-1	BI9B-1-007		DNC-2.347
Paramount Blvd/Eckleson St	66" Discharge	33.849146	-118.159614	LACFCD	L	2.804	Lakewood	BI9B-1	BI9B-1-008	BI9B-1-008	DNC-2.804A
Paramount Blvd/Eckleson St	66" Discharge	33.849096	-118.159614	LACFCD	R	2.804	Lakewood	BI9B-1	BI9B-1-009	BI9B-1-008	DNC-2.804B
LOS CERRITOS CHANNEL											
Knoxville Ave/E. Atherton St	36" Discharge (1 of 3)	33.78867	-118.10368	Long Beach	R	7.386	Long Beach	LCERR-5	LCERR-5-003		LCC-0.030
Knoxville Ave/E. Atherton St	36" Discharge (2 of 3)	33.78884	-118.10370	Long Beach	R	7.386	Long Beach	LCERR-5	LCERR-5-004		LCC-0.031
Knoxville Ave/E. Atherton St	36" Discharge (3 of 3)	33.78902	-118.10369	Long Beach	R	7.387	Long Beach	LCERR-5	LCERR-5-005		LCC-0.032
Vuelta Grande Ave/E. Atherton St	42" Discharge	33.78917	-118.10331	Long Beach	L	7.417	Long Beach	LCERR-5	LCERR-5-006		LCC-0.062
2040 Knoxville Ave	48" Discharge (1 of 3)	33.79319	-118.10369	LACFCD	R	7.876	Long Beach	LCERR-5	LCERR-5-007		LCC-0.521
2040 Knoxville Ave	48" Discharge (2 of 3)	33.79336	-118.10368	LACFCD	R	7.877	Long Beach	LCERR-5	LCERR-5-008		LCC-0.522

2040 Knoxville Ave	48" Discharge (3 of 3)	33.79356	-118.10369	LACFCD	R	7.878	Long Beach	LCERR-5	LCERR-5-009		LCC-0.523
Vuelta Grande Ave/N. Hidden Ln	42" Discharge	33.79304	-118.10333	LACFCD	L	7.899	Long Beach	LCERR-5	LCERR-5-010		LCC-0.544
Vuelta Grande Ave/E. Stearns St	48" Discharge	33.79565	-118.10330	LACFCD	L	8.135	Long Beach	LCERR-4	LCERR-4-001		LCC-0.780
Vuelta Grande Ave/E. la Marimba St	36" Discharge	33.79793	-118.10332	Long Beach	L	8.387	Long Beach	LCERR-4	LCERR-4-004		LCC-1.032
2372 Knoxville Ave/E. Cantel St	36" Discharge	33.80000	-118.10472	Long Beach	R	8.682	Long Beach	LCERR-4	LCERR-4-007		LCC-1.327
6400 Willow St/Palo Verde Ave	42" Discharge	33.80262	-118.10779	Long Beach	L	9.071	Long Beach	LCERR-4	LCERR-4-008		LCC-1.716
6220 Willow St/Palo Verde Ave	48" Discharge	33.80304	-118.10890	PVRT	R	9.181	Long Beach	LCERR-4	LCERR-4-009		LCC-1.826
Spring St/San Anseline Ave	66" Discharge	33.81035	-118.12130	LACFCD	L	0.725	Long Beach	LCERR-3	LCERR-3-002		LCC-3.388
Spring St/Bellflower Blvd	36" Discharge	33.81043	-118.12552	LACFCD	L	1.115	Long Beach	LCERR-3	LCERR-3-006		LCC-3.778
Spring St/Montair Ave	45" Discharge	33.81014	-118.12680	Long Beach	R	1.230	Long Beach	LCERR-3	LCERR-3-009		LCC-3.892
Heather Rd/Spring St	45" Discharge	33.81026	-118.13101	UNK	R	0.135	Long Beach	LCERR-2	LCERR-2-002		LCC-4.301A
Clark Ave/Spring St	96" Discharge	33.81034	-118.13376	LACFCD	C	0.392	Long Beach	LCERR-2	LCERR-2-004		LCC-4.558

N. Lakewood Blvd/E. Spring St	96" Discharge	33.81303	-118.13950	LACFCD		1.077	Long Beach	LCERR-2	LCERR-2-007		LCC-5.221
Lakewood Blvd/Spring St	36" Discharge	33.81306	-118.13949	LACFCD	L	1.045	Long Beach	LCERR-2	LCERR-2-005		LCC-5.229
Spring St/Lakewood Blvd	54" Discharge	33.81313	-118.14033	LACFCD	R	1.135	Long Beach	LCERR-2	LCERR-2-006		LCC-5.319
Spring St/Lakewood Blvd	108" Discharge	33.81316	-118.14235	LACFCD	L	1.322	Long Beach	LCERR-1	LCERR-1-001		LCC-5.506
Spring St/Lakewood Blvd	120" Discharge	33.81288	-118.14249	LACFCD	R	1.341	Long Beach	LCERR-1	LCERR-1-002		LCC-5.525
WARDLOW CHANNEL											
Clark Ave/Keynote St	228" Discharge	33.82331	-118.13408	LACFCD		5.885	Long Beach	BI9C	BI9C-001		WC-5.883
Lakewood Blvd	36" Discharge	33.82333	-118.13822	LACFCD	L	6.194	Long Beach	BI9C	BI9C-004		WC-6.264
Lakewood Blvd	42" Discharge	33.82332	-118.14130	LACFCD	L	6.482	Long Beach	BI9C	BI9C-005		WC-6.555
Lakewood Blvd	228" Discharge	33.82332	-118.14165	LACFCD		6.520	Long Beach	BI9A-5	BI9A-5-017		WC-6.586
PALO VERDE CHANNEL											
WOODRUFF AVE / SPRING ST	54" Discharge	33.81090	-118.11427	Long Beach	R	0.430	Long Beach	BI9E-2	BI9E-2-006		PVC-0.430
3055 SHADYPARK DR/McNab Ave	36" Discharge	33.81224	-118.11410	Long Beach	L	0.584	Long Beach	BI9E-2	BI9E-2-007		PVC-0.584

LOS CERRITOS DRAIN LINE E / LOS COYOTES DIA/E.Pagentry St	36" Discharge (1 of 2)	33.81329	-118.11409	LACFCD	R	0.723	Long Beach	BI9E-2	BI9E-2-009		PVC-0.723
LOS CERRITOS DRAIN LINE E / LOS COYOTES DIA/E.Pagentry St	36" Discharge (2 of 2)	33.81359	-118.11407	LACFCD	R	0.727	Long Beach	BI9E-2	BI9E-2-010		PVC-0.727
LOS COYOTES DIA / GONDAR AVE	48" Discharge	33.81550	-118.11258	LACFCD	R	0.987	Long Beach	BI9E-2	BI9E-2-014		PVC-0.987
6228 WARDLOW RD/Los Coyotes Dia W	36" Discharge	33.81864	-118.10980	Long Beach	R	1.426	Long Beach	BI9E-2	BI9E-2-016		PVC-1.426
Los Coyotes Dia/Conquista Ave	42" Discharge	33.82054	-118.10802	Long Beach	L	1.684	Long Beach	BI9E-2	BI9E-2-019		PVC-1.684
PALO VERDE AVE / LOS COYOTES DIA	36" Discharge (1 of 2)	33.82110	-118.10793	LACFCD	L	1.748	Long Beach	BI9E-2	BI9E-2-021		PVC-1.747
PALO VERDE AVE / LOS COYOTES DIA	36" Discharge (2 of 2)	33.82110	-118.10793	LACFCD	L	1.748	Long Beach	BI9E-2	BI9E-2-022		PVC-1.748
3778 PALO VERDE AVE/Harco St	36" Discharge	33.82715	-118.10795	LACFCD	L	2.434	Long Beach	BI9E-2	BI9E-2-026		PVC-2.434
3788 CONQUISTA AVE/Harco St	48" Discharge	33.82758	-118.10811	LACFCD	R	2.470	LA County(LBC-254)	BI9E-2	BI9E-2-027		PVC-2.470
Palo Verde Ave/E. Parkcrest St	72" Discharge	33.83025	-118.10793	LACFCD	L	2.778	Los Angeles County	BI9E-2	BI9E-2-028		PVC-2.778A
	72" Discharge	33.83026	-118.10793	LACFCD	L	2.7779	Los Angeles County	BI9E-2	BI9E-2-029		PVC-2.778B
Carson St/Palo Verde Ave	48" Discharge	33.83232	-118.10832	Long Beach	L	3.008	Long Beach	BI9E-1	BI9E-1-034		PVC-3.008
Harvey Way/Palo Verde Ave	36" Discharge	33.83585	-118.10829	LACFCD	L	3.418	Lakewood	BI9E-1	BI9E-1-006	BI9E-1-006	PVC-3.417
Harvey Way/Palo Verde Ave	36" Discharge	33.83592	-118.10840	LACFCD	R	3.418	Lakewood	BI9E-1	BI9E-1-007	BI9E-1-007	PVC-3.418

Harvey Way/Palo Verde Ave	36" Discharge	33.83613	-118.10839	LACFCD	R	3.438	Lakewood	BI9E-1	BI9E-1-008	BI9E-1-008	PVC-3.437
Centralia St/Palo Verde Ave	48" Discharge	33.83948	-118.10822	LACFCD	L	3.827	Lakewood	BI9E-1	BI9E-1-013	BI9E-1-013	PVC-3.827
Henrilee Lateral/Conquista Ave	6'x7' Trap Channel Discharge	33.84132	-118.10834	LACFCD	R	4.017	Lakewood	BI9E-1	BI9E-1-032	BI9E-1-032	PVC-4.017
Turnergrove Dr/Silva St	48" Discharge (1 of 2)	33.84822	-118.10873	LACFCD	R	4.793	Lakewood	BI9E-1	BI9E-1-025	BI9E-1-025	PVC-4.793
Turnergrove Dr/Silva St	48" Discharge (2 of 2)	33.84824	-118.10873	LACFCD	R	4.795	Lakewood	BI9E-1	BI9E-1-026	BI9E-1-025	PVC-4.795
Palo Verde Ave/Carfax Ave	48" Discharge	33.84925	-118.10918	LACFCD	L	4.905	Lakewood	BI9E-1	BI9E-1-027	BI9E-1-027	PVC-4.905
Candlewood St/Carfax Ave	51" Discharge	33.85309	-118.11127	LACFCD	L	5.368	Lakewood	BI9E-1	BI9E-1-030	BI9E-1-030	PVC-5.368
Candlewood St/Carfax Ave	54" Discharge	33.85313	-118.11142	LACFCD	R	5.374	Lakewood	BI9E-1	BI9E-1-031	BI9E-1-031	PVC-5.374
South St/Canehill Ave	63" Discharge	33.85820	-118.11151	LACFCD	L	5.960	Lakewood	BI446B	BI446B-004	BI446B-004	PVC-5.960
South St/Canehill Ave	42" Discharge	33.85854	-118.11148	LACFCD	L	6.004	Lakewood	BI446B	BI446B-007	BI446B-007	PVC-6.004
Snowden Ave/Charlwood St	36" Discharge	33.85921	-118.11171	LACFCD	R	6.080	Lakewood	BI446B	BI446B-008	BI446B-000	PVC-6.080
Allington St/Canehill Ave	72" Discharge	33.86546	-118.11160	LACFCD	L	6.792	Lakewood	BI446B	BI446B-011	BI446B-011	PVC-6.793B
Allington St/Canehill Ave	75" Discharge	33.86546	-118.11161	LACFCD	R	6.792	Lakewood	BI446B	BI446B-012	BI446B-011	PVC-6.793A

Minor Outfalls (12-36 inches) in the Los Cerritos Channel Watershed

DISCHARGE POINT	EFFLUENT DESCRIPTION	DISCHARGE POINT LATITUDE	DISCHARGE POINT LONGITUDE	OWNER	SIDE (L/R)	DISTANCE FROM CHANNEL STARTING POINT (km)	JURISDICTION	MODEL SUB WATERSHED	UNIQUE ID	PHOTO UNIQUE ID	CHANNEL UNIQUE ID
CLARK CHANNEL											
Charlemagne Ave/Spring St	24" Discharge	33.81081	-118.13000	LACFCD	R	1.662	Long Beach	LCERR-3	LCERR-3-011		CC-0.009A
Rutgers Ave/Spring St	18" Discharge	33.81079	-118.12973	LACFCD	L	1.662	Long Beach	LCERR-3	LCERR-3-012		CC-0.009B
N. Charlemagne Ave/E. Wardlow Rd	18" Discharge	33.81895	-118.12994	Long Beach	R	2.565	Long Beach	BI9A-5	BI9A-5-008		CC-0.914B
E. Wardlow Rd/N. Rutgers Ave	18" Discharge	33.81897	-118.12970	Long Beach	L	2.565	Long Beach	BI9A-5	BI9A-5-009		CC-0.914A
Stanbridge Ave/E. Wardlow Rd	24" Discharge	33.81936	-118.12971	LACFCD	L	2.612	Long Beach	BI9A-5	BI9A-5-010		CC-0.961
E. Monlaco Rd/N. Rutgers Ave	18" Discharge	33.82216	-118.12968	Long Beach	L	2.924	Long Beach	BI9A-5	BI9A-5-012		CC-1.273
E. Monlaco Rd/N. Rutgers Ave	18" Discharge	33.82236	-118.12967	Long Beach	L	2.941	Long Beach	BI9A-5	BI9A-5-013		CC-1.290A
E. Monlaco Rd/N. Charlemagne Ave	18" Discharge	33.82233	-118.12995	Long Beach	R	2.941	Long Beach	BI9A-5	BI9A-5-014		CC-1.290B
E. Conant St/N. Charlemagne Ave	15" Discharge	33.82498	-118.12992	Long Beach	R	3.239	Long Beach	BI9A-4	BI9A-4-003		CC-1.587
E. Conant St/N. Charlemagne Ave	15" Discharge	33.82517	-118.12992	Long Beach	R	3.256	Long Beach	BI9A-4	BI9A-4-004		CC-1.605
N. Charlemagne Ave/E. Brittain St	24" Discharge	33.82604	-118.12991	Long Beach	R	3.354	Long Beach	BI9A-4	BI9A-4-005		CC-1.703
Carson St/N. Bellflower Blvd	12" Discharge	33.83070	-118.12970	LACFCD	L	3.865	Long Beach	BI9A-4	BI9A-4-006		CC-2.214
Carson St/N. Greenbrier Rd	24" Discharge	33.83223	-118.13231	Long Beach	R	4.168	Long Beach	BI9A-4	BI9A-4-009		CC-2.517A
Carson St/Heather Rd	24" Discharge	33.83223	-118.13210	Long Beach	L	4.168	Long Beach	BI9A-4	BI9A-4-010		CC-2.517B
Carson St/N. Greenbrier Rd	24" Discharge	33.83246	-118.13231	Long Beach	R	4.211	Long Beach	BI9A-4	BI9A-4-012		CC-2.560A
Carson St/Heather Rd	24" Discharge	33.83246	-118.13209	Long Beach	L	4.211	Long Beach	BI9A-4	BI9A-4-013		CC-2.560B
Harvey Way/Heather Rd	18" Discharge	33.83606	-118.13204	Long Beach	L	4.598	Long Beach	BI9A-4	BI9A-4-014		CC-2.947A

Harvey Way/Heather Rd	18" Discharge	33.83606	-118.13232	Long Beach	R	4.598	Long Beach	BI9A-4	BI9A-4-015		CC-2.947B
Harvey Way/N. Greenbrier Rd	18" Discharge	33.83620	-118.13231	Long Beach	R	4.610	Long Beach	BI9A-4	BI9A-4-018		CC-2.958A
Harvey Way/Heather Rd	18" Discharge	33.83620	-118.13205	Long Beach	L	4.610	Long Beach	BI9A-4	BI9A-4-019		CC-2.958B
E. Centralia St/N. Greenbrier Rd	18" Discharge	33.83969	-118.13227	Long Beach	R	4.994	Long Beach	BI9A-3	BI9A-3-003		CC-3.342A
E. Centralia St/Heather Rd	18" Discharge	33.83967	-118.13203	Long Beach	L	4.994	Long Beach	BI9A-3	BI9A-3-004		CC-3.342B
E. Centralia St/Pan American Park	15" Discharge	33.84087	-118.13202	Long Beach	L	5.129	Long Beach	BI9A-3	BI9A-3-005		CC-3.477
E. Arbor Rd/Pan American Park	15" Discharge	33.84154	-118.13203	Long Beach	L	5.205	Long Beach	BI9A-3	BI9A-3-006		CC-3.554
E. Arbor Rd/N. Charlemagne	24" Discharge	33.84312	-118.13202	Long Beach	L	5.379	Long Beach	BI9A-3	BI9A-3-009		CC-3.728
E. Arbor Rd./Fidler Ave	30" Discharge	33.84351	-118.13202	Long Beach	L	5.416	Long Beach	BI9A-3	BI9A-3-010		CC-3.764
Del Amo Blvd/Fidler Ave	33" Discharge	33.84693	-118.13217	LACFCD	L	5.801	Lakewood	BI9A-3	BI9A-3-012	BI9A-3-012	CC-4.149
Del Amo Blvd/Fidler Ave	18" Discharge	33.84701	-118.13216	UNK	L	5.802	Lakewood	BI9A-3	BI9A-3-013	BI9A-3-013	CC-4.150
Del Amo Blvd/Civic Center Way	30" Discharge	33.84721	-118.13220	UNK	L	5.834	Lakewood	BI9A-2	BI9A-2-001		CC-4.182
Civic Center/Del Amo Blvd	24" Discharge	33.84984	-118.13231	UNK	R	6.123	Lakewood	BI9A-2	BI9A-2-003		CC-4.484
Civic Center Way/Hardwick St	30" Discharge	33.85077	-118.13222	LACFCD	L	6.215	Lakewood	BI9A-2	BI9A-2-004		CC-4.575
Civic Center Way/Candlewood St	12" Discharge	33.85243	-118.13229	UNK	R	6.401	Lakewood	BI9A-2	BI9A-2-007		CC-4.762
Civic Center Way/Candlewood St	18" Discharge	33.85268	-118.13229	Lakewood	R	6.422	Lakewood	BI9A-2	BI9A-2-008		CC-4.783
Candlewood St/Clark Ave	18" Discharge	33.85382	-118.13222	LACFCD	R	6.545	Lakewood	BI9A-1	BI9A-1-001		CC-4.906
Candlewood St/Clark Ave	12" Discharge	33.85493	-118.13235	UNK	R	6.674	Lakewood	BI9A-1	BI9A-1-004		CC-5.035
Clark Ave/Michelson St	12" Discharge	33.85577	-118.13230	UNK	R	6.774	Lakewood	BI9A-1	BI9A-1-005		CC-5.135
Clark Ave/Michelson St	12" Discharge	33.85594	-118.13231	UNK	R	6.791	Lakewood	BI9A-1	BI9A-1-006		CC-5.151
Clark Ave/Michelson St	12" Discharge	33.85612	-118.13231	UNK	R	6.807	Lakewood	BI9A-1	BI9A-1-007		CC-5.168
Clark Ave/Michelson St	12" Discharge	33.85631	-118.13231	UNK	R	6.834	Lakewood	BI9A-1	BI9A-1-009		CC-5.194
Fidler Ave/Bigelow St	12" Discharge	33.85765	-118.13232	UNK	R	6.981	Lakewood	BI9A-1	BI9A-1-011		CC-5.342
Clark Ave/South St	24" Discharge	33.85968	-118.13228	Lakewood	R	7.192	Lakewood	BI9A-1	BI9A-1-012		CC-5.553
South St/Dagwood Ave	20" Discharge	33.86046	-118.13233	UNK	R	7.289	Lakewood	BI9A-1	BI9A-1-015		CC-5.649
South St/Fidler Ave	30" Discharge	33.86045	-118.13219	UNK	L	7.291	Lakewood	BI9A-1	BI9A-1-016		CC-5.652
Hedda St/Fidler Ave	15" Discharge	33.86417	-118.13221	UNK	L	7.697	Lakewood	BI9A-1	BI9A-1-020		CC-6.058

Hedda St/Fidler Ave	15" Discharge	33.86427	-118.13221	UNK	L	7.708	Lakewood	BI9A-1	BI9A-1-021		CC-6.089
Ashworth St/Fidler Ave	15" Discharge	33.86783	-118.13225	Lakewood	L	8.112	Lakewood	BI9A-1	BI9A-1-023		CC-6.472
Ashworth St/Fidler Ave	15" Discharge	33.86799	-118.13227	Lakewood	L	7.708	Lakewood	BI9A-1	BI9A-1-024		CC-6.485
DEL AMO CHANNEL											
Del Amo Blvd/Fidler Ave	24" Discharge	33.84697	-118.13290	UNK	L	0.079	Lakewood	BI9B-2	BI9B-2-001	BI9B-2-001	DAC-0.079
Del Amo Blvd/Whitewood Ave	24" Discharge	33.84697	-118.13540	Lakewood	L	0.283	Lakewood	BI9B-2	BI9B-2-002	BI9B-2-002	DAC-0.328
Del Amo Blvd/Graywood Ave	18" Discharge	33.84680	-118.13791	Long Beach	R	0.517	Lakewood	BI9B-2	BI9B-2-007	BI9B-2-007	DAC-0.562
Del Amo Blvd/Graywood Ave	15" Discharge	33.84680	-118.13827	Long Beach	R	0.538	Lakewood	BI9B-2	BI9B-2-008	BI9B-2-008	DAC-0.583
Del Amo Blvd/Graywood Ave	15" Discharge	33.84680	-118.13930	Long Beach	R	0.554	Lakewood	BI9B-2	BI9B-2-009	BI9B-2-009	DAC-0.599
Del Amo Blvd/Hazelbrook Ave	36" Discharge	33.84694	-118.13953		L	0.6642	Lakewood	BI9B-2	BI9B-2-010		DAC-0.709
Del Amo Blvd/Blackthorne Ave	18" Discharge	33.84680	-118.14030	Long Beach	R	0.742	Lakewood	BI9B-2	BI9B-2-013	BI9B-2-013	DAC-0.784
Del Amo Blvd/N. Blackthorne Ave	18" Discharge	33.84698	-118.14024	LACFCD	L	0.739	Lakewood	BI9B-2	BI9B-2-012	BI9B-2-012	DAC-0.787
Del Amo Blvd/N. Pepperwood Ave	15" Discharge	33.84681	-118.14139	Long Beach	R	0.836	Lakewood	BI9B-2	BI9B-2-015	BI9B-2-015	DAC-0.881
Del Amo Blvd/Lakewood Blvd	15" Discharge	33.84682	-118.14225	Long Beach	R	0.908	Lakewood	BI9B-2	BI9B-2-017	BI9B-2-017	DAC-0.953
Del Amo Blvd/Lakewood Blvd	18" Discharge	33.84700	-118.14241	Long Beach	L	0.924	Lakewood	BI9B-2	BI9B-2-019	BI9B-2-019	DAC-0.970
Del Amo Blvd/Lakewood Blvd	12" Discharge	33.84689	-118.14267	Lakewood	L	1.005	Lakewood	BI9B-2	BI9B-2-021	BI9B-2-021	DAC-1.005
Del Amo Blvd/Lakewood Blvd	18" Discharge	33.84681	-118.14264	Long Beach	R	1.961	Lakewood	BI9B-2	BI9B-2-022	BI9B-2-021	DAC-1.006
Del Amo Blvd/Oliva Ave	30" Discharge	33.84683	-118.14493	UNK	R	1.207	Lakewood	BI9B-2	BI9B-2-023	BI9B-2-023	DAC-1.252
Del Amo Blvd/Hayter Ave	30" Discharge	33.84686	-118.14618	UNK	R	1.289	Lakewood	BI9B-2	BI9B-2-026	BI9B-2-026	DAC-1.324
Del Amo Blvd/Hayter Ave	30" Discharge	33.84701	-118.14623	UNK	L	1.279	Lakewood	BI9B-2	BI9B-2-025	BI9B-2-025	DAC-1.334A
Del Amo Blvd/Verdura Ave	24" Discharge	33.84705	-118.14970	UNK	L	1.614	Lakewood	BI9B-2	BI9B-2-028	BI9B-2-028	DAC-1.659
Del Amo Blvd/Downey Ave	18" Discharge	33.84723	-118.15061	UNK	R	1.693	Lakewood	BI9B-2	BI9B-2-030	BI9B-2-030	DAC-1.738
DOWNEY CHANNEL											
Hardwick St/Downey Ave	30" Discharge	33.85025	-118.15041	UNK	L	0.165	Lakewood	BI447A	BI447A-001		DNC-0.165
Hardwick St/Downey Ave	30" Discharge	33.85031	-118.15054	UNK	R	0.173	Lakewood	BI447A	BI447A-002	BI447A-002	DNC-0.173
Candlewood St/Downey Ave	24" Discharge	33.85372	-118.15039	UNK	L	0.554	Lakewood	BI447A	BI447A-004	BI447A-004	DNC-0.554

Downey Ave/Eckleson St	18" Discharge	33.84919	-118.15089	Lakewood	L	1.985	Lakewood	BI9B-1	BI9B-1-001		DNC-1.985
Downey Ave/Eckleson St	21" Discharge	33.84920	-118.15121	UNK	L	2.019	Lakewood	BI9B-1	BI9B-1-002		DNC-2.019
Downey Ave/Eckleson St	18" Discharge	33.84908	-118.15121	UNK	R	2.022	Lakewood	BI9B-1	BI9B-1-003		DNC-2.022
LOS CERRITOS CHANNEL											
Knoxville Ave/E. el Progreso St	24" Discharge	33.79599	-118.10369	Long Beach	R	8.172	Long Beach	LCERR-4	LCERR-4-002		LCC-0.817
Vuelta Grande Ave/Stearns St	24" Discharge	33.79599	-118.10328	Long Beach	L	8.173	Long Beach	LCERR-4	LCERR-4-003		LCC-0.818
Vuelta Grande Ave/Los Arcos St	33" Discharge	33.79944	-118.10356	Long Beach	L	8.555	Long Beach	LCERR-4	LCERR-4-005		LCC-1.199
Vuelta Grande Ave/Ladoga Ave	21" Discharge	33.80006	-118.10427	LACFCD	L	8.649	Long Beach	LCERR-4	LCERR-4-006		LCC-1.294
Vuelta Grande Ave/Snowden Ave	24" Discharge	33.80557	-118.11188	Long Beach	L	9.678	Long Beach	LCERR-4	LCERR-4-010		LCC-2.323
Spring St/Lomina Ave	21" Discharge	33.81012	-118.12110	LACFCD	R	0.721	Long Beach	LCERR-3	LCERR-3-001		LCC-3.384
Spring St/San Anseline Ave	18" Discharge	33.81036	-118.12163	LACFCD	L	0.759	Long Beach	LCERR-3	LCERR-3-003		LCC-3.422
Spring St/Bellflower Blvd	21" Discharge	33.81013	-118.12411	LACFCD	R	1.000	Long Beach	LCERR-3	LCERR-3-004		LCC-3.663
Spring St/Bellflower Blvd	15" Discharge	33.81041	-118.12514	LACFCD	L	1.085	Long Beach	LCERR-3	LCERR-3-005		LCC-3.748
Spring St/Montair Ave	15" Discharge	33.81042	-118.12562	LACFCD	L	1.135	Long Beach	LCERR-3	LCERR-3-007		LCC-3.798
Spring St/Montair Ave	18" Discharge	33.81041	-118.12674	Long Beach	L	1.222	Long Beach	LCERR-3	LCERR-3-008		LCC-3.885
Charlemagne Ave/Spring St	15" Discharge	33.81051	-118.13042	Long Beach	L	0.078	Long Beach	LCERR-2	LCERR-2-001		LCC-4.245
Heather Rd/Spring St	24" Discharge	33.81023	-118.13107	Long Beach	R	0.135	Long Beach	LCERR-2	LCERR-2-003		LCC-4.301B
WARDLOW CHANNEL											
Clark Ave/Keynote St	18" Discharge	33.82335	-118.13495	Long Beach	L	5.885	Long Beach	BI9C	BI9C-002		WC-5.964
Clark Ave/Keynote St	18" Discharge	33.82337	-118.13574	Long Beach	L	5.918	Long Beach	BI9C	BI9C-003		WC-6.038
Lakewood Blvd	18" Discharge	33.82331	-118.14151	Long Beach	L	6.519	Lakewood	BI9A-5	BI9A-5-016		WC-6.571
SOUTH OF ATHERTON											
Vuelta Grande Ave/Espanita St	30" Discharge	33.78581	-118.10343	Long Beach	L	7.049	Long Beach	LCERR-5	LCERR-5-001		LCC-7049.1
Vuelta Grande Ave/E. Driscoll St	30" Discharge	33.78644	-118.10384	Long Beach	R	7.116	Long Beach	LCERR-5	LCERR-5-002		LCC-7116.2
PALO VERDE CHANNEL											
WOODRUFF AVE / VUELTA GRANDE AVE	24" Discharge	33.80836	-118.11435	Long Beach	R	0.156	Long Beach	BI9E-2	BI9E-2-001		PVC-0.156

6036 SPRING ST/Woodruff Ave	15" Discharge	33.81039	-118.11423	Long Beach	L	0.377	Long Beach	BI9E-2	BI9E-2-002		PVC-0.377
WOODRUFF AVE / SPRING ST	18" Discharge	33.81039	-118.11432	Long Beach	R	0.378	Long Beach	BI9E-2	BI9E-2-003		PVC-0.378
SPRING ST / WOODRUFF AVE	18" Discharge	33.81064	-118.11431	LACFCD	R	0.408	Long Beach	BI9E-2	BI9E-2-004		PVC-0.408
SPRING ST / WOODRUFF AVE	15" Discharge	33.81065	-118.11431	Long Beach	R	0.408	Long Beach	BI9E-2	BI9E-2-005		PVC-0.408
3128 LOS COYOTES DIA/E. Pageantry St	24" Discharge	33.81311	-118.11411	LACFCD	R	0.705	Long Beach	BI9E-2	BI9E-2-008		PVC-0.705
3143 LOS COYOTES DIA/E. Pagentry St	30" Discharge	33.81394	-118.11397	Long Beach	R	0.775	Long Beach	BI9E-2	BI9E-2-011		PVC-0.775
3142 LOS COYOTES DIA/E. Pagentry St	21" Discharge	33.81406	-118.11376	Long Beach	L	0.792	Long Beach	BI9E-2	BI9E-2-012		PVC-0.792
3169 LOS COYOTES DIA/N. Hayfield Dr	15" Discharge	33.81449	-118.11347	Long Beach	R	0.848	Long Beach	BI9E-2	BI9E-2-013		PVC-0.848
3302 LOS COYOTES DIA/Metz St	21" Discharge	33.81666	-118.11144	Long Beach	L	1.154	Long Beach	BI9E-2	BI9E-2-015		PVC-1.154
3425 LOS COYOTES DIA/Canehill Ave	21" Discharge	33.81940	-118.10913	Long Beach	R	1.527	Long Beach	BI9E-2	BI9E-2-017		PVC-1.527
LOS COYOTES DIA / PALO VERDE AVE	21" Discharge	33.82048	-118.10807	Long Beach	L	1.676	Long Beach	BI9E-2	BI9E-2-018		PVC-1.676
LOS COYOTES DIA / PALO VERDE AVE	18" Discharge	33.82081	-118.10792	LACFCD	L	1.721	Long Beach	BI9E-2	BI9E-2-020		PVC-1.721
PALO VERDE AVE/E. Monlaco Rd	24" Discharge	33.82224	-118.10796	Long Beach	R	1.878	Long Beach	BI9E-2	BI9E-2-023		PVC-1.878
Palo Verde Ave/E. Keynote St	27" Discharge	33.82280	-118.10793	Long Beach	L	1.937	Long Beach	BI9E-2	BI9E-2-024		PVC-1.937
3702 CONQUISTA AVE/Palo Verde Ave	27" Discharge	33.82505	-118.10798	Long Beach	R	2.201	Long Beach	BI9E-2	BI9E-2-025		PVC-2.201
Carson St/Palo Verde Ave	12" Discharge	33.83210	-118.10836	Long Beach		2.985	Long Beach	BI9E-1	BI9E-1-001		PVC-2.985
Carson St/Palo Verde Ave	18" Discharge	33.83235	-118.10832	Long Beach	L	3.009	Long Beach	BI9E-1	BI9E-1-002		PVC-3.009
Carson St/Palo Verde Ave	18" Discharge	33.83241	-118.10833	UNK	L	3.030	Lakewood	BI9E-1	BI9E-1-033	BI9E-1-033	PVC-3.030
Carson St/Palo Verde Ave	30" Discharge	33.83240	-118.10843	UNK	R	3.031	Lakewood	BI9E-1	BI9E-1-003	BI9E-1-003	PVC-3.031
4139 Palo Verde Ave/Harvey Way	18" Discharge	33.83433	-118.10831	UNK	L	3.228	Lakewood	BI9E-1	BI9E-1-004	BI9E-1-004	PVC-3.228
4222 Conquista Ave/Harvey Way	18" Discharge	33.83500	-118.10841	UNK	R	3.300	Lakewood	BI9E-1	BI9E-1-005	BI9E-1-005	PVC-3.300
Harvey Way/Palo Verde Ave	18" Discharge	33.83611	-118.10829	Lakewod	L	3.438	Lakewood	BI9E-1	BI9E-1-009	BI9E-1-009	PVC-3.438
Harvey Way/Palo Verde Ave	18" Discharge	33.83615	-118.10828	UNK	L	3.444	Lakewood	BI9E-1	BI9E-1-010	BI9E-1-010	PVC-3.444
Centralia St/Palo Verde Ave	15" Discharge	33.83775	-118.10824	UNK	L	3.622	Lakewood	BI9E-1	BI9E-1-011	BI9E-1-011	PVC-3.622

Centralia St/Palo Verde Ave	15" Discharge	33.83936	-118.10822	UNK	R	3.804	Lakewood	BI9E-1	BI9E-1-012	BI9E-1-012	PVC-3.804
Centralia St/Palo Verde Ave	24" Discharge	33.83947	-118.10842	UNK	R	3.824	Lakewood	BI9E-1	BI9E-1-014	BI9E-1-014	PVC-3.824
Centralia St/Palo Verde Ave	15" Discharge	33.83958	-118.10822	UNK	L	3.829	Lakewood	BI9E-1	BI9E-1-015	BI9E-1-015	PVC-3.829
Conquista Ave/Arbor Rd	15" Discharge	33.84135	-118.10821	UNK	L	4.020	Lakewood	BI9E-1	BI9E-1-016	BI9E-1-016	PVC-4.020
Arbor Rd/Palo Verde Ave	15" Discharge	33.84306	-118.10820	UNK	L	4.208	Lakewood	BI9E-1	BI9E-1-017	BI9E-1-017	PVC-4.208
Arbor Rd/Palo Verde Ave	24" Discharge	33.84326	-118.10841	UNK	R	4.228	Lakewood	BI9E-1	BI9E-1-018	BI9E-1-018	PVC-4.228
Arbor Rd/Palo Verde Ave	30" Discharge	33.84327	-118.10841	UNK	L	4.229	Lakewood	BI9E-1	BI9E-1-019	BI9E-1-019	PVC-4.229
Arbor Rd/Palo Verde Ave	18" Discharge	33.84332	-118.10820	UNK	L	4.235	Lakewood	BI9E-1	BI9E-1-020	BI9E-1-020	PVC-4.235
Arbor Rd/Palo Verde Ave	15" Discharge	33.84507	-118.10822	UNK	L	4.434	Lakewood	BI9E-1	BI9E-1-021	BI9E-1-021	PVC-4.434
Del Amo Blvd/Palo Verde Ave	15" Discharge	33.84685	-118.10819	UNK	L	4.628	Lakewood	BI9E-1	BI9E-1-022	BI9E-1-022	PVC-4.628
Del Amo Blvd/Palo Verde Ave	18" Discharge	33.84713	-118.10821	LACFCD	L	4.659	Lakewood	BI9E-1	BI9E-1-023	BI9E-1-023	PVC-4.659
Del Amo Blvd/Palo Verde Ave	24" Discharge	33.84714	-118.10836	LACFCD	R	4.659	Lakewood	BI9E-1	BI9E-1-024	BI9E-1-024	PVC-4.660
5023Carfax Ave/E. Hardwick St	18" Discharge	33.85007	-118.10960	UNK	L	4.962	Lakewood	BI9E-1	BI9E-1-028	BI9E-1-028	PVC-4.962
6251 McKnight Dr/Chesteroark Dr	24" Discharge	33.85057	-118.11001	UNK	R	5.075	Lakewood	BI9E-1	BI9E-1-029	BI9E-1-029	PVC-5.075
Candlewood St/Carfax Ave	24" Discharge	33.85321	-118.11132	UNK	L	5.403	Lakewood	BI446B	BI446B-001		PVC-5.403
Candlewood St/Cardale St	30" Discharge	33.85389	-118.11155	Lakewood	L	5.489	Lakewood	BI446B	BI446B-002		PVC-5.489
Candlewood St/Capetown St	27" Discharge	33.85441	-118.11167	Lakewood	R	5.543	Lakewood	BI446B	BI446B-003	BI446B-003	PVC-5.543
South St/Canehill Ave	18" Discharge	33.85822	-118.11172	UNK	R	5.970	Lakewood	BI446B	BI446B-005		PVC-5.970
South St/Canehill Ave	12" Discharge	33.85827	-118.11172	Lakewod	R	5.980	Lakewood	BI446B	BI446B-006		PVC-5.980