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

Submitted to:

California Regional Water Quality Control Board
Los Angeles Region
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Los Angeles, CA 90013-2343

Submitted by:

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SEPTEMBER 12, 2011

A. PROJECT MANAGEMENT

1. TITLE AND APPROVAL SHEETS

MACHADO LAKE NUTRIENT TMDL MONITORING PROGRAM QUALITY ASSURANCE PROJECT PLAN (QAPP)

Project Manager	Fred Gonzalez, Monitoring Programs Unit Head, Data Management Section	Date
Project QA Manager	Hoan Tang, Environmental Analysis Section Head	Date
Lab Manager	Thant Zin Win, Chief, Environmental Toxicology Laboratory, County of Los Angeles	Date
Lab QA Officer	Shaomeng Maggie Xuan, Senior Industrial Hygiene Chemist, Environmental Toxicology Laboratory, County of Los Angeles	Date
LARWQCB Project Manager	To be determined by LARWQCB	Date
LARWQCB QA Officer	To be determined by LARWQCB	Date

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ABBREVIATIONS

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

3. DISTRIBUTION LIST

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LARWQCB Project manager			
LARWQCB QA Officer			

4. PROJECT ORGANIZATION

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 a parallel effort, 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, 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 been measured in fish tissues for the last 25 years.

Both the Nutrient and Toxics TMDLs require the preparation of a Monitoring and Reporting Program (MRP). The mass-based nutrient waste load allocation (WLA) compliance alternative for the Nutrient TMDL, which the County is utilizing, requires that a MRP 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. Both the Nutrient and Toxics TMDL Basin Plan Amendments (BPAs) additionally require that all compliance monitoring be conducted in conjunction with a Regional Board approved Quality Assurance and Project Plan (QAPP).

The County is submitting the MRP and this QAPP to fulfill the requirements of the BPAs. Program responsibilities are as follows:

- Project Manager: Fred Gonzalez, PE
- Project Quality Assurance Manager: Hoan Tang
- Laboratory Project Manager: Thant Zin Win
- Laboratory Quality Assurance Officer: Maggie Xuan
- Sample Collection: Watershed Management Division, LA County Dept. of Public Works
- QAPP changes / updates: Project Manager. Changes to the QAPP may be made upon

concurrent approval of necessary changes by the Project Manager, Project Quality Assurance Manager and the Regional Board's Quality Assurance Officer. The Project Manager will be responsible for making the changes, submitting drafts for review, preparing a final copy, and submitting the final revision for signature and distribution.

This QAPP describes the quality assurance requirements for the adopted multipollutant MRP for the Unincorporated Areas of Los Angeles County within the Machado Lake Watershed developed to comply with the adopted Machado Lake TMDLs. It also describes information necessary to collect water quality data for additional listed constituents of concern in the Machado Lake watershed concurrently with the nutrient constituents. Any contractors selected to perform the sampling and laboratory analyses must meet the quality control criteria necessary to satisfy the data quality objectives of this program, including those for precision, accuracy, detection and reporting.

This QAPP is based on the State's Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Management Plan (Puckett 2002) and was prepared in accordance with the State Water Resources Control Board's SWAMP QAPP Template (SWRCB, 2004a) and the SWAMP QA Checklist (SWRCB, 2004b). A general organizational structure for the MRP is illustrated in **Figure 1.**

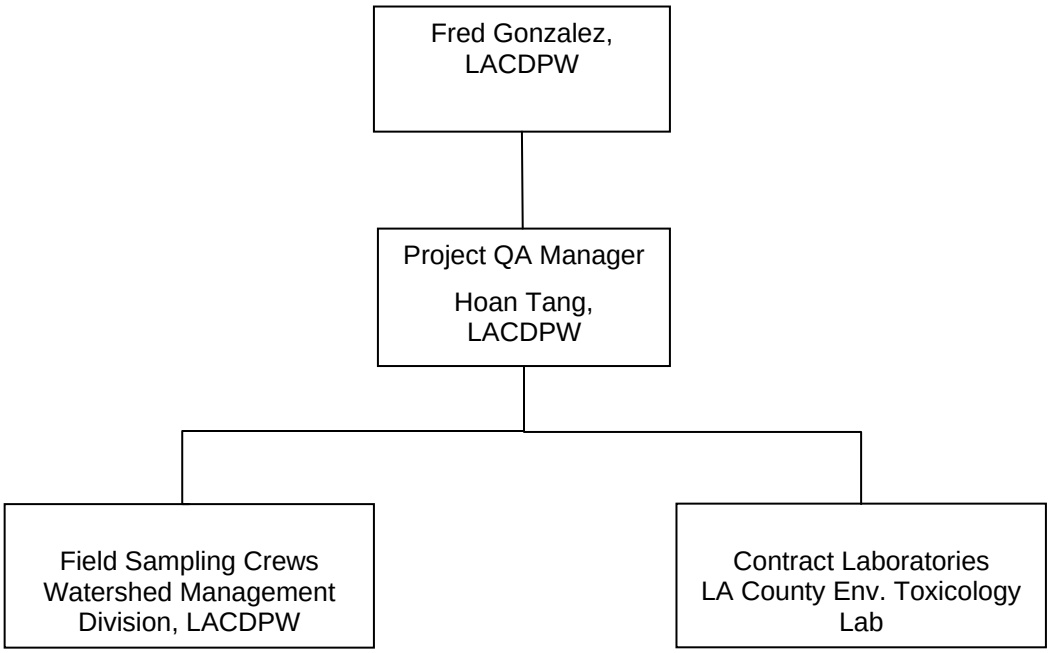

Figure 1: Machado Lake Nutrient TMDL MRP Management Structure

5. PROBLEM DEFINITION/BACKGROUND

Machado Lake is located in the Dominguez Channel Watershed Management Area 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 Palo Verdes, Rolling Hills, Rolling Hills Estates, Palo Verde Estates, Torrance, Lomita, and Carson, and unincorporated areas of 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 2**. 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.

Machado Lake is impaired for nutrients, toxics, and 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. As described previously, TMDLs have been developed to address nutrients and toxics loadings to Machado Lake. The Trash TMDL went into effect on March 6, 2008 and the final associated tasks are to be completed by March 6, 2016[1]. The USEPA, in its most recent consultation with the Regional Board for consent decree TMDLs[2], concluded that the water body-pollutant combination is currently meeting water quality standards, and therefore EPA does not anticipate developing TMDLs for metals in Wilmington Drain. However, this waterbody-pollutant combination remains on California's EPA 303(d) list.

The BPA sets 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 Optional Special Study #3 on March 11, 2010. 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 hm^3(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. The following table presents both the interim and final WLAs based on this area (**Table 1**).

[1] http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/tmdl_list.shtml

[2] http://www.epa.gov/region9/water/tmdl/la-lakes/LaConsentDecreeTMDLsRevSched2.pdf

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

	WLAs	
Year after TMDL Effective Date	**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 and is summarized in **Table 2**.

Table 2: MS4 Permittees Toxics TMDL Waste Load Allocations

Pollutant	**WLA for Suspended Sediment Associated Contaminants (µg/kg 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

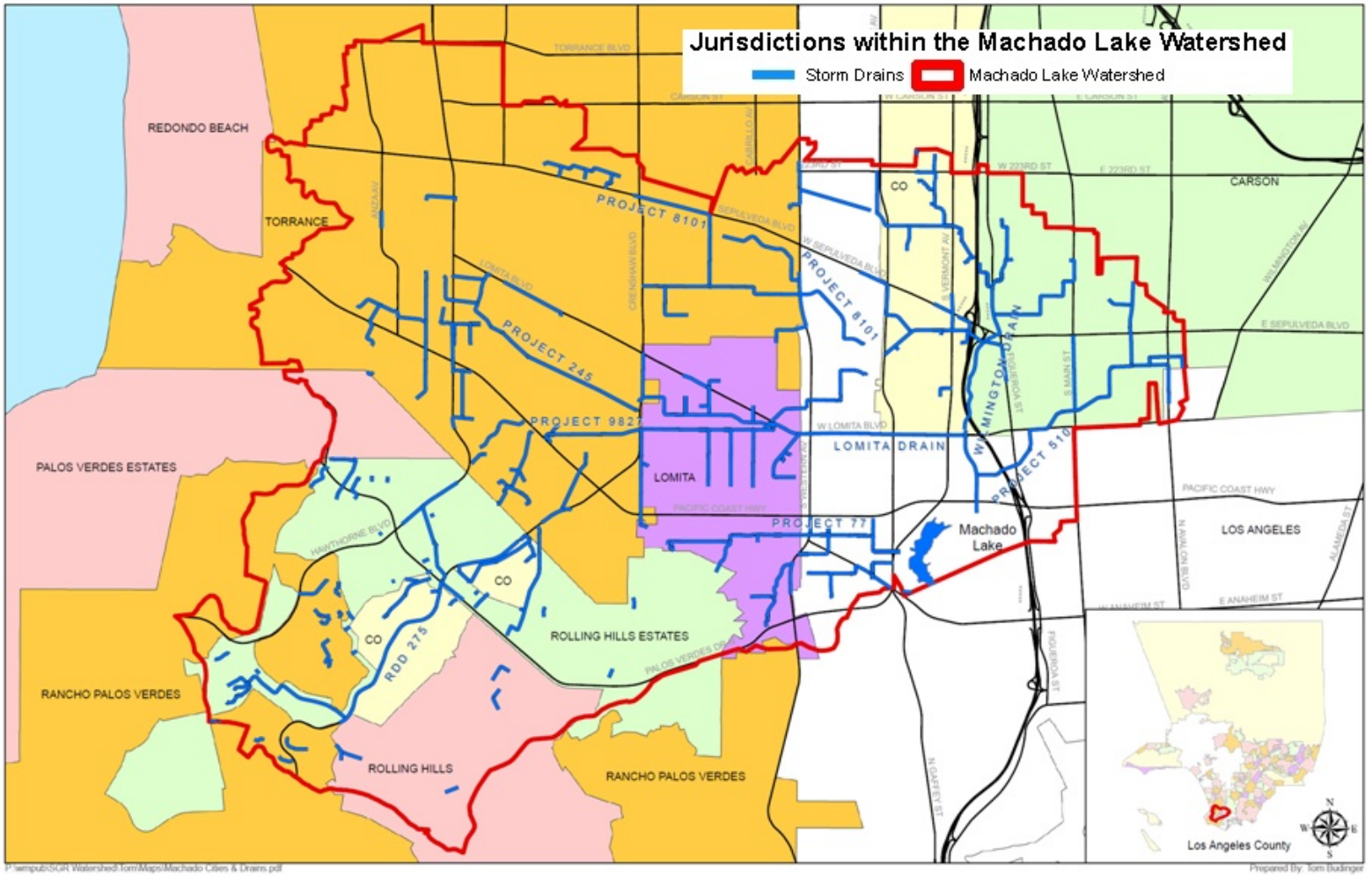

Figure 2: Machado Lake Watershed and Jurisdictions within the Watershed

Monitoring Program Objectives

Both the Nutrient and Toxics TMDLs require the preparation of a Monitoring and Reporting Program (MRP). For the mass-based nutrient WLA compliance alternative for the Nutrient TMDL, which the County is utilizing, the TMDL 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. Both the Nutrient and Toxics TMDL BPAs additionally require that all compliance monitoring be conducted in conjunction with a Regional Board approved QAPP. This document meets the requirements of the BPA related to a Regional Board approved QAPP.

The purpose of the MRP and supporting QAPP is to evaluate the progress of pollutant load reductions. The MRP addresses 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 has 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 Multipollutant TMDL MRP QAPP for the unincorporated County areas. The QAPP is consistent with the Multipollutant TMDL MRP and incorporates knowledge gained through the County's Special Study. The Special Study results were used to develop the nutrient monitoring approach, select monitoring sites and nutrient monitoring frequency, and identify nutrient sample collection techniques.

Water Quality or Regulatory Criteria

The BPAs for both the Nutrients and Toxics TMDLs provide the applicable criteria and concentration-based allocations. As discussed previously, the County is utilizing the mass-based nutrient WLA compliance alternative and was assigned concentration-based toxicity WLAs that are presented in **Table 1** and **Table 2**, respectively. Data collected through the monitoring program will be compared against the WLAs to evaluate compliance with the Machado Lake Nutrient and Toxics TMDLs.

There are no regulatory requirements to sample for copper, lead, and bacteria, however, they are monitored to further evaluate the constituents and the associated Wilmington Drain impairment listings.

6. PROJECT DESCRIPTION

The primary purpose of the QAPP is to outline the process for collecting data to meet the goals of the Machado Lake Multipollutant TMDL MRP.

Monitoring Elements

The following surface water monitoring elements are included in the Machado Lake Multipollutant TMDL MRP;

- Conventional water quality constituents;
- Nitrogen and phosphorus compounds (nutrients).
- Organochlorine pesticides and PCB compounds (organics);
- Total and dissolved copper and lead compounds (metals)
- Bacterial water quality constituents.

The constituents for which samples will be analyzed for compliance with the Nutrient TMDL are listed in **Table 3**. The constituents for which samples will be analyzed for compliance with the Toxics TMDL are listed in **Table 4**. The additional constituents which will also be analyzed under the MRP are listed in **Table 5**. Various field parameters will also be measured during each event and these are shown in **Table 6**.

Furthermore, the monitoring sites are described in Section 10 Sampling Process Design. The sampling and analytical methods are summarized in Section 11 and Section 13 respectively.

Table 3: Nutrient TMDL Constituents

Constituent Class	Constituent
Conventional	Total Suspended Solids (TSS)
	Total Dissolved Solids (TDS)
Nutrient	Total Kjeldahl Nitrogen (TKN)
	Nitrate as Nitrogen (NO3-N)
	Nitrite as Nitrogen (NO2-N)
	Total Nitrogen[1]
	Ammonia as Nitrogen (NH3-N)
	Total Phosphorous
	Dissolved Phosphorous
	Total Ortho-phosphate (PO4)

1. Total Nitrogen is the sum of TKN, NO3-N, and NO2-N.

Table 4: Toxics TMDL Constituents

Constituent Class	Constituent
Conventional (collected in water)	Total Suspended Solids (TSS)
Organochlorine Pesticides (collected as suspended sediment)	Chlordane Compounds: Heptachlor Heptachlor Epoxide gamma-Chlordane alpha-Chlordane Oxychlordane trans-Nonachlor cis-Nonachlor Other Organochlorine Pesticides: 2,4'-DDD 2,4'-DDE 2,4'-DDT 4,4'-DDD 4,4'-DDE 4,4'-DDT Total DDT Dieldrin

Table 5: Additional Constituents

Constituent Class	Constituent
Conventional	Hardness
Metals	Total Copper
	Dissolved Copper
	Total Lead
	Dissolved Lead
Bacteria	*E. coli*

Table 6: Field Measured Constituents

Constituent Class	Constituent
Physical	Velocity/Flow[1]
Conventional	pH
	Temperature
	Dissolved oxygen
	Turbidity
	Conductivity

1. 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.

Project Schedule

The Effective Date of the Nutrient TMDL is March 11, 2009. Per the BPA, point source dischargers utilizing mass-based WLAs must submit an MRP to the Regional Board within two and half years of the effective date of the TMDL (September 11, 2011). To date, no Effective Date has been established for the Toxics TMDL. For the Multipollutant MRP to remain in compliance, the project will follow the most conservative deadlines of the associated TMDLs, which are found in the Nutrient TMDL. the deliverables scheduled for the first year of monitoring is outlined in **Table 7**.

Table 7: Year 1 Project Deliverable Schedule for the Multipollutant MRP

Deliverable	Date of Initiation	Date of Completion
MRP and QAPP	July 2010	September 11, 2011
Initiate Monitoring	60 days after EO Approval of MRP	Not Applicable
1st Annual Report	Not Applicable	6 Months from sampling event corresponding to completion of one year of monitoring

7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The objective of the monitoring program, in terms of data quality is to produce data that represent as closely as possible, *in situ* conditions of waterbodies from which samples are collected. This objective will be achieved by using accepted, standard methods for sample collection and laboratory analysis. Assessing the program's ability to meet this objective will be accomplished by evaluating the resulting laboratory measurements in terms of detection limits, precision, accuracy, representativeness, comparability, and completeness, as discussed in Section 14. Quality Control).

Table 8 lists data quality objectives for the constituents that will be measured through this monitoring program.

Table 8: Data Quality Objectives (Replicating MRP)

Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Field Measurements					
Water Velocity (for Flow calc.)	± 2%	NA	NA	0.05 ft/sec	See Section 14
pH	± 0.2 pH units	± 0.5 pH units	NA	NA	See Section 14
Temperature	± 0.5 ºC	± 5%	NA	NA	See Section 14
Dissolved Oxygen	± 5 mg/L	± 5%	NA	0.5 mg/L	See Section 14
Turbidity	± 10%	± 10%	NA	0.2 NTU	See Section 14
Conductivity	± 5%	± 5%	NA	2.5 µmhos/cm	See Section 14
Laboratory Analyses					
Total Suspended Solids (TSS)	80-120%	25%	80-120%	1 mg/L	See Section 14
Total Dissolved Solids (TDS)	80-120%	25%	80-120%	10 mg/L	See Section 14
Ammonia-Nitrogen	80-120%	25%	80-120%	0.1 mg/L	See Section 14
Nitrate-Nitrogen	80-120%	25%	80-120%	0.1 mg/L	See Section 14
Nitrite-Nitrogen	80-120%	25%	80-120%	0.1 mg/L	See Section 14
Total Kjeldahl Nitrogen	80-120%	25%	80-120%	0.3 mg/L	See Section 14
Total Phosphorous	80-120%	25%	80-120%	0.01 mg/L	See Section 14
Dissolved Phosphorous	80-120%	25%	80-120%	0.01 mg/L	See Section 14
Total Ortho-phosphate	80-120%	25%	80-120%	0.03 mg/L	See Section 14
Total and Dissolved Copper	45-150%	0-30%	45-150%	0.8 µg/L	See Section 14
Total and Dissolved Lead	45-150%	0-30%	45-150%	0.5 µg/L	See Section 14
Hardness	70-130%	0-30%	70-130%	10 mg/L	See Section 14
E. coli	70-130%	0-30%	70-130%	2 MPN	See Section 14
Organochlorine Pesticides	25 – 145%	0 – 30%	25 – 145%	TBD	See Section 14
PCBs	60 – 135%	0 – 30%	60 – 135%	TBD	See Section 14
TOC	TBD	TBD	TBD	TBD	See Section 14

NA: Not Applicable

8. TRAINING AND CERTIFICATION

No specialized training or certifications are required for sampling personnel. However, staff performing field sampling should receive annual refresher training to ensure the samples are collected correctly and safely. The Project Manager, or designee, will provide training prior to initiation of sampling and will document training of staff. Documentation will consist of a sign in sheet, time and date, and instructor. The documentation will be maintained in the project files of the Project Manager. All sampling shall be performed under the supervision of experienced staff. No volunteers will be used for sampling.

At minimum, laboratories selected to perform analysis for this program must maintain current certification through the California Department of Health Services – Environmental Laboratory Accreditation Program (ELAP) or the National Environmental Laboratory Accreditation Program (NELAP).

9. DOCUMENTS AND RECORDS

Annual Monitoring Report

Per the Nutrient TMDL BPA, an Annual Monitoring Report must be prepared and submitted to the Regional Board annually from the date of the MRP approval. 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. The additional constituents 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

QAPP

The Project Manager is responsible for the development, distribution, and management of the QAPP.

Distribution and Management of Documents

The Project Manager is responsible for the development, distribution, and management of the approved QAPP, Annual Report (including the database), and other relevant documentation to all individuals listed Section 3. Distribution List of this document. All data will be stored by the Project Manager. Data will be maintained for the length of the program and available for review. A backup of each report will be placed on an external storage device (i.e., compact disc). Upon completion of the program, hard copy data will be retained for an additional five years.

B. DATA GENERATION AND ACQUISITION

Sample collection and analysis will be the most involved and resource intensive aspect of the monitoring program. The numerous requirements and considerations which must be taken into account are described below.

10. SAMPLING PROCESS DESIGN

The following Element provides a description and justification for the sampling design strategy and site selection. The primary drivers in designing the monitoring outlined in the QAPP is to:

1. Evaluate the progress of pollutant load reductions in meeting the interim and final mass-based WLAs; and
2. Collect data on additional constituents of concern for future compliance or implementation planning or actions.

The nutrient sampling process includes the sampling of each unincorporated County Island during the wet season and two of the three County Islands during the dry season over a four year monitoring effort[3]. Nutrient wet weather monitoring will continue until at least 10 wet weather samples are collected and when possible coincide with the toxic monitoring program. At the end of the fourth year of the five year monitoring period, the County will review the monitoring results to assess whether the proposed approach should be modified.

Toxics sampling consists of two phases of wet weather monitoring designed to collect suspended solids such that there are sufficient volumes (approximately 60 L of sample) available for the analysis of pollutants associated with the sediments. Phase 1 monitoring will be conducted for a two year period. Samples shall be collected during three wet weather events each year, 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 other year during Phase 2 monitoring through five years.

Metals and bacteria samples will be collected in conjunction with Nutrient and Toxics TMDL sampling through the first four years of monitoring. Flow measurements will continue to be taken at all of the special study discharge sites and County Island 2 (seven total) and throughout the year.

Sampling Sites

Monitoring sites were selected based on the results of the Special Study. As mentioned above, no sites from the Special Study were identified as contributing a unique distribution of concentrations that significantly deviates from the watershed-wide distribution. Therefore, all monitoring sites are assumed to adequately characterize and document pollutant concentrations in water and suspended sediment from the unincorporated County Islands. Sites which were the

[3] 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).

most representative of flows from each of the three County Islands were selected, with additional consideration given to safety and access at the sites.

1O_ACAD was selected to represent loads from unincorporated County Island 1 as the Special Study observed dry weather flows from the site were more consistent and significant than flows at its companion site 1O_EAST. The 1O_ACAD site is a storm drain manhole near the base of the County Island, and drains flows from a residential areas and schoolyard.

2O_SCBG (South Coast Botanical Garden) was selected to represent wet weather loads from unincorporated County Island 2. The Special Study found no dry weather flows originating 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. This site was considered to be the optimal location to measure wet weather flows from the County Island and is designated as Site 2O_SCBG.

3O_VAND was selected to represent loads from unincorporated County Island 3 as the Special Study observed that loadings from companion site 3O_VERSEP were predominantly from loadings external to the County Islands. The site is a concrete-lined channel which drains much of the northern portion of County Island 3, which includes various types of residential areas.

The site locations as well as the rationale for inclusion in the MRP are described in **Table 9**.

Table 9: Site Locations

Site ID	County Island	Type	Nearest Intersection	Latitude	Longitude	Rationale
1O_ACAD	1	Island Outlet	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	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	Van Deene Ave./228th 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.

Sampling Schedule

Dry weather nutrient sampling will occur quarterly at both dry weather monitoring sites. The dry weather sampling will produce sufficient data to adequately characterize and document the nutrient loads from the unincorporated County areas. No dry weather sampling will occur within County Island 2 as dry weather flows were not observed during the Special Study. Wet weather nutrient sampling will be collected during three wet weather events per year, including the first large storm of the season, at all three monitoring sites for four years or until a total of 10 storm

events are collected. Aliquots for nutrient analyses will be portioned from the wet weather samples prior to filtration.

Phase 1 Toxics 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 samples will be collected during one wet weather event every other year.

Metals and bacteria samples will be collected at every event required by the Nutrient and Toxics sampling frequency protocols through the first four years of monitoring. Flow measurements will be collected year round at all sites.

A summary of the proposed MRP monitoring program, including frequency, location, and monitored parameters, is shown in **Table 10**. As noted previously the proposed monitoring effort is for a five year period at which time the County will review the monitoring results to assess whether modifications should be made. Nutrients, metals, and bacteria are sampled only during the first four years of the monitoring program.

Table 10: Summary of Multipollutant TMDL MRP Monitoring Events

		Year 1		Year 2		Year 3		Year 4		Year 5(1)	
Site ID	Constituents	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.

Classification of Measurements

Because the MRP is intended to be a long term monitoring program and several constituents intend to provide "non-TMDL" related data, data that are not successfully collected for a specific monitoring event will not be collected at a later date. Rather, subsequent events conducted over the course of the program will provide a data set of sufficient size to appropriately characterize conditions at individual sampling sites. Moreover, some monitoring sites will often be dry during the dry season, which is relevant information, identifying areas where discharge is not

occurring. For these reasons, most of the data planned for collection cannot be considered absolutely critical. All information collected as outlined in the QAPP will be reported.

Validation of Non-Standard Methods

For non-standard sampling and analytical methods or other unusual situations, appropriate method validation study information will be documented to confirm the performance of the method for the particular need. The purpose of this validation is to assess the potential impact on the representativeness of the data generated. Such validation studies may include the initial demonstration of capability, split samples sent to another laboratory for analysis by a standard method, or round-robin studies performed by USEPA or other organizations. If previous validation studies are not available, some level of validation study will be performed during the project and included as part of the project's final report.

11. SAMPLING METHODS

All samples will be collected in a manner appropriate for the specific analytical methods to be used. Proper sampling techniques must be used to ensure that samples are representative of environmental conditions. 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. Standard operating procedures (SOPs) for collection of samples are provided in Appendix B and summary descriptions are provided below.

Field Protocols

Briefly, the key aspects of quality control associated with sample collection for eventual chemical analyses are as follows:

- Field personnel will be thoroughly trained in the proper use of sample collection gear and will be able to distinguish acceptable versus unacceptable water samples in accordance with pre-established criteria;
- Field personnel will be thoroughly trained to recognize and avoid potential sources of sample contamination (*e.g.*, engine exhaust, ice used for cooling);
- Sampling gear and utensils which come in direct contact with the sample will be made of non-contaminating materials (*e.g.*, borosilicate glass, high-quality stainless steel and/or Teflon™, according to protocol) and will be thoroughly cleaned between sampling stations according to appropriate cleaning protocol (rinsing thoroughly with laboratory reagent water at minimum);
- 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.

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.

Field crews (2 persons per crew, minimum; 3 persons per crew 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. Record relevant data on the chain of custody forms using the field log sheets.
7. Repeat the procedures in steps 3, 4, 5, and 6 for each of the remaining monitoring sites.
8. After sample collection is completed at all monitoring sites or if the sample hold time requires it, deliver and/or ship samples to the appropriate laboratory.

Water Sample Collection

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. 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.

It is the combined responsibility of all members of the sampling crew to determine if the performance requirements of the specific sampling method have been met, and to collect additional samples if required. If the performance requirements outlined above or documented in sampling protocols are not met, the sample will be re-collected. If contamination of the sample container is suspected, a fresh sample container will be used. The Project Manager will be contacted if at any time the sampling crew has questions about procedures or issues based on site-specific conditions.

Dry Weather Sample Collection

Grab samples will be collected at approximately mid-stream, 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, especially during wet events. 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 11, Table 12, and Table 13**). Clean, powder-free nitrile gloves will be worn while collecting samples. In the event that a peristaltic pump and priority-cleaned silicone and Teflon™ tubing are used as a last resort to collect samples (*i.e.*, due to unsafe conditions during wet events), the sample collection tubing and the sample bottle and lid shall come into contact only with surfaces known to be clean, or with the water sample. Standard operating procedures (SOPs) for collection of surface water samples are provided in Appendix A of this QAPP.

The potential exists for monitoring sites to lack discernable flow. The lack of discernable flow may generate unrepresentative data as standing puddles will not appropriately characterize discharges. To address the potential confounding interference that can occur under such conditions, sites monitored under the guidance of this QAPP 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 site visit), and the site condition should be photo-documented.
- Flowing water (*i.e.*, determined by visual observations, flow meter data, and a photo-documented assessment of conditions immediately upstream and downstream of the sampling site) should be sampled.

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 to fill sample bottles.

It is considered very important to <u>not</u> 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.

Wet Weather Sample Collection

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.

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; however, similar studies have found 60 L of sample necessary to collect sufficient mass of solids. Provisionally, the sample volume for the Machado Lake MRP is set to 60 L, and is to be adjusted as necessary to ensure the desired solids are collected. 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.

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.

Clean Sample Collection Techniques

To prevent contamination of samples, clean sampling techniques using USEPA protocols outlined in USEPA Method 1669[4] will be used throughout all phases of the sampling and laboratory work for all metal constituents, 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.

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

Quality Control Sample Collection

Quality Control (QC) samples will be collected in conjunction with environmental samples to verify data quality. QC samples collected in the field include field blanks and field duplicates. The frequency of QC sample collection is presented in Section 14. Quality Control.

Field Measurements and Observations

Field measurements (listed in **Table 6**) will be taken, and observations made, at each sampling site after a sample is collected. All field measurement results and field observations will be recorded in 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 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 HOBO meters. HOBO meters continuously record time, temperature, and pressure data, which is then converted to density and depth measurements. Manual flow measurements will be taken at each site following water sample collection and the data for the HOBO 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.

Velocity Meter Flow Measurements

During dry weather, in 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 * 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.

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:

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

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:

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

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

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

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 Study (CREST 2008) a value of 0.75 will be used for *f*.

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. This section will be developed to include determination of flow during wet weather for determination of loads. It is likely that wet weather flows will be determined utilizing modeled flows (e.g. the County BMPDSS model) or nearby stream gages.

12. SAMPLE HANDLING AND CUSTODY

Documentation Procedures

The Project Manager is responsible for ensuring that each field sampling team adheres to proper custody and documentation procedures. Field log sheets documenting sample collection and other monitoring activities for each site will be bound in a separate master logbook for each event. Field personnel have the following responsibilities:

- Keep an accurate written record of sample collection activities on the field log sheets.
- Ensure that all field log sheet entries are legible and contain accurate and inclusive documentation of all field activities.
- Note errors or changes using a single line to cross out the entry and date and initial the change.
- Ensure that a label is affixed to each sample collected and that the labels uniquely identify samples with a sample ID, site ID, date and time of sample collection and the sampling crew initials.
- Complete the chain of custody forms accurately and legibly.

Field Documentation/Field Logs

Field crews will keep a field log book for each sampling event. The Nutrient TMDL, Toxics TMDL, and supplemental sample field logs may be combined or left as separate books. The field log books will contain a calibration log sheet, a field log sheet for each site, and appropriate contact information. The following items should be recorded on the field log sheet 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.

Container Labeling and Sample Identification Scheme

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. The format for sample ID codes is *MLMRP - ###.# - AAAA - XXX*, where:

- *MLMRP* indicates the sample was collected as part of the Machado Lake MRP.
- *###.#* identifies the sequentially numbered sample event and .# is an optional indicator for resamples collected for the same event. Sample events are numbered starting from 001 and will not be repeated.
- *AAAA* indicates the unique site identification code assigned to each site described in Section 10. Sampling Process Design - Sampling Sites)
- XXX identifies the sample number unique to a sample bottle collected for a single event. Sample bottles are numbered sequentially from 001 to 999 and will not be repeated within a single event. This numbering sequence will reset to 001 for each event.

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 include the following information:

- Program Name
- Station ID
- Sample ID
- Date
- Collection Time
- Sampling Personnel
- Analytical Requirements
- Preservative Requirements
- Analytical Laboratory

Sample Containers, Storage, Preservation, and Holding Times

Sample containers must be pre-cleaned and certified free of contamination according to the USEPA specification for the appropriate methods. Sample container, required sample volume, storage and preservation, and holding time requirements are provided in **Table 11, Table 12, Table 13, and Table 14**. The analytical laboratories will supply sample containers that already contain preservative (also identified in **Table 11, Table 12, and Table 13**), including ultra pure acids, where applicable. After collection, samples will be stored at 4^{o}C until arrival at the contract laboratory.

Table 11: Nutrient TMDL Sample Container, Volume, Initial Preservation, and Holding Time Requirements

Parameter	Sample Container	Sample Volume[1]	Immediate Processing and Storage	Holding Time
Conventional				
Total Suspended Solids (TSS)	HDPE[2]	1L	Store at 4°C	7 days
Total Dissolved Solids (TDS)		500 mL		
Nutrient				
Total Kjeldahl Nitrogen (TKN)	HDPE	500 mL	H2SO4; Store at 4°C	28 days
Ammonia as Nitrogen (NH3-N)				
Total Phosphorous				
Nitrate as Nitrogen (NO3-N)		500 mL	Store at 4°C	48 hours
Nitrite as Nitrogen (NO2-N)				
Dissolved Phosphorous				
Total Ortho-phosphate (PO4)				

1 Additional sample volume may be required for quality control analyses.
2 HDPE = High Density Polyethelyne

Table 12: Toxics TMDL Sample Container, Volume, Initial Preservation, and Holding Time Requirements

Constituent	Sample Container and Volume[1]	Immediate Processing And Storage	Holding Time
Total Suspended Solids (TSS)	1L 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_2SO_4	28 days
Ammonia as Nitrogen (NH_3-N)			
Total Phosphorus			

[1] Additional volume may be required for QC analyses.

Table 13: Additional Constituents Sample Container, Volume, Initial Preservation, and Holding Time 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 14: 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		4° C	48 hours / 6 months[2]
	Total and Dissolved Lead			
Bacteria	*E. coli*	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.

Sample Handling and Shipment

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^{o}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.

The following procedures are used to prevent bottle breakage and cross-contamination:

- Bubble wrap or foam pouches are used to keep glass bottles from contacting one another to prevent breakage.
- All samples are transported inside hard plastic coolers or other contamination-free shipping containers.
- The coolers are taped shut to prevent accidental opening.
- Arrangements must be made in advance to notify the laboratory's sample receiving department prior to sample shipment.

All samples remaining after successful completion of analyses will be disposed of properly. It is the responsibility of each analytical laboratory to ensure that all applicable regulations are followed in the disposal of samples or related chemicals.

Chain-of-Custody Form

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. A typical COC form is illustrated in Appendix C

Laboratory Custody Procedures

Contract laboratories will follow sample custody procedures as outlined in the laboratory's Quality Assurance (QA) Manual. A copy of each contract laboratory's QA Manual is retained in the project file. Laboratories shall maintain custody logs sufficient to track each sample submitted and to analyze or preserve each sample within specified holding times. The following sample control activities must be conducted at the laboratory:

- Initial sample login and verification of samples received with the COC form;
- Document any discrepancies noted during login on the COC;
- Initiate internal laboratory custody procedures;
- Verify sample preservation (*e.g.*, temperature);

- Notify the Project Manager if any problems or discrepancies are identified; and
- Perform proper sample storage protocols, including daily refrigerator temperature monitoring and sample security.

Laboratories shall maintain records to document that the above procedures are followed. Once samples have been analyzed, samples will be stored at the laboratory for at least 30 days. After this period, samples may be disposed of properly.

13. ANALYTICAL METHODS

Table 15 lists the constituents for which samples will be analyzed, analytical methods, project method detection limits and project reporting limits for each constituent under the Nutrient TMDL. **Table 16** lists the constituents for which samples will be analyzed, analytical methods, project method detection limits and project reporting limits for each constituent under the Toxics TMDL, with **Table 17** describing the specific project related limits for individual Organochlorine pesticides.

Table 18 lists the additional constituents for which samples will be analyzed, 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 19** during each event.

Table 15: Nutrient TMDL Constituents, Analytical Methods, and Quantification 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)	EPA 351.1	0.455	0.50
	Nitrate as Nitrogen (NO3-N)	EPA 300.0	0.01	0.10
	Nitrite as Nitrogen (NO2-N)	EPA 300.0	0.01	0.05
	Total Nitrogen[1]	calculation	NA	NA
	Ammonia as Nitrogen (NH3-N)	EPA 350.1	0.01	0.10
	Total Phosphorous	SM 4500-P E or F	0.02	0.1
	Dissolved Phosphorous	SM 4500-P E or F	0.02	0.1
	Total Ortho-phosphate (PO4)	SM 4500-P E or F	0.001	0.01

1. Total Nitrogen is the sum of TKN, NO3-N, and NO2-N.

Table 16: Toxics TMDL Constituents, Analytical Methods, and Quantification 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)	1 ng/dry g	5 ng/ dry g
	Total PCBs[2]		10 ng/dry g	20 ng/dry g
	Total Organic Carbon (TOC)	Dry combustion/IR detection		0.1%-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 17: Organochlorine Pesticides

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 18: Additional Constituents, Analytical Methods, and Quantification 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	*E. coli*	IDEXX Colilert	10 MPN/100 mL	10 MPN/100 mL

Table 19: 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 ^oC	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
1. 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.

Detection and Reporting Limits

Method detection limits (MDL) and reporting limits (RLs) must be distinguished for proper understanding and data use. The MDL is the minimum analyte concentration that can be measured and reported with a 99% confidence that the concentration is greater than zero.

The RL represents the concentration of an analyte that can be routinely measured in the sampled matrix within stated limits and with confidence in both identification and quantification.

For this program, RLs must be verifiable by having the lowest non-zero calibration standard or calibration check sample concentration at or less than the RL. RLs have been established in this QAPP based on the verifiable levels and general measurement capabilities demonstrated for each method. These RLs should be considered as maximum allowable reporting limits to be used for laboratory data reporting. Note that samples diluted for analysis may have sample-specific RLs that exceed these RLs. This will be unavoidable on occasion. However, if samples are consistently diluted to overcome matrix interferences, the analytical laboratory will be required to notify the Project Manager how the sample preparation or test procedure in question will be modified to reduce matrix interferences so that project RLs can be met consistently.

Method Detection Limit Studies

Any laboratory performing analyses under this program must routinely conduct method detection limit (MDL) studies to document that the MDLs are less than or equal to the project-specified RLs. If any analytes have MDLs that do not meet the project RLs, the following steps must be taken:

- Perform a new MDL study using concentrations sufficient to prove analyte quantification at concentrations less than or equal to the project-specified RLs per the procedure for the Determination of the Method Detection Limit presented in Revision 1.1, 40 Code of Federal Regulations (CFR) 136, 1984.
- No samples may be analyzed until the issue has been resolved. MDL study results must be available for review during audits, data review, or as requested. Current MDL study results must be reported for review and inclusion in project files.

An MDL is developed from seven aliquots of a standard containing all analytes of interest spiked at five times the expected MDL. These aliquots are taken through the analytical method's sample processing steps. The data are then evaluated and used to calculate the MDL. If the calculated MDL is less than 0.33 times the spiked concentration, another MDL study should be performed using lower spiked concentrations.

Project Reporting Limits

Laboratories generally establish RLs that are reported with the analytical results—these may be called *reporting limits*, *detection limits*, *reporting detection limits*, or several other terms by the analyzing laboratory. These laboratory limits must be less than or equal to the project RLs listed in **Table 15, Table 16, Table 17, or Table 18**. Laboratories performing analyses for this project must have documentation to support quantification at the required levels.

Laboratory Standards and Reagents

All stock standards and reagents used for standard solutions and extractions must be tracked through the laboratory. The preparation and use of all working standards must be documented according to procedures outlined in each laboratory's Quality Assurance Manual; standards must be traceable according to U.S. EPA, A2LA or National Institute for Standards and Technology (NIST) criteria. Records must have sufficient detail to allow determination of the identity, concentration, and viability of the standards, including any dilutions performed to obtain the working standard. Date of preparation, analyte or mixture, concentration, name of preparer, lot or cylinder number, and expiration date, if applicable, must be recorded on each working standard.

Alternate Laboratories

In the event that the laboratories selected to perform analyses for Los Angeles County are unable to fulfill data quality requirements outlined herein (e.g., due to an instrument is malfunction), alternate laboratories will be selected based on their ability to meet ELAP and/or NELAP certification and data quality requirements specified in this QAPP. The original laboratory selected may recommend a qualified laboratory to act as a substitute. However, the final decision regarding alternate laboratory selection rests with the Project Manager and Project QA Manager.

14. QUALITY CONTROL

Quality control procedures for field and laboratory activities are summarized in **Table 20** and are discussed in more detail below. There are no SWAMP requirements for quality control for field analysis of general parameters (*i.e.*, flow, pH, temperature, dissolved oxygen, turbidity, and conductivity). However, field crews will be required to calibrate equipment as outlined in Section 16. Instrument/Equipment Calibration and Frequency).

Table 20: Quality Control Requirements – Field and Laboratory

Quality Control Sample Type	QA Parameter	Frequency[1]	Acceptance Limits	Corrective Action
Quality Control Requirements – Field				
Equipment Blanks	Contamination	Once per equipment batch cleaned [2]	< MDL	Identify contamination source, re-clean equipment, and re-run equipment blank.
Field Blank	Contamination	5% of all samples	< MDL	Examine field log. Identify contamination source. Qualify data as needed.
Field Duplicate	Precision	5% of all samples	RPD $\leq$ 25% if |Difference| $\geq$ RL	If laboratory duplicate is within acceptance limits, no corrective action needed. Otherwise, reanalyze both samples if possible. Identify variability source. Qualify data as needed.
Quality Control Requirements – Chemistry Laboratory				
Method Blank	Contamination	1 per analytical batch	< MDL	Identify contamination source. Reanalyze method blank and all samples in batch. Qualify data as needed.
Matrix Spike	Accuracy	1 per analytical batch	70-120% Recovery for GWQC 45-150% for Metals 50-150% Recovery for Pesticides [3]	Check LCS/SRM recovery. Attempt to correct matrix problem and reanalyze samples. Qualify data as needed.
Matrix Spike Duplicate	Precision	1 per analytical batch	RPD < 30% if |Difference| > RL	Check lab duplicate RPD. Attempt to correct matrix problem and reanalyze samples. Qualify data as needed.
Lab Duplicate	Precision	1 per analytical batch	RPD < 25% if |Difference| > RL	Recalibrate and reanalyze.
Laboratory Control Sample (or SRM)	Accuracy	1 per analytical batch	80-120% Recovery	Recalibrate and reanalyze LCS/ SRM and samples.

MDL = Method Detection Limit RL = Reporting Limit RPD = Relative Percent Difference
LCS = Laboratory Control Sample/Standard SRM = Standard/Certified Reference Material
GWQC = General Water Quality Constituents

1 "Analytical batch" refers to a number of samples (not to exceed 20 environmental samples plus the associated quality control samples) that are similar in matrix type and processed/prepared together under the same conditions and using the same reagents (equivalent to preparation batch).

2 Equipment blanks will be collected by the analytical laboratory responsible for cleaning equipment, before returning equipment to the field crew for use.

3 Or control limits set at + 3 standard deviations based on actual laboratory data.

Comparability

Comparability of the data can be defined as the similarity of data generated by different monitoring programs. For this monitoring program, this objective will be ensured mainly through use of standardized procedures for field measurements, sample collection, sample preparation, laboratory analysis, and site selection; adherence to quality assurance protocols and

holding times; and reporting in standard units. If monitoring requires participation of several monitoring teams, data comparability will be ensured through regular group training sessions, as well as adherence to standard sample collection procedures outlined in the MRP. Additionally, comparability of analytical data will be addressed through the use of standard operating procedures and extensive analyst training at the analyzing laboratory.

Representativeness

Representativeness can be defined as the degree to which the environmental data generated by the monitoring program accurately and precisely represent actual environmental conditions. For the MRP, this objective will be addressed by the overall design of the program. Representativeness is attained through the selection of sampling locations, methods, and frequencies for each parameter of interest, and by maintaining the integrity of each sample after collection. Sampling locations were chosen that are representative of discharges from unincorporated County areas, which will allow for the characterization of the impacts that such discharges may have on receiving water quality.

Completeness

Data completeness is a measure of the amount of successfully collected and validated data relative to the amount of data planned to be collected for the project. It is usually expressed as a percentage value. A project objective for percent completeness is typically based on the percentage of the data needed for the program or study to reach valid conclusions.

Because the MRP is intended to be a long term monitoring program, data that are not successfully collected for a specific monitoring event will not be collected at a later date. Rather, subsequent events conducted over the course of the program will provide a data set of sufficient size to appropriately characterize conditions at individual sampling sites. Moreover, some monitoring sites will often be dry during the dry season, which is relevant information, identifying areas where discharge is not occurring. For these reasons, most of the data planned for collection cannot be considered absolutely critical. However, some reasonable objectives for data are desirable, if only to measure the effectiveness of the program. The program goals for data completeness shown in **Table 21** are based on the planned sampling frequency, SWAMP recommendations, and a subjective determination of the relative importance of the monitoring element within any associated TMDL Monitoring Program(s). All information collected as outlined in the QAPP will be reported.

Table 21 Required Data Completeness

Monitoring Element	Completeness Objective
Field Measurements	90%
General Water Quality Constituents	90%

Field Procedures

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.

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.

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. If no contamination is detected for conventional constituents repeatedly following multiple events, field blanks may be discontinued for these constituents.

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.

Laboratory Analyses

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.
- Routine analysis of standard reference materials (SRMs) and method blanks.

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.

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.

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.

15. INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Sample Equipment Cleaning Procedures

If equipment is used for sample collection (*i.e.*, peristaltic pump tubing, sample containers and caps) it will be cleaned by the analytical laboratory prior to each monitoring event, according to procedures documented for each analytical method. After cleaning, sample containers will be stored with lids secured, and additional clean caps will be stored in clean re-sealable bags. Cleaned tubing will be stored in clean polyethylene bags.

Each batch of cleaned equipment will be used to generate an equipment blank as discussed in Section 14 (Quality Control).

Field Measurement Equipment

Each field crew will be responsible for testing, inspecting, and maintaining their field measurement equipment in accordance with the manufacturer's specifications. This includes battery checks, routine replacement of membranes, and cleaning of probes and electrodes.

Analytical Equipment Testing Procedures and Corrective Actions

Testing, inspection, and maintenance of analytical equipment used by the contract laboratory and corrective actions are documented in the QA Manual for each analyzing laboratory. Laboratory QA Manuals are available for review at the analyzing laboratory.

16. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Laboratory Analytical Equipment

Frequencies and procedures for calibration of analytical equipment used by each contract laboratory are documented in the QA Manual for each contract laboratory. Any deficiencies in analytical equipment calibration should be managed in accordance with the QA Manual for each contract laboratory. Any deficiencies that affect analysis of samples submitted through this program must be reported to the Project Manager or designee. Laboratory QA Manuals are available for review at the analyzing laboratory.

Field Measurement Equipment

Calibration of field measurement equipment is performed as described in the user manual for each individual instrument. Each field crew will be responsible for calibrating their field measurement equipment. Field monitoring equipment must meet the requirements outlined in **Table 19** and be calibrated at a frequency recommended by the manufacturer, but at a minimum prior to each event. Each calibration will be documented on each event's calibration log (**Figure 3**).

If calibration results do not meet manufacturer specifications, the field crew should first try to recalibrate using fresh aliquots of calibration solution. If recalibration is unsuccessful, new calibration solution should be used and/or maintenance should be performed. Each attempt should be recorded on the equipment calibration log. If the calibration results cannot meet manufacturer's specifications, the field crew should use a spare field measuring device that can be successfully calibrated. Additionally, the Project Manager should be notified.

Calibration should be verified using at least one calibration fluid within the expected range of field measurements, both immediately following calibration and at the end of each monitoring day. Individual parameters should be recalibrated if results for the calibration check do not fall within the range of accuracy identified in **Table 19**. Calibration verification documentation will be retained in the event's Calibration Verification Log presented in **Figure 4**. **Table 22** outlines the typical field instrument calibration procedures for each field probe requiring calibration. Results of initial calibration checks will be recorded on the Field Measurement Equipment Calibration Log, an example of which is shown in **Figure 3**.

Table 22. Calibration of Field Measurement Equipment

Field Meter Parameter	Calibration and Verification Description	Frequency of Calibration	Frequency of Calibration Verification	Responsible Party
pH	Calibration for pH measurement is accomplished using standard buffer solutions. Analysis of a mid-range buffer will be performed to verify successful calibration.	Day of sampling event	After each day's calibration and at the end of the sampling day	Individual Sampling Crew
Temperature	Temperature calibration is factory-set and requires no subsequent calibration.			
Dissolved Oxygen	Calibration for dissolved oxygen measurements is accomplished using a water saturated air environment. Dissolved oxygen measurement of water-saturated air will be performed to verify successful calibration.			
Conductivity	Conductivity calibration will follow manufacturer's specifications. A mid-range conductivity standard will be analyzed to verify successful calibration.			
Turbidity	Turbidity calibration will follow manufacturer's specifications. A mid-range turbidity standard will be analyzed to verify successful calibration.			

Field Measurement Equipment Calibration Log

Date:

Parameter	Meter ID	Calibration Standard	Post-Cal Measurement	Calibration Valid if:	Time	Initials
Dissolved Oxygen		_____ mmHG _____ ^{o}C	_____ mg/L (water-sat'd air)	D.O. reads within 10% of value from D.O. tables [5]		
Conductivity		500 µmhos/cm				
		10,000 µmhos/cm	_____ µmhos/cm (mid-range std.)	Cond. reads w/in 5% of expected value		
pH		7.0 Units				
		10.0 Units	_____Units (pH = 8.0)	pH 8 reads within $\pm$ 0.2 Units (or w/in manuf's specs)		
Turbidity		0 NTU				
		100 NTU				
		1000 NTU	_____NTU (100 NTU)	NTU reads within 10% of expected value		

Notes:

Figure 3: Example Field Measurement Equipment Calibration Log Sheet

[5] "D.O. tables" refers to tables of dissolved oxygen in water as a function of temperature and barometric pressure, typically found in wastewater engineering text books.

Field Measurement Equipment Calibration Verification Log

Date:

Parameter	Meter ID	Verification Standard	Measurement	Calibration Valid if:	Time	Initials
Dissolved Oxygen		_____ mmHg _____ ^{o}C	_____ mg/L (water-sat'd air)	D.O. reads within 10% of value from D.O. tables [6]		
Conductivity		_____ µmhos/cm	_____ µmhos/cm (mid-range std.)	Cond reads w/in 5% of expected value		
pH		_____Units	_____Units (pH = 8.0)	pH 8 reads within ± 0.2 Units (or w/in manuf's specs)		
Turbidity		_____ NTU	_____NTU (100 NTU)	NTU reads within 10% of expected value		

Notes:

Figure 4: Example Field Measurement Equipment Calibration Verification Log Sheet

17. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Inspection of gloves, sample containers, and any other consumable equipment used for sampling will be the responsibility of each individual sampling crew. Inspection should be conducted immediately upon receipt of equipment; equipment should be rejected/returned if any obvious signs of contamination (torn packages, etc.) are observed. Inspection protocols and acceptance criteria for laboratory analytical reagents and other consumables are documented in the QA Manual for each laboratory.

18. NON-DIRECT MEASUREMENTS

Water quality data collected through other monitoring programs may be used to augment data collected through the MRP. Data reported by other entities will be evaluated for suitability for inclusion in an associated Monitoring Program database for each suite of constituents. It is the responsibility of the Project QA Manager or designee to acquire,validate, and compile the necessary data from other programs. The data will be assessed against the data quality objectives stated in Section 7. Quality Objectives and Criteria for Measurement Data).

[6] "D.O. tables" refers to tables of dissolved oxygen in water as a function of temperature and barometric pressure, typically found in wastewater engineering text books.

19. DATA MANAGEMENT

The field crew shall retain the original field logs. The contract laboratory shall retain original COC forms. Concentrations of all parameters will be calculated as described in laboratory SOPs or referenced method document for each analyte or parameter. The various data and information generated through the MRP will be stored and maintained as described in Section 9. Documents and Records).

The field log and analytical data generated will be converted to a standard database format maintained on personal computers. After data entry or data transfer procedures are completed for each monitoring event, data will be validated as described in Section D. DATA VALIDATION AND USABILITY). After the final quality assurance checks for errors are completed, the data will be added to the final database.

Program data will be submitted electronically with the Annual Monitoring Report in either Microsoft Access® or Microsoft Excel® file format. Data concerning additional constituents may also be supplied at the discretion of the Project Manager. Tabular data summaries included in the Annual Monitoring Report will be generated from this data file ("database"). Additionally, those data collected by the program will be formatted to be compatible with SWAMP database requirements.

C. ASSESSMENT AND OVERSIGHT

20. ASSESSMENTS AND RESPONSE ACTIONS

Data will be evaluated and documented after each monitoring event to determine whether project quality assurance objectives have been met, to quantitatively assess data quality, and to identify potential limitations on data use. The following assessments of compliance with quality control procedures will be performed during the data collection phase of the project:

- Performance assessment of the sampling procedures will be performed by the field sampling crews. Corrective action shall be carried out by the field sampling crew and reported to the Project Manager.
- Field crews will be audited annually by the Project Manager or designee. Additional audits will occur as necessary to observe corrective actions taken to resolve errors identified during a previous audit.
- The laboratory is responsible for following established SOPs, including those for proper instrument maintenance, calibration of the instruments, and analytical methods used for samples submitted through the Nutrient TMDL Monitoring Program.
- Assessment of laboratory QC results and implementation of corrective actions will be the responsibility of the QA Officer at each laboratory and shall be reported to the Project QA Manager or designee as part of any data reports.
- Assessment of field QC results and implementation of corrective actions shall be the responsibility of the Project QA Manager or designee.

All project data must be reviewed as part of the data assessment. Review is conducted on a preparation batch basis by assessing QC samples and all associated environmental sample results. Project data review established for this project includes the following steps:

- Initial review of analytical and field data for complete and accurate documentation, chain-of-custody procedures, compliance with required holding times, and required frequency of field and laboratory QC samples;
- Evaluation of analytical and field blank results to identify random and systematic contamination;
- Comparison of all spike and duplicate results with data quality objectives for precision and accuracy;
- Assigning data qualifier flags to the data as necessary to reflect data use limitations identified by the assessment process; and
- Calculating completeness by analyte.

The Project QA Manager or designee is responsible for conducting the data assessment and for ensuring that data qualifier flags are assigned, as needed, based on the established quality control criteria. If an assessment or audit discovers any discrepancy, the Project QA Manager will address the observed discrepancy with the appropriate person responsible for the activity. Discussion points will include whether the information collected is accurate, identifying the cause(s) leading to the deviation, how the deviation might impact data quality, and what

corrective actions might be considered. The Project QA Manager will maintain a QA Log of all communications and any specified corrective actions, and will make the QA Log available to the Project Manager upon request.

Routine procedures to assess the success of the data collection effort are discussed in Section D. DATA VALIDATION AND USABILITY). Routine procedures for corrective actions are summarized in **Table 20.**

21. REPORTS TO MANAGEMENT

No additional documents, except those listed in Section 9. Documents and Records), will be generated.

D. DATA VALIDATION AND USABILITY

22. DATA REVIEW, VERIFICATION AND VALIDATION REQUIREMENTS

The acceptability of data is determined through data verification and data validation. Both processes are discussed in detail below. In addition to the data quality objectives presented in **Table 8**, the standard data validation procedures documented in the contract laboratory's QA Manual will be used to accept, reject, or qualify the data generated by the laboratory. Each laboratory's QA Officer will be responsible for validating data generated by the laboratory.

Once analytical results are received from the analyzing laboratory, the Project QA Manager or designee will perform an independent review and validation of analytical results. Appendix D contains equations that are used to calculate precision, accuracy, and completeness of the data. Decisions to reject or qualify data will be made by the Project QA Manager, based on the evaluation of field and laboratory quality control data according to procedures outlined in Section 13 of Caltrans document No. CTSW-RT-00-005, *Guidance Manual: Stormwater Monitoring Protocols*, 2nd Edition (LWA 2000), included in this QAPP as Appendix E.

23. DATA VERIFICATION

Data verification involves verifying that required methods and procedures have been followed at all stages of the data collection process, including sample collection, sample receipt, sample preparation, sample analysis, and documentation review for completeness. Verified data have been checked for a variety of factors, including transcription errors, correct application of dilution factors, and correct application of conversion factors. Verification of data may also include laboratory qualifiers, if assigned.

Data verification should occur in the field and the laboratory at each level (*i.e.*, all personnel should verify their own work) and as information is passed from one level to the next (*i.e.*, supervisors should verify the information produced by their staff). Records commonly examined during the verification process include field and sample collection logs, chain-of-custody forms, sample preparation logs, instrument logs, raw data, and calculation worksheets.

In addition, laboratory personnel will verify that the measurement process was "in control" (*i.e.*, all specified data quality objectives were met or acceptable deviations explained) for each batch of samples before proceeding with the analysis of a subsequent batch. Each laboratory will also establish a system for detecting and reducing transcription and/or calculation errors prior to reporting data.

24. DATA VALIDATION

In general, data validation involves identifying project requirements, obtaining the documents and records produced during data verification, evaluating the quality of the data generated, and determining whether project requirements were met. The main focus of data validation is determining data quality in terms of accomplishment of measurement quality objectives (*i.e.*, meeting QC acceptance criteria). Data quality indicators, such as precision, accuracy, sensitivity, representativeness, and completeness, are typically used as expressions of data quality. The Project QA Manager or designee will review verified sample results for the data set as a whole, including laboratory qualifiers, summarize data and QC deficiencies and evaluate the

impact on overall data quality, assign data validation qualifiers as necessary, and include this information in a Quality Assurance Report. The validation process applies to both field and laboratory data.

In addition to the data quality objectives presented in **Table 8** the standard data validation procedures documented in the analyzing laboratory's QA Manual will be used to accept, reject or qualify the data generated. The laboratory will submit only data that have met data quality objectives, or data that have acceptable deviations explained. When QC requirements have not been met, the samples will be reanalyzed when possible, and only the results of the reanalysis will be submitted, provided that they are acceptable. Each laboratory's QA Officer is responsible for validating the data it generates.

E. AMENDMENTS TO QAPP

The intent of this section is to provide a place within the QAPP to document significant additions, deletions and revisions to the approved QAPP and to provide the rationale for changes.

F. REFERENCES

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