Stream Pollution Trends Monitoring Program

Quality Assurance Project Plan

State Water Resources Control Board
December 2018

GROUP A: PROJECT MANAGEMENT

A.1: Title and Approval

Project Title: Surface Water Ambient Monitoring Program (SWAMP) Stream Pollution Trends (SPoT) Monitoring Program Quality Assurance Project Plan (QAPP)

Lead Organization: University of California, Davis Marine Pollution Studies Laboratory at Granite Canyon (UCD-GC), 34500 Highway One, Monterey, CA 93953; Environmental Laboratory Accreditation Program Certificate No. 2821

Primary Contact:

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Effective Date: This QAPP is effective from May 2018 to May 2019

Version: 6

Preface: This QAPP document defines procedures and criteria for the SPoT program that will be used by the staff of SWAMP and all involved parties. The SPoT program started in 2008 as a means to monitor long-term pollution trends and their effects on stream biota in California. Doing so enables the State and Regional Water Boards to relate this water quality data to land-use and agency management efforts so that appropriate steps can be taken. Version 5 of this QAPP reflects recent changes in the roles and responsibilities of the SWAMP staff involved in this project, as well as expanding upon the information provided in previous versions.

Cite as: State Water Resources Control Board. 2018. Statewide Stream Pollution Trends Monitoring Program: Quality Assurance Project Plan. Sacramento, CA: Surface Water Ambient Monitoring Program.

The approvals below were submitted separately, preventing their inclusion in this signature block. Instead, they appear in Appendix I of this document. Originals are kept on file by the SWRCB.

Katie Siegler
PM, UCD-GC

____ Date ______________________

Bryn Phillips
Laboratory Director and QAO, UCD-GC

____ Date ______________________

Autumn Bonnema
Metals Chemistry Laboratory QAO, Moss Landing Marine Laboratory Marine Pollution Studies Laboratory (MPSL-DFW)

____ Date ______________________

Timea Majoros
Organics Chemistry Laboratory QAO, Delta Environmental

____ Date ______________________

Alex Long
Grain Size and Total Organic Carbon (TOC) Laboratory QAO, California State University, Long Beach, Institute for Integrated Research in Materials, Environments, and Society (CSULB-IIRMES)

____ Date ______________________

Dawit Tadesse
Project Oversight, Office of Information Management and Analysis (OIMA), State Water Resources Control Board (SWRCB)

____ Date ______________________

Melissa Morris
SWAMP QAO, SWRCB

____ Date ______________________

Renee Spears
SWRCB QAO

____ Date ______________________

A.2: Table of Contents

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A.3: Distribution List

Table 1. Distribution List

Position	Name	Responsibilities
Region 9 EPA Surface Water Standards Coordinator	Terry Fleming (U.S. EPA)	Oversees SWAMP federal funding and Program outputs.
State Board Management	Greg Gearheart (OIMA)	Program planning and oversight; project budget allocation and reconciliation with program objectives.
Project Oversight	Dawit Tadesse (OIMA)	Coordination with the Project Manager; reviewing monitoring plans, QAPP, and reports; participating in project workgroups; and maintaining information available on the SWAMP webpages.
Contract Manager	Chad Fearing (OIMA)	Approves invoices.
Contract Contact	Jennifer Salisbury (OIMA)	Reviews deliverables and invoices and submits recommendations for invoice approval to contract manager.
Laboratory Director and Laboratory QAO	Bryn Phillips (UCD-GC)	Conducts toxicity analyses; ensures that the laboratory quality assurance plan and QAPP criteria are met through routine monitoring and auditing of the systems; reviews and approves data prior to submission to the SWAMP Information Management and Quality Assurance Center (SWAMP IQ); investigates and conduct laboratory corrective actions.
Project Manager	Katie Siegler (UCD-GC)	Generates and maintains project QAPP; ensures all activities are completed within proper timeframes; oversees project deliverables, and entry of field and laboratory-generated data into SWAMP formats.
State Board QA Officer	Renee Spears (OIMA)	Approves QAPP; reports to U.S. EPA and SWRCB management.
Program QA Officer, Database Manager, SWAMP IQ	Melissa Morris (SWAMP IQ)	Reviews and approves QAPP; oversees Data Quality Managers; establishes program-level quality objectives and requirements for project; reports to U.S. EPA and SWRCB management and coordinates with SWRCB QAO.
SWAMP IQ Data Quality Managers	Kimberly Pham (SWAMP IQ) Brian Ogg (SWAMP IQ)	Reviews, verifies, validates and loads chemistry and composite data to SWAMP database; generates QA narrative; reports to program QAO.
Laboratory QAO	Autumn Bonnema (MPSL-DFW)	Oversees trace metals analyses; ensures proper QA/QC measures are employed.
Laboratory QAO	Timea M Majoros (Delta Environmental)	Conducts organic chemistry analyses; ensures proper QA/QC measures are employed.
Laboratory QAO	Alex Long (CSULB-IIRMES)	Conducts TOC and grain size analyses; ensures proper QA/QC measures are employed.

A.4: Project/Task Organization and Schedule

Involved Parties and Roles

UCD-GC staff will organize sample collection, conduct field and laboratory toxicity analyses, and manage contracts with laboratories for analyses of organic chemistry, trace metals, total organic carbon (TOC), and grain size. The PM (Katie Siegler, UCD-GC) oversees all aspects related to the planning and timely completion of the project. This includes organizing field crews, instructing UCD-GC staff, scheduling sampling days, and interacting with the contract laboratories. Bryn Phillips, the Laboratory Director and QAO for the SPoT program, is in charge of all sediment toxicity analyses. The role of the Laboratory QAO is to ensure that quality control for all sample processing and data analysis procedures, as described in this QAPP, are maintained throughout the life of the project. The Laboratory QAO will report all findings to the SWAMP QAOs and the PC, including all requests for corrective action. The Laboratory and Program QAOs have the authority to halt actions if there are significant deviations from required procedures or evidence of a systematic failure.

CSULB-IIRMES is the contract laboratory responsible for total organic carbon (TOC) and grain size analyses, and Alex Long is the QAO. Delta Environmental is the contract laboratory for all organic chemical analyses, and Timea Majoros is the QAO. MPSL-DFW is the contract laboratory for all trace metal analyses, and Autumn Bonnema is the QAO. These laboratories will analyze samples in accordance with all of the applicable QA/QC requirements established in this QAPP.

SWAMP IQ Data Quality Managers (Brian Ogg: Toxicity, Kim Pham: Chemistry) will review data received from UCD-GC and the contract laboratories to ensure that it meets all of the applicable QA and quality control (QC) requirements established in this QAPP. This data will then be entered into the SWAMP database and the California Environmental Data Exchange Network when the sampling year is complete.

The Program QAO (Melissa Morris, SWAMP IQ) assesses the data for compliance with the project and SWAMP program and ensures that the project meets U.S. EPA requirements for projects receiving federal EPA funds. The Program QAO also works with the State Board QA Officer, Renee Spears, to ensure that the project and data meets the requirements of the SWRBC's Quality Assurance Program Plan.

The Program manager, Greg Gearheart (OIMA, Director), oversees programmatic strategic and operational planning, and proposes and approves OIMA budgets and budget change proposals. U.S. EPA Region 9 Standards Liaison Terry Fleming ensures OIMA is in compliance with federal regulations and approves federal funding for its programs.

The SWRCB Contract Managers, Chad Fearing and Jennifer Salisbury will manage the SPoT program contract, invoices, and deliverables.

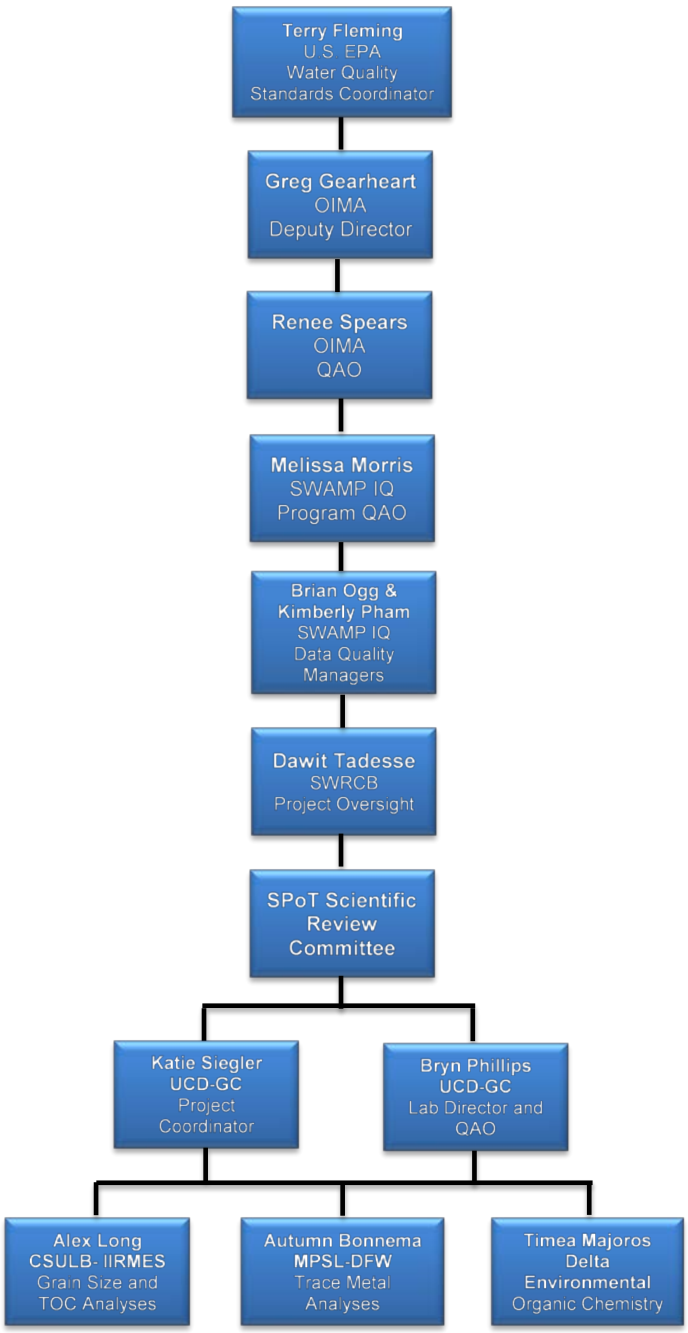
The SPoT Scientific Review Committee, comprised of staff from U.S. EPA, United States Geological Survey (USGS), California Department of Pesticide Regulation (CDPR) and TDC Environmental, reviews the assessment questions, objectives, design, indicators, and methods used in the SPoT program and provides recommendations as needed.

Revisions and updates to this QAPP will be carried out by Katie Siegler, with technical input from the Laboratory and Program QAOs. All changes will be considered draft until reviewed and approved by the PM, the Program QAO, and SWRCB QAO. The QAPP must be reviewed at least annually and revised where necessary. It must meet USEPA, SWRCB, and SWAMP quality system requirements to be approved. Copies of this QAPP will be distributed to all parties involved in the project. Any future amended QAPPs will be held and distributed in the same fashion.

Project Organization

The following chart depicts the structure of the SPoT program. Management responsibilities extend downward, while the flow of data moves upwards from the bottom of the chart.

Figure 1. Organizational Chart



Project Schedule
Each calendar year's field work and toxicity testing will be completed by November 15th. Chemical analyses are estimated to be completed by no later than October 15th of the following year, along with data submissions to SWAMP IQ by no later than November 1st of the following year. Toxicity data analyses will occur within 30 days of test completion and chemistry data analyses will occur immediately upon receipt of complete data sets. Annual reports synthesizing data will be completed the year following sample collection and analyses, assuming chemistry data are available.

A.5: Problem Definition/Background

The SPoT program was developed with the purpose of improving our understanding of watersheds and water quality through the monitoring of in-stream contaminants and sediment toxicity. The first annual SPoT survey, carried out in 2008, was documented in the report *Statewide Perspective on Chemicals of Concern and Connections between Stream Water Quality and Land Use* (Hunt et al., 2012). These findings have served as the baseline from which long-term trends in the categories and quantities of pollutants have since been determined.

Focusing on the impacts of land use and development, the SPoT program compares monitoring results across watersheds throughout the state in order to evaluate changes over time and assess potential risk to aquatic life. In addition, the SPoT program is designed to help establish a statewide network of sites that can link together monitoring efforts by storm water agencies, Total Maximum Daily Load (TMDL) programs, agricultural waiver programs, and regional monitoring to provide a statewide context for local monitoring. The network is composed of informal collaborations to provide additional information or leverage existing data and makes it possible to relatively compare data among local areas and regions, to indicate the relative magnitude of problems, and to gauge the success of management programs. The SPoT field survey document, *Standard Operating Procedures (SOPs) for Conducting Field Collections of Bed Sediment Samples at Watershed Integrator Sites in the Surface Water Ambient Monitoring Program (SWAMP) Stream Pollution Trend (SPoT) Program*, (Appendix B) has been developed to foster consistency for related monitoring efforts.

A.6: Project/Task Description

Monitoring Schedule
All sites are sampled as part of a continuous monitoring effort that began in 2008. Ninety sites are sampled during base flow or near-base flow conditions following annual peak flows. Sampling should occur before significant contaminant breakdown occurs via hydrolysis or photolysis. Surveys are scheduled based on regional hydrologic cycles, with Southern California coastal streams sampled in spring, and other regions sampled later in the year as stream flows recede.

Geographic Locations
When selecting sampling sites for the SPoT program, the geographic characteristics considered include: location in a large watershed with heterogeneous land cover; location at or near the base of a watershed, defined as the confluence with either an ocean, lake, or another stream of equal or greater stream order; and location where site-specific conditions are appropriate for the indicators selected (e.g. depositional areas, sufficient flow, appropriate channel morphology, substrate). Availability of previous data on sediment contaminant concentrations, biological impacts, or other relevant water quality data was also an

important consideration, particularly if sites could be co-located with key sites from cooperative programs. A list of sampling sites for the 2018 survey is provided in Appendix D and Table 2.

Constraints
Funding constraints have reduced the number of sites and analytes SPoT measures during a sampling year. In 2018, 10 of the 100 sites were removed, as they did not meet data quality objectives. The remaining 90 sites will be measured annually.

Extreme wet weather can affect sampling by significantly diluting or mobilizing the constituents to be measured. Extreme dry weather can also limit or prevent representative sampling due to low flow or no flow at a sampling location. Freezing weather can cause conditions that adversely affect the constituents to be measured or prevent access to some of the areas where sampling is needed.

Access to sampling sites may also be limited by legal restrictions which, in turn, could affect some of the conclusions drawn from the data. Unexpected topographical features that make it impractical to sample a chosen site will necessitate selection of an alternate location as well. These alternate locations will be determined on an as-needed basis at the time of sample collection; often based on hydrologic changes from the previous year.

Samples of Opportunity
Regional personnel may find it necessary to collect a sample from a water body or area that is not accounted for or covered in this QAPP when a complaint from a concerned citizen is received; when spills are reported; or for field observations (e.g. odors, color changes, etc.) used to justify the investigation of a potential water quality problem. When the opportunity to conduct unplanned sampling is presented, samples will be collected, labeled, documented, and processed following standard procedure, including relevant QA/QC, so that data results remain comparable to other data collected under this QAPP.

A.7: Quality Objectives and Criteria

Project Objectives/Intended Use of Data

- Determine long term trends in stream contaminant concentrations and effects statewide.
- Relate water quality indicators to land use characteristics and management efforts.
- Establish a network of sites throughout the state to serve as a backbone for collaboration with local, regional, and federal monitoring programs.

Under the 2018 SWAMP Quality Assurance Program Plan, the SPoT monitoring program collects data under the Ambient data classification and, therefore, must meet the quality objectives of the project classification including those required for 303(d) and 305(b) listing purposes.

SPoT data may also be used for a variety of Water Board and other agency programs. Analysis of pollutant concentrations in streams aids in the listing and reporting of impaired lotic water bodies under Clean Water Act sections 303(d) and 305(b); providing a possible means of tracking the effectiveness of TMDLs; and may help identify contaminants of emerging concern. Evaluating temporal trends may also provide useful information for the Water Boards’ agriculture and storm water programs, as well as the U.S. EPA Watershed Improvement Measure. SPoT data may also be used by the California Department of Pesticide Regulation (CDPR) to survey current pesticide use, reevaluate registrations, and reassess pesticide surface water regulations. The data quality objectives for data uses beyond 303(d) and 305(b) listing purposes has not been evaluated for the purposes of this study.

Listing Policy Data Requirements
The data collected from SPoT and other SWAMP programs is used by the SWRCB's 303(d) Assessment Unit to develop the biannual California Integrated Report, as directed by the Listing Policy. This policy also establishes data quality requirements for the evaluation of water quality standards attainment:

- *Water Body Specific Information:* Data used to assess water quality standards attainment should be actual data that can be quantified and qualified.
- *Spatial Representation:* Samples should be representative of the water body segment. To the extent possible, samples should be represented statistically or in a consistent, targeted manner in a segment of a water body.
- *Quantitation of Chemical Concentrations:* When available data are less than or equal to the quantitation limit and the quantitation limit is less than or equal to the water quality standard, the value will be considered as meeting the water quality standard, objective, criterion, or evaluation guideline. When the sample value is less than the quantitation limit and the quantitation limit is greater than the water quality standard, objective, criterion, or evaluation guideline, the result shall not be used in the analysis. The quantitation limit includes the minimum level, practical quantitation level, or reporting limit.
- *Evaluation of Data Consistent with the Expression of Numeric Water Quality Objectives, Water Quality Criteria, or Evaluation Guidelines:* If the water quality objectives, criteria, or guidelines state a specific averaging period and/or mathematical transformation, the data should be evaluated in a consistent manner prior to conducting any statistical analysis for placement of the water on the section 303(d) list. If sufficient data are not available for the stated averaging period, the available data shall be used to represent the averaging period.

Data Quality Indicators

Representativeness
SPoT sampling locations were selected to provide a statewide network of sites at the drainage points of large watersheds to support collaboration with watershed-based monitoring programs throughout the state. To establish this network, SPoT staff met with Regional Board monitoring coordinators and storm water agencies to develop a coordinated monitoring design. The Southern California Stormwater Monitoring Coalition participated in site selection for the southern California SPoT sites. A representative from the Bay Area Stormwater Management Agencies Association served on the SWAMP committee that designed the program, and all SPoT sites in the San Francisco Bay Region are aligned with monitoring sites for the Municipal Regional Stormwater National Pollutant Discharge Elimination Permit (SFBRWQCB, 2011). SPoT sites in the Central Coast and Central Valley Regions are shared by the Cooperative Monitoring Program for Agriculture and Irrigated Lands Program, respectively. In most cases, the SPoT assessments of sediment toxicity and chemistry complement water column measurements made by cooperating programs.

The SPoT program indicators are measured in stream sediment because this matrix best accommodates program goals. Most trace metal and organic pollutants that enter streams adhere to suspended sediment particles and organic matter, and this sediment-associated phase is the major pathway for contaminant loading in streams and downstream waterways (Karickhoff, 1984; DiToro et al., 1991; Foster and Charlesworth, 1996). In addition, sediment measurements are appropriate for long-term trend monitoring because pollutants that accumulate in depositional sediment on the stream bed are much more stable over time (~months to years) than dissolved or suspended pollutants that move downstream in pulses that are highly variable over short time scales (~hours). SPoT surveys are timed to collect sediment from recent stream bed deposits during base flow periods after the high-water season when most sediment and pollutant transport takes place. In 2018, SPoT will incorporate water column toxicity monitoring at up to twelve sites (in collaboration with CDPR) to incorporate emerging pesticides that are not associated with the sediments.

Sensitivity
In accordance with SWAMP's Measurement Quality Objectives (MQO) and internal QA plans, MPSL-DFW, CSULB-IIRMES, and Delta Environmental developed method detection limits (MDL) to ensure the proper level of sensitivity for chemical analyses. For applications requiring a greater degree of statistical confidence, the reporting limit (RL), based upon project requirements and proven laboratory capabilities, is used. The sensitivity of toxicity tests is dependent upon the number of replicates, the evaluation threshold, and the statistical approach utilized.

Completeness
The specified method and quantity of analyses denoted in the monitoring plan (Appendix C) must be met.

Precision
The precision of chemistry analyses will be determined by field and laboratory replicates. Field duplicates must account for 5% of the project's total sample count, and each must have a relative percent difference (RPD) less than 20%. At least one laboratory replicate per batch of 20 samples is required. The RPD between two replicate samples or the relative standard deviation (RSD) between more than two replicate samples will be less than the SWAMP MQOs listed for each analyte of interest. The calculations are as follows:

RPD = Absolute Value (of replicate 1 - replicate 2) x 100/Average (replicate 1, replicate 2)

RSD = Standard Deviation (of all replicate samples) x 100/Average (all replicate samples)

In regard to toxicity testing, interlaboratory precision is assessed using reference toxicant tests and sample duplicates, which must equal 5% of the total project sample count.

Bias
Given that trace metals and organic pollutants adhere to suspended sediment particles and organic matter, the SPoT program utilizes fine depositional sediment rather than bank deposits or gravel. This bias is, therefore, intentional in regard to the program's sampling methodology. Bias can be unintentionally introduced, however, through improper timing, reach selection, sample contamination, and depositional area selection for the surveys. These biases can be eliminated by ensuring field crews sample in the lowest gradient (i.e. calmest) reaches, and during the base flows that follow the high flow season (i.e. late spring through fall). Field blanks will also be used to measure any contamination introduced during sample collection and handling of water samples. Field blanks must meet the minimum number required for this project, and must not produce a statistically different result from that of the controls.

For chemistry analyses, bias is measured by the analysis of matrix spikes, surrogates, laboratory control samples, instrument blanks, and laboratory blanks.

- *Matrix spikes* (and matrix spike duplicates) are prepared by adding a known quantity of the target analyte to an environmental sample in order to measure method accuracy and analyte recovery. While matrix spikes do not demonstrate laboratory performance, they indicate the potential bias of matrix effects on the target analyte.

- *Surrogates* are non-target analytes with chemical properties similar to those of the analyte of interest that are used to evaluate the response of the analyte to sample preparation and analytical procedures.
- *Laboratory control samples* contain an analyte-free matrix that is representative of the environmental sample to be analyzed and are used to establish intra-laboratory or analyst-specific precision and bias.
- *Instrument blanks* utilize laboratory or distilled water to find instrument contamination and measure bias.
- *Laboratory blanks* (or “method blanks”) are analyte-free samples that closely resemble the environmental sample matrix that they are simultaneously processed alongside of. Laboratory blanks are used to determine if interferences are present in the reagents, instruments, or the broader laboratory environment.

Comparability
All sample collection, analyses, and reporting will be carried out with procedures and methodologies consistent with past SPoT data collection efforts and SWAMP.

A.8: Special Training/Certification

Specialized Training and Safety Requirements
No specialized training or certifications are required for this project. All laboratory staff are required to maintain training per field and laboratory specific requirements and follow the safety protocols established in each their respective laboratories and applicable SOPs.

Training Provided

UCD-GC
Staff provides hands-on training for SPoT sample collection and toxicity testing. All new staff members are evaluated and supervised in the field and lab setting before they are allowed to work independently. All trainings are recorded in a safety training log.

MPSL-DFW
In accordance with the MPSL-DFW QA plan, each new employee is assigned to a staff member who provides:

- Detailed readings of the SOP(s) and attendant literature references
- Practice for the method(s) using standards and certified reference materials
- Supervised analysis of samples
- Guidance for MDL development

Completion of these steps is documented using a training checklist, signed by the trainee and the supervisor. Once the new employee has proven his/her ability to successfully complete a specific analysis, he/she is considered trained in that method.

Delta Environmental

Staff must perform supervised analyses before taking a written proficiency test and conducting a series of calibration and MDL studies. When staff has demonstrated the ability to successfully complete laboratory control sample (LCS) and continuing calibration verification recoveries at the regulatory limit for a given method, certification is granted for that specific test. Thereafter, proficiency is evaluated on an annual basis through various measures including the successful analyses of blind samples, and at least four consecutive LCS recoveries with acceptable levels of precision and accuracy.

Personnel Responsible for Ensuring Training

UCD-GC
The Project Manager trains all field staff in a field training day, while the Laboratory QAO trains new staff in all laboratory procedures related to the SPoT toxicity tests.

MPSL-DFW
New employees are assigned to a staff member well-versed in a specific analytical method.

Delta Environmental
New employees are assigned to a staff member well-versed in a specific analytical method.

A.9: Documentation and Records Requirements

Planning Documents

- SWRCB staff will send an electronic copy of this QAPP to the PC, who will then distribute to all parties directly involved in this project. Any future amendments to this QAPP will be distributed in the same fashion. Each version of this QAPP will be retained at the SWRCB. QAPPs are reviewed and updated on an annual basis.

Sample Collection and Handling Records

- The SPoT Monitoring Plan will detail the sampling scheme for the upcoming year and will be submitted to the SWAMP Contract Manager in an electronic format.
- Field sampling sheets will be completed by the staff at UCD-GC and submitted to the SWAMP Contract Manager, electronically, upon conclusion of the survey. These documents will be made available to the State and Regional Water Boards upon request.
- An electronic copy is forwarded to the analyzing laboratory in advance of sample receipt.

Training, Safety, and Certification Documentation

- UCD-GC has ELAP certification and conforms to all requirements. All SOPs and documentation pertaining to laboratory safety procedures will be retained by all laboratories involved in the SPoT program.

Analytical Records

Contract labs will maintain logs measuring routine inspections, calibrations, and measurements for the items listed. All equipment logs and data sheets will be retained at their respective laboratories for a minimum of 10 years from the contract's cessation (if applicable), and provided to State or Regional Water Board staff upon request.

Lab Reports

Annual summary reports will be written by the Laboratory QAO and submitted to the State Board Contract Manager. Reports will include summary information about emerging trends and data of particular interest. A ten-year interpretive report will be developed in 2018, summarizing data from 2008-2017.

Electronic Data Deliverables
Toxicity test results, analyte measurements, and field data collected for the 2018 SPoT survey will be submitted electronically to SWAMP IQ.

Corrective and Preventative Action Reports
Corrective actions are documented in the laboratory record. If a failure is not resolved, it is conveyed to the Lab QAO who determines if the failure compromised associated results. The nature and disposition of the problem will be documented in the data report sent to the SWAMP Project Manager.

Trend Reports
A 10-year report will be written interpreting the results of data analyses from the first 10 years of the SPoT program (2008-2017). Shorter annual reports will be prepared to highlight recent findings and will be completed within 1 month of receiving data from the participating laboratories.

GROUP B: ANALYTICAL METHODS REQUIREMENTS

B.1: Sampling Process Design

The monitoring design of SPoT is based on USGS's National Water Quality Assessment program (USGS, NAWQA: http://water.usgs.gov/nawqa/). NAWQA utilizes "integrator sites" for its sampling, which are areas established near the base of larger, relatively heterogeneous drainage basins with complex combinations of environmental settings, slow water flow, and appropriate micro-morphology to allow deposition and accumulation. These basins are indexed using eight-digit USGS hydrologic unit codes (HUC) and include watersheds for the Russian, South Fork American, Salinas, and Santa Clara Rivers. Sediment samples collected from integrator sites are considered to be a relatively good and logistically feasible means of assessing large watersheds for long-term trends.

Initially, SPoT sampled 100 sites, throughout California, on an annual basis. Starting in 2018, 90 sites will be sampled, along with two additional sites as part of an intensive study. All sites were chosen for geographical representation combined with input from the nine Regional Water Quality Control Boards and local and regional monitoring programs, such as those directed by storm water agencies and coalitions, irrigated lands programs, and regional monitoring programs. By co-locating sampling sites with local programs, SPoT provides statewide perspective for local programs, as well as local enhancement and detail to the statewide program.

Table 2. SPoT Stations to be Sampled in 2018

Station ID	Station Name	Lat	Long
103SM1009	Smith River at Sarina Road (ref)	41.9134	-124.1716
105KLAMKK	Klamath River at Kamp Klamath	41.5171	-124.039
109MAD101	Mad River upstream Hwy 101	40.9176	-124.0895
111EELFRN	Eel River at Fernbridge	40.6113	-124.2041
111SF0933	Eel River - South Fork at Myers Flat	40.2618	-123.8802
114RRDSDM	Russian River downstream Duncan Mills	38.44750	-123.0558
201LAG125	Lagunitas Creek at Coast Guard (ref)	38.0692	-122.7981
201WLK160	Walker Creek Ranch	38.1755	-122.8204
204ALA020	Alameda Creek E. of Alvarado Blvd	37.58200	-122.05200

204SLE030	San Leandro Creek at Empire Road	37.7256	-122.1836
204SMA020	San Mateo Creek at Gateway Park	37.5703	-122.3186
205COY060	Coyote Creek at Montague	37.39540	-121.9149
205GUA020	Guadalupe Creek at USGS Gaging Station 11169025	37.3739	-121.9319
207KIR020	Kirker Creek at Floodway	38.01650	-121.8388
207LAU020	Laurel Creek at Pintail Drive	38.24830	-122.0067
207WAL020	Walnut Creek at Concord Ave O.C.	38.9806	-122.05160
304SLRWAT	San Lorenzo River below Water Street	36.9769	-122.02390
304SOK	Soquel Creek at Knob Hill Parking Lot	36.9801	-121.95624
305THU	Pajaro River at Thurwachter Bridge	36.8798	-121.792
307CML	Carmel River at Hwy 1	36.5364	-121.9117
309DAV	Salinas River at Davis Road	36.6468	-121.7014
309TDW	Tembladero Slough at Monterey Dunes Way	36.7722	-121.78660
310ARG	Arroyo Grande Creek at 22nd Street	35.0952	-120.6063
310SLB	San Luis Obispo Creek at San Luis Bay Drive	35.1883	-120.7179
312SMA	Santa Maria River at Estuary	34.96046	-120.64256
314SYN	Santa Ynez River at 13th St	34.6768	-120.5544
315ATA	Atascadero Creek at Ward Dr	34.4235	-119.81929
315MIS	Mission Creek at Montecito St	34.413	-119.694
402VRB0xx	Ventura River	34.2817	-119.3067
403STCBQT	Bouquet Canyon Creek	34.4278	-118.5402
403STCEST	Santa Clara River Estuary	34.2356	-119.2167
404BLNAxx	Ballona Creek Downstream of Sawtelle (Centinela)	33.98600	-118.41700
405SGRA2x	San Gabriel River RA-2	33.7871	-118.0937
408CGCS06	Calleguas Creek Below Camrosa WWTP	34.1798	-119.0405
412LARWxx	LA River near Willow	33.80490	-118.20500
504BCHROS	Big Chico Creek at Rose Ave	39.7272	-121.8631
504SACHMN	Sac R at Hamilton City	39.75110	-121.998
508SACBLF	Sacramento River at Balls Ferry	40.4176	-122.1933
510LSAC08	Clarksburg Marina	38.38312	-121.52057
511CAC113	Cache Creek at Hwy 113	38.7207	-121.76430
515SACKNK	Sacramento Slough at Karnak	38.7846	-121.6544
515YBAMVL	Yuba R at Maryville	39.1342	-121.59290
519AMNDVY	American R at Discovery Park	38.6009	-121.50550
519BERBRY	Bear R at Berry Rd.	38.9618	-121.5468
519FTRNCS	Feather R at Nicolaus	38.8975	-121.59050
520BUTPAS	Butte Slough Upstream of Pass Rd bridge	39.1879	-121.9092
520CBDKLU	Colusa Basin Drain at Knights Landing Upstream	38.79923	-121.72504
520SACLSA	Sacramento River at Colusa near Bridge Street	39.2142	-122.0003
526PRFALR	Pit River at Cassel-Fall River Road	40.998	-121.4351
531SAC001	Cosumnes River at Twin Cities Road	38.29083	-121.37583
535STC206	Dry Creek at La Loma Rd.	37.6457	-120.9808
541MERECY	Marsh Creek at E Cypress Rd	37.9911	-121.6963
541STC019	Orestimba Creek at River Road	37.41389	-121.01417
541STC516	Del Puerto Creek at Vineyard Avenue	37.52139	-121.14861
603BSP002	Bishop Creek at East Line St	37.3616	-118.3861
631WWKLAR	West Walker River at Larson Lane	38.5468	-119.4949
633WCRSED	West Fork Carson River at Paynesville	38.8089	-119.7773
634UTRSED	Upper Truckee River near inlet to Lake Tahoe	38.9344	-120.0004
635MARSED	Martis Creek near mouth	39.3021	-120.1214
635TRKSED	Lower Truckee River near CA/NV state line	39.4648	-120.00320
635TROSED	Trout Creek (Truckee) near mouth	39.33240	-120.1656

637SUS001	Susan River,nr Litchfield	40.3777	-120.3951
723ARGRB1	Alamo River Outlet	33.19920	-115.59710
723NROTWM	New River Outlet	33.1047	-115.6636
801CCPT12	Chino (San Antonio) Ck at Euclid/Hwy 83 bridge	33.9402	-117.6543
801SDCxxx	San Diego Creek at Campus	33.6556	-117.8447
901SJSJC9	San Juan Creek 9	33.48443	-117.6758
902SSMR07	Santa Margarita at Basilone Rd	33.3112	-117.3454
903SLRRBB	San Luis Rey River at Benet Road Bridge	33.2204	-117.3582
904ESCOxx	Escondido Creek at Camino del Norte	33.0483	-117.226
905SDSDQ9	San Dieguito River 9	32.9788	-117.2351
906LPLPC6	Los Penasquitos Creek 6	32.90720	-117.2306
907SDRWAR	San Diego River at Ward Rd	32.7803	-117.1105
909SWRWSx	Sweetwater River at Willow St bridge	32.65898	-117.04231
911TJHRxx	Tijuana River at Hollister Rd	32.5514	-117.0839
519SED008	Pleasant Grove Creek Sediment #8	38.79490	-121.37280
901INTSC5	Salt Creek	33.50553	-117.70885

B.2: Sampling Methods

Sediment samples will be collected in accordance with the SOP in Appendix B. Samples are collected along a 100m reach, with subsamples collected from up to 10 depositional areas depending on the location of fine sediment deposits. Subsamples are homogenized to address variability and create a sample representative of depositional sediment mobilized within the watershed. Care is taken to sample recent sediment deposits in active areas of the streambed by avoiding banks, beaches, and other areas where sediment may have been deposited more than one year previously. Surveys are scheduled based on regional hydrologic cycles, with Southern California coastal streams sampled in spring, and other regions sampled progressively later in the year as stream flows recede.

Sediment is sampled to a depth of up to 5 cm, if the entire 5 cm core is homogeneous and appears to have been deposited within the same hydrologic cycle of seasonal high water receding to annual base flow. Surficial sediment as shallow as 1 cm may need to be collected if there is clear layering indicating deposition over multiple annual cycles.

Spatial and temporal variability was characterized through a pilot study in which three additional reaches, per watershed, were sampled during spring, summer, and fall of the 2009-2010 SPoT survey. The results from the three additional samples were then compared to the results from other years using an F-Ratio test to determine if seasonal variability was significantly greater than annual variability. It was determined that a single station at the base of the watershed was representative of other stations in the lower part of the watershed, and was also seasonally representative.

Water samples will be collected at up to12 SPoT sites by CDPR, as part of a collaborative study evaluating pesticides and potential toxicity in California and transported to UCD-GC on ice. Water column toxicity tests will include 96-hour acute exposures with *Hyalella azteca* and 10-day chronic exposures with *Chironomus dilutus* (U.S. EPA, 2002). CDPR SOPs can be referenced at https://www.cdpr.ca.gov/docs/emon/pubs/sop_qaqc.htm.

Equipment
The following items will be used in the field:

- YSI 600R sonde
- Sediment core tubes
- Sediment scoops

The YSI 600R sonde is used to conduct field measurements of dissolved oxygen, temperature, conductivity, and pH.
The sediment core tubes and scoops are to collect sediment samples in accordance with the procedures outlined in Appendix B.

Cleaning/Decontamination
It is critical that sample contamination be avoided during collection. All sampling equipment is composed of a non-contaminating material and is thoroughly cleaned before each use as described in the UCD-GC SOP (Appendix B). Sampling personnel wear nitrile gloves whenever taking or processing samples to avoid contact contamination. In addition, airborne contamination is avoided by keeping sample containers appropriately covered when not in use.

All laboratory equipment will be cleaned/decontaminated in accordance with the applicable laboratory's SOP(s). Copies of these SOPs are retained by the SWRCB and will be made available to the Regional Water Boards upon request.

B.3: Sample Handling and Custody

Sample Documentation
All raw and statistical analysis data are subject to a 100% check for accuracy by the UCD PC and Laboratory QAOs, who in turn have the authority to issue stop work orders if needed. Data are analyzed and proofread for accuracy, then checked against the QAPP and SWAMP acceptability criteria before being entered into the SWAMP database. All field data are entered by Sylvia Zamudio, and all toxicity test data by Laura McCalla. Data are reviewed for accuracy by the Laboratory QAO and/or the PC before being submitted electronically. Original copies of the field sheets, lab logs, and data generated at UCD-GC and stored there for 20 years.

Sample Handling Requirements
The sample handling requirements for SPoT analytes are listed in Table 9. These requirements were excerpted from SWAMP's MQOs for Conventional Parameters in Freshwater Sediment and Marine Sediment; Inorganic Analytes in Freshwater Sediment and Marine Sediment; Synthetic Organic Compounds in Freshwater Sediment and Marine Sediment; and Freshwater Sediment Toxicity Testing.

Sample Chain of Custody
Project COC procedures require that possession of samples to be traceable from the time they are collected until completion and submittal of analytical results. Therefore, a complete COC form will accompany the transfer of samples to each analyzing laboratory and will be forwarded to the PC with the data reporting package (see Appendix E for the UCD-GC COC form).

All samples will be handled, prepared, transported, and stored in a manner so as to minimize bulk loss, analyte loss, contamination, or biological degradation, according to the applicable MQOs (Tables 5-12),

and the SOP in Appendix B. Sample container caps and lids will be checked for tightness and clearly labeled with an indelible marker. Samples are then placed in an insulated cooler with enough dry or wet ice to completely fill the space and sealed with tape before shipping. Forms are either placed in an envelope and taped to the top of the cooler or placed in a Ziploc plastic bag and taped to the inside of the lid. It is assumed that samples in tape-sealed coolers are secure whether being transported by staff vehicle, by common carrier, or by commercial package delivery.
The receiving laboratory has a sample custodian who examines the samples for proper documentation, preservation, and holding times. For SPoT, samples will be collected by UCD-GC personnel, so samples will not change custody between field collection and laboratory storage. When samples are transported from UCD-GC to other labs, the temperature will be checked at the receiving lab using an infrared thermometer. Contract laboratories will follow the COC procedures outlined in their respective QA plans (available upon request).

Sample Retention and Disposal
All samples will be retained for the entire duration of their required holding times and analysis. Any samples remaining after successful completion of analyses will be properly disposed of after written confirmation from the UCD-GC PC (stating that the data have been received, reviewed and validated) has been obtained.

It is the responsibility of the personnel of each analytical laboratory to ensure that all applicable regulations are followed in the disposal of samples or chemicals.

B.4: Analytical Methods Requirements

The standardized test methods used to measure the analytes of interest to the SPoT program are listed in Table 3, along with the laboratory responsible for conducting them. It should be noted that five of the methods utilized have been modified to address four issues:

- *Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices* (EPA 3052) has been modified for digestion of trace metals samples in order to reduce hazards to laboratory staff, and to more closely fit the requirements of MPSL-DFW’s Microwave Assisted Reaction System 5 unit. These modifications are detailed in an internal MPSL-DFW SOP that will be made available upon request. Samples are subsequently analyzed by *Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma - Mass Spectrometry* (EPA 200.8)
- *Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)* (EPA 8270D) has been modified to address calibration and to conduct negative chemical ionization (NCI) GC/MS
- *Total Organic Carbon* (EPA 9060A) has been modified to address the temperature control device (TCD)

These modified methods have been denoted with an “M” in Table 3 on the following page. SOPs from UCD-GC, MPSL-DFW are available upon request.

Table 3. SPoT Analytes and Methodology

Laboratory/ Organization	Method	Analyte	Unit
UCD-GC	EPA 600/R-99/064; SOP 2.7	Freshwater Sediment Toxicity	LC50; TU
UCD-GC	Digital Titration SOP 3.1	Alkalinity	mg/L
UCD-GC	Accumet SOP 3.13	• Dissolved Oxygen • pH • Conductivity	mg/L; pH units; mS/cm
UCD-GC	Hach DR/2010 Spectrophotometer SOP 3.2	Ammonia	mg/L
UCD-GC	Digital Titration SOP 3.5	Hardness	mL
MPSL-DFW	EPA 200.8; EPA 3052M (Modified for digestion)	Trace Metals	mg/kg dw
MPSL-DFW	EPA 7473	Mercury	mg/kg dw
Delta Environmental	EPA 8270C EPA 8270-NCI Low Detection	• PAH • PBDE • Fipronil	ng/g dw
Delta Environmental	EPA 8270-NCI Low Detection	• Pyrethroids	ng/g dw
Delta Environmental	EPA 8081	• OCh Pesticides	mg/kg dw
Delta Environmental	EPA 8082 EPA 8270	• PCB • PCB Congeners	µg/g dw
CSULB	EPA 9060AM (Modified for TCD)	TOC	mg/g
CSULB	Plumb RH Jr, 1981	Grain Size	um

Table 4. Laboratory Reporting Limits for SPoT Analytes in Sediment

Analyte	Unit	RL	Analyte Group
Arsenic (total)	mg/kg dw	0.3	Metals
Cadmium (total)	mg/kg dw	0.1	Metals
Chromium (total)	mg/kg dw	1	Metals
Copper (total)	mg/kg dw	1.5	Metals
Lead (total)	mg/kg dw	0.5	Metals
Manganese (total)	mg/kg dw	3	Metals
Mercury (total)	mg/kg dw	0.012	Metals
Nickel (total)	mg/kg dw	0.4	Metals
Silver (total)	mg/kg dw	0.2	Metals
Zinc (total)	mg/kg dw	10	Metals
Aldrin (total)	ng/g dw	1	OCP
Chlordane (cis-; total)	ng/g dw	1	OCP
Chlordane (trans-; total)	ng/g dw	1	OCP
Dacthal (total)	ng/g dw	1	OCP
DDD (o,p'; total)	ng/g dw	1	OCP
DDD (p,p'; total)	ng/g dw	1	OCP
DDE (o,p'; total)	ng/g dw	2	OCP
DDE (p,p'; total)	ng/g dw	2	OCP
DDMU (p,p'; total)	ng/g dw	3	OCP
DDT (o,p'; total)	ng/g dw	3	OCP
DDT (p,p'; total)	ng/g dw	5	OCP
Dieldrin (total)	ng/g dw	0.5	OCP
Endosulfan I (total)	ng/g dw	2	OCP
Endosulfan II (total)	ng/g dw	5	OCP
Endosulfan Sulfate (total)	ng/g dw	5	OCP
Endrin Aldehyde (total)	ng/g dw	2	OCP
Endrin Ketone (total)	ng/g dw	2	OCP
Endrin (total)	ng/g dw	2	OCP
HCH (alpha-; total)	ng/g dw	0.5	OCP
HCH (beta-; total)	ng/g dw	1	OCP
HCH (gamma-; total)	ng/g dw	0.5	OCP
Heptachlor Epoxide (total)	ng/g dw	1	OCP
Heptachlor (total)	ng/g dw	1	OCP
Hexachlorobenzene (total)	ng/g dw	0.2	OCP
Methoxychlor (total)	ng/g dw	3	OCP
Mirex Total (total)	ng/g dw	1.5	OCP
Nonachlor (cis-; total)	ng/g dw	1	OCP
Nonachlor (trans-; total)	ng/g dw	1	OCP
Oxadiazon (total)	ng/g dw	1	OCP
Oxychlordane (total)	ng/g dw	1	OCP

Bolstar (total)	ng/g dw	10	OPP
Chlorpyrifos Methyl (total)	ng/g dw	20	OPP
Chlorpyrifos (total)	ng/g dw	5	OPP
Demeton-s (total)	ng/g dw	10	OPP
Diazinon (total)	ng/g dw	5	OPP
Dichlofenthion (total)	ng/g dw	20	OPP
Disulfoton (total)	ng/g dw	10	OPP
Ethion (total)	ng/g dw	20	OPP
Ethoprop (total)	ng/g dw	10	OPP
Fenchlorphos (total)	ng/g dw	20	OPP
Fenitrothion (total)	ng/g dw	20	OPP
Fensulfothion (total)	ng/g dw	100	OPP
Fenthion (total)	ng/g dw	10	OPP
Fonofos (total)	ng/g dw	20	OPP
Malathion (total)	ng/g dw	20	OPP
Mevinphos (total)	ng/g dw	10	OPP
Parathion, Ethyl (total)	ng/g dw	10	OPP
Parathion, Methyl (total)	ng/g dw	10	OPP
Phorate (total)	ng/g dw	10	OPP
Sulfotep (total)	ng/g dw	20	OPP
Tetrachlorvinphos (total)	ng/g dw	10	OPP
Thionazin (total)	ng/g dw	20	OPP
Tokuthion (total)	ng/g dw	20	OPP
Trichloronate (total)	ng/g dw	20	OPP
Acenaphthene (total)	ng/g dw	2	PAH
Acenaphthylene (total)	ng/g dw	2	PAH
Anthracene (total)	ng/g dw	2	PAH
Benz(a)anthracene (total)	ng/g dw	2	PAH
Benzo(a)pyrene (total)	ng/g dw	5	PAH
Benzo(b)fluoranthene (total)	ng/g dw	2	PAH
Benzo(e)pyrene (total)	ng/g dw	5	PAH
Benzo(g,h,i)perylene (total)	ng/g dw	5	PAH
Benzo(k)fluoranthene (total)	ng/g dw	5	PAH
Biphenyl (total)	ng/g dw	2	PAH
Chrysene (total)	ng/g dw	2	PAH
Chrysenes, C1- (total)	ng/g dw	2	PAH
Chrysenes, C2- (total)	ng/g dw	2	PAH
Chrysenes, C3- (total)	ng/g dw	2	PAH
Dibenz(a,h)anthracene (total)	ng/g dw	5	PAH
Dibenzothiophene (total)	ng/g dw	2	PAH
Dibenzothiophenes, C1- (total)	ng/g dw	2	PAH
Dibenzothiophenes, C2- (total)	ng/g dw	2	PAH

Dibenzothiophenes, C3- (total)	ng/g dw	2	PAH
Dimethylnaphthalene, 2,6- (total)	ng/g dw	2	PAH
Dimethylphenanthrene, 3,6- (total)	ng/g dw	2	PAH
Fluoranthene/Pyrenes, C1- (total)	ng/g dw	2	PAH
Fluoranthene (total)	ng/g dw	2	PAH
Fluorene (total)	ng/g dw	2	PAH
Fluorenes, C1- (total)	ng/g dw	2	PAH
Fluorenes, C2- (total)	ng/g dw	2	PAH
Fluorenes, C3- (total)	ng/g dw	2	PAH
Indeno(1,2,3-c,d) pyrene; (total)	ng/g dw	5	PAH
Methyldibenzothiophene, 4- (total)	ng/g dw	2	PAH
Methylfluoranthene, 2- (total)	ng/g dw	2	PAH
Methylfluorene, 1- (total)	ng/g dw	2	PAH
Methylnaphthalene, 1- (total)	ng/g dw	2	PAH
Methylnaphthalene, 2- (total)	ng/g dw	2	PAH
Methylphenanthrene, 1- (total)	ng/g dw	2	PAH
Naphthalene (total)	ng/g dw	5	PAH
Naphthalenes, C1- (total)	ng/g dw	5	PAH
Naphthalenes, C2- (total)	ng/g dw	5	PAH
Naphthalenes, C3- (total)	ng/g dw	5	PAH
Naphthalenes, C4- (total)	ng/g dw	5	PAH
Perylene (total)	ng/g dw	5	PAH
Phenanthrene/Anthracene, C1- (total)	ng/g dw	5	PAH
Phenanthrene/Anthracene, C2- (total)	ng/g dw	5	PAH
Phenanthrene/Anthracene, C3- (total)	ng/g dw	5	PAH
Phenanthrene/Anthracene, C4- (total)	ng/g dw	5	PAH
Phenanthrene; Total (total)	ng/g dw	5	PAH
Pyrene; Total (total)	ng/g dw	2	PAH
Trimethylnaphthalene, 2,3,5- (total)	ng/g dw	2	PAH
PBDE 017/25 (total)	ng/g dw	0.2	PBDE
PBDE 028/33 (total)	ng/g dw	0.2	PBDE
PBDE 030 (total)	ng/g dw	0.2	PBDE
PBDE 047 (total)	ng/g dw	0.2	PBDE
PBDE 049 (total)	ng/g dw	0.2	PBDE
PBDE 066 (total)	ng/g dw	0.2	PBDE
PBDE 085 (total)	ng/g dw	0.4	PBDE
PBDE 099 (total)	ng/g dw	0.4	PBDE
PBDE 100 (total)	ng/g dw	0.4	PBDE
PBDE 138 (total)	ng/g dw	0.4	PBDE
PBDE 153 (total)	ng/g dw	0.4	PBDE
PBDE 154 (total)	ng/g dw	0.4	PBDE
PBDE 179 (total)	ng/g dw	1	PBDE

PBDE 183 (total)	ng/g dw	1	PBDE
PBDE 184 (total)	ng/g dw	1	PBDE
PBDE 188 (total)	ng/g dw	1	PBDE
PBDE 190 (total)	ng/g dw	1	PBDE
PBDE 200/203 (total)	ng/g dw	0.8	PBDE
PBDE 201 (total)	ng/g dw	0.8	PBDE
PBDE 202 (total)	ng/g dw	0.8	PBDE
PBDE 206 (total)	ng/g dw	2	PBDE
PBDE 207 (total)	ng/g dw	2	PBDE
PBDE 208 (total)	ng/g dw	2	PBDE
PBDE 209 (total)	ng/g dw	10	PBDE
PCB 008 (total)	ng/g dw	0.02	PCB
PCB 018 (total)	ng/g dw	0.2	PCB
PCB 027 (total)	ng/g dw	0.2	PCB
PCB 028 (total)	ng/g dw	0.2	PCB
PCB 029 (total)	ng/g dw	0.2	PCB
PCB 031 (total)	ng/g dw	0.2	PCB
PCB 033 (total)	ng/g dw	0.2	PCB
PCB 044 (total)	ng/g dw	0.2	PCB
PCB 049 (total)	ng/g dw	0.2	PCB
PCB 052 (total)	ng/g dw	0.2	PCB
PCB 056 (total)	ng/g dw	0.2	PCB
PCB 060 (total)	ng/g dw	0.2	PCB
PCB 066 (total)	ng/g dw	0.2	PCB
PCB 070 (total)	ng/g dw	0.2	PCB
PCB 074 (total)	ng/g dw	0.2	PCB
PCB 087 (total)	ng/g dw	0.2	PCB
PCB 095 (total)	ng/g dw	0.2	PCB
PCB 097 (total)	ng/g dw	0.2	PCB
PCB 099 (total)	ng/g dw	0.2	PCB
PCB 101 (total)	ng/g dw	0.2	PCB
PCB 105 (total)	ng/g dw	0.2	PCB
PCB 110 (total)	ng/g dw	0.2	PCB
PCB 114 (total)	ng/g dw	0.2	PCB
PCB 118 (total)	ng/g dw	0.2	PCB
PCB 128 (total)	ng/g dw	0.2	PCB
PCB 137 (total)	ng/g dw	0.2	PCB
PCB 138 (total)	ng/g dw	0.2	PCB
PCB 141 (total)	ng/g dw	0.2	PCB
PCB 149 (total)	ng/g dw	0.2	PCB
PCB 151 (total)	ng/g dw	0.2	PCB
PCB 153 (total)	ng/g dw	0.2	PCB

PCB 156 (total)	ng/g dw	0.2	PCB
PCB 157 (total)	ng/g dw	0.2	PCB
PCB 158 (total)	ng/g dw	0.2	PCB
PCB 170 (total)	ng/g dw	0.2	PCB
PCB 174 (total)	ng/g dw	0.2	PCB
PCB 177 (total)	ng/g dw	0.2	PCB
PCB 180 (total)	ng/g dw	0.2	PCB
PCB 183 (total)	ng/g dw	0.2	PCB
PCB 187 (total)	ng/g dw	0.2	PCB
PCB 189 (total)	ng/g dw	0.2	PCB
PCB 194 (total)	ng/g dw	0.2	PCB
PCB 195 (total)	ng/g dw	0.2	PCB
PCB 200 (total)	ng/g dw	0.2	PCB
PCB 201 (total)	ng/g dw	0.2	PCB
PCB 203 (total)	ng/g dw	0.2	PCB
PCB 206 (total)	ng/g dw	0.2	PCB
PCB 209 (total)	ng/g dw	0.2	PCB
Bifenthrin (total)	ng/g dw	0.25	Pyrethroid Pesticide
Cyfluthrin (total)	ng/g dw	1.25	Pyrethroid Pesticide
Cyhalothrin, Lambda (total)	ng/g dw	0.5	Pyrethroid Pesticide
Cypermethrin (total)	ng/g dw	1	Pyrethroid Pesticide
Deltamethrin/Tralomethrin (total)	ng/g dw	1	Pyrethroid Pesticide
Esfenvalerate/Fenvalerate (total)	ng/g dw	0.5	Pyrethroid Pesticide
Fenpropathrin (total)	ng/g dw	0.25	Pyrethroid Pesticide
Permethrin (cis-; total)	ng/g dw	1.25	Pyrethroid Pesticide
Permethrin (trans-; total)	ng/g dw	2.5	Pyrethroid Pesticide
Permethrin (total)	ng/g dw	4	Pyrethroid Pesticide
Fipronil	ng/g dw	2	Phenylpyrazole Pesticide
Fipronil desulfinyl	ng/g dw	2	Pesticide degradate
Fipronil sulfide	ng/g dw	2	Pesticide degradate
Fipronil sulfone	ng/g dw	2	Pesticide degradate
Imidacloprid	ng/l	0.40	Neonicotinoid Pesticide

B.5: Quality Control

The laboratories participating in the SPoT program employ multiple approaches to quality control in order to identify possible contamination problem(s), matrix interference, and evaluate the ability to duplicate results. When control limits are exceeded, the Laboratory QAO will determine the cause(s) by reviewing SOPs and identifying, documenting, and correcting any deficiencies. A written report of the corrective action(s) will be provided to the PC and PM via email. The PM will contact the Program QAO as needed.

The following tables list the quality control MQOs for the SPoT program's laboratory and field methodology.

Table 5. Quality Control[1] for Inorganic Analytes in Sediment

Laboratory Quality Control	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	50-140% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material/Lab Control Sample	Per 20 samples or per analytical batch, whichever is more frequent	50-140% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-140% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	50-140% recovery; RPD<30%
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<30% (n/a if native concentration of either sample<RL)
Internal Standard	Accompanying every analytical run when method appropriate	50-140% recovery
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate[2]	5% of total project sample count	RPD <30% (n/a if native concentration of either sample<RL), unless otherwise specified by method
Field Blank, Travel Blank, Equipment Blank	Per method	Blanks<RL for target analyte

1 Unless method specifies more stringent requirements.

Table 6. Quality Control[1] for Synthetic Organic Compounds in Sediment[2]

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Tuning	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[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[3]
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%

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
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	Per method
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analytes

1 Unless method specifies more stringent requirements; ELISA results must be assessed against kit requirements
2 All detected analytes must be confirmed with a second column, second technique, or mass spectrometry
3 Mass spectrometry only

Table 7. Quality Control[1] for Pyrethroids in Sediment

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Tuning[2]	Per analytical method	Per analytical method
Calibration	Daily, or just prior to analysis; five or more level standards spanning the sample result range[3], with the lowest standard at or below the RL	r ≥0.995 (or r^2 ≥0.995, all curve types not forced through origin)
Calibration Verification	Per 10 analytical samples[4]	80-120%[5]
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analytes
Laboratory Control Sample	Per 20 samples or per analytical batch (preferably blind)	50-150%
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150%
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	50-150%; RPD≤35%
Surrogate[7]	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
Field Quality Control[8]	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	Per method

1 Unless project specifies more stringent requirements
2 Mass spectrometry only
3 Sample results above the highest standard are to be diluted and re-analyzed.
4 Analytical samples include samples only and do not include clean-out or injection blanks.
5 Limit applies to a mid-level standard; low-level calibration checks near the reporting limit may have a wider range that is project-specific.
6 Laboratory control samples must be matrix-specific. A clean sediment, roasted sand, or roasted sodium sulfate may be used for sediments.
7 Laboratory historical limits for surrogate recovery must be submitted to the SWAMP database in the lab result comment section.
8 A technical group consisting of regional, laboratory, and research representatives determined that field blanks do not add technical value to a pyrethroids data set.

Table 8. Quality Control for Sediment Toxicity

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Laboratory Control Water	Laboratory control water consistent with Section 7 of the appropriate EPA method/manual must be tested with each analytical batch.	Laboratory control water must meet all test acceptability criteria (please refer to Section 7 of the appropriate EPA method/manual) for the species of interest.
Conductivity/Salinity Control Water	A conductivity or salinity control must be tested when these parameters are above or below the species tolerance.	Follow EPA guidance on interpreting data and refer to tables below for tolerance ranges.
Additional Control Water	Additional method blanks are required whenever manipulations are performed on one or more of the ambient samples within each analytical batch (e.g., pH adjustments, continuous aeration).	There must be no statistical difference between the laboratory control water and each additional control water within an analytical batch.
Sediment Control	Sediment control consistent with Section 7 of the appropriate EPA method/manual must be tested with each analytical batch of sediment toxicity tests.	Sediment control must meet all data acceptability criteria (please refer to Section 7 of the appropriate EPA method/manual) for the species of interest.

Table 9. Sample Handling Requirements for SPoT Analytes in Sediment

Analyte	Recommended Container[1]	Recommended Preservation	Required Holding Time[2]
Grain Size	Glass	Wet ice to ≤ 6 °C in the field, then refrigerate at ≤ 6 °C	1 year
Organic Carbon (Total)	Glass	Cool to ≤ 6 °C; acidify to pH < 2 with HCl, H_3PO_4, or H_2SO_4 within 2 hours	28 days
Trace Metals[3]	Glass	Cool to ≤ 6 °C within 24 hours, then freeze to ≤ -20 °C	1 year; samples must be analyzed within 14 days of collection or thawing
• Diesel Range Organics • Organochlorine Pesticides • Organophosphate Pesticides • Organotins • Polynuclear Aromatic Hydrocarbons • Surfactants • Wastewater Organochlorine Pesticides	Glass	Cool to ≤ 6 °C within 24 hours, then freeze to ≤ -20 °C	1 year; samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction
• Polybrominated Diphenyl Ethers • Polychlorinated Biphenyls (as Congeners/Aroclors)	Glass	Cool to ≤ 6 °C within 24 hours, then freeze to ≤ -20 °C	None[4]
Pyrethroids (sediment)	Glass	Short-term storage: ≤ 6 °C in the dark; long-term storage, or storage of remaining sample: ≤ -20 °C in the dark	1 year at ≤ -20 °C in the dark; samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction
Freshwater Sediment Toxicity	Amber glass recommended, but clear glass or	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times	< 14 days (recommended) or < 8 weeks (required) at ≤ 6 °C in the dark; do not freeze

	plastic (polyethylene or polycarbonate) are acceptable		
Freshwater Water Toxicity	Amber glass recommended	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times	48 hours at 4°C in dark

1 Samples for TOC and grain size analysis can be combined in one 250-mL clear glass jar, and sub-sampled at the laboratory in order to utilize holding time differences for the two analyses. If this is done, the 250 mL combined sediment sample must be refrigerated (not frozen) at ≤6 °C for up to 28 days, during which time the sub-samples must be aliquoted in order to comply with separate storage requirements.

2 Each "Required Holding Time" is based on the assumption that the "Recommended Preservation" (or a method-mandated alternative) has been employed. If a "Required Holding Time" for filtration, preservation, preparation, or analysis is not met, the PM and SWAMP QAO must be notified. Regardless of preservation technique, data not meeting the "Required Holding Time" will be appropriately flagged in the SWAMP database.

3 With the exception of methylmercury

4 Holding time established by Delta Environmental:1 year; samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction

Table 10. Recommended Corrective Actions for SPoT Analytes in Sediment

Analyte	Laboratory Quality Control	Recommended Corrective Action
• Inorganic Analytes in Sediment • Synthetic Organic Compounds in Sediment	Calibration Standard	Recalibrate the instrument. Affected samples and associated QC must be reanalyzed following successful instrument recalibration.
• Inorganic Analytes in Sediment • Synthetic Organic Compounds in Sediment	Calibration Verification	Reanalyze the calibration verification to confirm the result. If the problem continues, halt analysis and investigate the source of the instrument drift. The analyst should determine if the instrument must be recalibrated before the analysis can continue. All of the samples not bracketed by acceptable calibration verification must be reanalyzed.
• Inorganic Analytes in Sediment • Synthetic Organic Compounds in Sediment	Laboratory Blank	Reanalyze the blank to confirm the result. Investigate the source of contamination. If the source of the contamination is isolated to the sample preparation, the entire batch of samples, along with the new laboratory blanks and associated QC samples should be prepared and/or re-extracted and analyzed. If the source of contamination is isolated to the analysis procedures, reanalyze the entire batch of samples. If reanalysis is not possible, the associated sample results must be flagged to indicate the potential presence of the contamination.
• Inorganic Analytes in Sediment • Synthetic Organic Compounds in Sediment	Reference Material	Reanalyze the reference material to confirm the result. Compare this to the matrix spike/matrix spike duplicate recovery data. If adverse trends are noted, reprocess all of the samples associated with the batch.
• Inorganic Analytes in Sediment • Synthetic Organic Compounds in Sediment	Matrix Spike	The spiking level should be near the midrange of the calibration curve or at a level that does not require sample dilution. Reanalyze the matrix spike to confirm the result. Review the recovery obtained for the matrix spike duplicate. Review the results of the other QC samples (such as reference materials) to determine if other analytical problems are a potential source of the poor spike recovery.
• Inorganic Analytes in Sediment • Synthetic Organic Compounds in Sediment	Matrix Spike Duplicate	The spiking level should be near the midrange of the calibration curve or at a level that does not require sample dilution. Reanalyze the matrix spike duplicate to confirm the result. Review the recovery obtained

		for the matrix spike. Review the results of the other QC samples (such as reference materials) to determine if other analytical problems are a potential source of the poor spike recovery.
• Inorganic Analytes in Sediment • Synthetic Organic Compounds in Sediment	Laboratory Duplicate	Reanalyze the duplicate samples to confirm the results. Visually inspect the samples to determine if a high RPD between the results could be attributed to sample heterogeneity. For duplicate results due to matrix heterogeneity, or where ambient concentrations are below the reporting limit, qualify the results and document the heterogeneity.
• Inorganic Analytes in Sediment • Synthetic Organic Compounds in Sediment	Internal Standard	Check the response of the internal standards. If the instrument continues to generate poor results, terminate the analytical run and investigate the cause of the instrument drift.
• Synthetic Organic Compounds in Sediment	Surrogate	Analyze as appropriate for the utilized method. Troubleshoot as needed. If no instrument problem is found, samples should be re-extracted and reanalyzed if possible.
Analyte	**Field Quality Control**	**Recommended Corrective Action**
• Inorganic Analytes in Sediment • Synthetic Organic Compounds in Sediment	Field Duplicate	Visually inspect the samples to determine if a high RPD between results could be attributed to sample heterogeneity. For duplicate results due to matrix heterogeneity, or where ambient concentrations are below the reporting limit, qualify the results and document the heterogeneity. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.

Table 11. Recommended Corrective Actions for Pyrethroids

Laboratory Quality Control	Recommended Corrective Action
Calibration Standard	Affected samples and associated quality control must be reanalyzed following successful instrument recalibration.
Calibration Verification	Initial calibration is analyzed immediately after calibration and should be from a source different than the calibration curve. Bracketing continuing calibration standards are used every ten sample runs for quantitation per method protocol. The analysis must be halted, the problem investigated, and the instrument recalibrated. All samples after the last acceptable continuing calibration verification must be reanalyzed.
Laboratory Blank	The sample analysis must be halted, the source of the contamination investigated, the samples along with a new laboratory blank prepared and/or re-extracted, and the sample batch and fresh laboratory blank reanalyzed. If reanalysis is not possible due to sample volume, flag associated samples.
Laboratory Control Sample	The LCS is analyzed in the same manner as an environmental sample and the spike recovery demonstrates the accuracy of the method. Affected samples and associated quality control must be reanalyzed following LCS troubleshooting and resolution. After troubleshooting, compare to matrix spike/matrix spike duplicate recovery data. If adverse trends are noted, reprocess all samples associated with the batch.
Matrix Spike	The spiking level should be near the midrange of the calibration curve or at a level that does not require sample dilution. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected, the matrix spike result must be flagged. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected and LCS recoveries are acceptable, the matrix spike and matrix spike duplicate results must be flagged.
Matrix Spike Duplicate	The spiking level should be near the midrange of the calibration curve or at a level that does not require sample dilution. Appropriately spiked results should be compared to the matrix spike to investigate matrix interference. If matrix interference is suspected and LCS recoveries are acceptable, the matrix spike duplicate result must be flagged.

Surrogate	Analyze as appropriate per method. Trouble shoot as appropriate, if no instrument problem is found samples should be re-extracted and re-analyzed if possible.
Internal Standard	Analyze as appropriate per method. Troubleshoot as appropriate. If, after trouble-shooting, the responses of the internal standards remain unacceptable, the analysis must be terminated and the cause of drift investigated.
Field Quality Control	**Recommended Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be flagged. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.

Table 12. Recommended Corrective Actions for Freshwater Sediment Toxicity Tests

Laboratory Quality Control	Recommended Corrective Action
Laboratory Control Water	If tested with in-house cultures, affected samples and associated quality control must be retested within 24 hours of test failure. If commercial cultures are used, they must be ordered within 16 hours of test failure for the earliest possible receipt. Retests must be initiated within 30 hours of receipt, depending on the need for organism acclimation. The laboratory should try to determine the source of the control failure, document the investigation, and document the steps taken to prevent a recurrence.
Conductivity Control Water	Affected samples and associated quality control must be flagged.
Additional Control Water	Based on the objectives of the study, a water sample that has similar qualities to the test sample may be used as an additional control. Results that show statistical differences from the laboratory control should be flagged. The laboratory should try to determine the source of variation, document the investigation, and document the steps taken to prevent a recurrence. This is not applicable for TIE method blanks.
Sediment Control	Based on the objectives of the study, a sediment sample that has similar qualities to the test sample may be used as an additional control. Results that show statistical differences from the laboratory control should be flagged. The laboratory should try to determine the source of variation, document the investigation, and document the steps taken to prevent a recurrence.
Positive Controls: Reference Toxicant Tests	If the LC50 exceeds +/- two standard deviations of the running mean of the last 20 reference toxicant tests, the test should be flagged.
Field Quality Control	**Recommended Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix, results that do not meet SWAMP criteria should be flagged. The project coordinator should be notified so that the sampling team can identify the source of variation and perform corrective action prior to the next sampling event.
Field Blanks	If contamination of the field blanks and associated samples is known or suspected, the laboratory should flag the affected data. The project coordinator should be notified so that the sampling team can identify the contamination source(s) and perform corrective action prior to the next sampling event.
Equipment Blanks	If contamination of the field blanks and associated samples is known or suspected, the laboratory should flag the affected data. The project coordinator should be notified so that the sampling team can identify the contamination source(s) and perform corrective action prior to the next sampling event.

B.6: Instrument/Equipment Testing, Inspection, and Maintenance

Laboratory instruments are inspected and maintained in accordance with lab SOPs, which include those specified by the manufacturer and those specified by the method. These SOPs have been reviewed by each respective Laboratory QAO and found to be in compliance with SWAMP criteria. Analysts are responsible for equipment testing, inspection, and maintenance.

The manufacturer's instructions for the laboratory equipment used in the SPoT program will be followed as a minimum requirement. The results of equipment tests, inspections, maintenance, and repairs will be documented in the appropriate logbook. If an instrument fails to meet the accuracy and/or precision criteria after maintenance has been performed, the manufacturer will be contacted.

B.7: Instrument/Equipment Calibration and Frequency

Laboratory instruments are calibrated, standardized, and maintained according to the analytical method (see Table 3) and the manufacturer's specifications. Analytical instruments that fail to meet performance requirements will be checked according to their respective SOP and recalibrated. If the instrument still does not meet specifications, it will be repaired and retested until performance criteria are achieved. In addition, all maintenance activities will be recorded into the instrument's log. If sample analytical information is in question due to instrument performance, the PM will be contacted regarding the proper course of action.

At a minimum, all calibration procedures will meet the requirements specified in the U.S. EPA-approved methods of analysis. The means and frequency of calibration recommended by the manufacturer of the equipment or devices, as well as any instruction given specifically for an analytical method, will be followed. When such information is not specified by the method, instrument calibration will be performed at least once daily, and continuing calibration will be performed on a 10% basis thereafter (with the exception of analysis by GC/MS). It is also required that records of calibration be kept by the person performing the calibration and be accessible for verification during either a laboratory or field audit.

Table 13. Project Inspection/Acceptance Requirements for Field Supplies and Consumables

Instrument Name/Model	Date Purchased	Inspection/ Calibration Specifications	Acceptance Criteria	Frequency
YSI 600R sonde (field water quality)	2008	Per manual	Varies for each parameter	Calibrated before each field run; dissolved oxygen calibrated before each measurement
Accumet XL60 (lab water quality)	2013	Per manual	Varies for each parameter	Calibrated with standards daily
Hach DR/2010 spectrophotometer (lab ammonia)	2005	Per manual	Standards must read within 10% of target	Calibrated with standards for each use

B.8: Inspection/Acceptance of Supplies and Consumables

All supplies will be examined for damage as they are received. Laboratory personnel will review all supplies as they arrive to ensure the shipment is complete and intact. All chemicals are logged into the appropriate logbook and dated upon receipt. All supplies are stored appropriately and are discarded upon expiration date. If items are not found to be in compliance with accuracy, precision, and contamination criteria, they will be returned to the manufacturer.

B.9: Non-direct Measurements

Data will not be used from non-direct measures in this study.

B.10: Data Management

Field data will be entered into the SWAMP Database upon return to the lab. Original field sheets (Appendix F) will be retained in a log book, and copies of the COCs (Appendix E) will be kept by each receiving laboratory. An electronic copy of the COC will be provided to the Contract Contact and SWAMP IQ within 10 business days of submission of samples to the laboratory. SWAMP Analysis of Authorization forms will also accompany samples sent to each laboratory (Appendix G). Original hard copies of SPoT data are filed in a secure cabinet until requested by the PM and/or included into the Final Report. Original copies of the field sheets, lab logs, and data generated at UCD-GC and stored there for 20 years.

Lab data will be entered into the applicable SWAMP template by laboratory staff and submitted to SWAMP's Online Data Checker to ensure compliance with business rules. Upon approval, the data template will then be submitted to the OIMA Helpdesk inbox for the SWAMP IQ Data Managers to verify.

All raw and statistically analyzed data are subject to a 100% check for accuracy by the PC and Laboratory QA Officers and SWAMP IQ. Data are reviewed for accuracy and checked against the QAPP and applicable MQOs before being uploaded into the SWAMP database. See section D.1 for more information.

Hardware and software will be updated as recommended by the manufacturer or as needed. Testing of each component is not required on a regular basis, aside from day to day functionality. Each entity is responsible for the necessary updates or upgrades, whether provided regularly through an Information Technology department or otherwise.

Data management checklists are not required. Analytical completeness will be tracked through the SWAMP Database.

GROUP C: ASSESSMENTS

C.1: Assessments and Response Actions

Project Kickoff (Readiness Review)

Prior to the start of each sampling season, the PM will arrange a teleconference or web conference with the Laboratory QAOs from each of the participating laboratories, applicable SWAMP IQ Data Managers, Project Oversight, and the Contract Contact. These meetings will facilitate coordination of project planning and logistics, and should address the following: Project Work Order, Field Sheets, Chain of Custody Forms, Analysis Authorization Forms, sample collection timing, sample handling (shipping), and laboratory turnaround times,

Real-Time Data Audits

Data will be reviewed by each Laboratory QAO prior to submission of each batch to the PM or SWAMP Database. Field crew audits will be conducted once per sampling season, and a review of sampling procedures will be made by the Sample Manager and the PC should problems arise. As SOPs are updated and refined, additional reviews will be made. Each data technician is responsible for flagging data that does not meet established QA/QC criteria.

If a reviewer discovers any discrepancy, the Laboratory QAO will discuss it with the personnel responsible for the activity. The discussion will include the accuracy of the information, potential factors leading to the deviation, how the deviation might impact data quality, and the corrective actions that might be considered. If the discrepancy is not resolved, the Laboratory QAO will issue a stop work order until the problem is fixed.

Assessments by the Laboratory QAO will be oral; if no discrepancies are noted and corrective action is not required, additional records will not be required. If discrepancies are observed, analytical equipment fails, or quality check samples fall outside of acceptability limits, personnel are to record the problem according to their documentation protocols and take necessary corrective actions to correct and resolve the issue. Corrective actions will be documented and provided in a Corrective Action Report at the request of the SWAMP Project Manager, SWAMP QA Officer, or Water Boards' Contract Manager. The SWAMP QA Officer will review the report and may request additional information or actions to be taken. The laboratory shall respond with an amended Corrective Action Report within the timeframes agreed upon in the current contract. The laboratory will notify the Project Manager, SWAMP QA Officer, and Contract Manager before proceeding with an analysis that will result in a hold time violation and shall seek permission from the Project Manager before proceeding with the analysis. Associated data resulting from a corrective action shall be flagged accordingly.

Technical System Audit

Field Procedures

The Field Crew Manager shall conduct random field procedure audits to ensure adherence to the standard operating procedures, field health and safety requirements, and sample handling and custody procedures.

Lab Procedures

The Laboratory Director or QA Officer shall conduct laboratory systems audits per the Laboratory Quality Management Plan.

Deviations and Corrective Actions

Analyses are conducted according to procedures and conditions recommended by the U.S. EPA, and described in laboratory SOPs, with the exception of those reported herein. Beyond those identified, deviations from these recommended conditions are reported to the Laboratory QAO. The PM and Program QAO will also be notified within 48 hours of a deviation.

In the event of an SOP/QAPP deviation or corrective action, a Corrective Action Report will be prepared, completed, and signed, and the PM and Program QAO will both be notified. Best professional judgment will be used in interpretation of results obtained when deviations in the test conditions have occurred. All deviations and associated interpretations will be reported in interim and final reports. Protocol amendments will be submitted to the Laboratory QAO, Program QAO, and PM. Upon approval, protocol amendments will be employed.

Data Quality Assessment

A data quality assessment is conducted at the end of each sampling season and includes the following:

- Initial review of analytical and field data for complete and accurate documentation, COC procedures, compliance with analytical holding times, and required frequency of laboratory QA samples;
- Review of data verification and validation results;
- Reconciliation with corrective actions; and
- Discussion of any remaining issues and potential improvements for the following sampling season

A summary of the data quality assessment shall be developed and included with the final project report.

C.2: Reports to Management

Corrective and Preventative Action Reports
Corrective actions are documented in the laboratory record. If a failure is not resolved, it is conveyed to the Laboratory QAO who determines if the failure compromised associated results. The nature and disposition of the problem will be documented in the data report sent to the SWAMP Project Manager.

GROUP D: DATA VALIDATION AND USABILITY

D.1: Data Review, Verification and Validation Requirements

All data reported for SPoT will be checked for errors in transcription, calculation, and computer input by the Laboratory Director, Sample 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. 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.

D.2: Verification and Validation Methods

Field Data will be submitted electronically through the SWAMP database or shell database. Field crews will check the entered data for typos and errors before LAB QAO and PM verify the data to ensure proper flagging for equipment failures and impossible values.

Laboratory data will be sent electronically to SWAMP IQ for verification and inclusion in the SWAMP Database. SWAMP IQ will follow the applicable SOPs and Data Management Plans when reviewing submitted data and determining compliance with the appropriate MQOs. Discrepancies in flagged data, noted during the data verification process, will be communicated to the Program QAO, Laboratory QAO, and PM prior to loading. Excessive amounts of data discrepancies may warrant corrective action, as described in section C.1.

D.3: Reconciliation with User Requirements

Sediment toxicity and chemistry data are collected annually from a subset of SPoT sites. Toxicity data are initially analyzed using traditional hypothesis testing (t-test) for submittal to the SWAMP Database. Then, using the Test for Significant Toxicity (U.S. EPA, 2010), the data are reanalyzed for reporting purposes and the results are binned based on the magnitude of toxicity (non-toxic, toxic and highly toxic). Toxicity responses are also averaged for each site and categorized as “no toxicity,” “some toxicity,” “moderate toxicity,” and “high toxicity.” Sites with no toxic samples are non-toxic; sites with at least one toxic sample have some toxicity; sites with at least one sample below the high toxicity threshold (38.6%) have moderate toxicity, and sites with an average survival less that the high toxicity threshold have high toxicity. Toxicity responses are also compared to chemical concentrations within land uses using Spearman rank correlation, and further compared to individual chemical thresholds based on median lethal concentrations. Significant trends at individual sites, and within land uses, are determined using Mann Kendall analysis.

APPENDIX A: LIST OF ACRONYMS AND INITIALISMS

COC: Chain of Custody

CSULB-IIRMES: California State University, Long Beach, Institute for Integrated Research in Materials, Environments, and Society

ELAP: Environmental Laboratory Accreditation Program

GC/MS: Gas Chromatography/Mass Spectrometry

GC/MS/MS: Gas chromatography coupled to tandem mass spectrometry

HUC: Hydrologic Unit Codes

MDL: Method Detection Limit

MPSL-DFW: Moss Landing Marine Laboratory, Marine Pollution Studies Laboratory

MQO: Measurement Quality Objectives

NAWQA: National Water Quality Assessment

NCI: Negative Chemical Ionization

OIMA: Office of Information Management and Analysis

PC: Project Coordinator

PM: Project Manager

QAO: Quality Assurance Officer

QAPP: Quality Assurance Project Plan

QC: Quality Control

RPD: Relative Percent Difference

RL: Reporting Limit

RSD: Relative Standard Deviation

SOP: Standard Operating Procedures

SPoT: Stream Pollution Trends monitoring program

SCCWRP: Southern California Coastal Water Research Project

SWAMP: Surface Water Ambient Monitoring Program

SWAMP IQ: Surface Water Ambient Monitoring Program Information Management and Quality Assurance Center

SWRCB: State Water Resources Control Board

TMDL: Total Maximum Daily Load

TOC: Total Organic Carbon

UCD-GC: University of California, Davis, Marine Pollution Studies Laboratory at Granite Canyon

U.S. EPA: U.S. Environmental Protection Agency

USGS: U.S. Geological Survey

APPENDIX B: STANDARD OPERATING PROCEDURES (SOPS) FOR CONDUCTING FIELD COLLECTIONS OF BED SEDIMENT SAMPLES AT WATERSHED INTEGRATOR SITES IN THE SURFACE WATER AMBIENT MONITORING PROGRAM (SWAMP) STREAM POLLUTION TREND (SPOT) PROGRAM

Marine Pollution Studies Laboratory (MPSL) – Granite Canyon

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Field Collection Procedures for Bed Sediment Samples in the SWAMP SPoT Program

Fundamental Considerations

1. The SWAMP SPoT program monitoring at Watershed Integrator Sites is based on the concept that sediment collected from stream depositional areas serves as an indicator of recent pollutant mobilization throughout the upstream watershed. It is therefore critical that sediments are collected from multiple streambed areas where active deposition occurs. Field crews are trained in the field to be well acquainted with stream geomorphology to distinguish between areas of recent deposition (within the past year), and areas where benches, failed banks, or other features indicate older deposits.

2. Contaminants washed from watershed surfaces predominantly adsorb to and are transported with fine particulate matter. Thus it is also critical for contaminant detection and method standardization over time that only fine grained sediments are sampled. Ideally, only fine sediments of less than 64 um in diameter would be collected. In practice, the target is for fine-grained sediments to make up more than 50% of the sample (>50% fines). Before collection, sediment grain size should be checked in the field. Sediment that feels smooth when rubbed between gloved fingers is preferred, and sediment that feels gritty should be rejected unless finer sediment is unavailable in depositional areas at suitable integrator sites.

If suitable depositional areas for collecting sediments cannot be found at a target site, the project scientist (Bryn Phillips or designee) may decide to search the general area for an alternate integrator site where fine sediment is deposited. If an alternate location is sampled, the project scientist will notify collaborating institutions (Regional Monitoring Coordinators, stormwater agencies, etc.) of the change in location. This may result in renaming of the site, and may affect trends analyses. If no suitable depositional areas can be found, sampling personnel should not collect the sediment sample, and should discuss alternatives with the project scientist and collaborators. In this case, a note is added to the cruise report so that the missing sample is accounted for in the reconciliation of monitoring events. Sites that are routinely difficult to collect should be considered for elimination or relocation from the sample schedule, if appropriate.

Field Data Sheets

Field data sheets are used to record specific information about site location, number of depositional areas sampled, types of analyses to be conducted, collection method, and other information. Field data sheets are provided through the Marine Pollution Studies Laboratory website at: http://swamp.mpsl.mlml.calstate.edu/resources-and-downloads/database-management-systems/swamp-25-database/templates-25. Click on the *Field Data Sheets* for the most recent versions. There are guidelines provided below to standardize what is recorded on all data sheets and that should be helpful in completing each form. The entries discussed below and on the field data sheets are recorded at each sampling site.

Notes to Standardize SWAMP Field Data Sheets

(For in the field use)

Key Reminders to identify samples:

1. **Sample Time** is the SAME for all samples (Water, Sediment, & Probe) taken at the sampling event. Use time of FIRST sample as it is important for the chain of custody (COC).
2. **Left Bank/Right Bank**
   Left bank is defined as the bank to the left of the observer when facing downstream, and the *right bank* is to the right of the observer when facing downstream.

Field Observations: (each one of these observations has a *Comment* field in the database so use comment space on data sheet to add information about an observation if necessary)

1. **Dominant Substrate**: If possible; describe DOMINANT substrate type; use UNK if you cannot see the dominant substrate type.
2. **Wadeability**: In general, is the water body being sampled wadeable to the average person at the point of sample?
3. **Photos:** Digital photos are taken to help document the actual sampling site. The convention is to take photos facing DOWNSTREAM, overlooking the site. Right bank and left bank are thus defined in this downstream-facing direction. Document any discrepancies from this convention. Only one photo is necessary if both left and right banks fit into one frame. Record all photos in the field data sheet space to record picture numbers given by camera; be sure to rename accordingly back in the office. All photos should be renamed and saved with the StationCode_yyyy_mm_dd_uniquecode (e.g. 123ABC123_2007_07_01_BBDS).

Sample Details:

1. **Event Type**: Note the event type based on which type of media is being collected. For integrator sites, this will always be "WQ."
2. **Personnel**: First initial and last name (J. Smith, S. Ride). The first person listed is crew leader.
3. **Target Lat/Long**: Refers to the existing station location that the sampling crew is trying to achieve; can be filled out prior to sampling
4. **Actual Lat/ Long**: is the location of the current sample event. Record coordinates for both upstream extent of sampled reach [Pt1 (U/S)] and downstream extent of sampled reach. [Pt2 (D/S)] Sampling that occurs more than 500m from the target site, due to access issues or lack of fine sediments, may be designated as a separate sampling site.
5. **Occupation Method**: Circle descriptor of how the site is accessed.
6. **Sample Type**: For integrator sites, this will always be "Integrated."
7. **Number of Containers Filled**: Record the number of containers filled for each analysis type.
8. **Depositional Area Sample Information**: For each depositional area sampled, circle the appropriate notations in each column. "Under" indicates sediment was submerged; "P" = present; "A" = absent; the "DepthCollec" is the thickness of the sediment layer removed; "SS" = stainless steel; "PC" = polycarbonate; "PE" = polyethylene.
9. **Comments**: In the comments box, draw a rectangle to indicate the shape of the reach sampled, and mark an "x" within it to show the approximate distribution of depositional areas sampled. Record the approximate average water depth, and add any comments about observed inputs or conditions that might affect sediment quality.

Site Summaries
After each field survey, text describing the following characteristics of the site and collection process should be recorded for the cruise report:

1. Site location: Provide details (beyond lat longs and other information on the field data sheet) that would allow future field crews or analysts to understand the nature of the sediment sampled, such as water depth, flow, and whether sediment was collected under a bridge, behind an obstruction, within vegetation patches, inside bends, etc.

2. Access: Provide information to help with future access, such as contact information for permissions, information about gates and locks, specific location of access paths, etc.

3. Representativeness of depositional areas: Since sediment deposition depends on stream morphology, not all streams will allow collection of sediment from multiple areas along a 100

meter reach. If sediment is collected from other types of depositional areas, the configuration of the depositional area(s) sampled should be described, and a justification should be given as to how the sampled area is expected to contain the range of fine material representative of that generally transported by the stream over the target time period.

Bed Sediment Sample Collection

If samples of water and bed sediment (hereafter termed "sediment") are taken in the same 100m reach, water samples are collected first. Care must be taken not to sample sediments that have been walked on or disturbed in any manner by field personnel. Sediment samples from all depositional areas within a site are placed into the same 4-liter composite jar, which is filled at least three quarters full. Once all depositional areas at a site have been sampled, the jar is sealed and placed on ice in a cooler. Once sample jars arrive at MPSL, they are thoroughly homogenized, and then aliquoted into separate jars for chemical or toxicological analysis. Sediment samples for metals and organics are submitted to the respective analytical laboratories in separate glass jars, which have been pre-cleaned according to laboratory protocol.

Labeling

Label the jars with the station ID, sample code, matrix type, project ID, time, and date of collection, as well as the type of analysis requested (e.g., metals, conventionals, organics, or archives).

Characteristics of Ideal Sediment Material to be Collected

Many of the chemical constituents of concern are adsorbed onto fine particles. One of the major objectives in selecting a sample site, and in actually collecting the sample while on site, is to obtain recently deposited fine sediment, to the extent possible. Avoid hard clay, bank deposits, gravel, disturbed and/or filled areas. In following this guidance, the collection of sediment is purposefully being biased for fine materials, which must be discussed thoroughly in any subsequent interpretive reporting of the data, in regards to representation of the collected sample to the environment from which it was collected.

Characteristics of an Ideal Site

Quiescent areas are conducive to the settling of finer materials (EPA/USACOE, 1981). Within the 100-meter reach of the site, choose depositional areas with lower hydrologic energy, such as the inner (depositional) side of bends or eddies where the water movement may be slower. Impoundments, reservoirs and estuaries are also generally depositional environments.

Selecting the Appropriate Sediment Type for Analysis

Sediment will vary from site to site and can vary between sample events at a particular site.

Streams and Rivers: Sediment collection in flowing streams is often a challenge. In areas of frequent scouring, there may not be sufficient sediment for collection during or following periods of high flow. Sediment collection during these times may prove unsuccessful and may have to be rescheduled or cancelled.

More often than not, a dredge or mechanical grab device does not function well for collection of sediment in smaller streams. In many cases, sediment will have to be collected using a pre-cleaned polyethylene scoop or polycarbonate core tube. Collect the top 1 to 5 cm for analysis, depending on the homogeneity of the sediment. If the sediment exhibits clear layering, collect only the upper-most layer. If the sediment appears vertically homogeneous, the entire top 5 cm may be collected. Sediment is collected from 5 to 10 depositional areas within a 100-m reach and these are composited within the sample jar.

Reservoirs, ponds, and other impoundments: Collect the top 1 to 5 cm for analysis, as above. Five to 10 grabs are composited for the sediment sample, with grabs spaced within an area comparable to a 100 meter reach that would be expected to yield fine sediment representative of that transported by the stream.

General Procedure for Collection of Bed Sediment

After choosing appropriate depositional areas within the site reach, collect the sample using one or more of the following procedures, depending on the setting. Access to the sediment often depends on the type of protective clothing worn by field crews. Field crews generally wear chest waders. Wet suits and other diving gear are generally avoided due to hygiene considerations in contaminated streams. When crews can reach the stream bottom with their hands (without diving), short core tubes are preferred. When water is more than about half a meter deep, longer cores tubes are preferred. Core tubes are preferred over scoops because tubes minimize the loss of fine material from the sediment surface. Scoops may be used when debris makes cores ineffective, or when sampling dry or damp sediment that is no longer submerged. Grabs are used when water is too deep to wade, or when long cores are ineffective.

The goal is to collect the top 1 to 5 cm of recently-deposited fine sediment only. Survey the sampling area for appropriate fine-sediment depositional areas before stepping into the stream to avoid disturbing possible sediment collection sub-sites. Carefully enter the stream and start sampling at the closest appropriate reach, then continue sampling UPSTREAM. Advancing downstream may in some cases lead to sampling disturbed sediment.

A. Hand Core Method – primary method for shallow streams

1. Short cores:

- The short hand core sampler consists of a 10-cm-diameter polycarbonate core approximately 50 cm long.
- One method of using short core tubes is to:

  a. Push the tube vertically into the sediment to beyond the desired sample depth
  b. Cap the bottom with a polyethylene core cap or by placing a gloved hand underneath the tube to hold the sediment in place
  c. Pull the core out of the sediment
  d. Slowly decant off overlying water
  e. Push the sediment out of the tube, discarding all but the top 5 cm (or less), and
  f. Place the remaining surficial sediment in the collection jar

- A second method for using short core tubes is to slide the tube horizontally along the sediment, with the bottom edge 5 cm or less below the sediment surface. The core is thus used as a scoop, but has better control and retention of fine surficial material. Both ends of the core are then covered with gloved hands, the core is raised out of the water, overlying water is slowly decanted off, and the sediment sample is placed in the jar.

2. Long cores:

- The long hand core sampler consists of a 5-cm-diameter polycarbonate core approximately 1.5 meters long.
- To collect samples with a long core:

  a. Push the tube vertically into the sediment to beyond the desired sample depth
  b. Cap the top of the core with a gloved hand to create suction
  c. Pull the core out of the sediment

d. Slowly decant off overlying water
e. Push the sediment out of the tube, discarding all but the top 5 cm (or less), and
f. Place the remaining surficial sediment in the collection jar

B. Sediment Scoop Method – Alternate Method for Shallow Streams with Debris

In situations where the target fine sediment is found among plants, rocks, sand, shells, or other debris, a scoop may be the best way to collect. Use a separate pre-cleaned polyethylene scoop for each site. The same scoop may be used for multiple depositional areas within a site. Push the scoop up to 5 cm below the sediment surface and gently slide it along until it is just full of sediment. Place a gloved hand over the sediment as the scoop is brought to the water surface to minimize loss of fine material. Place the sediment into the collection jar.

In situations where adequate depth and quantities of homogeneous fine sediment is found beneath mats of vegetation, the sediment may be scooped with a gloved hand, brought to the surface, and placed in the jar. If necessary, vegetation and other debris may be removed with a gloved hand.

C. Sediment Grab Method — Alternate method for deeper waters.

Description of sediment grab equipment:

- A mechanical sediment grab such as a stainless steel “Young-modified Van Veen" or “Petite Ponar” is suitable.
- The mechanical grab is deployed primarily from a boat, and is used in deeper, non-wadeable waters.
- It is also deployed by field personnel from land in settings which allow its use: primarily from bridges; from smaller vessels in deep streams or drainage channels.
- Smaller grabs (e.g. Petite Ponar) may be deployed while wading in channels if necessary.

Deploying and retrieving the grab:

- Slowly lower the grab to the bottom with a minimum of substrate disturbance.
- Retrieve the closed dredge at a moderate speed (e.g., less than two feet per second).
- Upon retrieval, open the lids of the sediment grab, examine the sample to ensure that the sediment surface is undisturbed, that fine-grained material has been collected, and that the sample should not be rejected.

Rejection Criteria—reject the sample if the following are not met:

- Mud surface must not be pressing out of the top of the sampler. If it is, lower the grab more slowly.
- Overlying water must not be leaking out along the sides of the sediment in the grab. This ensures the surficial sediment is not washed out.
- Sediment surface is flat and level in the sampler. If it is not level, the grab has tilted over before closing.

Processing the sediment sample from the grab equipment:

- The water overlying the sediment in the grab is very gently decanted by slightly tipping the grab with the lid closed until the water runs out the top.
- The decanting process should remove all of the overlying water but not remove the surficial sediments. The laboratory reports percent water for the sample, so overlying water is not included

in the sample container.
- The sediment is examined for depth of penetration, color and thickness of top aerobic zone, and texture. These observations are recorded in the logbook.
- Use a pre-cleaned polyethylene scoop to collect the top 1 to 5 cm from at least five sub-samples, and otherwise, exclude the bottom-most layer.

Cleaning the Grab Equipment and Protection from Potential Contaminating Sources:

- The sediment sampler will be cleaned prior to sampling EACH site by: rinsing all surfaces with ambient water; scrubbing all sediment sample contact surfaces with Micro™ or equivalent detergent; rinsing all surfaces with ambient water; rinsing sediment sample contact surfaces with 5% HCl; and rinsing all sediment sample contact surfaces with methanol.
- The sediment grab will be scrubbed with ambient water between successive deployments at ONE site, in order to remove adhering sediments from contact surfaces possibly originating below the sampled layer, thus preventing contamination from areas beyond target sampling area.
- Sampling procedures will attempt to avoid exhaust from any engine aboard any vessel involved in sample collection. An engine will be turned off when possible during portions of the sampling process where contamination from engine exhaust may occur. It is critical that sample contamination be avoided during sample collection. All sampling equipment (e.g., siphon hoses, scoops, containers) will be made of non-contaminating material and will be appropriately cleaned before use. Samples will not be touched with un-gloved fingers. In addition, potential airborne contamination (e.g., from engine exhaust, cigarette smoke) will be avoided.

General Procedure for Processing of Bed Sediment Samples, Once They are Collected

Transport of Sample Jars:

- Make sure all containers are capped tightly and stored in a cooler on cube ice at 4 °C.
- Check cooler temperature and record in log book every 8-12 hours or whenever sampler suspects that the temperature has not been maintained at 4 °C.

Sediment Homogenization, Aliquoting and Transport

Sediment samples from the multiple depositional areas within a reach may be put in the collection jar, sealed, and placed in coolers for transport without field homogenization. Immediately place the labeled jar on ice, cool to 4 °C, and keep in the dark at 4 °C until delivery to the laboratory. Once samples arrive at the laboratory, the sediment in the container is homogenized and aliquoted. All sample identification information (station numbers, etc.) will be recorded prior to homogenizing and aliquoting. The sample is stirred with a polyethylene scoop or spoon for at least 2 min, but longer if necessary, until sediment/mud appears homogeneous. The sediment sample is then aliquoted, using a clean plastic scoop, into appropriate containers for trace metal chemistry, organic chemistry, and toxicity testing, as described in the table below.

Summary of Sample Container, Volume, Preservation, and Storage Requirements for Bed Sediment Samples (for contaminant analysis)

Sample Handling: Inorganic Analytes in Freshwater Sediment and Marine Sediment

Parameter	Recommended Container[1]	Recommended Preservation	Required Holding Time[2]
Grain Size	Glass	Wet ice to ≤ 6 °C in the field, then refrigerate at ≤ 6 °C	1 year
Organic Carbon (Total)	Glass	Cool to ≤ 6 °C or freeze to ≤ -20 °C	28 days at ≤ 6 °C; 1 year at ≤ -20 °C

[1] Samples for total organic carbon and grain size analysis can be combined in one 250-mL clear glass jar, and sub-sampled at the laboratory in order to utilize holding time differences for the two analyses. If this is done, the 250 mL combined sediment sample must be refrigerated only (not frozen) at ≤6 °C for up to 28 days, during which time the sub-samples must be aliquoted in order to comply with separate storage requirements.

[2] Each "Required Holding Time" is based on the assumption that the "Recommended Preservation" (or a method-mandated alternative) has been employed. If a "Required Holding Time" for filtration, preservation, preparation, or analysis is not met, the PM and SWAMP Quality Assurance Officer must be notified. Regardless of preservation technique, data not meeting the "Required Holding Time" will be appropriately flagged in the SWAMP database.

Sample Handling: Inorganic Analytes in Freshwater Sediment and Marine Sediment

Analyte	Recommended Container	Recommended Preservation	Required Holding Time[1]
Methylmercury	Glass	Freeze to ≤ -20 °C immediately	1 year
Trace Metals[2]	Glass	Cool to ≤ 6 °C within 24 hours, then freeze to ≤ -20 °C	1 year; samples must be analyzed within 14 days of collection or thawing

[1] Each "Required Holding Time" is based on the assumption that the "Recommended Preservation" (or a method-mandated alternative) has been employed. If a "Required Holding Time" for filtration, preservation, preparation, or analysis is not met, the PM and SWAMP Quality Assurance Officer must be notified. Regardless of preservation technique, data not meeting the "Required Holding Time" will be appropriately flagged in the SWAMP database.

[2] With the exception of methylmercury

Sample Handling: Synthetic Organic Compounds in Freshwater Sediment and Marine Sediment

Analyte	Recommended Container	Recommended Preservation	Required Holding Time[1]
Diesel Range Organics **Organochlorine Pesticides** **Organophosphate Pesticides** **Organotins** **Polynuclear Aromatic Hydrocarbons** **Surfactants** **Wastewater Organochlorine Pesticides**	Glass	Cool to ≤ 6 °C within 24 hours, then freeze to ≤ -20 °C	1 year; samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction
Polybrominated Diphenyl Ethers **Polychlorinated Biphenyls** (as Congeners/Aroclors)	Glass	Cool to ≤ 6 °C within 24 hours, then freeze to ≤ -20 °C	None
Pyrethroids	Glass	Short-term storage: ≤ 6 °C in the dark; long-term storage, or storage of remaining sample: ≤ -20 °C in the dark	1 year at ≤ -20 °C in the dark; samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction

[1] Each "Required Holding Time" is based on the assumption that the "Recommended Preservation" (or a method-mandated alternative) has been employed. If a "Required Holding Time" for filtration, preservation, preparation, or analysis is not met, the PM and SWAMP Quality Assurance

Officer must be notified. Regardless of preservation technique, data not meeting the “Required Holding Time” will be appropriately flagged in the SWAMP database.

Sample Handling: Sediment Toxicity in Freshwater Sediment and Marine Sediment

Analyte	Recommended Container	Recommended Preservation[2]	Required Holding Time[1]
Sediment Toxicity in Freshwater Sediment	Glass (amber)	Cool to ≤ 6 °C with wet or blue ice in the field, store at ≤ 6 °C refrigeration in the dark at all times	< 14 days (recommended) or <8 weeks (required) at ≤ 6 °C in the dark; do not freeze
Sediment Toxicity in Marine Sediment	Glass (amber)	Cool to ≤ 6 °C with wet or blue ice in the field, store at ≤ 6 °C refrigeration in the dark at all times	< 14 days (recommended) or < 8 weeks (required) at ≤ 6 °C in the dark; do not freeze

[1] Each “Required Holding Time” is based on the assumption that the “Recommended Preservation” (or a method-mandated alternative) has been employed. If a “Required Holding Time” for filtration, preservation, preparation, or analysis is not met, the PM and SWAMP Quality Assurance Officer must be notified. Regardless of preservation technique, data not meeting the “Required Holding Time” will be appropriately flagged in the SWAMP database.

APPENDIX C: MONITORING PLAN

PROJECT NAME: Stream Pollution Trends (SPoT) Program

Lead Organization: University of California, Davis Marine Pollution Studies Laboratory at Granite Canyon (UCD-GC), 34500 Highway One, Monterey, CA 93953

Primary Contact:
Katie Siegler, Project Manager (PM)
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December 2018

This field monitoring plan covers work to be performed under Contract Task 3.

OBJECTIVE

The SPoT program was developed with the purpose of improving our understanding of watersheds and water quality through the monitoring of in-stream contaminants and sediment toxicity. Focusing on the impacts of land use and development, the SPoT program compares monitoring results across watersheds throughout the state in order to evaluate changes over time, and assess potential risk to aquatic life. In addition, the SPoT program is designed to help establish a statewide network of sites that can link together monitoring efforts by storm water agencies, Total Maximum Daily Load (TMDL) programs, agricultural waiver programs, and regional monitoring to provide a statewide context for local monitoring.

APPROACH

Monitoring Schedule

All SPoT sites are sampled as part of a continuous monitoring effort that began in 2008. Ninety sites are sampled during base flow or near-base flow conditions following annual peak flows. Sampling should occur before significant contaminant breakdown occurs via hydrolysis or photolysis. Surveys are scheduled based on regional hydrologic cycles, with Southern California coastal streams sampled in spring, and other regions sampled later in the year as stream flows recede. Additionally, four sites are samples twice per year to assess any temporal changes.

Geographic Locations

When selecting sampling sites for the SPoT program, the geographic characteristics considered included: location in a large watershed with heterogeneous land cover; location at or near the base of a watershed, defined as the confluence with either an ocean, lake, or another stream of equal or greater stream order; and location where site-specific conditions are appropriate for the indicators selected (e.g. depositional areas, sufficient flow, appropriate channel morphology, substrate). Availability of previous data on sediment contaminant concentrations, biological impacts, or other relevant water quality data was also an important consideration, particularly if sites could be co-located with key sites from cooperative programs. A list of sampling sites for the 2018 survey is provided in the QAPP.

Sample Collection
Sediment samples will be collected in accordance with the SOP in Appendix B. Samples are collected along a 100m reach, with subsamples collected from up to 10 depositional areas depending on the location of fine sediment deposits. Subsamples are homogenized to address variability and create a sample representative of depositional sediment mobilized within the watershed. Care is taken to sample recent sediment deposits in active areas of the streambed by avoiding banks, beaches, and other areas where sediment may have been deposited more than one year previously. Surveys are scheduled based on regional hydrologic cycles, with Southern California coastal streams sampled in spring, and other regions sampled progressively later in the year as stream flows recede.

Sediment is sampled to a depth of up to 5 cm, if the entire 5 cm core is homogeneous and appears to have been deposited within the same hydrologic cycle of seasonal high water receding to annual base flow. Surficial sediment as shallow as 1 cm may need to be collected if there is clear layering indicating deposition over multiple annual cycles.

Five field duplicates (FIELDA) are collected each year in sites that are pre-selected for temporal and spatial representativeness.

Water samples will be collected at twelve SPoT sites by CDPR, as part of a collaborative study evaluating pesticides and potential toxicity in California, and transported to UCD-GC on ice. Water column toxicity tests will include 96-hour acute exposures with *Hyalella azteca* and 10-day chronic exposures with *Chironomus dilutus* (U.S. EPA, 2002). CDPR SOPs can be referenced at https://www.cdpr.ca.gov/docs/emon/pubs/sop_qaqc.htm.

Sampling Equipment
Sediment samples will be collected in 4L glass jars and the following items will be used in the field:

- YSI 600R sonde
- Sediment core tubes
- Sediment scoops

The YSI 600R sonde is used to conduct field measurements of dissolved oxygen, temperature, conductivity, and pH.

The sediment core tubes and scoops are to collect sediment samples in accordance with the procedures outlined in the QAPP.
All materials that come into contact with the samples will be cleaned according to the SWAMP comparable protocols described in MPSL Standard Operating Procedure 1.3.

Toxicity Tests and Chemical Analyses
All sediment samples will be tested for toxicity using the *Hyalella azteca* 10-d toxicity test, and a subset will be tested with the *Chironomus dilutus* 10-day toxicity test (U.S. EPA, 2000). Grain size and total organic carbon are analyzed on all samples. Chemical analyses, varying per site, include pyrethroids, fipronil, PAHs, PBDEs, and metals.

PROJECT FUNDING

This project is funded by the State Water Resources Control Board.

APPENDIX D: SPoT 2018 Sampling Stations

Station Code	Station Name	Target Lat	Target Long
105KLAMKK	Klamath River at Kamp Klamath	41.5171	-124.03896
109MAD101	Mad River upstream Hwy 101	40.91763	-124.08946
111EELFRN	Eel River at Fernbridge	40.61129	-124.20407
113NA3269	Navarro at Dimmick St Park	39.15911	-123.63861
114LAGWOH	Laguna de Santa Rosa at Wohler	38.49254	-122.88327
114RRDSDM	Russian River downstream Duncan Mills	38.44750	-123.05583
201WLK160	Walker Creek Ranch	38.17545	-122.82044
204ALA020	Alameda Creek E. of Alvarado Blvd	37.58200	-122.05200
204SLE030	San Leandro Creek at Empire Road	37.72556	-122.18361
204SMA020	San Mateo Creek at Gateway Park	37.57028	-122.31861
205COY060	Coyote Creek at Montague	37.39540	-121.91485
205GUA020	Guadalupe Creek at USGS Gaging Station 11169025	37.37389	-121.93194
206SON010	Sonoma Creek at Hwy 121 bridge	38.24061	-122.45128
207KIR020	Kirker Creek at Floodway	38.01650	-121.83881
207LAU020	Laurel Creek at Pintail Drive	38.24830	-122.00668
207WAL020	Walnut Creek at Concord Ave O.C.	37.98063	-122.05160
304SLRWAT	San Lorenzo River below Water Street	36.97685	122.02390
304SOK	Soquel Creek at Knob Hill Parking Lot	36.98014	-121.95784
305THU	Pajaro River at Thurwachter Bridge	36.87977	-121.79195
307CML	Carmel River at Hwy 1	36.53677	-121.91241
309DAV	Salinas River at Davis Road	36.64681	-121.70139
309TDW	Tembladero Slough at Monterey Dunes Way	36.77218	-121.78660
310ARG	Arroyo Grande Creek at 22nd Street	35.09521	-120.60625
310SLB	San Luis Obispo Creek at San Luis Bay Drive	35.18832	-120.71792
312SMA	Santa Maria River at Estuary	34.96377	-120.64180
313SAI	San Antonio Creek at San Antonio Rd West	34.78233	-120.52997
314SYN	Santa Ynez River at 13th St	34.67677	-120.55442
315ATA	Atascadero Creek at Ward Dr	34.42345	-119.81929
315MIS	Mission Creek at Montecito St	34.41304	-119.69401
402VRB0xx	Ventura River	34.28173	-119.30669
403STCBQT	Bouquet Canyon Creek	34.42782	-118.54022
403STCEST	Santa Clara River Estuary	34.23557	-119.21674
403STCSSP	Sespe Creek	34.39414	-118.94096
404BLNAxx	Ballona Creek Downstream of Sawtelle (Centinela)	33.98600	-118.41700
405SGRA2x	San Gabriel River RA-2	33.78708	-118.09367
408CGCS06	Calleguas Creek Below Camrosa WWTP	34.17920	-119.03897
412LARWxx	LA River near Willow	33.80490	-118.20500

504BCHROS	Big Chico Creek at Rose Ave	39.72716	-121.86308
504SACHMN	Sac R at Hamilton City	39.75110	-121.99798
508SACBLF	Sacramento River at Balls Ferry	40.41762	-122.19334
510LSAC08	Clarksburg Marina	38.38312	-121.52057
511CAC113	Cache Creek at Hwy 113	38.72066	-121.76430
515SACKNK	Sacramento Slough at Karnak	38.78456	-121.65439
515YBAMVL	Yuba R at Maryville	39.13421	-121.59290
519AMNDVY	American R at Discovery Park	38.60094	-121.50550
519BERBRY	Bear R at Berry Rd.	38.96175	-121.54677
519FTRNCS	Feather R at Nicolaus	38.89746	-121.59050
520BUTPAS	Butte Slough Upstream of Pass Rd bridge	39.18786	-121.90919
520CBDKLU	Colusa Basin Drain at Knights Landing Upstream	38.79923	-121.72504
520SACLSA	Sacramento River at Colusa near Bridge Street	39.21415	-122.00031
531SAC001	Cosumnes River at Twin Cities Road	38.29083	-121.37583
532AMA002	Sutter Creek at Hwy 49	38.39250	-120.80139
535MER007	Bear Creek near Bert Crane Road	37.25556	-120.65194
535MER546	Merced River at River Road	37.35041	-120.96223
535STC206	Dry Creek at La Loma Rd.	37.64568	-120.98081
535STC504	SJR at Crows Landing	37.43323	-121.01597
541MER522	San Joaquin River at Lander Avenue	37.29528	-120.85028
541MER542	Mud Slough downstream of San Luis Drain	37.26389	-120.90611
541MERECY	Marsh Creek at E Cypress Rd	37.99107	-121.69626
541SJC501	SJR at Airport Way	37.67556	-121.26417
541STC019	Orestimba Creek at River Road	37.41389	-121.01417
541STC516	Del Puerto Creek at Vineyard Avenue	37.52139	-121.14861
544SAC002	Mokelumne River at New Hope Road	38.23611	-121.41889
551LKI040	Kings River - S. Fork	36.25580	-119.85510
558CCR010	Cross Creek - Rd. 60 and Hwy 99	36.40437	-119.45697
558PKC005	Packwood Creek in pond upstream of Rd 94	36.27894	-119.35971
558TUR090	Tule River - Rd. 64 bridge	36.08837	-119.42891
603BSP002	Bishop Creek at East Line St	37.36156	-118.38606
631WWKLAR	West Walker River at Larson Lane	38.54679	-119.49494
633WCRSED	West Fork Carson River at Paynesville	38.80885	-119.77725
634UTRSED	Upper Truckee River near inlet to Lake Tahoe	38.93439	-120.00035
635MARSED	Martis Creek near mouth	39.30211	-120.12135
635TRKSED	Lower Truckee River near CA/NV state line	39.46477	-120.00320
635TROSED	Trout Creek (Truckee) near mouth	39.33240	-120.16558
637SUS001	Susan River,nr Litchfield	40.37771	-120.39514
719CVSCOT	Coachella Valley Stormwater Channel Outlet	33.52444	-116.07778
723ARGRB1	Alamo River Outlet	33.19920	-115.59710

723NROTWM	New River Outlet	33.10472	-115.66361
801CCPT12	Chino (San Antonio) Ck at Euclid/Hwy 83 bridge	33.94016	-117.65427
801SARVRx	Santa Ana River at Prado Basin Park Rd	33.92927	-117.59532
801SDCxxx	San Diego Creek at Campus	33.65556	-117.84472
901SJSJC9	San Juan Creek 9	33.48443	-117.67577
902SSMR07	Santa Margarita at Basilone Rd	33.31117	-117.34538
903SLRRBB	San Luis Rey River at Benet Road Bridge	33.22036	-117.35821
904ESCOxx	Escondido Creek at Camino del Norte	33.04829	-117.22602
905SDSDQ9	San Dieguito River 9	32.97877	-117.23506
906LPLPC6	Los Penasquitos Creek 6	32.90722	-117.23047
907SDRWAR	San Diego River at Ward Rd	32.78032	-117.11046
909SWRWSx	Sweetwater River at Willow St bridge	32.6581	-117.0434
911TJHRxx	Tijuana River at Hollister Rd	32.55142	-117.08394
519SED008	Pleasant Grove Creek Sediment #8	38.79490	-121.37280
901INTSC5	Salt Creek	33.50553	-117.70885

APPENDIX E: UCD-GC CHAIN OF CUSTODY FORM

University of California, Davis - Marine Pollution Studies Laboratory							
Chain of Custody							
34500 Coast Route One				Contact: Katie Siegler			
Monterey, CA 93940				Phone: 831-624-0947			
Final Destination:				Contact:			
				Phone:			
Sample Name	Sample ID	Date	Analysis	Quantity			
	Number	Sampled					
	Date	Signature		Time	Location		
Relinquished by:							
Received by:							
Relinquished by:							
Received by:							
Relinquished by:							
Received by:							

APPENDIX F: FIELD SHEET

SWAMP Field Data Sheet (Sediment Chemistry) - Integrator Study (EventType=WQ)		Entered in d-base (initial/date)	Pg _of_Pgs
***StationID:**	*Date (mm/dd/yyyy): / /	*Group:	*Agency: UCD-GC
***Funding:**	*SampleTime (1st sample):	*Project: SWB_SPoT_2017	*Protocol: SWAMP_SPoT
Personnel:	*Purpose (circle all that apply): SedChem SedTox FieldObs	*PurposeFailure:	

***Location**: Reach	*GPS/DGPS		**Lat (dd.ddddd)**	**Long (ddd.ddddd)**	**Corrections/Changes**
GPS Device: Garmin 72H	**Target:**			-	
Datum: NAD83 Accuracy (ft / m):	***Pt1 (Upstream):**			-	
Sonde: YSI 650 Calibr. Date	***Pt2 (Downstream):**			-	

Field Observations (SampleType = FieldObs)		WADEABILITY: Y / N / Unknown	**Field Dup: YES / NO**	SampleType=Integrated; LABEL_ID = FieldQA; create collection record upon data entry
DOMINANT SUBSTRATE:	Bedrock, Concrete, Cobble, Gravel, Sand, Mud, Unk, Other		OCCUPATION METHOD: Walk-in R/V _____	
WATER CLARITY: Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis)		WATER COLOR: Colorless, Green, Yellow, Brown		
PLANT PRESENCE:	Vascular, Nonvascular, Benthic Algae, Filamentous, Periphyton Layer, None	D.O.	pH	Cond. (us)	Temp.

Depositional Area Sample Information

Area	Overlying Water	Sample Debris	Depth Collection (cm)	Equipment Used	Notes
1	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	
2	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	
3	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	
4	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	
5	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	
6	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	
7	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	
8	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	
9	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	
10	Under / Damp / Dry	P A		**Scoop** (PE) **Core** (PC) **Gloved Hand**	

COMMENTS: SAMPLE 5-10 DEPOSITIONAL AREAS WITHIN A 100 METER AREA, DRAW A BOX (USING 'X' FOR SAMPLE AREAS) WITH AN IDEA OF THE SPACING; SEDIMENT SHOULD BE FINE-GRAIN AND NOT FEEL GRITTY; ADD COMMENTS ABOUT OUTFALLS, PIPES, DRAINS, AND TRIBUTARIES

DO

% Sat Pre Sample		
% Sat Post Sample		
Bar. Pressure		

APPENDIX G: ANALYSIS OF AUTHORIZATION FORM

Analysis Authorization		**Funding:**			
Contract:	SPoT	**Group:**	2017	Contact Person:	Katie Siegler
Region:	SPoT	**Date:**	2017	Phone:	(831) 624-0947
				email:	csiegler@ucdavis.edu
				Mailing Address:	34500 Highway One Monterey, CA 93940

Station	SampleType	Sediment Grain Size	Sediment TOC
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	Integrated	x	x
	TOTAL	16	16

APPENDIX H: REFERENCES

DiToro, D.M., Zarba, C.S., Hansen, D.J., Berry, W.J., Swartz, R.C., Cowan, C.E., Pavlou, S.P., Allen, H.E., Thomas, N.A., Paquin, P.R., 1991. Technical basis for establishing sediment quality criteria for nonionic organic chemicals by using equilibrium partitioning. Environ Toxicol Chem 10, 1541-1583.

Foster, I.D.L., Charlesworth, S.M., 1996. Heavy metals in the hydrological cycle: Trends and explanation. Hydrological Processes 10, 227-261.

Hunt, J.W., Phillips, B.M., Anderson, B.S., Siegler, C., Lamerdin, S., Sigala, M., Fairey, R., Swenson, S., Ichikawa, G., Bonnema, A., Crane, D., 2012. Statewide perspective on chemicals of concern and connections between water quality and land use. Surface Water Ambient Monitoring Program – Stream Pollution Trends (SPoT) Program. California State Water Resources Control Board. Sacramento, CA.

Karickhoff, S.W., 1984. Organic pollutant sorption in aquatic systems. J Hydraulic Engineering 110, 707-736.

SFBRWQCB, 2011. Municipal Regional Stormwater NPDES Permit Order R2-2009-0074; NPDES Permit No. CAS612008. California Regional Water Quality Control Board- San Francisco Bay Region. Adopted October 14, 2009; Revised November 28, 2011.

U.S. EPA, 2000. Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates. EPA/600/R-99/064. Office of Research and Development, Washington D.C.

U.S. EPA, 2002. Methods for measuring acute toxicity of effluents and receiving water to freshwater and marine organisms. EPA-821-R-02-012. Office of Research and Development, Washington, D.C.

U.S. EPA, 2010. National Pollutant Discharge Elimination System Test of Significant Toxicity Technical Document. EPA 833-R-10-004. Office of Wastewater Management. Washington DC.

APPENDIX I: SIGNATURES

Katie Siegler
PM, UCD-GC

Katie Siegler ____________ Date 2/4/19

Bryn Phillips
Laboratory QAO, UCD-GC

____________ Date 2/4/19

Autumn Bonnema
Metals Chemistry Laboratory QAO, Moss Landing Marine Laboratory Marine Pollution Studies Laboratory (MPSL-DFG)

____________ Date 18 Dec 2018

Timea Majoros
Organics Chemistry Laboratory QAO, Delta Environmental

____________ Date 11/30/18

Alex Long
Grain Size and Total Organic Carbon (TOC) Laboratory QAO, California State University, Long Beach, Institute for Integrated Research in Materials, Environments, and Society (CSULB-IIRMES)

____________ Date 1/17/19

Dawit Tadesse
Project Oversight, Office of Information Management and Analysis (OIMA), State Water Resources Control Board (SWRCB)

____________ Date 12/4/2018

Marisa Van Dyke (in leu of Melissa Morris)
SWAMP QAO, SWRCB

____________ Date 3/4/2019

Renee Spears
SWRCB QAO

Renée Spears ____________ Date 12.04.2018