

Machado Lake Multipollutant TMDL Monitoring and Reporting Program (MRP) for the Unincorporated Areas of Los Angeles County Within the Machado Lake Watershed

Submitted to:

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List of Abbreviations

BPA	Basin Plan Amendment
MS4	Municipal Separate Storm Sewer System
MRP	Monitoring and Reporting Program
PCBs	Polychlorinated Biphenyls
QA/QC	Quality Assurance/Quality Control
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USEPA	United State Environmental Protection Agency
WLA	Waste Load Allocation

Section 1. Introduction

1.1 BACKGROUND

Machado Lake is located in the Dominguez Channel Watershed and has a total drainage area of approximately 23 square miles. The lake itself is under the jurisdiction of the City of Los Angeles, while the drainage area is within the jurisdiction of several cities, including Rancho Palos Verdes, Rolling Hills, Rolling Hills Estates, Palos Verde Estates, Torrance, Lomita, and Carson, and unincorporated Los Angeles County (County). The map of the drainage area of the lake and the different jurisdictions located within the drainage area is shown in **Figure 1**. Within the boundary of the drainage area, there are three unincorporated County areas that account for a total of 8.4% of the total Machado Lake drainage area.

The Machado Lake Nutrient Total Maximum Daily Load (Nutrient TMDL) was adopted by the Los Angeles Regional Water Quality Control Board (Regional Board) and approved by the State Water Resources Control Board (State Board). The U. S. Environmental Protection Agency (USEPA) approved the TMDL on March 11, 2009, which is the effective date of the Nutrient TMDL. The Nutrient TMDL was developed to address nutrient-related beneficial use impairments including, eutrophication, algae, ammonia, and odor in Machado Lake.

The Machado Lake Toxics TMDL (Toxics TMDL) was adopted by the Regional Board on September 2, 2010. The Toxics TMDL addresses impairments due to chlordane, Chem-A pesticides, DDT, and PCBs in fish tissue. Although Chem-A pesticides include a suite of bioaccumulative compounds (aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexane (including lindane), endosulfan, and toxaphene), the Regional Board limited the Basin Plan Amendment for toxics to chlordane compounds and dieldrin since the other compounds had not shown up in fish tissues for the last 25 years.

In addition to nutrients and toxics, Machado Lake is also impaired for trash. Further, Wilmington Drain, which contributes more than 80% of the flow to Machado Lake and to which all of the County areas drain is impaired for metals (copper and lead) and bacteria. The metals TMDL is expected to be completed by January 1, 2019 while the coliform bacteria TMDL was originally scheduled for January 1, 2007.

The Nutrient TMDL Basin Plan Amendment (BPA) set waste load allocations (WLAs) for municipal separate storm sewer system (MS4) permittees as monthly average concentrations of 0.1 mg/L for Total Phosphorous (TP) and 1 mg/L for Total Nitrogen (TN). The TMDL also allows a mass-based WLA option for point sources to be established through a special study, defined in the BPA as Optional Special Study #3. The County submitted a Draft Work Plan for the Optional Special Study #3 on March 11, 2010. The County has subsequently conducted the Special Study from May 2010 through April 2011. The results and Final Report of the Special Study will be submitted with this document to the Regional Board. In response to the approaches to developing mass-based WLAs included in the Draft Work Plan for Optional Special Study #3, the Regional Board Executive Officer presented a mass-based WLA approach deemed adequate to fulfill the requirements of the Nutrient TMDL:

The Machado Lake Nutrient TMDL allows for the establishment of annual mass-based WLAs for total phosphorus (TP) and total nitrogen (TN) equivalent to monthly average concentrations of 0.1 mg/L TP and 1.0 mg/L TN, based on

approved flow conditions. When the concentration based WLA are met under the approved flow condition of 8.45 hm³ (cubic hectometers or million cubic meters/year), the annual mass of the TP discharged to the lake will be 845 kg and the annual mass of TN discharged to the lake will be 8450 kg. The Los Angeles County mass-based WLA should be proportional to the County owned area in the sub-watershed. The unincorporated County area accounts for 8.4% of the Machado Lake sub-watershed. Both the interim and final WLAs based on the approved flow condition and fraction of unincorporated County area in the watershed are listed in **Table 1**.

Table 1: Los Angeles County Nutrient TMDL Mass-based Waste Load Allocations

Year after TMDL Effective Date	WLAs	
	TP (kg)	TN (kg)
5 (interim WLAs)	887	1739
9.5 (final WLAs)	71	710

The Toxicity TMDL BPA assigned WLAs for MS4 permittees as concentration-based allocations (equal to the sediment numeric targets) for suspended sediment-associated contaminants are presented in **Table 2**.

Table 2: MS4 Permittees Toxics TMDL Waste Load Allocations

Pollutant	WLA for Suspended Sediment Associated Contaminants (µg/kg or ng/g dry weight)
Total PCBs	59.8
DDT (all congeners)	4.16
DDE (all congeners)	3.16
DDD (all congeners)	4.88
Total DDT	5.28
Chlordane ¹	3.24
Dieldrin	1.9

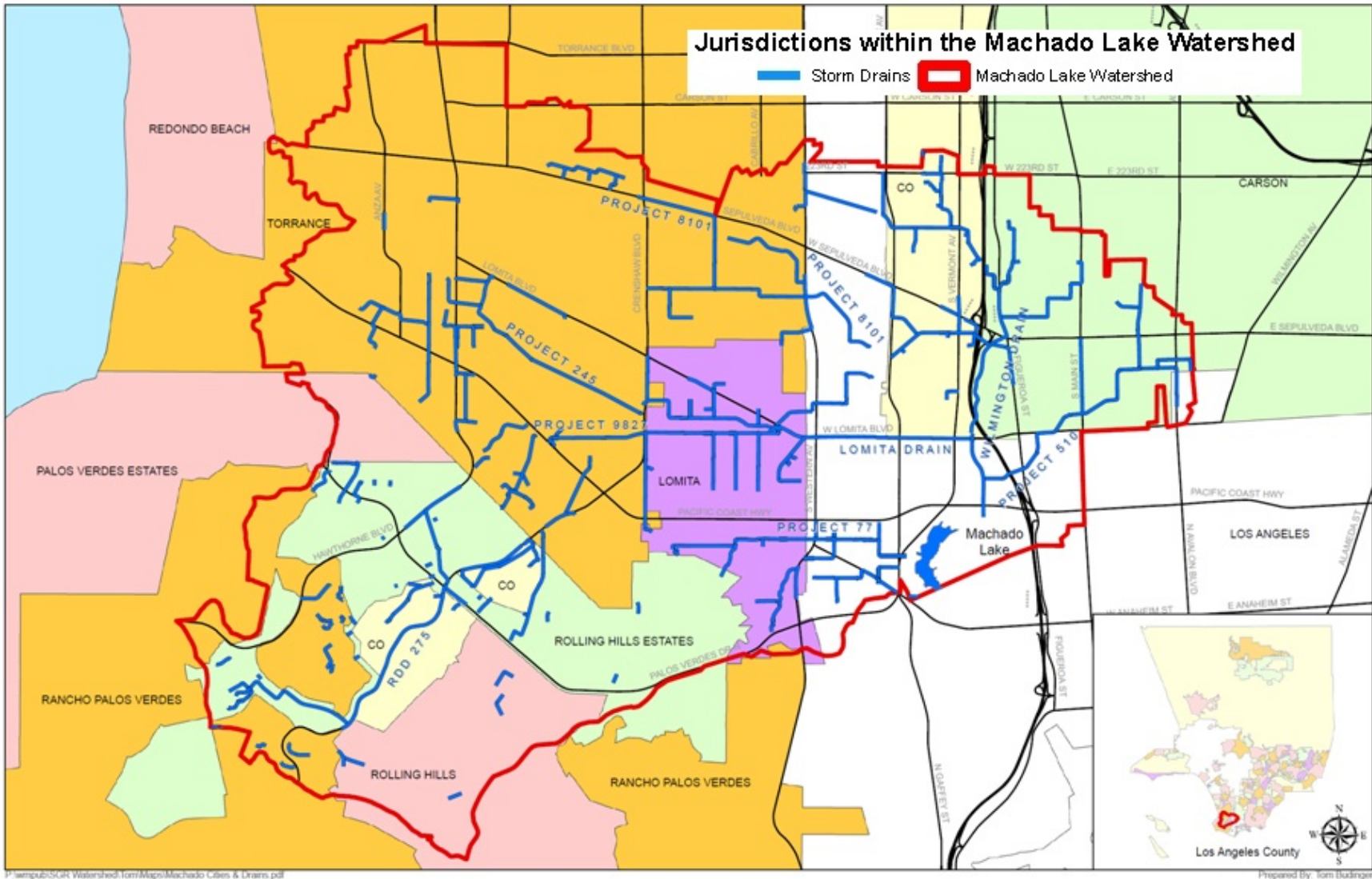


Figure 1: Machado Lake Watershed and Jurisdictions within the Watershed

1.2 PURPOSE AND OBJECTIVES

Both the Nutrient and Toxics TMDLs require the preparation of a Monitoring and Reporting Program (MRP). The mass-based nutrient WLA compliance alternative for the Nutrient TMDL, which the County is utilizing requires that a MRP plan be prepared and submitted to the Regional Board within two and half years of the effective date of the Nutrient TMDL (September 11, 2011). The MRP for the Toxics TMDL is due to the Regional Board within six months of the effective date of the Toxics TMDL.

This MRP plan will address nutrients and toxics as required by the adopted TMDLs, as well as copper, lead, and bacteria in the unincorporated County islands within the Machado Lake Watershed. The MRP will have the following core objectives:

- Monitor attainment of the TMDLs waste load allocations as required in the relevant TMDLs
- Guide the design of future implementation actions
- Monitor the effectiveness of implementation actions in improving water quality
- Guide pollutant source investigations

This document presents a TMDL MRP for the unincorporated County areas to address requirements in the Nutrient TMDL and Toxics TMDL. The knowledge gained through the County's Special Study was used to develop the nutrient monitoring approach, selection of monitoring sites, nutrient monitoring frequency, and nutrient sample collection techniques such that the MRP will accomplish its objectives and adequately characterize and document the following:

- County's pollutant loads;
- Progress towards pollutant load reductions; and
- Improvement in water quality, sediment quality, and fish tissue.

The Special Study monitored flow for a year from the County Islands that was not attributable to wet-weather and found that each monitored constituent could be confidently represented with one statistical distribution representing conditions in non-wet weather runoff from all County Islands as opposed to several site-specific or island-specific distributions. Note that County Island 2 does not have non-wet weather discharges and was not monitored during the Special Study. Furthermore, the Special Study also found that a significant percentage of the estimated annual loading for Total Nitrogen was coming from dry weather events (41%), whereas dry weather loadings for Total Suspended Solids and Total Phosphorus did not show significant contributions to the estimated annual loadings (5.2% and 5.0% respectively). These conclusions were considered in tailoring the approach, site location, and frequency of the MRP.

Section 2. Approach

The County's MRP approach includes monitoring each County Island during wet weather and dry weather events, and is designed to address the requirements of both the Nutrient TMDL and Toxics TMDL. In addition, the monitoring of additional pollutants, specifically metals and bacteria, shall be included in the MRP to assist in future TMDL development and compliance assessment for the respective constituents.

2.1 NUTRIENT TMDL MONITORING APPROACH

Based on the Special Study, analysis of the dry weather sampling concluded that each distribution of water quality constituent was similar for County Islands 1 and 3 (County Island 2 had no observed dry weather runoff). As a result, estimations of dry weather loading may be achieved without sampling at all six monitoring locations identified in the Special Study. One outlet monitoring location in each of County Islands 1 & 3 will be sampled for both dry and wet weather. County Island 2 had no observed dry weather runoff per the Special Study, and thus will only be sampled for wet weather events; however, site visits shall continue to be conducted during each dry weather event to confirm that no dry weather flows are being observed.

Furthermore, flow measurements will continue to be taken at all of the Special Study discharge sites and County Island 2 (seven sites total) following protocols developed in the Special Study. Monitoring will continue until at least 10 wet weather samples are collected and when possible coincide with the toxic monitoring program (see Section 2.2). At the end of this monitoring period, the County will review the monitoring results to assess whether the proposed approach should be modified.

Further details regarding the monitoring site locations, frequencies, and parameters are described in Sections 3-5 of the MRP.

2.2 TOXICS TMDL MONITORING APPROACH

The Toxics TMDL monitoring approach will consist of two phases of wet weather monitoring designed to collect suspended solids such that sufficient volumes (estimated at 60 L of sample from the water column) are available for the analysis of pollutants in bulk sediments. Phase 1 monitoring will be conducted for a two year period. In Phase 1 monitoring, samples shall be collected during three wet weather events each yearⁱ, including the first large storm event of the season. Phase 2 monitoring will commence once Phase 1 monitoring has been completed. Samples will be collected during one wet weather event every year during Phase 2 monitoring through five years. At the end of the fourth year of a five year period, the County will review the monitoring results to assess whether the proposed approach should be modified.

Further details regarding the monitoring site locations, frequencies, and parameters are described in Sections 3 through 5 of the MRP.

ⁱ The Department of Water Resources classifies water year based on the time period from October 1 through September 30. For the purposes of this document it is recommended using October 1 as the starting date for the wet season and that the DWR classification be used for annual monitoring reporting. Thus 3 wet weather events per year will be interpreted to be 3 storm events per water year (October-September).

2.3 MONITORING APPROACH FOR ADDITIONAL POLLUTANTS

Metals and bacteria samples will be collected in conjunction with Nutrient TMDL and Toxics TMDL sampling, and will follow the protocols and frequencies of the Nutrient sampling. Metals and bacteria data will be beneficial during the future development and compliance assessment of TMDLs for the respective constituents.

Section 3. Monitoring Sites

Monitoring sites were selected based on the results of the Special Study. An overview of the County Islands and the six monitoring sites as identified in the Special Study is presented in **Figure 2**. As previously mentioned, no sites were identified as contributing a unique distribution of concentrations that significantly deviates from the watershed-wide distribution during non-wet weather conditions. Therefore, all monitoring sites can adequately characterize and document pollutant concentrations in water and suspended sediment from the unincorporated County Islands. A total of three monitoring locations have been selected. One outlet location within each of County Island 1 and 3 will be monitored for both dry weather and wet weather, and one outlet location within County Island 2 for wet weather only, as there is no dry weather discharge from County Island 2. Flow measurements will continue to be collected at all six sites identified in the Special Study, and a new site in County Island 2, to better estimate the total pollutant loadings throughout the County Islands. A map of the Machado Lake watershed with the location of the three proposed monitoring sites is presented in **Figure 3**.

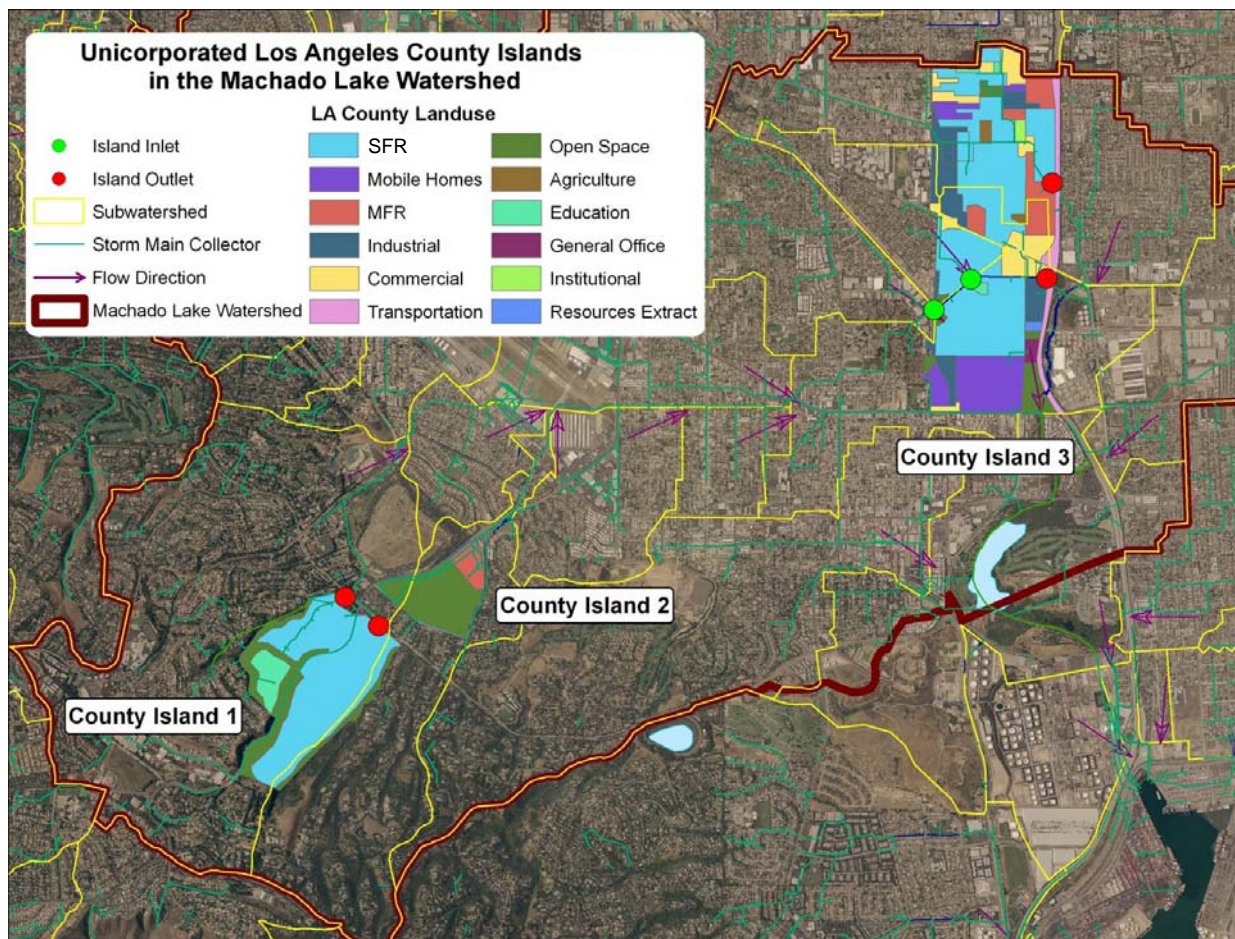


Figure 2: Overview of County Islands and Special Study Monitoring Sites in the Machado Lake Watershed.

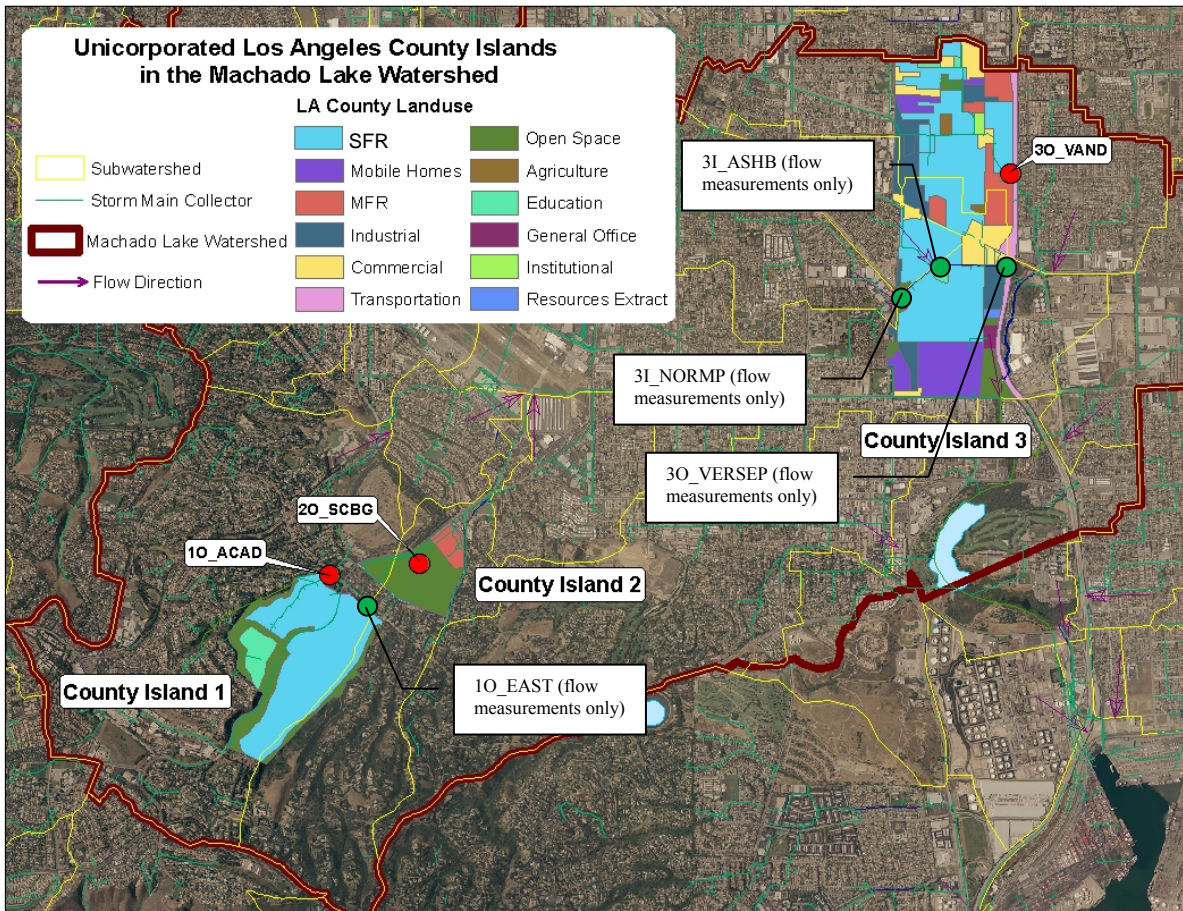


Figure 3: Machado Lake Watershed and MRP Monitoring Stations.

10_ACAD was selected to represent loads from unincorporated County Island 1 as the Special Study observed dry weather flows from the site was more consistent and significant than its companion site 10_EAST. The 10_ACAD site is a storm drain manhole near the base of the County Island, draining flows from the upstream residential areas and schoolyard. An aerial image of site 10_ACAD and the surrounding areas is presented in **Figure 4**.



Figure 4: Aerial view of 10_ACAD.

20_SCBG (South Coast Botanical Garden) was selected to represent loads from unincorporated County Island 2. The Special Study found no dry weather flow originated from within County Island 2 but observed that a spillway in the South Coast Botanical Gardens was a likely pathway for wet weather flows and provided safe and easy access for sampling. The selected site was considered to be the optimal location to measure wet weather flows from the County Island and is designated as Site 20_SCBG, consistent with the naming conventions used in County Islands 1 and 3. An aerial view of site 20_SCBG and the surrounding areas is presented as **Figure 5**.



Figure 5: Aerial View of Site 20_SCBG.

30_VAND was selected to represent loads from unincorporated County Island 3 as the Special Study observed that loadings from companion site 30_VERSEP were predominantly from loadings external to the County Islands as measured from the island inlet sites. The site is a concrete-lined channel which drains flow from much of the northern portion of County Island 3, which includes various types of residential areas. An aerial view of site 30_VAND and the surrounding areas is presented in **Figure 6**.



Figure 6: Aerial View of Site 30_VAND.

The site locations as well as the rationale for inclusion in the MRP are listed in **Table 3**. Additional information and photographs of the sites are available in Appendix A.

Table 3: Site Locations

SiteID	County Island	Type	Nearest Intersection	Latitude	Longitude	Rationale for Selection
1O_ACAD	1	Island Outlet (Storm drain manhole)	Academy Dr./ Palos Verdes Dr.	33.7831	-118.3537	Representative of County Island outlet; will be used to characterize loading from the County Island.
2O_SCBG	2	Island Outlet (Spillway area)	Crenshaw Blvd./ Palos Verdes Dr.	33.7844	-118.3441	Sole identified potential source of wet weather flow within County Island; will be used to characterize loading from the County Island.
3O_VAND	3	Island Outlet (Concrete-lined channel)	Van Deene Ave./228 th St.	33.8158	-118.2878	Drains large section of County Island. This site will be used to characterize loading from the County Island and evaluate loadings from other portions of the County without an associated outlet site.

Section 4. Sampling Frequency

A summary of the proposed MRP monitoring program, including frequency, location, and monitored parameters, is shown in **Table 4**. After each monitoring year, the County will review the monitoring results to assess whether modifications to the monitoring program should be made. This review also coincides with the Regional Board effort to revisit the Nutrient TMDL scheduled for September 2016.

Table 4: Summary of Multipollutant TMDL MRP Monitoring Events.

Site ID	Constituents	Year 1		Year 2		Year 3		Year 4		Year 5 ⁽¹⁾	
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
1O_ACAD	Nutrients	3	4	3	4	3	4	1	4	-	-
	Toxics	3	-	3	-	1	-	-	-	1	-
	Metals	3	4	3	4	3	4	1	4	-	-
	Bacteria	3	4	3	4	3	4	1	4	-	-
2O_SCBG	Nutrients	3	-	3	-	3	-	1	-	-	-
	Toxics	3	-	3	-	1	-	-	-	1	-
	Metals	3	-	3	-	3	-	1	-	-	-
	Bacteria	3	-	3	-	3	-	1	-	-	-
3O_VAND	Nutrients	3	4	3	4	3	4	1	4	-	-
	Toxics	3	-	3	-	1	-	-	-	1	-
	Metals	3	4	3	4	3	4	1	4	-	-
	Bacteria	3	4	3	4	3	4	1	4	-	-

¹ At the end of Year 4, the County will review the monitoring results to determine whether additional monitoring is required in Year 5.

4.1 NUTRIENT TMDL SAMPLING

Nutrient sampling for dry weather shall be conducted quarterly at the two outlet monitoring sites in County Islands 1 and 3. No dry weather sampling will occur within County Island 2 as no dry weather flows were observed during the Special Study; however, site visits will continue to be conducted during each dry weather event to verify that there are no dry weather flows. Nutrient sampling for wet weather will be conducted to coincide with the toxic monitoring frequency and include three storm events per year at all three monitoring sites, including the first large storm of the season, until a total of 10 storm events are collected. The nutrient sampling schedule is presented in **Table 5**.

Table 5: Summary of Nutrient TMDL Sampling.

Site ID	Constituents	Year 1		Year 2		Year 3		Year 4		Year 5 ⁽¹⁾	
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
10_ACAD	Nutrients	3	4	3	4	3	4	1	4	TBD	TBD
2O_SCBG	Nutrients	3	-	3	-	1	-	-	-	TBD	TBD
3O_VAND	Nutrients	3	4	3	4	3	4	1	4	TBD	TBD

1 Nutrient sampling to be determined (TBD) in year 5 based on data review.

4.2 TOXICS TMDL SAMPLING

The frequency for the Toxics TMDL Sampling will follow the requirements set forth in the Toxics TMDL BPA. Phase 1 Toxics TMDL samples will be collected during three wet weather events, including the first large storm of the season for two years. Phase 1 sampling will begin within 60 days of Executive Officer approval of the MRP and QAPP. Phase 2 will begin following the completion of Phase 1. Phase 2 Toxics TMDL samples will be collected during one wet weather event every other year as outlined in **Table 6**.

Table 6: Summary of Toxics TMDL Sampling.

Site ID	Constituents	Phase 1				Phase 2					
		Year 1		Year 2		Year 3		Year 4		Year 5	
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
10_ACAD	Toxics	3	-	3	-	1	-	-	-	1	-
2O_SCBG	Toxics	3	-	3	-	1	-	-	-	1	-
3O_VAND	Toxics	3	-	3	-	1	-	-	-	1	-

4.3 METALS AND BACTERIA SAMPLING

Metals and bacteria samples will be collected at every event following the protocols and frequency of the nutrient sampling. The sampling schedule for metals and bacteria is presented in **Table 7**.

Table 7: Summary of Metals and Bacteria TMDL Sampling.

Site ID	Constituents	Year 1		Year 2		Year 3		Year 4		Year 5 ⁽¹⁾	
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
1O_ACAD	Metals	3	4	3	4	3	4	1	4	TBD	TBD
	Bacteria	3	4	3	4	3	4	1	4	TBD	TBD
2O_SCBG	Metals	3	-	3	-	3	-	1	-	TBD	TBD
	Bacteria	3	-	3	-	3	-	1	-	TBD	TBD
3O_VAND	Metals	3	4	3	4	3	4	1	4	TBD	TBD
	Bacteria	3	4	3	4	3	4	1	4	TBD	TBD

1 Metals and Bacteria sampling to be determined (TBD) in year 5 based on data review.

Section 5. Monitored Parameters

Table 8 lists the constituents for which samples will be analyzed for the Nutrient TMDL, the analytical methods, project method detection limits and project reporting limits for each constituent. Data will be collected for multiple nutrient constituents to assist in the understanding of nutrient loadings from the County areas and support identification of methods for reducing those loadings in the implementation plan.

Table 9 lists the constituents for which samples will be analyzed for the Toxics TMDL, the analytical methods, project method detection limits and project reporting limits for each constituent.

Table 10 lists the method detection levels and method reporting levels for the organochlorine pesticide analyses of particulate matter.

Table 11 lists the additional constituents for which samples will be analyzed, the analytical methods, project method detection limits and project reporting limits for each constituent.

Additionally, field measurements will be collected for the parameters listed in **Table 12** during each event.

Table 8: Nutrient TMDL Constituents, Analytical Methods, and Quantitation Limits

Constituent Class	Constituent	Method	Detection Limit (mg/L)	Reporting Limit (mg/L)
Conventional	Total Suspended Solids (TSS)	SM 2540D	0.5	1.0
	Total Dissolved Solids (TDS)	SM 2540C	1.0	10
Nutrient	Total Kjeldahl Nitrogen (TKN) ¹	EPA 351.1	0.455	0.50
	Nitrate as Nitrogen (NO ₃ -N) ¹	EPA 300.0	0.01	0.10
	Nitrite as Nitrogen (NO ₂ -N) ¹	EPA 300.0	0.01	0.05
	Total Nitrogen ¹	calculation	NA	NA
	Ammonia as Nitrogen (NH ₃ -N)	EPA 350.1	0.01	0.10
	Total Phosphorus	SM 4500-P E or F	0.02	0.1
	Dissolved Phosphorus	SM 4500-P E or F	0.02	0.1
	Total Orthophosphate (PO ₄ -P)	SM 4500-P E or F	0.001	0.01

1. Total Nitrogen is the sum of TKN, nitrate, and nitrite.

Table 9: Toxics TMDL Constituents, Analytical Methods, and Quantitation Limits

Sample Medium	Constituent	Method	Detection Limit	Reporting Limit
Water	Total Suspended Solids (TSS)	SM 2540D	0.5 mg/L	1.0 mg/L
Sediment (collected as suspended sediment)	Organochlorine Pesticides ¹	EPA8270C(m)	0.1-1 ng/dry g	0.5-5 ng/ dry g
	Total PCBs ²		10 ng/dry g	20 ng/dry g
	Total Organic Carbon (TOC)	EPA 9060 Dry combustion/IR detection	0.05 % dry weight	0.05%-66% dry weight

1. Organochlorine Pesticides to be analyzed include chlordane-alpha, chlordane gamma, 2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dieldrin.

2. PCBs in water and sediment are measured as sum of seven Aroclors identified in the CTR (1016, 1221, 1232, 1242, 1248, 1254, and 1260). Congeners will also be analyzed to provide a better estimate of PCB concentrations and loads for PCBs. Method Detection Limit/Reporting Limit for individual congeners are 1 ng/dry g and 5 ng/dry g.

Table 10: Pesticides and the Associated Method Detection Levels (MDL) and Method Reporting Levels (MRL).

Organochlorine Pesticides	Laboratory MDL ng/g – dry weight	Laboratory MRL ng/g – dry weight
Chlordane Compounds		
Heptachlor	0.1	0.5
Heptachlor Epoxide	0.1	0.5
gamma-Chlordane	0.1	0.5
alpha-Chlordane	0.2	1
Oxychlordane	0.1	0.5
trans-Nonachlor	0.1	0.5
cis-Nonachlor	0.1	0.5
Other Organochlorine Pesticides		
2,4'-DDD	1	2
2,4'-DDE	1	2
2,4'-DDT	1	2
4,4'-DDD	1	2
4,4'-DDE	1	2
4,4'-DDT	1	2
Total DDT	1	2
Dieldrin	1	5

Table 11: Additional Constituents, Analytical Methods, and Quantitation Limits

Constituent Class	Constituent	Method	Detection Limit (mg/L)	Reporting Limit (mg/L)
Conventional	Hardness	SM 2340B	1 mg/L	10 mg/L
Metals	Total and Dissolved Copper	EPA 200.8	0.4 µg/L	0.8 µg/L
	Total and Dissolved Lead		0.1 µg/L	0.5 µg/L
Bacteria	<i>E. coli</i>	IDEXX Colilert	10 MPN/100 mL	10 MPN/100 mL

Table 12: Project Reporting Limits for Field Measurements

Parameter/Constituent	Range	Project RL
Velocity/Flow ¹	-0.5 to +20 ft ³ /s	
pH	0 – 14 pH units	NA
Temperature	-5 – 50 °C	NA
Dissolved oxygen	0 – 50 mg/L	0.5 mg/L
Turbidity	0 – 3000 NTU	0.2 NTU
Conductivity	0 – 10000 µmhos/cm	2.5 µmhos/cm

RL – Reporting Limit

NA – Not applicable

- For velocity/flow, range refers to velocities measured by a handheld flow meter. The lower limit for measuring flow is dependent upon the size of the specific pipe or channel.

Section 6. Reporting Requirements

6.1 ANNUAL MONITORING REPORT

Monitoring results are to be reported annually to the Los Angeles Regional Water Quality Control Board (LARWQCB). Each annual report is to be submitted to the LARWQCB within six months from the final sampling event of a year. For example, if the final sampling event representing a year worth of sampling is conducted on March 11, 2013, the annual monitoring report would be due to the LARWQCB September 11, 2013. The report will summarize the events conducted, samples collected, QA/QC results, and the analysis results. A comparison between the measured loads and the waste load allocations (WLAs) for the County is to be presented in the monitoring reports. Nutrient WLAs for Machado Lake are specified as annual loads. The Toxics TMDL BPA requires the responsible parties to report compliance or non-compliance with WLAs as part of annual (or biennial during Phase 2 monitoring) reports submitted to the Regional Board. WLA for toxics are specified as 3-year average values. The assessment of compliance would require results from three consecutive years of sampling.

The additional constituents as shown in **Table 11** collected under this MRP are voluntary and there are no compulsory reporting requirements. However, the County may choose to report the additional data collected in a manner similar to the data being collected per the adopted Nutrient and Toxics TMDLs either as part of, or as an Addendum to, the TMDL Annual Monitoring Report(s).

The Annual Monitoring Report will report compliance and non-compliance with waste load allocations and will contain at minimum the following components:

- Methods
- Monitoring Results/Analyses
- Quality Assurance/Quality Control
- Conclusions and Recommendations

Section 7. Monitoring Event Preparation

Monitoring event preparation will include mobilizing field equipment, placing bottle orders, and contacting the necessary personnel regarding site access and scheduling. The following steps will be completed prior to each sampling event:

1. Contact laboratories or other suppliers to obtain sample containers.
2. Confirm scheduled monitoring date with the field crew and set up sampling day itinerary, including courier pickup/drop-off if applicable.
3. Mobilize sampling equipment. Examine all equipment for defects and replace if necessary. Ensure that all samplers have appropriate personal protective equipment prior to going to the field.
4. All samplers to confirm contact information, review sampling and urgent care location maps, and review/discuss safety protocols when in the field. Samplers should also discuss informal rescue plans in case of a serious incident occurring while on site.
5. Prepare sample container labels with sample date, sample time, sample point, sample type (grab/composite), preservatives added (if needed), and analyses needed.
6. Prepare field log sheet to indicate the type of field measurements, field observations and samples to be collected.
7. Prepare chain of custody forms.
8. Calibrate field measurement instruments and fill out calibration logs.

The following equipment will be mobilized prior to each sampling event:

- First aid kit
- Cellular phone
- Field log, H&S Plan
- Nitrile or latex powder-free gloves
- Flow meter
- Camera
- Coolers for all sample bottles
- GPS
- Multi-parameter meter (temperature, pH, DO, conductivity, and turbidity)
- Ladder
- Cleaning solutions as required by sampling equipment
- Clipboard
- Chain of custody forms
- Sample bottles
- Intermediate bottles
- Labels
- Ice
- Bucket and Rope
- Sand Bag
- Field kit (tape, knife, zip-lock bags, tie-wraps, sharpie pens, pencils, screw driver, and other miscellaneous supplies)
- Confined space entry equipment and permits, if necessary
- Rinse water as required by sampling equipment.

7.1 BOTTLE ORDER

Sample bottle orders will be placed with the appropriate analytical laboratory at least two weeks prior to each sampling event. Containers will be ordered for all water samples, including quality control samples, as well as extra containers in case the need arises for intermediate containers or replacements. The containers must be of the proper type and size and contain preservative as appropriate for the specified laboratory analytical methods. **Table 13, Table 14, and Table 15**

list specific constituents for which samples will be analyzed and specifies the sample container, volume required, and immediate processing, storage, and holding time requirements. The field crew will inventory sample containers upon receipt from the laboratory to ensure that adequate containers have been provided to meet analytical requirements for each monitoring event.

Table 13: Nutrient TMDL Sample Container Requirements

Constituent	Sample Container and Volume ¹	Immediate Processing And Storage	Holding Time
Total Suspended Solids (TSS)	1 L HDPE	4° C	7 days
Total Dissolved Solids (TDS)	500 mL HDPE	4° C	7 days
Nitrate as Nitrogen (NO ₃ -N)	500 mL HDPE	4° C	48 hours
Nitrite as Nitrogen (NO ₂ -N)			
Dissolved Phosphorus			
Total Orthophosphate (PO ₄ -P)			
Total Kjeldahl Nitrogen (TKN)	500 mL HDPE	H ₂ SO ₄	28 days
Ammonia as Nitrogen (NH ₃ -N)			
Total Phosphorus			

¹ Additional volume may be required for QC analyses.

Table 14: Toxics TMDL Sample Container Requirements

Sample Medium	Constituent	Sample Container and Volume ³	Immediate Processing And Storage	Holding Time
Water	Total Suspended Solids (TSS)	1L HDPE	4° C	7 days
Sediment (collected as suspended sediment)	Organochlorine Pesticides ¹	2-4 grams (min 0.5 grams)	4° C	1 year ⁴
	Total PCBs ²			
	Total Organic Carbon (TOC)	1 gram (min 0.25 grams)	4° C	28 days

1. Organochlorine Pesticides to be analyzed include chlordane-alpha, chlordane gamma, 2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dieldrin.

2. PCBs in water are measured as sum of seven Aroclors identified in the CTR (1016, 1221, 1232, 1242, 1248, 1254, and 1260). Individual congeners will also be analyzed.

3. Additional volume may be required for QC analyses.

4. One year if frozen, otherwise 14 days to extract and 40 days from extraction to analysis.

Table 15: Additional Constituents Sample Container Requirements

Constituent Class	Constituent	Sample Container and Volume ¹	Immediate Processing And Storage	Holding Time
Conventional	Hardness	500 mL HDPE	4° C	6 months
Metals	Total and Dissolved Copper Total and Dissolved Lead	500 mL HDPE	4° C	48 hours/ 6 months ²
Bacteria	<i>E. coli</i>	100mL HDPE	4° C	6 hours

1. Additional volume may be required for QC analyses.

2. 48 hours to filter for dissolved metals, then 6 months to analyze for both filtered dissolved and total.

7.2 SAMPLE BOTTLE LABELING

All samples will be identified with a unique identification code to ensure that results are properly reported and interpreted. Samples will be identified such that the site, sampling location and sample type (*i.e.*, environmental sample or QC sample) can be distinguished by a data reviewer or user. Sample identification codes will consist of a site identification code and a unique sample ID number assigned by the monitoring manager.

Labels will be placed on the appropriate bottles in a dry environment; applying labels to wet sample bottles will be avoided. Labels will be placed on sides of bottles rather than on bottle caps. Labels will be produced by the County’s Integrated Water Quality System Database, to uniquely identify samples, the required analyses, and for subsequent uploading of data to the database.

Section 8. Sample Collection

8.1 SAMPLING TECHNIQUE

Sampling technique for Nutrient TMDL monitoring will be mirror the methods used in the Special Study Dry weather grab sampling techniques are currently described in Section 8.1.1. Wet weather samples are included in the Nutrient TMDL monitoring approach and will be partitioned from the wet weather toxics sampling prior to being filtered.

Specific sample techniques were developed for wet weather Toxics TMDL sampling and are presented under Toxics TMDL wet weather sampling, Section 8.1.2.

Sampling for metals and bacteria samples will utilize the sampling techniques presented for Nutrient and Toxics TMDL sampling with the following exceptions. Metals sampling requires the use of clean sampling techniques presented below. Additionally, metals and bacteria samples collected during Toxics TMDL sampling will be collected from the water column rather than from suspended sediment.

8.1.1 Nutrient TMDL, Metals, and Bacteria Dry Weather Sampling

Samples will be collected in a manner that minimizes the possibility of sample contamination. These sampling techniques are summarized below:

- Samples are collected only into rigorously pre-cleaned sample containers.
- At least two persons are required on a sampling crew.
- Clean, powder-free nitrile gloves must be worn while collecting samples and must be changed whenever something not known to be clean has been touched.
- To reduce the potential for contamination and to ensure crew safety, field crews must observe the following precautions while collecting samples:
 1. Smoking is prohibited.
 2. Collecting samples near a vehicle, running or otherwise, is prohibited.
 3. Eating or drinking during sample collection is prohibited.
 4. Sampling personnel should avoid breathing, sneezing or coughing in the direction of an open sample container.

Each person on the field crew will wear clean clothing that is free of dirt, grease, or other substances that could contaminate the sampling apparatus or sample bottles.

Grab samples will be collected at approximately mid-channel, mid-depth at the location of greatest flow (where feasible) by direct submersion of the sample bottle. This is the preferred method for grab sample collection; however, due to monitoring site configurations and safety concerns, direct filling of sample bottles may not always be feasible. Monitoring site configuration will dictate grab sample collection technique. Grab samples will be collected directly into the appropriate bottles whenever feasible (containing the required preservatives as outlined in **Table 13**). As protocols are developed by the County to uniquely address the urban conveyance system sampling they will supersede the procedures outlined in the MRP.

During dry weather sampling events, some channels and drains may not contain sufficient flow to collect samples by direct submersion. Intermediate containers will be used in instances where flows are too shallow for the direct submersion of sampling containers, and in instances where

sheet flow is present. In these instances, a HDPE bottle free of preservative will be used as the intermediate container to fill sample bottles.

It is considered very important to not scoop up algae, sediment, or other particulate matter on the bottom of the channel because such debris is not representative of surface flows. To prevent collection of such debris:

- A location should be found where the channel bottom is relatively clean and allows for the intermediate container to fill, or
- A clean Ziploc bag should be placed on the bottom of the channel and water should be collected from on top of the bag. A fresh Ziploc bag pre-rinsed with site water should be used at each site, when required, or
- For certain manholes, a temporary device that would serve to impede flows and create a pool (e.g. a sandbag) may be employed during the sampling event.

The potential exists for monitoring sites to lack discernable flow. The lack of discernable flow may generate unrepresentative data. To address the potential confounding interference that can occur under such conditions, sites sampled should be assessed for the following conditions and sampled or not sampled accordingly:

- Pools of water with no flow or visible connection to another surface water body should **NOT** be sampled. The field log should be completed for non-water quality data (including date and time of visit) and the site condition should be photo-documented.
- Flowing water (*i.e.*, based on visual observations, flow meter data, and a photo-documented assessment of conditions immediately upstream and downstream of the sampling site) site **SHOULD** be sampled.

Field personnel will adhere to established sample collection protocols to ensure the collection of representative and uncontaminated (*i.e.*, contaminants not introduced by the sample handling process itself) samples for laboratory analyses. Deviations from the standard protocols must be documented in the field log at the time of sampling. Sampling gear and utensils which come in direct contact with the sample will be made of non-contaminating materials and will be thoroughly cleaned between sampling stations according to appropriate cleaning protocols. Sample containers will be of the recommended type and will be free of contaminants (*i.e.*, pre-cleaned). Conditions for sample collection, preservation and holding times will be followed.

Field crews (2 persons per crew, minimum; 3 persons per crew, minimum, when confined space entry is required) will be mobilized for sampling only when weather conditions and flow conditions are considered to be safe. For safety reasons, sampling will occur only during daylight hours. Sampling events should proceed in the following manner:

1. Before leaving the sampling crew base of operations, confirm number and type of sample containers as well as the complete equipment list.
2. Proceed to the first sampling site.
3. Record the general information on the field log sheet.
4. Collect the samples indicated on the event summary sheet in the manner described herein. Collect additional volume and blank samples for field-initiated Quality Control (QC) samples, if necessary. Place filled sample containers in coolers and carefully pack and ice samples as described herein. Using the field log sheet, confirm that all appropriate containers were filled.

5. Collect field measurements and observations, and record these on the field log sheet.
6. Repeat the procedures in steps 3, 4, and 5 for each of the remaining monitoring sites.
7. Complete the chain of custody forms using the field log sheets.
8. After sample collection is completed at all monitoring sites, deliver and/or ship samples to the appropriate laboratory.

8.1.2 Toxics TMDL Wet Weather Sampling

8.1.2.1 Background

Compliance monitoring specified in the Basin Plan Amendment requires that pollutant concentrations are measured by collecting sufficient volumes of stormwater such that quantities of suspended solids are suitable for direct analyses in bulk sediments filtered from the discharges. In addition, stormwater is to be sampled using procedures that allow for representative samples proportioned based upon flow rates during the storm events. As noted, earlier pollutants specified for direct analysis in the bulk sediment include:

- Total Organic Carbon
- Total PCBs
- DDT and Derivatives
- Dieldrin
- Total Chlordane

Although a number of studies have been performed to directly measure the concentration of contaminants associated with suspended solids, there are no standardized procedures for this type of testing. Given the lack of a standard method, a brief review of the various methods used to collect, concentrate and quantify suspended sediments and to quantify pollutant loads associated with suspended sediments is warranted.

The usual approach for measuring hydrophobic chemicals associated with suspended particulates has been to analyze whole water samples. Mahler et al. (2006) noted that most water samples with less than a couple hundred mg/L of TSS could still result in mostly non-detects even when the pollutant concentrations in the suspended sediment exceeded Probable Effects Levels (PELs) if they had been measured in bedded sediments. The combined use of more sensitive analytical methods such as GCMS-NCIS and increasing sample volumes can substantially improve sensitivity but values are still often within 10 times the reporting limits and thus would be expected to have limited value in determining loads.

The number of strategies used to determine the concentrations and loads associated with suspended sediments (and those in the dissolved or colloidal form) nearly match the number of studies conducted. All require a method to separate suspended sediment from the water samples and very high volumes of water. Horowitz (1995) used centrifugation but most other studies have used some type of filtration. Studies conducted in the Raritan Bay area by USGS and the New Jersey Department of the Environment (Bonin and Wilson, 2006) used Trace Organic Platform Samplers (TOPS) units to collect and filter water. These units typically use stainless steel canister filters fitted with 0.5 μm Glass Fiber Filters (GFF) to remove the coarser material without substantial flow restriction. Since these filters tend to get breakthrough of approximately 10% of the suspended sediment, they are followed by large (142 mm or 293 mm) flat GFF filter with a nominal pore size of 0.7 or 1.0 μm and no binders. The water then passes through an

XAD resin to extract the dissolved fraction. The volume of water passing through the system is collected and measured to establish the volume for use in calculating concentrations. Other studies conducted in the Great Lakes Region (McCarty et al. 2004) have simply quantified the mass of pollutants present in the particulate fraction relative to the total volume of water.

Sediment trapped in the canister filter and flat GFF cannot be recovered for quantification so most studies collect additional TSS samples to use in calculating the total mass of sediment trapped by the sampler. The average concentration of TSS is then multiplied by the total volume of water to estimate the mass of particulates captured by the filters. Other studies conducted in the Great Lakes Region (McCarty et al. 2004) have simply quantified the mass of pollutants present in the particulate fraction relative to the total volume of water.

A more recent USGS study conducted in Austin, Texas (Mahler et al. 2006) explored use of large volume suspended sediment sampling to measure concentrations and loads of both metals and organic compounds that were associated with suspended sediment during storm events in Barton Creek. Initially, this study eliminated use of the GFF filter cartridges typically used in such studies and only used 293 mm GFF filters with nominal pore sizes of 0.7 μm . Seven 9 L samples were taken at fixed time intervals and later composited based upon average flow within each time interval. As the study proceeded, 0.45 μm PTFE filters were tested as replacements for the GFF filters. USGS found that these filters, when handled correctly, were able to fully recover all sediment so that particulates could be directly quantified. As the filter periodically became clogged, they would be removed from the filter holder and placed in a sealed plastic bag. The filter would then be gently massaged to remove the sediment and typically reused two more times with the same sample. Although the PTFE filters successfully allowed complete recovery of sediment from the water samples they required some special handling due to their hydrophobicity. A light spray with methanol was necessary to get water to start flowing through the membrane. Complete recovery of the sediment allowed the sample to be freeze-dried in the laboratory prior to analysis.

Stenstrom and Suffet (2009) used similar methods to collect and fractionate samples of stormwater entering Puddingstone Lake in Los Angeles County. Water samples were filtered to separate total suspended solids (TSS) from the aqueous phase using pre-weighed 142 mm, 0.7 μm pure glass (no binder) TCLP filters (Whatman Inc., UK) and a Hazardous Waste Pressure Filter System (Millipore, Billerica, MA). They then dried the filters containing the TSS in 250 mL glass jars containing calcium chloride over a 24-hour period and then refrigerated the samples at 4°C until extracted. Filters were reweighed after drying to determine the amount of particulates collected on the filters.

As part of a TMDL effort, LWA is conducting a monitoring program designed to quantify organochlorine pesticides associated with suspended sediments in Calleguas Creek during storm events. This study is designed to determine if organochlorine pesticides are more strongly associated with one of three major sediment particle size fractions including <1 μm to <64 μm , $\geq 64 \mu\text{m}$ to 2 mm, and particles greater than 2 mm. Stormwater samples are taken as large single grab samples. A subsample is taken for measurement of total suspended solids. The smallest filter (<1 mm) is a glass fiber filter that requires that extractions include the filter. As with many other programs, the separate TSS and wet-weight data are used to normalize results of analyses conducted on wet sediment, from each fraction.

8.1.2.2 Recommended Sampling Procedures

Major factors considered in the development of sampling procedures for the specified hydrophobic pesticides included:

- the ability to obtain flow-weighted stormwater samples,
- collect the necessary volumes of stormwater to assure that sufficient sediment is available to meet analytical requirements inclusive of QA/QC,
- sampling equipment is comprised of materials that are both non-contaminating and resistant to both adsorption or desorption of organic materials,
- suitable for direct quantification of solids,

Water samples will be collected using automated stormwater sampling equipment capable of obtaining flow-weighted composite samples. The efficiency of autosamplers is known to decline once particle sizes start to exceed 250 μm (Clark, 2009) but ability to obtain large numbers of samples over the duration of a storm event is a significant benefit. Although USGS normally prefers use of isokinetic samplers for obtaining representative samples of suspended solids, they also recognize that this sampling method is often not practical. Mauler et al. (2006) compared suspended sediment concentrations collected using a fixed point autosampler with samples obtained using isokinetic samplers and concluded that differences were not significant for the Barton Creek site.

Equipment selected to monitor flow will be based upon specific characteristics of each selected sites. Unless suitable rating curves exist for the selected site, it is likely that an Area Velocity Bubbler (AVB) will be used to estimate open channel flows. An autosampler equipped with a peristaltic pump will be used to collect water samples. The intake hose will consist of pre-cleaned FEP (Teflon) hose fitted with stainless steel strainer and secured to the bottom of the channel. The autosampler will use a minimal length of peristaltic hose to connect to the FEP intake hose and pass it through the peristaltic pump. Another length of FEP hose will be connected to the peristaltic hose and directed into the sampling container.

Sample volumes will depend largely on the concentrations of sediment in the discharges and storm volumes. The filtrations should be performed using 0.45 μm PTFE membrane filters. These can be either 143 mm or 250 mm in diameter. Initial settings will be based upon a target of 5 grams of suspended sediment to analyze all target analytes and maintain suitable reporting limits. One site will be set with an objective of obtaining 10 grams for duplicate sampling. The minimum sample mass will be 1.5 grams. Since these objectives are based upon dry weight, professional judgment will be needed to determine if adequate volumes are available. If sediment is limited, the laboratory should provide dry weight measurements to the Project Manager as soon as they become available to determine if the laboratory should proceed with the designated analyses or reconsider allocation of sediment for the required analyses.

The Los Cerritos Channel watershed has similar characteristics to the Machado Lake watershed in that it is highly urbanized and relatively small. EMCs for TSS have been measured for 54 storm events and resulted in a median EMC of 168 mg/L. The 10th and 90th percentile values were 66 and 364 mg/L, respectively. Assuming similar results at the Machado sites, a total of 60 liters of water will provide adequate quantities of sediment even with 10th percentile TSS values (approximately 4 grams). If TSS concentrations are near the median EMC for the Los Cerritos Channel, adequate sediment (approximately 10 grams) would be available for testing.

Standard 20-L borosilicate media bottles composite containers should be used to collect the stormwater samples. Alternatively, 32 gallon roughneck trash cans or other comparable plastic containers can be used with 33-gallon Teflon liners. A similar design was used by Mauler (2006) in Austin. Although this provides more than adequate capacity to collect the sample in a single container, the potential weight can be prohibitive. If Teflon liners are used, tie wraps should be used to secure the bag around the discharge hose. A short length of hose (approx. 4-5 inches) should be included to assure the bag is vented.

8.1.3 Clean Sample Collection Techniques

To prevent contamination of samples, clean metal sampling techniques using USEPA protocols outlined in USEPA Method 1669ⁱⁱ will be used throughout all phases of the sampling and laboratory work, including equipment preparation, sample collection, and sample handling, storage, and testing. All containers and test chambers will be acid-rinsed prior to use. Filled sample containers will be kept on ice until receipt at the laboratory.

The protocol for clean metal sampling, based on USEPA Method 1669, is summarized below:

- Samples are collected in rigorously pre-cleaned sample bottles with any tubing specially processed to clean sampling standards.
- At least two persons, wearing clean, powder-free nitrile or latex gloves at all times, are required on a sampling crew.
- One person, referred to as “dirty hands”, opens only the outer bag of all double-bagged sample bottles.
- The other person, referred to as “clean hands”, reaches into the outer bag, opens the inner bag and removes the clean sample bottle.
- Clean hands rinses the bottle at least two times by submerging the bottle, removing the bottle lid, filling the bottle approximately one-third full, replacing the bottle lid, gently shaking and then emptying the bottle. Clean hands then collects the sample by submerging the bottle, removing the lid, filling the bottle and replacing the bottle cap while the bottle is still submerged.
- After the sample is collected, the sample bottle is double-bagged in the opposite order from which it was removed from the same double-bagging.
- Clean, powder-free gloves are changed whenever something not known to be clean has been touched.
- The time of sample collection is recorded on the field log sheet.

8.2 FIELD MEASUREMENTS AND OBSERVATIONS

Field measurements (listed in **Table 8**) will be taken, and observations made and recorded, at each sampling site after a sample is collected. All field measurement results and field observations will be recorded on a field log. Field measurements will include dissolved oxygen, temperature, conductivity, pH, turbidity, and flow. Measurements (except for flow) will be collected at approximately mid-stream, mid-depth at the location of greatest flow (if feasible) with a multi-probe meter, or comparable instrument(s). For measurements of relatively deep

ⁱⁱ USEPA. April 1995. *Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels*. EPA 821-R-95-034.

flows, the sensors will be placed directly into the flow path. For measurements of shallow flows, water will be collected in a rinsed intermediate container prior to measurement.

Prior to each day of each sampling event, water quality meters will be calibrated using fresh calibration solutions. After each calibration, the sensor will be checked to verify the accuracy is within an acceptable range. Otherwise, this process will be repeated until the calibration is verified. The acceptable range of accuracy will be included on a calibration sheet included in the field log.

Continuous flow monitoring will be employed at each site (original special study sites plus County Island 2) using HOBOT meters, HOBOT meters continuously record time, temperature, and pressure data, which is then converted to water density and depth measurements. An additional set of HOBOT meters are used to monitor atmospheric pressure as the meters in the water are measuring the combined pressure of water and atmosphere.

Manual flow measurements will be taken at each site following water sample collection and the data from the HOBOT meters downloaded. The following section describes the field methods that will be used to measure flow rates. The method of flow rate measurement will be dependent on the depth/flow at the sampling site, as described below.

8.2.1 Velocity Meter Flow Measurements

During dry weather, in the open channel sites and some manholes the water is deep enough (>0.1-foot) to allow for use of a velocity meter. For these cases, velocity will be measured at approximately equal increments across the width of the flowing water using a velocity meter. A “flow pole” will be used to measure the water depth at each measurement point and to properly align the sensor so that the depth of each velocity measurement is $0.6 * \text{total depth}$ (for electromagnetic meters), which is representative of the average velocity, or on the bottom (for Doppler velocity meters). The distance between velocity measurements taken across the stream is dependent on the total width. No more than 10% of the flow will pass through any one cross section.

8.2.2 Shallow Sheet Flow Measurements

If the depth of flow does not allow for the measurement of flow with a velocity meter (<0.1 foot) a “float” will be used to measure the velocity of the flowing water. The width, depth, velocity, cross section, and corresponding flow rate will be estimated as follows:

Sheet flow width: The width (W) of the flowing water (not the entire part of the channel that is damp) is measured using a tape measure at the “top”, “middle”, and “bottom” of a marked-off distance – generally 10 feet (e.g., for a 10-foot marked-off section, W_{Top} is measured at 0-feet, W_{Mid} is measured at 5 feet, and W_{Bottom} is measured at 10 feet).

Sheet flow depth: The depth of the sheet flow is measured at the top, middle, and bottom of the marked-off distance. Specifically, the depth (D) of the sheet flow is measured at 25%, 50%, and 75% of the flowing width (e.g., $D_{50\%}^{Mid}$ is the depth of the water at middle of the section in the middle of the sheet flow) at each of width measurement locations. It is assumed that the depth at the edge of the sheet flow (i.e., at 0% and 100% of the flowing width) is zero.

Representative cross-section: Based on the collected depth and width measurements, the representative cross-sectional area across the marked-off sheet flow is approximated as follows:

Representative Cross Section =

$$\text{Average} \left\{ \left[\frac{W_{\text{Top}}}{4} \times \left(\frac{D_{25\%}^{\text{Top}}}{2} + \frac{(D_{50\%}^{\text{Top}} + D_{25\%}^{\text{Top}})}{2} + \frac{(D_{75\%}^{\text{Top}} + D_{50\%}^{\text{Top}})}{2} + \frac{D_{75\%}^{\text{Top}}}{2} \right) \right], \right. \\ \left. \left[\frac{W_{\text{Mid}}}{4} \times \left(\frac{D_{25\%}^{\text{Mid}}}{2} + \frac{(D_{50\%}^{\text{Mid}} + D_{25\%}^{\text{Mid}})}{2} + \frac{(D_{75\%}^{\text{Mid}} + D_{50\%}^{\text{Mid}})}{2} + \frac{D_{75\%}^{\text{Mid}}}{2} \right) \right], \right. \\ \left. \left[\frac{W_{\text{Bottom}}}{4} \times \left(\frac{D_{25\%}^{\text{Bottom}}}{2} + \frac{(D_{50\%}^{\text{Bottom}} + D_{25\%}^{\text{Bottom}})}{2} + \frac{(D_{75\%}^{\text{Bottom}} + D_{50\%}^{\text{Bottom}})}{2} + \frac{D_{75\%}^{\text{Bottom}}}{2} \right) \right] \right\}$$

Sheet flow velocity: Velocity is calculated based on the amount of time it took a float to travel the marked-off distance (typically 10-feet or more). Floats are normally pieces of leaves, litter, or floatables (suds, etc.). The time it takes the float to travel the marked-off distance is measured at least three times. Then average velocity is calculated as follows:

$$\text{Average Surface Velocity} = \frac{\text{Distance Marked off for Float Measurement}}{\text{Average Time for Float to Travel Marked off Distance}}$$

Flow Rate calculation: For sheet flows, based on the above measurements/estimates, the estimated flow rate, Q, is calculated by:

$$Q = f \times (\text{Representative Cross Section}) \times (\text{Average Surface Velocity})$$

The coefficient *f* is used to account for friction effects of the channel bottom. That is, the float travels on the water surface, which is the most rapidly-traveling portion of the water column. The average velocity, not the surface velocity, determines the flow rate, and thus *f* is used to “convert” surface velocity to average velocity. In general, the value of *f* typically ranges from 0.60 – 0.90. Based on flow rate measurements taken during the LA River Bacteria Source Identification Studyⁱⁱⁱ a value of 0.75 will be used for *f*.

8.2.3 Wet Weather Flow Determination

Toxics TMDL sampling takes place during wet weather and requires flow measurements to be taken during each event. Wet weather flow determination will depend on the monitoring sites selected due to the different measurement strategies that would be utilized for different site configurations including manholes, hard-bottomed open channels, and soft-bottomed open channels. Wet weather flow determination strategy will be developed in conjunction with site selection.

8.3 FIELD LOGS

In addition to field measurements, observations shall be made at each sampling station and noted on the field log form. Observations will include color, odor, floating materials, and foreign

ⁱⁱⁱ CREST. Los Angeles River Bacteria Source Identification Study: Final Report. November 2008.

matter. Field crews will keep a field log book for each sampling event. The field log book will contain a calibration log sheet, field log sheets for each site, and appropriate contact information. The following items will be recorded in the field log for each sampling event:

- Monitoring station location (Site ID);
- Date and time(s) of sample collection;
- Name(s) of sampling personnel;
- Sampling depth;
- Sample ID numbers and unique IDs for any replicate or blank samples;
- QC sample type (if appropriate);
- Requested analyses (specific parameters or method references);
- Sample type, (*i.e.*, grab);
- The results of any field measurements (*e.g.*, flow, temperature, dissolved oxygen, pH, conductivity, turbidity), and the time that field measurements were made;
- Qualitative descriptions of relevant water conditions (*e.g.*, water color, flow level, clarity) or weather (*e.g.*, wind, clouds) at the time of sample collection; and,
- A description of any unusual occurrences associated with the sampling event, particularly those that may affect sample or data quality.

8.4 CHAINS OF CUSTODY

Sample custody procedures provide a mechanism for documenting information related to sample collection and handling. Sample custody must be traceable from the time of sample collection until results are reported. A sample is considered under custody if:

- It is in actual possession.
- It is in view after in physical possession.
- It is placed in a secure area (accessible by or under the scrutiny of authorized personnel only after in possession).

A chain-of-custody (COC) form will be completed after sample collection and prior to sample shipment or release. The COC form, sample labels, and field documentation will be cross-checked to verify sample identification, type of analyses, number of containers, sample volume, preservatives, and type of containers. A complete COC form will accompany the transfer of samples to the analyzing laboratory.

8.5 SAMPLE HANDLING AND DELIVERY

The field crews will have custody of samples during each monitoring event. COC forms will accompany all samples during shipment or delivery to contract laboratories to identify the shipment contents. All water quality samples will be transported to the analytical laboratory by the field crew or by shipment. The original COC form will accompany the shipment, and a signed copy of the COC form will be sent, typically via fax, by the laboratory to the field crew to be retained in the project file.

While in the field, samples will be stored on ice in an insulated container, so that they will be kept at approximately 4°C. Samples must have lids securely tightened and must be placed on ice to maintain the temperature at approximately 4°C. The original COC form(s) will be bagged in re-sealable plastic bags and either taped to the outside of the cooler or to the inside lid. Samples

will be hand delivered or shipped to the laboratory according to Department of Transportation standards.

Coolers will be sealed with packing tape before shipping and must not leak. It is assumed that samples in tape-sealed ice chests are secure whether being transported by field staff vehicle, by common carrier, or by commercial package delivery. The laboratory's sample receiving department will examine the shipment of samples for correct documentation, proper preservation, and compliance with holding times.

Section 9. Quality Assurance/Quality Control

Quality assurance and quality control (QA/QC) measures are built into the Study to assure data will be credible. Data quality objectives are listed in **Table 16**.

9.1 FIELD QA/QC

Field QA/QC for this project includes the following:

- Equipment Blanks
- Field Blanks
- Field Duplicates
- Proper collection, handling, and preservation of samples
- Maintenance of a field log

9.1.1 Equipment Blanks

The purpose of analyzing equipment blanks is to demonstrate that sampling equipment is free from contamination. Equipment blanks will be collected by the analytical laboratory responsible for cleaning equipment, before sending cleaned equipment back to the field crew for use. Equipment blanks will consist of laboratory-prepared blank water (certified to be contaminant-free by the laboratory) processed through the sampling equipment that will be used to collect environmental samples.

It is unlikely that equipment blanks will be required for this monitoring program. However, if collected, the blanks will be analyzed using the same analytical methods specified for environmental samples. If any analytes of interest are detected at levels greater than the MDL, the source(s) of contamination will be identified and eliminated (if possible), the affected batch of equipment will be re-cleaned, and new equipment blanks will be prepared and analyzed before the equipment is returned to the field crew for use.

9.1.2 Field Blanks

The use of field blanks is intended to test whether contamination is introduced from sample collection and handling, sample processing, analytical procedures, or the sample containers. The field crew will use blank water provided by the laboratory to generate field blanks by pouring blank water directly into the appropriate sample containers. Field blanks will be identified with a unique Site ID prior to each monitoring event and submitted “blind” to the laboratory. If any analytes of interest are detected at levels greater than the MDL, the source(s) of contamination will be identified and eliminated, if possible. The sampling crew will be notified so that the source of contamination can be identified (if possible) and corrective measures implemented prior to the next sampling event. Field blanks will be collected for all constituents in water samples. If no contamination is detected for conventional constituents repeatedly following multiple events, field blanks may be discontinued for these constituents. Field blanks will not be collected for sediment samples.

9.1.3 Field Duplicates

The purpose of analyzing field duplicates is to demonstrate the precision of sampling and analytical processes. Field duplicates will be analyzed along with the associated environmental samples. Field duplicates will consist of two aliquots from the same grab sample.

9.2 LABORATORY QA/QC

Laboratory QA/QC for this project includes the following:

- Use of the lowest available method detection limits (MDLs) for trace elements.
- Analysis of method blanks and laboratory duplicates.
- Use of matrix spikes (to test analytical accuracy) and matrix spike duplicates (to test analytical precision) (MS/MSD).
- Routine analysis of standard reference materials (SRMs) and method blanks.

9.2.1 Method Blanks

The purpose of analyzing method blanks is to demonstrate that sample preparation and analytical procedures do not result in sample contamination. Method blanks will be prepared and analyzed by the contract laboratory at a rate of at least one for each analytical batch. Method blanks will consist of laboratory-prepared blank water processed along with the batch of environmental samples. If the result for a single method blank is greater than the MDL, the source(s) of contamination should be corrected, and the associated samples should be reanalyzed.

9.2.2 Laboratory Duplicates

The purpose of analyzing laboratory duplicates is to demonstrate the precision of the sample preparation and analytical methods. Laboratory duplicates will be analyzed at the rate of one pair per sample batch. If the Relative Percent Difference (RPD) for any analyte is greater than 25% and the absolute difference between duplicates is greater than the RL, the analytical process is not being performed adequately for that analyte. In this case, the sample batch should be prepared again, and laboratory duplicates should be reanalyzed. Since the quantity of suspended solids is likely to be limited, reanalysis may not be an option. This will need to be separately assessed based upon available sediment in each sample.

9.2.3 Matrix Spikes and Matrix Spike Duplicates

The purpose of analyzing matrix spikes and matrix spike duplicates is to demonstrate the performance of the sample preparation and analytical methods in a particular sample matrix. Double or triple the sample volume will be necessary for each set of MS/MSD samples. MS/MSD samples will be analyzed for OC pesticides and PCBs and metals samples. If sufficient sediment is not available to run both MS and MSD samples, analyses may be limited to a single matrix spike to assess potential matrix impacts on the analyses and utilize either laboratory duplicates or blank spike/spike duplicates to assess precision.

9.2.4 Laboratory Control Samples

The purpose of analyzing laboratory control samples (or a standard reference material) is to demonstrate the accuracy of the sample preparation and analytical methods. Laboratory control samples will be analyzed at the rate of one per sample batch. Laboratory control samples will

consist of laboratory fortified method blanks or a standard reference material. If recovery of any analyte is outside the acceptable range, the analytical process is not being performed adequately for that analyte. In this case, the sample batch should be prepared again, and the laboratory control sample should be reanalyzed.

Table 16: Data Quality Objectives

Parameter	Accuracy	Precision	Recovery	Target Reporting Limits
Field Analyses - Water				
pH	± 0.2 pH units	± 0.5 pH units	NA	NA
Temperature	± 0.5 °C	± 5%	NA	NA
Dissolved Oxygen	± 0.5 mg/L	± 5%	NA	0.5 mg/L
Turbidity	± 10%	± 10%	NA	0.2 NTU
Conductivity	± 5%	± 5%	NA	2.5 umhos/cm
Laboratory Analyses – Water				
Total Suspended Solids (TSS)	80-120%	25%	80-120%	1 mg/L
Total Dissolved Solids (TDS)	80-120%	25%	80-120%	10 mg/L
Total Kjeldahl Nitrogen	80-120%	25%	80-120%	0.3 mg/L
Ammonia-Nitrogen	80-120%	25%	80-120%	0.1 mg/L
Nitrate-Nitrogen	80-120%	25%	80-120%	0.1 mg/L
Nitrite-Nitrogen	80-120%	25%	80-120%	0.1 mg/L
Total Phosphorus	80-120%	25%	80-120%	0.01 mg/L
Dissolved Phosphorus	80-120%	25%	80-120%	0.01 mg/L
Total Orthophosphate	80-120%	25%	80-120%	0.03 mg/L
Total and Dissolved Copper	45-150%	0-30%	45-150%	0.8 µg/L
Total and Dissolved Lead	45-150%	0-30%	45-150%	0.5 µg/L
Hardness	70-130%	0-30%	70-130%	10 mg/L
<i>E. coli</i>	70-130%	0-30%	70-130%	2 MPN
Laboratory Analyses – Sediment				
Organochlorine Pesticides	25 – 145%	0 – 30%	25 – 145%	0.1-0.5 ng/g dry weight
PCBs	60 – 135%	0 – 30%	60 – 135%	5-20 ¹ ng/g dry weight
TOC	80-120%	25%	80-120%	0.05% dry weight

1. Target RL for aroclors is 20 ng/g and target RLs for congeners is 5 ng/g.

9.3 QUALITY CONTROL SAMPLE COLLECTION SCHEDULE

The QC sample collection schedule for the first year of MRP sampling is presented in **Table 17**. The QC schedule is intended to provide general guidance on the timing of QC sample collection. Due to the nature of environmental sampling, it may not be possible to collect all QC samples as outlined in the schedule. Therefore, the schedule is flexible and may be modified to meet in-field

conditions and sampling schedule requirements. Deviations from this schedule will be recorded on the field log sheet. A field blank, field duplicate, and matrix spike and matrix spike duplicate will be conducted during every event. QC sample collection for subsequent years will follow a similar pattern outlined in **Table 17**.

Table 17: QA/QC Sample Schedule

Sample Event Type and Number	Sample Site		
	1O_ACAD	2O_SCBG	3O_VAND
Dry Weather 1	FB, FD, MS/MSD		
Dry Weather 2			FB, FD, MS/MSD
Dry Weather 3	FB, FD, MS/MSD		
Dry Weather 4			FB, FD, MS/MSD
Dry Weather 5	FB, FD, MS/MSD		
Dry Weather 6			FB, FD, MS/MSD
Wet Weather 1	FB, FD, MS/MSD		
Wet Weather 2		FB, FD, MS/MSD	
Wet Weather 3			FB, FD, MS/MSD

FB = Field Blank, FD = Field Duplicate, MS/MSD = Matrix Spike/Matrix Spike Duplicate

9.5 MANAGEMENT OF DATA

The County utilizes the Integrated Water Quality Database System (IWQDBS), an Oracle® database developed to support the Department’s water quality monitoring, analysis, and reporting activities. The system is accessed via interfaces running on web browsers (i.e. Internet Explorer).

The IWQDBS is set up in six different modules to assist the user with several tasks including:

- Sampling event preparation (creating and printing sampling bottle labels, chain of custody forms, etc.).
- Capturing field observation data (site and sampling event conditions, field parameters such as water temperature, etc.).
- Storing and analyzing water quality data.
- Preparing customized water quality data reports, executing of water quality queries including on-the-fly water quality results comparison with established water quality standards (i.e. Basin Plan, Ocean Plan, and California Toxics Rule)

- Exporting water quality data using the Standardized Data Exchange Format (SDEF) developed by the Stormwater Monitoring Coalition (SMC). Exported files are created in MS Excel. Alternatively, the user may export data using additional templates.
- Using Geographic Information Systems (GIS) to facilitate spatial analysis and direct query to the database.
- Accounting System to facilitate laboratory invoicing reconciliation.

The IWQDBS uses usernames and passwords to grant different levels of access to the user.

Data can be entered either manually (field observation data and specific event information) or it can be uploaded using tab delimited files following specific formats.

9.5.1 Data Review

The data review process begins with the preparation of the data for upload to the IWQDBS. Formatting the data for upload allows checks on data completeness and gross errors. Once uploaded and internal to the IWQDBS, there are checks between required samples for each site and event against the data received by the County.

9.5.2 Data Validation

The IWQDBS is used to cross validate the sample results to the corresponding QA/QC information.

Section 10. References

- 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.
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- 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.
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- McCarty, Harry B., Judy Schofield, Ken Miller, Robert N. Brent, Patricia Van Hoof, and Brian 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.
- 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 County Lakes. Institute of the Environment, UCLA. Report to Los Angeles Regional Water Quality Control Board, March 15, 2009.
- 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: Sampling Site Photographs



Figure A-1: Site 10_ACAD viewed from above the manhole. Taken March 1, 2011 at 3:40 p.m.



**Figure A-2: Site 10_EAST viewed from above the manhole.
Taken on January 11, 2011 at 12:30 p.m.**



**Figure A-3: Site 3I_ASHB viewed from downstream looking upstream.
Taken on May 26, 2010 at 2:20 p.m.**



Figure A-4: Downstream of Site 3I_NORMP. Taken on March 1, 2011 at 11:30 a.m.



Figure A-5: Downstream of Site 30_VAND. Taken on January 11, 2011 at 10:15 a.m.



Figure A-6: Downstream of Site 30_VERSEP. Taken on November 4, 2010 at 12:00 p.m.



Figure A-7 - The South Coast Botanical Gardens Pond spillway, 20_SCBG, viewed from upstream looking downstream. Taken on September 28, 2010 at 1:15 p.m.