SECTION 6
SAMPLING AND ANALYSIS PLAN (SAP)

Proper documentation will be required for any Caltrans monitoring program. A stormwater SAP and Health and Safety Plan (HSP) should be prepared prior to initiation of any sampling activities.

This section provides general guidance for preparation of practical, useable SAPs for stormwater monitoring programs. See ***Appendix D*** for detailed information regarding individual components to be included in the HSP.

The following are sections that should be included in a stormwater SAP:

KEY TOPICS

- **Project Overview/Description**
- **Monitoring Site(s)**
- **Analytical Constituents**
- **Data Quality Objectives (DQOs)**
- **Field Equipment Maintenance**
- **Monitoring Preparation and Logistics**
- **Sample Collection, Preservation, and Delivery**
- **Quality Assurance/Quality Control**
- **Laboratory Sample Preparation and Analytical Methods**
- **Data Management and Reporting Procedures**
- **Appendices:**
  - **Clean Sampling Techniques and Equipment Cleaning Protocols**
  - **Health and Safety Plan (HSP)**

Inclusion of these sections will ensure development of a useable and practical SAP. The final product should be a single bound document that can be easily referenced during stormwater monitoring activities. This can be conveniently done by including the HSP as an appendix to the SAP. Printing the SAP/HSP on waterproof paper will reduce the potential for water damage to the document during field use.

All Caltrans stormwater monitoring documentation must be assigned a document identification number prior to document completion. The document identification number, assigned by the Stormwater Management Program document distribution system manager, is used to track the document and develop document distribution lists. Two weeks prior to expected document deliverable date, the author must contact the Caltrans

stormwater management program document distribution system manager to receive a document identification number and mailing labels.

The monitoring objectives, project organization, sampling frequency, sampling site locations and directions to each site, field equipment operation, QA/QC protocols, monitoring constituents, sample collection methods, analytical methods, and logistical details for each project should be documented in a project SAP. The process and criteria for selecting and implementing these monitoring components are described in more detail in ***Sections 2*** through ***5*** (Preparing the Monitoring Plan) and ***Sections 7*** through ***13*** (Implementing the Monitoring Plan).

The SAP should be prepared by someone with a good understanding of field sampling procedures, laboratory analytical methods, and data validation procedures. The analytical laboratory should provide input to ensure that the SAP (especially the QA/QC portion) is realistic, and consistent with the laboratory's operating procedures. Field personnel should also provide input regarding logistical details, and ensure that the plan is practical and easy to use.

The SAP should include a thorough description of all activities required to implement the monitoring program. The plan should be organized to provide an overview of the project goals and organization, followed by a description of all monitoring activities in the chronological sequence in which they will typically occur. That is, pre-monitoring preparations should be described, followed by activities to be undertaken during storm events, followed by post-storm activities. The plan should specify the quality assurance/quality control protocols that will be followed by field and laboratory personnel, and how the field and laboratory results will be managed and reported.

The contents of a typical stormwater SAP are shown in Figure 6-1.

1.0 PROJECT OVERVIEW/DESCRIPTION
- 1.1 Description of why the project is being conducted
- 1.2 Description of who is conducting the project
- 1.3 General scope of monitoring activities
- 1.4 Project organization/roles and responsibilities

2.0 MONITORING SITE(S)
- 2.1 Site location (map)
- 2.2 Written driving directions
- 2.3 Site access instructions (gates, locks, keys, combinations)
- 2.4 Notification procedures

3.0 ANALYTICAL CONSTITUENTS
List of constituents for sampling and analysis (including sample collection method, bottle type, volume required, preservation, and laboratory performing analysis)

4.0 DATA QUALITY OBJECTIVES (DQOs)
- 4.1 Analytical reporting limits
- 4.2 Analytical precision, accuracy, and completeness

5.0 FIELD EQUPMENT MAINTENANCE
- 5.1 Equipment calibration
- 5.2 Equipment maintenance
- 5.3 Equipment cleaning (bottles/lids/tubing)

6.0 MONITORING PREPARATION AND LOGISTICS
- 6.1 Weather tracking
- 6.2 Storm selection criteria
- 6.3 Storm action levels
- 6.4 Communications/notification procedures
- 6.5 Sample bottle order
- 6.6 Sample bottle labeling
- 6.7 Field equipment preparation

7.0 SAMPLE COLLECTION, PRESERVATION, AND DELIVERY
- 7.1 Sample collection methods
- 7.2 Field measurement methods
- 7.3 Field equipment list
- 7.4 Sample containers, preservation, and handling
- 7.5 QA/QC sample collection methods
- 7.6 Sample labeling (site names/codes, etc.)
- 7.7 Composite sample splitting
- 7.8 Forms and procedures for documenting sample collection and field measurements
- 7.9 Laboratory communication procedures
- 7.10 Sample shipping/delivery, chain-of-custody

8.0 QUALITY ASSURANCE/QUALITY CONTROL
Field procedures for QA/QC sample collection

9.0 LABORATORY SAMPLE PREPARATION AND ANALYTICAL METHODS
- 9.1 Laboratory sample preparation procedures
- 9.2 Analytical constituent table (including analytical methods, holding times, and reporting limits)

10.0 DATA MANAGEMENT AND REPORTING PROCEDURES
- 10.1 Analytical data validation
- 10.2 Electronic data transfer
- 10.3 Filing of electronic and hard copy data
- 10.4 Reports

APPENDICES
- A Clean Sampling Techniques
- B Health and Safety Plan

Figure 6-1. Outline for a Typical Stormwater Sampling and Analysis Plan

The following sub-sections further describe the contents of a typical stormwater SAP.

➤ OVERVIEW: PROJECT DESCRIPTION, ORGANIZATION, AND RESPONSIBILIES

This section of the SAP should briefly describe:

- ✔ Description of why the project is being conducted,
- ✔ Description of who is conducting the project,
- ✔ General scope of monitoring activities, and
- ✔ Roles and responsibilities of the key field and laboratory personnel who will be involved in the project (typical roles include project manager, sampling coordinator, sampling team leaders, field crew, project QA/QC officer, and laboratory QA/QC manager).

➤ MONITORING SITES

This section should describe the sampling sites selected for the monitoring program and provide rationale for the inclusion of a site. Site selection should be based upon representativeness of land uses in the area, achievable flow measurement, site access, personnel safety, equipment security, and availability of electrical power and telephone. See ***Section 3*** for monitoring site selection guidance.

The following detailed information should be included for each monitoring site:

- ✔ Site location map,
- ✔ Written driving directions,
- ✔ Site access instructions (locked gate keys or combinations), and
- ✔ Notification procedures (if notification is required prior to site access).

➤ ANALYTICAL CONSTITUENTS

This section should specify all of the analytical constituents necessary to meet program objectives. See ***Section 4*** for constituent selection guidance. The SAP should include a list of constituents, in tabular form, that includes at a minimum the following columns:

- ✔ Constituent name,
- ✔ Constituent abbreviation or acronym,
- ✔ Sample collection method (i.e. grab or composite),

- ✔ Bottle type,
- ✔ Volume required,
- ✔ Preservation, and
- ✔ Laboratory performing analysis.

➤ DATA QUALITY OBJECTIVES (DQOs)

This appendix should specify the project goals and objectives, key project parameters, and the DQOs that were deemed appropriate for the project. Numerical DQOs should be established for analytical reporting limits, analytical precision, accuracy, and completeness. See ***Section 2*** for guidance on the development of DQOs.

➤ FIELD EQUIPMENT MAINTENANCE

This section should include specific information concerning the maintenance of all sampling equipment. At a minimum, all equipment should be maintained according to manufacturer specifications. The following is a list of items that typically require regular maintenance:

- ✔ Automatic sampler - calibrate and check battery,
- ✔ Intake tubing/strainer - inspect & clear or replace,
- ✔ Flow measuring device - calibrate, check battery and check/replace desiccant,
- ✔ Rain gauge - calibrate and check for debris, and
- ✔ Portable field interments (such as pH meter) – calibrate.

Bottle and equipment cleaning should also be covered in this section of the SAP (see ***Appendix E*** for guidance on sample bottle and equipment cleaning procedures). In addition, if equipment is located in a confined space, this section should include a discussion on the acceptable confined space entry procedures. See ***Section 5*** for guidance on the selection of sampling methods and equipment, and ***Section 7*** for detailed equipment installation and maintenance guidance.

➤ MONITORING PREPARATION AND LOGISTICS

This section should describe the necessary pre-storm preparations including:

- ✔ Weather tracking
  - Procedures
  - Responsibilities
  - Obtaining quantity of precipitation forecast (QPF)

- ✔ Storm selection criteria
  - Stage of wet season
  - Antecedent conditions
  - Storm duration
  - Recommended minimum storm size
  - Logistical constraints
- ✔ Storm action levels
  - Non-monitoring
  - Standby
  - Pre-alert
  - Alert
  - Go
  - Post-storm
- ✔ Communication/notification procedures
  - Telephone tree
- ✔ Sample bottle order
- ✔ Sample bottle labeling
- ✔ Field equipment preparation
  - Inspect
  - Calibrate
  - Charge batteries
  - Check

See ***Section 9*** for monitoring preparation and logistics guidance.

➤ SAMPLE COLLECTION, PRESERVATION, AND DELIVERY

This section should provide detailed guidance on standard operating procedures for field personnel (i.e., a concise, useable guide for sampling activities). At a minimum, this section should include:

- ✔ Sample collection methods to be used at each location,
- ✔ Field measurement equipment (e.g., pH meter) and methods to be used at each location,
- ✔ Field equipment that will be required for monitoring at each station (often includes a checklist so field people can ensure they have everything they will need before proceeding to the sampling location),
- ✔ Sample analyses, containers and preservatives required for each sampling station (usually in table format),

- ✔ Sample preservation and handling procedures,
- ✔ Procedures for collecting and labeling field duplicate samples,
- ✔ Sample labeling procedures (site name/code, sample date and time, etc.),
- ✔ Sample compositing and splitting procedures (including analytical prioritization for instances of insufficient sample volume),
- ✔ Forms and procedures for documenting sample collection and field measurements,
- ✔ Laboratory communication procedures, points of contact, and phone numbers, and
- ✔ Procedure for sample shipment or delivery to laboratory.

See ***Section 10*** for detailed sample collection guidance.

➤ QUALITY ASSURANCE/QUALITY CONTROL

The QA/QC section should focus on QA/QC procedures necessary for field activities, such as field procedures and collection frequencies for the following:

- ✔ Field duplicates
- ✔ Laboratory duplicates
- ✔ Field blanks
- ✔ Equipment blanks
- ✔ Matrix/Matrix spike duplicates

QA/QC sample collection frequencies are best presented in a QA/QC sample collection schedule table with a column for each event and a row for each site.

Laboratory QA/QC should be discussed in an appendix and should include the frequency and type of laboratory QA samples (e.g., laboratory duplicates, matrix spikes and spike duplicates, laboratory control samples, standard reference materials), data reporting requirements (electronic and hard copy) and corrective actions. See ***Section 11*** for detailed QA/QC guidance.

➤ LABORATORY SAMPLE PREPARATION AND ANALYTICAL METHODS

This section should describe the activities to be conducted by the analytical laboratory, including sample preparation procedures. A constituent table containing the following information should be presented:

- ✔ Constituent name,
- ✔ Analytical method,

- ✔ Holding times,
- ✔ Reporting limit, and
- ✔ Reporting units.

See ***Section 12*** for laboratory sample preparation and analytical methods guidance.

➤ DATA MANAGEMENT AND REPORTING PROCEDURES

This section should describe how the analytical data generated from the laboratory and field measurements are to be handled, evaluated, and reported. It should address:

- ✔ Analytical data validation (QA/QC review in light of project DQOs),
- ✔ Electronic data transfer,
- ✔ Filing of electronic and hard copy data,
- ✔ Data analysis (e.g., loading estimation, statistical evaluation, etc.), and
- ✔ Reports (e.g., quarterly, annual, end of project).

At the beginning of the project, the field and laboratory personnel should review the entire SAP to obtain an overview of their respective roles and responsibilities. Before each sampling event, the field personnel should review the sampling methods section in detail, and the laboratory personnel should review the laboratory sample preparation and analytical methods section. See ***Section 13*** for QA/QC data evaluation guidance. Also see Caltrans Storm Water Management Program 1999-2000 Data-Reporting Protocols, 10/18/99 (or latest version) for data reporting guidance (Caltrans, 1999c; see also ***Section 14*** and ***Appendix H***).

A P P E N D I C E S:

➤ CLEAN SAMPLING TECHNIQUES AND EQUIPMENT CLEANING PROTOCOLS

This appendix should describe clean sample collection and handling techniques, and protocols for cleaning sample collection equipment (e.g. sample bottles, intake tubing, suction tubing, and intake strainers). Clean sampling techniques should be used whenever low-level analytical reporting limits are to be employed for analytical analysis of metals or organic constituents. See ***Appendix F*** for clean sample and equipment handling, and sample collection equipment cleaning guidance.

➤ HEALTH AND SAFETY PLAN

Stormwater monitoring involves activities that have the potential to adversely affect the health and safety of field personnel. Stormwater monitoring field crews often work in wet, poor-visibility conditions. Sampling sites may be located along streets or stream channels, or in remote, poorly-lit areas, and may require access on a 24-hour basis. Workers may be exposed to traffic hazards, confined spaces, biological hazards, hazardous materials, fast-moving storm waters, and slippery conditions. Besides monitoring activities during storm events, monitoring equipment installation and maintenance activities may also take place under these conditions.

The information contained herein is for guidance only, and does not supersede or otherwise change any applicable state, local, or agency health and safety requirements or programs.

The general steps in HSP development for a given stormwater monitoring project are listed below:

- ✔ Assign a health and safety officer to oversee all health and safety activities.
- ✔ Write concise descriptions of all of the field activities that will be included in the program.
- ✔ Identify and evaluate the potential physical, chemical, and biological hazards associated with each activity.
- ✔ Specify the measures to be employed to reduce the health and safety risks associated with the identified hazards (i.e., precautions).
- ✔ Specify health and safety training and documentation requirements.
- ✔ Develop an emergency response/contingency plan.

Each of these steps is described in ***Appendix D***. Figure 6-2 contains an example outline for a project-specific HSP.

1.0 Introduction

2.0 Project And Safety Personnel

3.0 Site Information

4.0 Work Activities Covered By Health And Safety Plan

5.0 Hazard Assessment
- 5.1 Chemical Hazards
- 5.2 Confined Spaces
- 5.3 Physical Hazards
- 5.4 Biological Hazards

6.0 General Health And Safety Requirements
- 6.1 Employee Clearance
- 6.2 Site Safety Meetings
- 6.3 Accident Reporting
- 6.4 Prohibited On-Site Activities
- 6.5 Communications

7.0 Site-Specific Health And Safety Requirements
- 7.1 Special Medical Tests
- 7.2 Special Training
- 7.3 Physical Hazards
- 7.4 Hazardous Materials Identification And Protection
- 7.5 Confined Space Entry
- 7.6 Traffic Control
- 7.7 Personal Protective Equipment
- 7.8 Site Illumination
- 7.9 Biological Hazard

8.0 Emergency Response Procedures
- 8.1 Hospital Information
- 8.2 Emergency Route to Hospital
- 8.3 First Aid & Related Equipment

Figure 6-2. Typical Outline for a Health and Safety Plan