Monitoring Plan

2023-24 Monitoring Season

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The Caltrans National Pollutant Discharge Elimination System (NPDES) Permit requires development of a plan for monitoring receiving waters, characterizing runoff, and determining BMP effectiveness. This monitoring plan describes proposed monitoring for the 2023-24 and 2024-25 fiscal years.

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LIST OF ACRONYMS

BMP	Best Management Practice
ELAP	Environmental Laboratory Accreditation Program
NPDES	National Pollutant Discharge Elimination System Permit
PCBs	Polychlorinated Biphenyls
QAPP	Quality Assurance Program Plan
SAP	Sampling and Analysis Plan
SMARTS	Stormwater Multiple Application and Report Tracking System
TMDL	Total Maximum Daily Load
U.S. EPA	United States Environmental Protection Agency

SECTION 1
Introduction

1.1 Purpose

The purpose of this Monitoring Plan is to present the California Department of Transportation (Caltrans) approach to comply with the monitoring requirements set forth in Attachment F of its National Pollutant Discharge Elimination System Permit (Permit; State Water Board 2023). This Monitoring Plan also complies with the State Water Resources Control Board (State Water Board) requirement in the Permit, cited below:

> ***Attachment F, Section F2***. The Monitoring Plan shall include the elements required by section F2 through F2.15 of this Attachment. The Monitoring Plan shall be submitted within 12 months of the Effective Date of this Order. Annual updates shall be submitted by November 30 of each year. The Department shall submit updates to the Monitoring Plan and annual updates for review and consideration of approval by State Water Board Executive Director.
>
> The Monitoring Plan shall address the requirements of this Attachment. The Monitoring Plan shall include all proposed monitoring and a monitoring schedule for the upcoming fiscal year and the following fiscal year, including monitoring of applicable water body reaches in total maximum daily load (TMDL) watersheds where the Department is named as a responsible party where required through region-specific monitoring requirements or, where there are no region-specific monitoring requirements, as needed to demonstrate compliance with TMDLs in accordance with the Department's TMDL Compliance Plan. The Monitoring Plan and annual updates shall be implemented upon approval by the State Water Board Executive Director.

1.2 Caltrans Stormwater Program

The Caltrans Stormwater Program, established over 25 years ago, is a well-developed and extensive program that has received environmental awards. This program includes water quality monitoring for chemical constituents, microbiological constituents, and gross solids; BMP testing for assessing feasibility and effectiveness within the highway environment; and source control studies. Additionally, guidance documents for this program have been created and are routinely updated. This Monitoring Plan is supported by the following Caltrans Stormwater Program guidance documents:

- The *Stormwater Monitoring Guidance Manual* (Caltrans 2020). This document provides direction on: (1) planning and implementation of stormwater monitoring projects; (2) standardized procedures for sample collection, sample analysis, and data reporting to ensure that all monitoring is performed consistently throughout the state, and (3) data quality objectives that should be adhered to by all program laboratories and guidance on other aspects of stormwater monitoring, such as monitoring equipment maintenance, training, and health and safety.

- The *BMP Pilot Study Guidance Manual* (Caltrans 2021). This document provides guidance on planning, performing, evaluating, and reporting of BMP pilot studies. Appendix D in this document contains guidance on selecting an appropriate statistical method, understanding the limitations of the analysis method, and interpreting statistically valid conclusions.

1.3 Organization

This Monitoring Plan is organized into the following six sections plus appendices:

Section 1 – Introduction. This section contains the purpose and outlines the organization of the Monitoring Plan.

Section 2 – Sampling and Analysis and Quality Assurance Project Plans. This section outlines the Permit requirements and references appropriate sections in the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP).

Section 3 – Receiving Water Monitoring. This section contains receiving water monitoring programs that the Caltrans participates in.

Section 4 – Region-Specific TMDL Monitoring. This section describes Caltrans region-specific TMDL monitoring and the monitoring options that Caltrans has selected as described in Section F2.12 of the Permit.

Section 5 – Runoff Characterization Monitoring. This section contains the planning and activities for runoff characterization monitoring.

Section 6 – BMP Effectiveness Monitoring. This section contains the planning and activities for BMP effectiveness monitoring.

Section 7 – References. This section contains the list of references cited in the Monitoring Plan.

Appendix A contains the Sampling and Analysis Plan that will be used for Caltrans monitoring projects.

Appendix B contains the Quality Assurance Project Plan that will be used for Caltrans monitoring projects.

Where appropriate, Permit sections are referenced in parentheses next to section/subsection titles.

SECTION 2

Sampling and Analysis and Quality Assurance Project Plans

2.1 Purpose (Permit Section F2.1)

The Sampling and Analysis Plan (SAP) describes the standard equipment and methods that will be employed to collect stormwater samples. The Quality Assurance Program Plan (QAPP) describes in detail the Quality Assurance, Quality Control, and other technical procedures that will be followed to ensure that the monitoring results satisfy Permit needs. The QAPP follows the State Water Board Surface Water Ambient Monitoring Program's Quality Assurance Project Plan (State Water Board 2021). The SAP is provided in Appendix A and the QAPP is provided in Appendix B.

2.2 Representative Samples, Field Tests, and Monitoring Results (Permit Section F2.2)

All monitoring samples and measurements will be representative of the monitored volume and characteristics of the monitored discharge. Sections B1 and B2 of the QAPP describe the procedures for collection of representative samples and measurements. Monitoring will include field measurement of pH, temperature, dissolved oxygen, and turbidity concurrently with each sample collected for analytical laboratory analysis.

2.3 Analytical Methods for Laboratory Analysis (Permit Section F2.3)

Samples will be analyzed using United States Environmental Protection Agency (U.S. EPA)-approved methods selected from Table F-1, Attachment F of the Permit. Table 8 of the QAPP presents the selected methods.

2.4 Minimum Level and Method Detection Limits (Permit Section F2.4)

The selected analytical methods have minimum levels consistent with Title 40, Section 136 of the Code of Federal Regulations. Table 8 of the QAPP lists the minimum levels for this project. QAPP Section B4.1 describes how sample results less than the minimum level but above method detection level (MDL) will be reported.

2.5 Sufficiently Sensitive Analytical Methods (Permit Section F2.5)

The selected methods are sufficiently sensitive to ensure detection and measurement of pollutants at, or below, the applicable water quality criteria or waste load allocation. It is sometimes desirable to analyze samples using modified methods that have not yet been fully adopted by the U.S. EPA. Typically, these method modifications are improvements to existing methodology that are developed to address emerging contaminants, or that result in greater method sensitivity. Alternate methods must be approved by the State Water Board Executive

Director, and must have sensitivity that is equal to or greater than the sensitivity of the methods specified by the Permit. Table 8 of the QAPP provides the selected analytical methods.

2.6 Environmental Laboratory Accreditation Program Certification (Permit Section F2.6)

Samples will be analyzed by laboratories that are certified or accredited by the Environmental Laboratory Accreditation Program (ELAP). The QAPP does not include a list of ELAP-certified laboratories. The ELAP certified laboratories used for this project will be selected by the respective monitoring consultants selected for the project(s).

2.7 Sample Location Information (Permit Section F2.7)

Table 4 of the QAPP lists the global positioning system Global Positioning System coordinates for all monitoring sites. Global Positioning System coordinates will be provided with all monitoring reports. Global Positioning System coordinates are recorded at the physical location at which samples are collected.

2.8 Monitoring Schedule and Type of Monitoring (Permit Section F2.8)

Table 4 of the QAPP details the proposed monitoring sites, together with the type and category of monitoring (e.g., effectiveness, effluent, receiving water, etc.), the watershed in which the monitoring site is located, and the TMDL pollutants associated with the site. Table 4 of the QAPP also provides the monitoring schedule and list of parameters for each site.

2.9 Electronic Monitoring Data Reporting (Permit Section F2.9)

Monitoring data will be submitted electronically in the Stormwater Multiple Application and Report Tracking System (SMARTS) using a format in accordance with the State Water Board's California Environmental Data Exchange Network data submission template. Section B10.5 of the QAPP provides details on the SMARTS reporting.

2.10 Analytical Methods and Monitoring Parameters (Permit Section F2.10)

The monitoring parameters selected for each monitoring site are based on the site location and purpose. Table 8 of the QAPP provides the analytical methods and monitoring parameters for each monitoring site.

SECTION 3
Receiving Water Monitoring

3.1 Purpose (Permit Section F2.11)

The purpose of receiving water monitoring is to determine if water quality objectives are being met in receiving waters. This section describes Caltrans participation in regional, local, and other cooperative receiving water monitoring programs.

3.2 Regional Monitoring Programs (Permit Sections F2.11.2, F2.11.4)

Caltrans works with regional monitoring groups to maximize monitoring resources. Table 3-1 lists Caltrans participation in regional receiving water monitoring programs.

3.3 Cooperative Monitoring Programs (Permit Sections F2.11.1, F2.11.2, F2.11.5)

Caltrans works with local agencies, stakeholders, and permittees to maximize receiving water monitoring resources. Tables 3-2 and 3-3 provide details on the cooperative receiving water monitoring programs, including coordinated integrated monitoring programs, that Caltrans is currently participating in the Los Angeles/Santa Ana region and San Diego region, respectively.

Table 3-1
Caltrans Participation in Regional Monitoring Programs

Program	Regional Board	Purpose/TMDLs	Major Analyte Categories	Document Links
Klamath Basin Monitoring Program	North Coast	Trends monitoring, TMDL compliance • Klamath River Temperature, Dissolved Oxygen and Nutrients TMDLs • Lost River Nitrogen and BOD TMDL • Trinity River & South Fork Trinity Rivers Sediment TMDLs • Shasta & Scott Rivers Sediment and Temperature TMDLs	TSS, nutrients, field tests, sediment, phytoplankton	Water Quality Monitoring Plan, 2016
Phase I Methylmercury Delta Regional Monitoring Program	Central Valley	Trends Monitoring, TMDL compliance, characterization • Sacramento-San Joaquin Delta Methylmercury TMDL	TSS, methylmercury, nutrients, field tests, pesticides, constituents of emerging concern, toxicity, phytoplankton	Monitoring Workplan Fiscal Year, 2023-2024 Annual Regional Monitoring Report, 2021 - 2022
Central Valley Region Salts Monitoring Program	Central Valley	Trends monitoring, characterization • Central Valley Salts Monitoring TMDL	Salinity, nitrate, TDS	Surveillance and Monitoring Program, 2023 Final Baseline Characterization Report, 2024
Lake Tahoe Regional Stormwater Monitoring Program	Lahontan	Trends monitoring, TMDL compliance, characterization, BMP effectiveness • Lake Tahoe Sediment and Nutrients TMDL	TSS, turbidity, particle size distribution, nutrients, field tests	Monitoring Plan Update, 2023 Annual Stormwater Monitoring Report, Water Year 2023
Southern California Stormwater Monitoring Coalition	All Southern California	Trends monitoring, TMDL compliance, characterization, BMP effectiveness • Multiple TMDLs in the Los Angeles, Santa Ana, and San Diego Regions[1]	TSS, bacteria, nutrients, metals, organics, pesticides, field tests, sediment, biological indicators	Workplan, 2021 - 2025 Annual Report, 2022 - 2023
San Francisco Bay Regional Monitoring Program	San Francisco	Trends Monitoring, TMDL compliance, characterization • San Francisco Bay PCBs and Mercury TMDLs	TSS, PCBs, mercury, contaminants of emerging concern, field tests, sediment, turbidity	Water Year 2024 Near-Field Sampling and Analysis Plan Regional Monitoring Program Update, 2023

1 - Table 7 of *Bioassessment Survey of the Stormwater Monitoring Coalition, Workplan for Years 2021 through 2025*. SCCWRP Technical Report #1174.

Table 3-2
Caltrans Participation in Los Angeles and Santa Ana Cooperative Monitoring Programs

Program	Regional Board	Group Name/Lead Agency	Purpose/TMDLs	Major Analyte Categories	Document Links
Calleguas Creek Watershed Total Maximum Daily Load Compliance Monitoring Program	Los Angeles	Stakeholders Implementing TMDLs in the Calleguas Creek Watershed	TMDL compliance • Calleguas Creek Watershed OC Pesticides and PCBs TMDL	Nutrients, metals, selenium, PCBs, pesticides, organics, field tests, sediment, toxicity	No online documents
Development of a Dominguez Channel Estuary Remediation Plan Phase I Work Plan[1]	Los Angeles	Dominguez Channel Watershed Management Area Group/ Los Angeles County Public Works	TMDL compliance • TMDL for Toxic Pollutants in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters	Sediment, sediment toxicity, benthic community	No online documents
Ventura River Algae TMDL Monitoring	Los Angeles	Ventura County Watershed Protection District/ TMDL Responsible Parties	TMDL compliance • Ventura River and its Tributaries Algae, Eutrophic Conditions and Nutrients TMDL	Nutrients, field tests, phytoplankton	No online documents
Ventura River Estuary Trash TMDL Monitoring	Los Angeles	Ventura County	TMDL compliance • Ventura River Estuary Trash TMDL	Trash	No online documents
Revolon Slough/Beardsley Wash Trash Monitoring	Los Angeles	Ventura County	TMDL compliance • Revolon Slough and Beardsley Wash Trash TMDL	Trash	No online documents
Lake Elsinore and Canyon Lake TMDL Task Force	Santa Ana	Lake Elsinore & San Jacinto Watersheds Authority	TMDL compliance • Lake Elsinore and Canyon Lake Nutrient TMDL	TSS, nutrients, field tests	Comprehensive Monitoring Work Plan, 2016 2022-2023 Annual Report

1 - Requested by Regional Board to address lack of information on spatial variability of sediment contamination and location of hot spots.

Table 3-3
Caltrans Participation in San Diego Cooperative Monitoring Programs

Program	Regional Board	Group Name/Lead Agency	Purpose/TMDLs	Major Analyte Categories	Document Links
Chollas Creek Diazinon and Dissolved Metals TMDL Monitoring[1]	San Diego	San Diego Bay Responsible Parties	TMDL compliance • Chollas Creek Diazinon TMDL • Chollas Creek Dissolved Copper, Lead and Zinc TMDL	Diazinon, metals, toxicity	No online documents
Project I-Twenty Beaches and Creeks in the San Diego Region	San Diego	San Diego Bay Responsible Parties	TMDL compliance • Project I – Twenty Beaches and Creeks in the San Diego Region (including Tecolote Creek) Indicator Bacteria, Revised TMDL	Bacteria, field tests	No online documents
Los Peñasquitos Lagoon Sediment TMDL	San Diego	Los Peñasquitos Watershed Management Area Permittees	TMDL compliance • Los Peñasquitos Lagoon Sediment TMDL	TSS, field tests, sediment, vegetation	No online documents
San Diego River Human Fecal Material - Investigative Order	San Diego	County of San Diego	Investigative	Bacteria	No online documents

1 - Caltrans has continued participation in this program even though it has selected self-monitoring as the compliance option for this watershed

SECTION 4

Region-Specific TMDL Monitoring

4.1 Purpose (Permit Section F2.12)

This section describes Caltrans region-specific TMDL monitoring and the monitoring options that Caltrans has selected as required by Section F2.12 of the Permit.

4.2 Region-Specific TMDL Monitoring Options

4.2.1 North Coast Water Board Sediment TMDL (Permit Section F2.12.1)

Caltrans monitoring options for sediment in the North Coast Water Board region are:

1. *Cooperative Monitoring*. (a) Allocate a one-time funding contribution equivalent to ten percent of each TMDL sediment reduction project cost to maintain existing watershed-based status and trends monitoring programs or (b) contribute funding proportionate to its share of waste load allocation among stakeholders for each TMDL sediment reduction project, or
2. *Self-Monitoring*. Implement a watershed monitoring program associated with state highways within the North Coast region TMDL watersheds. State highways are broadly distributed and therefore the monitoring will be watershed-based to allow North Coast Water Board staff to assess water quality impacts from state highways and progress toward achieving TMDL targets from Caltrans implementation of TMDL sediment reduction projects. The watershed-based monitoring program will include a number of monitoring locations and frequency of monitoring proportional to Caltrans sediment load in excess of its load allocation for each TMDL watershed.

Table 4-1 describes the Caltrans monitoring strategy for the North Coast Sediment TMDLs.

Table 4-1
North Coast TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Options	Caltrans Strategy
North Coast Sediment TMDLs	Attachment F, Section F2.12.1 Attachment D, Section D5.7	Cooperative monitoring: (a) Provide 10% additional funding contribution for each Cooperative Implementation Agreement project in lieu of Caltrans monitoring (b) Contribute funding proportionate to its share of waste load allocation among stakeholders Self-monitoring: Monitor at a number of monitoring locations in each TMDL watershed	Caltrans has selected cooperative monitoring. Caltrans will contribute funding for existing cooperative watershed health (status and trends) monitoring programs based on its share of waste load allocation among stakeholders.

Caltrans monitoring strategy in the North Coast TMDL watersheds is based on its share of waste load allocation among stakeholders. Table 4-2 provides Caltrans responsibility and proposed funding contribution for overall watershed health monitoring in each TMDL watershed.

In addition to funding cooperative monitoring based on its share of waste load allocation among stakeholders, Caltrans will monitor BMP effectiveness at one low impact development BMP in the South Fork Eel River watershed. Monitoring at this site, which is currently in the planning phase, is expected to begin during the 2023-24 fiscal year. Details on this additional monitoring are provided in Section 6 and Appendix B.

Table 4-2
Caltrans Responsibility for North Coast Sediment TMDLs Watershed Monitoring

Watershed	Watershed Area (mi^2)	Caltrans Load Allocation[1] (t/y)	Total Management Load in Watershed[2] ($t/mi^2/y$)	Management Load Reduction Required[2] (%)	Management Load Allocation[2] ($t/mi^2/y$)	Management Load Allocation[3] (t/y)	Proportional Responsibility for Watershed Health Monitoring Programs[4] (%)
Albion River	43	1.9	435	69%	135	5799	0.03%
Big River	181	43.4	314	75%	79	14209	0.31%
Eel River, Upper Main	708	70.9	152	49%	78	54884	0.13%
Eel River, Middle Fork	753	105.7	82	65%	29	21611	0.49%
Eel River, Lower Main	300	73.7	775	77%	178	53475	0.14%
Eel River, South Fork	689	4848.2	845	71%	247	170376	2.85%
Garcia River	114	100.0	1380	60%	552	62928	0.16%
Gualala River	299	20.6	840	89%	96	28632	0.07%
Mad River	374	515.0	1580	89%	174	65001	0.79%
Navarro River	316	1362.6	775	62%	293	92572	1.47%
Noyo River	113	32.8	274	70%	82	9317	0.35%
Redwood Creek	282	855.6	4360	65%	1510	425820	0.20%
Scott River	814	66.7	299	63%	111	90053	0.07%
Ten Mile River	120	1.1	318	75%	80	9540	0.01%
Trinity River	1694	88.9	548	68%	178	301018	0.03%
Trinity River, South Fork	931	352.3	371	68%	119	110528	0.32%
Van Duzen River	428	67.8	586	72%	162	69368	0.10%

1 – Table A-3, State Water Board (2023)

2 – Derived from TMDL staff reports. Management Load Allocation ($t/m^2/y$) is the Total Management Load in Watershed (t/mi2/y) multiplied by [100 – Management Load Reduction Required (%)]

3 – Management Load Allocation (t/y) is the Management Load Allocation ($t/mi^2/y$) multiplied by the Watershed Area (mi^2)

4 – Proportional monitoring responsibility assumed to be same as share of management waste load allocation. The percent share of management waste load allocation is [Caltrans Load Allocation (t/y) divided by the Management Load Allocation (t/y)] multiplied by 100

4.2.2 San Francisco Bay Mercury & PCBs TMDLs (Permit Section F2.12.2)

San Francisco Bay Mercury TMDL (Permit Section F2.12.2.1)

Caltrans mercury monitoring options are as follows:

1. *Regional Monitoring*. Participate in mercury monitoring via the Regional Monitoring Program for Water Quality in San Francisco Bay; or
2. *Self-Monitoring*. Develop and implement a mercury monitoring plan to quantify the mercury loads or load reductions achieved through treatment, source control, and other management efforts. Sample bedded fine sediment for a minimum of four wet weather events per year over the term of the Order. Select sample locations at or near a point of discharge from the right-of-way and into the system that discharges stormwater into San Francisco Bay.
3. *Combination*. Implement a combination of monitoring requirements in options 1 or 2, above, provided that the combination provides equivalent monitoring.

Table 4-3 describes the Caltrans monitoring strategy for the San Francisco Bay Mercury TMDL.

Table 4-3
San Francisco Bay Mercury TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Options	Caltrans Strategy
San Francisco Bay Mercury TMDL	Attachment F, Section F2.12.2.1 Attachment D, Section D5.8	Regional monitoring: Participate in Regional Monitoring Program Self-monitoring: Monitor to quantify mercury loads or load reductions achieved through treatment, source control, and other management efforts. Include bedded fine sediment sampling Combination: Participate in Regional Monitoring Program and perform self-monitoring	Caltrans has selected combination monitoring. Caltrans will continue to contribute funding for the Regional Monitoring Program for Water Quality in San Francisco Bay and perform as needed self-monitoring to quantify mercury loads and load reductions achieved through treatment, source control, and other management efforts. Caltrans may also enter into cooperative implementation agreements for treatment projects outside its right-of-way. Monitoring for these projects may be performed by other stakeholders.

In addition to participating in the Regional Monitoring Program, Caltrans will characterize mercury in its runoff at 4 sites and monitor BMP effectiveness at one site in the TMDL watershed. Monitoring at these sites, which are either ongoing monitoring sites or are currently in the planning phase, is expected to continue or commence during the 2024-25 fiscal year. Additional details on this self-monitoring are provided in Sections 5 and 6, and Appendix B.

San Francisco Bay PCBs TMDL (Permit Section F2.12.2.2)

Caltrans PCBs monitoring options are as follows:

1. *Regional Monitoring*. Participate in PCBs monitoring via the Regional Monitoring Program for Water Quality in San Francisco Bay; or
2. *Self-Monitoring*. Develop, submit, and implement a Caltrans-specific monitoring plan to quantify PCBs stormwater runoff loads and the load reductions achieved through treatment, source control and other actions. Sample bedded fine sediment a minimum of four wet weather events per year over the term of the Order. Sample locations will be at/near a point of discharge from the right-of-way and into the conveyance system that discharges stormwater into San Francisco Bay. Monitoring will be representative of pollutant concentrations or loadings in discharges from Caltrans right-of-way or will be representative of the effects of discharges from Caltrans right-of-way on water qualities in the TMDL waterbodies.
3. *Combination*. Implement a combination of monitoring requirements in options 1 or 2, above, provided that the combination provides equivalent monitoring.

Table 4-4 describes the Caltrans monitoring strategy for the San Francisco Bay PCBs TMDL.

Table 4-4
San Francisco Bay PCBs TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Options	Caltrans Strategy
San Francisco Bay PCBs TMDL	Attachment F, Section F2.12.2.2 Attachment D, Section D5.8	Regional monitoring: Participate in Regional Monitoring Program Self-monitoring: Monitoring to quantify PCBs stormwater runoff loads and the load reductions achieved through treatment, source control and other actions. Include bedded fine sediment sampling Combination: Participate in Regional Monitoring Program and perform self-monitoring	Caltrans has selected combination monitoring. Caltrans will continue to contribute funding for the Regional Monitoring Program for Water Quality in San Francisco Bay and perform as needed self-monitoring to quantify PCBs loads and load reductions achieved through treatment, source control, and other management efforts. Caltrans may also enter into cooperative implementation agreements for treatment projects outside its right-of-way. Monitoring for these projects may be performed by other stakeholders.

In addition to participating in the Regional Monitoring Program, Caltrans will characterize PCBs in its runoff at 4 sites and monitor BMP effectiveness at one site in the TMDL watershed. The focus of self-monitoring will be in old urban and industrial areas which are expected to be hotpots for PCBs. Monitoring at these sites, which are either ongoing monitoring sites or are currently in the planning phase, is expected to continue or commence during the 2024-25 fiscal year. Additional details on this self-monitoring are provided in Sections 5 and 6, and Appendix B.

4.2.3 Los Angeles Water Board TMDLs (Permit Section F2.12.3)

Caltrans monitoring options for TMDLs in the Los Angeles Water Board region (Los Angeles Region) are:

1. *Coordinated Integrated Monitoring*. Caltrans may continue to participate in Coordinated Integrated Monitoring Programs for individual TMDL watersheds or participate in other watershed cooperative monitoring programs in lieu of self- monitoring; or
2. *Self-Monitoring*. Caltrans will implement self-monitoring through development of a monitoring plan and schedule to monitor its rights-of-way. The monitoring plan will be equivalent in methods, precision, accuracy, and quality to the (1) relevant Coordinated Integrated Monitoring Programs or other watershed cooperative monitoring programs and (2) the monitoring requirements in this Attachment. The monitoring plan shall include a work plan and schedule to implement the monitoring. The watershed and TMDL shall be identified in the monitoring plan; or
3. *Combination*. Caltrans may implement a combination of requirements in options 1 or 2, above, provided that the combination is equivalent to the monitoring via watershed cooperative monitoring and right-of-way monitoring.

Table 4-5 describes the Caltrans monitoring strategy for the Los Angeles Region TMDLs.

Table 4-5
Los Angeles Region TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Options	Caltrans Strategy
Los Angeles Region TMDLs	Attachment F, Section F2.12.3 Attachment D, Section D5.10	Coordinated Integrated monitoring: Participate in Coordinated Integrated Monitoring Programs Self-monitoring: Monitoring shall be equivalent in methods, precision, accuracy, and quality to the relevant Coordinated Integrated Monitoring Programs or other watershed cooperative monitoring programs Combination: Participate in Coordinated Integrated Monitoring Programs and perform self-monitoring providing that it is equivalent to the monitoring via watershed cooperative monitoring and right-of-way monitoring	Caltrans has selected combination monitoring. Caltrans will continue to contribute funding or enter into new Coordinated Integrated Monitoring Programs for individual TMDL watersheds, and perform additional self-monitoring to quantify its loads and load reductions achieved through treatment, source control, and other management efforts. Caltrans may continue to enter into cooperative implementation agreements for treatment projects outside its right-of-way. Monitoring for these projects may be performed by other stakeholders.

Caltrans is currently participating in a number of Coordinated Integrated Monitoring Programs in the Los Angeles Region and is planning to participate in new programs in the future. Current Coordinated Integrated Monitoring Programs are listed in Table 3-2. Caltrans anticipates participating in the new programs after management approval of terms and conditions of participation and upon acceptance from existing stakeholders.

As efforts continue to pursue participation in Coordinated Integrated Monitoring Programs, Caltrans will characterize its runoff at 15 sites and monitor BMP effectiveness at 8 sites in various Los Angeles Region TMDL watersheds. Six of the BMP effectiveness sites are pilot trash devices. Monitoring at these sites, which are either ongoing monitoring sites or are currently in the planning phase, is expected to continue or commence during the 2024-25 fiscal year. To characterize dry weather flows, monitoring will include field observations on the frequency of dry weather flows and dry weather flow sampling at select locations during the dry season. Additional details on this self-monitoring are provided in Sections 5 and 6, and Appendix B.

4.2.4 Central Valley Water Board TMDLs (Permit Section F2.12.4)

In the Central Valley Water Board region (Central Valley Region), Caltrans will continue to participate in the Central Valley Water Board approved Delta Regional Monitoring Program. In the event the Delta Regional Monitoring Program is no longer approved by the Central Valley Water Board Executive Officer, Caltrans will submit a Methylmercury Monitoring Plan that assesses attainment with the TMDL allocations in its stormwater discharges, and implement it within six months of the Central Valley Water Board Executive Officer approval. The Methylmercury Monitoring Plan and Quality Assurance Project Plan that is to be included will meet the requirement of Section F2.12.4 of the Permit.

Table 4-6 describes the Caltrans monitoring strategy for the Central Valley Region.

In addition to participating in the Delta Regional Monitoring Program, Caltrans will characterize its runoff at 4 sites in the Sacramento-San Joaquin Delta Methylmercury TMDL watershed. Monitoring at these sites, which are either ongoing monitoring sites or are currently in the planning phase, is expected to continue or commence during the 2024-25 fiscal year. Additional details on this self-monitoring are provided in Sections 5 and 6, and Appendix B.

Table 4-6
Central Valley Region TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Requirement	Caltrans Strategy
Sacramento-San Joaquin Delta Methylmercury TMDL	Attachment F, Section F2.12.4 Attachment D, Section D5.11	Regional monitoring: Participate in Delta Regional Monitoring Program	Caltrans will continue to participate in Delta Regional Monitoring Program. Caltrans may perform as needed self-monitoring to quantify its loads and load reductions achieved through treatment, source control, and other management efforts.

As required in Section F2.12.4 of the Permit, Caltrans will continue to implement turbidity monitoring for construction projects in the Clear Lake Nutrients TMDL watershed and the Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch Mercury TMDL watershed.

4.2.5 Lahontan Water Board TMDLs (Permit Section F2.12.5)

Caltrans monitoring options in the Lahontan Water Board region (Lahontan Region) are:

1. *Cooperative Monitoring*. Caltrans will participate in the Lake Tahoe Regional Stormwater Monitoring Program; or
2. *Self-Monitoring*. Caltrans will prepare and submit a Stormwater Monitoring Plan for review and consideration of approval to the State Water Board Executive Director in consultation with the Lahontan Water Board Executive Officer. Caltrans monitoring plan will have the same monitoring parameters, locations, frequencies, and reporting as the Lake Tahoe Regional Stormwater Monitoring Program.

Table 4-7 describes the Caltrans monitoring strategy for the Lahontan Region.

Table 4-7
Lahontan Region TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Options	Caltrans Strategy
Lake Tahoe TMDL	Attachment F, Section F2.12.5 Attachment D, Section D5.12	<u>Cooperative monitoring</u>: Participate in Lake Tahoe Regional Stormwater Monitoring Program <u>Self-monitoring:</u> Prepare and submit a Stormwater Monitoring Plan for review and approval that has the same monitoring parameters, locations, frequencies, and reporting as the Lake Tahoe Regional Stormwater Monitoring Program	Caltrans has selected cooperative monitoring. Caltrans will continue to participate in the Lake Tahoe Regional Stormwater Monitoring Program.

4.2.6 Colorado River Basin Water Board TMDLs (Permit Section F2.12.6)

For the Coachella Valley Stormwater Channel Bacterial Indicators TMDL, Caltrans will monitor for *Escherichia coli* during a minimum of two qualifying precipitation events per calendar year that result in a discharge and for a minimum of eight sampled events over four years, excluding years less than two qualifying precipitation events. Caltrans will sample at the monitoring locations identified in the Caltrans document "Coachella Valley Stormwater Channel Bacterial Indicator Monitoring Quality Assurance Project Plan (QAPP), Document No. CTSW-PL-22-423.04.2, March 2022".

Table 4-8 describes the Caltrans monitoring strategy for the Colorado River Basin.

Table 4-8
Colorado River Basin TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Requirement	Caltrans Strategy
Coachella Valley Stormwater Channel Bacterial Indicators TMDL	Attachment F, Section F2.12.6	Sample at monitoring locations identified in Caltrans "Monitoring and Reporting Project Plan and Quality Assurance Project Plan for 2-Year Bacteria Indicator Monitoring in Conformance with Phase I Implementation for the Coachella Valley Stormwater Channel Total Maximum Daily Load, Riverside County, California"	Caltrans will monitor at Caltrans right-of-way sites stated in the Monitoring and Reporting Project Plan

Caltrans will perform monitoring at four locations in the Coachella Valley Stormwater Channel watershed: I-10 West of Jackson Street, I-10 East of Jackson Street, I-10 West of Monroe Street, and SR-86 near the interchange. Monitoring at these sites, which are existing monitoring sites, is expected to continue during the 2024-25 fiscal year. Additional details on these monitoring sites are provided in Section 5 and Appendix B.

4.2.7 Santa Ana Water Board TMDLs (Permit Section D5.13)

The monitoring options for the Lake Elsinore and Canyon Lake Nutrient TMDL are:

1. *Cooperative Monitoring*. Caltrans will continue participation with the Lake Elsinore and Canyon Lake Nutrients TMDL Task Force for cooperative implementation actions, monitoring, and special studies; or
2. *Self-Monitoring*. Caltrans will develop and implement a program consistent with the Lake Elsinore and Canyon Lake TMDL Task force, which will include Canyon Lake in-lake monitoring consistent with the TMDL Task Force monitoring program and a monitoring program to evaluate the success of in-lake sediment reduction strategies that will be implemented.

Table 4-9 describes the Caltrans monitoring strategy for the Santa Ana Region.

Table 4-9
Santa Ana Region TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Options	Caltrans Strategy
Lake Elsinore and Canyon Lake Nutrient TMDL	Attachment D, Section D5.13	Cooperative monitoring: Participate in Lake Elsinore and Canyon Lake Nutrients TMDL Task Force Self-monitoring: Prepare and implement a monitoring program that is consistent with that conducted by the Lake Elsinore and Canyon Lake TMDL Task force	Caltrans has selected cooperative monitoring. Caltrans will continue to participate in the Lake Elsinore and Canyon Lake Nutrients TMDL Task Force

In addition to participating in the Lake Elsinore and Canyon Lake Nutrients TMDL Task Force, Caltrans will characterize its runoff at 4 sites in the Big Bear Lake and Calleguas Creek watersheds. Monitoring at these new sites is expected to commence during the 2023-24 fiscal year. Additional details on this self-monitoring are provided in Section 5 and Appendix B

4.2.8 San Diego Water Board TMDLs (Permit Section F2.12.7)

Twenty Beaches & Creeks Bacteria TMDL (Permit Section F2.12.7.1)

Caltrans monitoring options in the Project I – Twenty Beaches and Creeks Bacteria TMDL watersheds are:

1. *Cooperative Monitoring*. Caltrans will participate in cooperative watershed monitoring with the other responsible municipalities, as approved by the State Water Board Executive Director in consultation with the San Diego Water Board Executive Officer. Caltrans participation shall be a proportional responsibility that is calculated in accordance with Caltrans land use coverage in the watershed; or
2. *Self-Monitoring*. Caltrans will conduct compliance monitoring to demonstrate the effectiveness of best management practices (BMPs) in controlling bacteria loads. Receiving water monitoring will be conducted in three representative watersheds annually for the Permit term. For each of the twenty beaches and creeks watersheds, outfalls shall be monitored weekly during the dry season and a minimum of three rain events during one wet season. This monitoring will be conducted in two different sampling years and at a minimum of twice per Permit term.

Table 4-10 describes the Caltrans monitoring strategy for the Twenty Beaches & Creeks Bacteria TMDL.

In addition, Caltrans will continue to self-monitor indicator bacteria in its runoff at five characterization sites in the Chollas Creek watershed. Monitoring at these sites, which are existing monitoring sites, is expected to continue during the 2024-25 fiscal year. Additional details on this self-monitoring are provided in Sections 5 and 6, and Appendix B.

Table 4-10
Twenty Beaches & Creeks Bacteria TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Options	Caltrans Strategy
Twenty Beaches & Creeks Bacteria TMDL	Attachment F, Section F2.12.7.1 Attachment D, Section D5.14.1	Cooperative monitoring: Participate in an approved cooperative watershed monitoring program Self-monitoring: Conduct annual receiving water in three representative watersheds, and outfall monitoring in each of the twenty beaches and creeks watersheds. May conduct compliance monitoring to demonstrate BMP effectiveness for bacteria	Caltrans has selected cooperative monitoring. Caltrans will continue to participate in Project I-Twenty Beaches and Creeks/ Chollas Creek Bacteria TMDL Monitoring in cooperation with the County and City of San Diego and other responsible municipalities

Chollas Creek Dissolved Metals TMDL (Permit Section F2.12.7.2)

Caltrans monitoring options in the Chollas Creek Dissolved Copper, Lead, and Zinc TMDL (Chollas Creek Metals TMDL) watershed are:

1. *Cooperative Monitoring*. Caltrans may participate in or contribute to a cooperative watershed monitoring program with the other responsible municipalities, as approved by the State Water Board Executive Director in consultation with the San Diego Water Board Executive Officer. Receiving water will be sampled monthly during the wet season; or
2. *Self-Monitoring*. Caltrans may develop and conduct compliance monitoring to demonstrate the effectiveness of best management practices (BMPs) at outfalls. Representative outfalls will be monitored for applicable metals for one rain event per year over three separate years during the wet season per the Permit term or per every five years, whichever is less.

Table 4-11 describes the Caltrans monitoring strategy for the Chollas Creek Metals TMDL.

Table 4-11
Chollas Creek Dissolved Copper, Lead, and Zinc TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Options	Caltrans Strategy
Chollas Creek Metals TMDL	Attachment F, Section F2.12.7.2 Attachment D, Section D5.14.2	Cooperative monitoring: Participate in an approved cooperative receiving water monitoring program Self-monitoring: Perform representative outfall monitoring for applicable metals for one rain event per year over three separate years during the wet season per the Permit term or per every five years, whichever is less. Caltrans may develop and conduct compliance monitoring to demonstrate the effectiveness of BMPs	Caltrans has selected self-monitoring. Caltrans will continue monitoring at representative BMP sites that have been approved by the Water Board. The approved sites are an Austin sand filter and a bioswale. Monitoring at these approved sites will target a minimum of one rain event per year over three separate years during the wet season, and will include north and south fork receiving water sampling for hardness and pH. Although not required by the Permit since self-monitoring is selected, Caltrans will continue to participate in the Regional Monitoring Program with the City of San Diego to assess compliance in the receiving water

Since 2010, Caltrans has installed more than 20 structural BMPs within its right-of-way to treat stormwater runoff in the Chollas Creek watershed. Five monitoring stations, located at representative Caltrans BMP locations on the north and south forks of Chollas Creek, have been selected for Caltrans runoff characterization and BMP effectiveness monitoring. These locations include an Austin sand filter and one receiving water station on the north fork and a bioswale and one receiving water station on the south fork. To improve assessments of the dissolved metals TMDL acute and chronic thresholds, two receiving water monitoring stations located on the north and south fork of Chollas Creek are also being monitored. Monitoring at these BMP and receiving water sites, which are existing monitoring sites approved as representative sites by the San Diego Water Board, is expected to continue during the 2024-25 fiscal year. Additional details on this self-monitoring are provided in Sections 5 and 6, and Appendix B.

Los Peñasquitos Lagoon Sediment TMDL (Permit Section F2.12.7.3)

Caltrans monitoring options in the Los Peñasquitos Lagoon Sediment TMDL watershed are:

1. *Cooperative Monitoring*. Caltrans will participate in or contribute to an approved cooperative watershed monitoring program with the other responsible parties; or
2. *Self-Monitoring*. Caltrans will develop and conduct compliance monitoring to demonstrate the effectiveness of best management practices and to demonstrate compliance with the load reduction. Best management practices effectiveness will be demonstrated through monitoring a minimum of either (i) 20 percent of the total inventoried best management practices in the Los Peñasquitos Watershed or (ii) a total of three best management practices in the Los Peñasquitos Watershed, whichever is greater. The minimum number of treatment best management practices selected for monitoring must be representative of the BMPs being relied upon for meeting the Required Sediment Load Reduction. Monitoring for BMPs must be conducted annually for 3 rain events during the wet season. Caltrans will monitor representative outfalls draining from Los Peñasquitos, Carroll Canyon, and Carmel Creek locations prior to entering the Los Peñasquitos Lagoon. Outfall monitoring will be performed during three storms over two wet seasons.

Table 4-12 describes the Caltrans monitoring strategy for the Los Peñasquitos Lagoon Sediment TMDL.

Table 4-12
Los Peñasquitos Lagoon Sediment TMDL Monitoring

TMDL(s)	Section in Permit	Monitoring Options	Caltrans Strategy
Los Peñasquitos Lagoon Sediment TMDL	Attachment F, Section F2.12.7.3 Attachment D, Section D5.14.3	Cooperative monitoring: Participate in an approved cooperative watershed monitoring program Self-monitoring: Conduct compliance monitoring to demonstrate BMP effectiveness. Monitor a minimum of either (i) 20 percent of the BMPs or (ii) a total of 3 BMPs, whichever is greater. Monitor representative outfalls draining from the Los Peñasquitos, Carroll Canyon, and Carmel Creek locations prior to entering the Los Peñasquitos Lagoon	Caltrans has selected cooperative monitoring. Caltrans, together with other permittees, submitted the Los Peñasquitos Watershed Management Area Water Quality Improvement Plan and Comprehensive Load Reduction Plan in 2015. Caltrans will continue to participate in the Los Peñasquitos Lagoon Restoration Project, which includes approved cooperative monitoring activities.

SECTION 5

Runoff Characterization Monitoring

5.1 Purpose (Permit Section F2.13)

This section describes current and proposed Caltrans runoff characterization monitoring in all watersheds, including TMDL watersheds. The purpose of runoff characterization monitoring is to collect data at representative runoff locations to inform selection of BMPs and establish Caltrans baseline concentrations and loads to demonstrate compliance.

Examples of demonstrating compliance include demonstrating that no discharges occurred from the Caltrans right-of-way to the waterbody, that exceedances of receiving water limits are due to loads from other sources, or modeling indicates that Caltrans discharges comply with TMDL waste load allocations.

5.2 Characterization Monitoring Sites (Permit Section F2.13)

Table 4 in the QAPP (Appendix B) lists the current and proposed runoff characterization monitoring sites, together with information on the station codes, where the sites are located, and the type of monitoring (edge-of-pavement, right-of-way, or BMP influent). Caltrans intends to monitor 36 runoff characterization sites during the 2023-24 fiscal year.

Site selection for runoff characterization focused on TMDL watersheds. For each TMDL watershed, an analysis was performed to determine the number of existing runoff monitoring sites and representative runoff sites that had at least five analytical results for the TMDL constituent. Representative sites are sites that are located outside the TMDL watershed but are considered representative of sites within the TMDL watershed based on important factors such as traffic. Traffic was the main factor found to govern Caltrans runoff quality in previous characterization studies (Section 4 in Caltrans 2003). Following this approach, new runoff monitoring sites were identified in the following TMDL watersheds: Big Bear Lake, Los Angeles River, Redwood Creek, Sacramento- San Joaquin River Delta Estuary, South Fork Eel River, San Francisco Bay, San Gabriel River, and some smaller watersheds.

5.3 Characterization Monitoring Approach (Permit Section F2.13)

Caltrans approach for collecting representative runoff samples for the sites listed in Table 4 of the QAPP is described in Appendix B (Group B: Data Generation and Acquisition). Runoff characterization monitoring will follow guidance established in the Caltrans Monitoring Guidance Manual (Caltrans 2020).

5.4 Characterization Monitoring Schedule (Permit Section F2.13)

Table 4 of the QAPP (Appendix B) provides the monitoring schedule for runoff characterization sites in each TMDL watershed. Table 4 specifies monitoring that will be conducted during the

2023-24 fiscal year and monitoring that is proposed for the 2024-25 fiscal year. The decision to monitor these sites during the 2024-25 fiscal year will be made after the current season, when the total number of usable data points for the sites are known.

SECTION 6

BMP Effectiveness Monitoring

6.1 Purpose (Permit Section F2.14)

This section describes current and proposed Caltrans BMP effectiveness monitoring in all watersheds, including TMDL watersheds. The purpose of BMP effectiveness monitoring is to collect data at representative BMP locations to determine the effectiveness of Caltrans BMPs and establish Caltrans BMP effluent concentrations and loads to demonstrate compliance.

Examples of demonstrating compliance include demonstrating that no BMP effluent discharge occurred to the waterbody, that exceedances of receiving water limits are due to loads from other sources, or modeling indicates that effluent from Caltrans BMPs complies with TMDL waste load allocations.

6.2 BMP Monitoring Sites (Permit Section F2.14)

Table 4 of the QAPP (Appendix B) lists the current and proposed BMP effectiveness monitoring sites, together with information on the influent and effluent station codes, where the sites are located, and key TMDL pollutants. Caltrans intends to monitor a total of 16 BMP sites during the 2023-24 fiscal year, including 6 pilot trash devices.

Site selection for BMP effectiveness assessment focused on ecoregions. For each ecoregion, an analysis was performed to determine the number of existing BMP monitoring sites of a given type that had at least five analytical results for the TMDL constituent. Representative sites outside the ecoregion were also identified. Representative sites outside an ecoregion are sites that are located outside the ecoregion but are considered representative of sites within the ecoregion based on traffic, the main factor found to govern Caltrans runoff quality in previous characterization studies (Section 4 in Caltrans 2003). Following this approach, new BMP effectiveness monitoring sites were identified in the following water board regions: North Coast, San Francisco Bay, Central Valley, Los Angeles, and San Diego.

6.2.1 North Coast Region (Permit Section F2.14)

Caltrans intends to monitor the effectiveness of two bioswales, one that drains to McCoy Creek in the South Fork Eel River watershed and another near Lord Ellis Summit that drains to Redwood Creek. Monitoring at these new BMP sites, which will include influent and effluent stations, is expected to commence during the 2023-24 fiscal year. Details on these BMP sites are given in Table 4 of the QAPP.

6.2.2 San Francisco Bay Region (Permit Section F2.14)

Caltrans is currently monitoring the effectiveness of an Austin sand filter vault that drains to Carquinez Strait in the San Francisco Bay region. This BMP site, which includes influent station

4-434 and effluent station 4-435, will be monitored during the 2023-24 fiscal year. Details on this BMP site are given in Table 4 of the QAPP.

6.2.3 Central Valley Region (Permit Section F2.14)

Caltrans is currently monitoring the effectiveness of three types of Open Graded Friction Course (OGFC) near Santa Nella in the Central Valley: Non-Rubberized, Rubberized, and Modified Rubberized. The Santa Nella OGFC study consists of four monitoring stations: three stations with OGFC overlays (10-307, 10-308, 10-310), while the remaining station (10-306) is a control station that collects runoff from standard dense-graded hot mix asphalt. Monitoring of these stations will continue during the 2023-24 fiscal year. Details on these BMP sites are given in Table 4 of the QAPP.

6.2.4 Los Angeles Region (Permit Section F2.14)

Caltrans is currently monitoring the effectiveness of two Austin sand filters in the Los Angeles Region, one in the Ballona Creek watershed and one in the Peck Road Park Lake (Los Angeles River) watershed. The Ballona Creek filter, located off I-10, includes influent station 7-413 and effluent station 7-414. The Peck Road Park Lake filter, located off SR-210, includes influent station 7-422 and effluent station 7-423. These BMP sites will be monitored during the 2023-24 fiscal year. Details on these BMP sites are given in Table 4 of the QAPP.

Caltrans will also continue monitoring the effectiveness of pilot trash devices with biochar media at six locations in the Los Angeles Region, all in the Los Angeles River watershed. These pilot trash devices are gross solid removal devices that have been retrofitted with biochar media, an economical and easily available filtration media that has the potential to provide treatment for metals and other pollutants. These devices will be monitored during the 2023-24 fiscal year. Details on the trash BMP sites are given in Table 4 of the QAPP.

6.2.5 San Diego Region (Permit Section F2.14)

Caltrans has constructed bioswales, modular infiltration trenches, and an Austin sand filter to address the Chollas Creek Diazinon TMDL, Dissolved Metals TMDL, and Twenty Beaches and Creeks Bacteria TMDL. Caltrans has selected and is performing effectiveness monitoring of one bioswale and one Austin sand filter. The bioswale, located off SR-94, includes influent station 11-357 and effluent station 11-358. The Austin sand filter, also located off SR-94, includes influent station 11-359, effluent station 11-360, and bypass station 11-361. In addition to BMP effectiveness monitoring, Caltrans is also conducting monitoring at two receiving water stations (11-355 and 11-356) to improve assessments of dissolved metals TMDL acute and chronic thresholds. These BMP and receiving water sites will be monitored during the 2023-24 fiscal year. Details on these sites are given in Table 4 of the QAPP.

Caltrans is also conducting a pilot pervious pavement BMP monitoring study at three sites near Encinitas in the Cottonwood Creek watershed. The Encinitas Pervious Pavement Pilot Monitoring Project (Encinitas Pilot Project) consists of three stations that evaluate the performance of pervious highway shoulders for runoff treatment. One station (11-362) monitors untreated runoff while the other two monitor treated effluent (11-363 and 11-364). Continuation of monitoring at these sites will depend on a review of operational monitoring data collected to date. Details on these BMP sites are given in Table 4 of the QAPP.

6.3 BMP Monitoring Approach (Permit Section F2.14)

Caltrans approach for collecting representative samples for the BMP sites listed in Table 4 of the QAPP is described in Appendix B (Group B: Data Generation and Acquisition). BMP effectiveness monitoring will follow guidance established in the Caltrans Monitoring Guidance Manual (Caltrans 2020).

6.4 BMP Monitoring Schedule (Permit Section F2.14)

Table 4 of the QAPP (Appendix B) provides the monitoring schedule for BMP effectiveness sites in each TMDL watershed. Table 4 specifies monitoring that will be conducted during the 2023-24 fiscal year and monitoring that is proposed for the 2024-25 fiscal year. The decision to monitor these sites during the 2024-25 fiscal year will be made after the current season, when the total number of usable data points for the sites are known.

SECTION 7

Conditionally Exempt Non-Stormwater Discharge Monitoring

Section F2.15 of the Caltrans Permit allows certain types of non-stormwater discharges that are not considered to be sources of pollutants. However, if the State Water Board Executive Director determines that any category of allowed non-stormwater discharge is a source of pollutants, the State Water Board Executive Director may require the Department to conduct additional monitoring and submit a report on such discharges. The State Water Board Executive Director may also order the Department to cease a non-stormwater discharge.

During the 2023-24 season, the State Water Board Executive Director has not identified any of the conditionally exempt non-stormwater discharges to be a source of pollutants.

SECTION 8

References

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Appendix A
Sampling and Analysis Plan

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SAP-1 Monitoring Equipment and Sample Collection

This chapter describes the equipment and methods employed by California Department of Transportation (Caltrans) monitoring consultants to collect stormwater samples, have them analyzed by environmental laboratories, implement quality control, and manage data. Methods for making field measurements and collecting hydrologic and rainfall data are also discussed in this chapter.

This document is intended to be a guide for field personnel, project managers, and other consultant personnel who are directly involved with stormwater monitoring activities. For more detailed information about the principles and theory of stormwater monitoring, see the Caltrans Stormwater Monitoring Guidance Manual (Caltrans 2015).

SAP-1.1 Sample Types

Nearly all water samples that are collected as part of the Caltrans stormwater program are taken from either stormwater discharge streams or receiving waters. Samples fall into one of two categories:

- Grab Sample – A single sample collected and analyzed discretely.
- Composite Sample – A sample that is composed of two or more subsamples (called aliquots) that are collected at different times over the life of the monitoring event. Subsamples are combined in the field, either manually or with the use of automated equipment, and sent to the laboratory as a single sample to be analyzed. Under some circumstances, a laboratory may also combine subsamples into a single sample before analysis (see Section SAP-1.7.1).

Grab samples are collected at only a single point in time, so they represent the runoff stream or waterbody at only that point in time. Composite samples are made up of many subsamples collected over a period of time, so the composite sample is representative of a larger portion of the storm. However, composite samples require more resources to collect. This is a common tradeoff that must be considered when planning a monitoring project. For a further discussion of this topic, refer to Chapter 2 of the Caltrans Stormwater Monitoring Guidance Manual (Caltrans 2015).

SAP-1.2 Composite Sample Collection

There are two approaches for collecting composite samples:

- Time-proportioned – A composite sample produced from aliquots that are taken at regular time intervals; each aliquot is of equal volume. A time-proportioned composite sample represents every portion of the storm hydrograph equally, regardless of changes in flow rate.

- Flow-proportioned – A composite sample that is produced from aliquots that are taken in proportion to the rate or volume of flow. The resulting composite sample is more representative of the entire discharge volume than either a grab sample or a time-proportioned composite sample because each portion of the hydrograph is represented in proportion to the flow volume.

Flow-proportioned sample collection is more common than time-proportioned sample collection for Caltrans stormwater monitoring, but time-proportioned composite sample collection may be performed in some cases, depending on the study design.

Composite samples are most commonly collected using automated sampling equipment, but can also be collected manually. Automated sample collection is described in Sections SAP-1.2.1 through SAP-1.2.4; Section SAP-1.2.5 describes manual collection of composite samples.

SAP-1.2.1 Composite Sample Collection Equipment

A standard stormwater monitoring station consists of the following components:

- A flow-measurement structure such as a flume, weir, or pipe
- A flowmeter/data logger
- An autosampler (an automated peristaltic-pump sample-collection device)
- A tipping bucket rain gauge
- A marine battery and one or more solar panels
- Telecommunications equipment
- Security enclosure

The electronic equipment will be placed in a locked steel or fiberglass security enclosure to prevent theft and vandalism.

SAP-1.2.2 Composite Sample Collection Equipment Installation

A flow-measurement structure will be constructed at a point in the discharge stream where it can constrict flow without causing upstream flooding or other problems during heavy storms.

Flumes and weirs will be used whenever possible because they allow for more accurate flow measurement than other structures such as pipes or channels. Prefabricated primary flow measurement devices come calibrated from the manufacturer. Primary devices that are constructed on site must be sized properly for the expected range of flow rates. Primary devices do not usually need to be recalibrated unless some condition at the site changes.

The most important consideration when selecting a primary device is that it be the proper size for the expected flow rates. Flumes and weirs are calibrated for a minimum and maximum flow rate, and flow rates outside these limits will not be measured accurately.

In cases where it is not possible or desirable to construct a flow-measurement structure, an existing conveyance may be used as a flow-measurement device.

The construction of flow-measurement structures requires considerable skill, experience, and expertise. Experienced field technicians and project managers will supervise the construction of these structures.

SAP-1.2.2.1 Flumes

Flumes may be installed in channels of small-to-moderate size. The width of the entrance to the flume should equal the width of the channel being monitored. The flume crest is usually set level with or slightly higher than the bed of the approach channel. Flumes may be set in concrete or earth or bolted to companion structures. When pouring concrete, the flume should be braced internally to prevent distortion of the flume walls.

Water must enter the flume in a smooth, free-flowing manner, with minimal turbulence and uniform velocity across the width of the channel. To create these conditions there must be a section of straight length of channel upstream from the flume that is long enough to produce steady, uniform flow without standing waves. The straight length of channel required may be 10 to 40 times the flume throat width. Upstream turbulence must be avoided because it can cause errors in flow measurement.

The portion of the channel directly downstream from the flume should allow water to flow freely away from the flume. A downstream channel that is restricted or undersized can cause resistance to flow, creating a backwater effect.

Because water accelerates through a flume, the deposition of sediment is not normally a serious problem. However, flumes can become clogged with debris. When constructing a monitoring site, consideration will be given to conditions upstream that could contribute vegetation, litter, or other materials that could get stuck while passing through a flume.

SAP-1.2.2.2 Weirs

Weirs can be installed in channels and pipes of a wide range of sizes. A weir must be installed in an area where the approaching flow is a smooth stream free from turbulence. Approaching flow should have low velocity as it enters the pool area formed behind the weir, and the velocity should be uniformly distributed across the channel. To achieve these conditions, the weir should be installed in a natural channel with a long approach and with little or no slope. When possible, the approach to a weir should be a straight channel for a distance of at least 20 times the maximum expected depth of water within the pool.

Weirs must be constructed and installed to ensure that water flows over the crest in free fall, with air space between the nappe (flow over the weir) and the downstream face of the weir. A weir plate should be ⅛- to ¼-inch thick with a straight edge or a thicker plate with a downstream chamfered edge. The upstream edge of the weir must be sharp, with right angle corners. The upstream face should be smooth and perpendicular to the axis of the channel in both horizontal and vertical directions. The weir crest must be set higher than the water level downstream from the weir so that water gravity-flows over the weir freely. The crest of the weir also must be exactly level to ensure a uniform depth of flow over the weir crest.

SAP-1.2.2.3 **Existing Conveyances**

In cases where building a flow-measurement structure is not possible or desirable for some reason, a monitoring site will be selected at a point where stormwater discharge flows through some natural or artificial conveyance with a known geometry that can be used for flow monitoring in conjunction with a depth measurement device or an area-velocity flowmeter.

SAP-1.2.2.4 **Rain Gauge**

Rain gauges will be mounted on top of steel poles. The signal wire will be threaded down through the pole and into the protective equipment enclosure, where it will connect to the data logger (in most cases, this is the flowmeter). The exposed length of signal wire between the pole and the enclosure will be protected by metal or PVC (polyvinyl chloride) conduit.

Rain gauges must be installed securely in a location where buildings, trees, overpasses, additional solar panels mounted on adjacent poles, or other objects will not obstruct or divert rainfall from falling into the rain gauge. They will be installed such that the openings are horizontal and level, and secured so that they remain level in extreme weather conditions.

Rain gauges will be installed over undisturbed land at least 3 feet above the ground. In areas having an accumulation of over 2 feet of snow per year, a rain gauge will be installed at least 12 inches above the usual seasonal snow level. If a heated rain gauge is used to operate under freezing conditions, additional solar panels and an additional battery will be installed to provide extra power.

SAP-1.2.2.5 **Solar Panels**

Solar panels will be installed on steel poles at a height of at least 8 feet. Power cables will be threaded down through the pole and into the protective equipment enclosure, where it will connect to the solar panel regulator and a marine battery. Solar panels will be installed in areas where they are not shadowed by taller structures or trees, and will not be installed on the same pole as the rain gauge unless absolutely necessary.

SAP-1.2.2.6 **Security Enclosure**

A lockable steel or fiberglass enclosure will be installed on each site to protect monitoring equipment. Where possible, a concrete pad will be installed at each monitoring site and the enclosure will be bolted to it. In cases where concreate cannot be used, a wooden platform will be constructed and the enclosure will be fastened to it.

Enclosures will be situated near the monitoring site; however, they will also be placed where they are not visible to automobile or foot traffic whenever possible.

SAP-1.2.2.7 **Composite Sample Collection Equipment Calibration and Maintenance**

Table SAP-1.1 shows the calibration and maintenance requirements for automated stormwater monitoring equipment.

Table SAP- 1.1 – Calibration and Maintenance Requirements

Equipment	Annual Maintenance	Pre-Storm Maintenance	Calibration
Autosampler	– Visually inspect and test the instrument; replace the Teflon peristaltic pump tubing.	– Visually inspect and test the instrument	– Once per season, pump a known amount of water into a bucket and check to make sure that the sampler is pumping an accurate volume
Bubbler	– Ensure bubbler tube is anchored securely	– Check that bubbler tube slopes downward continuously from flowmeter to allow condensation in tubing to drain out – Check that opening of bubbler tube does not point upstream in pipe or channel – Inspect outlet of bubbler tube for clogging due to sediment or algae – Bubbler flowmeter should read 0.0 inches of water level when no water is present.	Before each event, verify bubbler depth readings consistent with independent measurements (e.g., simple staff gauge)
Pressure Transducer	– Ensure transducer is at invert of primary device and to one side of flow stream to prevent silt buildup – Confirm sensor's cable and conduit are secured and do not create turbulence	– Check that no silt buildup on the transducer – Check that cord connecting sensor to the controller unit is not damaged	Before each event, verify transducer depth readings are consistent with independent measurements (e.g., simple staff gauge)
Ultrasonic Depth Sensor	Check there are no obstructions between sensor and water surface	– Check there are no obstructions between sensor and water surface – Check that sensor cable is not damaged, and both cable and protective conduit are secured and do create turbulence	Before each event, verify ultrasonic sensor depth readings consistent with independent measurements (e.g., simple staff gauge)
Area-Velocity Probe	Ensure probe is at invert of pipe or channel and center of flow stream	– Check that probe is not damaged by heavy trash and debris	– Annually, calibrate probe following

Equipment	Annual Maintenance	Pre-Storm Maintenance	Calibration
		– Check there is no silt buildup on the probe or obstructions near it – Check that probe cable is not damaged, and both cable and protective conduit are secured and do create turbulence – Area velocity flowmeter should be reading 0.0 velocity when probe is dry	manufacturer's directions – Before each monitoring event, verify depth readings correspond to independent measurements (e.g., simple staff gauge)
Flowmeter	– Inspect all cables and connections – Ensure flowmeter is not close to batteries and sample carboys that are removed or replaced more frequently – Replace internal desiccant and internal batteries	– Inspect all cables and connections after significant flow events – Check moisture indicators during each site visit and before each monitoring event. Replace desiccant that turns pink – Confirm adequate battery voltage before storms (i.e., 12.0-Volt or higher)	– Before season starts, calibrate flowmeter following manufacturer's instructions – Before each monitoring event, verify depth readings correspond to independent measurements (e.g., simple staff gauge) – Record calibration data on standard calibration form (see Section 8.3.1.4 of Monitoring Guidance Manual, Caltrans 2015)
Data Logger	Inspect battery and ensure it holds charge	– Inspect before each storm event and verify working properly. Check battery holds charge – Download "old" data and verify sufficient memory available for new event – Verify sample collection programming is a minimum of 5 minutes during events, and is more frequent, depending on size and intensity of storm, memory capacity of logger, and requirements of project	N/A
Rain Gauge	Inspect the unit and cables for damage or wear	Inspect the unit and cables for damage or wear; inspect the rain gauge opening to make sure that it is not clogged with debris	N/A
Pump Tubing	Tubing must be correct size for pump. Confirm tubing meets	- Check tubing is securely threaded between pump housing and rotors	N/A

Equipment	Annual Maintenance	Pre-Storm Maintenance	Calibration
	manufacturer's specification	- Check tubing for wear after each monitoring event. Replace worn or damaged tubing before next monitoring event	
Sample Intake Tubing	- Intake tubing must fit tightly inside sampler tubing. Confirm tubing meets manufacturer's specification - Check sampler vertical lift does not exceed 27 feet and, ideally, is below 15 feet - Check protective metal or PVC conduit holding intake tubing is secured to enclosure and primary device or conveyance - Use clean-hands techniques discussed in Appendix A when handling tubing	- Check intake tubing is tight inside sampler tubing, has no cracks or kinks, and is securely fastened to sampler - Check intake tubing slopes downward from protective enclosure to allow draining between sample collections - Use clean-hands techniques discussed in Appendix A when handling tubing	N/A
Strainer	Ensure strainer at invert of primary device or conveyance and able to collect low flow samples. Strainer may be mounted above invert or on channel side wall if it remains submerged during lowest expected flows and high solids loadings is expected	- Check strainer is clean, not clogged, and fastened securely to the intake tubing	N/A

SAP-1.2.3 Automated Collection of Composite Samples

As mentioned in Section SAP-1.2, most composite sample collection that is performed for Caltrans is flow-proportioned composite sampling; an aliquot is collected from the discharge every time a certain predetermined volume of runoff passes the monitoring station. This predetermined volume of flow is called a "trigger volume," since it is the volume required to trigger the autosampler to take an aliquot. The resulting composite is a flow-proportionate representation of the entire discharge.

The trigger volume for a station varies with site hydrology and storm size, and must be determined before each storm using the Quantity Precipitation Forecast (QPF) of the upcoming storm. The trigger volume is programmed into the flowmeter before the monitoring event begins.

Estimating an appropriate trigger volume is critical for composite sample collection. Too large a trigger volume will result in too few aliquots being collected to represent the storm (see Table SAP-1.2); too small a trigger volume will result in too many aliquots, which can overflow the composite sample container.

SAP-1.2.3.1 **Calculating the Trigger Volume**

The trigger volume is expressed as a volume, and is calculated based on the number of aliquots that will be required for the final composite sample (see Table SAP-1.2). The volume of sample required is determined by the amount of sample that the laboratory requires to perform all of the analyses on the project constituent list.

Trigger volume is calculated as follows:

$$Trigger\ Volume\ (cf) = \frac{Vr(cf)}{CSA}$$

Where:

Vr = Total expected runoff volume for forecast storm (calculated based on storm QPF and site hydrology)
CSA = Number of composite sample aliquots required for the composite

For a full discussion of this calculation, see the Stormwater Monitoring Guidance Manual (Caltrans 2015).

If a storm delivers more precipitation than expected, composite bottle replacement may be required to capture runoff from the entire storm event, as noted previously.

SAP-1.2.3.2 **Automatic Composite Sampling**

This procedure applies to both flow-proportionate and time-proportionate composite sample collection.

When a storm is imminent, the station is checked in accordance with the instructions given in Table SAP-1.1. If a flow-proportionate composite sample will be collected, the correct trigger volume is programmed into the flowmeter/data logger. The station is then ready to begin monitoring.

Automatic monitoring stations must be checked periodically throughout a monitored storm event to make sure the station is functioning properly. If the composite sample container (carboy) fills more rapidly than expected, field personnel must be mobilized to exchange if for an empty one. If the composite sample collection period exceeds 24 hours, then the carboy must be replaced with a clean, empty carboy. For constituents with short holding times (48 hours or less), the carboy will be transported to the laboratory so that the analyses with short holding times can be performed.

After the storm event has ended, field personnel will retrieve the filled composite carboys, perform any necessary port-event activities at the site, and lock all equipment in the safety enclosure.

SAP-1.2.3.3 **Changing Carboys**

When an automated monitoring station is used for the collection of composite stormwater samples and a carboy change is required, the change is conducted using the following steps:

1. The automated sampling equipment is placed in pause mode before the initiation of a carboy change.
2. Changing carboys requires two field crew members: “clean hands” and “dirty hands” (see Section 1.6). Both team members wear clean, powder-free nitrile gloves. “Clean hands” only touches suction tubing and Teflon® composite bottle lids. Keep extra gloves within easy reach.
3. Before putting on clean gloves, the clean empty sample bottle is placed near the automated sampling unit, and the sampler is opened.
4. Wearing clean powder-free nitrile gloves, “dirty hands” removes the lid clamps from both the full sample bottle and the clean sample bottle.
5. “Clean hands” removes the end of the pump tubing from the composite bottle and “dirty hands” places a clean Ziploc® bag over the end of the tubing securing it with a rubber band. The inside of the bag should never be touched by sampling personnel.
6. “Clean hands” switches the bottle lids, putting the solid lid on the full bottle and the perforated lid on the clean empty bottle.
7. “Dirty hands” installs the lid clamps on both bottles, removes the full bottle from the sampler, replacing it with the clean empty bottle.
8. “Clean hands” holds the tubing while “dirty hands” removes the Ziploc® bag from the end of the pump tubing, being careful not to touch the tubing.
9. “Clean hands” inserts the tubing through the lid of the clean bottle.
10. The sampler is closed and the sampling equipment is placed in sample mode. Remote operation personnel are notified as soon as the bottle change is complete.
11. The sampling team fills out the appropriate information on the label of the full sample bottle.
12. The full bottle is placed on ice and secured inside the vehicle for transport.

SAP-1.2.3.4 Flow and Rainfall Measurement

When a flowmeter/data logger is used at a monitoring site, the data logger begins taking discrete flow measurements as soon as the stormwater runoff begins (concurrently with sample collection). The tipping-bucket rain gauge records rainfall throughout the storm and these data are also recorded by the data logger. The data logger will record the flow rate at either 1- or 5-minute intervals over the life of the storm and record each tip of the rain gauge. After the storm ends, field technicians will download these data into a laptop computer.

SAP-1.2.3.5 Composite Sample Representativeness

Immediately following sample collection, composite sample representativeness must be evaluated to determine whether samples meet the study's minimum acceptable storm capture requirements, listed in Table SAP-1.2. Percent storm capture is the percentage of the total event flow that passes the sampling station during which sample collection has occurred. This is a measurement of how representative the sample is of the whole discharge.

Table SAP- 1.2 - Required Number of Aliquots for Storm Representation

Total Event Precipitation	Minimum Number of Aliquots	Minimum Percent Storm Capture
0–0.25	6	85
0.25–0.5	8	80
0.5–1	10	80
>1	12	75

Source: Stormwater Monitoring Guidance Manual (Caltrans 2015).

If a composite sample does not meet this criterion, the Caltrans Task Order Manager will be notified immediately. The Caltrans Task Order Manager will determine whether or not to have the samples analyzed.

The minimum number of sample aliquots and minimum acceptable storm percent capture depend upon the total event precipitation, as shown in Table SAP-1.2. The specified minimum number of sample aliquots is intended to ensure the composite sample adequately represents the monitored storm event. Higher numbers of sample aliquots are desirable whenever possible, subject to the practical limits of sample collection.

SAP-1.2.3.6 Manual Collection of Composite Samples

Composite samples can be made by adding manually-collected grab samples together in a single sample container and then homogenized by swirling the container vigorously. A large carboy is normally used as the final sample container.

To produce a manually-collected composite, grab samples are collected in accordance with the methodology discussed in Section SAP-1.3.1. The individual grab samples must be treated as individual samples before compositing; all of the requirements for sample handling, such as keeping the samples cool and using proper custody procedures, apply to the individual samples before they are composited.

Samples are taken from the monitoring site either at regular intervals (to create a time-proportioned composite), or each time a specified volume of discharge has passed through the monitoring station (to create a flow proportioned composite). After all of the samples have been collected, they are shaken or swirled vigorously in order to homogenize them and the then quickly poured into the final sample container before the solids have a chance to settle. All of the subsamples are combined in this way. After each subsample bottle is emptied into the final container, field technicians will examine it to make sure that all of the solid material has been emptied into the final container. If solid residue is left in the subsample container, some of the final sample can be poured back into the subsample bottle in order to rinse the remaining material out, and then poured back into the composite container. Subsample containers will be thoroughly emptied into the composite container before they are discarded.

SAP-1.3 Grab Sample Collection

Composites will be used for most stormwater monitoring projects because they represent a storm more fully than grab samples do. However, some grab samples will also be collected. For a complete discussion of the advantages and disadvantages of composite and grab samples, see the Stormwater Monitoring Guidance Manual (Caltrans 2015).

A grab sample is defined as an individual discrete sample collected over a period of time not exceeding 15 minutes. It can be taken manually, using a pump, scoop, or other suitable device, or collected directly into laboratory-supplied sample bottles.

Field personnel will use their best judgement to collect grab samples that are representative of the monitoring event, as close as possible to the estimated peak of the discharge. For storms, samples will be collected sometime during the middle of the storm whenever possible. When a storm discharge is expected to last more than three hours, grab samples will not be collected during that “first flush” portion of the event. Grab samples will also not be collected during the final stage of the event, where storm runoff has declined significantly from peak flow.

If grab samples are collected during the first three hours for some reason (during short storm events, for example), field technicians will verify visually that the stormwater flow and the turbidity have stabilized before grab samples are collected.

Grab samples are usually collected manually. However, autosamplers can also be used to collect grab samples.

SAP-1.3.1 Manual Collection of Grab Samples

Manual grab samples will be collected either by filling sample bottles directly from the stream or by filling some intermediary container and then pouring the sample into the sample bottles. For this project, it is preferable to fill sample bottles directly from the stream if that can be done easily and safely. Intermediary containers will be used for collecting grab samples only when necessary.

Many sample bottles contain preservatives when they are received from the lab. Care will be taken not to rinse the preservatives out of the bottles when direct-filling them.

Manual grab samples may be taken either by completely submerging the bottle into the runoff stream and allowing it to fill, or by half-submerging the bottle and filling it from the air-water interface. Either is acceptable for most samples; however, samples collected for oil and grease must be collected at the air-water interface in order to catch petroleum compounds that float on the surface of the stream. For all other constituents, field technicians should use their best professional judgment to decide how best to fill the bottles without introducing any sediment or floating debris into the samples.

If an intermediary container such as a bailer must be used, field personnel must make sure that the intermediary container is completely clean before use. Non-disposable intermediary containers must be cleaned by the laboratory according to the method listed in Appendix B. If field crews have any reason to believe that an intermediary container has been contaminated, then it must not be used until it has been cleaned. Intermediary containers are filled either from the air-water interface or by complete submersion, the same way that sample bottles are filled.

Regardless of which sample collection method is selected for each monitoring site, samples for oil and grease and microbiological analyses will be collected manually, directly into the sample containers without the use of intermediary containers.

SAP-1.3.2 Automated Collection of Grab Samples

Grab samples may also be collected using the peristaltic pump on an autosampler. The sample intake tube is submerged into the runoff stream and the pump outlet tube is placed in the sample bottle or intermediary container. The containers are filled by running the pump. As with manual collection, care must be taken to make sure that preservative is not rinsed out of preserved bottles by overfilling them.

Samples for microbiological analysis, for volatile organic compounds, for low-level mercury, and for oil and grease may not be collected using the automated method; samples for these analyses must be collected directly into the sample bottles provided by the laboratory.

SAP-1.3.3 Manual Measurement of Stormwater Flow

In the event that manually-collected grab samples must be combined into a flow-proportioned composite, measurements of flow must also be made by field personnel using one of the following measurement methods.

SAP-1.3.3.1 Bucket and Stopwatch Method

The bucket and stopwatch method is a manual flow measurement procedure that can be used in low-flow conditions where the stormwater discharges from a pipe or other structure where it can be captured in a bucket. The method consists of simply catching a measured volume of flow in a bucket during a measured period of time. The flow is then calculated by dividing the volume of water in the bucket by the time recorded.

Equation SAP 1.1

$$\text{Flow Rate} = \frac{\text{Volume of Sample Collected}}{\text{Time}}$$

When using this method, the discharge should be allowed to fill the bucket for at least 15 seconds. Longer measurement times usually result in more accurate flow measurement. For this reason, this method is suitable only for small or moderate flows that will not overflow a bucket quickly.

SAP-1.3.3.2 **Float Velocity Method**

The float velocity method is commonly used in large channels such as rivers, especially when it is difficult to establish a stage-discharge relationship for a channel, and when it is not practical to install an area-velocity meter to measure flow velocity. The velocity measured via the float method is used in conjunction with some means of estimating cross-sectional area of flow to compute instantaneous flow rate.

Where this method is employed, field crews will determine the cross-sectional area of the flow at a specific location and estimate the expected flow depth and width. They will then mark two places within the discharge area that are at least five feet apart. When this setup is complete, the flow can be measured by releasing a buoyant object into the channel upstream of the two marked points and measuring the time it takes to travel between them. The rate of flow can be calculated by the following formula:

Equation SAP 1.2

$$\text{Flow Rate (feet}^3\text{/second)} = \frac{\text{Distance Between Points (feet)}}{\text{Traverse Time (seconds)}} * \text{Cross Sectional Area (feet}^2\text{)}$$

If the flow is overland, the water will be directed into a channel or ditch so that accurate float measurements can be taken. The initial preparation will require that a shallow channel or ditch be dug that is at least 6 feet long and 4 to 12 inches wide. The channel or ditch must be shallow enough to easily obtain a sufficient flow depth and deep enough to carry all of the water that is directed into it.

SAP-1.4 Quality Control Samples

In addition to normal project samples, monitoring crews will collect extra samples for the purpose of quality control. This section discusses only the collection of quality control samples; the purpose of these samples and their processing by the laboratory is discussed in detail in Section SAP-2.2 of the Quality Assurance Project Plan (QAPP).

Three types of quality control samples will be collected as part of this project: field blanks, field duplicates, and matrix spikes.

- Field Blanks – Field blanks are created in the field by filling a sample bottle with reagent-grade deionized water that has been provided by the laboratory. This sample is then submitted "blind" (i.e., not identified as a quality control sample) to the laboratory for analysis.

- Field Duplicates – Field duplicates are simply two field samples that are collected the same way at the same time, and are expected to be as identical as possible to each other. Field duplicates are labeled as individual samples, not as duplicates, and submitted "blind" to the laboratory for analysis.

- Matrix Spikes – Matrix spikes are prepared in the laboratory, not in the field, but they require that triple the normal sample volume be collected. Matrix spikes are performed in duplicate, and are usually referred to as matrix spike/spike duplicate, or MS/MSD. MS/MSDs are not submitted "blind" to the laboratory, but will be clearly marked as MS/MSD samples both on the sample bottle and on the chain-of-custody (COC) form.

Field duplicates and matrix spikes are collected in the same way that normal field samples are collected. For example, if a sample for nutrient analysis is collected as a flow-proportioned composite, the corresponding duplicate and matrix spike samples will also be collected as flow-proportioned composites. This rule does not apply to field blanks, which are prepared the same way no matter how the field samples are collected.

Table SAP-1.3 shows the frequency with which quality control samples will be collected.

Table SAP- 1.3 - Frequency of Field Quality Control Sample Collection

QA/QC Sample Type	Minimum Sampling Frequency
Field Duplicate	Once every 20 samples collected at a given site or once per sampling station per season, whichever is more frequent.
Field Blank	Once every 20 samples collected at a given site or once per sampling station per season, whichever is more frequent.
Matrix Spike/Matrix Spike Duplicate	Once every 20 samples collected at a given site or once per sampling station per project, whichever is more frequent.

SAP-1.5 Field Testing

Temperature, conductivity, salinity, turbidity, dissolved oxygen, and pH may be measured in the field. A single measurement for each of these parameters will be taken during each monitoring event as required by the project. Measurements should be made somewhere during the middle of the sampled storm event, based on the best estimate that can be made by field technicians.

Table SAP-1.4 lists the various types of field measurement probes that will be employed as necessary.

Table SAP- 1.4 - Field Testing Equipment

Constituent	Units	Sensor Type	Resolution	Range
Temperature	Degrees Celsius	Glass thermometer; infrared; thermistor	0.1	0 to 40˚ Celsius
pH	pH units	Glass Combination Electrode	0.1	0 to 14 units
Conductivity	mS/cm	Four-electrode cell	1	0 to 200 mS/cm
Salinity	ppt	Calculated from conductivity and temperature	1	0 to 70 ppt
Dissolved Oxygen	mg/L	Polarographic or Galvanic	0.5	0 to 500%

Field probes and measurement devices will be maintained and calibrated in accordance with manufacturers' instructions. Field probes will be calibrated before each use.

Field personnel will record the results of all field measurements in their field logs. For quality control purposes, 10 percent of all field measurements will be made in duplicate, and the duplicate analysis will also be recorded and reported.

SAP-1.6 Sample Bottle Labeling

All sample bottles must be clearly labeled before they are used. Applying labels to sample bottles in a dry environment prior to field crew mobilization is preferable to applying them in the field as samples are collected. Labels do not stick to wet bottles, and a loosely adhered label may fall off during sample transport. The labels must be applied to the bottles rather than to the caps.

Sample bottles can be pre-labeled with all information except for the ‘Date and Time’ and the ‘Collectors Initials’ fields, which can be filled out by field technicians as the samples are collected. Figure SAP-1.1 shows an example of a bottle label.

A standardized bottle label must include the following information:

- Project Name
- Sample ID
- Site Name
- Site ID
- Date and Time
- Sample Matrix (e.g., aqueous)
- Sample Type (grab or composite)
- Bottle _ of _ (for multiple bottle samples)
- Collectors Initials:
- Preservative
- Analyte(s)

Computer labeling programs can save a great deal of time in generating bottle labels. The sites and analytical constituent information can be entered in the computer program for each monitoring program in advance, and printed as needed prior to each monitoring event.

<table>
<tr><td colspan="2" rowspan="2">Project Name:

Caltrans Long-term Characterization Study</td><td colspan="3">Sample ID Number:
12-10-_ _ _ _ _ _ _ _ _ _ _ - _00</td></tr>
<tr><td>Preservative:
4°C</td><td colspan="2">Bottle:
___ of ___</td></tr>
<tr><td colspan="2">Site Name:
Sand Canyon Toll Road Maintenance Station-Outlet</td><td>Site ID:
12-10</td><td colspan="2">Sample Matrix:
Water</td></tr>
<tr><td colspan="5">Analyte(s): Hardness, TSS, Conductivity, pH, Turbidity, TOC, Nitrate as Nitrogen, TKN, Nitrite as Nitrogen, Total Phosphorus, Dissolved Ortho-Phosphate, Total and Dissolved Metals (Cd,Cu,Pd,Ni,Zn). Pesticides (Chlorpyrifos, Diazinon)</td></tr>
<tr><td>Date:
_ _/_ _/_ _ _ _</td><td>Time:
_ _ : _ _</td><td colspan="2">Collector’s Initials:
_ _ _</td><td>Sample type:
Composite</td></tr>
</table>

Figure SAP- 1.1 - Example of a Bottle Label

SAP-1.7 Sample Containers, Preservation, and Holding Times

When samples are collected, they must be put into bottles of the appropriate type, preserved correctly, and transported to the laboratory in a timely manner so that they can be analyzed within the recommended holding times. Sample containers are obtained pre-cleaned and pre-preserved from the laboratory.

Samples will be kept at a temperature of between 0 and 6 degrees Celsius from the time that sample collection begins until they are delivered to the laboratory. The laboratory will take the temperature of the samples when they are received and record this information on the COC.

Table SAP-1.5 lists these requirements for each project constituent.

Table SAP- 1.5- Containers, Preservation, Holding Times

Constituent	Bottle/Preservative	Holding Time
Conventionals		
Hardness as $CaCO_3$	1-liter poly/HNO_3	6 months
pH	Field	Field
Temperature	Field	Field
Flow Rate	Field	Field
Salinity	Field	Field
Total Dissolved Solids	1-liter poly	7 days
Total Suspended Solids	1-liter poly	7 days
Settleable Solids	1-liter poly	24 hours
Turbidity	1-liter poly	48 hours
Alkalinity as CaCO3	1-liter poly	14 days
Conductivity	1-liter poly or field	24 hrs unpreserved
Nutrients		
Total Kjeldahl Nitrogen	250 ml poly/H_2SO_4	28 days
Nitrate as N	250 ml poly	48 hours
Nitrite as N	250 ml poly	48 hours
Phosphorous as P	250 ml poly/H_2SO_4	28 days
Orthophosphate (Total)	250 ml poly	48 hours
Ammonia as N	250 ml poly/H_2SO_4	28 days
Metals (Total)		
Aluminum	1-liter poly/HNO3	6 months
Arsenic	1-liter poly/HNO3	6 months
Cadmium	1-liter poly/HNO3	6 months
Chromium	1-liter poly/HNO3	6 months
Copper	1-liter poly/HNO3	6 months
Iron	1-liter poly/HNO3	6 months
Lead	1-liter poly/HNO3	6 months
Mercury	1-liter poly/HNO3	6 months
Mercury (low-level)	Collection kit	28 days
Nickel	1-liter poly/HNO3	6 months
Selenium	1-liter poly/HNO3	6 months
Silver	1-liter poly/HNO3	6 months
Zinc	1-liter poly/HNO3	6 months
Hydrocarbons		
Oil & Grease	1-liter glass/HCl or H_2SO_4	28 days

Constituent	Bottle/Preservative	Holding Time
Organics		
Polynuclear Aromatic Hydrocarbons (PAHs)	1-liter glass	7 days
Chlorinated Phenolics	1-liter glass	7 days
Phenolic Compounds (non-chlorinated)	1-liter glass	7 days
Organochlorine Pesticides	1-liter glass	7 days
Organophosphorus Pesticides	1-liter glass	7 days
Pyrethroid Pesticides	1-liter glass	7 days
Microbiologicals		
Total Coliform	125 ml poly/$Na_2S_2O_3$	8 hours
Fecal Coliform	125 ml poly/$Na_2S_2O_3$	8 hours
Enterococcus	125 ml poly/$Na_2S_2O_3$	24 hours
E. Coli	125 ml poly/$Na_2S_2O_3$	24 hours
Other		
Cyanide	1-liter poly/NaOH	14 days
Total Chlorine Residual	250 ml poly	Immediate
Toxicity		
Acute Toxicity	20-liter Cubitainer	36 hours
Chronic Toxicity	20-liter Cubitainer	36 hours

SAP-1.8 Clean Sampling Technique

The clean sampling technique is used by field personnel to assure that samples are not contaminated during collection. The following summary of the clean sampling technique is based on US Environmental Protection Agency (EPA) methodology (EPA 1996).

The clean sampling technique requires a two-person sampling team.

- Upon arrival at the sampling site, one member of the sampling team is designated as “dirty hands”; the second member is designated as “clean hands.”
- All operations involving contact with the sample bottle, sample bottle lid, sample suction tubing, and the transfer of the sample from the sample collection device (if the sample is not directly collected in the bottle) to the sample bottle are handled by “clean hands” wearing clean powder-free nitrile gloves.
- “Dirty hands” (also wearing clean powder-free nitrile gloves) is responsible for preparation of the sampler (except the sample container itself), operation of any machinery, and for all other activities that do not involve handling items that have direct contact with the sample.
- “Clean hands” will change into clean gloves as frequently as required to ensure that the gloved hands contacting the sample container, container lid, and laboratory-cleaned sampling equipment have not contacted any source of potential contamination.

Although the duties of “clean hands” and “dirty hands” would appear to be a logical separation of responsibilities, the actual completion of the entire protocol may require a good deal of coordination and practice. For example, "dirty hands" must open the box or ice chest containing the sample bottle and unzip the outer bag; "Clean hands" must reach into the outer bag, open the inner bag, remove the bottle, collect the sample, replace the bottle lid, put the bottle back into the inner bag, and zip the inner bag. "Dirty hands" must close the outer bag and place the double-bagged sample in an ice-filled ice chest. "Dirty hands" completes the necessary sample documentation activities.

SAP-1.9 Sample Handling and Transport

SAP-1.9.1 Sample Compositing

Most composite samples that are taken for Caltrans stormwater monitoring projects are composited automatically by the sample collection equipment, as described in Section 1.2.4.

When subsamples are collected manually, they will be composited by pouring the individual subsamples into a large, pre-cleaned container (plastic or borosilicate carboys are ideal for this), mixed thoroughly by swirling the container vigorously, and then poured into the laboratory bottles.

In some cases, individual subsamples may be sent to the laboratory for compositing. This is usually done when a multi-day storm event is monitored and full carboys are replaced every day. In cases where the laboratory will composite the samples, they will hold all subsamples until the monitoring event ends. The consultant will send the laboratory a compositing scheme based on the event hydrograph, so that the final composite produced by the lab is a flow-proportioned representation of the storm. The laboratory will composite all subsamples into a single sample for analysis. As mentioned in Section SAP-1.2.4.1, short-holding time analyses will be performed on the subsamples as they arrive at the laboratory, so these analyses will not be performed on the final composite.

SAP-1.9.2 Sample Splitting

If a composite sample duplicate is required, the sampling team will split the composite sample into two carboys to generate a duplicate sample. Field personnel will swirl the carboy vigorously to make sure it is homogenized and then pour half of the contents into a second clean carboy. The duplicate carboys will be submitted as separate samples, as "blind" duplicates.

If samples must be split for toxicity analysis, this method will be followed, but the split sample will be poured into a clean Cubitainer instead of a second carboy. This sample will not be submitted "blind" since it is not a duplicate.

SAP-1.9.3 Field Filtration

It may be necessary to filter samples in the field before they are poured into the preserved laboratory containers. This may be necessary for analysis of the dissolved fraction of some constituents, depending on the project design. All samples analyzed for dissolved metals will be field-filtered within 15 minutes of collection.

Samples will be filtered in accordance with EPA methodology (EPA 1996). A field filtration setup consists of a disposable 100 ml plastic syringe and a 0.45-micron luer-lock filter. Field technicians remove the plunger, fill the syringe with sample, replace the plunger, and then attach a filter. The sample is then filtered directly into the laboratory sample bottle by pressing the plunger and forcing the sample through the filter.

If the water is turbid, the filter may clog before an adequate volume of sample is filtered; if this happens, the clogged filter will be replaced with a fresh one and the filtration procedure will continue until the final bottle contains enough sample volume for analysis.

Some samples may clog the filters too quickly to make field-filtration practical. Field technicians will use best professional judgement to decide whether a sample can or cannot be field filtered, and all samples that cannot be field-filtered will be sent to the laboratory with instructions to filter the samples immediately upon receipt. Field technicians will note this in their field logs so that Caltrans has a written record that an attempt was made to field-filter the samples.

SAP-1.9.4 Chain of Custody

COC forms will be completed by the sampling team for samples submitted to the analytical laboratory. COC forms keep a record of the transfer of sample custody, samples submitted to the laboratory, and requested analyses.

The COC forms will include the following information:

- Sampling date and time
- Laboratory delivery date and time
- Sampling location
- Sampler’s name and contact information
- Sample type (grab or composite)
- Sampling technique (manual or automatic)
- Sample volume, container type, and preservation
- List of the assigned analyses
- Detailed description of the unusual events associated with the sampling event, sample handling, or sample transport
- Special instructions for the laboratory (e.g., filtration for dissolved metals)
- Sample temperature and condition

Copies of COC forms will be kept with field notes in a field logbook. COC forms must be checked by the field task leader to ensure that the analyses specified by the sampling plan are included.

Figure SAP-1.2 is a standard chain-of-custody form that may be printed and used by field personnel. Alternately, this for can be reproduced electronically as a spreadsheet and printed as needed. The advantage of using an electronic version is that it can be partially filled out in the office before a monitoring event begins, which will save time in the field.

Chain of Custody

Company Name:		Project:	
Mailing Address:		Billing to:	
City: Sacramento	State: CA	Zip Code:	
Telephone:	Fax #:	P.O. #	
Report To:	E-mail Address:	QC Data:	☑ Level II (standard) ☐ Level III ☐ Level IV
Sampler name and signature:			Analyses Requested

Turnaround Time

- ☐ 10 Working Days (Standard)
- ☐ 7 Working Days
- ☐ 5 Working Days
- ☐ 72 Hours
- ☐ 48 Hours
- ☐ 24 Hours
- ☐ 2-8 Hours

Notes:

Client Sample I.D.	Date/Time Sampled	Matrix	# of Cont.	Container Type	Lab Sample ID										Comments
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															

Relinquished By:	Received By:	Date / Time:
Relinquished By:	Received By:	Date / Time:
Relinquished By:	Received By:	Date / Time:
Relinquished By:	Received By:	Date / Time:

Were Samples Received in Good Condition? ☐ Yes ☐ No Samples on Ice? ☐ Yes ☐ No Method of Shipment: Page of

Figure SAP 1.2 – Sample Chain of Custody Form (COC)

SAP-1.9.4.1 **Sample Transport**

Samples will be transported in coolers and kept on ice. Composite and grab samples must be kept between 0 and 6 degrees Celsius from the time of sample collection to the time of receipt by the laboratory. Sample coolers must be well packaged with bubble wrap, foam, or other packing during transport to keep the sample containers from breaking. Wet ice is preferable to reusable blue-ice packs. Wet ice must be double-bagged in sealable plastic bags so that they do not leak; shipping services may not deliver leaky coolers. Sample coolers will be secured with packing tape or duct tape.

Field samples will be transported to the laboratory by field personnel whenever possible. In cases where it is not practical to drive the samples directly to the laboratory, an overnight shipping company or courier service will be used to ship sample coolers to the laboratory.

Samples will be delivered to the analytical laboratory soon enough so that analysis begins within the maximum holding times specified by laboratory analytical methods (see Table SAP-1.5). For example, if the fecal coliform test is required, analysis must be started within 8 hours of sample collection (the analytical method allows 6 hours for transportation to the laboratory and 2 hours to begin analysis). Similarly, soluble reactive phosphorus (orthophosphate) or nitrite analyses must be performed within 48 hours after sample collection, so it must be received by the laboratory with enough time left so that the laboratory can meet that holding time.

SAP-1.10 Corrective Action

Consultant field team leaders will observe all monitoring activities, from the time that the monitoring equipment is installed, through the entire monitoring process, and until the samples are received by the laboratory. If the field team leader observes any problem or issue that might negatively impact monitoring data, he or she will use best professional judgment to resolve the problem. The problem will be noted in the field logs and reported to the consultant Project Manager as soon as possible.

In cases where some problem arises in the field that cannot be resolved by the field team leader, the Project Manager will be notified immediately. Any problem that was not resolved in time to prevent the monitoring data to be affected will be reported via email to the Caltrans Task Order Manager.

The field team leader will pay particular attention for safety violations. If any field technician is observed doing something that is unsafe, the field team leader is authorized to remove that individual from the field immediately. If any field technician believes that a monitoring site has become unsafe for any reason, they are to alert all other field personnel at the site, and all personnel are to leave the site immediately and report the problem to the field team leader, who will relay this information to the Project Manager.

SAP-2 Sediment Monitoring

Sediment monitoring will be conducted in accordance with the guidelines in Chapter 16 of the Caltrans Stormwater Monitoring Guidance Manual (Caltrans 2015).

SAP-3 Trash Monitoring for TMDL Watersheds

Caltrans complies with ten trash TMDLs in the Los Angeles RWQCB's jurisdiction. These are Los Angeles Area Lakes, Peck Road Park Lake; Los Angeles Area Lakes, Echo Park Lake; Ballona Creek; Los Angeles Area Lakes, Legg Lake; Los Angeles River; Machado Lake; Malibu Creek Watershed; Revolon Slough and Beardsley Wash; Santa Monica Bay Nearshore and Offshore; and Ventura River Estuary.

To achieve compliance with the trash TMDLs, Caltrans implements trash removal and/or reductions control measures within these trash TMDL watersheds which include installing, operating, and maintaining full capture systems and/or implementing institutional controls. Fact sheets in Appendix G of the Trash Monitoring Plan provide specific detail on each trash TMDL watershed. Caltrans tracks trash TMDL compliance through its GIS-based Trash Assessment & Compliance Dashboard which identifies Caltrans right-of-way subject to the TMDLs and associated trash reduction. The Trash Assessment & Compliance Dashboard is addressed in section 4.2 of the Trash Monitoring Plan.

SAP-1 Analytical Methods and Detection Limits

All project samples will be analyzed by environmental laboratories accredited by the California Environmental Laboratory Accreditation Program (ELAP). If the project constituent list includes tests that are not accredited under these programs, a laboratory will be selected that has demonstrated proficiency in the required analytical methods.

Project laboratories are responsible for analyzing all samples in accordance with analytical methods approved by the U S Environmental Protection Agency (EPA) and for which they are accredited. Laboratories are also responsible for meeting or exceeding the reporting limit requirements listed in Tables SAP-4.1 through SAP-4.6.

Where applicable, the reporting limits listed in Tables SAP-4.1 through SAP-4.6 are based on the recommended reporting limits provided in Appendix C of the Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Program Plan (SWAMP 2008).

Table SAP-4.1 lists all of the constituents that are currently required by the Caltrans stormwater monitoring program as well as other constituents that are commonly required on Caltrans projects. The tables list the appropriate analytical methods, units, reporting units, and required reporting limits for each constituent. Although Tables SAP-4.1 through SAP-4.6 list reporting limits, laboratories must report all analytical results down to the Method Detection Limit (MDL; see Section B4.8 of the Quality Assurance Project Plan) where they apply.

The reporting limits listed it Tables SAP-4.1 through SAP-4.6 are the maximum allowable; lower reporting limits are desirable whenever possible.

Table SAP- 1.1 - Methods and Reporting Limits

Constituent	Analytical Method(s)[1]	Units	Reporting Limit
Conventionals			
Hardness as $CaCO_3$	SM 2340 B or C	mg/L	1
pH	Calibrated Field Instrument	pH Units	Field
Temperature	Calibrated Field Instrument	° Celsius	Field
Flow Rate	Calibrated Field Instrument	ft^3/s	Field
Salinity	SM 2520 A	ppt	1
Total Dissolved Solids	EPA 160.1	mg/L	1
Total Suspended Solids	EPA 160.2	mg/L	1
Settleable Solids	SM 2540 F	mL/L	0.1
Turbidity	EPA 180.1	NTU	0.5
Total Organic Carbon	EPA 5310B or C	mg/L	0.6
Dissolved Organic Carbon	EPA 5310B or C	mg/L	0.6
Alkalinity as $CaCO_3$	EPA 310.1	mg/L	1
Conductivity	EPA 120.1	uS/cm	1
Nutrients			
Total Kjeldahl Nitrogen	EPA 351.3	mg/L	0.1
Nitrate as N	EPA 300.0/EPA 300.1	mg/L	0.1

Constituent	Analytical Method(s)[1]	Units	Reporting Limit
Nitrite as N	EPA 300.0/EPA 300.1	mg/L	0.1
Phosphorous as P	EPA 365.2	mg/L	0.03
Orthophosphate (Total)	SM 4500-P, E	mg/L	0.03
Ammonia as N	SM 4500-NH3 D	mg/L	0.1
Metals (Total and Dissolved)			
Aluminum	EPA 200.8/EPA 1640	µg/L	25
Arsenic	EPA 200.8/EPA 1640	µg/L	0.01
Cadmium	EPA 200.8/EPA 1640	µg/L	0.005
Chromium	EPA 200.8/EPA 1640	µg/L	0.025
Copper	EPA 200.8/EPA 1640	µg/L	0.01
Iron	/EPA 200.8/EPA 1640	µg/L	1
Lead	EPA 200.8/EPA 1640	µg/L	0.05
Manganese	EPA 200.8/EPA 1640	µg/L	0.01
Mercury	EPA 1631E/EPA 1640	µg/L	0.0002
Nickel	EPA 200.8/EPA 1640	µg/L	0.02
Selenium	EPA 200.8/EPA 1640	µg/L	0.3
Silver	EPA 200.8/EPA 1640	µg/L	0.02
Zinc	EPA 200.8/EPA 1640	µg/L	5
Hydrocarbons			
Oil & Grease	EPA 1664B	mg/L	1.4
Organics			
Polynuclear Aromatic Hydrocarbons (PAHs)	EPA 8310	ng/L	See Note[2]
Chlorinated Phenolics	EPA 625/EPA 8270	µg/L	1
Phenolic Compounds (non-chlorinated)	EPA 625/EPA 8270	µg/L	30
Organochlorine Pesticides	EPA 8081/EPA 625	µg/L	See Note[2]
Organophosphorus Pesticides	EPA 8141/EPA 625	ng/L	See Note[2]
Pyrethroid Pesticides	EPA 625/EPA 8270	ng/L	See Note[2]
PCBs	EPA 8081/EPA 8082	µg/L	See Note[2]
Microbiologicals			
Total Coliform	SM 9221 C	MPN/100 mL	2
Fecal Coliform	SM 9221 C	MPN/100 mL	2
Enterococcus	EPA 1600/Enterolert	CFU/100 mL	1
E. Coli	SM 9221 C	MPN/100 mL	2
Other			
Cyanide	EPA 335.2	mg/L	0.05
Total Chlorine Residual	EPA 330.1/EPA 330.5	mg/L	0.2
Toxicity			
Acute Toxicity	EPA-821-R-02-012	Pass/Fail	Not Applicable
Chronic Toxicity	EPA 821-R-02-013/ EPA-821-R-02-014	Pass Fail	Not Applicable

[1] Alternate analytical methods may be used, but the use of any method not listed on this table must be approved in advance and in writing by the Caltrans Task Order Manager.

[2] See Tables SAP-4.2 through SAP-4.6 for the individual compounds and their associated reporting limits.

Table SAP- 4.2 - Compound List/RLs for Polynuclear Aromatic Hydrocarbons

Constituent Name	Units	Reporting Limit
Acenaphthene	µg/L	0.05
Acenaphthylene	µg/L	0.05
Anthracene	µg/L	0.05
Benz(a)anthracene	µg/L	0.05
Benzo(a)pyrene	µg/L	0.05
Benzo(b)fluoranthene	µg/L	0.05
Benzo(g,h,i)perylene	µg/L	0.05
Benzo(k)fluoranthene	µg/L	0.05
Chrysene	µg/L	0.05
Dibenz(a,h)anthracene	µg/L	0.05
Fluoranthene	µg/L	0.05
Fluorene	µg/L	0.05
Indeno(1,2,3-c,d)pyrene	µg/L	0.05
Naphthalene	µg/L	0.05
Phenanthrene	µg/L	0.05
Pyrene	µg/L	0.05

Table SAP- 4.3 - Compound List/RLs for Organophosphorus Pesticides

Constituent Name	Units	Reporting Limit
Chlorpyrifos	µg/L	0.05
Chlorpyrifos methyl	µg/L	0.05
Diazinon	µg/L	0.05
Dichlofenthion	µg/L	0.05
Ethion	µg/L	0.05
Fenchlorphos (Ronnel)	µg/L	0.05
Fenitrothion	µg/L	0.05
Fonofos (Dyfonate)	µg/L	0.05
Malathion	µg/L	0.05
Ethyl parathion	µg/L	0.05
Methyl parathion	µg/L	0.05
Ethoprop (Prophos)	µg/L	0.05
Sulfotep	µg/L	0.05
Thionazin (Thionzin)	µg/L	0.05
Tokuthion (Prothiofos)	µg/L	0.05
Trichloronate	µg/L	0.05

Table SAP- 4.4 - Compound List/RLs for Organochlorine Pesticides

Constituent Name	Units	Reporting Limit
HCHs	µg/L	0.002
Endosulfan	µg/L	0.002
Endrin	µg/L	0.002

Table SAP- 4.5 - Compound List/RLs for Pyrethroid Pesticides

Constituent Name	Units	Reporting Limit
Bifenthrin	µg/L	Lowest possible
Cyfluthrin	µg/L	Lowest possible
Cypermethrin, total	µg/L	Lowest possible
Deltamethrin/Tralomethrin, total	µg/L	Lowest possible
Esfenvalerate/Fenvalerate, total	µg/L	Lowest possible
Fenpropathrin	µg/L	Lowest possible
lamda-Cyhalothrin, total	µg/L	Lowest possible
cis-Permethrin, total	µg/L	Lowest possible
trans-Permethrin	µg/L	Lowest possible

Table SAP 4.6 - Compound List/RLs for PCBs

Constituent Name	Units	Reporting Limit
Aroclor 1016	µg/L	10
Aroclor 1221	µg/L	10
Aroclor 1232	µg/L	10
Aroclor 1242	µg/L	10
Aroclor 1248	µg/L	2.5
Aroclor 1254	µg/L	1
Aroclor 1260	µg/L	1

SAP-5 Numeric Limits for Measurement Quality Objectives

This chapter provides the numeric limits that will be used to evaluate data quality according to the project Measurement Quality Objectives (MQOs). This information is taken from the 2013 addenda to the Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance.

Table SAP- 5.1 - MQO Limits for Conventional Analyses

Laboratory Quality Control[1]	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent (n/a for chlorophyll a and pheophytin a)	80-120% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent (n/a for chlorophyll a and pheophytin a)	80-120% recovery; RPD <25% for duplicates
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent (chlorophyll a/pheophytin a: per method)	RPD <25% (n/a if native concentration of either sample <RL)
Internal Standard	Accompanying every analytical run as method appropriate	Per method

1 Unless method specifies more stringent requirements

Table SAP- 5.2 - MQO Limits for Field Analyses

Field Quality Control	Frequency of Analysis	Measurement Quality Objective
Field Duplicate	5% of total project sample count	RPD <25% (n/a if native concentration of either sample <RL)
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analyte

Table SAP- 5.3 - MQO Limits for Metals and Inorganic Analyses

Laboratory Quality Control[1]	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material[2]	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg)
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% forMMHg); RPD<25%
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Internal Standard	Accompanying every analytical run when method appropriate	60-125% recovery

[1] Unless method specifies more stringent requirements

[2] Not applicable to selenium speciation

Table SAP- 5.4 - Limits for Solids in Water Analyses

Laboratory Quality Control[1]	Frequency of Analysis	Measurement Quality Objective
Laboratory Blank[2]	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Laboratory Duplicate[3]	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)

[1] Unless method specifies more stringent requirements

[2] Not applicable to volatile suspended solids

[3] Applicable only to total suspended solids, total dissolved solids, and ash-free dry mass

Table SAP 5.5 - MQO Limits for Microbiological Analyses

Laboratory Quality Control[1]	Frequency of Analysis[1]	Measurement Quality Objective
Sterility Checks[3]	Per new lot of dehydrated culture media as instructed in SM 9020B.4.i.5[2] and SM 9222D.1.a	No growth
Sterility Checks[3]	For non-sterile filters and pads per lot as instructed in SM 9020B.4.h.1.1	No growth
Sterility Checks[3]	Membrane Filter Media, filters, buffered dilution water, rinse water, and all equipment per series of samples as instructed in SM 9020B.8.a.5[2]	No growth
Sterility Checks[3]	Multiple Tube Media, dilution water, and glassware as instructed in SM 9020B.8.a.5[2]	No growth
Laboratory Positive Control	Per new lot of dehydrated culture media for the following methods: Colilert, Colilert -18, Colisure, Enterolert, or other chromogenic/fluorogenic methods. Per new lot of commercially-prepared culture media ampules for USEPA-approved fecal coliform and E. coli membrane filter methods (e.g. SM 9222, m-ColiBlue24, EPA 1603) Per batch for laboratory-prepared culture media for USEPA-approved fecal coliform and E. coli membrane filter methods (e.g., SM 9222)	Positive response

Laboratory Quality Control[1]	Frequency of Analysis[1]	Measurement Quality Objective
Laboratory Negative Control	Per new lot of dehydrated culture media for the following methods: Colilert, Colilert -18, Colisure, Enterolert, or other chromogenic/fluorogenic methods. Per new lot of commercially-prepared culture media ampules for USEPA-approved fecal coliform and E. coli membrane filter methods (e.g. SM 9222, m-ColiBlue24, EPA 1603) Per batch for laboratory-prepared culture media for USEPA-approved fecal coliform and E. coli membrane filter methods (e.g., SM 9222)	Negative response
Laboratory Blank[5]	Required only when samples are diluted; dilution water must be tested	No growth

[1] Unless method specifies more stringent requirements

[2] Citations from *Standard Methods for the Examination of Water and Wastewater*, 20th edition

[3] Sterility Checks
The specific type and number of sterility checks are method-dependent. For example, membrane filter tests require the testing of filters for sterility, while multiple-tube or pour plate procedures do not.

Table SAP- 5.6 - MQO Limits for Nutrient Analyses

Laboratory Quality Control[1]	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Calibration Verification	Per 10 analytical runs	90-110% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	90-110% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery RPD<25% for duplicates

Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)

[1] Unless method specifies more stringent requirements

Table SAP- 5.7 - MQO Limits for Semivolatile Analyses

Laboratory QualityControl[1]	Frequency of Analysis	Measurement Quality Objective
Tuning[3]	Per analytical method	Per analytical method
Calibration	Initial method setup or when the calibration verification fails	• Correlation coefficient (r^2 >0.990) for linear and non-linear curves • If RSD<15%, average RF may be used to quantitate; otherwise use equation of the curve • First- or second-order curves only (not forced through the origin) • Refer to SW-846 methods for SPCC and CCC criteria[3] • Minimum of 5 points per curve (one of them at or below the RL)
Calibration Verification	Per 12 hours	• Expected response or expected concentration ±20%
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch	70-130% recovery if certified; otherwise, 50-150% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD); RPD < 25%
Surrogate	Included in all samples and all QC samples	Based on historical laboratory control limits (50-150% or better)
Internal Standard	Included in all samples and all QC samples (as available)	Per laboratory procedure

[1] Unless method specifies more stringent requirements

[2] All detected analytes must be confirmed with a second column, second technique, or mass spectrometry

[3] Mass spectrometry only

The numeric MQOs in Table SAP-3.8 apply to analytical methods for the following kinds of compounds:

Carbamate Pesticides	Phenols	Pyrethroid Pesticides
Diesel Range Organics	Polynuclear Aromatic Hydrocarbons	Surfactants
Glyphosates	Polybrominated Diphenyl Ethers	Triazine Pesticides
Organochlorine Pesticides	Polychlorinated Biphenyls	Organochlorine Pesticides
Organophosphate Pesticides		

Table SAP 5.8 - MQO Limits for Analyses of Synthetic Compounds

Laboratory Quality Control[1]	Frequency of Analysis	Measurement Quality Objective
Tuning[4]	Per analytical method	Per analytical method
Calibration	Initial method setup or when the calibration verification fails	• Correlation coefficient (r >0.990) for linear and non-linear curves • If RSD<15%, average RF may be used to quantitate; otherwise use equation of the curve • First- or second-order curves only (not forced through the origin) • Refer to SW-846 methods for SPCC and CCC criteria[4] • Minimum of 5 points per curve (one of them at or below the RL)
Calibration Verification	Per 12 hours	• Expected response or expected concentration ±20% • RF for SPCCs=initial calibration[4]
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analytes
Reference Material	Per 20 samples or per analytical batch (preferably blind)	70-130% recovery if certified; otherwise, 50-150% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD); RPD<25%

Laboratory Quality Control[1]	Frequency of Analysis	Measurement Quality Objective
Surrogate	Included in all samples and all QC samples	Based on historical laboratory control limits (50- 150% or better)
Internal Standard	Included in all samples and all QC samples (as available)	Per laboratory procedure

1 Unless method specifies more stringent requirements; ELISA results must be assessed against kit requirements.

3 All detected analytes must be confirmed with a second column, second technique, or mass spectrometry.

4 Mass spectrometry only

Table SAP- 5.9 - MQO Limits for Analyses of Volatile Organic Compounds

Laboratory Quality Control[1]	Frequency of Analysis	Measurement Quality Objective
Tuning[2]	Per analytical method	Per analytical method
Calibration	Initial method setup or when the calibration verification fails	• Correlation coefficient (r2>0.990) for linear and non-linear curves • If RSD<15%, average RF may be used to quantitate; otherwise use equation of the curve • First- or second-order curves only (not forced through the origin) • Refer to SW-846 methods for SPCC and CCC criteria[2] • Minimum of 5 points per curve (one of them at or below the RL)
Calibration Verification	Per 12 hours	• Expected response or expected concentration ±20% • RF for SPCCs=initial calibration[2]
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more	70-130% recovery if certified; otherwise, 50-150% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD); RPD<25%
Surrogate	Included in all samples and all QC samples	Based on historical laboratory control limits (50- 150% or better)
Internal Standard	Included in all samples and all QC samples (as available)	Per laboratory procedure

[1] Unless method specifies more stringent requirements

[2] Mass spectrometry only

SAP-6 Monitoring Preparation and Logistics

Prior to deployment of field crews and the initiation of stormwater monitoring, weather systems must be tracked, field personnel must prepare, and necessary equipment must be inventoried. Sample bottles should be pre-labeled if possible.

Stormwater monitoring preparation includes the following elements:

- Weather Tracking
- Storm Selection Criteria
- Storm Action Levels
- Storm Staffing Plan and Communications/Notification Procedures

Weather Tracking

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States. Forecasts can be obtained from the NWS website (www.weather.gov), along with imagery, maps and graphical forecasts, and forecast model results. The website also provides access to radar, satellite, and land-based weather station data. Weather forecasts will be monitored continuously throughout the season in order to predict storms that qualify for monitoring. In addition, custom forecasting may be received from a private weather forecasting service. The Project Manager or field monitoring coordinator will be responsible for tracking weather conditions and potential storms.

SAP-6.1 Weather Tracking

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States. Forecasts can be obtained from the NWS website (www.weather.gov), along with imagery, maps and graphical forecasts, and forecast model results. The website also provides access to radar, satellite, and land-based weather station data. Weather forecasts will be monitored continuously throughout the season in order to predict storms that qualify for monitoring. In addition, custom forecasting may be received from a private weather forecasting service. The Project Manager or field monitoring coordinator will be responsible for tracking weather conditions and potential storms.

SAP-6.2 Storm Selection Criteria

The following criteria will be used to qualify storm events for monitoring:

1. Quantity Precipitation Forecast (QPF) – The amount of precipitation that the incoming storm is expected to produce.
2. Probability of Precipitation (POP) – The percent probability that the expected storm will occur.

3. Antecedent Dry Period – The time that has elapsed since the end of the previous measurable storm event. A measurable storm event is defined as more than 0.1″ of rainfall measured in a 24-hour period that generates runoff.

As a general rule, field crews will mobilize for incoming storms with a QPF of 0.1" or more and a POP of 70% or more, and that have an antecedent dry period of 72 hours or more. Caltrans may modify these mobilization criteria to suit specific monitoring areas or project requirements.

In cases where it is ambiguous whether an incoming storm meets the selection criteria, the monitoring consultant will contact the Caltrans Task Order Manager for guidance.

SAP-6.3 Storm Action Levels

Storm action levels are necessary for efficient stormwater monitoring preparation, mobilization, and demobilization. Project managers, field crews, and laboratories are notified each time the storm action level changes. Typical storm action levels are shown Table SAP-6.1.

Table SAP- 6.1 - Storm Action Levels

Action Level	Condition	Action
Non-Monitoring	Not actively seeking candidate storms	Project Manager: – Monitor weather reports weekly Field Crew Personnel: – No impact on activities
Standby	Evaluating developing storm systems	Project Manager: – Monitor weather reports semi-weekly Field Crew Personnel: – Notify Project Manager where they will be and how they can be reached if they leave the area for more than one or two days – Arrange for substitute if needed
Pre-Alert	Target storm expected within the next 72 hours	Project Manager : – Monitor weather reports every 24 hours – Verify operation of monitoring equipment as needed – Alert field crews regarding change in action level – Verify availability of field crews – Alert analytical laboratory and Caltrans Field Crew Personnel: – Remain in local area if possible – Verify availability with Project Manager
Alert	Target storm expected within the next 24 hours	Project Manager : – Monitor weather reports every 6 hours or more frequently as storm approaches – Alert field crews regarding change in action level and probable time of storm – If storm event is marginal, alert crews that event may be a go or no go and continue to notify every 4 hours Field Crew Personnel: – Prepare monitoring equipment for sampling and/or observations – Upload autosampler pacing specifications to remote sampling instruments – Prepare chain-of-custody forms and label sample bottles
Go	Precipitation is imminent or underway on targeted storm	Project Manager – Monitor weather reports as needed – Mobilize field crews Field Crew Personnel: – Mobilize to sample collection stations for during- storm event observations, sample bottle maintenance, grab sampling, etc. Alert the laboratory that samples are coming –

SAP-6.4 Storm Staffing Plan and Communications/Notification Procedures

A Storm Staffing Plan that specifies the personnel and equipment required for storm monitoring must be completed as soon as a potential event is forecast. Storm Staffing Plans will be for the consultant's internal use only.

Appendix B

Quality Assurance Project Plan (QAPP)

Caltrans
Division of Environmental Analysis
Stormwater Program

California Department of Transportation (Caltrans)

NPDES Permit No. CAS00003

Quality Assurance Project Plan

Caltrans Document CTSW-RT-23-438.04.01 Appendix B

November 2023

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Group A Elements: Project Management

Element 1: A1 – Title and Approval Sheets

A1.1 Project Title

California Department of Transportation (Caltrans)

NPDES Permit No. CAS00003

Monitoring Plan

A1.2 QAPP Revision Number

Revision Number 01

Revision Date: November 15, 2023

A1.3 Lead Organization

California Department of Transportation (Caltrans)

Division of Environmental Analysis

Stormwater Program MS-27

1120 N Street

Sacramento, CA 94274

Approvals

A1.4/A1.5/A1.6/A1.7/A1.8 Project Approval Signatures

Contract [Insert contract number], Task Order [Insert TO number]
-- Task Order Manager/Quality Assurance Officers for Caltrans [Insert Name] Date -- Consultant Task Order Manager [Insert Name] Date -- Quality Assurance Officer [Insert Name] Date

[Add signature blocks as necessary for each contract/task order]

Element 2: A2 – Table of Contents

A2.1 QAPP Information Section

A2.2 Document Control Information

See the Caltrans Documentation Page at the beginning of this document.

A2.3 List of Tables and Figures

Tables

Figures

A2.4/5 Appendices and Standard Operating Procedures

Appendix A contains a Sampling and Analysis plan that discussed in detail the collection and analysis of samples.

List of Abbreviations and Acronyms

% Recovery	Percent Recovery
BMP	Best Management Practice
Caltrans	California Department of Transportation
CEDEN	California Environmental Data Exchange Network
COC	Chain of Custody
CRM	Certified Reference Material
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
LCS	Laboratory Control Sample
MDL	Method Detection Limit
MQO	Measurement Quality Objectives
MRR	Monitoring Results Report
MS/MSD	Matrix Spike/Spike Duplicate
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PSTM	Post-Storm Technical Memorandum
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RDC	Regional Data Center
RL	Reporting Limit
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SDA	Stormwater Data Archive
SMARTS	Storm Water Multiple Application and Report Tracking System
SRM	Standard Reference Material

State Water Board	State Water Resources Control Board
SWRCB	State Water Resources Control Board
SOP	Standard Operating Procedures
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency

Element 3: A3 – Distribution List

A copy of this Quality Assurance Project Plan (QAPP), in a hard-copy or electronic format, is to be received and retained by at least one person from each participating organization. The consultant contact listed in Table 1 will be responsible for receiving, retaining, and distributing this QAPP to all personnel in their organization who are connected with this project, including subcontractors.

The Caltrans Task Order Manager will be responsible for distributing this QAPP, and for verifying that all parties listed in Table 2 have access to the current version.

Table 1 - Distribution List

Contact Information	Organization Name and Mailing Address
Caltrans – Contract [Insert contract number], Task Order [Insert TO number]	
[Insert Caltrans Task Order Manager name, phone number, and email address]	California Department of Transportation Division of Environmental Analysis Stormwater Program MS-27 1120 N Street Sacramento, CA 94274
Monitoring Consultant – Contract [Insert contract number], Task Order [Insert TO number]	
[Insert consultant Project Manager name, phone number, and email address]	[Insert consultant name and address]

Element 4: A4 – Project/Task Organization

A4.1/A4.2 Key Project Individuals and Responsibilities

Key project individuals and their responsibilities are listed in Table 2.

Table 2 - Key Project Individuals and Responsibilities

Position	Name	Responsibilities
Caltrans Project Coordinator	Bhaskar Joshi	Advisory Role: Oversee contract; review final project documents
Caltrans Task Order Manager	[Insert name]	Review and approve the QAPP; review, evaluate, and document project reports; coordinate consultant activities; verify the completeness of all tasks
Caltrans QA/QC Officer	Tod Granicher	Review final data for errors, accuracy, and completeness; assure that consultant data deliverables are complete and correctly formatted; resolve data problems with the consultant
Caltrans Data Manager	Tod Granicher	Receive data from consultant; upload data to Caltrans data system; upload final data to state agencies
Consultant Project Manager	[Insert name]	Act as primary contact and interface between consultant and laboratory; provide guidance as needed
Consultant Contract Manager	[Insert name]	Advisory role; Administer contract between Caltrans and consultant; responsible for consultant performance; provide guidance as needed
Consultant QA/QC Officer	[Insert name]	Review laboratory data for errors, accuracy and completeness; assure that laboratory deliverables are complete and correctly formatted; resolve data problems with the laboratory
Consultant Data Manager	[Insert name]	Receive data from laboratories; prepare electronic data deliverables for submittal to Caltrans
Consultant Field Crew Lead	[Insert name]	Responsible for managing field technicians while in the field; responsible for sample collection, transport, and custody; primary interface between consultant project management and field personnel
Laboratory Project Manager	[Insert name]	Act as primary contact and interface between consultant and laboratory; provide guidance as needed
Laboratory Contract Manager	[Insert name]	Advisory role; Administer contract between consultant and laboratory
Laboratory QA/QC Officer	[Insert name]	Advisory role; Assure that all operations in the laboratory are performed in accordance with the laboratory QA/QC Plan

A4.3 Quality Assurance Officer Independence

The function of project Quality Assurance Officer (QAO) will be carried out by the laboratory Quality Assurance/Quality Control (QA/QC) Officer, the consultant QA/QC Officer, and the Caltrans QA/QC Officer. These individuals are all independent of data generation.

A4.4 Individual(s) Responsible for the Quality Assurance Project Plan

The Consultant will be responsible for maintaining the official, approved version of the project QAPP. Revisions and updates to the QAPP and all associated documents will be made under the direction of the Caltrans Task Order Manager(s). All changes will be considered draft until reviewed and approved by the Caltrans Task Order Manager(s).

A4.5/6 Organizational Chart

Figure 1 shows the organizational chart for this project.

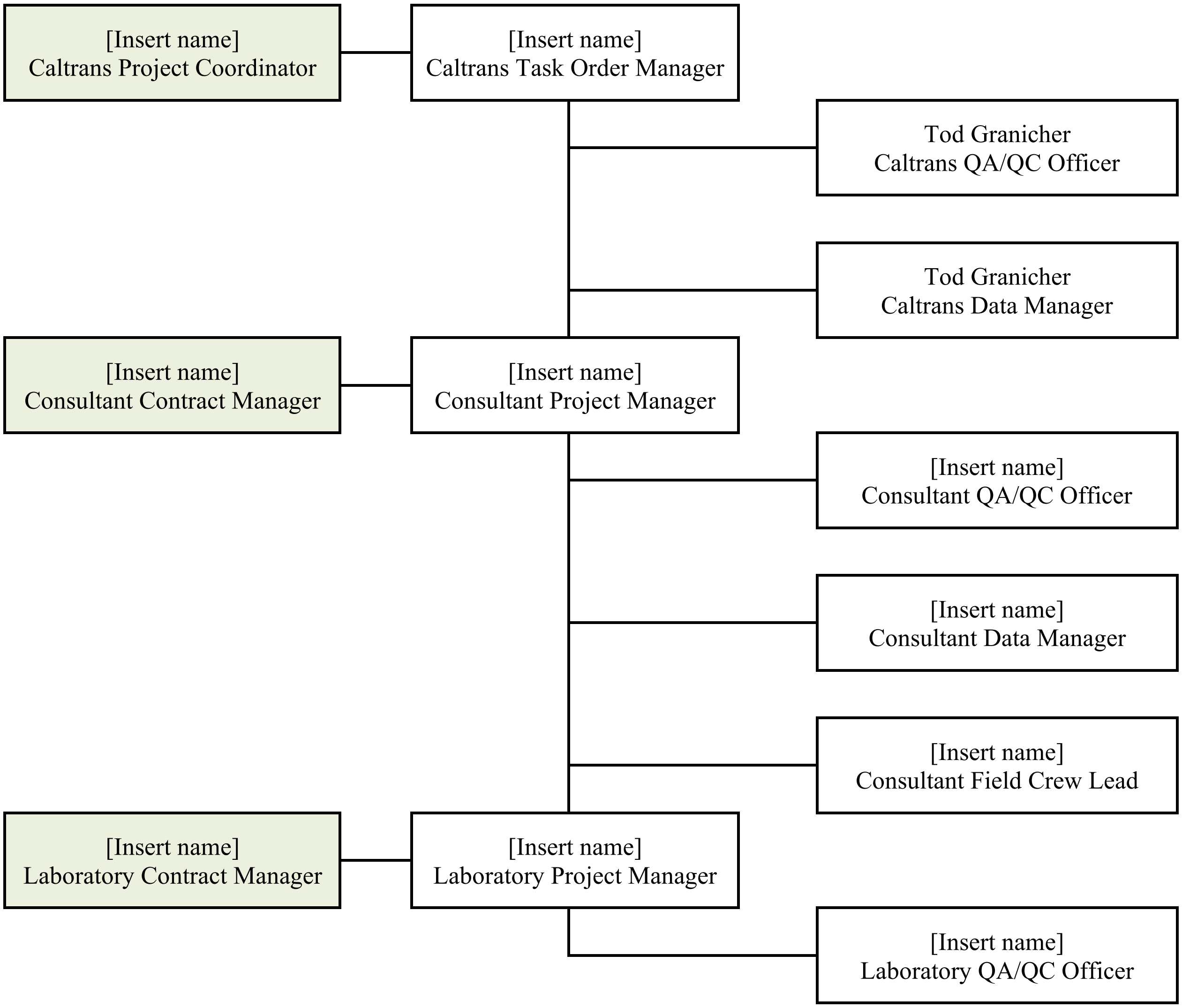

Figure 1 - Project Organizational Chart

Personnel who appear in shaded boxes participate only in an advisory role, and are not responsible for delivery of any work product.

Element 5: A5 – Problem Definition/Background

A5.1 Decisions/Actions/Outcomes

Stormwater that discharges from California Department of Transportation (Department) facilities is regulated under National Pollutant Discharge Elimination System (NPDES) Permit No. 2022-0033-DWQ (Permit). In order to demonstrate compliance with this order, the Department conducts a statewide stormwater monitoring program.

Monitoring is defined as sampling, analysis, field tests, and observations used to evaluate pollutant concentrations in receiving water, stormwater runoff, and best management practice (BMP) effectiveness for compliance with Permit requirements.

Monitoring may be performed by the Department or through the Department's participation in local and regional cooperative monitoring and through regional monitoring programs. Data will be collected in compliance with the terms of the permit and local basin plans, as well as with the monitoring requirements specified in the Permit, Attachment F.

A5.2 Project Initiation Rationale

This project has been initiated to comply with the monitoring and reporting requirements outlined in NPDES Permit No. 2022-0033-DWQ, Attachment F, as outlined in Section A5.1.

A5.3 Regulatory Information/Criteria/Action Limits

Receiving water and effluent water quality data will be uploaded to the California Environmental Data Exchange Network (CEDEN), submitted to the California Storm Water Multiple Application and Report Tracking System (SMARTS), and included in the annual Monitoring Results Report (MRR). State regulatory agencies will determine what further action will be taken, if any.

Element 6: A6 – Project/Task Description

A6.1 Work Planned

This QAPP will apply to all stormwater monitoring activities that Caltrans conducts in order to comply with the current NPDES permit cycle (NPDES NO. CAS000003). Monitoring requirements are specified in Attachment F.

Composite and grab samples will be collected from an agreed-upon number of monitoring sites located around the State of California. Samples will be collected for organic and inorganic constituents, microbiology constituents, and toxicity. Site hydrology and other field data will also be collected. Data will be reported to Caltrans electronically, both in PDF format and in spreadsheet format that is compatible with the CEDEN system.

Samples will be collected only for qualifying storms. Storm selection criteria appear in Appendix A, Section SAP-6.2. Please see Appendix C, Item 1, for the appropriate language from the Caltrans Stormwater Monitoring Guidance Manual.

Receiving water and effluent water quality data will be uploaded to the CEDEN data system and submitted to California SMARTS via email.

All project data will also be reported annually to the State Water Resources Control Board (State Water Board, formerly the SWRCB) in the MRR.

A6.2 Work Schedule

Table 3 shows the planned work schedule for principal project tasks.

Table 3 - Work Schedule

Task Number	Task Description	Deliverable	Due Date
1	Stormwater Monitoring	Collect samples and transport them to contract laboratories; obtain and record field information. Receive data back from laboratories.	Per storm
2	Reporting – Event Summary	Provide Post-Event Technical Memorandum (PSTM) to Caltrans	Draft: within 3 days of the successful completion of a monitoring event. Final: 2 weeks after comments are received from Caltrans
3	Reporting – Data, internal	Provide Electronic Data Deliverable (EDD) to Caltrans	30 days after the end of the storm event
4	Reporting – Data, to the state	Provide annual data	Annually, November 30th of the monitoring year.

A6.3 Geographical Locations

This section describes the physical locations (sites) at which monitoring will be conducted. All monitoring samples and measurements shall be representative of the monitored volume and characteristics of the monitored discharge at each monitoring site. At select monitoring locations, effluent from BMPs will be used as representative of the water quality of stormwater discharges from BMPs of the same type at other locations. Selection of representative BMP effectiveness monitoring sites are based on existing and proposed BMPs.

Table 4 lists all project monitoring sites, their geographical locations, and the type of monitoring, such as discharge characterization, BMP effectiveness, receiving water, or cooperative agreement, that will be conducted at each site.

Due to the large number of monitoring sites associated with this project, detailed site information has been broken out into a separate document. Please see the addendum to this Monitoring Plan for a full description of each project monitoring location.

Table 4 - Project Station Information

Station Code	Station Name	Latitude	Longitude	RWQCB	County	Route	Postmile	Catchment (ha)	Position	Monitoring Type	Watershed Name	TMDL Pollutant List	Monitored 2023-24	Monitored 2024-25
1-348	McCoy Creek Bioswale #1	39.95437	-123.77578	1	Mendocino	271	17.92 NB	0.526	Influent	Bioswale	South Fork Eel River	Temperature and Sediment	No	Yes
1-350	McCoy Creek Bioswale #2	39.95437	-123.77578	1	Mendocino	271	17.92 NB	0.526	Effluent	Bioswale	South Fork Eel River	Temperature and Sediment	No	Yes
1-351	Lord Ellis Influent	40.9303	-123.855	1	Humboldt	299	18.42	0.54	Influent	Bioswale	Redwood Creek	Sediment	No	Yes
1-352	Lord Ellis Effluent	40.9305	-126.855	1	Humboldt	299	18.42	0.54	Effluent	Bioswale	Redwood Creek	Sediment	No	Yes
3-411	Interstate 5 - Karbet North	38.53156	-121.51729	5	Sacramento	5	19.79	0.54	EOP	Characterization	Sacramento- San Joaquin River Delta Estuary	Methyl mercury	Yes	Unknown*
3-412	Interstate 5 - Karbet South	38.53076	-121.51744	5	Sacramento	5	19.73	1.76	EOP	Characterization	Sacramento- San Joaquin River Delta Estuary	Methyl mercury	Yes	Unknown*
3-413	Interstate 5 - Woodshire	38.51835	-121.52137	5	Sacramento	5	18.807	0.49	EOP	Characterization	Sacramento- San Joaquin River Delta Estuary	Methyl mercury	Yes	Unknown*
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Sacramento- San Joaquin River Delta Estuary	Methyl mercury	No	Yes
4-413	4-Sol-12-0.945	38.20833	-122.18550	2	Solano	Highway 12	0.945	0.32	Effluent	Bioswale	San Francisco Bay	PCBs, Mercury	No	Yes
4-434	Carquinez AVSF Influent	38.06798	-122.22665	2	Solano	80	27	8.9	Influent	Austin Vault Enhanced Media Filter	San Francisco Bay San Francisco Bay/Napa River	PCBs/ Mercury/ Sediment	Yes	Unknown*
4-435	Carquinez AVSF Effluent	38.06798	-122.22665	2	Solano	80	27	8.9	Effluent	Austin Vault Enhanced Media Filter	San Francisco Bay San Francisco Bay/Napa River	PCBs/ Mercury/ Sediment	Yes	Unknown*
4-442	Pescadero-Butano Creek	37.26482	-122.41199	2	San Mateo	1	13.92	0.2	Overside Drain	Characterization	Pescadero- Butano Creek	Sedimentation/ Siltation	Yes	Yes
4-443	Petaluma River	38.22989	-122.61671	2	Sonoma	101	3.433	0.48	End of Pipe	Characterization	Petaluma River	Bacteria	Yes	Yes
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	San Francisco Bay	PCBs, Mercury	No	Yes
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	San Francisco Bay	PCBs, Mercury	No	Yes
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	San Francisco Bay	PCBs, Mercury	No	Yes
5-311	Waterman Creek Tributary to Pescadero Creek	37.24625	-122.15202	2	Santa Cruz	9	24.4	0.16	Overside Drain	Characterization	Pescadero- Butano Creek	Sedimentation/ Siltation	Yes	Yes
7-127	Site 2, Interstate 210 mile post 40.8	34.12	-117.89	4	Los Angeles	210	40.8	0.4	EOP	Characterization	San Gabriel River	Nitrogen, Phosphorus, Copper, Lead, Zinc, Chlordane, DDT, PCBs, Mercury, Dieldrin, PAHs	Yes	Yes

Station Code	Station Name	Latitude	Longitude	RWQCB	County	Route	Postmile	Catchment (ha)	Position	Monitoring Type	Watershed Name	TMDL Pollutant List	Monitored 2023-24	Monitored 2024-25
7-128	Site 3, Interstate 91 post 8.92	33.8736	-118.236	4	Los Angeles	91	8.9	0.4	EOP	Characterization	San Gabriel River	Nitrogen, Phosphorus, Copper, Lead, Zinc,	Yes	Yes
												Chlordane, DDT, PCBs, Mercury, Dieldrin, PAHs	Yes	Yes
7-380	SAD1060	34.0156	-118.823	4	Los Angeles	1		3.181	EOP	Characterization	Los Angeles River	Mercury	Yes	Yes
7-413	I-10 Media Filter Influent	34.03619	-118.37821	4	Los Angeles	10	8.81	3.34	Influent	Media Filter	Ballona Creek Estuary & Wetlands	Sediment and Invasive Exotic Vegetation / Toxic Pollutants Ag, Cd, Cu,	Yes	Unknown*
												Pb, Zn, and Selenium, Chlordane, DDTs, Total PCBs, and Total PAHs	Yes	Unknown*
7-414	I-10 Media Filter Effluent	34.03619	-118.37821	4	Los Angeles	10	8.81	3.34	Effluent	Media Filter	Ballona Creek Estuary & Wetlands	Sediment and Invasive Exotic Vegetation / Toxic Pollutants Ag, Cd, Cu,	Yes	Unknown*
												Pb, Zn, and Selenium, Chlordane, DDTs, Total PCBs, and Total PAHs	Yes	Unknown*
7-420	Echo Park Lake Characterization	34.08379	-118.25996	4	Los Angeles	2	13.64	0.52	EOP	Characterization	Part B-Los Angeles Area Echo Park Lake	Nitrogen, Phosphorus, Chlordane, Dieldrin, PCBs, and Trash	Yes	Unknown*
7-421	Legg Lake Characterization	34.03978	-118.06391	4	Los Angeles	164	3.24	0.6	Pipe outlet	Characterization	Part B-Los Angeles Area North, Center & Legg Lake	Nitrogen, Phosphorus	Yes	Unknown*
7-422	Peck Road Park Lake SF Influent	34.13572	-117.98787	4	Los Angeles	210	34.66	2.35	Influent	Austin Sand Filter	Los Angeles Area Peck Road Park Lake	Nitrogen, Phosphorus, Chlordane,	Yes	Unknown*
												DDT, Dieldrin, and PCBs	Yes	Unknown*
7-423	Peck Road Park Lake SF Effluent	34.13572	-117.98787	4	Los Angeles	210	34.66	2.35	Effluent	Austin Sand Filter	Los Angeles Area Peck Road Park Lake	Nitrogen, Phosphorus, Chlordane,	Yes	Unknown*
												DDT, Dieldrin, and PCBs	Yes	Unknown*
7-425	Machado Lake Characterization	33.79089	-118.29129	4	Los Angeles	1	12.15	0.55	EOP	Characterization	Machado Lake	Eutrophic, Algae, Ammonia, and Odors (Nutrients) /Pesticides and PCBs	Yes	Unknown*
7-427	Maxella Ave Characterization	33.98649	-118.44431	4	Los Angeles	90	31.45	0.84	EOP	Characterization	Marina Del Rey Harbor	Toxic Pollutants (Cu, Pb, Zn,	Yes	Unknown*

Station Code	Station Name	Latitude	Longitude	RWQCB	County	Route	Postmile	Catchment (ha)	Position	Monitoring Type	Watershed Name	TMDL Pollutant List	Monitored 2023-24	Monitored 2024-25
												Chlordane and Total PCBs)		
7-432	GSRD 1 Influent	34.17738	-118.16291	4	Los Angeles	210	22.92	0.158	Influent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-433	GSRD 1 Effluent	34.17738	-118.16291	4	Los Angeles	210	22.92	0.158	BMP Effluent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-434	GSRD 2 Influent	34.17774	-118.16352	4	Los Angeles	210	22.88	0.255	Influent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-435	GSRD 2 Effluent	34.17774	-118.16352	4	Los Angeles	210	22.88	0.255	Effluent	GSRD	Los Angeles River and Tributaries	Trash, Copper, Lead, Zinc	Yes	Unknown*
7-436	GSRD 3 Influent	34.17761	-118.16458	4	Los Angeles	210	22.84	0.097	Influent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-437	GSRD 3 Effluent	34.17761	-118.16458	4	Los Angeles	210	22.84	0.097	BMP Effluent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-438	GSRD 4 Influent	34.17837	-118.16451	4	Los Angeles	210	22.81	0.21	Influent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-439	GSRD 4 Effluent	34.17837	-118.16451	4	Los Angeles	210	22.81	0.21	BMP Effluent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-440	GSRD 5 Influent	34.00578	-118.17184	4	Los Angeles	710	22.6	0.316	Influent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-441	GSRD 5 Effluent	34.00578	-118.17184	4	Los Angeles	TBD	22.6	0.316	BMP Effluent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-442	GSRD 6 Influent	34.16493	-118.48158	4	Los Angeles	101	18.6	1.085	Influent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
7-443	GSRD 6 Effluent	34.16493	-118.48158	4	Los Angeles	NULL	18.6	1.085	BMP Effluent	GSRD	Los Angeles River and Tributaries	Copper, Lead, Zinc, Trash	Yes	Unknown*
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Los Angeles Area Lake Sherwood	Mercury	No	Yes
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Ventura River and its Tributaries	Algae, Eutrophic Conditions, and Nutrients	No	Yes
8-313	I-10 West of Jackson St, FES	33.73723	-116.21556	7	Riverside	Inter	55.812	3.5	Flared End Section Outlet	Characterization	Coachella Valley Storm Water Channel	Bacterial Indicators	Yes	Yes
8-314	I-10 East of Jackson St, Inlet	33.73828	-116.2185	7	Riverside	Inter	55.629	1	Drop Inlet in Median	Characterization	Coachella Valley Storm Water Channel	Bacterial Indicators	Yes	Yes
8-315	I-10 West of Monroe St, Inlet	33.73882	-116.22513	7	Riverside	Inter	55.25	1.1	Drop Inlet in Median	Characterization	Coachella Valley Storm Water Channel	Bacterial Indicators	Yes	Yes
8-316	SR-86 near interchange, Inlet	33.71645	-116.1924	7	Riverside	State	R23.051	1	Drop Inlet	Characterization	Coachella Valley Storm Water Channel	Bacterial Indicators	Yes	Yes
8-317	Big Bear Lake Characterization	34.25964	-116.943	8	San Bernardino	SR 38	56.848	0.16	EOP	Characterization	Big Bear Lake	Nutrients for Dry Hydrological Conditions	Yes	Yes
8-320	Big Bear Lake Residential 6 Characterization	34.26532	-116.86591	8	San Bernardino	SR 38	50.728	0.17	EOP	Characterization	Big Bear Lake	Nutrients for Dry Hydrological Conditions	Yes	Yes
8-322	Big Bear Lake HDU 2 Characterization	34.24895	-116.88298	8	San Bernardino	SR 18	51.018	0.06	EOP	Characterization	Big Bear Lake	Nutrients for Dry Hydrological Conditions	Yes	Yes
10-306	SR 33-13.45-NB	37.0598	-121.01632	5	Merced	SR 33	13.45	0.1255	Edge of Pavement	Characterization	No TMDL	None	Yes	Yes

Station Code	Station Name	Latitude	Longitude	RWQCB	County	Route	Postmile	Catchment (ha)	Position	Monitoring Type	Watershed Name	TMDL Pollutant List	Monitored 2023-24	Monitored 2024-25
10-307	SR 33-14.33-NB	37.07254	-121.01615	5	Merced	SR 33	14.33	0.0567	Edge of Pavement	Porous Pavement (HMA-O)	No TMDL	None	Yes	Yes
10-308	SR 33-14.75-SB	37.07877	-121.01619	5	Merced	SR 33	14.75	0.142	Edge of Pavement	Porous Pavement (RHMA-O)	No TMDL	None	Yes	Yes
10-309	SR 33-14.75-NB	37.07877	-121.01610	5	Merced	SR 33	14-48 NB	0.028	Edge of Pavement	Porous Pavement (RHMA-O-MG)	No TMDL	None	No	Yes
10-310	SR 33-14.48-NB	37.07479	-121.01611	5	Merced	Sta SR 33te	14.48	0.028	Edge of Pavement	Porous Pavement (RHMA-O-MG)	No TMDL	None	Yes	Yes
11-355	RW-NF	32.71747	-117.11505	9	San Diego	94	3.3	2286	RW	Receiving Water	Chollas Creek	Hardness, TSS, Field Parameters	Yes	Unknown*
11-356	RW-SF	32.72306	-117.07598	9	San Diego	94	5.78	567	RW	Receiving Water	Chollas Creek	Hardness, TSS, Field Parameters	Yes	Unknown*
11-357	94E/College-INF	32.7404	-117.05211	9	San Diego	94	7.5	1.2626	Influent	Biofiltration Swale	Chollas Creek	Dissolved Copper, Dissolved Lead, Dissolved Zinc, Total Diazinon	Yes	Unknown*
11-358	94E/College-EFF	32.73943	-117.05318	9	San Diego	94	7.5	1.2626	Effluent	Biofiltration Swale	Chollas Creek	Dissolved Copper, Dissolved Lead, Dissolved Zinc, Total Diazinon	Yes	Unknown*
11-359	94E/Median ASF-INF	32.71663	-117.11878	9	San Diego	94	3	0.855	Influent	Austin Sand Filter	Chollas Creek	Dissolved Copper, Dissolved Lead, Dissolved Zinc, Total Diazinon	Yes	Unknown*
11-360	94E/Median ASF-EFF	32.71677	-117.11844	9	San Diego	94	3	0.855	Effluent	Austin Sand Filter	Chollas Creek	Dissolved Copper, Dissolved Lead, Dissolved Zinc, Total Diazinon	Yes	Unknown*
11-361	94E/Median ASF-Bypass	32.71677	-117.11844	9	San Diego	94	3	0.855	Bypass	Austin Sand Filter	Chollas Creek	Dissolved Copper, Dissolved Lead, Dissolved Zinc, Total Diazinon	No	Unknown*
11-362**	I-5S - Encinitas Porous Influent	33.05486	-117.28947	9	San Diego	5	41.883	0.3359	EOP	Characterization	Cottonwood Creek	Fecal Coliform	Yes	Yes
11-363**	I-5S - Encinitas Porous Effluent 1	33.05303	-117.28888	9	San Diego	5	41.883	0.4516	EOP	Porous Pavement (HMA-O over PCP)	Cottonwood Creek	Fecal Coliform	Yes	Yes
11-364**	I-5S - Encinitas Porous Effluent 2	33.05189	-117.28858	9	San Diego	5	41.883	0.1538	EOP	Porous Pavement (PCP over PAB)	Cottonwood Creek	Fecal Coliform	Yes	Yes
12-01	Site 1, District 12 Route 142, Post Mile 2.51	33.9225	-117.834	8	Orange	142	2.5	0.4	EOP	Characterization	Calleguas Creeks, its Tributaries and Mugu Lagoon	Total Nitrogen, Total Phosphorus, Toxaphene, DDT, Chlordane, Dieldrin, PCBs	Yes	Yes

* Unknown - The decision to monitor these sites during the 2024-25 storm season will be made after the current season, when the total number of usable data points for the site are known.

** Continuation of monitoring at these sites will depend on a review of operational monitoring data collected to date.

A6.4 Resources and Constraints

A monitoring season will be defined as the interval between October 1 and April 30 of the following calendar year. Sampling during a monitoring season will be performed during this period to meet analysis and reporting deadlines set forth in the Caltrans NPDES Permit, Section F. Caltrans may opt to extend the season if there are not enough storm events that meet the sampling criteria.

Element 7: A7 – Quality Objectives and Criteria

A7.1 Measurement Quality Objectives

The quality of project data is assessed with the use of a set of acceptance criteria called Measurement Quality Objectives (MQOs). Data are compared to the MQOs to verify that project data meet an acceptable standard of known and documented quality.

MQOs are used to evaluate project data with respect to precision, accuracy (bias), representativeness, and completeness. These terms are discussed in Sections A7.4 through A7.7. The MQOs used for this project are numeric objectives with the exception of representativeness.

MQO assessments are made by analyzing a set of samples that are prepared for this purpose. A discussion of the collection, preparation, and analysis of these samples appears in Section SAP-1.4 of Appendix A.

A7.2 Action Limits

MQOs are considered the applicable action limits for Caltrans stormwater monitoring projects. Any exceedance of a stated MQO is considered to be outside acceptable data quality range and should trigger appropriate corrective action.

A7.3 Acceptance Criteria for Previously Collected Information

Previously collected data relevant to this project will be validated in accordance with the project MQOs before they are used.

A7.4 Precision

Precision is a measurement of the degree to which an analytical result can be reproduced consistently under unchanging conditions. In water quality analysis, this is an expression of how closely replicate analyses of the same sample agree with each other.

Precision is assessed by analyzing samples more than once and comparing the results. The samples used for this data check are discussed in Section B5.1. The equation for calculating precision is shown in Section B5.3. Numeric MQOs for precision are provided in Tables SAP-3.1 through SAP-3.9 in Appendix A.

A7.5 Accuracy (Bias)

Accuracy is a measurement of the degree to which an analytical result agrees with the true value of the quantity being measured. In water quality analysis, this is an expression of how close an analytical result is to the actual concentration of analyte present in the sample.

Precision is assessed by fortifying a blank or sample with a known concentration of target analyte, analyzing it, and then comparing the analytical result to the known value. The samples used for this data check are discussed in Section B5.1. The equation for calculating accuracy is shown in Section B5.3. Numeric MQOs for accuracy are provided in Tables SAP-3.1 through SAP-3.9 in Appendix A.

A7.6 Representativeness

The representativeness of the data is mainly dependent on whether the sampling locations and the sampling procedures adequately represent the true condition of the sampling site. Requirements for selecting sampling sites are discussed in more detail in the Stormwater Monitoring Guidance Manual (Caltrans 2020). Sampling site selection, sampling of relevant media (water, sediment, and biota), and use of only approved/documented analytical methods will ensure that the measurement data does represent the conditions at the investigation site, to the greatest extent possible.

A7.7 Completeness

Completeness is expressed as the number of usable data points produced during the project as a percentage of the number of data points that were expected during the planning phase of the project. Completeness is calculated for each constituent.

The completeness MQO for this project is 95 percent for all constituents.

Please see Appendix C, Item 2, for the appropriate language from the Caltrans Stormwater Monitoring Guidance Manual.

Element 8: A8 – Special Training/Certification

A8.1 Specialized Training and Certification Requirements

All staff involved in sample collection will be trained in the proper procedures for water sample collection. For specific training requirements for equipment operation and sample collection, equipment operation, health and safety procedures, and initial and ongoing training meetings, refer to Chapter 9 of the Caltrans Stormwater Monitoring Guidance Manual (Caltrans 2020).

All project laboratories will be certified for all of the analyses that they perform, where applicable. Laboratories shall be certified under the California Environmental Laboratory Certification Program (ELAP).

A8.2 Training Procedures

Staff training will be conducted for proper sample collection, sample handling, sample transport, and recordkeeping procedures. New personnel will be trained before they are allowed to take part in any monitoring activity.

No certification is required for sample collection. If entry into confined spaces is required, the consultant will ensure that all personnel who enter a confined space are Occupational Safety and Health Administration (OSHA)-certified for this activity.

Each contract laboratory will be responsible for properly training their analysts, sample control, and field personnel, and for maintaining all training records in accordance with written laboratory policy.

A8.3 Responsible Individual(s)

The consultant Project Manager will be responsible for the training of all field personnel and the retention of training documentation.

The QAO of each laboratory will be responsible for the training of laboratory personnel in accordance with written laboratory policy.

A8.4 Training Documentation

Each field technician will sign a document verifying that he/she has read and understood this document and the project Health and Safety Plan. Each consultant will keep these documents on file for the duration of the project or the duration of the contract, whichever is longer.

Laboratories are expected to document all training procedures as part of their QA/QC program, and to keep these records on file. A complete record of each employee's training history will be kept on file while that individual is employed by the laboratory.

Element 9: A9 – Documents and Records

Documents and records generated from this project will be organized and stored in compliance with this QAPP.

A9.1 Data Report Packages

Monitoring data will be organized into individual Electronic Data Deliverable (EDD) files in ZIP format. EDDs will be submitted to the Department using the Caltrans FILR file transfer system (filr.dot.ca.gov). All monitoring data will be submitted no later than 30 days after each monitoring event. EDDs will be submitted to the State of California after all of the data has been received and checked for errors. Partial data packages will not be submitted except at the direction of the Caltrans Task Order Manager.

Each EDD will consist of the following elements:

1. Final Excel files in CEDEN format.
2. Excel file containing field data in CEDEN format (if applicable)
3. Hydrology data, where it is collected. This information will be submitted using the Caltrans Hydrologic Utility (https://ctsw.owp.csus.edu). PDF copies of all laboratory reports, including a completed chain-of-custody (COC) form
4. Scanned PDF copies of all field logs
5. Any other materials, such as pictures or site maps, that the consultant believes might be useful

EDDs will be submitted using the following naming convention (four parts):

Part 1. The Project's monitoring (TMDL) and the district number using the format: TMDL##, where ## is a 2-digit number corresponding to the Caltrans District where the sites are located (e.g., TMDL07 for a submittal from District 7)

Part 2. The Event Start Date listed in the PSTM for that storm event with the format: YYYYMMDD

Part 3. The type of analysis performed:

a. Field (field data)
b. Tox-*LabName* (toxicity – where *LabName* is the name of the laboratory performing the analysis)
c. Chem-*LabName* (chemistry – where *LabName* is the name of the laboratory performing the analysis)

Part 4. The submittal (version) number for that EDD with the format: v#, where # is 1 for the first submittal of that EDD; 2 is the second (i.e., revised) submittal of the original EDD, etc.

Naming examples:

TMDL03_20151208_Field_v1

TMDL10_20151128_Chem-Apex Labs_v1

TMDL04_20151031_Tox-Aquatic Analytical_v1

TMDL04_20151204_Tox- Aquatic Analytical _v2

A9.2 Other Project Documents, Records, and Electronic Files

In addition to the post-event deliverables packages discussed in Element A9.1, the consultant will also provide:

1. Post-Storm Technical Memoranda (PSTMs) after each monitoring event are prepared using the Caltrans PSTM Utility. A draft PSTM will be delivered to Caltrans no later than 5 days after the end of every storm event. Caltrans will review the draft PSTM, make comments, and return it to the consultant via email. The consultant will address all comments, make all required changes, and submit a final PSTM within 5 working days of receiving the draft.
2. An end-of-season technical memorandum will be prepared at the end of each monitoring season that summarizes monitoring data.

These documents shall be named following the Caltrans standard naming convention:

CSTW-TM-YY- XXX-ZZ.1* or CSTW-RT-YY- XXX-ZZ.NUM*

where

YY is the calendar year,

XXX is the contract number's last 3 digits,

ZZ is the task order number, and

NUM is the sequential report number issued under the specific task order.

*The following may be added to the end of the CTSW name string:

TMDL##, where ## is a 2-digit number corresponding to the Caltrans District where the sites are located YYYYMMDD: Event Date

v#: Version number for the document

Naming example:

CTSW-TM-YY-XXX-ZZ.1_TMDL03_20151208_v1

CTSW-TM-YY-XXX-ZZ.1_TMDL07_20150201_v2

Submit other generated electronic files (hydrographs, Images, Videos, etc.) using the following naming convention:

TMDL##-###: Where ##-### is the Caltrans site identification number,

YYYYMMDD: Event date (date the sample was obtained)

HHMM: Event time (24-hour clock – where time is appropriate, i.e. video or images)

HGRAPH, IMG, VID: The document type (use a 3 to 6 letter descriptive designation as appropriate), and

v#: Version number for the document.

Naming examples:

TMDL10-300_20151208_HGRAPH_v1

TMDL07-336_20151128_0800_IMG_v1

TMDL12-356_20151031_2156_VID_v2

Please see Appendix C, Item 3, for the appropriate language from the Caltrans Stormwater Monitoring Guidance Manual.

A9.3 Storage for Project Information

All laboratory logs and data sheets will be maintained at the generating laboratory for a minimum of 3 years following project completion, and will be available for review by the contract manager or designee during that time.

Caltrans will retain records of all monitoring information for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the State Water Board's Executive Director or Regional Water Board's Executive Officer at any time.

1. Records of monitoring information shall include:
2. The date, exact place, and time of sampling or measurements
3. The individual(s) who performed the sampling or measurements
4. The date(s) analyses were performed
5. The individual(s) who performed the analyses
6. The analytical techniques or methods used
7. The results of such analyses

Caltrans will be responsible for submitting stormwater monitoring data to the appropriate state data centers (CEDEN and SMARTS).

A9.4 Backup Plan for Electronic Records

Monitoring consultants are expected to keep an electronic backup of all project data for a period of no less than 3 years.

In addition, electronic reports records will be stored on a file server or servers at Caltrans headquarters in Sacramento, California. File servers are backed up periodically by Caltrans Information Technology staff.

A9.5 Quality Assurance Project Plan Updates and Distribution

The Caltrans Task Order Manager will provide each individual listed in Table 1 with the project QAPP (this document). The individuals listed in Table 1 are responsible for distributing this document to all members of their organization who will be involved in this project, and to all subcontractors.

Amendments or updates to this document will be made with prior approval from Caltrans and under the direct supervision of the Caltrans Task Order Manager. Each time a new version of this document is produced, the Caltrans Task Order Manager will distribute it to all of the individuals listed in Table 1, who will again distribute it to all members of their organization who will be involved in this project, and to all subcontractors.

Group B: Data Generation and Acquisition

Element 10: B1 – Sampling Process Design (Sampling Design and Logistics)

B1.1 Design Information

This project will span the duration of the Permit. The Permit became effective on January 1, 2023, and will expire on December 31, 2027.

Monitoring activities will be conducted at a variety of Caltrans facilities, including urban and rural roadways, highways and freeways, parking lots and Park & Ride facilities, maintenance stations, toll plazas, and receiving waters. The purpose of this monitoring effort will be to evaluate the concentrations of regulated pollutants in roadway runoff and in other, non-roadway Caltrans facilities, in receiving waters, and that discharge from treatment BMP devices.

Monitoring activities will include collecting composite and grab samples, analyses of samples both by contract laboratories and in the field, collecting hydrologic data, and making other field observations. Monitoring will be conducted by engineering consultants contracted by the Department. Analytical laboratories will be contracted by monitoring consultants as subcontractors.

Composite samples, rather than grab samples, may be collected at selected project sites in order to more accurately characterize the discharge. Composite samples may be collected either by hand as a series of discrete aliquots that are mixed together prior to analysis, or through the use of automated sample collection equipment.

In addition to collecting water samples, hydrology information will be collected at sites where this data may be appropriate or useful. Hydrograph/hyetograph data files will be constructed using the measured discharge volume over the life of the storm and the measured rainfall prior to and during the storm event. Discharge volumes will be measured using onsite equipment; rainfall data will be obtained either with measurements may be made by a rain gauge located at the monitoring site or by using rainfall data from a nearby non-Caltrans weather station.

In addition to direct monitoring, the Department may opt to satisfy some of their compliance requirement by participating in local and regional cooperative monitoring agreements and through regional monitoring programs.

B1.2 Design Strategy

This project was designed in accordance with the guidelines provided in Chapter 2 of the Stormwater Monitoring Guidance Manual (Caltrans 2020). Project monitoring sites have been selected to be representative of Caltrans facilities around the state. Analytical constituents and field measurements are discussed in Section A9. Analytical methods are specified in Table F.1. Project data will be analyzed consistent with the Caltrans Stormwater Monitoring Guidance Manual, with the requirements specified by the Permit, Attachment F, and reported in accordance with the requirements specified by the Permit, Attachment F.2.9, and of the State Water Board and CEDEN.

B1.3 Sample Count and Types

Table 5 lists the sample counts, sample types, and required analyses for each project site.

In addition to the analyses listed in Table 5, field tests will be conducted at every monitoring site during every event. Field testing shall include temperature, pH, conductivity, turbidity, and dissolved oxygen.

Table 5 - Sample Counts, Types, and Analyses

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
1-348	SSC	Grab	3
	Temperature	Field	3
1-349	SSC	Grab	3
	Temperature	Field	3
1-351	SSC	Grab	3
1-352	SSC	Grab	3
3-411	Methyl mercury	Grab	2
3-412	Methyl mercury	Grab	2
3-413	Methyl mercury	Grab	2
TBD Stations, District 3	Methyl mercury	Grab	2
	Mercury	Grab	2
4-413	Mercury	Grab	2
	PCBs (SF Bay List)	Composite	2
	TSS	Composite	2
	SSC	Grab	2
	Total Organic Carbon	Composite	2
	Dissolved Organic Carbon	Composite	2
4-434	Mercury	Grab	3
	PCBs (SF Bay List)	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3
4-435	Mercury	Grab	3
	PCBs (SF Bay List)	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
4-442	TSS	Composite	2
	SSC	Grab	2
4-443	Total Coliform	Grab	2
	Fecal Coliform	Grab	2
	E. Coli	Grab	2
TBD Stations, District 4	Mercury	Grab	2
	PCBs	Composite	2
	TSS	Composite	2
	SSC	Grab	2
	Total Organic Carbon	Composite	2
	Dissolved Organic Carbon	Composite	2
5-311	TSS	Composite	2
	SSC	Grab	2
7-127	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
	Copper	Composite	2
	Lead	Composite	2
	Mercury	Grab	2
	Zinc	Composite	2
	Chlordane	Composite	2
	DDTs, DDDs, DDEs (all forms)	Composite	2
	PCBs	Composite	2
	PAHs	Composite	2
	Dieldrin	Composite	2
	TSS	Composite	2
	SSC	Grab	2
	Total Organic Carbon	Composite	2
	Dissolved Organic Carbon	Composite	2

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
7-128	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
	Copper	Composite	2
	Lead	Composite	2
	Mercury	Grab	2
	Zinc	Composite	2
	Chlordane	Composite	2
	DDTs, DDDs, DDEs (all forms)	Composite	2
	PCBs	Composite	2
	PAHs	Composite	2
	Dieldrin	Composite	2
	TSS	Composite	2
	SSC	Grab	2
	Total Organic Carbon	Composite	2
	Dissolved Organic Carbon	Composite	2
7-380	Mercury	Grab	2
7-413	Cadmium	Composite	2
	Copper	Composite	2
	Lead	Composite	2
	Silver	Composite	2
	Zinc	Composite	2
	Selenium	Composite	2
	DDTs, DDDs, DDEs (all forms)	Composite	2
	Chlordane	Composite	2
	PCBs	Composite	2
	PAHs	Composite	2
	TSS	Composite	2
	SSC	Grab	2
	Total Organic Carbon	Composite	2
	Dissolved Organic Carbon	Composite	2

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
7-414	Cadmium	Composite	3
	Copper	Composite	3
	Lead	Composite	3
	Silver	Composite	3
	Zinc	Composite	3
	Selenium	Composite	3
	DDTs, DDDs, DDEs (all forms)	Composite	3
	Chlordane	Composite	3
	PCBs	Composite	3
	PAHs	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3
7-420	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
	Chlordane	Composite	2
	Dieldrin	Composite	2
	PCBs	Composite	2
	TSS	Composite	2
	SSC	Grab	2
	Total Organic Carbon	Composite	2
	Dissolved Organic Carbon	Composite	2
	Trash	Not Applicable	2
7-421	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
7-422	Nitrate as N	Composite	3
	Nitrite as N	Composite	3
	TKN	Composite	3
	Phosphorus as P	Composite	3
	Chlordane	Composite	3
	Dieldrin	Composite	3
	PCBs	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3
7-423	Nitrate as N	Composite	3
	Nitrite as N	Composite	3
	TKN	Composite	3
	Phosphorus as P	Composite	3
	Chlordane	Composite	3
	Dieldrin	Composite	3
	PCBs	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3
7-425	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
	Chlordane	Composite	2
	Dieldrin	Composite	2
	DDTs, DDDs, DDEs (all forms)	Composite	2
	PCBs	Composite	2
	TSS	Composite	2
	SSC	Grab	2
	Total Organic Carbon	Composite	2
	Dissolved Organic Carbon	Composite	2

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
7-427	Copper	Composite	2
	Lead	Composite	2
	Zinc	Composite	2
	Chlordane	Composite	2
	PCBs	Composite	2
	TSS	Composite	2
	SSC	Grab	2
	Total Organic Carbon	Composite	2
	Dissolved Organic Carbon	Composite	2
7-432	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-433	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-434	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-435	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-436	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-437	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-438	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
7-439	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-440	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-441	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-442	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
7-443	Copper	Composite	3
	Lead	Composite	3
	Zinc	Composite	3
	Trash	Grab	3
TBD Sites District 7	Mercury	Grab	2
TBD Sites District 7	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
TBD Sites District 7	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
8-313	Total Coliform	Grab	2
	Fecal Coliform	Grab	2
	E. Coli	Grab	2
	Enterococcus	Grab	2
8-314	Total Coliform	Grab	2
	Fecal Coliform	Grab	2
	E. Coli	Grab	2
	Enterococcus	Grab	2

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
8-315	Total Coliform	Grab	2
	Fecal Coliform	Grab	2
	E. Coli	Grab	2
	Enterococcus	Grab	2
8-316	Total Coliform	Grab	2
	Fecal Coliform	Grab	2
	E. Coli	Grab	2
	Enterococcus	Grab	2
8-317	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
8-320	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
8-322	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
10-306	Cadmium	Composite	3
	Chromium	Composite	3
	Copper	Composite	3
	Lead	Composite	3
	Mercury	Composite	3
	Zinc	Composite	3
	Hardness as CaCO3	Composite	3
	Nitrate as N	Composite	3
	Nitrite as N	Composite	3
	TKN	Composite	3
	Phosphorus as P	Composite	3
	PCBs	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
10-307	Cadmium	Composite	3
	Chromium	Composite	3
	Copper	Composite	3
	Lead	Composite	3
	Mercury	Composite	3
	Zinc	Composite	3
	Hardness as CaCO3	Composite	3
	Nitrate as N	Composite	3
	Nitrite as N	Composite	3
	TKN	Composite	3
	Phosphorus as P	Composite	3
	PCBs	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3
10-308	Cadmium	Composite	3
	Chromium	Composite	3
	Copper	Composite	3
	Lead	Composite	3
	Mercury	Composite	3
	Zinc	Composite	3
	Hardness as CaCO3	Composite	3
	Nitrate as N	Composite	3
	Nitrite as N	Composite	3
	TKN	Composite	3
	Phosphorus as P	Composite	3
	PCBs	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
10-309	Cadmium	Composite	3
	Chromium	Composite	3
	Copper	Composite	3
	Lead	Composite	3
	Mercury	Composite	3
	Zinc	Composite	3
	Hardness as CaCO3	Composite	3
	Nitrate as N	Composite	3
	Nitrite as N	Composite	3
	TKN	Composite	3
	Phosphorus as P	Composite	3
	PCBs	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3
10-310	Cadmium	Composite	3
	Chromium	Composite	3
	Copper	Composite	3
	Lead	Composite	3
	Mercury	Composite	3
	Zinc	Composite	3
	Hardness as CaCO3	Composite	3
	Nitrate as N	Composite	3
	Nitrite as N	Composite	3
	TKN	Composite	3
	Phosphorus as P	Composite	3
	PCBs	Composite	3
	TSS	Composite	3
	SSC	Grab	3
	Total Organic Carbon	Composite	3
	Dissolved Organic Carbon	Composite	3
11-355	TSS	Composite	1
	Hardness	Composite	1
11-356	TSS	Composite	1
	Hardness	Composite	1

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
11-357	Dissolved Copper	Composite	1
	Dissolved Lead	Composite	1
	Dissolved Zinc	Composite	1
	Diazinon	Composite	1
11-358	Dissolved Copper	Composite	1
	Dissolved Lead	Composite	1
	Dissolved Zinc	Composite	1
	Diazinon	Composite	1
11-359	Dissolved Copper	Composite	1
	Dissolved Lead	Composite	1
	Dissolved Zinc	Composite	1
	Diazinon	Composite	1
11-360	Dissolved Copper	Composite	1
	Dissolved Lead	Composite	1
	Dissolved Zinc	Composite	1
	Diazinon	Composite	1
11-361	Dissolved Copper	Composite	1
	Dissolved Lead	Composite	1
	Dissolved Zinc	Composite	1
	Diazinon	Composite	1
11-362	Fecal Coliform	Grab	3
11-363	Fecal Coliform	Grab	3
11-364	Fecal Coliform	Grab	3

Station Code	Analytical Constituent	Sample Type	Sample Frequency (per Year)
12-01	Nitrate as N	Composite	2
	Nitrite as N	Composite	2
	TKN	Composite	2
	Phosphorus as P	Composite	2
	Chlordane	Composite	2
	Dieldrin	Composite	2
	DDTs, DDDs, DDEs (all forms)	Composite	2
	PCBs	Composite	2
	TSS	Composite	2
	SSC	Grab	2
	Total Organic Carbon	Composite	2
	Dissolved Organic Carbon	Composite	2

Standard PCB List – Aroclors 1016 ,1221 ,1232 ,1242 ,1248, 1254, 1260

PCBs SF Bay List – See Table 6

PAHs - Acenaphthene, Chrysene, Acenaphthylene, Dibenzo(a,h)anthracene, Anthracene, Fluoranthene, Benzo(a)anthracene, Fluorene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Benzo(b)fluoranthene, Naphthalene, Benzo(ghi)perylene, Phenanthrene, Benzo(k)fluoranthene, Pyrene

In the TMDLs located near the San Francisco Bay Area, Caltrans has selected a list of 40 PCB congeners that will be analyzed for all samples. Table 6 lists these compounds.

Table 6 - PCB Congeners for San Francisco Bay

40 PCB Congeners - San Francisco Bay Area		
PCB 004	PCB 087	PCB 153
PCB 008	PCB 095	PCB 156
PCB 018	PCB 097	PCB 158
PCB 028	PCB 099	PCB 170
PCB 031	PCB 101	PCB 174
PCB 033	PCB 105	PCB 177
PCB 044	PCB 110	PCB 180
PCB 049	PCB 118	PCB 183
PCB 052	PCB 128	PCB 187
PCB 056	PCB 132	PCB 194
PCB 060	PCB 138	PCB 195
PCB 066	PCB 141	PCB 201
PCB 070	PCB 149	PCB 203
PCB 074	PCB 151	

B1.4 Sample Locations

A full description and discussion of project sample locations appears in Section A6.3.

B1.5 Inaccessible Sample Locations

If a monitoring site becomes temporarily inaccessible or unsafe for any reason, it will not be included in the monitoring effort for that event, and the Caltrans Task Order Manager will be notified. The Caltrans Task Order Manager will decide whether or not to authorize another event at that site when it becomes accessible and safe.

If a monitoring site becomes permanently unsafe or inaccessible, the consultant will discontinue monitoring at that location and notify the Caltrans Task Order Manager. The Caltrans Task Order Manager will decide whether or not to replace the inaccessible location with a new location.

B1.6 Project Activity Schedule

Monitoring will be conducted annually during the wet season (October 1 to April 30). Monitoring activities are weather-dependent. Receiving water monitoring will also be conducted during storm events, when Caltrans discharge is entering the waterbody.

B1.7 Critical Information

All water quality data collected as part of this project are considered critical. Hydrologic data collected in the field are also critical because they are useful for proper data interpretation and a are sometimes required by local regulations. Temperature and pH data are critical and will be recorded in field logs, and are considered critical data; other data contained in field logs are expected to be noncritical.

B1.8 Natural Variability

Storm-related environmental samples may be expected to exhibit natural variability from location to location, from storm to storm, and from season to season. Geographic differences between locations are a potential source of variability. The variation in duration and intensity of storms may be another source of variability in the data.

B1.9 Bias and Misrepresentation

No systematic bias or misrepresentation is expected over the life of this project.

Element 11: B2 – Sampling (Sample Collection) Methods

Sample collection will be performed using the methods provided in the project Sampling and Analysis Plan (SAP), contained in Appendix A of this document. Methods in the SAP were developed in accordance with the guidelines in Chapters 4, 8, and 11 of the Caltrans Stormwater Monitoring Guidance Manual (Caltrans 2020).

Composite samples will be collected using the methods provided in Section SAP-1.2 of Appendix A. Grab samples will be collected using the methods provided in Section SAP-1.3 of Appendix A.

Trash may also be collected and measured at some project sites. Methods for collection, analysis, and reporting of trash also appear in Appendix A.

B2.1 Collection Methods

Sample collection will be performed using the methods provided in the project SAP (Appendix A). Methods in the SAP were developed in accordance with the guidelines in Chapters 4, 8, and 11 of the Stormwater Monitoring Guidance Manual (Caltrans 2020).

In general, composite samples will be collected using the methods provided in Section SAP-1.2 of Appendix A. Grab samples will be collected using the methods provided in Section SAP-1.3 of Appendix A.

Time-Weighted Sample Collection and Compositing at TMDL Sites

Time-weighted composite samples for TMDL sites may be collected using the following procedures.

Grab samples are collected manually and combined into a single composite sample in accordance with the procedure outlined in Section SAP-1.3 of Appendix A. Grab samples will be collected according to the following strategy:

1. Storms with a duration greater than three hours: Samples shall be collected manually by taking at least three discrete grab samples during each of the first three hours of discharge.
2. Storms with a duration of three hours or less: at least three discrete grab samples shall be collected during each hour of discharge for the entire duration of the storm event.

Samples shall be collected between 15 and 20 minutes apart. The actual time that it takes to collect an individual grab sample will not exceed 15 minutes. The first flow measurement will be taken approximately 10 minutes after the discharge has stabilized and the first sample will be collected approximately 15 minutes after the discharge has stabilized. The discharge will be considered to have stabilized when flow rate and turbidity appear to be reasonably constant and/or sheet flow is well established.

Field crews will take instantaneous flow measurements at the sample collection point prior to the collection of each grab sample. Flow measurements will be made using the measurement methods described in Section SAP-1.3.3 of Appendix A. One flow measurement will be made approximately 5 to 10 minutes prior to the collection of each grab sample, so that each grab sample is associated with a corresponding flow measurement.

At the end of the monitoring event, field technicians will use the flow measurements to prepare a compositing scheme, as shown in Figure 2. Field technicians or office staff will prepare this compositing scheme using the tool that has been provided by Caltrans for this purpose. Each grab sample must be associated with a corresponding flow measurement in order to us this tool correctly.

The field crew will then send all discrete grab samples to the laboratory along with the compositing scheme. The laboratory will use this flow compositing scheme to combine all discrete grab samples into a single composite sample for analysis.

Samples such as coliform bacteria and oil & grease must be collected as single discrete samples. These samples will be collected sometime during 45 to 90 minutes after start of sampling, or if the event lasts more than 3 hours, approximately in the middle of the sampling event. These tests will be performed on individual grab samples, not on the composite sample.

Table 7 - Example of a Sample Compositing Scheme for a Standard 3-Hour Event

				TOTAL SAMPLE VOLUME REQUIRED (Vc)	**20000**	**mL**		
				DISCREET GRAB SIZE (Vgrab)	**4000**	**mL**		
Aliquot #	Time of Flow Measurement	Time of Grab Sample	Measured Flow Rate (L/min)	Time Interval Between Flow Measurements (min)	Averaged Flow Rate (L/min)	Flow Volume (L)	Unadjusted Aliquot Volume	**Final Aliquot Volume**
--	00:00	--	92	--	--	--	--	--
1	00:18	00:20	100	18	96	1728	840	**818**
2	00:36	00:41	115	18	108	1935	941	**916**
3	00:57	00:59	201	21	158	3318	1613	**1571**
4	01:16	01:20	330	19	266	5045	2453	**2388**
5	01:30	01:33	401	14	366	5117	2488	**2423**
6	01:52	01:57	367	22	384	8448	4108	**4000**
7	02:08	02:10	209	16	288	4608	2241	**2182**
8	02:25	02:30	301	17	255	4335	2108	**2053**
9	02:47	02:54	299	22	300	6600	3209	**3125**
							Final Composite Volume:	**19476**

Note: The start time of 00:00 reflects the time approximately 10 minutes after the flow appears to have stabilized, based on visual observation. During a storm event, actual times of day will be placed in these cells.

The volume of each grab sample that should be used to make the final composite (shown in Column 8 of Figure 2) is calculated as follows. These equations assume that the volume of the final composite will be 20 liters (20,000 ml) and that the target volume for each individual grab sample is 4 liters (4,000 ml).

First, for each discrete grab sample collected, determine the volume of discharge that it represents.

Equation B2.1

$$\text{Flow Volume (L)} = \Delta\text{Time} * ((dQ_{i\ t2} - dQ_{i\ t1}) / 2)$$

Where: Flow Volume = Volume of flow represented by the discrete grab sample
ΔTime = Interval in minutes between the current and the previous instantaneous flow measurements
$dQ_{i\ t2}$ = Instantaneous flow measurement (L/min) associated with this grab sample
$dQ_{i\ t1}$ = Previous instantaneous flow measurement (L/min)

Next, determine the volume of each discrete grab sample to be used as an aliquot in the final composite sample. This is an unadjusted volume based on the assumption that all discrete grabs will have sufficient volume.

Equation B2.2

$$\text{Unadjusted Aliquot Volume (mL)} = \text{Flow Volume} * \text{Final Composite Volume} / \sum dQi$$

Where: Initial Aliquot Volume = Volume of the discrete grab used in the composite (mL)
Flow Volume = Flow volume for this sample, from Equation B2.1
Final Composite Volume = Target volume of the final composite (ml)
$\sum dQi$ = Sum of all flow volumes (L)

If all individual grab samples have sufficient volume, then these volumes will be used to make the final composite However, if some grab samples do not have sufficient volume, then adjusted volumes must be calculated so that a flow-proportioned composite can be made accurately. The tool provided by Caltrans does this job automatically using the following formula:

Equation B2.3

$$\text{Final Aliquot Volume (ml)} = \text{Initial Aliquot Volume} * \text{Grab Volume}_{target} / \text{Grab Volume}_{max}$$

Where: Final Aliquot Volume = Volume of the discrete grab that will be used in the composite
Initial Aliquot Volume = Volume of the aliquot calculated in Equation B2.2
Grab Volume_{target} = Target volume for discrete grab samples
Grab Volume_{max} = Volume of largest discrete grab sample or Grab Volume_{target}, whichever is greater.

In the example shown in Figure 2, the final required volumes are shown in Column 9. These are final volumes of each discrete grab sample that will be used to make the composite sample.

B2.2 Bioassessment Sampling Methods

This project does not include bioassessment monitoring.

B2.3 Sample Collection Methods

Samples will be collected in accordance with the guidelines provided in the Caltrans Stormwater Monitoring Guidance Manual (Caltrans 2015). Sample collection methods for this project are discussed in Section SAP-1 of Appendix A.

B2.4 Homogenizing, Compositing, Splitting, and Filtering

Water samples are homogenized manually by swirling or rocking the container. When sample water is poured from a composite carboy into laboratory sample bottles, the carboy is swirled vigorously and the subsamples are poured off immediately, before the solids in the sample have had time to settle.

For storm events lasting more than 24 hours, composite carboys will be removed and replaced every 24 hours or less over the life of the storm. No carboy will be left in the monitoring station more than 24 hours. Carboys will be sent to the laboratory immediately, and the laboratory will analyze the sample for all short-hold time (48 hours or less) constituents. In this case, the laboratory will produce multiple results for the short hold analyses (one for each carboy submitted), and then composite the carboys at the end of the storm and perform all other tests on the composite. The monitoring consultant will provide the laboratory with the proper flow information so that the lab can properly mix the contents of all of the carboys into one final flow-proportioned composite.

Samples will be composited automatically during sample collection, using automated sample collection equipment as described in Section SAP-1.2.4 of Appendix A.

Manual compositing of samples will be performed according to the method outlined in Section SAP-1.7.1 of Appendix A.

Sample splitting will be performed according to the method outlined in Section SAP-1.7.2 of Appendix A.

Field filtration will be performed according to the method outlined in Section SAP-1.7.3 of Appendix A.

Please see Appendix C, Item 4, for the appropriate language from the Caltrans Stormwater Monitoring Guidance Manual.

B2.5/B2.6 Sample Containers and Volumes

Clean, pre-preserved bottles will be provided by the laboratory. Field personnel will request sets of bottles from the laboratory before each monitoring event, and make sure that they always have enough sample bottles on hand. It will not be necessary for field technicians to preserve sample containers.

The laboratory must receive sufficient sample volume to perform all of the required analyses. Field personnel must make sure to fill each of the required bottles with enough sample volume. Table SAP-1.5 in Appendix A lists the appropriate bottle types, preservations, and required sample volumes for each analysis.

If a monitoring event produces a sample volume that is insufficient to perform all of the required tests, the laboratory will analyze the sample using the priority list shown in Table 5. Analyses with priority 1 will be performed first, then analyses with priority 2, and so on, until the sample has been consumed.

B2.7 Equipment Cleaning

Pre-cleaned disposable items, such as sample bottles and disposable bailers, will not need cleaning because they are discarded after use. Field equipment that is reused will be cleaned before first use and between uses. Sampler parts, such as tubing and strainers, will be cleaned only at the beginning of each storm season. Laboratories will check the cleaned equipment before it is used to make sure that it has been cleaned satisfactorily. Cleaning and testing procedures are provided in Appendix B.

Equipment required for monitoring is discussed in Section SAP-1 of Appendix A. No other support facilities are expected to be required on this project.

B2.9 Problem Resolution

When field technicians become aware of some problem with monitoring equipment, sample collection protocols, laboratories, monitoring stations, or any other problems that they believe might impact the monitoring program, they will inform the consultant Project Manager as soon as possible. The consultant will take whatever corrective action is necessary based on best professional judgment. In cases where the problem cannot be resolved by the consultant, the Project Manager will notify the Caltrans Task Order Manager of the problem as soon as possible.

Element 12: B3 – Sample Handling and Custody

B3.1 Sample Hold Times

Samples must be analyzed within the recommended holding times specified by the analytical methods. This is necessary so that project data may be used for regulatory purposes. It is critical that samples are transported to the laboratory quickly enough so that the laboratory has time to meet the required holding times.

If any analysis is performed outside the associated holding time, the result of that analysis will be considered to be an estimated value and must be qualified accordingly.

Table SAP-1.5 of Appendix A lists the required holding times for all project constituents.

B3.2 Sample Handling

Care must be used when handling and transporting samples after they have been collected. Samples may be compromised if they are not handled properly. See Section SAP-1.7 of Appendix A for correct sample handling and transport procedures.

Please see Appendix C, Item 6, for the appropriate language from the Caltrans Stormwater Monitoring Guidance Manual.

B3.3 Documentation of Handling and Custody

During all phases of monitoring, samples will be handled in accordance with the practices discussed in the Stormwater Monitoring Guidance Manual (Caltrans 2020). Field personnel under direction of the field shift leader will be responsible for documenting the handling, transport, and storage of samples for the entire time that they are in the custody of the field team. If samples are relinquished to a shipping company or courier, the sample coolers will be packed carefully and sealed thoroughly with packing tape or duct tape. The driver or courier will sign the COC, and the COC will accompany the samples until they reach the laboratory.

B3.4 Chain-of-Custody Procedures

Custody procedures must be followed strictly from the time samples are collected until they are delivered to the laboratory. It is critical that the project COC forms be filled out completely and correctly. Custody documentation is an important part of the final legal record for project data, and can be useful during data review.

See Section SAP-1.9.4 of Appendix A for a discussion of COC procedures. A sample COC form is provided in Figure SAP-1 of Appendix A.

Element 13: B4 – Analytical Methods and Field Measurements

B4.1 Laboratory Methods

All project samples will be analyzed by environmental laboratories accredited by either the California ELAP. Monitoring consultants will ensure that all project laboratories hold a valid ELAP certification for every test they perform for this project. In the event that Caltrans is asked to test for a pollutant that is not accredited under these programs, a laboratory will be selected that has demonstrated proficiency in the required analytical method.

Project laboratories are responsible for analyzing all samples in accordance with analytical methods approved by the US Environmental Protection Agency and for which they are accredited. Sample analysis shall be conducted according to test procedures approved under 40 C.F.R. §136 unless another method is required under 40 C.F.R subchapters N or O. Any deviation from this requirement shall be approved in advance by the Caltrans Task Order Manager.

Where EPA-approved test methods exist, monitoring consultants and project laboratories will use methods that are sufficiently sensitive to detect and measure the pollutants at or below the applicable water quality criteria. A method will be considered sufficiently sensitive where:

1. The method minimum level (ML) is at or below the level of the applicable water quality criterion for the measured pollutant; or
2. The method ML is above the applicable water quality criterion, but the amount of the pollutant or pollutant parameter in the stormwater discharge is high enough that the method detects and quantifies the level of the pollutant in the discharge; or
3. The method has the lowest ML of the analytical methods approved under 40 CFR part 136 or required under 40 CFR chapter I, subchapter N or O for the measured pollutant.
4. In the case of pollutants or pollutant parameters for which there are no approved methods under 40 C.F.R. section 136 or otherwise required under 40 C.F.R. subchapter N, monitoring shall be conducted according to a test procedure specified in the Permit, Attachment F, Table F1, or as directed by the State Water Board.

The term minimum level is considered to be synonymous with the term reporting limit (RL).

Table 8 – Laboratory Methods

Pollutant Type	Constituent	Analytical Method	Minimum Level	Units
Conventionals	Flow	Field[1]	-	-
Conventionals	pH	Field	-	pH Units
Conventionals	Temperature	Field	-	˚C
Conventionals	Turbidity	Field	-	NTU
Conventionals	Dissolved Oxygen	Field	-	mg/L
Conventionals	Hardness as $CaCO_3$	SM 2340 B or C	5	mg/L
Conventionals	Total Dissolved Solids	EPA 160.1	1	mg/L
Conventionals	Total Suspended Solids	EPA 160.2	1	mg/L
Hydrocarbons	Oil and Grease	EPA 1664B	1.4	mg/L
Semivolatiles	PAHs[2]	EPA 8310	0.05	ug/L
Nutrients	Ammonia	EPA 350.1	0.2	mg/L
Nutrients	Total Kjeldahl Nitrogen	EPA 351.2	100	ug/L
Nutrients	Nitrate as Nitrogen	EPA 300.0/300.1	100	ug/L
Nutrients	Total Phosphorus	EPA 365.1	30	ug/L
Metals	Aluminum	EPA 200.8	25	ug/L
Metals	Chromium	EPA 200.8	1	ug/L
Metals	Copper	EPA 200.8	1	ug/L
Metals	Iron	EPA 200.8/200.7	1	ug/L
Metals	Lead	EPA 200.8	1	ug/L
Metals	Mercury	EPA 1631	0.2	ug/L
Metals	Zinc	EPA 200.8	5	ug/L
Metalloids	Selenium	EPA 200.8	0.5	ug/L
Microbiologicals	Fecal Coliform	SM 9221 C, E	2	MPN
Microbiologicals	Enterococcus[3]	Enterolert	2	CFU
PCBs	Aroclors[4]	EPA 1668	50	pg/Kg
OC Pesticides	DDTs	EPA 1669	5	pg/L
OC Pesticides	Chlordane	EPA 1669	5	pg/L
OC Pesticides	Dieldrin	EPA 1669	5	pg/L
OC Pesticides	Toxaphene	EPA 1669	5	pg/L
Toxicity	Chronic Toxicity	EPA 821-R-02-013	Pass/Fail	-

[1] Flow measurements shall be estimated using a U.S. EPA flow estimating methods provided in U.S. EPA Water Flow Webpage or U.S. EPA Water Flow Measurement Tech Notes.

[2] List of polycyclic aromatic hydrocarbons shall be the full list specified in EPA Method 8310.

[3] Only applicable for direct discharges to marine waters. See State Board Order 2022-0033-DWQ, Attachment B, for definitions.

[4] Aroclors shall include: 1016, 1221, 1232, 1242, 1248, 1254, and 1260.

SAP-Table 2.1 of Appendix A shows all of the required analytical methods for project constituents. In some cases, it may be necessary or desirable to analyze samples using some alternate method. For example, the contract laboratory may not be accredited for a method listed in Table SAP-2.1, but may be accredited by an alternate method. In some cases, lower detection limits may be attainable using a different method. Use of alternate methods is permissible if approved in advance and in writing by the Caltrans Task Order Manager.

Caltrans has opted to direct all project laboratories to report analytical results down to the Method Detection Limit (MDL), rather than the Minimum Level (ML). When an analytical result is reported below the ML, data will be qualified with a 'J' qualifier, indicating that the result is estimated.

B4.2 Field Methods

The following field analyses will be performed at all project stations as part of every monitoring event.

1. pH
2. Temperature
3. Dissolved Oxygen
4. Turbidity

Field technicians will be trained to use the appropriate analytical equipment to perform these measurements and then perform them as necessary. Results of all field testing will be recorded in field logs and then transferred to a CEDEN-compatible spreadsheet when field crews return to the office. Field analyses are discussed in Section SAP-1.5 of the project SAP (Appendix A). Field test results will be recorded in the field logs and transcribed into PSTM reports and electronic data deliverables (EDDs).

Field personnel will also take measurements of discharge flow volume at every site during each storm event. At sites where no flow measurement data is installed, field technicians will measure flow manually using the measurement methods described in Section SAP-1.3.3 of Appendix A.

Additionally, during the setup phase before each monitored storm event, field technicians will investigate the area and look for dry-weather discharges from the Caltrans right of way. If any dry-weather discharges are observed, field personnel will note this in their field logs, including the date and time that the observation was made, and contact the Caltrans Task Order Manager to discuss any follow-up that may be necessary.

B4.3/B4.4 *In Situ* Monitoring/Continuous Monitoring

At some stations, continuous flow and rainfall measurements may be made using automated flow meters and rain gauges that are connected to a data logger. After each monitoring event, field technicians will download this data from the data logger and store it in a format that can be processed using the Caltrans Hydrologic Utility (https://ctsw.owp.csus.edu).

No other *in situ* monitoring will be performed.

B4.5 Laboratory Standard Operating Procedures

The laboratory is required to perform all analyses in accordance with ELAPappro-ved methodology, and to keep a copy of laboratory standard operating procedures (SOPs) on file.

B4.6 Laboratory Equipment

All project laboratories shall operate and maintain all equipment in accordance with manufacturer's instructions, and to keep appropriate records for equipment purchase, setup, calibration, operation, and repair. Project laboratories shall maintain a full system of preventative maintenance as part of their laboratory QA/QC Plan.

B4.7 Method Performance Criteria

Laboratory performance will be evaluated using QA/QC samples. Some QA/QC samples, such as field blanks and field duplicates, are produced in the field and submitted to the laboratory along with the normal field samples. Other QA/QC samples are created in the laboratory. See Section B.5.1 for a full discussion of QA/QC samples and their uses.

In addition, the laboratory is expected to conduct internal method performance checks as necessary to comply with the requirements of each analytical method, and to document this information as part of the laboratory QA/QC Plan.

B4.8 Target Analytical Reporting Limits

For every constituent, the laboratory establishes a minimum concentration that can be reliably quantified using a given analytical method. These minimum concentrations, usually called Reporting Limits (RLs), can vary considerably from method to method and from lab to lab. All laboratories used for this project will be able to meet the project Measurement Quality Objectives (MQOs, see Element 7). Tables SAP-4.1 through SAP- 4.6 in Appendix A list the required reporting limits for all project constituents.

Along with each analytical result, the Department shall report the associated minimum level and method detection limit as determined by the procedure in 40 C.F.R. section 136. The term "reporting limit" is synonymous with the term "minimum level." The Department shall report analytical data using this reporting structure:

1. Sample results greater than or equal to the minimum level shall be reported as measured by the laboratory.
2. Sample results less than the minimum level, but greater than or equal to the laboratory's method detection limit shall be reported but considered estimated, and will be qualified with the QC flag "Detected but not quantified."
3. The laboratory may include numerical estimates of the data quality for the reported result, if such information is available. Numerical estimates of data quality may be percent

accuracy (+/- a percentage of the reported value), numerical ranges (low to high), or any other means the laboratory considers appropriate. If this information is provided, it will be included in the written laboratory report and in the comments column of the EDD. This information will be reported in addition to, not in lieu of, the analytical result, RL, and MDL.

4. Sample results less than the laboratory's MDL shall be reported as Not Detected.
5. The Department shall instruct laboratories to establish calibration standards so that the minimum level value (or its equivalent if there is differential treatment of samples relative to calibration standards) is the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method-specified sample weights, volumes, and processing steps have been followed.

A laboratory's MDLs change periodically, but their reporting limits will remain constant indefinitely; for this reason, the project MQOs are specified as required reporting limits for project constituents, not as MDLs.

Please see Appendix C, Item 7, for the appropriate language from the Caltrans Stormwater Monitoring Guidance Manual.

B4.9 Corrective Action

The laboratory QAO is responsible for enforcing the laboratory QA/QC Plan and for ensuring that data reported by the laboratory are of acceptable quality. Any deviation from the laboratory QA/QC Plan must be brought to the attention of the QAO, who will take the appropriate corrective action. The laboratory Project Manager will be informed of any problems that might impact data quality so that these can be communicated to the monitoring consultant and documented in the lab report.

If the monitoring consultant discovers some problem with data quality, the laboratory Project Manager will be notified immediately. If the laboratory is unable to take satisfactory corrective action, the consultant Project Manager will contact the Caltrans Task Order Manager to discuss the problem. The Caltrans Task Order Manager will decide what further corrective action is necessary.

B4.10 Sample Disposal

After analysis, including following QA/QC procedures, the laboratory will dispose of any excess samples in accordance with the laboratory SOP. The laboratory is expected to dispose of all samples in accordance with local, state, and federal law.

B4.11 Laboratory Turnaround Times

Laboratories will be expected to meet the turnaround time specified in the task order for all project data unless other arrangements are made in advance and with written authorization from the Caltrans Task Order Manager.

B4.12 Nonstandard Methods

No nonstandard methods will be used on this project.

Element 14: B5 – Quality Control

B5.1 Quality Control

The quality of laboratory data is evaluated using the MQOs discussed in Section A7. Several kinds of samples, called QC samples are analyzed by the laboratory, and the results of these analyses are compared to the appropriate MQOs to verify that the data are of acceptable quality.

Some types of QC samples are produced in the field and submitted to the laboratory along with the normal field samples. Other types of QC samples are generated by the laboratory. The following sections discuss the various types of QC samples, their uses, and where they originate.

Section B5.1 of this document describes the various kinds of QC samples used for Caltrans stormwater monitoring projects. Table 6 shows the frequencies with which field QC samples will be collected. Laboratory QC samples shall be analyzed per laboratory SOP.

Table 9 - QC Sample Schedule

	Field Blanks	Field Duplicates	Matrix Spikes	Equipment Blanks
Field				
pH	None	1 per event	None	None
Temperature	None	1 per event	None	None
Dissolved Oxygen	None	1 per event	None	None
Flow	None	None	None	None
Conventionals				
Turbidity	1 per 20 samples	1 per 20 samples	None	None
Hardness as CaCO3	1 per 20 samples	1 per 20 samples	1 per 20 samples	None
Total Dissolved Solids	1 per 20 samples	1 per 20 samples	None	None
Total Suspended Solids	1 per 20 samples	1 per 20 samples	None	None
Nutrients				
Kjeldahl Nitrogen	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Nitrate as N	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Nitrite	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Ammonia as N	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Phosphorus, Total	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Metals				
Aluminum	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Chromium	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Copper	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Iron	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch

	Field Blanks	Field Duplicates	Matrix Spikes	Equipment Blanks
Lead	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Mercury	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Selenium	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Zinc	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Organics				
PAHs	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Pesticides				
DDT	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Chlordane	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Dieldrin	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Toxaphene	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
PCBs				
Aroclors	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per cleaning batch
Microbiologicals				
Fecal Coliform	1 per 20 samples	1 per 20 samples	None	None
Enterococcus	1 per 20 samples	1 per 20 samples	None	None
Toxicity				
Toxicity	None	None	None	None

1 per 20 samples – Each monitoring consultant shall collect 1 sample per every 20 field samples collected on a monitoring project each season. A minimum of 1 set of QC samples per season will be collected by each monitoring consultant.

1 per cleaning batch - Each time a laboratory cleans a batch of monitoring equipment, such as tubing, strainers, and bailers, the lab will select one piece of cleaned equipment and blank-test it.

B5.1.1 Quality Control Batches

Environmental laboratories analyze multiple samples at once, in a group called a batch. A set of QC samples is analyzed with every batch, so a batch is also frequently called a QC batch. A QC batch is almost always a group of either 10 or 20 environmental samples plus one full set of QC samples. If the QC samples associated with a QC batch meet the project MQOs, then all of the analytical results from that batch are accepted.

B5.1.2 Field Quality Control Samples

The following types of QC samples are produced in the field.

B5.1.2.1 Field Blanks

Field blanks are produced by pouring water (obtained from the lab) that is known to be free of target analytes into clean sample containers. This is done in the field, and the blanks are processed, transported, stored, and delivered to the laboratory in exactly the way the environmental samples are. It is assumed that any contamination that enters the samples during this process will also enter the blanks, and will be detected during analysis. This check for contamination is not part of the MQO list discussed in Section A7, but it is an important check for lab data quality.

Field blanks should be labeled as ordinary field samples, so that the laboratory does not know that they are QC samples. This is known as submitting samples "blind" to the laboratory.

B5.1.2.2 Field Duplicates

A field duplicate is a sample that is split into two fractions in the field and sent to the laboratory for analysis as two different samples. The duplicate samples are analyzed and the results are compared to evaluate analytical precision (see Section A7.4). The degree to which duplicate results agree with each other is expressed as the Relative Percent Difference (RPD) of the two results. The method for calculating RPD is provided in Section B5.3.

As with field blanks, field duplicates should be submitted "blind" to the laboratory.

B5.1.2.3 Matrix Spikes

Matrix spikes are environmental samples that are fortified by the laboratory with a known amount of target analyte and then analyzed as ordinary field samples. Fortifying a sample in this way is often referred to as "spiking" the sample, and fortified samples are usually referred to as "matrix spikes."

Matrix spikes are used to demonstrate that the laboratory produces accurate results when analyzing environmental samples. Accuracy is discussed in detail in Section A7.5. The degree of accuracy exhibited by spiked samples is expressed as a Percent Recovery (% Recovery) of the spike to the true concentration of the analyte. The method for calculating % Recovery is provided in Section B5.3.

Matrix spikes are nearly always performed in duplicate to provide a second check of precision. For this reason, when submitting a sample to the laboratory to be used as a matrix spike, three times the normal sample volume must be submitted; the first volume to be analyzed as a normal environmental sample, the second and third volumes to be spiked and then analyzed. A set of matrix spike samples is usually referred to as a matrix spike/matrix spike duplicate, or MS/MSD.

Samples to be used for spiking cannot be submitted to the laboratory "blind" because the lab must know which sample is to be spiked. If a sample is to be used for spiking, this information must be made clear on the COC and on the labels of the sample bottles.

B5.1.3 Laboratory Quality Control Samples

The following types of QC samples are produced in the laboratory.

B5.1.3.1 Method Blanks

A method blank is a sample composed of reagent-grade deionized water that is known to be free of target analyte. The blank is processed through all steps of an analysis just as environmental samples are. Any contamination introduced by the lab is assumed to also be introduced into the blank, where it will be detected during analysis.

B5.1.3.2 Laboratory Control Samples

A Laboratory Control Sample (LCS) is a volume of reagent-grade water that is fortified with a known concentration of target analyte and then processed along with the rest of the samples in the QC batch. LCSs are also referred to as blank spikes. LCS samples are used to demonstrate laboratory precision in the absence of any interferences that might be present in field samples. LCS performance is expressed as % Recovery. The method for calculating % Recovery is provided in Section B5.3.

Laboratories occasionally use Standard Reference Materials (SRMs), or Certified Reference Materials (CRMs) instead of LCSs. For the purpose of this project, these terms may be used interchangeably.

B5.1.3.3 Laboratory Duplicates

Laboratory duplicates are almost identical to field duplicates. The only difference is that a random field sample is selected by the laboratory and split into two identical samples for analysis. Because it is prepared by the laboratory, it is not a "blind" sample, as a field duplicate is. Results for laboratory duplicates are calculated the same way that field duplicates are.

B5.1.3.4 Other Types of Quality Control Samples

Two other types of QC samples, equipment blanks and trip blanks, may be used on this project. These are not considered to be batch QC samples because they are not included routinely in every laboratory analytical batch. These QC samples are only used on an as-needed basis.

Equipment blanks are collected by rinsing sample collection equipment with reagent-grade clean water. The water is then analyzed by the laboratory, and any concentrations of target analytes that are detected in the blank water are assumed to have been rinsed off of the equipment. In this case, the equipment should be pre-cleaned and retested to be sure that the equipment is clean. Equipment blanks are usually used to test freshly cleaned equipment to verify that it has been cleaned completely.

Trip (travel) blanks are used to check for contamination of the samples by volatiles such as low-level metals or volatile organic compounds. Trip blanks are prepared by the laboratory and consist simply of a sample bottle filled with reagent-grade clean water. Trip blanks are delivered to the monitoring consultant along with the sample bottles and accompany them through all phases of sample collection, storage, and transport until the samples are received by the laboratory. Any volatile contamination that is detected in the blank is assumed to have been absorbed by the samples as well.

B5.2 Quality Control Exceedances

Failures in the field that might impact data quality must be reported by field personnel to the consultant Project Manager immediately. Depending on the nature of the problem, the Project Manager may direct field staff to take appropriate corrective action. If the problem cannot be resolved by the consultant, the Caltrans Task Order Manager should be notified via email as soon as possible.

If any MQO is exceeded, the monitoring consultant shall take appropriate corrective action. Depending on the nature of the problem, the laboratory may be directed to reanalyze the affected samples or the data may be qualified or rejected.

If the Project Manager or the Caltrans Task Order Manager have reason to believe that the failure may have affected the quality of the project data in some way, all communication and corrective action will be documented and discussed in the final project report.

Acceptance criteria for project data are provide in Tables SAP-5.1 through SAP-5.9 of the project SAP (Appendix A).

B5.3 Procedures and Formulas

This section provides the calculations for % Recovery and RPD discussed in Section B5.1 and mentioned in Section A7.

B5.3.1 Percent Recovery

Percent recovery (% Recovery) is used to calculate analytical accuracy (bias).

$$\%\,Recovery = \frac{C_s - C_{us}}{Spike\ Concentration}\ X\ 100$$

Where:

C_s = Target analyte concentration in the spiked sample
C_{us} = Target analyte concentration in the un-spiked sample

Spike Concentration = Concentration of target analyte spiked into the sample

C_{us} = zero in blank-spike samples such as Laboratory Control (LCS) and Certified Reference Material (CRM) samples.

B5.3.2 Relative Percent Difference

Relative Percent Difference (RPD) is used to calculate analytical precision. RPD is expressed as an absolute (positive) value.

$$RPD = \frac{C_1 - C_2}{(C_1 + C_2)\ /\ 2}\ X\ 100$$

Where:

C_1 = Analyte concentration in first replicate
C_2 = Analyte concentration in second replicate

Element 15: B6 – Instrument/Equipment Testing, Inspection, and Maintenance

B6.1 Equipment that Requires Periodic Maintenance

The laboratory will be responsible for maintaining all laboratory analytical equipment, and for keeping appropriate records of equipment maintenance and repair.

Automated monitoring equipment will be maintained in accordance with manufacturer's instructions and calibrated as necessary throughout the season. Guidelines for maintenance of monitoring equipment are provided in Chapter 8 of the Stormwater Monitoring Guidance Manual (Caltrans 2020).

Field testing meters will be maintained in accordance with manufacturer's instructions. Any field meter that appears to be malfunctioning will be repaired or replaced.

B6.2 Instrument Testing Criteria

The laboratory will be responsible for maintaining all analytical equipment in accordance with manufacturer's recommendations. Consultant field crews will maintain field meters in accordance with manufacturer's recommendations.

Field testing equipment such as handheld pH meters do not normally require separate testing protocol. These pieces of equipment will be calibrated before each use. If any piece of field testing equipment appears to be malfunctioning, it will be taken out of service and either repaired or replaced.

B6.3 Spare Parts

Caltrans maintains two storage areas (Sacramento County and Orange County) with surplus monitoring equipment that can be used to replace faulty or damaged equipment. If a replacement part or alternate piece of equipment cannot be found in storage, then the manufacturer will be contacted for servicing or replacement parts.

B6.4 Pre-usage Inspections

Field meters will be kept in a clean, dry storage area between uses. Field crews will inspect them before use to make sure that they appear to be in working order. Field meters will be calibrated before each use.

B6.5 Responsible Individual(s)

The field team shift leader will be responsible for making sure that field equipment is in working order before each monitoring event. If a field technician has any reason to believe that a piece of equipment is not working properly, the field shift leader will be notified as soon as possible. Malfunctioning equipment will be taken out of service, and the consultant project manager will notify the Caltrans Task Order Manager of the problem.

B6.6 Corrective Actions

If any field equipment is suspected of malfunctioning, this will be brought to the attention of the field team shift leader. The shift leader will check the equipment, and either repair it in the field or use another instrument during the monitoring event. Equipment that cannot be repaired will be replaced.

Element 16: B7 – Instrument/Equipment Calibration and Frequency

B7.1 Equipment Needing Calibration

The laboratory will be responsible for calibrating analytical equipment on an appropriate schedule, and for keeping a schedule of equipment maintenance as part of its Preventative Maintenance Plan.

Field meters will be calibrated before use, in accordance with manufacturer's instructions. Flow meters that require calibration will be calibrated at the beginning of the season and on an as-needed basis. Thermometers and tipping-bucket rain gauges do not require calibration.

B7.2 Calibration Procedures

All laboratory equipment is calibrated based on manufacturer recommendations and accepted laboratory protocol. The analytical laboratory maintains calibration practices as part of the method SOPs.

Field meters will be calibrated in accordance with the manufacturer's recommendations.

B7.3 Corrective Actions

The laboratory is expected to follow a program of corrective action that is part of its QA/QC Plan.

If any field equipment is suspected of malfunctioning, this will be brought to the attention of the field team shift leader. The shift leader will check the equipment and either repair it in the field or use another instrument during the monitoring event. Equipment that cannot be repaired will be replaced. Any factory service, repair, or disposal of monitoring equipment must be approved in advance by the Caltrans Task Order Manager.

Element 17: B8 – Inspection/Acceptance for Supplies and Consumables

B8.1 Critical Supplies and Consumables

Grab samples will be collected for this project. Normally, samples will be collected directly into pre-cleaned sample bottles that are provided by the laboratory. Occasionally, some intermediary container, such as a bailer or bucket, may be employed to collect samples.

Sampler tubing will be discarded annually when the monitoring stations are decommissioned at the end of the season, and replace when the stations are reinstalled at the beginning of the next season.

Composite samples by automated equipment are usually collected in 20-liter glass or plastic carboys. Carboys are cleaned by the laboratory before each use (see Appendix B for cleaning procedures). If plastic carboys become stained, scratched, or otherwise compromised, the will be replaced. Under normal conditions, glass carboys can be used indefinitely. Automated sampler stations also use pump tubing and sampler tubing, which should be replace each season.

B8.2 Responsible Individuals

The field crew leader will be responsible for acquiring and inspecting sample containers and for making sure that intermediary containers are in clean and serviceable conditions before they are used.

Element 18: B9 – Non-direct Measurements

B9.1 Sources of Non-direct Measurement Data

No non-direct measurement data will be used on this project.

B9.2 Intended Use of Non-direct Measurement Data

No non-direct measurement data will be used on this project.

B9.3 Acceptance Criteria for Non-direct Measurement Data

No non-direct measurement data will be used on this project.

B9.4 Key Resources and Support Facilities Needed for Non-direct Measurements

No non-direct measurement data will be used on this project.

B9.5 Determination of Limits Validity and Operating Conditions for Non-direct Measurement Data

No non-direct measurement data will be used on this project.

Element 19: B10 – Data Management

B10.1 Data Management Scheme

Project data originate from threes sources: automated data logging instruments, from field analyses, and from the laboratory.

After every storm, field technicians will download the data from the data logger onto a laptop computer. Data from field analyses such as pH and turbidity will be recorded in the field logs. All of this field data will be taken back to the office after each storm event and turned over to the consultant Project Manager or to an individual designated by the Project Manager. Data from the field logs will be transcribed into a CEDEN-formatted spreadsheet. Hydrology data will be submitted online via the Caltrans Hydrologic Utility.

The laboratory will submit all analytical data in two electronic formats, a PDF of the hard-copy report (including a completed copy of the COC) and a CEDEN-compliant Microsoft Excel spreadsheet. Both documents will be submitted to the consultant Project Manager via email. The data will be validated as described in Section D2.1.

If the data reviewers have questions or find problems with the data, they will notify the laboratory. Monitoring consultant staff will resolve all data issues with the laboratory, under the supervision of the Project Manager.

When all data from the monitoring event have been reviewed and all problems corrected, the Project Manager will assemble a final EDD (see Section A.9.1) and submit it via email to the Caltrans Task Order Manager. Data in the CEDEN-compliant data files will be uploaded to the Caltrans Stormwater Data Archive (SDA), a Microsoft SQL Server database.

B10.2 Raw Continuous Monitoring Data

Flow measurement and rainfall data will be downloaded from onsite data loggers after the end of each monitoring event, where this equipment is installed. Raw data files will be submitted to Caltrans as part of the final EDD package (see Section A.9.1).

B10.3 Filing and Document Control System

All hard copies will be stored at Caltrans headquarters and electronic data will be stored on a Caltrans server. Monitoring consultants are expected to keep an electronic backup of all project data for at least 3 years from the data of the monitoring event or for the life of the contract, whichever is later.

B10.4 Data Handling Equipment and Procedures

Desktop computers will be used to process, compile, analyze, and transmit data. Electronic files will be transferred in an Excel spreadsheet format, and transmitted either by email or by a file sharing service (e.g., SFTP). Final electronic data will be stored in a Microsoft SQL Server at Caltrans headquarters.

B10.5 Data Formatting and Entry into SMARTS

Data submittals will be delivered in Microsoft Excel spreadsheet files formatted in CEDEN format, and contain all of the information called for in Section F2.9 of the Caltrans NPDES Permit. Separate CEDEN formats will be used for laboratory chemistry data, laboratory toxicity data, and field data. Event data will be reported on a separate worksheet. All data will be submitted as a single Excel workbook.

Caltrans will upload the data in a single Excel workbook to SMARTS via the Reports tab..

B10.6 Responsible Individual(s)

The consultant data manager will receive data from the laboratory and from field staff and compile it into final deliverables under the supervision of the consultant Project Manager. Data will be received by the Caltrans Task Order Manager and delivered to the designated data manager for final storage.

B10.7 Acceptability of Hardware and Software Configurations

The only hardware and software required for data handling on this project are laptop and desktop computers running the Microsoft Windows operating system, and using Microsoft Excel and the Microsoft SQL server.

No special hardware or software configurations will be used on this project.

B10.8 Checklists and Forms

No checklists or forms for data handling will be used on this project.

Group C: Assessment and Oversight

Element 20: C1 – Assessments and Response Actions

C1.1 Project Assessments

Monitoring and data reporting activities will be assessed on an ongoing basis to confirm that the procedures in this QAPP are being followed and that project requirements are being met.

Project assessments fall into two categories, assessment of field (monitoring) activities and assessment of laboratory performance.

C1.1.1 Assessment of Field Activities

Periodic assessments will be made of field technicians to assure that they are properly trained on the following field practices:

1. Field safety
2. Sample collection
3. Sample transport
4. Clean sampling techniques
5. Correct use of COC forms
6. Performing field analyses
7. Recordkeeping

An assessment of each field technician will be made after initial training. An annual assessment of all field personnel will be made once per year at the beginning of the monitoring season, and may be made more often if deemed necessary by the field shift leader.

If the field shift leader finds any deficiencies, additional training will be administered as required until all field personnel are proficient in all monitoring procedures. If problems persist, the field shift leader will report the problem to the consultant Project Manager, who will determine what further corrective action is necessary.

The field crew lead will also monitor the performance of field personnel during sampling events to confirm that field activities are being carried out in accordance with the requirements of this QAPP.

C1.1.2 Assessment of Laboratory Performance

Laboratory performance will be assessed on an ongoing basis by the consultant Project Manager and the consultant data manager. Laboratory performance will be evaluated by assessing the following performance indicators:

1. Adherence to the COC form

2. Meeting hold time requirements
3. Adherence to a standard QA/QC program
4. Accurately analyzing field QC samples
5. Meeting detection limit requirements
6. Meeting turnaround times
7. Reporting data correctly

The laboratory will submit all data in both electronic and hard-copy formats. The consultant Project Manager or a designee will review the hard-copy reports for all of the indicators listed above. The consultant data manager will review the electronic data submittal for the same indicators. If the data manager finds any deficiencies in a data submittal, this will be reported to the Project Manager immediately. The Project Manager will take whatever corrective action is necessary.

If problems persist, or if problems come up that cannot be resolved between the consultant and the laboratory, the Project Manager will alert the Caltrans Task Order Manager that there is a difficulty with the laboratory. The Project Manager and Task Order Manager will then discuss further corrective actions that may be necessary.

The Caltrans data manager will perform a final check of all data received electronically. If any problems are found, the data manager will alert the Task Order Manager, who will in turn contact the consultant Project Manager to discuss the issue.

C1.2 Individuals Responsible for Assessments

The laboratory QAO is responsible for making sure that all laboratory operations are performed in accordance with the laboratory QA/QC Plan and that data are defensible. The laboratory data manager will be responsible for issuing all electronic data in the correct format, and the laboratory Project Manager will resolve any problem with the reports and make sure that they are issued on time

The consultant Project Manager will be responsible for checking all data reports as they are received and for taking corrective action as necessary to ensure that monitoring data meet project standards for data quality.

The Caltrans data manager will be responsible for making sure that all data are formatted properly for submittal to the state.

C1.3 Assessment Reporting

All PSTMs and final project reports will include assessment results. Any anomalies will be reported immediately to the Caltrans Task Order Manager.

C1.4 Corrective Action

The laboratory QAO will take corrective action as necessary in accordance with the laboratory QA/QC Plan.

The Project Manager and field shift leader are responsible for taking whatever corrective action is necessary to resolve problems as they arise. Both the Project Manager and field shift leader are expected to use their best professional judgment to determine the appropriate corrective action under the circumstances. The field shift leader will report serious or ongoing problems to the Project Manager to discuss further corrective action that may be required.

The field shift leader will pay particular attention to the performance of field personnel with respect to safety. When a violation of safety regulations is observed, the field shift leader will immediately take whatever corrective action he or she decides is appropriate. If a field technician repeatedly violates safety regulations, the field shift leader will remove the technician from the field and report the incident to the Project Manager for review.

If the Project Manager encounters problems that cannot be resolved satisfactorily, the Caltrans Task Order Manager will be contacted to discuss further corrective action.

Element 21: C2 – Reports to Management

C2.1 Quality Assurance Report Requirement and Frequency

Hard-copy laboratory reports will contain all appropriate QA/QC data. Problems with laboratory data are expected to be resolved between the consultant and their subcontract laboratories. If any problem arises with a laboratory that cannot be resolved by the Project Manager, the Project Manager will contact the appropriate Caltrans Task Order Manager via email with a description of the problem.

For each successfully monitored storm event, a PSTM (Section A9.2) will be submitted to Caltrans for review. A PSTM contains the following information, as appropriate:

1. A narrative of monitoring activities at each site
2. A table of sites monitored
3. Any pertinent observations
4. Completed field forms

The PSTM acts as a QA document. Any problems or failures are reported to Caltrans immediately via the PSTM, which allows the Task Order Manager to assess whether monitoring activities are being performed properly.

C2.2 Quality Assurance Report Authors and Recipients

Project laboratories will submit analytical data to the stormwater monitoring consultant.

The monitoring consultant is responsible for issuing completed PSTMs to the Caltrans Task Order Manager. Draft PSTMs will be submitted via email. After the final PSTM has been approved by Caltrans, the consultant will submit a final copy.

Group D: Data Validation and Usability

Element 22: D1 – Data Review, Verification, and Validation

D1.1 SWAMP Criteria for Accepting/Qualifying/Rejecting Data

All data reported for this project will be subject to a 100 percent check for errors in transcription, calculation, and computer input by the laboratory Project Manager and/or laboratory QAO. Additionally, the laboratory QAO will review sample logs and data forms to ensure that requirements for sample preservation, sample integrity, data quality assessments and equipment calibration have been met. At the discretion of the laboratory director, data that do not meet these requirements will either not be reported, or will be reported with qualifiers which serve as an explanation of any necessary considerations. Reconciliation and correction will be decided upon by the laboratory QAO and laboratory director.

The laboratory QAO will be responsible for informing data users of the problematic issues along with the associated reconciliations and corrections. Communication will be either via email or by conference call. No specific forms exist for this communication. Project data will be reviewed against the MQOs listed in Tables SAP-5.1 through SAP-5.9 of the attached project SAP (Appendix A).

Element 23: D2 – Verification and Validation Methods

D2.1 Data Verification and Validation Process

The laboratory Project Manager is responsible for assuring that all reported data have been reviewed before they are reported. Laboratory data must adhere to the control limits and quality objectives specified by the laboratory QA/QC Plan.

The consultant Project Manager will review all hard copies of laboratory reports as soon as they are received. Reports will be checked for:

1. Adherence to the COC form
2. Meeting hold time requirements
3. QA/QC samples within stated control limits
4. Results look reasonable in historical context
5. Accurately analyzing field QC samples
6. Meeting detection limit requirements
7. Meeting turnaround times
8. Data reported correctly
9. Correct units

The Project Manager is responsible for resolving all problems with the laboratory before a data report is submitted to Caltrans.

Electronic data deliverables will be submitted by the laboratory in CEDEN-compliant spreadsheet format. The consultant data manager will open each deliverable, verify that it is in the correct format, and then add the appropriate data (field data, station IDs, and so on) to complete the data file. When all data have been added to the file, the data manager will check it using the online CEDEN data checker, located here:

http://ceden.org/CEDEN_checker/Checker/CEDENUpload.php

This checker is mirrored at several Regional Data Centers (RDCs) around the state. Any RDC may be used to check data as long as it using the current version of the checker in use at CEDEN.org.

The data manager will resolve any errors found by the checker, and only submit the final electronic data files to Caltrans when they pass the checker with no errors.

D2.2 Responsible Individual(s)

The laboratory QAO is responsible for making sure that all laboratory operations are performed in accordance with the laboratory QA/QC Plan and that data are defensible. The laboratory director is responsible for assuring that that laboratory personnel interpret and complete the COC forms correctly, and that all custody, calibration, sample preparation, and analytical logs are completed and stored properly.

The consultant Project Manager is responsible for verifying that all data reported to Caltrans have been checked against the project MQOs, that data reports are complete, that data are properly qualified where appropriate, and that the data are delivered in the proper format.

D2.3 Issue Resolution

The laboratory director is responsible for laboratory performance. Any problems or questions that arise will be addressed by the laboratory director or by a designee of the laboratory director.

If the consultant discovers problems with laboratory or field data, it is the responsibility of the Project Manager to resolve them before data are submitted to Caltrans. The Project Manager is expected to use best professional judgment when resolving data issues.

D2.4 Checklists, Forms, and Calculations

No forms will be used for data verification and validation.

Element 24: D3 – Reconciliation with User Requirements

D3.1 Uncertainty Evaluation Procedures

Caltrans does not currently have procedures in place for assessing uncertainty in stormwater monitoring data.

D3.2 Reporting of Data Limitations

Data that do not meet the MQOs of this project will be flagged accordingly and reported with the appropriate qualifiers. Rejected data will be reported to the state with the appropriate qualifier, but will not be used in any data analyses.

Immediately after each monitoring event, the event will be analyzed to verify that monitoring was performed in accordance with this QAPP and met the requirements of the project. If the event is rejected for some reason, data produced for that storm event will be reported to the state, but will not be used in any data analyses.

D3.3 SWAMP Usage

All Caltrans stormwater monitoring data will be submitted in CEDEN format to SMARTS, where it will be available to SWAMP.

References

California Department of Transportation (Caltrans). 2022. Caltrans Hydrologic Utility v. 3.0.061, Caltrans, Division of Environmental Analysis. Sacramento, California.

California Department of Transportation (Caltrans). 2020. Stormwater Monitoring Guidance Manual. Report. CTSW-OT-20-350.04.01. Caltrans, Division of Environmental Analysis. Sacramento, California.

California Surface Water Ambient Monitoring Program (SWAMP). 2008. Quality Assurance Program Plan, Quality Assurance Research Group, Moss Landing Marine Laboratories, San José State University Research Foundation, San Jose, California.

US Environmental Protection Agency. 1996. Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. Method 1669. U.S. Environmental Protection Agency Office of Water Engineering and Analysis Division (4303), Washington, D.C.

Appendix C

Referenced Material from the Quality Assurance Project Plan

Introduction

The purpose of this document is to provide the actual text from the Caltrans Stormwater Monitoring Guidance Manual (MGM) that is referenced in Appendix B of the Caltrans Stormwater Monitoring Plan (the Quality Assurance Project Plan). Wherever reference is made to material in Appendix B, that language is provided here as it appears in the MGM.

The information in this appendix is organized in the order in which it is referenced in Appendix B.

Item 1 - Appendix B, Section A6.1 – Storm Selection

When a storm is approaching, the monitoring consultant must make the determination whether to mobilize. The following criteria are used to qualify storm events:

1. Quantity Precipitation Forecast (QPF) – The amount of precipitation that the incoming storm is expected to produce
2. Probability of Precipitation (POP) – The percent probability that the expected storm will occur
3. Antecedent Dry Period – The time that has elapsed since the end of the previous measurable storm event

Action Level	Task Manager Action	Field Crew Action
Non-Monitoring - Not actively seeking candidate storms	• Monitor weather reports weekly.	• None.
Standby - Evaluating developing storm systems	• Monitor weather reports semi-weekly.	• Notify project manager where crew members will be and how they can be reached if they leave the area for more than one or two days. • Arrange for substitute if needed.
Pre-Alert- Target storm expected within the next 72 hours	• Monitor weather reports every 24 hours. • Verify operation of monitoring equipment as needed. • Alert field crews regarding change in action level. • Verify availability of field crews. • Alert analytical laboratory and Caltrans.	• Remain in local area if possible. • Verify availability with project manager.
Alert - Target storm expected within the next 24 hours	• Monitor weather reports every six hours or more frequently as storm approaches. • Alert field crews regarding change in action level and probable time of storm. • If storm event is marginal, alert crews the event may be a go or no-go and continue to notify every four hours.	• Prepare monitoring equipment for sampling and/or observations. • Upload autosampler pacing specifications to remote sampling instruments. • Upload autosampler pacing specifications to remote sampling instruments. • Prepare COC forms and label sample bottles.
Go - Precipitation imminent or underway on targeted storm	• Monitor weather reports as needed. • Mobilize field crews.	• Mobilize to sample collection stations for during-storm event observations, sample bottle maintenance, grab sampling, etc.

Action Level	Task Manager Action	Field Crew Action
Post-Storm	• Demobilize field crews.	• Split composite samples for field duplicates. • Label and log samples on the COC form. • Ensure timely delivery of samples to analytical laboratory. • Complete field notes. • Prepare for next storm - inventory/clean/organize/replace equipment as necessary.

Item 2 - Appendix B, Section A7.1 – Measurement Quality Objectives

Any monitoring program can be expected to have some level of error associated with both sample collection and sample analysis. Performance criteria, also called Data Quality Objectives (DQOs), are developed in this planning step to specify acceptable levels of error. For a typical Caltrans project, DQOs are developed for the following aspects of the data:

- Precision – The degree to which duplicate sample results agree with each other
- Accuracy – A measurement of how close an analytical result is to the true value
- Contamination – The degree to which samples are kept free of substances that might interfere with the analysis
- Reporting limits – The lowest concentration that can be measured reliably
- Completeness – The number of samples that pass all quality control checks and produce usable data, expressed as a percentage of all samples collected

The following table provides an example of some DQOs for a typical Caltrans monitoring project. This information is presented only as an example; DQOs should always be developed based on the individual requirements of a monitoring project.

Constituent	Accuracy	Contamination	Precision	Completeness
Total Suspended Solids	N/A	<RL	<20%	95%
Total Kjeldahl Nitrogen	80% - 120%	<RL	<20%	95%
Nitrate	80% - 120%	<RL	<20%	95%
Oil and Grease	79% - 114%	<RL	<18%	95%

NOTE: This table is only for illustration. DQOs must be developed individually for each project.
N/A – Not Applicable
RL – Reporting Limit
RPD – Relative Percent Difference

The DQOs shown in Table 2.1 are for water quality data. Separate DQOs must be developed for other kinds of monitoring data such as toxicity and gross solids data. USEPA methods for toxicity testing define performance criteria as well as specifications for test conditions.

The output of this step is:

- Written data quality objectives for sample collection and analysis.

Item 3 - Appendix B, Section A9.2 – Data Reporting Requirements

Electronic Data Deliverable files (EDDs) should be named using the following four-part nomenclature scheme:

<Part 1>_<Part 2>_<Part 3>_<Part 4>

1. An abbreviation of the project name (for example, TMDL, Area of Special Biological Significance [ASBS]) and the district number. For example, a submittal from Caltrans District 7 for a TMDL monitoring site would begin with "TMDL07-."

   In most cases, the Caltrans District number should be used in conjunction with the project name. However, when monitoring in ASBSs, the ASBS number should be used instead.
2. The Event Start Date listed in the PSTM for that storm event with the format: YYYYMMDD
3. The type of analysis performed:
   a) Field (field data)
   b) Tox-LabName (toxicity – where LabName is the name of the laboratory performing the analysis [e.g., Tox-Nautilus])
   c) Chem-LabName (chemistry – where LabName is the name of the laboratory performing the analysis [e.g., Chem-Physis])
4. The submittal (version) number for that EDD with the format: v#, where # is 1 for the first submittal of that EDD; 2 is the second (i.e., revised) submittal of the original document, etc.

Naming examples:

TMDL03_20151208_Field_v1

TMDL10_20151128_Chem-Physis_v1

ASBS24_20151031_Tox-Nautilus_v1

ASBS33_20151204_Tox-Nautilus_v2

Other generated electronic files (hydrographs, images, videos, etc.) should be named using the same naming convention that is used for EDDs:

1. Project name abbreviation and two-digit number corresponding to the Caltrans district where the sites are located
2. YYYYMMDD : Event Date
3. Abbreviation of the document type. Use a three- or four-letter descriptive designation as appropriate, for example, HGRAPH for hydrographs, IMG for pictures, MAP for site maps.
4. v#: Version number for the document

Naming examples:

TMDL03_20151208_HGRAPH_v1.xlsm

ASBS33_20151128_IMG_v1.jpg

TMDL07_20151031_HGRAPH_v2.xlsm

Item 4 - Appendix B, Section B2.4 – Splitting Composite Samples

Splitting Composite Samples

The sampling team or analytical laboratory pours composite samples collected in a single composite sample container into individual sample containers for analysis. To limit contamination, splitting should be conducted by the laboratory.

If a composite sample duplicate is required, the sampling team should split the composite sample into two composite containers to generate a sub-sampling duplicate (replicate samples generated from a single composite sample container). As with field duplicate samples (replicate samples collected simultaneously in the field), sub-sampling duplicates should be submitted to the analytical laboratory “blind,” labeled as an ordinary field sample so the laboratory does not know it is a duplicate sample.

When toxicity testing is planned in conjunction with general stormwater monitoring, it can be viewed by the sampling crew as an additional constituent for analysis. Therefore, samples for toxicity testing need to be poured off into the appropriate sample containers in the same manner as samples for other analyses. When pouring off samples for toxicity testing, fill sample containers completely, leaving no space at the top.

Three sample splitting methods are described below.

Peristaltic Pump Method

The peristaltic pump method utilizes manual agitation to thoroughly mix the sample before splitting it by using a peristaltic pump. The following procedure is recommended:

1. Label the containers for drawing individual samples per required analyses.
2. Wear clean, powder-free nitrile gloves for handling containers and lids.
3. Clean items that will contact the sample using protocols presented in Appendix E.
4. Manually agitate the sample continuously and draw samples into individual sample containers using a portable peristaltic pump and clean tubing. The volume of sample drawn in various containers should be in accordance with laboratory-recommended sample volumes for relevant constituents.
5. Manually shake the composite sample container during sample transfer to ensure the individual samples are homogeneous and particulate matter in the original composite sample is drawn equally into the individual containers.
6. Clean and replace peristaltic pump tubing prior to splitting another composite sample into individual sample containers.

Performing sample splitting by agitation and peristaltic pump can be accomplished by both crews in the field and the analytical laboratory.

United States Geological Survey (USGS) Method

This method utilizes manual agitation to thoroughly mix the sample before splitting it by using a funnel splitter. The following procedure is recommended:

1. Label the containers for drawing individual samples per required analyses.
2. Wear clean, powder-free nitrile gloves for handling containers and lids.
3. Shake the composite container thoroughly, with lid in place, until the sample is well mixed.
4. Immediately after mixing, pour the composite sample into a pre-cleaned Teflon® funnel/splitter with clean tubes leading to individual sample containers. The volume of sample poured into the containers should be in accordance with laboratory-recommended sample volumes for relevant constituents.
5. Clean the funnel/splitter and tubing using protocols presented in Appendix D prior to splitting another composite sample into individual composite samples.

Performing sample splitting by funnel/splitter can be costly and may cause logistical problems because the splitting equipment must be cleaned after every use. It is recommended when a single composite sample must be split into multiple samples. This method can be used either in the field or in the laboratory, but it is often more practical for use in the lab because of the cleaning requirements.

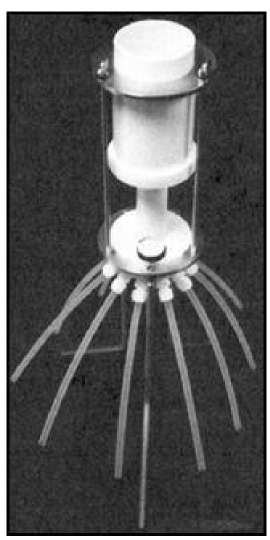

Figure 0-1 USGS Sample Splitting Method – Teflon® Funnel/Splitter

Manual Pouring Method

This method utilizes manual agitation to thoroughly mix the sample before splitting it by pouring into separate containers. The following procedure is recommended:

1. Label the containers for drawing individual samples per required analyses.
2. Wear clean, powder-free nitrile gloves for handling containers and lids.
3. Shake the composite container thoroughly, with lid in place, until the sample is well-mixed. For large composite containers, the use of a swiveling mechanical container holding/mixing/pouring device is recommended.
4. Immediately after mixing, pour the composite sample into individual sample storage containers. The volume of sample poured into various containers should be in accordance with laboratory-recommended sample volumes for relevant constituents.
5. Cap the containers.
6. Repeat Step 3 immediately prior to filling each sample storage container.

Performing sample splitting by the agitation and pour method is recommended for crews in the field because no added equipment is necessary except a mechanical holder/decanter, which does not contact the sample water. Also, large numbers of composite samples can be split into multiple sample containers without performing the necessary cleaning protocols required for the previous three methods.

Multi-Container Compositing

When multiple composite sample containers are filled at a single site during a single storm monitoring event, the sample containers are typically composited together to produce a single composite sample representing the entire monitoring event. Each sample container must be well-agitated prior to pouring the sample into another composite container. The sample is mixed thoroughly by shaking or otherwise agitating the composite container to prevent sediment from remaining on the bottom of the container; various methods for doing this are described below. Throughout the sample compositing procedures, clean, powder-free nitrile gloves are used for container and lid handling. This process can be done by analytical laboratory personnel or by field sampling personnel in a clean, dry setting.

To combine multiple sample containers and generate a single composite sample for the entire storm event, two items must be determined: (1) the percentage of the sampling event flow represented by each individual sample container; and (2) which of the sample container(s), if any, will limit the compositing of samples. Because individual sample containers will likely contain different volumes, one container will likely dictate the total sample volume available for compositing. Individual sample containers may contain different sample volumes for several reasons. For example, the number of aliquots may differ in each container if runoff ceased before triggering all programmed sample aliquots or if a composite bottle was changed prior to filling completely. Composite container volumes may also differ slightly due to unequal aliquot volumes caused by pump tubing blockages or wear.

The sample in each individual composite container is considered representative of the volume of stormwater runoff that passed the sampling point during the filling of that container. The volume drawn from each container should be in proportion to the portion of the total volume that passed the sampling point during the storm event. Therefore, to properly combine multiple composite samples, the following must be known:

- Individual sample volumes in each composite sample container
- Total flow volume that passed during the collection of the total sample volume in each individual composite sample container
- Total runoff volume for the monitoring event

Multi-container composite samples should be combined by first calculating the proportion of the runoff event represented by each composite container. The calculated proportions are then used to compute the volumes that should be drawn from each container using the equations presented below.

First, calculate the total sampled flow represented by a given sample container:

$$P_n = V_n/V_t \text{ x } 100$$

Where:

P_n = Percent of the total sampled flow represented by sample n
V_n = Volume of flow that passed during the collection of sample n
V_t = Total volume of flow that passed during the sample collection event

Next, calculate the exact volume of sample to be drawn from the container:

$$S_n = S_t \times P_n$$

Where:

S_n = Volume to be contributed from sample n to the composite sample
S_t = Volume needed for doing all sample analyses (normally about 20 L)
P_n = Percent of the total sampled flow represented by sample n

These calculations are repeated for all sample containers collected during the storm event. If the calculated contribution from any composite container exceeds the volume present in that container, then that container is the volume limited container. The total volume of the final composite is then calculated as Sn/Pn where Sn is the volume collected in the volume limited container and Pn is the percent of the storm event represented by that container.

Item 5 - Appendix B, Section B2.7 – Equipment Cleaning

Cleaning procedures for sample bottles and equipment must be established prior to sample collection in the field or sample storage in the laboratory. Tubing, lids, and strainers may contact the sample during collection; therefore, they must also be cleaned and dried using the appropriate procedures. Procedures for drying equipment and containers can vary depending on the samples being collected and must be discussed with laboratory personnel prior to sample collection. In addition, while performing these procedures, personnel must use the correct equipment and safety gear.

The following examples outline cleaning procedures that may be used by the laboratory for polyethylene plastic composite carboys, borosilicate glass composite carboys, and tubing and strainers. Appropriate safety precautions and quality control are also discussed.

Cleaning Procedures

Polyethylene Plastic Carboys

1. Clean inside composite carboy and cap with hot tap water and phosphate-free laboratory detergent. Scrub inside of carboy and cap with plastic brush.
2. Rinse carboy and cap twice with hot tap water.
3. Rinse capped carboy three times with 100 mL hexane, rotating carboy to cover entire inside surface and cap.
4. Rinse capped carboy once with 500 mL de-ionized water.
5. Rinse capped carboy three times with 200 mL 2N nitric acid.
6. Rinse capped carboy four times with 500 mL de-ionized water.

Notes:

1. If composite sample containers will not be cleaned the same day they are received by the laboratory, they must be emptied and rinsed thoroughly with hot tap water. Dirty containers must never be allowed to dry out without being rinsed.
2. The plastic brush used to clean carboys must be dedicated to the project. The brush must be stored with the brush head in a clean re-sealable bag.
3. The laboratory must use the same reagent-grade nitric acid for cleaning carboys as it routinely uses for metals digestion. Laboratory de-ionized water must meet American Society for Testing and Materials Type 1 standard.
4. Clean, powder-free nitrile gloves must be worn while cleaning carboys and handling cleaned carboys.

5. The technician must take care to rotate the composite sample carboy completely during each step to ensure the entire inner surface of the carboy is rinsed.
6. The technician must be alert for composite carboys that do not appear to have a completely clean, unblemished inner surface. If a carboy appears to contain contaminating material that has not been completely removed by the cleaning process, or has visible scratches on the inner surface, it must be set aside, and the laboratory must notify the client.
7. Do not store rinsed/cleaned carboys uncapped.

Blank-Testing Protocol for Polyethylene Carboys

A minimum of one composite sample carboy per cleaning batch must be blank-tested. A batch is defined as no more than 20 carboys, and may be fewer, at the laboratory's option. A new cleaning batch must be opened each time a new manufacturer's lot of methylene chloride or nitric acid is used. A cleaning batch may not span a period of greater than four days. The following protocol should be used for blank-testing of polyethylene carboys:

1. Fill a cleaned composite sample container with the minimum amount of de-ionized water necessary to perform the required analyses.
2. Rotate capped carboy several times to ensure the blank water comes into contact with the entire inner surface of the carboy.
3. Allow the blank water to stand in the composite sample carboy for a minimum of one hour.
4. Decant the blank water and test for analyses on the blank-test requirements list.

Table D.1 is a list of constituents that would be blank-tested on a typical Caltrans project. This is an example only. The actual requirements for blank-testing will vary from project to project, depending on the project constituent list.

Table 0-1 Example of a List of Constituents to Blank-Test

Blank-Test Constituent List
Metals (Total)
Antimony
Arsenic
Beryllium
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Selenium
Silver
Thallium
Zinc
Physical and Aggregate Properties
Conductivity
pH
Organic Compounds
Polynuclear Aromatic Hydrocarbons
Organochlorine Pesticides
Organophosphorus Compounds
Nutrients
Nitrate as Nitrogen
Total Phosphorus
Ammonia as Nitrogen

Borosilicate Glass Carboys

The following steps are to be used to clean borosilicate glass carboys.

1. Clean inside the composite carboy and cap with hot tap water and phosphate-free laboratory detergent. Scrub inside the carboy and cap with plastic brush.
2. Rinse the carboy and cap twice with hot tap water.

3. Rinse capped carboy three times with 100 mL methylene chloride, rotating carboy to cover the entire inside surface and cap.
4. Rinse the capped carboy once with 500 mL de-ionized water.
5. Rinse the capped carboy three times with 200 mL 2N nitric acid.
6. Rinse the capped carboy four times with 500 mL de-ionized water.

Notes:

1. If composite sample containers will not be cleaned the same day they are received by the laboratory, they must be emptied and rinsed thoroughly with hot tap water. Dirty containers must never be allowed to dry out without being rinsed.
2. The plastic brush used to clean carboys must be dedicated to the project. The brush must be stored with the brush head in a clean re-sealable bag.
3. The laboratory must use the same reagent-grade nitric acid for cleaning carboys as it routinely uses for metals digestion. Laboratory de-ionized water must meet American Society for Testing and Materials Type 1 standard.
4. Clean, powder-free nitrile gloves must be worn while cleaning carboys and handling cleaned carboys.
5. The technician must take care to rotate the composite sample carboy completely during each step to ensure the entire inner surface of the carboy is rinsed.
6. The technician must be alert for composite carboys that do not appear to have a completely clean, unblemished inner surface. If a carboy appears to contain contaminating material that has not been completely removed by the cleaning process, or has visible scratches on the inner surface, it must be set aside and the laboratory must notify the client.
7. Do not store rinsed/cleaned carboys uncapped.

Blank-Testing Protocol for Borosilicate Glass Carboys

A minimum of one composite sample carboy per cleaning batch must be blank-tested. A batch is defined as no more than 20 carboys and may be fewer at the laboratory's option. A new cleaning batch must be opened each time a new manufacturer's lot of methylene chloride or nitric acid is used. A cleaning batch may not span a period of greater than four days. The following protocol may be used for blank-testing of borosilicate glass carboys.

1. Fill a cleaned composite sample container with the minimum amount of de-ionized water necessary to perform the required analyses.

2. Rotate capped carboy several times to ensure the blank water comes into contact with the entire inner surface of the carboy.
3. Allow the blank water to stand in the composite sample carboy for a minimum of one hour.
4. Decant the blank water and analyze it for all constituents in the project blank-test list.
5. Analytical results for the blank must be below project RLs. If analytes are found in the blank above the RL, composite sample containers in the cleaning batch must be cleaned and tested again before being released back to the client.

Cleaning Procedure for Tubing and Strainers

The following steps are to be used to clean sample tubing and strainers.

1. Make up cleaning solution with two percent phosphate-free laboratory detergent in hot tap water.
2. Rinse inside tubing with cleaning solution three times. Wash strainers in cleaning solution and scrub using a plastic brush.
3. Rinse inside tubing and strainers three times with hot tap water.
4. Rinse inside tubing and strainers with 2N nitric acid.
5. Soak equipment that does not have exposed metal surfaces for 24 hours in 2N nitric acid.
6. Rinse inside tubing and strainers three times with de-ionized water.
7. Seal tubing at both ends with latex material.
8. Individually double-bag each tube in new polyethylene bags. Individually double-bag each strainer in new re-sealable bags.

Notes:

1. Clean, powder-free nitrile gloves must be worn while cleaning and handling tubing and strainers.
2. The technician must be alert for pieces that do not appear to be completely clean. If a piece appears to have contaminating material that has not been completely removed by the cleaning process, it must be set aside and the laboratory must notify the client.
3. Tubing and strainers must be stored double-bagged.

Blank-Testing Tubing and Strainers

On a seasonal basis, after completion of equipment cleaning and prior to sampling, the tubing and strainers must be blank-tested by the field personnel. The de-ionized water (American Society for Testing and Materials Type 1 standard) and sample bottles used in collection of the blank sample must be supplied by the laboratory performing the analysis. Generally, the blank samples can be developed by purging two liters of laboratory-supplied water through the tubing and strainer into a laboratory-supplied carboy (the amount of water is dependent on test requirements). Upon completion of the blank sample collection, the bottle must be sealed and stored between 0° and 4°C for shipment.

The blank sample must be analyzed for the constituents on the project blank-test list. Concentrations from the blank sample must be compared to the blank acceptability criteria (project specific RLs). If the blank exceeds acceptability criteria, then the tubing and strainers must be cleaned and tested again prior to sampling. Blank samples must be assessed at a frequency of one carboy per cleaning batch and used to isolate potential problems associated with the cleaning and installation procedures. As an alternative, the laboratory may blank-test the tubing immediately after cleaning it and before releasing it for installation.

A.1 Safety Precautions

The appropriate personal protective equipment must be worn by personnel involved in the cleaning procedures due to the corrosive nature of the chemicals being used to clean the carboys, tubing, and strainers. The personal protective equipment must include protective gloves, laboratory coats, chemically resistant aprons, goggles with side shields, and respirators. Material safety data sheets must be read and understood by personnel.

A.2 Quality Control

Clean, powder-free nitrile gloves must be worn while cleaning and handling bottles and equipment. Care must be taken to avoid the introduction of contaminants from outside sources.

To account for contamination introduced during sample collection, blank samples must be prepared and submitted "blind" to the laboratory. Collection of sample container blanks is not required if certified pre-cleaned sample bottles are used. In this case, the manufacturer provides a certification form that documents the carboys are "contaminant-free"; however, these concentrations must be equivalent to or less than the project-specific RLs. If the certification level is above the project-specific RLs, a minimum of one blank sample per batch (a batch is defined as no more than twenty sample bottles, and may be fewer at the laboratory's option), must be prepared and analyzed for chemical constituents specified in the QAPP or Operation, Monitoring, and Maintenance Plan. The results must be less than or equal to the project specific RLs before that batch of bottles may be used on the project.

Item 6 - Appendix B, Section B3.2 – Sample Handling and Transport

Transporting Samples to the Laboratory

Composite and grab samples must be kept on ice or refrigerated nominally at 4°C (0° to 6°C or 30° to 42.8°F is the acceptable range) from the time of sample collection to the time of receipt by laboratory personnel. Sample containers being delivered to the laboratory must be: (1) well-packaged with bubble wrap, foam, etc.; and (2) kept inside coolers with double-bagged ice (wet ice is preferable to gel ice). The drain plugs on the coolers must be sealed and the lids must be secured with packaging tape. Overnight services may not deliver leaky coolers or shipping containers.

It is imperative that samples are delivered to the analytical laboratory soon enough so analysis begins within the maximum holding times specified by laboratory analytical methods. For example, if the fecal coliform test is required, analysis must be started within eight hours of sample collection (the analytical method allows six hours for transportation to the laboratory and two hours to begin analysis). Similarly, soluble reactive phosphorus (orthophosphate) or nitrite analyses must be performed within 48 hours after sample collection. For composite samples, this 48-hour period starts based on the last sample aliquot rather than the first sample aliquot.

Toxicity samples need to be delivered to the toxicity laboratory within 24 hours and toxicity tests initiated within 36 hours. Although this is the acceptable holding time for freshwater acute and chronic toxicity tests, there may be situations where it is logistically impossible to submit samples to the toxicity laboratory within 24 hours. For composite samples, this 36-hour period starts based on the last sample aliquot rather than the first sample aliquot.

Analytical results reported for samples that were analyzed outside of the allowable hold time must be reported as qualified data and should be considered estimated.

Item 7 - Appendix B, Section B4.8 – Target Reporting Limits

Method Detection Limits

The MDL is defined as the minimum concentration of analyte that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero. MDLs must be calculated separately for each constituent and for each analytical instrument used to perform the analysis. For instance, if a lab uses two instruments to analyze samples for trace metals, then MDLs for each element would have to be established for both instruments. If both instruments analyze samples for copper and lead, then separate MDLs are required for both elements on both instruments.

An MDL is determined from analysis of a sample in a given matrix containing the analyte. The material, such as water and sediment, that composes the sample, is called the “sample matrix” or simply “matrix.” In strict terms, “matrix” refers to the components of a sample other than the analyte.

As indicated earlier, Caltrans now requires all constituents must be reported to the MDL. Concentrations reported between the MDLs and the RLs should be considered to be estimates.

Reporting Limits

For most constituents, laboratories establish RLs for the purpose of reporting analytical results. A reporting limit is the minimum concentration of an analyte that can be measured within specified limits of precision and accuracy. If the concentration of a target analyte is measured at or above the RL then it is reported at that concentration; if it is detected below that value, then it is reported as “less than” the RL.

Unlike MDLs, there is no rigorous mathematical process for establishing a reporting limit. Laboratories usually define the RL as three to five times the MDL.

A reporting limit is established above the MDL so that the lab does not need to report concentrations down to the ideal MDL, but has a kind of “comfort zone” above that ideal value. Environmental samples that may not behave ideally can still be reported down to the RL with confidence.

Limits of quantitation can be defined in various ways by different labs, which can create confusion if these terms are not defined properly and used consistently. Some common acronyms used for quantitation limits are summarized in **Table 0-2**. These may be encountered when communicating with a laboratory or reviewing lab data.

Table 0-2 Some Common Acronyms Used for Limits of Quantitation

Acronym	Name	Description[1]
RL	Reporting Limit	Lowest concentration reported by the laboratory. Any concentrations detected below this value are usually reported as “less than” this value.
DL	Detection Limit	Commonly used synonymously with RL.
EQL	Estimated Quantitation Limit	Commonly used synonymously with RL.
IDL	Instrument Detection Limit	Lowest concentration that can be detected by an instrument. Does not take methodological factors into account.
LLD	Lower Limit of Detection	Commonly used synonymously with IDL.
LLQ	Lower Limit of Quantitation	Commonly used synonymously with RL.
LOD	Limit of Detection	Commonly used synonymously with MDL, and sometimes with IDL.
LOL	Limit of Linearity	Highest concentration that is within the linear calibration range of the instrument or method.
LOQ	Limit of Quantitation	Commonly used synonymously with RL.
MDC	Minimum Detectable Concentration	Commonly used synonymously with MDL
MDL	Method Detection Limit	Lowest concentration that can be resolved from method baseline noise with a 99% confidence in a sample that does not contribute any matrix effect.
MQL	Method Quantitation Limit	Commonly used synonymously with RL.
PQL	Practical Quantitation Limit.	Commonly used synonymously with RL.
SDL	Sample Detection Limit	The MDL adjusted to take specifics of sample matrix and preparation into account.
SQL	Sample Quantitation Limit	Commonly used synonymously with SDL.
UCL	Upper Calibration Limit	Commonly used synonymously with LOL.

[1]These descriptions are intended to be used only as a reference for non-laboratory personnel who may run across them. Many of these terms have more specific, rigorous definitions that are beyond the scope of this manual.