SWAMP
Surface Water
Ambient Monitoring
Program

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SURFACE WATER AMBIENT MONITORING PROGRAM QUALITY ASSURANCE PROGRAM PLAN

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Approvals

An approval signature page will be maintained by the SWAMP QA Officer and will be made available upon request.

List of Acronyms

A list of acronyms used in this plan can be located in Appendix A: List of Acronyms.

Distribution List

The distribution list can be located in Appendix B: Distribution List.

TABLE OF CONTENTS

PREFACE

This Quality Assurance Program Plan (Program Plan) establishes the requirements for collecting data as part of the Surface Water Ambient Monitoring Program (SWAMP). The purpose of the Program Plan is to establish quality assurance (QA) and quality control (QC) standards and procedures to be applied to SWAMP projects in order to produce data that are scientifically valid and defensible, and of known and documented quality. The format and elements of this Program Plan are in accordance with United States Environmental Protection Agency (US EPA) guidance, including US EPA Region 9 Guidance for Quality Assurance Program Plans (US EPA R9QA/03.2, March 2012) and US EPA Elements of a State Water Monitoring and Assessment Program (US EPA 841-B-03-0003, March 2003). The content of this Program Plan is in conformance with the State Water Resources Control Board (State Water Board) Quality Management Plan (February 2017) and fulfills the US EPA requirement for programs receiving Federal grant monies for water quality monitoring under the Federal Clean Water Act (CWA).

PROGRAM MANAGEMENT

PRINCIPAL DATA USERS & DECISION MAKERS

Data collected under the Surface Water Ambient Monitoring Program (SWAMP) are used to guide environmental, resource management, regulatory and public health decisions. The data are also used to investigate and assess water quality and stream health, and promote scientific advancement and understanding of California's surface waters. The principal data users and decision makers include the United State Environmental Protection Agency (US EPA); State Water Board; Regional Water Quality Control Boards (Regional Water Boards); Office of Environmental Health Hazard and Assessment (OEHHA); California Department of Public Health; California Department of Fish and Wildlife (CDFW); other state, federal, county and city agencies; members of the scientific, regulated, and tribal communities; and the public. SWAMP data are made available to principal data users via the California Environmental Data Exchange Network (CEDEN). CEDEN is a public web-based portal for accessing and downloading surface water quality data collected in California. For more information on how SWAMP data are utilized, please see the Program Description and Program Quality Objectives sections of this Program Plan.

PROGRAM ROLES AND RESPONSIBILITIES

SWAMP is administered by the State Water Board, Office of Information Management and Analysis (OIMA) and functions as a collaboration between California's State and nine Regional Water Boards, along with partnership scientists from CDFW, the University of California (UC), California State University (CSU), San Francisco Estuary Institute-Aquatic Science Center (SFEI-ASC), and the Southern California Coastal Water Research Project (SCCWRP).

The program is organized into four major components:

1. Program Administration
2. Project Management and Coordination
3. Quality Assurance and Data Management
4. Field, Laboratory, and Technical Services

Work completed under each of the components is carried out through collaboration between the State Water Board, Regional Water Boards, and partnerships. These relationships and entities are described below. Given the size and complexity of SWAMP, the following sections describe the general roles and responsibilities of each

programmatic component and the responsible lead(s). For information on the specific roles and responsibilities of a SWAMP member for a given project, please refer to the quality assurance planning document for that project as described in the Quality Assurance Planning Documents.

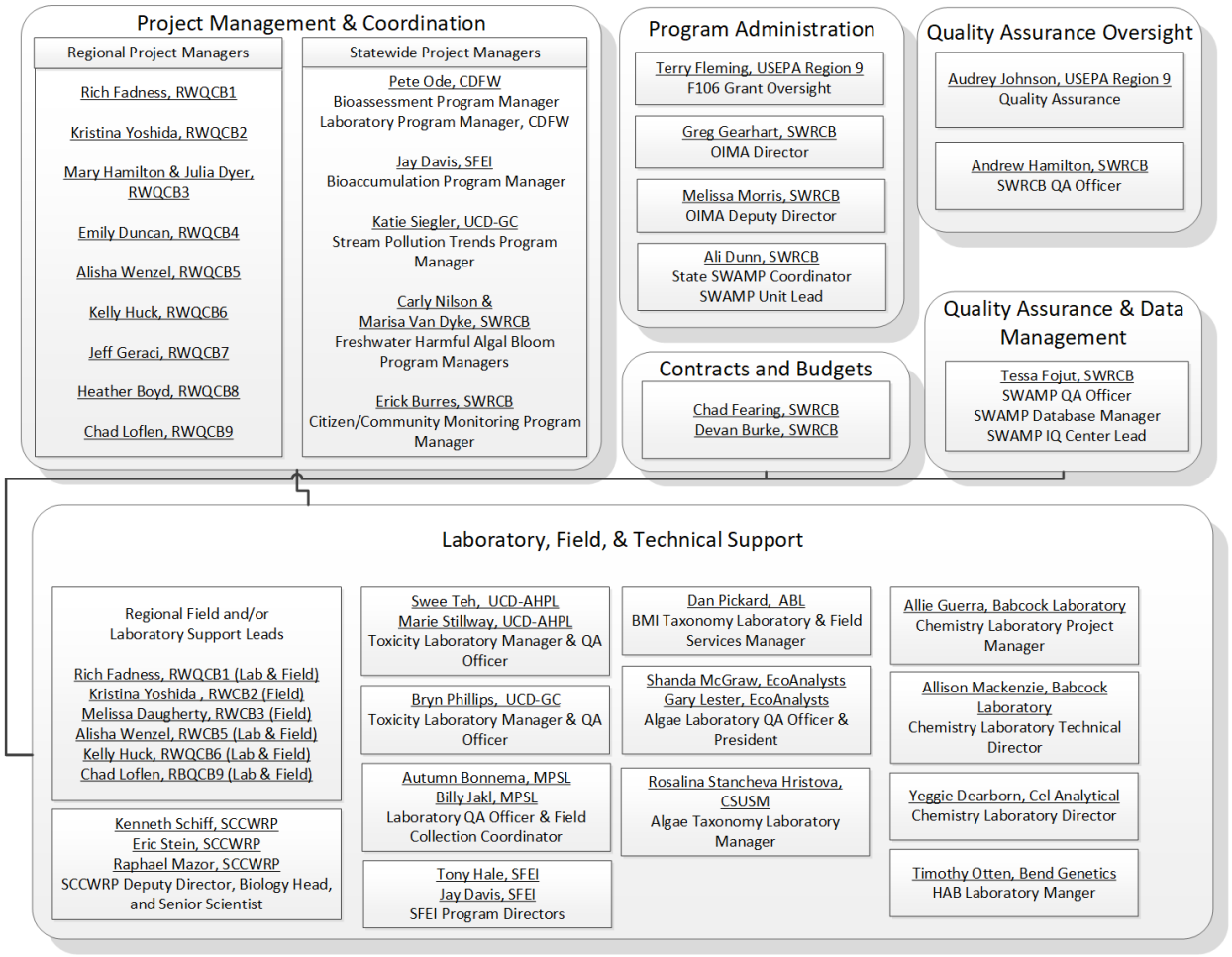

Figure 1. SWAMP Entity Organization

PROGRAM ADMINISTRATION

In coordination with US EPA Region 9, OIMA is tasked with the general management of the program. Responsibilities include directing and overseeing program activities, coordinating and managing program funds. OIMA receives a portion of the Federal CWA 106 Grant to support program administration activities, QA and data management support services, and implementing statewide ambient monitoring programs. OIMA also receives a portion of fees collected under the state Waste Discharge Permit Fund to support ambient monitoring needs at the regional level.

These funds are allocated to a SWAMP representative at each of the nine Regional Water Boards.

Program Management

- Terry Fleming (US EPA Region 9, Standards Liaison)
- Greg Gearheart (OIMA, Deputy Director)
- Melissa Morris (OIMA, Assistant Deputy Director)

SWAMP Management is responsible for the overall direction of the program. Duties include:

- ❑ Directing and overseeing programmatic strategic planning
- ❑ Overseeing the review and revision of mission planning documents
- ❑ Ensuring programmatic compliance with state and federal regulations
- ❑ Implementing and managing operational plans
- ❑ Proposing and approving the OIMA budget and budget change proposals
- ❑ Reporting to US EPA and State Water Board Management.

Program Coordinator

- Ali Dunn (OIMA, SWAMP Unit Lead)

The State SWAMP Coordinator is responsible for oversight and coordination of the program. Duties include:

- ❑ Coordinating and participating in programmatic strategic planning
- ❑ Coordinating and participating in the revision of mission planning documents
- ❑ Directing and organizing programmatic roundtable and workgroups
- ❑ Managing programmatic processes, deliverables, and timeframes
- ❑ Reviewing project monitoring plans and write-ups for compliance with this Program Plan
- ❑ Implementing and managing operational plans
- ❑ Reporting to OIMA management and the US EPA liaison
- ❑ Overseeing the measurement and reporting of programmatic performance measures to management.

Contracts and Budgets Staff

- Chad Fearing (OIMA)
- Devan Burke (OIMA)

OIMA Contracts and Budget staff are responsible for the management of both federal and state SWAMP funds. Duties include:

- ❑ Preparing and managing contracts with partnership agencies and vendors
- ❑ Distributing funds to regional support staff for purchasing and independent contracts
- ❑ Processing and tracking invoices
- ❑ Providing assistance to state and regional project managers for budget planning
- ❑ Reporting to OIMA management
- ❑ Coordinating with QA and information management staff to verify completed tasks, deliverables and compliance with this Program Plan.

Statewide Project Oversight

- Ali Dunn (OIMA, SWAMP Unit Lead, Freshwater Harmful Algal Bloom (FHAB) Program Oversight)
- Shuka Rastegarpour (OIMA, Statewide Bioassessment Program Coordinator)
- Anna Holder (OIMA, Bioaccumulation Monitoring Program Coordinator)
- Brian Ogg, (OIMA, Stream Pollution Trends (SPoT) Monitoring Program Coordinator)

Oversight of the SWAMP statewide projects include coordination with the partnership statewide Project Managers; reviewing monitoring plans, QA planning documents, and reports; participating in project workgroups; maintaining information available on the SWAMP webpages; managing project tools (where applicable); and providing assistance.

Project Management and Coordination

Project management staff are responsible for the overall coordination, planning, design, documentation, and implementation of monitoring projects. Duties may also include organizing and facilitating technical workgroups supporting those projects. SWAMP projects occur at the statewide and regional levels. The required duties of both the Statewide and Regional Project Managers differ, thus are addressed separately.

Statewide Monitoring Projects

- Pete Ode, Ph.D. (CDFW, Statewide Bioassessment Program Manager)
- Jay Davis, Ph.D. (SFEI, Bioaccumulation Monitoring Program Manager)
- Katie Siegler (UCD-GC, SPoT Program Manager)

- Carly Nilson (OIMA, FHAB Program Co-Manager)
- Marisa Van Dyke (OIMA, FHAB Program Co-Manager)
- Erick Burres (OIMA, Clean Water Team Program Manager)

Statewide Project Managers are responsible for participation in focused technical workgroups and the SWAMP Roundtable. In this role, there is an opportunity to discuss new and emerging water quality topics affecting their projects, discuss program performance and coordination, and highlight project accomplishments. The Statewide Project Manager is responsible for the planning, design, implementation, and oversight of each project including:

- ❑ Identifying the project scope, goals and deliverables
- ❑ Defining project tasks and resource requirements
- ❑ Developing and maintaining the Statewide Monitoring Project Planning (Specific Requirements)
- ❑ Assembling and coordinating project staff
- ❑ Completing project Budget Plans
- ❑ Planning and scheduling project timelines
- ❑ Scheduling and organizing project Kickoff Meetings
- ❑ Tracking project deliverables
- ❑ Directing and supporting the project team
- ❑ Monitoring and reporting progress of the project to appropriate stakeholders
- ❑ Evaluating and assessing project completeness and data quality assessment of project results
- ❑ Communicating project status and results to principal decision makers and data users.

Regional Monitoring Projects

There are nine Regional Water Boards in California (Figure 2). Participation in SWAMP at the regional level allows for targeted support of regional monitoring needs. Each of the nine Regional Water Boards provides at least one staff person to serve as a Regional Project Manager. While Regions five (5) and six (6) are subdivided further, representation within SWAMP for these regions is equal to the remaining regions.

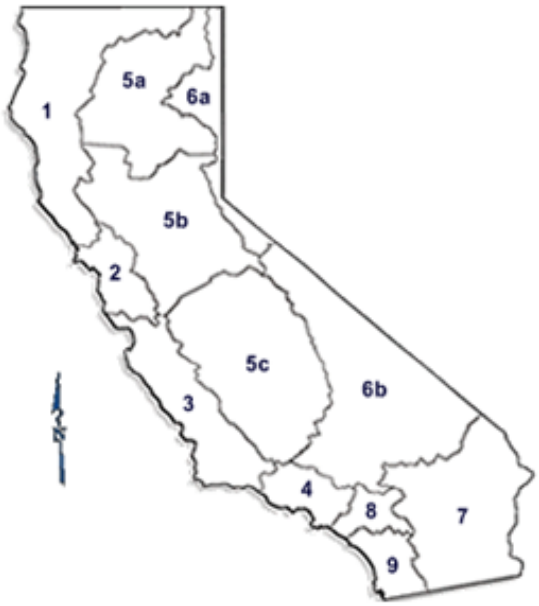

Figure 2. Regional Water Quality Control Board Jurisdictions

- Rich Fadness (Regional Water Board 1: North Coast Region)
- Kristina Yoshida (Regional Water Board 2: San Francisco Bay Region)
- Julia Dyer, Melissa Daugherty, and Mary Hamilton (Regional Water Board 3: Central Coast Region)
- Emily Duncan (Regional Water Board 4: Los Angeles Region)
- Anne Walters/Alisha Wenzel/Cameron Alfving (Regional Water Board 5: Central Valley Region)
    - (5a): Redding Office
    - (5b): Sacramento Office
    - (5c): Fresno Office
- Daniel Sussman/Kelly Huck (Regional Water Board 6: Lahontan Region)
    - (6a): South Lake Tahoe Office
    - (6b): Victorville Office
- Jeff Geraci (Regional Water Board 7: Colorado River Basin Region)
- Heather Boyd (Regional Water Board 8: Santa Ana Region)
- Chad Loflen (Regional Water Board 9: San Diego Region)

Regional Project Managers are responsible for participation in the SWAMP Coordinators Group, voluntary workgroups, and the SWAMP Roundtable. In this role, there is opportunity to discuss new and emerging water quality issues, discuss program performance and coordination, highlight regional accomplishments and vote on programmatic changes. Regional Project Managers also serve as SWAMP liaisons to

their region and are responsible for the prioritization, design, management, and coordination of monitoring projects within their region. As a liaison, the manager is responsible for identifying regional monitoring needs that support that region's Water Quality Control Plan(s), emerging water quality concerns or unmet assessment needs; assessing feasibility and scope within the region's allotted budget; and identifying key projects for possible discretionary funding and coordinating with those projects once started. Once key projects are identified, the Project Manager is responsible for the planning, design, documentation, and implementation of the projects including:

- ❏ Defining the project scopes, goals and deliverables
- ❏ Identifying the project tasks and resource requirements
- ❏ Completing Regional Project Write-ups
- ❏ Assembling and coordinating project staff
- ❏ Planning project budgets within the regional allocation and completing a Budget Plan
- ❏ Planning project timelines
- ❏ Scheduling and organizing Project Kickoff Meetings
- ❏ Tracking project deliverables
- ❏ Providing direction and support to the project team
- ❏ Ensuring implementation of QA with assistance from SWAMP IQ
- ❏ Monitoring and reporting on project progress to appropriate stakeholders
- ❏ Evaluating and assessing project completeness and data quality assessment of project results
- ❏ Communicating project status and results to principal decision makers and data users.

QUALITY ASSURANCE AND INFORMATION MANAGEMENT

QUALITY ASSURANCE OVERSIGHT

- Audrey Johnson (US EPA, Region 9 QA Manager)
- Andrew Hamilton (OIMA, State Water Board QA Officer)

Oversight of program quality assurance activities includes reviewing and approving the SWAMP Program Plan under the requirements prescribed by the State Water Board Quality Management Plan (February 2017) and the US EPA requirement for programs receiving federal grant monies for water quality monitoring under the CWA. The SWRCB QA Officer is also responsible for reviewing and approving Project Plans for the SWAMP statewide projects.

Quality Assurance and Information Management

The design, maintenance, and implementation of SWAMP's QA and information management systems are carried out by SWAMP IQ. Below is a list of the roles and tasks fulfilled by this unit.

SWAMP Quality Assurance Officer

- Tessa Fojut, Ph.D. (OIMA, SWAMP IQ)

The SWAMP QA Officer is responsible for overseeing the design and implementation of the program's QA standards. The SWAMP QA Officer works with the SWRCB QA Officer to ensure that the activities and planning documents are consistent with the State Water Board Quality Management Plan. Duties include:

- ❑ Reviewing and approving:
  - Statewide Monitoring Project Plans
  - Regional Project Planning Write-ups
  - Standard Operating Procedures (SOP)
  - Corrective and Preventative Action Reports (CPARs)
  - Non-SWAMP Project Plans seeking SWAMP Comparability or use of SWAMP resources.
- ❑ Overseeing verification, validation, and completeness checks of programmatic data
- ❑ Reviewing programmatic audit reports and performance measures
- ❑ Developing QA policies and procedures
- ❑ Interpreting and implementing QA standards
- ❑ Evaluating the adequacy of QA standards
- ❑ Documenting internal audits and other QA activities
- ❑ Providing recommendations for and monitoring the status of CPARs
- ❑ Assuring ongoing compliance with the elements within this Program Plan
- ❑ Participating in QA workgroups and roundtables.

SWAMP Database Manager

- Tessa Fojut, Ph.D. (OIMA, SWAMP IQ)

The SWAMP Database Manager oversees SWAMP information management systems and standards. The program information management systems include the Program Management and Water Quality databases. Duties include:

- ❑ Implementing policies and guidelines for data management
- ❑ Developing and modifying data management infrastructure to expedite data upload and reporting
- ❑ Managing the development of SWAMP data tools, including loaders, checkers, query tools, reporting modules, and calculators
- ❑ Facilitating the development and expansion of data type modules
- ❑ Working closely with CEDEN staff and the State Water Board Division of Information Technology
- ❑ Participating in data management workgroups.

SPECIALIZED DATA-TYPE MANAGERS

Specialized data-types include: microbiology and genetics; chemistry; toxicity and tissue; algae taxonomy; benthic macroinvertebrate taxonomy; and field, habitat, and geospatial data.

- ■ Delany Broome (OIMA, SWAMP IQ, Field Measurements and Chemistry Data Manager)
- ■ Kimberly Pham (OIMA, SWAMP IQ, Chemistry Data Manager)
- ■ Charles Brooke (OIMA, SWAMP IQ, Microbiology Data Manager)
- ■ Brian Ogg (OIMA, SWAMP IQ, Toxicity Data Manager)
- ■ Candice Levesque (OIMA, SWAMP IQ, Algae Taxonomy Data Manager)
- ■ Toni Marshall (OIMA, SWAMP IQ, Benthic Macroinvertebrate Taxonomy Data Manager)
- ■ Jennifer Salisbury (OIMA, Tissue Data Manager)

Each Specialized Data-Type Manager is responsible for general quality assurance and data management support, as well as specialized support for one or more unique data types. Specialized data support allows for subject-level expertise that applies to both the recording of that data type within the database as well as the analytical and quality control needs unique to that data type. For each data type, the staff person is responsible for:

- ❑ Developing and reviewing measurement quality objectives (MQOs)
- ❑ Developing or reviewing standard operating procedures (SOPs)
- ❑ Verifying and validating (where required) incoming SWAMP data
- ❑ Uploading data into the SWAMP data system
- ❑ Providing guidance and business rules for reporting data
- ❑ Identifying and defining data reporting requirements
- ❑ Participating in workgroups to assess data and tool needs.

PROJECT DATA LIAISON

Each Project Data Liaison is responsible for serving as a data liaison to a specific statewide project and/or regions.

- Delany Broome (OIMA, SWAMP IQ, Liaison to: RWQCB 4 & 8)
- Kimberly Pham (OIMA, SWAMP IQ, Liaison to: RWQCB 3)
- Charles Brooke (OIMA, SWAMP IQ, Liaison to: RWQCB 7, FHAB & CWT Programs)
- Brian Ogg (OIMA, SWAMP IQ, Liaison to: RWQCB 1, 5 & SPoT)
- Candice Levesque (OIMA, SWAMP IQ, Liaison to: RWQCB 2 & 9)
- Toni Marshall (OIMA, SWAMP IQ, Liaison to: RWQCB 6 & Statewide Bioassessment Program)
- Jennifer Salisbury (OIMA, Liaison to: Bioaccumulation Monitoring Program)

Duties of the Project Data Liaisons include:

- ❑ Serving as the quality assurance and data management liaison in project Kickoff Meetings
- ❑ Assisting Statewide Project Managers with completing Project Plans
- ❑ Assisting Regional Project Managers with completing Project Write-ups
- ❑ Reviewing submitted Project Plans and Project Write-ups to ensure required elements are present
- ❑ Performing project data completeness checks at the conclusion of a project
- ❑ Providing information on project and data status when requested.

FIELD, LABORATORY, AND TECHNICAL SERVICES

Field, laboratory and technical services are provided through Regional Water Boards and SWAMP partnership agencies. These relationships are maintained through communication, coordination, and participation within workgroups and the roundtable. Partnerships are financially supported by contracts developed and managed by the Contracts and Budgets staff of OIMA or Regional Contract Management staff. Only lead staff are indicated below. Duties include, but are not limited to the following:

- ❑ Coordination and communication with Statewide and Regional Project Managers
- ❑ Participation in project Kick-off meeting
- ❑ Ensuring the collection and analysis of samples per the requirements within the Statewide Project Plans or Regional Project Write-ups

- ❑ Entry of field and laboratory data into the SWAMP data system (templates, shells, forms)
- ❑ Completion of CPARs when deviation in protocol or requirements are noted
- ❑ Coordination and communication with SWAMP IQ.

Regional Field and/or Laboratory Support Services

Some of the Regional Water Boards have additional support staff assigned to SWAMP for in-house logistical, field sample collection, data entry, and laboratory services. The support staff is funded utilizing SWAMP funds, allocations for part-time/temporary state positions, or through independent funds via each Regional Water Board. Regions 1, 2, 3, 5, 6 and 9, have additional staff to assist with logistics, field collection and data entry. Regions 1, 5, and 6 currently have laboratories for in-house microbial analyses. Region 9 is in the process of adding in-house microbial analysis capabilities to their laboratory. The regional staff leads are:

- Rich Fadness, Regional Water Board 1 (Lab and Field)
- Kristina Yoshida, Regional Water Board 2 (Field)
- Melissa Daugherty, Regional Water Board 3 (Field)
- Alisha Wenzel, Regional Water Board 5 (Lab and Field)
- Kelly Huck, Regional Water Board 6 (Lab and Field)
- Chad Loflen, Regional Water Board 9 (Lab and Field).

Partnership Field and/or Laboratory Support Services

California Department of Fish and Wildlife

California Department of Fish and Wildlife (CDFW) provides technical expertise in the fields of water and tissue chemical analysis, quality assurance, benthic macroinvertebrate (BMI) taxonomy, metrics for assessing stream health, and spearheading workgroups and professional organizations such as the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT). CDFW's support of SWAMP is divided into the three sub entities below:

CDFW Aquatic Bioassessment Lab

- Dan Pickard, Ph.D. (ABL, Taxonomy Laboratory and Field Services Manager)

CDFW Aquatic Bioassessment Lab (ABL) provides taxonomic identification of BMI samples and bioassessment field services for SWAMP. ABL staff also serve as scientific technical leads for SWAMP's bioassessment and taxonomy monitoring and analysis program, assist with program development, and participate in taxonomy workgroups and SAFIT activities.

CDFW Marine Pollution Studies Lab

- Autumn Bonnema (MPSL, Laboratory QA Officer)
- Billy Jakl (MPSL, Field Collection Coordinator)

CDFW Marine Pollution Studies Lab (MPSL) provides field collection and laboratory analytical services for analysis of water and tissue, QC, data reporting, project-interpretive reporting, and participation in related workgroups. MPSL also serves as the Tissue Data Coordinator for SWAMP's Bioaccumulation Monitoring Program and regional tissue contaminant studies.

UNIVERSITY OF CALIFORNIA, DAVIS

Aquatic Health Program Laboratory

- Swee Teh, Ph.D. (Toxicity Laboratory & Field Services Manager)
- Marie Stillway (Laboratory Safety & QA/QC Officer)

University of California, Davis Aquatic Health Program Laboratory (UCD-AHPL) provides logistical coordination, statewide field collection and subsequent laboratory analytical services for toxicity analysis, QC, and subcontract preparation and management services.

Granite Canyon

- Bryn Phillips (UCD-GC, Toxicity Laboratory & Field Services Manager)

University of California, Davis, Granite Canyon Marine Pollution Studies Laboratory (UCD-GC) serves as the scientific technical lead for SWAMP's toxicity monitoring and SPoT, provides toxicity analysis and help desk services, and participates in SWAMP and SWRCB Toxicity Workgroups.

CALIFORNIA STATE UNIVERSITY

CSU, San Marcos (California Primary Algae Lab)

- Rosalina Stancheva Hristova, Ph.D. (CSUSM, Taxonomy Laboratory Manager)

California State University, San Marcos (CSUSM) provides laboratory analytical services for algal and diatom taxonomic analysis and QC, and serves as scientific lead for SWAMP's algae taxonomy. CSUSM maintains the algae and diatom master taxonomic list for California's surface waters, and leads the external QC activities process.

SCIENCE AND RESEARCH INSTITUTES

San Francisco Estuary Institute (SFEI)

- Tony Hale, Ph.D. (SFEI, Program Director for Environmental Informatics)
- Jay Davis, Ph.D. (SFEI, Program Director Clean Water Program)

SFEI supports the statewide Bioaccumulation Monitoring and FHAB Programs, providing technical services, workgroup participation, and data portal maintenance.

Southern California Coastal Water Research Project (SCCWRP)

- Kenneth Schiff (SCCWRP, Deputy Director)
- Eric Stein, D.Env. (SCCWRP, Head of Biology Department)
- Raphael Mazor, Ph.D. (SCCWRP, Senior Scientist)

SCCWRP provides scientific technical assistance, protocol development, data analysis, project logistics, sample collection, and planning and documentation services.

COMMERCIAL LABORATORIES

Bend Genetics, LLC.

- Timothy G. Otten (Laboratory Director, SWAMP Liaison)

Bend Genetics provides laboratory analytical services, QC and data reporting, for the identification of cyanobacteria and toxin analysis.

EcoAnalysts, Inc.

- Shanda McGraw (Laboratory QA Officer, SWAMP Liaison)
- Gary Lester (President, Sales Coordinator)

EcoAnalysts provides laboratory analytical and reporting services for taxonomic analysis of diatom samples. EcoAnalysts participate in external QC workshops with the scientific lead for SWAMP's algae taxonomy (CSU, San Marcos).

Primary Chemistry Lab - Babcock Laboratories

- Allie Guerra (Project Manager, SWAMP Liaison)
- Allison Mackenzie (Laboratory Technical Director)

This laboratory provides chemical laboratory analytical services, QC, and data reporting services for the core statewide and regional SWAMP projects, as well as for other Water Boards programs. Babcock Laboratories began this role in March 2021. This role was previously filled by the CA Department of Fish and Wildlife's Water Pollution Control Laboratory (Closed 2017), followed by Delta Environmental Laboratory (agreement ended February 2021).

Cel Analytical, Inc.

- Yeggie Dearborn, Ph.D. (Laboratory Director)

CEL Analytical provides laboratory analytical services, QC and data reporting, for chemical analysis for Region 2. This laboratory is contracted through the San Francisco Bay Regional Water Board.

PROGRAM DOCUMENTATION

Program documentation includes mission planning and QA planning documents, SOPs, standardized forms, and reports. SWAMP Mission Planning documents are compliant under the California Comprehensive Monitoring Program Strategy; a multi-agency statewide monitoring coordination effort. The SWAMP Quality Assurance Planning documents are compliant under the State Water Board Quality Management Plan; an agency-wide QA standard guidance document. These categories are visualized below in Figure 3 and described in the following sections.

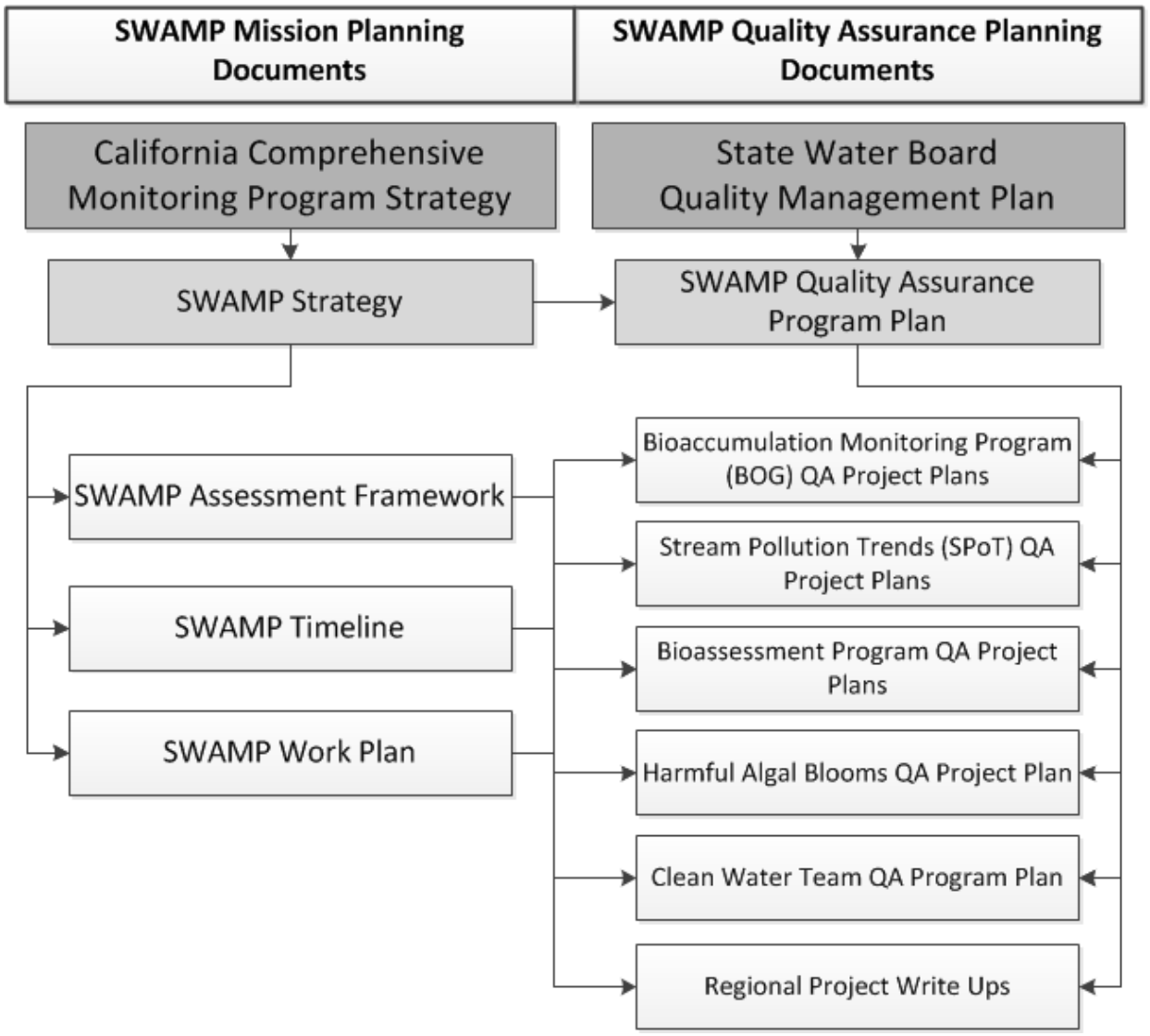

Figure 3. SWAMP Planning Documentation Overview

MISSION PLANNING DOCUMENTS

SWAMP STRATEGY

SWAMP's Comprehensive Monitoring and Assessment Strategy to Protect and Restore California's Water Quality (SWAMP Strategy) presents SWAMP's vision to fulfill California's CWA responsibilities and the State Water Board's Strategic Plan to improve monitoring, assessment and reporting activities. The goal of strategic planning is to evaluate SWAMP's program functions and effectiveness, and to recommend actions to ensure the program's continued success. The SWAMP Strategy describes the program's mission, goals, objectives and tasks. The SWAMP Strategy is reviewed, and updated as needed, by the SWAMP Roundtable at an annual strategic planning

session that occurs each fall. Starting for FY20, SWAMP developed a Strategic Action Plan for 2020-2023, which describes SWAMP staff activities that help fulfill SWAMP's vision and mission. This review is coordinated by the State SWAMP Coordinator.

SWAMP Assessment Framework

SWAMP's Assessment Framework is a companion document to the SWAMP Strategy. Its purpose is to present a framework for surface water monitoring and assessment for all Water Board programs (e.g., National Pollutant Discharge Elimination System (NPDES) permitting, Total Maximum Daily Loads; see Strategy for a complete list) that will address the State Water Board's strategic goals through approaches intended to: increase the amount of usable data and information regarding water quality and beneficial uses; reliably and consistently translate data into useful information; and coordinate the collection, assessment, and reporting of water quality information among Water Board programs, agencies, and stakeholders. The SWAMP Assessment Framework and the SWAMP Strategy were historically reviewed annually to ensure the Water Board's mission, and current regulatory objectives and requirements were met. This review was coordinated by the State SWAMP Coordinator. The SWAMP Strategic Action Plan includes key priorities from the SWAMP Assessment Framework and Strategy and focuses on the specific projects and actions required to continue implementation of current priorities aimed at fulfilling our vision and mission.

SWAMP Timeline

The SWAMP Timeline is an organization tool to track upcoming events from the Annual Work Plan and communicate them to the SWAMP Roundtable and managers. A visual timeline showing the major tasks of the program and the schedule in which they are to be completed, can be found in (Appendix F: Program Timeline). The timeline is updated monthly by the State SWAMP Coordinator.

SWAMP Work Plan

An annual SWAMP Work Plan is regularly submitted to both the State Water Board Deputy Management committee (DMC) and US EPA Region 9. The Work Plan outlines the activities anticipated per annum and the tasks completed for the previous year. The State SWAMP Coordinator oversees the development of the annual SWAMP Work Plan. More information can be found in the Reports to Management section of this Plan.

QUALITY ASSURANCE PLANNING DOCUMENTS

SWAMP monitoring projects occur at both the state and regional level. Statewide projects are generally large-scale, multi-year projects with consistent objectives and quality level needs. In contrast, regional projects vary in size, timeframes, objectives, and quality needs according to the monitoring priorities of each region at a given time. As such, the number of regional projects in a given year may differ among regions. Therefore, the following section is organized as follows: requirements specific to statewide projects, requirements specific to regional projects, and requirements shared by both project categories.

STATEWIDE MONITORING PROJECT PLANNING (SPECIFIC REQUIREMENTS)

All SWAMP statewide monitoring projects are required to have an approved Quality Assurance Project Plan (Project Plan). Project Plans shall follow the template provided in Appendix D and follow the EPA Guidance for Project Plans. Project Plans are to be developed in coordination between the Statewide Project Manager, the associated technical workgroup (if applicable), the Statewide Project Coordinator (if applicable), the State SWAMP Coordinator, and SWAMP QA Officer. Project Managers may defer monitoring design information to a separate document called a Monitoring Plan, if desired. However, the combination of both documents must meet the required elements of a Project Plan, be consistent in the scope, objectives, and detailed quality control requirements and must be submitted for review and approval at the same time. The Statewide Project Manager must review the Project Plan(s) annually and revise where necessary. Final approval on new or revised Project Plans must be given to the State SWAMP Coordinator, SWAMP QA Officer, and State Water Board QA Officer prior to initiating monitoring.

REGIONAL MONITORING PROJECT PLANNING (SPECIFIC REQUIREMENTS)

All SWAMP regional monitoring projects are required to, at a minimum, have an approved Regional Project Write-up. Regional Project Write-ups shall follow the guidance provided in Appendix E: Regional Project Write-ups Guidance Document. Write-ups combine the core elements of the Data Quality Objectives (DQO) planning process utilized in Project Plan development, and shall be used in lieu of developing complete, individual Project Plans. Individual Project Plans may be developed and submitted, if desired. Write-ups must identify:

- ❏ Question, management action, problem, or activity the project will support
- ❏ Beneficial uses and water quality objectives the study will assess

- ❑ List of parameters the study will measure and whether lab certification is required
- ❑ Appropriate Assessment Thresholds and reporting limits (if applicable)
- ❑ Where and when the project will take place
- ❑ Most appropriate Data Use Category(s)
- ❑ Sampling design
- ❑ Applicable quality controls and measurement quality objectives to be utilized.

Regional Project Managers are required to coordinate their monitoring efforts within their regional office and are encouraged to share the draft or final Write-ups with management at their Region. New and revised Write-ups must be submitted to SWAMP IQ for review and approval by the SWAMP QA Officer and the State SWAMP Coordinator. Each section of the Write-ups will be reviewed and approved for completeness and adherence to the requirements within this Program Plan. Write-up sections may be completed and submitted for approval separately as project details are finalized (i.e., sampling site lists). Regional Project Managers shall strive to have the priority sections of a Write-up for a project complete and submitted for approval no less than two weeks before the start of the project. Priority sections are marked as such in the guidance document. The remaining sections of the Write-up must be completed no later than two months after the start of the project. A single Write-Up may be used for a multi-year monitoring project; however, the Write-Up must be reviewed at least annually and the applicable sections must be updated and submitted for approval prior to collection of samples under the new conditions.

The information produced as part of the Regional Project Write-up is directly entered into and stored in an online form and answer sheet, as a component of the SWAMP Internal Information Management System. The goal of entry of the regional project information into the SWAMP Internal Information Management System is to have the information centralized and easily accessible for communication between project managers, SWAMP IQ, program managers, and reporting to the public.

Other Planning Documentation (All Projects)

Budget Plan

All Statewide and Regional Project Managers are required to complete a three-year Budget Plan. Budget Plans are completed through the Budget Planning Module of the SWAMP Program Management Tool. This tool is populated with price lists from all SWAMP vendors and budget allocations for each statewide program and region. Project Managers then select which tasks and services will be utilized over the course of three years and assign how many of each task or service will be required within their

budget per project. The Budget Plans should correspond to the approved Sampling and Analysis Plans or Regional Project Write-ups. Budget Plans are reviewed and approved by the OIMA Contracts and Budgets Staff. Approved plans are then used to assemble contracts with each vendor and verify invoices for payment. The Budget Plan is used to create a Project Work Order that details the type of analyses and services planned for each project. This Work Order is utilized for coordination and communication between the Project Manager, Field and Laboratory Staff and SWAMP IQ. See Appendix J for more information and instructions on the Program Management Tool.

SWAMP Standard Contract Language

All contracts created and managed through OIMA for sample collection or analysis services must include SWAMP's Standard Contract Language. This language details SWAMP's requirements for sample collection, analysis, and data reporting. Utilizing this language ensures that all services are consistent with this Program Plan, SWAMP MQOs and SOPs, and that services are performed within timeframes that ensure program success. It is highly recommended that the language also be used in contracts independently managed by the Regions utilizing SWAMP funds. This language is maintained in coordination with the SWAMP QA Officer, SWAMP Coordinator, OIMA Management staff, the Water Board Contracts unit, and the Department of General Services. This language is included as Appendix C. Specific tasks and schedules should be added to a contract scope of work where needed.

Project Kickoff Preparation Materials

To ensure successful communication and coordination of field, laboratory, management, and quality assurance and data management staff, all statewide and regional SWAMP projects are required to hold Kickoff Meetings prior to the first sampling event of a project. These meetings include the Project Manager, Project Data Liaison, testing laboratory personnel, field personnel, and others. They are intended to facilitate coordination of planning and logistics. The group discusses the following items: Project Work Order, Field Sheets, Chain of Custody Forms, sample collection timing, sample handling (shipping), laboratory turnaround times, SWAMP QC requirements, Communication Plan, and Kickoff Checklist. Kickoff Meeting instructions are included as Appendix G. Documentation and notes from kickoff meetings are stored in the SWAMP Internal Information Management System.

Standard Operating Procedures (SOP)

SWAMP strives to obtain scientifically defensible results in samples fully representative of the water bodies being investigated. One key factor in ensuring this goal is the use

of standardized procedures for all field and laboratory work. An SOP is defined as a written document that details the method of an operation, analysis, or action with techniques and procedures that are thoroughly prescribed for performing certain routine or repetitive tasks (FEM, 2012). In general, an SOP should provide a level of detail that allows an analyst to perform that analytical method without having extensive experience with that method.

For more information on program methodology requirements, see the Analytical Methods Policy Section. Any SOP developed for SWAMP must be distributed to appropriate SWAMP workgroups and SWAMP IQ for internal review. In some cases an SOP may be distributed outside of SWAMP to interested parties and workgroups for further consideration and feedback. Final approval is given by the SWAMP QA Officer. All SOPs are reviewed and updated, at a minimum, every five years. Many SOPs are reviewed and updated yearly or as needed. SWAMP SOPs can be found on the SWAMP IQ Wiki.

STANDARDIZED FORMS

FIELD SHEETS

SWAMP has prepared standardized field sheets for water quality, tissue, and bioassessment data and sample collection. The standardized field sheets ensure that all required information is recorded consistently for successful entry into the SWAMP database. Field sheets can be customized in coordination with the SWAMP IQ group.

CHAIN-OF-CUSTODY

SWAMP has prepared a standardized set of chain-of-custody (COC) forms for use by SWAMP members. The standardized forms ensure that all required information is recorded consistently and completely for successful transfer of samples from field staff to laboratory staff, and that all requested analyses, sample information and conditions are communicated effectively. The standardized form may be customized by members, however, required fields must not be removed. The COC forms will also be used by SWAMP IQ staff to verify initial record activation within the SWAMP database and support data completeness checks during verification. COCs will also be utilized by Contract Management staff to assist with budget tracking and invoice approvals.

COMMUNICATION PLAN

The SWAMP Communication Plan is a form populated by the Project Manager and distributed at Kick-off Meetings to all parties involved with the project. The purpose of the form is to provide all parties with contact information of key players of the project,

including the Project Manager, the SWAMP QA Officer, Data Management Coordinator, field crews, lab contacts and other important parties. The form is used to inform those who should be notified if certain project issues arise, and to improve communication throughout all steps of the project. The Communication Plan is included in Appendix G: Project Kickoff SOP and Preparation Materials.

Report Documents

SWAMP Statewide Project Reports

Documents detailing the findings of SWAMP's various statewide projects are posted to the SWAMP Reports webpage. In addition to providing context for regional monitoring projects, SWAMP's statewide reports examine long-term trends in water quality, facilitate managerial decisions, and inform the public. Additional information about the goals of these studies is provided in the "Statewide Monitoring Projects" section of this Program Plan. Project Reports are completed as specified within the Statewide Project Plans and on an as-requested basis.

SWAMP Newsletter

The SWAMP Newsletter was a quarterly publication highlighting the recent activity of SWAMP and its partners that was published from 2006-2017. Each issue featured a selection of articles covering the program's water quality monitoring and assessment efforts at both the statewide and regional scales. The intent was to demonstrate the relevance of SWAMP's various programs to decision makers, managers, and the public. The newsletter went on hiatus in 2018 as the program shifted leadership and is working towards more data-driven methods of sharing information generated by SWAMP, such as data dashboards.

SWAMP Data Visualizations

SWAMP has been working to develop more interactive data visualizations as a way of making data collected by SWAMP accessible, useful, and usable to the primary data users as well as the general public.

As a first step toward this goal, SWAMP produced Water Quality Status Reports in 2017, 2018, and 2019. These reports summarize key findings from SWAMP's statewide monitoring programs and regional monitoring projects, as well as other analyses of SWAMP data in conjunction with other relevant water quality datasets (e.g., national survey data, citizen monitoring data). The target audience is Water Boards management and staff, other water management agencies, stakeholders, and the public. The reports were written by the Statewide Project Coordinators, the

Statewide and Regional Project Managers, and the SWAMP Coordinator. The reports were released each June to coincide with the annual Water Board Science Symposium and are posted on the SWAMP Water Quality Status Report website.

In the future, SWAMP aims to develop data visualizations highlighting data from each of the statewide monitoring programs and to continue working with regions to meet their data visualization needs. Examples of these types of data visualizations include:

- HABs Portal
    - HAB Incident Reports Map
    - HAB Data Viewer
- Lahontan Regional Board Water Quality Monitoring Dashboard.

SWAMP Technical Memos and Fact Sheets

SWAMP develops technical memos and fact sheets to educate and inform other programs and interested parties about new developments within the program or provide overviews of portions of the program that may be of interest. These documents can be found on the SWAMP website, where applicable.

State Water Board Annual Quality Assurance Report and Work Plan

SWAMP participates in the reporting of quality assurance activities and work plans submitted to US EPA Region 9 as part of the Annual State Water Board Quality Assurance Report. Activities summaries and work plans are developed and submitted to the State Water Board QA Officer annually.

Corrective and Preventative Action Reports

Corrective and Preventative Action Reports (CPARs) are reports that are developed in response to an incident of non-conformance at any stage of data collection, from site visitation to sample analysis. CPARs are to be filled out by field crew members and laboratory personnel when a deviation from standard or required protocol has occurred. A CPAR template is included as Appendix H. Corrective and preventative actions both include investigation, action, review, and further action if so required. CPARs must include the following information:

- Clearly identify the non-conformance including, but not limited to, the date, location, analysis/sample(s)/procedure/instrument affected, and the resulting effect
- Clearly identify the root cause of the discrepancy or deviation

- Suggest or summarize corrective actions taken to:
    - Address the immediate issue
    - Prevent future occurrences.

The CPAR is to be submitted to the SWAMP QA Officer for review and approval. The SWAMP QA Officer may request further information or provide feedback on the report. Please see the Standard SWAMP Contract Language for additional requirements regarding CPARs for contract partnerships.

PROGRAM DESCRIPTION

SWAMP was created under the State Water Board in response to the Legislature's direction in Assembly Bill 982 (Statutes of 1999), and California Water Code Section 13192, to create a proposal for a unified surface water monitoring program for the state. That "Report to Legislature" served as the foundation for the creation of the program in 2000. [Water Code Section 13192 was repealed by Assembly Bill 2701 (Statutes of 2004).] SWAMP now works in partnership with the California Water Quality Monitoring Council, which was created in response to Senate Bill 1070 (Statutes of 2006), that rewrote Water Code Section 13181, to help achieve the goals of the Council's 2010 recommendations for A Comprehensive Monitoring Program Strategy for California. The Council's program strategy document has recommended SWAMP's Comprehensive Monitoring and Assessment Strategy to Protect and Restore California's Water Quality (SWAMP Strategy) as a key component of the monitoring and assessment strategy for the state.

The State Water Board's mission is "to preserve, enhance, and restore the quality of California's water resources and drinking water for the protection of the environment, public health, and all beneficial uses, and to ensure proper water resource allocation and efficient use, for the benefit of present and future generations." This mission applies to all Regional Water Boards and all programs governed by the Boards. In alignment with this overarching agency mission, the program's specific mission is "to provide resource managers, decision makers, and the public with high-quality and timely information and tools needed to evaluate the condition of surface waters throughout California." The information collected and tools developed under SWAMP are used to inform and make regulatory decisions to protect:

- **the environment,**
- **public health, and**
- **beneficial uses.**

For more information on relevant regulations and decisions made by the principal data users, please see the Program Quality Objectives Section. In addition to providing information and tools, SWAMP's goals are to (1) improve the way that Water Board and its partner agencies monitor and assess how well California's water bodies support their various beneficial uses and (2) enhance the ability of the Water Board and its partner agencies to protect and restore California's water resources. To achieve these goals, the SWAMP Strategy requires that the program:

- ❑ **Conduct statewide and regional ambient monitoring projects:**
  - To support Water Board programs and inform management decisions to protect the environment, public health, and beneficial uses.
- ❑ **Coordinate internally and externally:**
  - To standardize the way California's surface water monitoring data are collected, stored, shared and interpreted; and
  - Leverage limited resources by coordinating with other water quality monitoring efforts on a local, regional and statewide level.
- ❑ **Develop and maintain infrastructure and resources:**
  - To support data compatibility, production of high quality data, and appropriate data analysis for useful data interpretation inside and outside of the program; and
  - Develop assessment tools (indices, indicators, endpoints) that directly assess beneficial use impairment or support status.

Information on monitoring projects and coordination efforts are provided below. The requirement for infrastructure and resources is met through the individual projects described, as well as through the development, approval, and implementation of the Program Plan.

MONITORING PROJECTS

SWAMP implements both statewide and regional monitoring and assessment projects, as well as special studies, to investigate key water quality concerns and inform management decisions. The statewide assessments provide a "big picture" of the overall status and trends of water quality throughout California, while the regional assessments provide more detailed information needed by water regulators and managers to detect and fix problems within a specific waterbody or watershed in that region's jurisdiction.

STATEWIDE MONITORING PROGRAMS

SWAMP facilitates five specialized statewide monitoring programs that support the Water Board's mission to evaluate and protect the environment, human health, and beneficial uses on a statewide scale. Each statewide program may contain multiple sub-projects that address specific components of the larger program, such as waterbody types, reference conditions, special studies, or stakeholder involvement. The statewide programs also work towards the programmatic goals of coordination, infrastructure, and resource support. The five statewide programs are listed below and general data use is discussed. More detailed information about each program is provided in the following section.

- Bioassessment Program
- Stream Pollution Trends Monitoring Program
- Bioaccumulation Monitoring Program
- Freshwater Harmful Algal Bloom Program
- Citizen Monitoring Program (Clean Water Team)

The Bioassessment and SPoT Monitoring Programs focus on supporting the protection of the environmental and habitat-related beneficial uses by assessing aquatic ecosystem health in streams and rivers. These programs provide data for development of the CWA Section 303(d) List/305(b) Report (Integrated Report), that assesses California water and stream health. The data produced from these programs are also used in the development of new water quality regulations, such as the proposed Biostimulatory Substances Objective and Program to Implement Biological Integrity.

The Bioaccumulation Monitoring Program and FHAB Programs focus on the protection of human health and beneficial uses pertaining to fishing, drinking, and contact recreation by assessing fish consumption safety in fishable waters and addressing cyanobacteria blooms and cyanotoxins in our lakes and streams, respectively. The data collected by the Bioaccumulation Monitoring Program are utilized by the State Water Board to assess the impairment of fishing and shellfish harvesting in California's water bodies through the Integrated Report process. In addition, fish tissue studies have led to the development of OEHHA's Fish Consumption Advisories, and the Statewide Mercury Program. The FHAB Program supports multi-agency incident management response for harmful algal blooms (HABs), and developed a new monitoring and assessment strategy for this emerging water quality and public health concern. The FHAB Program has facilitated trainings and developed guidance materials, web data displays and other tools for cyanobacteria bloom management.

The Citizen Monitoring Program is a SWAMP initiative to support the efforts of citizen monitoring groups in California. The program addresses the Water Boards' mission to

provide information, training, and coordination to our citizen monitoring partners. Those partners assist the Water Boards in filling information gaps in watersheds within their own communities and share in the observation and protection of California's watersheds. Citizen monitoring data is primarily used by local groups to answer questions or address concerns related to water quality in their own watersheds. Citizen monitoring data have also been used to support activities such as water quality assessments for the Integrated Report; compliance monitoring of discharge permits; monitoring the safety of swimming holes (Safe-to-Swim studies); and others.

For more program information, please see the Intended Data Uses. Below is an overview of each statewide program, including a description of that program's sub-projects (if applicable). For additional information, please click on the links provided.

BIOASSESSMENT PROGRAM

The overall objective of SWAMP's Bioassessment Program is to promote the integration of measures of ecological integrity into California's water resource management programs so that biological information can be used to assess, protect, and restore multiple waterbody types throughout the state. The Bioassessment Program's strategy is to provide information and tools for assessing ecological health and causes of impairment, and to support the integration of ecological condition indicators into an expanding range of regulatory and resource management programs. The program facilitates two statewide monitoring efforts, the Perennial Streams Assessment and the Reference Condition Management Program along with coordination with the US EPA National Surveys Project and the Forest Service Management Indicator Species Monitoring Program.

The Bioassessment Program also develops and maintains the infrastructure for conducting bioassessment in California including field and lab methods, data analysis tools, and taxonomic standardization. Early investments of the Bioassessment Program were focused on infrastructure development. The Bioassessment Program is now shifting investments to expand State Water Board capacity to assess multiple indicators (e.g., benthic algae) and multiple waterbody types (e.g., non-perennial streams, lakes, depressional wetlands). This expansion is accompanied by targeted efforts to encourage successful adoption and implementation of ecological indicators in Water Board programs and those of its partner agencies.

Perennial Streams Assessment

The Perennial Streams Assessment (PSA) is an ongoing, long-term statewide survey of the ecological condition of wadeable perennial streams and rivers throughout California. The PSA collects samples for biological indicators (benthic macroinvertebrates (BMI) and algae) and chemical constituents (nutrients, major ions,

etc.), and also conducts habitat assessments for both instream and riparian-corridor conditions. SWAMP's PSA plays an important role in standardizing, linking, and supporting numerous independent programs conducting probability surveys in California. Partners include US EPA's National Rivers and Streams Assessment, Southern California Stormwater Monitoring Coalition, San Francisco Bay Regional Monitoring Program, Tahoe Regional Planning Agency, Bureau of Land Management, and U.S. Forest Service. Such partnerships help create a statistically robust, yet cost-effective and efficient, approach to answering important water quality monitoring questions.

In 2020 and 2021, COVID-19-related travel restrictions, unprecedented droughts and wildfires substantially impacted field sampling efforts for PSA. Sampling for the statewide Perennial Streams Assessment (PSA) was restricted in 2020 (both geographically and in terms of analytes collected) and was completely postponed in 2021. PSA monitoring will not occur in 2022 and starting in 2023, PSA monitoring will be coordinated with US EPA’s National Rivers and Streams Assessment (NRSA), with sampling occurring two of every five years.

Reference Condition Management

The Reference Condition Management Program (RCMP) is California’s program for establishing and maintaining a network of relatively undisturbed “reference” sites for wadeable streams and rivers throughout California. This network is vital to the establishment of reference conditions, which define the biological conditions expected in healthy streams when human activity in the environment is absent or minimal. The RCMP plays a central role in developing assessment thresholds for biotic integrity and implementation, and is supplemented by reference programs of several partner agencies, such as the U.S. Forest Service, the Tahoe Regional Planning Agency, and the US EPA.

In 2020 and 2021, COVID-19-related travel restrictions, unprecedented droughts and wildfires substantially impacted field sampling efforts for RCMP. In 2022, RCMP sampling will increase to better characterize how streams and biological communities have responded to drought, wildfire, and other environmental impacts caused by climate change. This information will be used to inform management questions related to post-fire recovery, drought resilience, watershed restoration, and identification of high quality waters.

Dry Phase Intermittent Rivers and Ephemeral Streams

The Bioassessment Program is beginning to collect investigative bioassessment data for terrestrial invertebrates and bryophyte assemblages for assessing the ecological health of intermittent rivers and ephemeral streams during their dry phases. The goal of

this is to expand the types of waterbodies that can be assessed for biological integrity beyond perennial streams because in some ecoregions of California, the majority of water bodies are non-perennial.

U.S. Forest Service Management Indicator Species Monitoring Program

The Bioassessment Program is collaborating with the U.S. Forest Service Management Indicator Species Program and the Sierra Forest Management Indicators Project to produce a more comprehensive assessment of forested areas in northern California. The U.S. Forest Service is adopting SWAMP bioassessment monitoring protocols.

US EPA National Aquatic Resource Surveys

The Bioassessment Program also manages the state implementation of three of the five National Aquatic Resource Surveys in California (Large Rivers, Streams and Lakes).

Stream Pollution Trends Monitoring Program

SWAMP initiated the Stream Pollution Trends Monitoring Program (SPoT) in 2008 to determine the long-term, statewide trends and impacts of pesticides, heavy metals, and other stream contaminants that accumulate in sediment. Upon approval by the SPoT Scientific Review Committee, data are collected annually to evaluate land-use patterns and the effectiveness of water quality management programs over time. In addition, SPoT's network of 100 monitoring sites serves to foster collaborative efforts with local, regional, and federal water quality programs.

Bioaccumulation Monitoring Program

The mission of the SWAMP Bioaccumulation Monitoring Program is to assess the impacts of contaminants in fish and shellfish on beneficial uses in California water bodies through statewide monitoring under SWAMP. The Bioaccumulation Monitoring Program conducted the first-ever statewide assessments of contamination in fish from lakes, rivers, and coastal waters across the State, and the results demonstrated widespread contamination of fish tissue. This led the State Water Board to initiate development of a Statewide Mercury Control Program for Reservoirs. Additional monitoring has been conducted to support the development of OEHHA's fish consumption advisories to alert the public about significant health threats at specific water bodies. The SWAMP Bioaccumulation Monitoring Program has also worked through the Safe to Eat Workgroup (formerly Bioaccumulation Oversight Group (BOG)) of the Monitoring Council to help develop the Safe to Eat portal that presents this information to decision-makers and the public in a form that they can easily use.

Since the Bioaccumulation Monitoring Program's long-term monitoring study was initiated in 2007 with the first screening survey, several rounds of trends monitoring have been implemented and corresponding data reports generated. Efforts are underway to ensure bioaccumulation monitoring continues to be aligned with the public's needs, particularly in areas where communities rely on fishing for consumption, subsistence, sustenance and cultural purposes.

Lakes and Reservoirs

The Bioaccumulation Monitoring Program's Lakes and Reservoirs project focused on the long-term sampling and analysis of sport fish to track status and trends in fish tissue concentrations of contaminants in the many California lakes and reservoirs where bass and other species are present. The Long-term Monitoring Study (initiated in 2015) will continue to monitor long-term trends in mercury concentrations in lakes dominated by bass (a fish species known to accumulate high levels of mercury). This study will provide updated information on the status of these lakes and a statewide perspective on long-term trends to evaluate effectiveness of management actions (e.g., mercury control plans) as well as the impacts of factors such as increases in global emissions or climate change on fish mercury levels. Monitoring occurred in 2015, 2017 and 2019, and is planned for 2021, 2023 and 2025.

Rivers and Streams

The Bioaccumulation Monitoring Program's Rivers and Streams project focuses on the sampling and analysis of sport fish in a one-year screening survey of bioaccumulation in California rivers and streams. The study aims to provide reasonable coverage of popular fishing locations.This effort is part of a long-term comprehensive study of bioaccumulation in California water bodies and occurs every 10 years. Monitoring occurred in 2012 and is planned to occur in 2022.

Coastal Waters

The Bioaccumulation Coastal Waters project focuses on sampling and analysis of sport fish in a two-year screening survey of bioaccumulation on the California coast. The study evaluates two closely associated habitat types (the coast, bays and estuaries) to evaluate the current fishing beneficial use status. This effort is part of a long-term comprehensive study of bioaccumulation in California water bodies and occurs every 10 years. Monitoring occurred in 2009 and 2019 in southern California zones and in 2010 and 2020 in central and northern California zones.

Wildlife Study

The Bioaccumulation Wildlife Study project focuses on developed and demonstrated methods of monitoring mercury in two closely related avian wildlife species widely distributed across California's lakes and reservoirs. Monitoring mercury in blood and

eggs proves to be a particularly effective technique for obtaining estimates of wildlife risk across these water bodies. The study also provides guidance on the prey fish monitoring that is needed to support estimations of wildlife risk when wildlife cannot be directly sampled. Wildlife Study monitoring occurred in 2012 and 2013.

Freshwater Harmful Algal Bloom Program

The SWAMP FHAB Program is part of a recent statewide initiative, established in 2016, to address cyanobacteria and other harmful algal blooms and algal toxins in our lakes, estuaries, and streams. The mission of the SWAMP FHAB Program is to support the protection of animal and human health by being a resource for coordinated HAB response, assessment, and communication. This is accomplished through outreach and providing technical support services. Phase 1 of a statewide assessment and support strategy for the new program was developed in 2015 and finalized January 2016. Work began quickly to establish the program infrastructure recommended in the Phase 1 strategy, including the following components: incident response guidance for recreational waters, standardized field and laboratory procedures, quality assurance, centralized website (HABs portal), outreach and education, and limited applied research to support program implementation. FHAB Program staff implement the program in close collaboration with the Regional Water Quality Control Boards and the California Cyanobacteria and Harmful Algal Blooms Network (CCHAB) of the California Water Quality Monitoring Council. A web-based satellite imagery analysis tool to support mapping of developing cyanobacteria blooms was beta tested and released to the public in summer 2019. A series of workshops and webinars (approximately 50) have been hosted statewide to provide education and outreach to health agencies, water managers, recreation land managers, non-governmental organizations, and other stakeholders. Work began in late 2018 to develop a Phase 2 comprehensive statewide monitoring and research strategy and the final report is anticipated in Fall 2020. All voluntary reports of blooms, including data from incident response investigations and waterbody-specific monitoring, are published daily to the public CA HABs Portal Incident Reports Map. The FHAB Program's incident response and coordination, a key component of the Phase 1 strategy, provides response leadership, training, limited laboratory testing services, and communication to ensure that the public is informed.

Citizen Monitoring Program (Clean Water Team)

The Clean Water Team is an initiative to support the efforts of citizen/community monitoring groups in California. This free program assists groups with citizen monitoring programs through six core functions: outreach and communication, technical assistance/quality assurance, training, equipment loans, event support, and

information management. The Clean Water Team is a vital resource that these monitoring programs can rely upon for support and guidance. The goals of the Clean Water Team are to build and support the State's watershed stewardship through citizen monitor involvement in the Total Maximum Daily Load program; reducing and preventing water pollution and recovering lost beneficial uses; and to support citizen monitoring activities funded through State Water Board-awarded grants.

SWAMP recognizes several benefits provided by citizen monitoring programs. With appropriate training, citizen monitors are capable of supplying useful, scientifically-defensible data to state agencies. In addition, a well-organized network of local residents conducting monitoring can leverage limited resources as they can conduct intensive monitoring of a relatively large area on a more regular basis than a field crew from a Regional Water Board or other state agency. Another recognized benefit of citizen monitoring is the way in which it promotes awareness of water quality issues and stewardship of the environment in local communities.

REGIONAL MONITORING PROJECTS

SWAMP's regional assessments are individually planned and executed by each of the nine Regional Water Boards. Each region identifies its own ambient monitoring priorities and designs assessments at the appropriate scale (i.e., regional, watershed, or waterbody-scale) to answer specific monitoring questions of priority to that region. For example, regional monitoring projects may be designed to:

- ❑ Identify pollutant sources
- ❑ Provide long-term data sets (to track trends over time)
- ❑ Target information gaps (to meet the needs of multiple programs)
- ❑ Support the Integrated Report process
- ❑ Support enforcement actions
- ❑ Measure success of regulatory/management efforts
- ❑ Match/leverage funding of multiple partners for studies within the region
- ❑ Pilot innovations (which, once vetted, are used by others).

Per the Porter-Cologne Water Quality Control Act, the nine Regional Water Boards exercise rulemaking and regulatory activities within the geographic watershed basin(s) in which they govern. Each Regional Board has specific Water Quality Control Plans for watersheds within the region. The data provided by regional projects is primarily utilized to address water quality issues or topics governed by the Water Quality Control Plans specific to the waterbody studied.

SWAMP's regional assessments also complement the statewide assessments by allowing the flexibility needed to address the highest priority ambient monitoring needs in each region. For example, some (primarily urban) regions use much of their SWAMP resources to partner with other entities (such as regulated dischargers) to establish and implement coordinated regional monitoring partnerships, while other (primarily rural) regions have (depending on the watershed) fewer potential partners and, therefore, use their SWAMP resources to conduct monitoring on their own. The regions also use SWAMP funds to conduct crucial follow-up monitoring in response to the findings of SWAMP's statewide assessments (SWAMP, 2014). For more information on the ways the program data are used, please see the Intended Data Uses.

More information on regional efforts is available in the SWAMP Achievements Report. Some examples of past regional monitoring projects are included below:

- **Regional Monitoring Coalition for the San Francisco Bay Region** - The Bay Area Stormwater Management Agencies Association Regional Monitoring Coalition samples urban streams according to the Municipal Regional Stormwater NPDES Permit. From 2012-2015, SWAMP sampled 42 non-urban sites to support this effort. The addition of these samples provide valuable perspective for the urban data collected by the stormwater programs. The most recent annual report based on the data collected in 2015 will be available at the SF Bay SWAMP website.
- **Central Coast Ambient Monitoring Program (Central Coast Region)** - The Central Coast Ambient Monitoring Program (CCAMP) is the Central Coast Regional Water Board's regionally-scaled water quality monitoring and assessment program. The Central Coast Region is divided into five watershed rotation areas. In each watershed rotation area, approximately 30 stations are monitored monthly for one year. Stations are selected along the mainstem and at major tributary inputs. This tributary-based design is intended to aid in efficient identification of the general source areas of pollutant problems. In addition, 33 long-term-trends sites are located at the bottom of the Region's largest coastal watersheds. Each month, staff collects measurements onsite for flow, pH, oxygen, water temperature, turbidity, and salinity, and collects samples for lab analysis of nutrients, salts, metals, fecal indicator bacteria, and dissolved and suspended solids. Some sites are also monitored for toxicity and biological community health.
- **Non-Perennial Streams Monitoring (San Diego and Colorado River Basin Regions)** - Non-perennial streams range from ephemeral washes and headwaters that flow for only a few hours after rain events to streams with sustained flows lasting nearly all year. Although these streams function

differently from perennial streams, they also provide essential ecosystem services. These ecosystem services include watershed and landscape hydrologic connections; water supply protection and water quality filtering; wildlife habitat and movement/migration corridors; sediment transport, storage and deposition; groundwater recharge and discharge; vegetation community support; and nutrient cycling and movement. This project's bioassessment tools (algal and BMI indices and California Rapid Assessment Method (CRAM)) serve a subset of non-perennial streams that contain flow for sufficient duration to allow the establishment and support of in-stream benthic communities. The Extent, Hydrology and Ecology of Non-Perennial Streams in the San Diego Region monitoring plan provides more information.

- **Safe to Swim (Central Valley Region)** - SWAMP field crews monitor bacteria levels in eight watersheds to assess recreation safety. The watersheds include a mix of areas without previous monitoring data and areas with a history of elevated bacteria levels. The Central Valley SWAMP has collected nine years of data through a series of Safe to Swim studies. More information is available on the Central Valley SWAMP website.

- **Tulare Lake Basin Rotational Watershed Monitoring (Central Valley Region)** - SWAMP field crews in the Central Valley Region's Fresno Office initiated monitoring in the Tule River watershed, the third watershed in the Tulare Lake Basin Rotational Watershed Monitoring program. Nine sites are monitored for a one-year period. Water quality sampling includes nutrients, minerals, bacteria, metals, and surfactants. The Tule watershed is the third of four watersheds in the Tulare Lake Basin that are monitored under the rotational monitoring project.

COORDINATION AND WORKGROUPS

Coordination is one of the key elements of the SWAMP strategy to support the State Water Board's mission. Coordination in SWAMP takes place at numerous levels both internally and externally. External coordination takes place at levels ranging from statewide multi-agency efforts, such as the California Water Quality Monitoring Council, to small workgroups addressing key developments in emerging areas of monitoring methods, such as the California Cyanobacteria Laboratory Network. Internally, the support and continued development of SWAMP is achieved through multi-level coordination including routine meetings of the SWAMP Coordinators Group, SWAMP Roundtable, and subject-specific workgroups. Workgroups may be established and ongoing for continuing topics, or newly created and limited-term for emerging or priority topics. Below is a list of major coordination groups in which SWAMP participates or

facilitates. Below is a description of the major coordination efforts and workgroups of the program.

California Water Quality Monitoring Council

The California Water Quality Monitoring Council (SB 1070) is co-chaired by the Cal/EPA and the Natural Resources Agency, and is composed of stakeholders from state regulatory, public health, and natural resource agencies, the regulated community, non-governmental organizations, and academia. The mission of the council is to develop, maintain, and coordinate the implementation of a comprehensive monitoring program strategy for California to improve the efficiency and effectiveness of California's system of water quality and associated ecosystem monitoring and assessment, and to ensure that the resulting data and information are made available to decision makers and the public via the internet. To achieve this mission, the Council targets significant coordination through seven interagency, theme-specific workgroups (Safe Drinking Water Workgroup, Safe-to-Swim Network, Safe to Eat Workgroup (formerly Bioaccumulation Oversight Group (BOG)), Wetland Monitoring Workgroup, Healthy Watersheds Partnership, Estuary Monitoring Workgroup, and California CyanoHAB (CCHAB) Network) and two support workgroups (Data Management Workgroup and Water Quality Monitoring Collaboration Network) staffed by issue experts representing key stakeholders.

SWAMP is a key partner and active participant in the California Water Quality Monitoring Council and its Workgroups. SWAMP staff leads three of the Council Workgroups: the Safe to Eat Workgroup (formerly BOG), the Healthy Watersheds Partnership, and the newly-formed Inland Beaches Workgroup, which is part of the Safe-to-Swim Network. SWAMP staff also participates in the CCHAB Network and Data Management Workgroups. SWAMP staff and funding support all or part of the Safe to Eat, Healthy Watersheds and CCHAB Portals. SWAMP also collaborates with partners through its statewide monitoring programs and other avenues. More information is provided below on the workshops that SWAMP staff lead or participate in.

Healthy Watersheds Partnership

The Healthy Watersheds Partnership is a workgroup of the California Water Quality Monitoring Council whose mission is to promote the identification of healthy watersheds, protect and maintain healthy watersheds, and raise the visibility and importance of protecting high-quality waters. The goals of the Partnership are to: (1) create a common framework for generating, assembling, disseminating, and analyzing data related to water quality, landscape condition, and ecological integrity by leveraging

existing efforts across agencies, (2) serve as an increasingly essential resource for scientists, resource managers, and the public, and (3) affect change through improved coordination and collaboration among local, state, and federal agencies, tribes, non-governmental organizations, and other California Water Quality Monitoring Council workgroups.

Safe to Eat Workgroup (formerly BOG)

The Safe to Eat Workgroup (STEW), a workgroup of the California Water Quality Monitoring Council, was created to assess the impacts of contaminants in fish and shellfish in water bodies throughout the state. In addition to conducting bioaccumulation research and synthesizing data from other studies, STEW manages the Safe to Eat Portal and a forum for coordinating bioaccumulation monitoring. STEW discussions have also created partnerships between state and regional SWAMP monitoring efforts, and between SWAMP and other programs such as the Regional Monitoring Program for Water Quality in the San Francisco Estuary, and the Southern California Bight Regional Monitoring Program.

Inland Beaches Workgroup

The Inland Beaches Workgroup was formed to provide guidance and protocols for use by SWAMP; to monitor, assess, and report on swimming safety of inland waters; and to facilitate coordination and data sharing with monitoring groups throughout the state. The goals of the workgroup are to add inland water bacterial indicator data to the Safe-to-Swim Portal; standardize methods to monitor and assess swimming safety information for decision makers and the public; and to encourage all bacterial indicator data be reported in CEDEN.

California Cyanobacteria and Harmful Algal Bloom Network (CCHAB)

The CCHAB network is a statewide inter-entity workgroup assembled to work towards the development and maintenance of a comprehensive, coordinated program to identify and address the causes and impacts of cyanobacteria and harmful algal blooms (HABs) in California.

The objectives of the network are to:

- ❏ Develop a unified multi-entity program to identify and address HABs in California's freshwater ecosystems;
- ❏ Promote improvements in, and coordination of, monitoring, assessment, reporting, and management of HABs in California;

- ❏ Develop collaborative relationships among entities (e.g., federal, tribal, state, and local agencies, academic researchers, end-users, and stakeholders) responsible for addressing cyanobacteria concerns and impacts on beneficial uses;
- ❏ Coordinate with the California Harmful Algal Bloom Monitoring and Alert Program
- ❏ Make efficient use of federal, tribal, state, regional, and academic resources to address cyanobacteria and HAB concerns by sharing information to avoid duplicative efforts; promoting research, monitoring, and assessment; identifying technical and policy gaps; and communicating cyanobacteria concerns to the public;
- ❏ Work collaboratively toward public awareness of the risks associated with HABs to people, pets, livestock, and wildlife.

SWAMP Roundtable

The purpose of the SWAMP Roundtable is to coordinate and share information among state and regional SWAMP staff and partners in order to manage SWAMP in a manner consistent with the SWAMP Mission, the SWAMP Strategy, the SWAMP Timeline, and other applicable procedures and processes. Roundtable discussions include technical issues related to monitoring and assessment; quality assurance and data management issues; updates on regional and statewide monitoring programs; liaison reports from other programs; messages from Water Board management; and similar items. For more information on the structure and function of the SWAMP Roundtable, please see the SWAMP Programmatic SOP.

SWAMP Coordinators Group

The SWAMP Coordinators Group includes staff from the State and Regional Water Boards, and a representative from US EPA. This group discusses internal issues related to program management and implementation and is responsible for the development of the annual SWAMP Work Plan for EPA Region 9. The Coordinators Group also plans and facilitates the SWAMP Strategy meetings and provides discussion and proposals to OIMA management regarding statewide monitoring projects. Open, transparent, and timely communication is essential for SWAMP. When decisions that affect group members need to be made, the informed person(s) will notify the group, who in turn will seek clarity on the decision-making authority. The informed person(s) will also share their justification/rationale/recommendation for determining the authority to make the decision. Generally, decisions are made by consensus. This group was also responsible for the review and ranking of monitoring project proposals submitted for potential funding through non-discretionary Waste

Discharge Permit Funds prior to 2019, when that process was changed. The role of this process was to ensure coordination and comparability of monitoring projects carried out both inside and outside of SWAMP, as well as ensuring efficient use of state funds. For more information on the structure, function, and guiding principles of the SWAMP Coordinators Group, please see the SWAMP Programmatic SOP.

STATEWIDE PROJECT WORKGROUPS

SWAMP STEW SCIENTIFIC REVIEW COMMITTEE

The Safe to Eat Workgroup (formerly BOG) is a subcommittee of the SWAMP Roundtable that provides oversight of SWAMP's statewide Bioaccumulation Monitoring Program. The STEW Scientific Review Committee reviews the assessment questions, objectives, design, indicators, and methods used in the Bioaccumulation Monitoring Program, and provides recommendations as needed. Comprising staff from US EPA, OEHHA, US Fish and Wildlife Service, CA Department of Fish and Wildlife, SFEI, and Moss Landing Marine Labs, the Scientific Review Committee actively works with the State and Regional Water Boards to help refine the program.

SWAMP SPOT SCIENTIFIC REVIEW COMMITTEE

The SPoT Scientific Review Committee reviews the assessment questions, objectives, design, indicators, and methods used in the SPoT program, and provides recommendations as needed. Comprising staff from the California Department of Pesticide Regulation, United States Geological Survey, and SFEI, the Scientific Review Committee actively works with the State and Regional Water Boards to help refine the SPoT Program. In 2015, the Committee members proposed the most significant change to the program yet, resulting in a rotating monitoring schedule, the addition of a test species sensitive to fipronil and neonicotinoids, and a collaborative pesticide monitoring effort with the Department of Pesticide Regulation.

CYANOBACTERIA LABORATORY NETWORK

The Cyanobacteria Laboratory Network consists of federal, state, and university laboratories that perform cyanobacteria testing for water and other complex matrices, such as tissue, sediment, and serum. Additional members include interagency staff working to manage and respond to HABs, while a SWAMP IQ staff member facilitates the Lab Network. The purpose of the Lab Network is to: (1) improve data comparability and reduce variability among labs, (2) improve sample preparation and analysis, and (3) test split samples. Several products are planned, including: a lab services handout for the public (version 2 released), data interpretation guidelines (complete), sampling design recommendations (complete), and how to report toxin detections (complete).

OTHER SWAMP PROJECT WORKGROUPS

SWAMP convenes various technical workgroups, as needed, for a limited time basis. Examples of topics include: constituents of emerging concern, bioassessment coordination, sensor data, algal blooms, ocean standards, open data, tool development, etc. These groups address topics like technical issues, project scoping, event planning, coordination, and fact sheet development. Participation is voluntary.

PROGRAM QUALITY OBJECTIVES

Data quality objectives (DQOs) are developed as part of a systematic planning process designed to assist investigators in the development of a sound and defensible project. DQOs are the qualitative and quantitative statements that clarify the study's objectives, define the appropriate type, quantity, and sensitivity of data to collect, and specify the tolerable levels of potential error that will be used to establish the level of quality needed to support decisions (US EPA QA/G-5, 2002).

SWAMP aims to collect and provide data that are well planned and documented, valid and defensible, and supportive of making decisions required by California's Water Quality Control System. Data types collected by the program include physical habitat assessments; flow and chemical sensor readings; chemical composition analysis of water, sediment, and tissue; fecal indicator, pathogen, antibiotic resistance, and microbial source analyses; trash; bioassessment; and satellite detection data. Data collected under SWAMP are used to make environmental, regulatory, and public health decisions as well as promote scientific advancement and understanding of California's surface waters. The decisions and information provided by the program can have significant health, economic, and political effects. Therefore, it is important that the data collected by SWAMP should be of the appropriate type, quality, and quantity needed to support the intended data use.

The following sections address the intended uses of data collected by the program, an explanation of California's Water Quality Control System, which determines the targeted water quality thresholds for useful reporting limits, and the data quality indicators that provide a rubric for assessing and limiting error in the program data.

INTENDED DATA USES

As discussed in the Program Description section, SWAMP projects at both the statewide and regional levels address a variety of intended data uses. These uses vary widely from informing the listing of impaired water bodies to conducting cutting edge research. Below is an example list of the types of intended uses of SWAMP data:

- ❑ Integrated Report development
- ❑ Total Maximum Daily Load (TMDL) development and/or evaluation
- ❑ Beneficial use protection assessments
- ❑ Developing or refining beneficial uses
- ❑ Developing regulatory policy
- ❑ Developing fish consumption advisories
- ❑ Swimming advisories
- ❑ Identifying pollutant sources
- ❑ Providing long-term data sets (to track trends over time)
- ❑ Targeting information gaps (to meet the needs of multiple programs)
- ❑ Supporting enforcement actions
- ❑ Measuring success of regulatory/management efforts (e.g., WDRs, waivers of WDRs, NPDES permits, watershed plans)
- ❑ Maintaining data on relatively undisturbed reference sites to act as a baseline to assess the effects of drought and climate change
- ❑ Research.

As depicted by the list above, the uses vary widely and therefore the type and number of data needed, method sensitivity, and level of quality needed to address each type of intended data use also vary. For example, data used for the Integrated Report must meet specific requirements as outlined in the Water Quality Control Policy for Developing California's CWA Section 303(d) List. Whereas, data collected for fish consumption advisories must be able to be used to assess human health risks as determined by OEHHA toxicologists. Therefore, to begin to identify and address the differing data needs, the program quality objectives must be categorized. After a review of the various intended data uses and the existing requirements of each data type, the following four categories were developed:

- **Investigation**
- **Ambient**
- **Public Health**
- **Regulation**

Definitions of these categories are provided below. For the purposes of this document, the section below will focus on type, quantity, timing, and method sensitivities needed, if applicable, to address the intended data uses in regard to the relevant regulations, decisions, and decision makers. Discussion of the required performance criteria for each category will be discussed in the Quality Control and Performance Criteria Section.

INVESTIGATION

The “Investigation” category pertains to data collected for exploratory purposes only. These purposes can include a project utilizing and testing cutting edge methodologies, piloting innovations, or conducting preliminary explorations and/or characterization of watersheds or water quality issues with little or no supporting data. This data collection is often utilized at the statewide and regional levels as special studies to determine if more intensive studies are warranted. Applicable intended data uses include:

- ❏ Research
- ❏ Pilot studies
- ❏ Contaminants of emerging concern monitoring
- ❏ Incident/spill/harmful algal bloom response

Data collected under this category include situations where the study is not tied directly to a regulatory, compliance, or policy statute that determines the level of quality required; where regulations are established, but no methodologies have been standardized at this time; or where no data has been collected, to date, at a site. Under this category, the method sensitivity, quality, and amount of data collected should be sufficient to meet the project’s specific needs. Those needs should be addressed and documented with the applicable required QC planning documentation. If a water quality issue is identified by the study, it is strongly recommended that a more detailed investigation and analysis should take place, utilizing Data Quality Objectives appropriate for addressing the issue. If data from this category are to be utilized beyond the project staff directly, it is recommended that the data be looked at more closely to ensure that the measured uncertainty is stringent enough to support their use. Reduced costs shall not be utilized as a motivator to utilize this category. Investigative studies should determine appropriate assessment thresholds utilizing the standard process identified in the Assessment Threshold Selection section of this Program Plan.

AMBIENT

The “Ambient” classification pertains to data that are intended to be used for support of Water Quality Control Plans, Integrated Report development, policy development, and other beneficial use assessments to “answer specific questions about the status and trends in water quality and/or beneficial uses of water.” This data type is the core intended use of SWAMP data including regional monitoring efforts, statewide Bioassessment, Stream Pollution Trends, Bioaccumulation, and Citizen Monitoring Programs. Applicable intended data uses may include:

- ❑ Regional beneficial use protection assessment
- ❑ Bi-annual Integrated Report development
- ❑ Development of TMDLs
- ❑ Development of regulatory policy
- ❑ Inform monitoring requirements in permits
- ❑ Statewide assessments of status and trends
- ❑ Determining background or reference conditions
- ❑ Measuring success of regulatory/management efforts.

Status and trends questions usually pertain to whether surface water quality meets the applicable water quality objectives and promulgated criteria to protect the beneficial uses of a waterbody. Water quality objectives are assigned through Water Quality Control Plans and Policies as required under California's Water Quality Control System. The data collected by projects under this category are utilized by staff at the State and Regional Water Boards in evaluating the overall water quality and stream health in watersheds as well as site-specific determinations. These assessments can then determine if water quality control measures are effective under the plan or policy, and identify areas of concern not yet addressed. This information is also often used to adjust compliance-based monitoring requirements and can even reduce monitoring burden, and associated compliance costs, for regulated entities within the affected watershed or region through regional assessments.

In addition, the requirements for Water Quality Control Plans and Policies, Sections 305(b) and 303(d) of the Federal CWA require the state to report to the US EPA regularly on the condition of California surface waters. This report, entitled the "California Integrated Report," assesses the quality of the state's waters and identifies waters that do not meet applicable water quality objectives or standards, and then schedules those waters for development of further water quality regulation. The data collected under SWAMP are used by the State Water Board's Water Quality Assessment Unit directly to develop the biannual California Integrated Report, along with other readily available data sets submitted through CEDEN, as directed by the State Water Board's Listing Policy. The Listing Policy requires the quality of the data used in the development of the CWA Section 303(d) List shall be of sufficiently high quality to make determinations of water quality standards attainment. If the primary goal of the monitoring study is to immediately support a listing or delisting decision, the single study should meet all the criteria below. However, if updating a listing decision is a secondary goal, then data from the proposed study will be merged with previous and future studies or other ambient data in the same water body to ultimately fulfill all the Listing Policy requirements for spatial and temporal representativeness. The policy defines the following main requirements:

- **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 waterbody segment. To the extent possible, samples should represent statistically or in a consistent targeted manner the segment of the waterbody.
- **Temporal Representation:** Samples should be representative of the critical timing that the pollutant is expected to impact the waterbody. Samples used in the assessment must be temporally independent. In general, samples should be available from two or more seasons or from two or more events when effects or water quality objective exceedances would be expected to be clearly manifested.
- **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 (RL).
- **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.

California is also in the process of developing plan amendments and policies to address specific stressors and assessment needs. For example, the State Water Board is proposing to adopt statewide amendments related to biostimulatory substances and biological integrity. The Biostimulatory Substances Amendment could include: a statewide numeric objective or a statewide narrative objective (with a numeric translator), and various regulatory control options for point and nonpoint sources. This project will also include a water quality control policy to establish and implement biological condition assessment methods, scoring tools, and targets aimed at protecting the biological integrity of wadeable streams. SWAMP's bioassessment program has collected data for ecological response indicators such as benthic

macroinvertebrates, soft-bodied algae and diatoms, stream physical habitat, and basic water chemistry at over 1,000 wadeable stream reaches (reference and ambient). These data are being analyzed to inform the development of ecological response indicator thresholds for the Biostimulatory Substances and Biological Integrity Amendments.

Due to the importance and complexity of these projects, all ambient data collected must be of a known and sufficient quality. The sensitivity and amount of data collected should meet the most appropriate assessment thresholds for the study that support the water quality objectives required by a given Water Quality Control Plan and Policy. Guidance for selecting the most appropriate assessment thresholds can be found in the Assessment Threshold Selection section.

Public Health

The “Public Health” (Health) category specifically addresses beneficial uses where human and sentinel animal health can be impacted, such as fishing, shellfish harvesting, wildlife habitat, contact recreation (swimming), and drinking water. This data type is the core of the SWAMP statewide and regional bioaccumulation projects, FHAB Program, and regional safe-to-swim programs.

Animals are exposed to diverse environmental risks through their wide range of diets and biology, thus, making them sentinels for human exposures. These sentinels consist of domestic animals, aquatic animals, and wildlife. Data from sentinel animal exposure and health impacts can predict an emerging threat to public health and supports actions to prevent and evaluate human exposure and health impacts (Backer and Miller, 2016).

Because human health can be impacted based on the beneficial use of the waterbody, this category is subdivided into the following unique categories:

- **Fish Consumption Advisories**
- **Swimming Advisories/Beach Closures**
- **Harmful Algal Bloom Advisories**

Due to the importance of protecting human health, data collected under this category should be timely and of a level of quality sufficient to accurately assess human health risks. The sensitivity, amount of data collected, and timeliness of the data release should meet the unique requirements necessary to make a decision to post warnings or advisories that are protective of human health for that beneficial use. Additional levels of data review may also be required to evaluate data usability specific to this data use. The categories for public health protection are detailed below.

Fish Consumption Advisories

Fish Consumption Advisories are developed and published by OEHHA. SWAMP tissue data collected to assist in the development of these advisories should follow similar fish sampling and analysis protocols to ensure that data collected are useful in the development of advisories. The data collected should mirror the OEHHA protocols for selecting:

- ❑ Target species and number of species representative of what anglers are likely to catch in a given waterbody
- ❑ Number and type of samples
- ❑ Fish or shellfish size
- ❑ Sample timing
- ❑ Collection method
- ❑ Sample preparation
- ❑ Chemical analysis.

Data collected for the purposes of development of fish consumption advisories, should be sensitive enough to evaluate the data against the Advisory Tissue Levels developed by OEHHA.

Harmful Algal Bloom Advisories

The State's effort to coordinate monitoring and posting of advisories, closures, and drinking water notifications for harmful algal blooms in California's surface water bodies has been an evolving process. A draft voluntary guidance document was first published by the Statewide Blue-Green Algae Work Group in 2008 in collaboration with the State Water Board, California Department of Public Health (CDPH), and OEHHA. This voluntary guidance document about harmful algal blooms was updated in 2010, to include a decision tree for posting health advisory warnings and recommendations for health advisory warning signs.

Since that time, US EPA has released new health advisory guidance for algal toxins in drinking water and OEHHA has released new recommendations for health-based toxin exposure thresholds. In June 2015, US EPA released health advisory guidance for algal toxins in drinking water in order to protect human health. The recommended 10-day health advisory values are 0.3 µg/L for microcystin and 0.7 µg/L for cylindrospermopsin for children younger than school age (values are 1.6 µg/L for microcystin and 3.0 µg/L for cylindrospermopsin for all other ages). OEHHA has recommended health-based toxin exposure thresholds (also known as "action levels") to protect humans, pets, and livestock during recreational exposure for three

cyanotoxins (microcystins, cylindrospermopsin, and anatoxin-a). These health-based exposure thresholds are published in the "Toxicological summary and suggested action levels to reduce potential adverse health effects of six cyanotoxins" (OEHHA, 2012).

Based on the new recommendations from US EPA and OEHHA, the CCHAB Network completed a 2016 update of the 2010 Draft Voluntary Guidance, by publishing a new decision tree, updated trigger levels, and advisory signage. In 2020, the CCHAB Network, led by SWAMP IQ staff, further updated the Guidance based on recent science. All CCHAB Network guidance for human and animal health-based thresholds are published on the CA HABs Portal. SWAMP also published the California Freshwater Harmful Algal Blooms Assessment and Support Strategy - Phase I in 2016. The strategy includes a freshwater HAB assessment and support framework that has three components: (A) response to HAB incidents, (B) field assessment and ambient monitoring, and (C) risk assessment for potential HAB incidents. Data collected for the purposes of evaluating human risk and posting of advisories or closures, should be collected in a manner consistent with the framework, statewide Project Plan, and be sensitive enough to evaluate the data against the health advisory guidance, health-based toxin exposure thresholds, and Ambient data-use needs.

SWIMMING ADVISORIES/BEACH CLOSURES

Swimming safety is assessed by using standardized field and laboratory procedures to measure levels of fecal indicator bacteria in areas where body contact with water occurs. Indicator bacteria have unique holding time and analytical needs that may affect the data quality and data use requirements. California's coastal beaches are routinely monitored by a coordinated network of public health agencies that have developed posting and closure notification guidance to protect human health. However, historically, no such effort has been developed for inland beaches and waterways. Currently, inland waterways are assessed for beneficial use impairment through SWAMP regional monitoring and the information is available to the public through the Safe-to-Swim Portal. The Inland Beaches Work Group was recently formed to oversee actions of SWAMP to monitor, assess, and report on swimming safety of inland waters and to facilitate coordination. If and when advisory recommendations are developed by the group or by other efforts, the data collected for the purpose of posting advisories and closures should be of a quality, amount, and sensitivity to support that process and the Ambient data-use needs.

REGULATION

The "Regulation" classification pertains to data intended to be used for compliance with the National Pollutant Discharge Elimination System Permitting Program, Municipal Separate Storm Sewer System Program (MS4 Permits), CWA Section 401

Certifications, Waste Discharge Requirements, TMDL, or other regulatory permits, orders, and waivers. Applicable Programmatic Intended Data Uses:

- ❑ Compliance with regulatory permits, orders, and waivers
- ❑ Supporting enforcement actions
- ❑ Support for determining compliance with regulatory orders, permits, and certifications
- ❑ Measuring success of regulatory/management efforts as required
- ❑ Evidence collection.

These data must be collected under the terms, conditions, and requirements set forth by the regulatory order. Assessment thresholds are already determined through the development of the regulatory document. It is recommended that any permit, order, or waiver include SWAMP collection and laboratory methods and SOPs. At a minimum, method minimum quality control samples and measurement acceptance criteria should be utilized. The use of SWAMP performance criteria, or more stringent guidelines, is highly recommended. National Environmental Laboratory Accreditation Program (NELAP) or Environmental Laboratory Accreditation Program (ELAP) certification is required of all laboratories performing analytical work for regulatory projects. In addition, methods should be compliant with 40 CFR where applicable and required.

Data used for regulatory purposes must be reviewed on a case-by-case basis.

CALIFORNIA'S WATER QUALITY CONTROL SYSTEM

State policy for protecting surface water quality in California stems from the 1969 Porter-Cologne Water Quality Control Act (Porter-Cologne Act) and the 1972 Federal CWA. These statutes are centralized toward protecting the beneficial uses of surface water for the benefit of the people of the state. Beneficial uses of surface water include, but are not limited to: municipal, domestic, and agricultural supply; habitat, migration, and cultural preservation; fish and shellfish harvesting; and recreation. Beneficial uses then serve as a basis for establishing water quality and habitat objectives, which are numerical or narrative criteria that define the concentration or other limits in bodies of water that the Water Board considers protective of those beneficial uses.

The Porter-Cologne Act also recognizes that factors affecting water quality and use of water may vary from watershed to watershed. Therefore, specific beneficial uses and water quality objectives are assigned to individual water bodies through Water Quality Control Plans. A Water Quality Control Plan identifies the beneficial uses that the plan will protect, the water quality objectives needed to protect that beneficial use, and the implementation strategy for achieving the water quality objectives. California currently

has fourteen plans that cover watersheds in each of the regions (these plans are commonly referred to as Basin Plans), as well as statewide plans for enclosed bays and estuaries, the delta, and the ocean.

The State Water Board also adopts regulations and policies for water quality control that include implementing the federal water quality criteria for toxic pollutants in the National Toxics Rule and the California Toxics Rule that apply to all inland waters, enclosed bays, and estuaries of the state.

Assessment Threshold Selection

SWAMP monitoring projects are tailored to address the statewide and/or regional Water Quality Control Plans, relevant policy, or information gaps in those plans or policies, to assess the status of a watershed or provide information to develop new policies. These plans and policies are then used to identify the parameters that will be measured for the project, the sensitivity of the methods, and the possible frequency and timing of sampling required. Often, this requires Project Managers to select the most appropriate assessment thresholds for the study. An assessment threshold is defined as the most relevant and defensible numeric threshold selected to meet a water quality objective to protect one or more beneficial uses. The State Water Board has outlined a process for selecting assessment thresholds detailed within a document called A Compilation of Water Quality Goals. In preparing to select the most appropriate assessment thresholds, SWAMP Project Managers are required to identify and document within the Project Plan or Regional Project Write-up, the following information:

- ❑ What water bodies are being studied?
- ❑ What are the beneficial uses of those water bodies?
- ❑ What are the water quality objectives and promulgated criteria to protect those beneficial uses?
- ❑ What is the natural background concentration for those analytes?

Project Managers shall follow the appropriate procedures for selecting the most appropriate assessment threshold. Once appropriate assessment thresholds have been identified, the Project Manager and Regional Project Data Liaison must work with the laboratory to choose analytical methods that are capable of achieving reporting limits at or below the assessment thresholds to the degree feasible. The selected assessment thresholds, methods and reporting limit must be documented within the Project Plan or Regional Project Write-up, and approved by the SWAMP QA Officer.

DATA QUALITY INDICATORS

Data are never free of error and always have some level of uncertainty. Uncertainty is most easily defined as the sum of all errors introduced in a measurement and is often communicated to data users through the use of error bars on graphs, or confidence intervals in text. In water quality sampling, error is introduced as early as the sampling design phase and continues to be added at each stage of monitoring: from the sample collection, preservation and handling, to the analytical measurement and the data record in the database and report. Uncontrolled error can have a significant impact on the results and can lead to decision-making errors and data that are not supportive of the project's goals. Therefore, it is important for the program to set limits on the allowable range of error, given the intended use(s), and, in turn, communicate those limits to the data users and decision makers.

Data quality indicators (DQIs) are the quantitative measures and qualitative descriptors used to set limits of acceptable levels of data error. The principal data quality indicators are precision, accuracy/bias, comparability, completeness, and representativeness. The quantitative measures include precision, bias, and sensitivity, while accuracy (in general), representativeness, and comparability are qualitative descriptors (US EPA QA/G-5, 2002). Completeness is unique and can be described by both quantitative measures and qualitative descriptors. DQIs are used as a means to specify MQOs which, if achieved, will provide an indication that the resulting data are valid and expected to meet the project DQOs (US EPA QA/G-5i, 2001). This provides a method to set an acceptable amount of uncertainty for each data point during project planning, and ultimately, to assess project performance and confidence in the results.

SWAMP requires that all limits on error be established for applicable DQIs for every measurement conducted. Program definitions for each DQI are provided below.

PRECISION

The precision of a measurement system describes how close the agreement is between multiple measurements. For example, if a piece of lumber is measured twice, the resulting value may vary slightly due to user error and the limits of the measuring device. If the two values are close together, then the measurement was said to have a high degree of precision. The application of precision can be further applied to two categories: reproducibility and repeatability.

> Repeatability-Precision is a measure of how close multiple measurements of the same material agree, while the conditions remain the same or substantially the same (US EPA QA/G-5, 2002).

> Reproducibility-Precision is the measure of how close multiple measurements agree, while using the same measurement process among different instruments or operators.

An MQO can then be set to allow for a reasonable level of error to occur within the limits of the technology and expertise available, and set an objective of precision to be achieved for a measurement to reduce decision error when the data are used.

In the SWAMP program, measures of analytical precision are made through a variety of quality control samples including, but not limited to, field and laboratory duplicates, laboratory replicates, split samples, and matrix spike duplicates. In bioassessment, precision is measured by collecting replicate samples and by performing replicate counts, identifications, or observations of the same organism, matrix, or sampling point. For example, in taxonomy, one measure of precision is expressed as “percent taxonomic disagreement,” where two taxonomists compare their identifications.

Accuracy

Accuracy is the assessment of the closeness of agreement between a measured or determined value and the true value. The term “accuracy” is sometimes used to describe both precision and bias because accuracy is a reflection of both systematic error (bias) and random error (which impacts precision). MQOs can be set to allow for a reasonable level of error to occur within the limits of the technology available for both precision and bias. Those MQOs combined set an objective of accuracy to be achieved for a measurement to reduce decision error.

Bias

Bias is the quantitative measure of the difference between those values (NDT, 2016).

Sources of bias that can be introduced into analytical systems and methods include systematic error, matrix interference, and contamination. These sources of error can be controlled through quality assurance practices (e.g., calibration). Quality control check samples (e.g., using reference materials and blank samples) are used to verify that bias is not present.

Systematic errors result in consistent bias, such as when an instrument consistently shifts the value in a predictable way or an analyst performs a procedure in a way that consistently shifts the value. The first step to controlling this type of error is to properly calibrate an instrument (see Quality Control Definitions and Requirements section for definition and types of calibrations). A common test to measure this kind of bias is to analyze a material of a range of known concentrations and compare the values that the

instrument reports to known values. These types of bias checks can include preparing and testing laboratory control spikes or certified reference materials. Some common reference materials in SWAMP field, chemical, and biological measurements include: standard buffers and conductivity solutions, analytical-grade reference materials, reference specimens, and positive controls. For chemical and biological assays, the degree to which a method detects all of the analyte within a sample is expressed by the percent recovery (US EPA, 2010).

Another source of bias may come from the sample matrix itself, where chemicals or conditions within the environmental sample interfere with the measurement. A common test for this source of bias is to create a duplicate of the environmental sample and spike it with a known amount of the analyte of interest. This type of check sample is referred to as a "matrix spike." Like testing reference materials, the degree to which a method detects the analyte within a sample in the presence of possible interferences is also expressed by the percent recovery.

A blank sample such as a field blank or method blank is measured to provide an independent confirmation that the analytical system is not contaminated and is performing within parameters. When contamination is introduced into the analytical system, the result of the blank sample provides the degree of bias that distorts the measured value higher than the true value.

Sensitivity and Resolution

Analytical sensitivity is most commonly defined as the lowest value an instrument or method can measure with reasonable statistical certainty. Resolution refers to the capability of a method or instrument to recognize small differences between values. These two terms are often used to assess if an instrument or method is useful to a study.

For water quality measurements, it is important to understand the capability of an instrument or testing method to provide a measurement that allows for a decision or assessment to be made. For example, if a health effect occurs from any concentration of lead in water greater than 5 ug/L, and the method used to measure lead does not have the capability to report a measurement any lower than 10 ug/L (reporting limit), then the method does not have a sufficient level of sensitivity. In another example, a field sensor is used to measure pH in a river with a threshold for toxic effects set at a pH of 4.05. In this instance, the sensor utilized must have a resolution of at least 0.05 increments to be useful. Sensitivity and resolution can also be applied to taxonomic identifications, where organisms are identified to a specific rank in the hierarchy of classification of biological organisms based on need. This level of identification is referred to as "standard taxonomic effort" (Stribling 2003). SWAMP projects will define

the required reporting limits and standard taxonomic effort needed for the project during the project planning phase.

Representativeness

Representativeness is the degree to which measurements correctly represent the environmental condition, target organism population, and/or watershed to be studied (US EPA QA/G-5, 2002). Representativeness touches on how well the site and sample collection represent the study area and analyte of interest, and whether or not the sample represents the conditions in the field at the time of analysis. Representativeness, itself cannot be directly confirmed. However, careful study design, adherence to standard operating procedures, use of appropriate sampling equipment (e.g., containers, preservatives), and maintaining proper sampling, handling, and storage conditions can strengthen a project's representativeness.

Comparability

Comparability expresses the measure of confidence that one dataset can be compared to and combined with another for a decision(s) to be made (US EPA QA/G-5, 2002). When projects utilize similar methodology, data reporting and units, have similar expectations for the level of quality needed, and document and provide similar amounts of metadata and quality assurance information, the data from multiple projects can be combined for decision-making purposes. SWAMP projects maintain comparability through the fulfillment of the requirements within this Program Plan. SWAMP also provides water quality monitoring projects outside of SWAMP with resources for SWAMP Comparability.

Completeness

Completeness refers to the comparison between the amount of valid data originally planned to be collected, and the actual quantity collected (US EPA QA/G-5, 2002). Completeness is commonly expressed as the percentage of reported measurements that meet DQOs compared with the number of projected quality measurements. For data to be valid and useful, completeness in SWAMP includes meeting the data reporting business rules for the database, and reporting quality assurance samples and information and metadata along with the measurements and observations. Completeness checks are carried out at the end of SWAMP projects to ensure complete data reporting, evaluate project logistics and performance, provide feedback to project teams and management, and confirm work task completion for contract invoices.

SPECIAL TRAINING/CERTIFICATION

All SWAMP personnel must undergo and maintain training specific to their role(s) in the program to ensure the successful implementation of the program. Specific academic, certification, or experience requirements of personnel are deferred to the hiring authorities of the individual agencies or entities and shall not be included in the Program Plan. The Water Board's Training Academy offers a variety of courses including field safety, Assessment Threshold selection, TMDL development, and a course series titled the College of Bioassessment supported by SWAMP.

FIELD CREWS

Field crews must be overseen by a Field Coordinator/Manager. The Field Coordinator/Manager is responsible for the oversight of field activities, ensuring routine pre-season and new employee training, maintaining records/field logbook, performing routine quality system assessments, and employing corrective actions where necessary. A field logbook must be maintained that includes, but is not limited to, the following elements: equipment inventory, instrument calibration dates and results, sensor/probe accuracy and precision check results and dates performed, personnel training records, and a log of corrective actions. This logbook shall be maintained and stored on site and made available for review upon request.

TRAINING

All SWAMP field staff must be trained on the field protocols utilized by a project prior to sample collection and documented in the field logbook. The training must be comprehensive and cover all topics, including, but not limited to:

- Sampling preparation
- Field safety
- Decontamination
- Invasive species prevention
- Calibration
- Collection, handling and holding times
- Chain of custody procedures
- Field data entry and verification.

FIELD ACTIVITIES PERMITS & PERMISSIONS

All SWAMP participants must obtain appropriate permission for their field activities. During the planning stages of any project, SWAMP participants are to request

permission from landowners to access sites on private or public property. Keys may be needed to access certain locations on private or government property. California Scientific Collecting Permits from the California Department of Fish and Wildlife must be obtained for all biological collections. Additional biological collection permits are required for some governmental land types, such as State and National Parks. These permits are independent of access permissions. These permits must be in possession during all collection activities. Additional permits for collecting threatened or endangered species may also be required.

LABORATORIES

All SWAMP laboratories must have an internal Quality Assurance Manual that is maintained and actively implemented in the day-to-day operations of the laboratory. This manual shall contain or reference other laboratory documents with the following information: organization and management structure; laboratory quality system; training requirements; equipment maintenance and calibration requirements; batch and data checks; supply ordering; record maintenance and retention requirements; preventative and corrective actions; internal audits; SOPs and subcontracting requirements. This manual shall be maintained and stored on site and provided to the SWAMP or State Water Board QA Officer upon request.

Laboratory personnel should receive and maintain current training in all aspects of the process relating to their role in the laboratory including, but not limited to: sample handling and custody; sample storage, preparation, extraction, and archiving; analyses; data entry; formatting; and review. Records of staff training shall be maintained by the laboratory and made available on request.

LABORATORY ACCREDITATION REQUIREMENTS

Laboratories shall possess and maintain State Water Resources Control Board - Environmental Laboratory Accreditation Program (ELAP) accreditation to perform an analysis that has been requested as part of compliance with regulatory conditions including, but not limited to, a waiver, order, permit, or Basin Plan. The requirement for accreditation shall be noted within an appropriate and approved QA planning document and through a contract. Accreditation is encouraged for all laboratories performing standardized methodology, and may be required as part of contract terms.

The laboratory shall use the methods specified by each approved SWAMP Project Plan or Regional Project Write-up. The Project Plan or Write-up must clearly indicate when accreditation is required for an analysis. Analyses and determinations shall be performed by qualified personnel in accordance with that accreditation.

Project Managers

All SWAMP Project Managers are offered training in the following categories: budget planning; project planning and DQOs; selection of assessment thresholds; SWAMP quality systems; field SOPs; MQOs; data querying; project data completeness; and data analysis and quality assessment. These trainings are provided by the Training Academy, SWAMP IQ, and the SWAMP unit upon request.

SWAMP Members

SWAMP members are offered training in the following categories: SWAMP quality systems; data querying; and data analysis and quality assessment. This training is provided by SWAMP IQ and the SWAMP unit upon request.

SWAMP IQ

SWAMP IQ staff members are required to be trained in the following categories: selection of assessment thresholds; MQOs and QA documentation; data verification and validation; database systems and data upload; project completeness; MQO development; performance auditing; corrective action processes; project communication processes; contract dispute notifications; process tracking; and custom data querying. Staff are also required to attend topic-specific training relating to their data specialty and cross-training in at least one other data specialty type as those courses are offered. Courses may be taken through University Extension, Water Boards Training Academy, or another contracted vendor. Staff is also encouraged to attend free online training when available. The SWAMP QA Officer is responsible for maintaining records of the training completed by SWAMP IQ staff.

SWAMP Contract Managers

All staff that manage contracts utilizing SWAMP funds within the State and Regional Water Boards must complete Contract Management Training. Training records for these staff are maintained by the State Water Board's Personnel Services Training Office.

Documents and Records

All reports, presentations, posters, flyers, fact sheets, newsletters and articles created on behalf of SWAMP, or utilizing SWAMP-funded data, shall include the SWAMP logo and a statement of credit to the SWAMP program and reference individual participants, SWAMP reports, publications, and/or events where applicable. These documents are

stored on the State Water Board servers indefinitely and public websites for a minimum of ten years. Servers and public websites are backed up nightly.

Field and laboratory records are maintained and stored by the contracted field and laboratory entities for a minimum of 10 years after the document approval or finalization date, or per contract requirements. Electronic field and laboratory data are received through the SWAMP data management process. Copies of all data files and databases are made at the time of submission and stored on the State Water Board servers and are backed up nightly. Copies of data files submitted to the State Water Board are stored indefinitely for Public Record Act purposes. Microsoft Access databases are stored for a maximum of 6 months due to storage-size considerations.

All environmental and associated quality assurance data that are ready for public release are transferred to the California Environmental Data Exchange Network (CEDEN) database and website hosted by the State Water Board. Data can be accessed by the public on the CEDEN website. Data within CEDEN are uploaded to the EPA WQX system on a weekly basis.

Contract documents are maintained and stored by the OIMA Contract Managers, Department of General Services Contracts Office, the State Water Board Division of Administrative Services Contracts Unit, and respective vendors for a minimum of 10 years after the agreement finalization date or per contract requirements. Storage and backup of those documents and files are at the discretion of those respective departments and agencies.

DATA GENERATION AND ACQUISITION

SAMPLING DESIGN

SAMPLING DESIGN PROGRAM POLICY

SWAMP projects sampling designs must be consistent with the SWAMP Monitoring Strategy and SWAMP Assessment Framework. Sampling designs are to be included as part of a Project Plan (or separately in a Monitoring Plan), or in respective sections of a Regional Write-up. It is recommended that US EPA's Guidance on Choosing a Sampling Design for Environmental Data Collection (EPA QA/G-5S) be utilized during the development of a sampling design. A project's sampling design must support the objectives of the study. Both statewide and regional sampling designs must include the following information:

- ❑ Sampling location information: Station Code, Station Name, and GIS Coordinates
- ❑ Sampling schedule, frequency, and number of events planned
- ❑ Measurements and analytes of interest
- ❑ Sampling matrices and sample types
- ❑ Narrative on the sampling design
- ❑ Rationale for the design.

REFERRAL OF SAMPLING DESIGN DESCRIPTION

Sampling design descriptions for SWAMP projects are described in Project Plans and Regional Project Write-ups as applicable. For statewide projects, sampling design is developed as part of the DQO process by the scientific leads and reviewed by the project staff, oversight committees, the SWAMP Coordinator, and SWAMP QA Officer. The statewide sampling design must be reviewed and revised (as needed) annually as part of the Project Plan. For regional projects, the sampling design is developed and documented by the Regional Project Manager as part of the Regional Project Write-up process. The regional sampling design must be reviewed and revised as needed as part of the Regional Project Write-up review and approval process by the SWAMP Coordinator and SWAMP QA Officer.

SAMPLING METHODS

SAMPLING METHOD PROGRAM POLICY

For routine monitoring under the Ambient, Health, and Regulatory data uses, SWAMP projects must collect samples using established sampling protocols for routine monitoring efforts. For the purposes of SWAMP, the term “established sampling methods” is defined as protocols developed and published by US EPA, US Geological Survey (USGS), California Department of Water Resources (DWR), CDFW, or SWAMP. SWAMP SOPs are available on the SWAMP IQ Wiki. For monitoring under the Investigative data use SWAMP projects may use established sampling protocols, new or experimental methodology from other sources, or design the project to develop sampling protocols appropriate for the objectives of the project.

REFERRAL OF SAMPLING METHOD INFORMATION

The protocol(s) that are employed by a project must be identified within the SWAMP project Project Plan or Regional Project Write-up as applicable.

PROGRAM-DEFINED SAMPLING METHOD QA REQUIREMENTS

With the exception of bioassessment monitoring, SWAMP projects may select an established sampling protocol that fits the needs of the project. The method must be clearly indicated in the Project Plan or Regional Write-up. The use of SWAMP bioassessment sampling protocols, or SWAMP endorsed methods, are required for all SWAMP projects conducting bioassessment studies. The required bioassessment sampling protocols are described below.

New methods, experimental methods, modifications to established methods, or methods submitted as SWAMP-comparable will be considered on a case-by-case basis. The proposed method or modification shall be submitted to the SWAMP QA Officer for review and approval prior to use. Submission of proposed modification to sampling protocols must be accompanied with adequate justification for the change to the protocol. The SWAMP QA Officer may distribute the modification request to a subject matter expert or peer reviewer for consultation (as needed) before formal approval. The approval process may take up to twenty business days to complete. The review process schedule will be communicated to the requestor. Approved method modifications must be clearly indicated within all planning documents, field sheets, data records and reports. The SWAMP QA Officer shall retain copies of any new or modified methods and add them to the index of available methodologies for SWAMP use.

SWAMP Bioassessment Required Sampling Protocols

Macroinvertebrates and Algae

Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat (May 2016):

This document details the collection of benthic macroinvertebrates and algae, as well as the associated physical and chemical data required for conducting ambient bioassessment work. The standard procedures are designed to support general assessment of the ecological condition of wadeable streams and rivers based on the composition of the benthic macroinvertebrate and benthic algal assemblages. The procedures outlined in this document also produce standardized measurements of instream and riparian habitat, and ambient water chemistry that support interpretation of biological data.

This document's use is required by all SWAMP projects incorporating bioassessment analyses in wadeable streams. No deviations or modifications to this method are acceptable.

Standard Operating Procedures (SOP) for Collection of Macroinvertebrates, Benthic Algae, and Associated Physical Habitat Data in California Depressional Wetlands (February 2015):

This document includes SOPs for sampling the biological, chemical, and physical condition of freshwater wetlands within California. The procedures include detailed instructions on how to sample macroinvertebrate and algae assemblages, water and sediment chemistry, and physical habitat within, and adjacent to the wetland.

This document's use is required by all SWAMP projects incorporating bioassessment analysis in depressional wetlands. No deviations or modifications to this method are acceptable.

California Rapid Assessment Method

SWAMP has endorsed the use of the California Rapid Assessment Method (CRAM) for projects conducting rapid site assessments. SWAMP projects that utilize CRAM shall follow the methods and requirements indicated in the CRAM documents including the CRAM Calibration Quality Assurance Project Plan.

Sample Handling and Custody

Sample Handling and Custody Program Policy

All samples collected for SWAMP projects must follow SWAMP's program-defined QA requirements for sampling containers, holding time, and sample custody. These requirements are defined in the SWAMP Programmatic MQOs.

Referral of Sample Handling and Custody Information

Any sample handling and custody information that deviates from the SWAMP sample handling and custody requirements shall be described within the Project Plan or Regional Project Write-up, as applicable.

Program-Defined Sample Handling and Custody QA Requirements

Sample Containers

Recommendations for sample containers are detailed in SWAMP's Quality Control and Sample Handling Guidelines. The guidelines provide recommendations on the type and size of sample containers for each analyte group. Projects may utilize the recommended list of sample containers or choose a container that is equivalent to those listed. The container chosen shall be noted on the COC form and shall be of appropriate size and material for the collection, preservation, extraction, and analysis, as applicable. At no time shall a SWAMP project use a non-standard or inappropriate sampling container. Should a laboratory receive a sample in an inappropriate container, the sample shall not be analyzed. Sample containers must be clean, and for indicator bacteria samples the containers must be sterilized, in order to avoid sample contamination. Records of certificates of conformance for sterile sample containers should be maintained until data are verified in case the data are investigated for possible sources of contamination.

Holding Time

Holding times are dependent on the parameter being analyzed. SWAMP has developed a list of required sample holding times for all applicable SWAMP parameters. These required holding times were drawn from information published in the Code of Federal Regulations, Title 40 Protection of the Environment, Section 136

"Guidelines Establishing Test Procedures for the Analysis of Pollutants" (40 CFR Section 136) to promote comparability with other federal and state monitoring activities.

For analytes absent from 40 CFR Section 136 (e.g., pyrethroid pesticides), or where the holding times are unrealistic (e.g., distance from sampling site to laboratory), the program's workgroups have developed program-specific, application-appropriate holding times. SWAMP members may contact SWAMP IQ staff if they have questions or wish to begin development of holding times for new analytes.

Samples requiring filtration shall meet the holding times for filtration developed by SWAMP. Required holding times for filtration of samples begin at the time of sample collection and conclude when the sample is filtered. Required holding times for sample preservation or extraction begin at the time of sample collection and conclude when the sample is preserved or extracted, respectively. Required holding times for sample analysis begin either at the time of sample collection, the time of filtration or the time extraction and conclude when sample analysis is completed.

Holding times for all applicable SWAMP parameters are detailed in the SWAMP MQOs and Sample Handling Tables.

When a sample has a holding time violation, the laboratory shall notify the Project Manager, SWAMP QA Officer, and Contract Manager, and shall seek permission from the Project Manager before proceeding with the analysis.

Sample Custody

A documented chain-of-custody is required for all samples collected for SWAMP projects. The custody trail begins at the point of sample collection and ends at the point of sample disposal. All transfers of custody shall be documented utilizing the SWAMP COC forms. The specific information required is dependent on the matrix of the samples and the preparation, storage/handling, and analyses required. For example, some water samples may require storage at a specified temperature while others may require acidification; sediment samples may need to be shipped and received frozen; and benthic macroinvertebrate samples need to be preserved with 95% ethanol. Relevant sample custody information is contained in the SWAMP MQOs and Sample Handling Tables; as well as the applicable SWAMP SOPs, Project Plans, or methods.

Analytical Methods

Analytical Methods Policy

SWAMP projects may utilize a variety of methods depending on the intended uses of the data and technology available at the time of sample collection. These methods include the use of standardized methods, performance-based methods, and investigation methodology. All methodologies utilized for each project and each analyte must support the intended use of the data.

Referral of Information on Analytical Methods

All analytical methods employed by a project must be identified within the Project Plan or Regional Project Write-up, as applicable, and shall be subject to the requirements below.

Program-Defined Analytical Method QA Requirements

Standardized Methodology

Applicable SWAMP Data Use Category: Regulation, Health, Ambient

Standardized methods may be required if the SWAMP project is collecting data identified for use under the SWAMP Classification Category of “Regulation”. The required methods may be detailed within the Order, permit, or contract. Standardized methods are recommended and preferred for projects or analytes identified as “Ambient” and “Health” under SWAMP’s Classification Categories. All methods used must meet the project-required reporting limit and applicable MQOs.

For the purposes of SWAMP, standardized methodology is defined as methods that have been developed and published by US EPA or U.S. Geological Survey, or collected in publications such as *Standard Methods for the Examination of Water and Wastewater, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (US EPA, SW-846), and ASTM International methods. References to established methods shall include the source, method number, and revision number (e.g., *EPA Method 1668, Revision A*). Additional details that may distinguish the method cited from other versions (e.g., the date of publication) shall also be provided.

Modifications to standardized methods for SWAMP shall follow the allowable modification criteria specified in 40 CFR Part 136.6 where applicable. For projects with a Regulatory intended data use, the alternate test procedure (ATP) process must be

followed when modifications are not allowable according to 40 CFR Part 136.6. When modified standardized methods are utilized for SWAMP, the following requirements must be met:

- ❑ References to modified methods shall include the original source, method number, and revision number; and the method shall clearly be designated as modified in both the method name and method code (e.g., Modified EPA Method 1668, Revision A and EPA 1668 M)

- ❑ Method modifications shall be documented by the testing laboratory and submitted upon request. The documentation shall include the results of method modification validation by the testing laboratory. Validation may include, but is not limited to:

    - Method detection limit (MDL) study
    - Calibration
    - Initial precision and recovery analysis
    - Ongoing precision and recovery analyses
    - Contamination checks
    - Field sample analysis
    - Inter-calibration with other methods or laboratories.

PERFORMANCE-BASED METHODS

Applicable SWAMP Data Use Category: Ambient, Health, Regulation (where allowed)

For the purposes of SWAMP, “performance-based methods” are analytical methods and technology that demonstrate the ability to meet established performance criteria, and comply with specified DQOs and MQOs of the project in which the sampling and analytical technology is employed. Performance-based methods may include:

- Standardized methods modified in a manner inconsistent with the flexibility allowed in 40 CFR Part 136.6
- SWAMP-developed methods
- Research methods
- Modified or original SOPs for analytical test kits.

Methods utilized by SWAMP projects for the Ambient, Health, or Regulation data categories must meet the DQOs of the project and be capable of achieving all applicable MQOs for each analyte. The use of performance-based methods is preferred when standardized methods are unable to achieve the required or desired MQOs, or where no standardized method is available. SWAMP-developed or SWAMP-

endorsed bioassessment taxonomy methods are required for all projects conducting bioassessment.

New performance-based methods must be submitted to the SWAMP QA Officer for approval. The documentation shall include details of the method modification and the results of the validation by the testing laboratory.

Documentation of performance-based chemical methods must include, but is not limited to:

- Calibration record
- Initial precision and recovery analysis
- Ongoing precision and recovery analyses
- Contamination checks
- Example data
- Method procedures document
- RLs and MDLs.

If performance-based methodologies are to be incorporated into a regulatory order, then it is highly recommended that a method validation and peer review package be submitted to US EPA Region 9 Quality Assurance for consideration of approval under 40 CFR Part 136. In some situations, submission of this package to US EPA Region 9 is required, for example, modification of a standardized method. The State Water Board and SWAMP QA Officers should be included in correspondence with US EPA to ensure follow-up and record keeping.

REQUIRED SWAMP-DEVELOPED TAXONOMY LABORATORY METHODS

Standard Operating Procedures for Laboratory Processing and Identification of Benthic Macroinvertebrates in California (October 2012): This document describes the full procedures of SWAMP's BMI laboratory, the Department of Fish and Wildlife Aquatic Bioassessment Laboratory, as well as requirements and recommendations for all laboratories performing SWAMP-comparable BMI taxonomic identifications.

Standard Operating Procedures (SOP) for External Quality Control of Benthic Macroinvertebrate Taxonomy Data Collected for Stream Bioassessment in California (July 2015): This document outlines procedures for the external QC of BMI taxonomy data generated for SWAMP and participating SWAMP-comparable bioassessment projects. The BMI QC Template is populated by the QC Laboratories during the external QC process and is used with the BMI QC tool to calculate MQOs. For information on the tool, please contact SWAMP IQ. An SOP for use of the BMI QC tool will soon follow.

Standard Operating Procedures (SOP) for Laboratory Processing, Identification, and Enumeration of Stream Algae (November 2015): This document outlines SWAMP procedures for laboratory processing, identification, and enumeration of soft-bodied algae and diatoms. This document also describes staff qualifications; species documentation; archiving of samples and slides; quality assurance and quality control procedures; harmonization procedures; and data reporting to SWAMP.

Standard Operating Procedures for Internal and External Quality Control of Laboratory Processing, Identification and Enumeration of Stream Algae in California (2019): This document outlines SWAMP procedures for internal and external quality control of soft-bodied algae and diatom taxonomy data generated for SWAMP and participating SWAMP-comparable bioassessment projects.

Investigation Methods

Applicable SWAMP Data Use Category: Investigation

For the purposes of SWAMP, “Investigation” methodology is defined as new, cutting-edge, or limited methodology that does not yet have developed performance-based MQOs established by SWAMP, or is incapable of meeting all applicable existing MQOs for the analyte measured. Investigative methods may only be used for studies meeting the Investigation Data Classification intended use.

Investigation methods must meet minimum QC as required by the method. Investigation methods must be submitted to the SWAMP QA Officer for general review and data verification purposes. SWAMP QA Officer approval of the method is not required, but the method must be identified within the Project Plan or Regional Project Write-up, as applicable.

Investigation methods may include:

- SWAMP developed methods
- Research methods
- Modified or original SOPs for analytical benchtop or field test kits.

Investigation methods may be submitted to the SWAMP QA Officer for consideration as a new SWAMP performance-based method if the method can demonstrate achievement of existing MQOs, or provide a basis for MQO development as described by the Measurement Quality Objectives Framework.

Quality Control and Performance Criteria

Program Policy

All data collected under SWAMP must have defined quality control checks that address the defined DQIs to assess the usability of the data for their intended purpose. These checks shall address appropriate DQIs based on the methodology employed and assigned Data Classification Categories. All SWAMP projects are also required to utilize the language and terminology defined by this Program Plan to ensure common understanding and comparability across the program.

All SWAMP projects shall utilize MQOs to establish limits of error, determine data acceptability, and apply appropriate data flags. These MQOs shall be based on the intended use of the data identified during the DQO process. SWAMP has assigned the minimum level of MQOs for each Intended Data Use Category:

Investigation: Method Minimum Objectives (Required)

Ambient: SWAMP Programmatic MQOs (Required)

Health: SWAMP Programmatic MQOs (Recommended), Method Minimum Objectives (Required)

Regulation: Method Minimum Objectives (Required), SWAMP Programmatic MQOs (Recommended).

Regional projects may develop custom quality control requirements and performance criteria where no other programmatic requirements are available, or where more stringent QC is required for the intended data use. These requirements must be documented within a Project Plan or Write-Up, follow the SWAMP Measurement Quality Objectives Framework, and utilize the programmatic terminology and calculations defined below.

SWAMP Programmatic MQOs

SWAMP Programmatic MQOs provide a consistent rubric to measure data quality and usability. Use of consistent methods, SOPs, and MQOs, assists in producing comparable data sets for the most abundant data categories produced by SWAMP collected under the Intended Data Use Categories of Ambient and Public Health.

The current MQOs are subdivided by matrix (i.e., freshwater, marine water, sediment, tissue), then by analytical category (e.g., inorganic analytes, indicator bacteria). All

requirements referenced in this element also contain guidelines for corrective actions that may become necessary during data generation. The objectives and corrective actions are divided into categories based on the type of work performed (i.e., testing laboratory activities, field activities) and the involved QC sample type (e.g., field blanks, laboratory blanks, internal standards). The SWAMP MQOs supersede method QC requirements, unless the method QC requirements are more stringent.

The current SWAMP Programmatic MQOs were developed prior to the establishment of the SWAMP Measurement Quality Objectives Framework. Therefore, the MQOs are reviewed against the framework and revised when necessary. SWAMP IQ staff plan to review at least two MQOs per year until all SWAMP MQOs follow the SWAMP MQO framework described in this Program Plan. Following that, SWAMP IQ staff will continue to review at least two MQOs per year to check if updates are appropriate based on updated guidance from US EPA or other relevant authorities. Additionally, within the next five years, the current MQOs will undergo an analysis of total expected uncertainty as compared to the actual uncertainty of the data collected within a specified timeframe. More information on this analysis is provided within the Reconciliation with Data Quality Objectives section. Until the review and revision finalization are complete, the current MQOs will be utilized.

WATER

- Conventional Parameters in Fresh and Marine Water (2013)
- Field Measurements in Fresh and Marine Water (revised 2019)
- Indicator Bacteria in Freshwater (revised 2022)
- Inorganic Analytes in Fresh and Marine Water (2013)
- Nutrients in Fresh and Marine Water (2013)
- Semi-Volatile Organic Compounds in Fresh and Marine Water (2013)
- Solid Parameters in Fresh and Marine Water (2013)
- Synthetic Organic Compounds in Fresh and Marine Water (2013)
- Volatile Organic Compounds in Fresh and Marine Water (2013)

SEDIMENT

- Ancillary Parameters in Freshwater Sediment and Marine Sediment (2013)
- Conventional Parameters in Freshwater Sediment and Marine Sediment (2013)
- Inorganic Analytes in Freshwater Sediment and Marine Sediment (2013)
- Synthetic Organic Compounds in Freshwater Sediment and Marine Sediment (2013)

Tissue

- Ancillary Parameters in Freshwater Tissue and Marine Tissue (2013)
- Inorganic Analytes in Freshwater Tissue and Marine Tissue (2013)
- Synthetic Organic Compounds in Freshwater Tissue and Marine Tissue (2013)

Toxicity

- Acute Freshwater Toxicity Test Methods (2018)
- Acute Marine Water Toxicity Test Methods (2018)
- Chronic Freshwater Toxicity Test Methods (2018)
- Chronic Marine Water Toxicity Test Methods (2018)
- Chronic Freshwater Sediment Toxicity Test Methods (2018)
- Acute and Chronic Marine Sediment Toxicity Test Methods (2018)

Cyanobacteria & Cyanotoxins

- Cyanotoxins in Water and Tissue (2015)

Taxonomy

- Benthic macroinvertebrates (BMI) Taxonomy (2020)
- Algae Taxonomy (Soft-bodied algae and diatoms) (2019)

Measurement Quality Objectives Framework

In order to ensure that SWAMP MQOs are developed in a consistent and transparent manner, the SWAMP MQO framework was developed. The SWAMP MQO framework is composed of eight components to ensure results are robust, complete, and scientifically defensible. The final product of the SWAMP MQO framework is an “MQO Document” that covers the necessary QC parameters for multiple stages of the measurement process, including sample collection, sample handling, analysis, and corrective actions. The language is intended to convey unambiguous guidance to the current and future users and facilitate compliance with the MQOs.

Organizations that would like to produce data comparable to SWAMP are encouraged to utilize the SWAMP Programmatic MQOs. If the SWAMP Programmatic MQOs do not meet the non-SWAMP program or project plan DQOs, they may develop their own MQOs utilizing the MQO Framework. An MQO framework template is included as Appendix I. SWAMP MQO framework components are:

Component 1: Determine the analytical platform or measurement process. An analytical platform includes analytical instruments that utilize similar procedures to

obtain measurements. Examples of categories include: gas or liquid chromatography, real-time quantitative polymerase chain reaction (RT qPCR) platform, immunosorbent assays, culture-based platform, microscopy platform, and others. The intent is to consolidate all QC parameters for similar measurement processes in a clear manner.

Component 2: Provide overview of all analytes, matrices, and fractions covered by MQO documents. More than one analyte or group of analytes may be covered by an MQO document. An analytical platform or measurement process is often utilized to analyze more than one analyte or group of analytes. For example, liquid chromatography instruments are utilized by similar procedures to analyze multiple organic compounds, such as pesticides and polycyclic aromatic hydrocarbons. An MQO document may cover these groups of organic compounds, regardless of whether or not they are measured under different SOPs.

Component 3: Address each of the six DQIs. The Data Quality Indicators include precision, accuracy, sensitivity, representativeness, comparability, and completeness.

Component 4: Provide QC requirements for each stage of measurement process. Many water quality measurements begin with sample collection and end with analysis and data generation. Measurements must include sample collection QC and laboratory QC. The QC requirements include parameters, frequency of each parameter, acceptance criteria (i.e., measurement quality objective), purpose, and corrective actions, depicted in Table 1. To ensure MQOs are presented in a clear manner, the format of the table may be modified.

Table 1. Example format for Quality Control Requirements Table

Report to database	QC Component	Frequency	Acceptance criteria	Purpose	Corrective Action(s)

- "QC component" is most often a QC sample (e.g., sample duplicate, matrix spike, etc.) or QC measure (e.g., calibration). All QC components must be defined; this Program Plan includes definitions for existing QC components used in SWAMP. Any new QC components should be defined within the MQO document and submitted to SWAMP for consideration during the next SWAMP Program Plan review cycle.

- “Frequency” of the QC component describes how often (e.g., hourly, once per lab batch, etc.) the component must be measured.
- “Acceptance criteria” may be described in quantitative or qualitative terms to clearly state the criteria/threshold that is acceptable.
- “Purpose” of the QC component describes what information is gained by measuring the QC component and which DQI is measured. The purpose of each QC component found in the grandfathered MQOs is provided in Table 2 below.
- “Corrective action(s)” describe steps that must be taken when results do not meet acceptance criteria. Unacceptable results often highlight an issue that warrants an investigation. Corrective actions must be taken prior to reporting results from the original or repeated measurements. If actions do not remedy the issue, comments must be submitted with a Corrective Action Report. The SWAMP QA Officer will then determine the validity of the data.

Table 2. Purpose of QC Components

QC Component	Purpose of Assessment
Certified reference material (CRM)/standard reference material (SRM)	Lab accuracy
Equipment Blank	Bias, potential sample contamination
Field Sample Duplicate	Precision, sample collection
Filter Blank	Bias, filtering instrument
Instrument Calibration	Bias, instrument
Instrument Calibration Verification	Bias, continued instrument assessment
Internal Standard	Verify instrument response and retention time stability
Lab (reagent) Blank	Bias, potential lab processing contamination
Lab Control Sample	Lab accuracy (systemic bias)
Lab Control Sample Duplicate	Lab precision, lab accuracy (for individual sample)
Lab (environmental) Sample	Description not required. This represents the measured sample, processed from the original sample collection.
Lab (environmental) Sample Duplicate	Precision, sample preparation and analysis
Matrix Spike Sample	Accuracy, matrix interference bias
Matrix Spike Duplicate Sample	Matrix precision and accuracy, matrix interference
Method Blank	Bias, method process contamination
Negative Sample	Bias, contamination/sterility check (bacteria), specificity check (PCR), organism health (toxicity)
Positive Sample	Bias, biological reaction
Surrogate	Bias, sample processing
Instrument Tuning	Bias, instrument performance

Component 5: Provide sample handling guidelines to ensure sample integrity from collection to analysis. Indicate if each guideline is recommended or required. The guidelines should include the following considerations, as applicable:

- Sample collection containers
- Preservation of sample
- Sample storage (short term and long term)
- Sample shipping conditions
- Holding time from collection to analysis
- Develop additional guidelines as necessary.

Component 6: Provide citation for each QC requirement (Component 4) and sample handling guideline (Component 5). The source of any objective may include standard or investigative method criteria, journal articles, reports, data sets, best professional judgement, and others. If an objective is tentative pending further assessment, this should be indicated under the citation.

Component 7: Identify whether the results obtained from a QC parameter (Component 4) must be reported with the data set. This should clearly identify for the reporting entity which QC parameters should be included in the SWAMP data entry forms. When the results are not reported, they should be stored according to the reporting entity's internal QC documentation procedures.

Component 8: Review MQOs to ensure cost effectiveness. All required MQOs should be reviewed to ensure that they are appropriate to meet the needed data quality. Implementing the MQOs in monitoring plans should not cause unnecessary economic burden, but the costs should not be the sole reason for removing requirements or widening acceptance criteria.

QUALITY CONTROL DEFINITIONS AND REQUIREMENTS

Quality control definitions and requirements are listed below in the following subjects:

- Field and Laboratory Corrective Action
- Field Quality Control
- Laboratory Quality Control (Chemistry)
- Laboratory Quality Control (Biology)
- Laboratory Quality Control (Toxicity)
- Laboratory Quality Control (Taxonomy)

The quality control definitions and associated requirements are provided to establish clarity and understanding of the program requirements, so that they may be successfully implemented. Mathematical formulas are included where applicable.

Field and Laboratory Corrective Action

Field Corrective Action

The field crew is responsible for responding to non-conformities in their sampling and field measurement systems. If monitoring equipment fails or there are other deviations from the field sampling plan, personnel are to record the problem according to their documentation protocols. Failing equipment shall be replaced or repaired prior to subsequent sampling events. If data quality issues are identified following sample analysis (e.g., field blank contamination), a root cause analysis and field corrective action may be necessary to correct the problem. Field corrective actions may include, but are not limited to, training or retraining field crews, updating field sampling protocols, such as adding additional checks in the field. It is the combined responsibility of all members of the field organization to determine if the performance requirements of the specific sampling method have been met, and to collect additional samples if necessary. Associated data are entered into the SWAMP Internal Information Management System and flagged accordingly.

Laboratory Corrective Action

The laboratory is responsible for responding to non-conformities in their measurement systems and in meeting the program or project requirements. If analytical equipment fails, quality check samples fall outside of acceptability limits, or the laboratory does not follow program requirements (e.g., uses an unapproved method), personnel are to record the problem according to their documentation protocols and take necessary corrective actions to correct and resolve the issue. Corrective actions shall 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 shall notify the Project Manager, SWAMP QA Officer, and Contract Manager when a sample has a hold time violation, and shall seek permission from the Project Manager before proceeding with the analysis. All data associated with a corrective action shall be flagged accordingly.

Field Quality Control

Field QC results shall meet the frequency requirements and acceptance limits detailed in the applicable Programmatic MQOs or custom MQOs detailed within an approved Project Plan or Regional Write-up.

Field Probe/Sensor Calibration

Definition: Sensors are calibrated by subjecting them to known conditions, measuring the sensor's responses and adjusting the sensor to provide accurate measurements. In an attempt to accommodate a wide variety of technologies and the proper technique for each, the program defers to manufacturer specifications or SWAMP guidelines for field instrument calibration, whichever is more stringent. Proper calibration procedures are critical to ensuring the overall accuracy and precision of measurements.

Requirements: Field probes/sensors must be calibrated properly prior to use or deployment as specified in the Field Measurements for In-Situ Water Quality Monitoring in Fresh and Marine Water MQOs.

Field Probe/Sensor Accuracy Check

Definition: Sensor/Probes must be checked for accuracy on a routine basis.

Requirements: Conduct routine one point accuracy checks in the lab with a standard before field use, as specified in the Field Measurements for In-Situ Water Quality Monitoring in Fresh and Marine Water MQOs. After the instrument stabilizes, record the reading and calculate the percent recovery between the reading and known standard. If the percent recovery exceeds the MQO, the instrument must be re-calibrated and checked again.

Field Probe/Sensor Precision Check

Definition: Sensor/Probes must be checked for precision on a routine basis.

Requirements: At a minimum of one site per day, repeat a field measurement at least twice by removing the probe from the water, re-submerging the probe and allowing the probe to stabilize. After the instrument stabilizes, record the reading and calculate the relative percent difference between the readings. If the relative percent difference exceeds the MQO, perform the test again to ensure that the required stabilization period is adhered to. If the instrument continues to provide measurements that exceed the MQO, the instrument must be re-calibrated.

Field Probe/Sensor Stabilization

Definition: Introducing *in situ* probes to water from a dry state can cause existing environmental conditions to affect sensor readings (Wilde, 2008). This effect can cause the initial readings from the probe to have a high degree of variability in some cases. Including an initial stabilization period after submergence or filling allows the sensor to stabilize and ensures the readings it produces are accurate.

Requirements: When a sensor is submerged, or filled, an initial stabilization and equilibrium period must be observed prior to recording information from the probe. Refer to the manufacturer's recommendations for the length of this stabilization period. Projects should define an acceptable range of variability in readings based on manufacturer's recommendations to ensure accuracy. Instrument accuracy specifications for SWAMP can be found in the MQOs for Field Measurements for In-Situ Water Quality Monitoring in Fresh and Marine Water.

Field Crew Calibration Exercises (Bioassessment)

Definition: Annual field crew inter-calibration events are conducted by the California Department of Fish and Wildlife's Aquatic Bioassessment Laboratory to ensure that bioassessment data are being measured in a consistent manner (Ode et al., 2016). Generally, the calibration events consist of multiple field crews that conduct bioassessment exercises on the same stream segment while being observed by experts. If major SOP deviances are observed by the experts, then the field crews discuss differences and are reminded of correct SOPs to ensure consistency.

Requirements: Formal field training (made available by the Water Board's Training Academy) of field crews and calibration exercises are required for new field staff prior to collecting data for SWAMP. Annual field calibration exercises are highly recommended for all crews. Field crew audits conducted by an expert are highly recommended annually or on an as-needed basis for corrective action.

Equipment Blank (Chemistry and Microbiology)

Definition: An equipment blank is a sample of analyte-free media that has been used to rinse the sampling equipment. It is collected after completion of decontamination and prior to sampling through clean equipment. This blank is useful in documenting adequate decontamination of sampling equipment (BC, 2003). This blank is used to provide information about contaminants/bias that may be introduced during sample collection when using filtration equipment or equipment that must be decontaminated between use.

Requirements: Equipment blanks will be generated by the personnel responsible for cleaning sampling equipment.

To ensure that sampling equipment is contaminant-free, water known to be free of or low in the target analyte(s) (i.e., pre-tested for contamination levels) shall be processed through the equipment as during sample collection. The specific type of water used for blanks is selected based on the information contained in the relevant sampling or analysis methods. The water shall be collected in an appropriate sample container, preserved, and analyzed for the target analytes (i.e., treated as an actual sample).

An equipment blank shall be prepared for metals in water samples whenever a new lot of filters is used.

Equipment blanks are prepared once per sampling event under the following conditions:

- When new equipment is deployed
- When equipment is cleaned after use
- When equipment that is not dedicated for surface water sampling is used.

Field Blank (Chemistry, Microbiology, and Toxicity)

Definition: A field blank is a sample of analyte-free media that is carried to the sampling site, exposed to the sampling conditions, returned to the laboratory, and treated as a routine environmental sample. Preservatives, if any, are added to the sample container in the same manner as the environmental sample. The field blank matrix should be comparable to the sample of interest. This blank is used to provide information about contaminants that may be introduced during sample collection, storage, and transport.

Requirements: One field blank shall be collected initially for a project to assess potential contamination levels that might occur during field sampling activities (with the exception of toxicity tests that utilize field blanks on a discretionary basis). The field blank water is taken to the sampling location, transferred to the appropriate container, preserved (if required by the method), and treated the same as the corresponding sample type during the course of a sampling event.

The water used for field blanks shall be free of target analyte(s) and appropriate for the analysis being conducted. If field blank performance is acceptable, further collection and analysis of field blanks should be performed on an as-needed basis.

Bottle Blank (Chemistry, Microbiology, and Toxicity)

Definition: A bottle blank is a sample of analyte-free media that is collected with the same bottle type as the environmental sample. Bottle blanks are used to provide information about possible contaminants that may be introduced by sample bottles during collection.

Requirements: Bottle blanks are used on a discretionary basis, when new bottle types or lots are ordered for the first time, or when there is suspected contamination.

Field Duplicate (Chemistry)

Definition: A field duplicate is an independent sample that is collected as close as possible to the same point in space, time, and collection methodology as the field sample.

Requirements: Field samples will be collected, in duplicate, at the frequency defined in the appropriate MQOs to evaluate precision as it pertains to the sampling process. The duplicate sample shall be collected in the same manner, and as close in time as possible, to the original sample. The same equipment used to collect the original sample should be used to collect the duplicate sample.

Matrix Representation Samples (Chemistry)

Definition: A matrix is the material that the sample is composed of, or the analyte of interest is contained in (US EPA, 2010). A matrix may also be referred to as a "medium" or "media."

Requirements: Matrices shall be collected that are representative of each matrix within a watershed that is being studied by a project. Matrices may include sample water and sediment. Representative matrices are used for Matrix Spikes and Matrix Spike Duplicates (MS/MSD) when required by an MQO. If MS/MSD are required, and multiple watersheds are addressed by a project, the site at which the representative matrix samples are collected should rotate to each watershed.

Laboratory Quality Control (Chemistry)

The following section describes terms and QC requirements carried out by the testing laboratory during sample preparation and chemical analysis. Laboratory QC results must meet the acceptance limits and frequency detailed in the applicable MQOs.

Analytical Batch

Definition: An analytical batch is a group of samples, including QC samples, that are processed together using the same method, the same reagents, and at the same time or in continuous, sequential time periods. Samples in each batch should be of similar composition and share common internal QC standards (FEM Glossary, 2015). Under the 2016 TNI Standard, this would be called two distinct batches, a preparation batch and an analytical batch.

Requirements: SWAMP MQOs have established QC samples and check frequencies based on the analytical batch. SWAMP requires that an analytical batch:

- Include 20 or fewer environmental samples;
- Is extracted and/or prepared “together” (sequentially or within 48 hours);
- Is analyzed “together” (sequentially or within 48 hours);
- Include the following associated and applicable laboratory QC samples when required by the MQOs:
    - Laboratory Control Sample (LCS), Standard Reference Material/Certified Reference Material, or Positive Control
    - Laboratory Blank or Negative Control
    - Laboratory Duplicate
    - MS/MSD*

*If an environmental sample is provided by a project for the purpose of an MS or MS/MSD pair, those samples must be included in the batch containing the parent sample. If no sample, or insufficient volume was provided by a project, these samples are not required as part of a batch. The use of non-project water or sediment for MS or MS/MSD pairs is not recommended.

Calibration Check Samples

Definition: Calibration check samples are analytical standards (containing the target analyte and surrogate) prepared from the same source as the calibration standards and are analyzed for initial or continuing calibration verification (FEM Glossary, 2015).

Requirements: In order to properly assess sensitivity changes, calibration check samples shall be from the same set of working standards used to calibrate the instrument.

Calibration Standard

Definition: A solution prepared from the dilution of stock standard solutions that includes the internal standards and surrogate analytes, when applicable. The calibration solutions are used to calibrate the instrument response with respect to analyte concentration (FEM Glossary, 2017).

Requirements:Defined per method and must include a laboratory-defined minimum reporting limit concentration (typically the lowest calibration standard).

Calibration Verification

Definition: Calibration verification is when calibration check samples are analyzed prior to (i.e., initial), during (i.e., continuing or ongoing), and/or after (i.e., final) analysis of samples (FEM Glossary, 2015). The initial calibration verification (ICV), continuing calibration verification (CCV), and final calibration verification (FCV) are used to verify the continued accuracy of an instrument calibration.

Requirements: If any calibration check sample falls outside the acceptance limits, corrective action(s) shall be taken, as outlined in the SWAMP MQOs. Data obtained while the instrument is not properly functioning are not reportable, and all samples analyzed during this period shall be reanalyzed. If reanalysis is not an option, the original data shall be flagged with the appropriate qualifier and reported. The laboratory shall include information about the magnitude and direction of the error within the laboratory results comments, in addition to the affected results.

Certified Reference Materials

Definition: A certified reference material or substance has one or more properties that are characterized by a metrologically valid procedure, accompanied by a certificate that provides the value of the specified property, its associated uncertainty, and a statement of metrological traceability (typically from EPA or the National Institute of Science and Technology (NIST)). Certified reference materials are used for calibrating an apparatus, assessing a measurement method, or assigning values to materials (FEM Glossary, 2017). Certified reference materials are used to measure the accuracy of analytical processes, either quantitatively to calibrate or determine concentration accuracy, or qualitatively to identify a substance or species.

Requirements: An Analytical Grade Material (AGM) that either meets the specification of the American Chemical Society or has a guaranteed purity of 95% is required for instrument calibration. A project may request the use of an AGM for batch accuracy if it is required for the intended use of the data.

Dilution of Samples

Definition: Dilution is the process of reducing the concentration of a solute in solution, usually by mixing with a diluent.

Diluent: a substance added to another to reduce the concentration and result in a homogeneous end product without chemically altering the compound of interest (US EPA, 2016).

Dilution factor: the numerical value obtained from dividing the new volume of a diluted substance by its original volume (US EPA, 2016).

Requirements: Final reported results shall be corrected for dilution carried out during the process of analysis. In order to evaluate the QC analyses associated with an analytical batch, corresponding batch QC samples shall be analyzed at the same dilution factor. For example, the data used to calculate the results of matrix spikes shall be derived from results of the native sample, MS, and MSD, analyzed at the same dilution. Results derived from samples analyzed at different dilution factors shall not be used to calculate QC results. In addition, MDLs and RLs shall be adjusted to account for sample dilution. The reported dilution factors shall be reported as whole numbers.

Dual-Column Confirmation

Definition: Analytical methods using chromatography can require two analytical columns for analysis. The first, or primary, column is used to compare the retention time with a standard. If analyte signals are detected, then the presence of the analyte is confirmed on a second, or confirmation, column of different selectivity. The measurements from the dual column analysis are used to confirm positive results (Stenerson, 2016).

Requirements: Due to the high probability of false positives from single-column analyses, dual column confirmation should be applied to all gas chromatography and liquid chromatography methods that do not provide definitive identifications. It should not be restricted to instruments with electron-capture detection.

Instrument Blank

Definition: An instrument blank is a clean sample (e.g., distilled water) processed through the instrumented steps of the measurement process in order to determine instrument contamination and measure bias (US EPA, 2010).

Requirements: See MQOs for frequency of use and acceptance criteria.

Instrument Calibration

Definition: Instrument calibration is used to correlate instrument response to an amount of analyte (concentration or other quantity). Calibration minimizes instrument bias and improves precision.

Requirements: Calibration curves shall be established for each analyte covering the range of expected sample concentrations utilizing analytical grade reference materials. The required frequency of instrument calibration and acceptance criteria that demonstrate the instrument's stability and appropriate settings should be specified in the applicable method or SOP (SWAMP MQOs may replace the acceptance criteria). If initial or continuing calibration verification is not acceptable, then calibration is required, as specified in the applicable method, SOP, or SWAMP MQOs. If instrument calibration is not satisfactory, the analysis shall not be conducted until the instrument is successfully recalibrated. Samples whose results are found to be outside of the calibration range must be diluted to within the calibration range and re-analyzed. Corrective actions must be employed should any of the above calibration samples indicate deviations from the method requirements for these samples.

Internal Standards

Definition: To monitor sensitivity of an analytical instrument over time, internal standards (also referred to as "injection internal standards") may be added to all field and QC samples or sample extracts (including calibration samples) prior to injection. Use of internal standards is particularly important for the analysis of complex extracts subject to retention-time shifts relative to the analysis of standards. Internal standards can also be used to detect and correct for problems in the injection port or other parts of the instrument.

Requirements: The analyst shall monitor internal standard retention times and recoveries to determine if instrument maintenance, repair, or changes in analytical procedures are needed. Corrective action is initiated based on the judgment of the analyst.

Laboratory Control Sample

Definition: A laboratory control sample is a sample matrix representative of the environmental sample (i.e., water, sand, etc.) that is prepared in the laboratory and is free from the analytes of interest. The LCS is spiked with verified amounts of analytes — or a material containing known and verified amounts of analytes. It is either used to establish intra-laboratory or analyst-specific precision and bias, or to assess the performance of a portion of the measurement system.

Requirements: The LCS shall be analyzed using the same preparation, reagents, and analytical methods employed for field samples. The percent recovery shall be calculated and reported along with the result. Deviations from the applicable MQOs for recovery shall be reported and flagged, as applicable. Corrective actions shall be employed, where applicable.

Calculation: Percent Recovery (% Recovery)

$$\% \text{ recovery} = (C_{analyzed} / C_{spiked}) \times 100$$

Where:

$C_{analyzed}$: the analyzed concentration of the LCS
C_{spiked}: the concentration spiked in the LCS.

Laboratory Duplicate

Definition: An analysis or measurement of the target analyte(s) performed identically on two sub-samples of the same sample, usually taken from the same container (US EPA, 2010). The results from laboratory duplicate analyses are used to evaluate analytical or measurement precision, and include variability associated with sub-sampling and the matrix (not the precision of field sampling, preservation, or storage internal to the laboratory).

Requirements: See MQOs for frequency of use and acceptance criteria. Relative Percent Difference must be calculated and reported.

Calculation: Relative percent difference (RPD)

$$RPD = ((C_{sample} - C_{duplicate}) / \text{mean}) * 100$$

Where:
C_{sample}: the concentration of the original sample
$C_{duplicate}$: the concentration of the duplicate sample
Mean: the mean concentration of both samples.

Matrix Effect

Definition: Matrix effects are the manifestations of non-target analytes or physical and chemical characteristics of a sample that impair quantification of the target analyte (i.e., prevent the compound or element of interest from being effectively quantified by the test method). Matrix effects typically adversely impact the reliability of the quantification (US EPA, 2010). A matrix effect can cause either high or low bias.

Matrix Spike/Matrix Spike Duplicate

Definition: A matrix spike is a sample prepared by adding a known amount of the target analyte to an environmental sample in order to increase the concentration of the target analyte (US EPA QA/G-5, 2002). The MS is used to determine the effect of the matrix on a method's recovery efficiency and is a measure of accuracy. A matrix spike duplicate (MSD) consists of an aliquot of the same environmental sample to which known quantities of the target analytes are added in the laboratory. Both the MS and MSD samples are analyzed exactly like an environmental sample within the lab batch (US EPA, 2010). The purpose of analyzing the MS and MSD samples is to determine whether the sample matrix contributes bias to the analytical results, and to measure precision of the duplicate analysis.

Requirements: See MQOs for frequency of use and acceptance criteria. The spiking level should be two to five times the ambient concentration. Ambient concentration should be determined prior to spiking. If this technique is not practical, then laboratories should spike near the midpoint of the calibration curve. The percent recovery (PR) and relative percent difference (RPD), if applicable, shall be calculated and reported along with the result. MS/MSD samples must be processed and analyzed within the same batch as the native sample. Only the native sample shall be subjected to data qualifiers or further analytical treatments resulting from the analysis of the MS/MSD samples.

Calculation: Percent Recovery (PR)

$$\% \text{ recovery} = ((C_{MS} - C_{native} / C_{spike}) * 100$$

Where:
C_{MS}: the concentration of the spiked sample
C_{native}: the concentration of the native (unspiked) sample
C_{spike}: the concentration of the spike added

Relative percent difference (RPD)

$$RPD = ((R_{MS} - R_{MSD}) / \text{mean}) * 100$$

Where:
R_{MS}: the recovery associated with the matrix spike
R_{MSD}: the recovery associated with matrix spike duplicate
Mean: the mean of the two recoveries ($Recovery_{MS}$ and $Recovery_{MSD}$).

Method Detection Limit (MDL)

Definition: An MDL is the minimum concentration of a substance that can be measured in a matrix and reported with 99% confidence that the analyte concentration is distinguishable from method blank results (82 FR 40939, Aug. 28, 2017). An MDL is determined using the procedure provided in 40 CFR 136, and may be referred to as the "limit of detection (LOD)." MDL values must be adjusted for dilutions or sample size variations.

Method (Laboratory) Blank

Definition: A method (laboratory) blank (often reagent water) is free from the target analyte(s) and is used to represent the environmental sample matrix as closely as possible. The method blank is processed simultaneously with and under the same conditions and steps of the analytical procedures (e.g., including exposure to all glassware, equipment, solvents, reagents, labeled compounds, internal standards, and surrogates that are used with samples) as all samples in the analytical batch (including other QC samples) (US EPA QA/G-5, 2002; FEM Glossary, 2015). The method blank is used to determine if target analytes or interferences are present in the laboratory environment, reagents, or instruments. Results of method blanks provide a measurement of bias introduced by the analytical procedure.

Requirements: At least one method blank per analytical batch must be analyzed. Method blanks should not exceed reporting limits. If an exceedance occurs, corrective actions need to be taken and documented properly.

Reporting Limit (RL)

Definition: An RL is considered to be the lowest level that can be quantified within the specified limits of precision and accuracy during routine laboratory operating conditions. It is often the lowest non-zero point of the calibration curve. RLs are commonly reported as a laboratory's Practical Quantitation Limit (PQL). RL values must be adjusted for dilutions or sample size variations.

Stock Solution

Definition: A solution containing an analyte that is prepared using a reference material traceable to EPA, NIST, or a source that will attest to the purity and authenticity of the reference material (FEM Glossary, 2017). A stock solution is diluted to make calibration standards or working standards.

Surrogate

Definition: A surrogate is a non-target analyte that has similar chemical properties to the analyte of interest. The surrogate standard is added to the sample in a known amount and used to evaluate the response (i.e., loss of analyte) of the analyte to sample preparation and analysis procedures (US EPA, 2010).

Requirements: Defer to methodology-specific requirements.

Working Standards

Definition: Dilutions of stock standard solutions are prepared for daily use in the testing laboratory. “Working standards” are used to prepare laboratory and matrix spikes and may be prepared at several different dilutions from a common stock standard. Working standards are diluted with solutions that ensure the stability of the target analyte.

Requirements: Preparation of the working standard shall be thoroughly documented such that each working standard is traceable back to its original stock standard by the laboratory. The laboratory shall keep records of working stock traceability and make those records available upon request. The concentration of all working standards shall be verified by analysis prior to use in the testing laboratory.

Laboratory Quality Control (Biology)

Biological assays include fecal indicator tests, microbial source tracking, enzyme-linked immunosorbent assays, and other applicable biological methodologies. The results of the in-test checks for accuracy, bias, and precision shall follow the requirements within the applicable MQO.

Analytical Batch

See Laboratory Quality Control (Chemistry) for applicable definition and requirements of analytical batches for microbiology.

Negative Control

Definition: A negative control is a blank consisting of a sterile form of the environmental matrix, sampled without the target analyte (FEM, 2012). The negative control is analyzed to measure bias introduced by contamination.

Requirements: See MQOs for frequency of use and acceptance criteria.

Positive Control Organism

Definition: Microorganisms with confirmed identities obtained from recognized sources are used in the microbiology laboratory. These cultures are maintained as stock cultures and used as reference organisms for microbiological testing.

Bacterial species are commonly obtained from American Type Culture Collection (ATCC) Bacteriology Collection and other microorganism repositories including: National Collection of Type Cultures (NCTC), UK's National Collection of Plant Pathogenic Bacteria (NCPPB), Belgian Coordinated Collections of Microorganisms (BCCM), the Deutsche Sammlung von Mikroorganismen und Zellkulturen (DSMZ).

Positive Control

Definition: A positive control is a sample containing the target analyte, used to produce a positive response in order to indicate that an instrument and technique is functioning according to parameters. For culture-based methods, a positive control is used to evaluate the technique used (e.g., the media, incubation time, and/or incubation temperature), and any matrix interference issues (FEM, 2012).

Requirements: See MQOs for frequency of use and acceptance criteria.

Reagent Blank

Definition: A reagent blank is a reagent sample, without the target analyte or sample matrix, introduced into the analytical procedure. A reagent blank is carried through all subsequent steps to determine the contribution of bias from the reagents and analytical steps (FEM Glossary, 2015).

Requirements: See MQOs for frequency of use and acceptance criteria.

Background Absorbance/Instrument Zero

Definition: Absorbance is a measure of the amount of light absorbed as the light passes through a sample solution or sample container. For enzyme-linked immunosorbent assays, the background absorbance is measured to determine the instrument background absorbance or “zero” level. The measured background absorbance is subtracted from the measured sample solution absorbance. The background signal is tracked by the laboratory and when high background signal is measured corrective actions are taken.

Requirements: Background absorbance/instrument zero is required for each batch. See MQOs for the acceptance criteria and appropriate corrective actions.

Laboratory Duplicate Samples

Definition: Laboratory duplicate samples are analyses, or measurements, of the variable of interest performed identically on two sub-samples of the same sample, usually taken from the same container (US EPA, 2010). The results from duplicate analyses are used to evaluate analytical or measurement precision, and include variability associated with sub-sampling and the matrix (not the precision of field sampling, preservation, or storage internal to the laboratory).

Requirements: See MQOs for frequency of use and acceptance criteria. For Fecal Indicator Bacteria analysis, the Rlog (from Standard Methods 9020 Section 8.b) of duplicate analyses must be calculated and reported.

Calculation: See MQOs for Indicator Bacteria in Freshwater.

Matrix Spike/Matrix Spike Duplicate (ligand-binding assays)

Definition: See definition under Laboratory Quality Control (Chemistry).

Requirements: See MQOs for requirements and acceptance criteria for matrix spikes. The percent recovery (PR) and relative percent difference (RPD) shall be calculated and reported along with the result.

Requirements: See calculations under Laboratory Quality Control (Chemistry).

Replicate Analyses

Definition: Replicate analyses are two or more aliquots taken from the same sample, after sample preservation and analytical preparation, and independently carried through the analytical measurement process in an identical manner. The sub-samples represent the same population characteristic, time, and place (BC, 2003). Replicate samples are used to measure precision of the analytical procedure. Variability in the microbiological concentration between one sub-sample volume and another is normal. Replicates provide additional QC and allow for the averaging of two or more samples to measure the variability (FEM, 2012). Replicates are not equivalent to “laboratory duplicate samples” because they are not prepared separately.

Requirements: Replicates are required for each batch. See MQOs for the acceptance criteria. Relative Percent Difference must be calculated and reported.

Calculation: See calculation under Laboratory Quality Control (Chemistry).

Laboratory Quality Control (Toxicity)

Reference Toxicants (Toxicity)

Definition: A reference toxicant is a known concentration of a reference material used to evaluate test organism response. Analogous to a positive control, reference toxicant tests assess precision and overall laboratory performance. Laboratories routinely expose toxicity test species to reference toxicants, such as potassium chloride and copper sulfate, in order to evaluate their health and sensitivity. The results of these tests are plotted on control charts that are used to assess test precision and overall laboratory performance.

Requirements: See MQOs for frequency of use and acceptance criteria.

Negative Control

Definition: A blank consisting of a sterile form of the environmental matrix sampled, such as laboratory water or control sediment. Negative controls are used to compare the potential toxicity in a sample to a control sample where chemical induced toxicity should occur. The negative control also provides information on stock organism health and the normal variability in survival or growth of those stock organisms. Negative controls may also be used to differentiate between chemical toxicity and toxicity caused by irregular conductivity, salinity, or pH. These controls will be altered to match the conductivity, salinity, or pH in the sample.

Requirements: A minimum of one negative control per toxicity test is required. Toxicity test species used in negative controls must meet the minimum requirements established by the method-specific test acceptability criteria (see MQOs).

Additional Controls

Definition: If sample parameters (e.g., salinity or pH) are outside the ranges established in the appropriate MQOs, additional negative controls matching these conditions are used to account for any potential effects.

Requirements: A conductivity or salinity control must be tested when these parameters are above or below a species' tolerance (see MQOs for tolerance ranges). All other parameter controls are utilized on a discretionary basis.

Laboratory Quality Control (Taxonomy)

The following section describes terms relating to benthic macroinvertebrate (BMI), soft-bodied algae and diatom samples and the processes carried out in the laboratory. Laboratory QC results must meet the error limits and frequency detailed in the applicable MQOs.

Original Taxonomy Lab (BMI and algae)

Definition: The Original Taxonomy Lab (OR lab) receives the field sample and conducts the initial processing of the samples (e.g., cleaning, sorting, sub-sampling) and taxonomic analysis.

Requirements: The OR lab provides specimen taxonomic identification and enumeration for all samples.

Quality Control Taxonomy Lab (BMI and algae)

Definition: The Quality Control Taxonomy Lab (QC lab) verifies the taxonomy of a sub-set of samples completed by the original lab.

Requirements: An expert taxonomist at the QC lab verifies taxonomic identification and enumeration of samples processed in the original lab.

Reference Specimen (BMI and algae)

Definition**:** Reference specimens are collections that may be made of preserved organisms, a genomic library, and/or high-quality, scaled pictures or photographs allowing for comparison of organisms for identification purposes. Reference specimens are used by taxonomists in the process of identifying BMI and algae. Sample specimens are compared to reference specimens in a documented reference collection to aid in identification of taxa where the keys and species descriptions are incomplete or inadequate.

Requirements**:** Laboratories must maintain a reference collection of specimens with confirmed identities. Laboratory staff must have access to these specimens.

Vouchered Specimens (BMI)

Definition**:** At least one specimen from every taxon identified in a sample is saved for reanalysis in an individual vial. Each vial corresponds to one line of data (i.e., one taxon/life stage combination) that the taxonomist enters into the database. Vouchered

specimens are used to confirm species and ultimately determine the validity of the data for any sample, should it be questioned.

Requirements**:** All components of samples are labeled and stored by the laboratory to allow for reanalysis as necessary. The sample components and required minimum storage times (measured from sample date) are as follows: (1) vials of identified organisms: 5 year minimum; (2) sorted sample residue: 1 year minimum; (3) unsorted sample remainder: 2 year minimum. If the Project Manager intends to have samples returned after the allotted storage time, they must notify the laboratory manager and make arrangements to have return shipments paid for. Otherwise, samples will be disposed of according to protocol.

Sample Preservation Check (BMI)

Definition: Samples are checked to assess whether they contain a minimum of level of preservative (70% ethanol). Specimens in a poorly preserved sample may begin to decompose before the BMI lab can begin processing the sample. Decomposed specimens often cannot be identified to the Standard Level of Taxonomic Effort (STE) level needed for the project. All samples that do not meet the preservation requirement are flagged so the data user will know that they may want to exclude these samples from the analysis.

Requirements: Check 10% of samples (or a minimum of one sample per taxabatch) with a hydrometer to document if samples are properly preserved during transport (Woodard, 2012). All checked samples must contain a minimum of 70% ethanol. If samples are found to not meet the minimum concentration, then the entire batch must be checked. Any sample not meeting the requirement must have fresh preservative placed in the container immediately, and any associated data must be flagged accordingly.

Subsampling (BMI)

Definition: After a sample is rinsed and the detritus is removed, the material is spread into a tray with grids marked on it. A random subsample of at least the target count of BMIs is removed (thus ensuring representativeness of the sample) from the surrounding matrix of the sample material (Woodard, 2012).

Requirements**:** A minimum of three separate randomly selected grid cells must be processed to ensure representativeness of the subsample. See SOP for Laboratory Processing and Identification of BMI in California for specific instruction on how grid cells are divided.

Picking Process (BMI)

Definition: The process of removing BMIs from a subsample (Woodard, 2012). Picking always occurs before sorting. Sorting can be performed simultaneously with picking or it can be performed later.

Sorting Process (BMI)

Definition: The process of separating BMIs to order for later taxonomic identification, usually to one of the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) STE levels (Woodard, 2012). Sorting can be performed simultaneously with picking, or it can be performed later. Sorting is separating the BMI, by quick identification, to a broad, easy-to-identify taxon (e.g., order).

Picking Effectiveness (BMI)

Definition: “Picking” is done by a technician by removing specimens from a subsample taken from the original field sample. As they are picked, specimens are sorted into specimen vials. The picking procedure is then verified by a second technician. Picking effectiveness measures how completely the first technician picked the randomly selected sub-sample. The second technician ensures that the residue of the sub-sample does not contain any remaining specimens. If any are found, they are picked and placed in a vial marked “QC,” and the vial is added to the others sorted for the sample (Woodard, 2012).

Requirements: The verification shall be completed by the taxonomy lab. The applicable equation must be used to calculate the error rate. See MQOs for frequency and error rate threshold.

Calculation: *Total number of organisms in initial sort / Total number of organisms after re-sort x 100*
(SMC QAPP, 2009)

Remnant Jar Quality Control Check (BMI)

Definition: After sorting, the remaining organic and inorganic material are placed in a jar that is later re-sorted to ensure that all organisms were removed. This internal process is used to quantify the picking effectiveness of the laboratory (Rehn et al., 2015).

Requirements: A QC check for picking effectiveness shall be conducted on at least one jar, or 10% of sample remnants, per project (whichever is greater). Periodically, a

check is performed by a supervisor on these sub-sample remnants to ensure that all specimens are picked out.

Taxa (BMI and Algae)

Definition: The term “taxon” refers to the taxonomic group of any classification level, such as family, genus, or species. The term “taxa” is the plural of taxon.

Taxonomic Resolution (BMI and Algae)

Definition: Taxonomic resolution is a system to rank identified organisms using the scientific taxonomic classification system of organisms (i.e., the system includes kingdom, phylum, class, order, family, genus, and species).

Standard Level of Taxonomic Effort (BMI and Algae)

Definition: Established standards that define the level of taxonomic resolution required for the identification of BMI and algal organisms.

Requirements (BMI): SWAMP requires that BMI organisms are identified to SAFIT Level II or IIa for CSCI calculations. SAFIT level definitions:

> SAFIT STE Level I: Typically genus-level identifications, with chironomid midges to family.
>
> SAFIT STE Level II: Typically genus/species identifications, with chironomid midges identified to genus/species group. This level may be used in calculation of the CSCI.
>
> SAFIT STE Level IIa: Typically genus/species identifications, with chironomid midges identified to subfamily. This level is used in calculation of the CSCI.

Requirements (Algae): SWAMP requires that algal organisms are identified to algae STE Level I or II based on the guidance outlined in the Standardized Taxonomic Effort (STE) for California Stream Algae (2019) document. STE level definitions for algae:

> Algae STE Level I: Identifications to genus-level (used for a limited number of macroalgae taxa that require reproductive features to identify to species level).
>
> Algae STE Level II: Identifications to species-level (or lower).

California Stream Condition Index (BMI)

Definition**:** The California Stream Condition Index (CSCI) is a biological scoring tool that helps aquatic resource managers translate complex data about BMIs found living in a given stream into an overall measure of stream health. The CSCI score is based on BMI community composition and provides a measure of whether, and to what degree, the ecology of a stream is altered from a healthy state.

Requirements**:** All SWAMP statewide bioassessment programs shall collect appropriate data to calculate the CSCI. The regional bioassessment projects may use the CSCI as desired.

Algal Stream Condition Indices (Algae)

Definition: The algal stream condition indices (ASCIs) are biological scoring tools that measure the condition of streams in California. There are three versions of the ASCI: one based on benthic diatoms, one based on benthic soft-bodied algae, and a “hybrid” based on both assemblages. The ASCIs are intended to be used in concert with the CSCI, providing a more broad-based evaluation of stream condition. In general, the ASCIs are slightly more sensitive to degraded water quality, whereas the CSCI is slightly more sensitive to habitat degradation; however, both indices can reflect impacts to both habitat and water quality.

Requirements**:** All SWAMP statewide bioassessment programs shall collect appropriate data to calculate the ASCIs. The regional bioassessment projects may use the ASCIs as desired.

External Quality Control (BMI and Algae)

Absolute Recount Error Rate (BMI)

Definition: The equation compares the number of specimens in a sample reported by the OR laboratory to the number of specimens reported by the QC laboratory (Rehn et al., 2015).

Requirement: The verification shall be completed by the QC laboratory. The applicable equation must be used to calculate the error rate. See MQOs for the frequency and error rate threshold.

Calculation:

Absolute Recount Error Rate = (Σ |*QC lab count-OR lab count*|) */ QC lab count x 100*

Where:
Absolute difference between QC lab count and OR lab count is per FinalID.

Acceptance criteria: <10% of QC lab count.

Individual Identification Error Rate (BMI)

Definition: The equation compares the number of specimens that were misidentified by the OR laboratory to the total number of specimens in the sample. The QC laboratory determines whether the OR laboratory's taxonomic identification was accurate (Rehn et al., 2015).

Requirements: The verification shall be completed by the QC laboratory. The applicable equation must be used to calculate the error rate. See MQOs for the frequency and error rate threshold.

Calculation:

Individual Identification Error Rate = (*Number of specimens misidentified per QC lab count / Total number of specimens in sample per QC lab count) x 100*

Lower Taxonomic Resolution Individual Error Rate (BMI)

Definition: Provides the percentage of specimens in a sample not identified to desired level of classification (STE) (Rehn et al., 2015).

Requirements: The verification shall be completed by the QC laboratory. The applicable equation must be used to calculate the error rate. See MQOs for the frequency and error rate threshold.

Calculation:

Lower Taxonomic Resolution Individual Error Rate = (*Number of specimens where QC lab Final ID is more resolved than OR lab Final ID / Total number of specimens in a sample per QC lab count) x 100*

Lower Taxonomic Resolution Count Error Rate (BMI)

Definition: Provides the percentage of taxa (Final IDs) in a sample not identified to the desired level of classification (STE).

Requirements: The verification shall be completed by the QC laboratory. The applicable equation must be used to calculate the error rate. See MQOs for the frequency and error rate threshold.

Calculation:

Lower Taxonomic Resolution Count Error Rate = (*Number of Final IDs where QC lab is more resolved than OR lab/ Number of Final IDs per QC lab) x 100*

Taxa Identification Error Rate (BMI and Algae)

Definition: Provides the rate of misidentified taxa in a sample for BMI or algae. The equation compares the number of taxonomic names that were misidentified by the OR laboratory to the number determined by the QC laboratory (Rehn et al., 2015).

Requirements: The verification shall be completed by the QC laboratory. The applicable equation must be used to calculate the error rate. See MQOs for the frequency and error rate threshold.

Calculation:

Taxa identification error rate = $(N_{ORMIS} / N_{QC}) \times 100$

Where:

N_{ORMIS} = number of species (taxa) misidentified by the OR laboratory
N_{QC} = total number of species (taxa) recorded by the QC laboratory.

Natural Counting Entity (Algae)

Definition: The “natural counting entity” (NCE) is each natural occurring form of algae (i.e., each unicell, colony, filament, tissue-like form, coenocyte, tuft, or crust), regardless of the number of cells in the thallus or colony. The main purpose of using “natural counting entity” is to prevent numerous small cells in a sample with macroscopic forms from dominating a count relative to their actual contribution to the community biomass. It also facilitates the counting of algal forms which have linked cells that may be hard to distinguish.

Requirements: The NCE is used as a unit when the soft-bodied microalgal fraction is identified and enumerated. At minimum, 300 NCE of soft-bodied microalgae are required to be identified and enumerated per sample (Stancheva et al., 2015).

Taxonomic Harmonization (Algae)

Definition: Taxonomic harmonization is achieved, in part, by the exchange of photographic documentation and text descriptions of algal specimens between both OR lab and QC lab taxonomists. The taxonomic harmonization process is identical for both soft-bodied algae and diatoms. Taxonomic harmonization ensures that: (1) the

taxonomic nomenclature used to report SWAMP data is consistent with the specimen; (2) identification of newly reported taxa is verified prior to reporting; and (3) The Algae Master Taxa List is regularly updated to include newly reported taxa names.

Requirements: Harmonization of newly identified algal names is needed in order to load data into the SWAMP database. Harmonization is mandatory for newly reported taxa included in the dataset, but it is not required for all previously reported species. SWAMP recommends harmonization of the entire dataset (including results from previously reported species), but does not currently require this, due to resource limitations.

Data Reconciliation (BMI and Algae)

Definition: The reconciliation process is conducted by the QC taxonomist when specimen identification by the OR lab is in dispute. For each sample, the type of error for incorrect identification and enumeration should be evaluated. Differences between the two taxonomists should be resolved by comparing the best available literature or online resources and verified using vouchered representative specimens with confirmed identifications (SWAMP IQ).

Requirements: For BMI, when an MQO has failed, a reconciliation between the QC lab and OR lab shall take place. Data reconciliation is done for each algal QC sample.

Instrument/Equipment Testing, Inspection and Maintenance

Programmatic Policies

Field Equipment

Field equipment calibration is covered under the Field Quality Control section. All field equipment must be inspected and repaired as necessary prior to each sampling event. The manufacturer's instruction manuals and guidelines shall be utilized for routine use and repairs. Information about the specific models and equipment files and field logbooks shall be maintained by the owner of the instrument. Results of equipment calibrations, inspections, and maintenance will be noted in a file for each instrument. Those records are to be maintained and stored at the storage location of the equipment. Any deficiencies in equipment must be noted in the equipment file and reported immediately to the appropriate staff, who must recheck the equipment and

arrange for repair by the manufacturer or replacement. Information included in the equipment file shall be made available to the Project Manager and SWAMP QA Officer upon request.

Laboratory Equipment

Laboratory equipment calibration is covered under the Laboratory Quality Control sections. Information regarding analytical equipment and associated maintenance used by contract laboratories shall be provided in the laboratory's Quality Assurance Manual. Information about the equipment, maintenance, and calibration shall be provided to the SWAMP QA Officer upon request.

Inspection/Acceptance of Supplies and Consumables

Programmatic Policies

Information about acceptance criteria for supplies and consumables is contained within the Laboratory Quality Assurance Manual and field logbook. Laboratories and field crews will determine that all supplies and consumables comply with acceptance criteria outlined in their Quality Assurance Manual and Standard Operating Procedures prior to conducting analyses or collecting samples.

All materials must be visually inspected upon receipt to assure that they are undamaged, in clean condition, and conform to what is listed on the packing invoice. The materials/equipment are also compared to the type/model listed on the purchase order. Sample containers provided by a laboratory will be analyte-free or demonstrated not to contain contaminants for the analytes being monitored.

Non-Direct Data

Non-direct data refers to data that are collected by a third-party. Third parties may include, but are not limited to, other Water Board programs, government agencies, organizations, tribes, and citizen monitoring groups. SWAMP Project Managers are encouraged to use data collected by other projects to complement and enhance project findings, and to make well-informed decisions. Non-direct data types may include traditional water quality monitoring, flow and stream gauge measurements, satellite readings and images, and water quality models. To ensure that the data used are of appropriate quality and has the necessary documentation, Project Managers should adhere to the requirements below.

WATER QUALITY DATA

Water quality data collected by other projects shall be reviewed for SWAMP Comparability prior to use. Project Managers may submit data and project QA documentation for review to the SWAMP QA Officer. The Project Manager will be provided a summary of the review findings and recommendations for data use.

OTHER DATA TYPES

Other data types collected by projects that will be used by SWAMP shall have appropriate quality assurance documentation that includes information on how and when the data were collected, SOPs, limitations of the data collected, references, and contact information. Project Managers may contact the SWAMP QA Officer for review of the data and QA documentation, and for guidance on data use.

DATA MANAGEMENT

SWAMP data systems are maintained by the SWAMP IQ unit and the Division of Information Technology (DIT) at the State Water Board. The data systems consist of Microsoft Access data-entry and data management tools, Access data storage tables, Structured Query Language (SQL) databases and servers, and .NET web pages. The SWAMP systems for surface water quality data contain structures, minimum data elements, and standardized vocabulary that are compatible with the State Water Board's CEDEN data system. The water quality system contains modules for the storage of measurements, observations, and metadata for field, chemical, biological, tissue, and toxicity determinations. SWAMP also maintains data systems and tools for internal programmatic functions such as contract management, budget planning, invoicing, and project documentation. This data system is for program internal use only and not available to the public.

All systems are backed up daily for short-term storage, and each weekend for long-term storage by the Water Boards Division of Information Technology (DIT). All State Water Board systems are also backed up monthly by the Office of Information Technology (OIT).

The main components of the SWAMP surface water quality data systems include:

- **SWAMP Entry Side Database (Historic)** - Access 2000 replica database

  The SWAMP Entry Side Database was phased out of use in July and August 2019 due to the use of outdated and unsupported technology (Access 2000), as

well as aiming to provide more timely data to the public and decision makers, as described below for the SWAMP Permanent Side Database.

The purpose of this database was to allow for the entry and upload of new water quality data. Data within this database were considered “pending” and were not yet available to the public. Once data sets underwent verification, validation, and completeness checks and were deemed complete and final, the entire project was transferred to the Permanent Side database via a query tool. New vocabulary terms were also added to the look-up lists for review and approval prior to transfer to the Permanent side database.

- **SWAMP Database** (formerly SWAMP Permanent Side Database) - Microsoft 2012 SQL database

  As of September 2019, the Entry Side Database was no longer in use and all data within it was migrated to the Permanent Side database. The Permanent Side Database is now the entirety of the SWAMP database. In part, shifting to a single database rather than a two-sided database was done to make data publicly accessible more quickly, rather than waiting until the entire project is finalized. This change is one aspect of SWAMP adopting principles outlined in the State Water Board’s "Open Data Resolution."

  The purpose of this database is to store finalized and some pending water quality data and synchronize that data with CEDEN. Most data within this database are considered final, and most datasets are made available to the public as soon as the records are loaded to the database. As of August 2019, the SWAMP database contains pending field data because since then, field data are primarily loaded through a new process that automatically loads field data submitted in a data entry shell via the SWAMP File Transfer Protocol (FTP) site using a process maintained by State Water Board DIT. Finalized vocabulary terms are also maintained within the lookup ups lists for synchronization with CEDEN.

- **SWAMP Data Warehouse Database** - Microsoft 2012 SQL database

  The purpose of this database is to format and report pending and finalized data for review and analysis by SWAMP Project Managers and partners. This database is re-created nightly from the SWAMP Database (prior to September 2019, it was re-created twice a month after the synchronization of the Entry Side replicas). Prior to September 2019, the data on the Entry Side were uploaded to a temporary database and then combined with the data on the Permanent Side

Database through an automated query program on the server. Additional calculations and data de-normalization are performed for reporting purposes.

- **SWAMP Online Data Checker** - Microsoft .NET 2016 public-facing webpage

  The Online Data Checker is an automated tool that reviews data within the SWAMP standardized data templates for appropriate business rules, required minimum data elements, and standardized vocabulary. SWAMP partners, after checking and correcting for errors, may submit data to SWAMP IQ through this tool. The tool provides the data submitted within an email to the OIMA helpdesk which is administered by SWAMP IQ staff. Data submittals are logged and assigned to the appropriate Data Manager within 48 hours of receipt.

All field and laboratory data collected by SWAMP are verified, validated, and stored electronically within the SWAMP data system. All data processes are carried out using standard procedures as detailed in the following sections on data verification, validation, and assessment. A visual guide and summary of the data management processes is provided in Figure 4. More detailed information about these processes is provided below.

In addition to data processes, various query and reporting tools are provided to SWAMP Project Managers and partners to access the data within the SWAMP Database and Data Warehouse Database. Contact SWAMP IQ staff for more information on what tools are available.

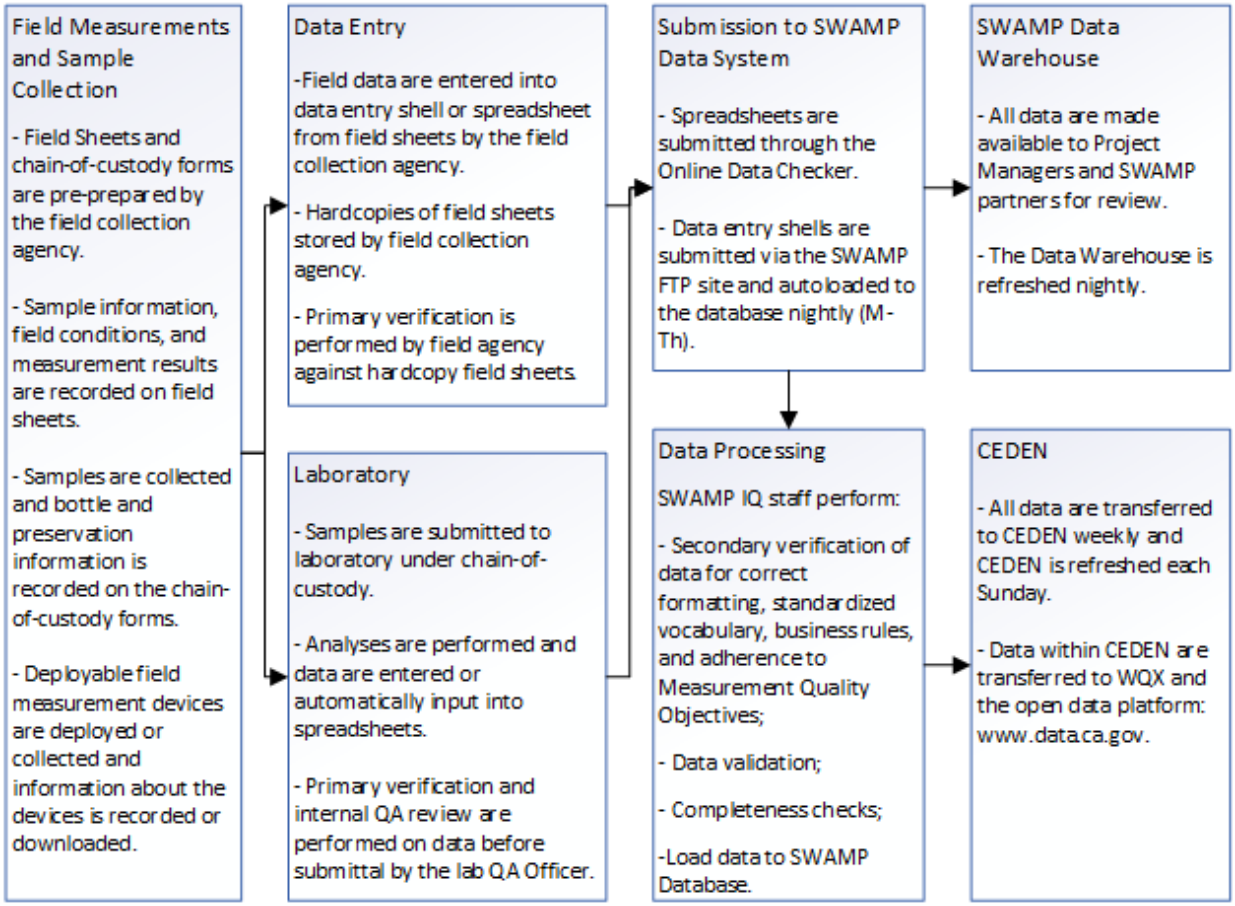

Figure 4. SWAMP Data Management Processes and Data Flow

FIELD DATA

Prior to visiting a site, field personnel may pre-fill core information about the planned sampling event into standardized Field Sheets and Chain-of-Custody forms. This information may include the project, station, and agency codes and information, along with the sample container types and number to be filled. Instrument calibration results should be recorded on the appropriate logs or field sheets at the time of instrument calibration. Once at a site, field measurement data and observations shall be recorded within the applicable field sheets as they are collected, or recorded or downloaded to the equipment's data storage device per agency policy or the manufacturers' guidance. Samples are to be submitted to the appropriate laboratories following chain-of-custody requirements and within the required holding time and sample handling conditions.

All data and observations taken in the field shall be entered or transferred into the applicable standardized data template or database. Field agencies are responsible for

primary verification of the data to ensure accurate and complete data collected in the field.

SWAMP partners who are responsible for field activities shall maintain and store all hardcopy and electronic field sheets and calibration logs per the time frames within the applicable contract to which the sample was collected. Electronic scans or photocopies of those records shall be made available to the Contract Manager and SWAMP QA Officer upon request.

Laboratory Data

Laboratories shall receive samples under chain-of-custody, and store and process samples within the appropriate holding time, handling, and methodology requirements. Core sample information shall be transferred from the chain-of-custody forms or pre-filled templates or spreadsheets to the SWAMP standardized templates, the laboratory information management system (LIMS) or other laboratory tracking reporting system. Laboratories must follow the applicable SWAMP business rules for each data type for submission of data to the SWAMP database. The business rules describe the columns and formats of the templates, the minimum data elements required for SWAMP data reporting, as well as how each of the sample types and results are to be reported. Business rules and templates can be found on the SWAMP webpage.

Laboratories shall maintain and store all hardcopy or electronic lab reports, bench sheets, calibration logs, and chain-of-custody forms per the time frames within the applicable contract to which the sample was received. Electronic scans or photocopies of those records shall be made available to the Contract Manager and SWAMP QA Officer upon request.

Data Submission

Data are submitted to SWAMP IQ either by template through the SWAMP Online Data Checker, or through upload of an Access data entry shell to the SWAMP FTP website. Data submitted through the Online Data Checker and the SWAMP FTP site are logged and tracked with the Data Submission Tracking Log, and forwarded, via email, to the appropriate Data Type Manager. The original file and a copy of the file for staff review are stored on the Water Boards shared network drive maintained by the State Water Board DIT. Data undergo secondary verification and validation within the template and are loaded to the SWAMP Database via queries within an Access tool.

As of September 2019, data loaded to the SWAMP Database are available immediately within the database. Prior to September 2019, Access replica databases were synchronized on the first and third Wednesday of each month. The first

synchronization of the month was mandatory to perform database maintenance and data transfers to the Permanent Side of the database and CEDEN. The second synchronization during each month was optional to receive vocabulary updates and the most recent data uploaded by SWAMP IQ.

SWAMP Data Within CEDEN

All data within the SWAMP Database are synchronized with CEDEN on a weekly basis. Data that are flagged for public use are made available on www.CEDEN.org. CEDEN sends a portion of the data within its system to US EPA's Water Quality Exchange (WQX) weekly.

Assessment Activities and Program Planning

Assessment of Program Activities

Pre-Kick-Off Project Readiness Review

Kickoff Meetings are held before the start of the sampling season for a project. The goal of these meetings is to ensure that everyone involved in the monitoring project understands their roles and responsibilities, and to coordinate logistics before sampling starts. Topics discussed at the meeting include assigned field crews, sample transport, Chain of Custody forms, sampling schedules, participating laboratories, quality assurance, and database readiness. Prior to scheduling these meetings, the Project Data Liaison will coordinate with the Project Manager to review the status of the following items:

- Coordination Readiness: Has the Communication Plan been completed?
- Database Readiness: Are all station, project, protocol, analyte, and equipment codes available within the database?
- Project Documentation Readiness: What is the status of the Regional Project Write-Up?

Field Activities Oversight

Field activities shall be directly overseen by the Field Coordinators. Field crews are to participate in annual calibration/refresher exercises. The Field Coordinator shall determine the breadth and scope of the calibration exercises depending on the responsibilities of each field crew. Participation and attendance in these exercises and other training is to be documented by the Field Coordinator. Field Coordinators shall conduct random reviews of field activities and provide training where needed. If data

issues are noted through the primary verification processes, issues should be resolved internally and at the discretion of the Field Coordinator. Documentation of assessment activities and training activities must be stored by the agency responsible for field activities per the requirements in the contract for which the activities occurred. That documentation must be made available to the Contract Manager and SWAMP QA Officer upon request. If data issues are noted within the secondary verification, the Field Coordinator will be notified of the issue via email. Corrective and Preventative Action Reports may be utilized at the discretion of the SWAMP QA Officer when necessary.

Laboratory Activities Oversight

Laboratory activities shall be directly overseen by the Laboratory Director and Laboratory Quality Assurance Officer. Laboratories shall maintain internal training and assessment schedules and documentation. Documentation of assessment activities and training activities must be stored by the agency responsible for field activities per the requirements in the contract for which the activities occurred. That documentation must be made available to the Contract Manager and SWAMP QA Officer upon request. If data issues are noted through the primary verification processes, issues should be resolved internally and at the discretion of the Laboratory QA Officer. If data issues are noted within the secondary verification, the Laboratory QA Officer will be notified of the issue via email. Corrective and Preventative Action Reports may be utilized at the discretion of the SWAMP QA Officer when necessary.

Programmatic Review

SWAMP undertakes internal routine programmatic reviews to assess the performance of the program in meeting strategic goals, evaluate if the program is meeting current State and Regional Water Board needs, and begin strategic planning for the future of the program.

SWAMP has undertaken both external and internal programmatic reviews. In 2006, the external Scientific Planning and Review Committee (SPARC) Review resulted in a set of recommended actions including a communication strategy, a robust planning framework, a pathway to ensure technical oversight and expertise, and a continued focus on assessment methods that more directly measure beneficial uses (e.g., SWAMP's bioassessment protocol using benthic macroinvertebrates).

In 2014, SWAMP conducted an internal programmatic review to evaluate program functions and effectiveness, and to recommend actions to ensure the program's continued success. Recommended actions included better documentation of

programmatic procedures, a strategic review of the statewide monitoring programs and the formation of the Data Synthesis and SWAMP Tools work groups.

In the fall of 2015, SWAMP Coordinators initiated the first Strategic Review to evaluate SWAMP's statewide monitoring programs – Bioassessment, Bioaccumulation, Stream Pollution Trends and Freshwater Harmful Algal Blooms – and recommend actions for a three-year period beginning July 1, 2017 (to coincide with the second round of SWAMP contracts). The Strategic Review will occur every three to five years. The results of this review are for internal planning purposes only.

In 2019, SWAMP began developing the SWAMP Strategic Action Plan for 2020-2023. The three priorities identified in the SWAMP Strategic Action Plan are:

1. Align statewide and regional monitoring and assessment efforts with Water Boards programs
2. Establish and maintain effective coordination and communication systems and processes
3. Develop and share user-centered assessment resources and tools.

REPORTS TO MANAGEMENT

ANNUAL WORK PLANS

US EPA F106 FUNDS

The US EPA requires an annual work plan describing the Section 106-funded work to be conducted by SWAMP. The F106 Work Plan is prepared by staff at the State Water Board. It is submitted to US EPA in April and covers the subsequent fiscal year (July-June). After the 2014 SWAMP Review, many recognized a need for a more comprehensive annual planning document to capture the state-funded tasks, as well as work leveraged by SWAMP's many partnerships. Accordingly, the FY16/17 and subsequent Annual Work Plans were expanded beyond 106-funded activities to incorporate some of these additional activities.

DEPUTY MANAGEMENT COMMITTEE (DMC)

SWAMP is also required to submit an annual roundtable work plan to the DMC at the beginning of each fiscal year. The first FY15/16 SWAMP Roundtable Work Plan was finalized in July of 2015 and described how the recommended actions from the 2014 SWAMP Review were to be implemented. The following year, the FY16/17 SWAMP Roundtable Work Plan was finalized and submitted to the DMC.

Since FY17/18, the F106 and SWAMP Roundtable Work Plans were integrated in both the planning phase and in the final document. Additionally, information on the regional monitoring programs from the Project Planning Tool (described below) has been incorporated into the Annual Integrated SWAMP Work Plan. The work plans described in this section are posted on the SWAMP Wiki.

US EPA Quality Assurance Report

Following each fiscal year, a Quality Assurance Report is prepared by the SWAMP QA Officer. This report provides updates on program documents, assessments, corrective actions, and QC, as well as proposed activities for the upcoming year. The report is submitted to the State Water Board QA Program. Information from the SWAMP Quality Assurance Report is incorporated into the State and Regional Water Boards' annual Quality Assurance Report to US EPA Region 9. SWAMP Quality Assurance Reports are electronically archived by the SWAMP Unit for a minimum of five years.

Data Verification, Validation, Completeness & Assessment

Purpose and Background

All SWAMP data are required to undergo review and evaluation to ensure that the data conform to SWAMP- and project-specific criteria within the Program Plan, the Project Plan, or Regional Project Write-up, as applicable. Additionally, data must be assessed to determine usability and support for the intended uses of the data. Review of data consists of three discrete processes: verification, validation, and assessment.

Data Verification

Data verification is the process of evaluating the correctness, consistency, conformance, and completeness of a specific data set against the original records, methods/procedures, format requirements, and contractual requirements. The data will be reviewed to ensure that all data collected have been reported, and done so accurately. Verification applies to all aspects of the data generation, from site visitation to analytical results submission (US EPA QA/G-5, 2002). Verification in SWAMP takes place at two levels: by the original data producers and at a secondary level by SWAMP IQ staff. Verification is overseen by the SWAMP QA Officer.

Data Validation

Data validation is the process by which environmental data are assessed for potential bias and flagged accordingly to alert the data user to potential issues that will affect usability. Data are evaluated at the result level in reference to the project DQIs, the assigned Data Classification Category, MQOs, the batch, and the associated QC check to determine appropriate flagging. Validation applies to all activities in the field as well as in the analytical laboratory (US EPA QA/G-5, 2002). Validation is performed by SWAMP IQ staff and is overseen by the SWAMP QA Officer.

Data Completeness Review

The data completeness review is the process by which SWAMP data are reviewed by project staff to ensure that all data that were expected to be collected are present within the data system. The process is carried out by performing queries of the data based on project and performing large scale review and record count.

Data Quality Assessment

Data assessment is the process of using the results of the verification and validation steps in conjunction with any other information known about the data collection to determine overall data usability (EPA R9QA/03.2). Data assessment in SWAMP will be performed by the Project Manager, Lead Scientist, or designated project staff.

Approaches to Verification, Validation, & Assessment

Approaches to Data Verification

Verification in SWAMP takes place at two levels: a primary level by the original data producers, and a secondary level by SWAMP IQ staff.

Primary Data Verification

Verification is part of the routine processes of field and laboratory staff. Field sheets, COC forms, laboratory logs, and information systems are checked on a daily basis to ensure accurate and complete information throughout a sample's collection, transport, and processing. Field and laboratory staff are responsible for ensuring that all data are entered accurately and completely into the final data-entry database shell or data-entry template.

Field Data

Sample information and requested analyses are entered into COC forms by the field staff or in combination with the Project Manager. The field crew shall ensure that the information entered is accurate and complete prior to transferring custody of the samples to the laboratory.

Field-generated observations and measurements are transferred from field data sheets into data entry shells and are loaded into the SWAMP database via the SWAMP FTP site, or into SWAMP Field Data Templates. Data are entered following SWAMP business rules for data reporting and formatting. Field staff shall review the field data entry records against the original field sheets to detect and correct typographical errors, as well as to confirm that all records have been entered. The field data verifier shall also ensure that the correct result qualifier and QA codes are applied to the results, where applicable.

Prior to submission of the Field Data Template to SWAMP IQ, data shall be run through the SWAMP Online Data Checker. The Online Data Checker is an online tool that checks for lookup list values and adherence to SWAMP Database business rules. Any issues that are found by the checker must be corrected prior to submission.

Original field sheets and field logs must be retained for a minimum of five years or per the terms within the contract, whichever is longer. Electronic scans or photocopies of those records shall be made available to the Contract Manager and SWAMP QA Officer upon request.

LABORATORY DATA

Sample information is entered into a laboratory information management system (LIMS) or into a SWAMP Data Template (i.e., excel file). Laboratory-generated data are entered into SWAMP Data Templates either manually from bench sheets or downloaded from the LIMS. Data are entered following SWAMP business rules for data reporting and formatting. The laboratory staff shall review 100% of the laboratory data entry records against the original bench sheets (if utilized) to detect and correct typographical errors, as well as confirm that all records have been entered. If a LIMS is used, laboratory staff shall verify 10% of the electronic data reports to ensure accuracy and completeness. If errors are detected during the 10% check, then 100% verification is required since the last successful verification check was completed. The laboratory data verifier shall also ensure that the correct result qualifier and QA codes are applied to the results, where applicable.

Prior to submission of a SWAMP Data Template to SWAMP IQ, data shall be run through the SWAMP Online Data Checker. The Online Data Checker is an online tool that checks for lookup list values and adherence to SWAMP database business rules. Any issues that are found by the checker must be corrected prior to submission.

Original bench sheets and lab reports must be retained for a minimum of five years or per the terms within the contract, whichever is longer. Electronic scans or photocopies of those records shall be made available to the Contract Manager and SWAMP QA Officer upon request.

SECONDARY DATA VERIFICATION

Secondary data evaluation is performed by SWAMP IQ staff after the data have been entered, verified, and submitted by the field or laboratory staff. SWAMP IQ staff will review 100% of the electronic data against the MQOs assigned to the data by the Project Manager, ensure proper business rules were followed, and highlight outlier and/or nonsensical data values for additional verification. Potential data issues

discovered during secondary verification may be communicated back to the original data producer for additional follow up or completion of a CPAR.

The data set is verified for both completeness and for meeting the specific MQOs and sample handling requirements of the SWAMP QA Program Plan:

- Field Conditions
- Sensor Information
- Holding Times
- Method Blanks
- Surrogates
- MS/MSD
- CRM
- LCS
- Laboratory Duplicates
- Equipment Blanks
- Field Blanks
- Field Duplicates
- Target Compounds and RLs

When MQOs are not met, verification codes from the Batch Verification Look-up and/or QA Code Look-up tables may be applied by SWAMP IQ staff, or QA Officer, and entered into the database. These codes are preceded by a “V” in the “Batch Verification Code” or “QA Code” fields. Individual records for field data and taxonomy, and laboratory batches for chemistry, tissue and toxicity will be coded “VAC” once secondary verification is complete. This code is contained in the Batch Verification Code field. If deviations from the MQOs are detected by SWAMP IQ that were not detected by the laboratory, the data is coded “VAC, VMD.” If some QC information is missing, the data will be coded with “VAC, VQI.” If all QA data were expected to be reported and none are available, then the data are coded as “VQN”. When batches are determined to be missing some or all QC required information, those batches are tracked and brought to the attention of the SWAMP QA Officer for development of a CPAR. When MQOs do not exist for certain data types, the data are coded as “NA” (“Not Applicable”). Certain field observations, for example, fall under this category.

Table 3. SWAMP Batch Verification Codes

Batch Verification Code	Description
VAC	Cursory Verification
VAC,VMD	Cursory Verification, Minor Deviations, Flagged by QAO
VAC,VQI	Cursory Verification, Incomplete QC, Flagged by QAO
VQN	No QC, Flagged by QAO

APPROACHES TO DATA VALIDATION

Validation in SWAMP will occur for all projects in order to assess potential bias and flag the data accordingly. Flagging is used as a means to alert the data user to potential issues that may affect usability. The data will be evaluated at the result level in reference to the project DQIs, the assigned Data Classification Category, MQOs, laboratory batch, and the associated QC. Validation will be performed by SWAMP IQ staff using standardized procedures, and will be overseen by the SWAMP QA Officer.

SWAMP currently performs two levels of validation: core programmatic and project-specific. All SWAMP projects undergo core validation that determines if the data met the project's baseline quality needs. Project-specific validation occurs for projects that require additional, project-defined scrutiny to assess usability. Currently, only the Bioaccumulation Monitoring Program for SWAMP requires this level of validation. Other projects may request custom validation by contacting the SWAMP QA Officer.

CORE PROGRAMMATIC VALIDATION

The core programmatic validation process reviews the results of the primary and secondary verification, and applies compliance codes to the results to communicate potential bias to data users. All data qualification flags should be considered by the data user (QA, batch, and compliance codes), to determine data usability during the Data Quality Assessment review. Core programmatic validation is carried out through standard operating procedures. These standard operating procedures, (currently named "Data Classification SOP") are available on the SWAMP IQ Wiki. Table 4 includes the compliance codes applied to data during the core validation process.

Table 4. Core Programmatic Validation Compliance Codes

Code	Name	Description
SCR	Screening	Data are for information purposes only and are considered to be non-quantifiable.
HIST	Historical	Historical; no supporting QC data
COM	Compliant	Compliant with associated Project Plans
EST	Estimated	Data are considered to be non-quantifiable, estimated
QUAL	Qualified	Non-compliant with associated Project Plans, analytes not covered in associated Project Plans, or insufficiently documented need supplementary info for data to be used

PROJECT SPECIFIC VALIDATION

STATEWIDE BIOACCUMULATION MONITORING PROGRAM VALIDATION

Tissue data collected under the Statewide Bioaccumulation Monitoring Program, and data collected by the Regions to enhance or expand the statewide program locally, are required to undergo an additional level of validation. This validation process is carried out by following the BOG Data Validation SOP and requires a specific batch validation code, unique quality assurance codes, and additional compliance codes.

Table 5. Compliance Codes unique to the Statewide Bioaccumulation Monitoring Program

Code	Description
VIL	RPD exceeds control limit, flagged by QAO
VIU	Percent Recovery exceeds laboratory control limit, flagged by QAO
VQCA	QA/QC protocols were not met for accuracy, flagged by QAO
VQCP	QA/QC protocols were not met for precision, flagged by QAO
VRIL	Data rejected - RPD exceeds control limit, flagged by QAO
VRIP	Data rejected - Analyte detected in field or lab generated blank, flagged by QAO
VRIU	Data rejected - Percent Recovery exceeds laboratory control limit, flagged by QAO

Table 6. Batch Validation Codes unique to the Statewide Bioaccumulation Monitoring Program

Code	Name	Description
VAP	Alternate Level Validation	Validation of electronic data against alternate MQOs: may or may not include an evaluation of calibration, sample raw data, and recalculation of sample results
VAP,VQI	Alternate Level Validation, Incomplete QC, Flagged by QAO	Validation of electronic data against alternate MQOs: may or may not include an evaluation of calibration, sample raw data, and recalculation of sample results; Batch has incomplete QC, batch comment required; Flagged by QAO

Approaches to Data Completeness Review

SWAMP data are reviewed by project staff to ensure that all data that was expected to be collected is present within the data system. This process is carried out by querying the project data and conducting a large-scale review and record count per the SOP (available on the SWAMP Wiki). As of 2019 when the database shifted from a two-sided (temporary/permanent) database to a one-sided (permanent) database, completeness reviews are initiated only by Project Manager request. Prior to 2019, completeness reviews were also initiated by the SWAMP IQ Project Data Liaison when approximately 3 months had passed since the last sample date for a Water Quality (WQ) or Tissue (TI) project, and 9 months had passed for a Bioassessment (BA) project.

Approaches to Data Quality Assessment

Data assessment is the final process of reviewing project data for usability. This review is performed by the Project Manager, Lead Scientist, or designated project staff. Project Managers should discuss the methodology that will be utilized for the data quality assessment within the appropriate project Quality Assurance Planning Documents. Project Managers may refer to EPA's Guidance for Data Quality Assessment: Practical Methods for Data Analysis (QA/G-9) for guidance. At a minimum, the methodology shall include the following elements:

- A review of the project DQOs and sampling design
- A review of the project data
- Identification of the statistical test that will be used and the assumptions (if applicable)
- A discussion on how conclusions will be drawn the from the data
- An evaluation of whether the MQOs were reasonable and useful to the study.

Reconciliation with Data Quality Objectives

Purpose/Background

The Program Quality Objectives section describes the role of the DQO process and identifies the program's objectives. Reconciliation with the DQOs involves reviewing the data to determine whether the DQOs have been attained and that the data are adequate for their intended use. For SWAMP, both the existing MQOs and data need to be reconciled with the programmatic intended data uses. At the project level, reconciliation occurs during the Data Quality Assessment.

Reconciling Current MQOs and Data with Program Objectives - A Proposal

SWAMP historically developed MQOs on the principle of performance-based methodology, rather than as part of the DQO process. The most recent MQOs were adopted for use in 2013. Over the next five years, SWAMP proposes to work towards adopting a method to calculate the allowable uncertainty that was set by the 2013 MQOs. This “allowable uncertainty” will then be evaluated to determine if it supports the programmatic SWAMP Intended Data Uses.

The uncertainty calculation method will then be evaluated for use to measure “actual” uncertainty in the SWAMP data sets. Example data sets will be extracted to have uncertainty measured for each result. If successful, the program proposes to calculate actual uncertainty for data collected between 2014 through 2018 to study data collected utilizing the 2013 MQOs. A field will be added to the database to record this value. The next step will be to compare the actual uncertainty measured to the allowable uncertainty in order to evaluate whether the allowable uncertainty is feasible and determine weaknesses in program quality control performance.

The information gathered from this project will allow for possible modifications to the MQOs, creation of additional sets of MQOs to align with the SWAMP Data Classification System, and the potential development of numerical, statistically-based DQOs for the program. An additional goal is to incorporate the calculation of uncertainty into the QA and data management processes, and present those values to the data users for data analysis and decision making.

Once the first round of the reconciliation process has occurred, the method of calculations and comparisons can be further utilized to develop a routine reconciliation process at the programmatic- and project-level, every two to three years, to correspond to the contract and project planning process.

SWAMP COMPARABILITY

The Water Boards utilize data from numerous sources in carrying out their requirements under California's Water Quality Control System to make environmental, regulatory, and public health decisions. The data collected are from diverse monitoring projects and programs, including SWAMP, which support a wide variety of monitoring objectives, organizations, methods, and data types. Therefore, when diverse data are combined to support a decision by the State or Regional Water Boards, it is of paramount importance that the data be "comparable." Data comparability is defined as the measure of confidence that one dataset can be compared to another and can be combined for a decision(s) to be made (US EPA QA/G-5, 2002).

As the Water Board's ambient water quality monitoring program, SWAMP is tasked with assisting other monitoring projects and programs with collecting and reporting data that can be utilized by the Water Boards. Permits, grants, waivers and other Water Board monitoring efforts often require monitoring projects to be "SWAMP Comparable," or meet the Water Boards' quality and data system requirements for non-surface water projects. These two requirements are equivalent and used interchangeably. To be SWAMP Comparable, projects and programs should share in SWAMP's goal "to collect and provide data that is well planned and documented, valid and defensible, and supportive of decisions required by California's Water Quality Control System". SWAMP achieves this goal through careful project management, data review, and reporting as detailed in this Program Plan. SWAMP's efforts are best summarized as a project lifecycle based on the principles of planning, documentation, implementation, review, and reporting (Figure 5). A summary of these principles is provided below.

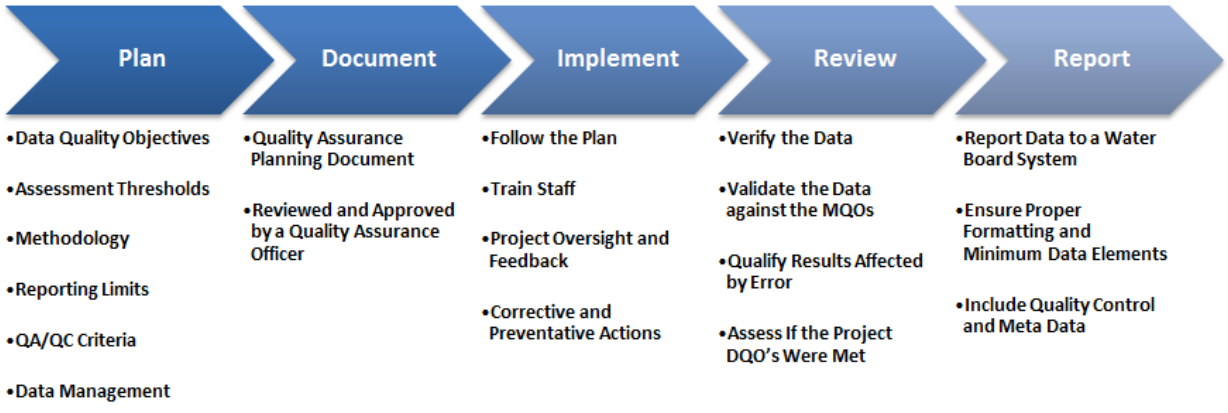

Figure 5. SWAMP Project Lifecycle

PLANNING

Projects seeking SWAMP Comparability should undertake a planning process equivalent to the DQO process to identify a project's intended data use and select the appropriate level of quality needed. During the planning phase, projects should identify the applicable beneficial uses, assessment thresholds, methodology, reporting limits, and create a data management plan for review, storage, analysis, and submission of data to a Water Boards system.

Ambient surface water projects should identify which SWAMP Program Quality Objectives and SWAMP Intended Data Use Categories apply. It is highly recommended that projects apply SWAMP Programmatic MQOs, where applicable, for maximum comparability with SWAMP data produced under the Ambient and Health data use categories, as well as the Regulatory and Investigative categories where possible.

DOCUMENTATION

All projects should document project information in an appropriate QA Planning document or equivalent planning document, and the document should be reviewed and approved by an appropriate QA Officer. The Water Boards have QA Officers at both the State and Regional level, but programmatic QA Officer review and approval may also be appropriate. Consult any grant, permit, waiver, order, or other policy to determine which QA Officer approval signatures are required.

For data intended for use with the Integrated Report, the following requirements must be met:

> A QAPP or equivalent documentation must be available containing, at a minimum, the following elements:
>
> - ❏ Objectives of the study, project, or monitoring program
> - ❏ Methods used for sample collection and handling
> - ❏ Methods used for field and laboratory measurement and analysis
> - ❏ Data management, validation, and recordkeeping (including proper chain of custody) procedures
> - ❏ QA and QC requirements
> - ❏ Personnel training requirements
> - ❏ DQOs, action levels, or requirements of the project
> - ❏ Rationale for the selection of sampling sites, water quality parameters, sampling frequency, and methods that assure the samples are spatially

and temporally representative of the surface water, and representative of conditions within the targeted sampling timeframe

- ❏ Certification statement of the adequacy of the QAPP (including name of person certifying the document)
- ❏ Documentation to support the conclusion that results are reproducible and the DQOs were achieved.

IMPLEMENTATION

To be SWAMP Comparable, projects should be implemented as described in the QA planning document. All project staff members should be familiar with the requirements within the plan, which can be ensured by Kickoff Meeting attendance. The Project Manager, or other designated staff shall be responsible for ensuring that project staff receive and maintain any required training or certification. Project management staff should carefully oversee project activities during the implementation phase of the project and ensure that those activities are carried out according to the plan. Project management staff should also provide feedback to field crews, laboratories, and data management staff as needed. When issues arise, project staff should implement corrective and preventative actions where applicable and necessary. Records of activities should be maintained to help provide a narrative for the data and project reports, and to communicate potential data errors.

REVIEW

Data collected by the project should first be reviewed by the person(s) responsible for creating the data to ensure accurate entry and reporting. It is highly recommended that field and laboratory staff evaluate the data for compliance with the project's MQOs as well. The project QA Officer or other designated staff should then verify and validate the data in order to determine compliance with the data management plan and MQOs. The data should be flagged/qualified accordingly to alert the project staff, and other data users, about potential data error or bias. It is highly recommended that project staff also perform a data quality assessment to determine the usability of the data for the project and the Water Boards.

For ambient surface water projects, data should be flagged/qualified following SWAMP business rules for data verification and validation. Data Quality Assessments should be performed, and a narrative developed for reporting, Integrated Report, and health advisory development.

Reporting

Data must be submitted to the appropriate Water Board Data System in the required format, and must include all required minimum data elements, metadata, and QC sample results.

Ambient surface water projects should meet the minimum required data elements, metadata, QC sample results, and business rules outlined in the SWAMP Data Management section. Data should then be submitted to the SWAMP Database or CEDEN.

SWAMP Comparability & Certification Review

Ambient surface water project staff that wish to submit their data for SWAMP studies, the Integrated Report, or health-based advisories may submit their project QA Planning documentation and export their project data for review and potential certification by SWAMP. SWAMP IQ staff will perform a review of the planning documentation and a randomized 10% to 30% check of the data to determine if the above conditions of SWAMP Comparability have been met. The results of the review will then be provided to project staff. It is highly recommended that QA planning documentation be submitted during the early stages of the project to ensure alignment with the comparability requirements. Projects that meet the above conditions at the conclusion of the project will be labeled as “SWAMP Certified” within CEDEN. Projects carrying this label will be queried with SWAMP data for use in the Integrated Report and health advisories, where applicable, allowing for expedited review and inclusion in the lines of evidence. The label will also be utilized for consideration of external data for incorporation within SWAMP studies, where applicable.

Communication and Resources

SWAMP IQ staff developed a SWAMP Comparability web page in 2020 to communicate and expand upon this information. The web page provides information on SWAMP’s Intended Data Uses, project planning resources, SOPs, measurement quality objectives, data reporting and review resources, and additional information will be added as needed to support SWAMP comparability for other water quality monitoring projects.

APPENDIX A: LIST OF ACRONYMS

Acronym	Definition
ABL	CDFW Aquatic Bioassessment Lab
BMI	benthic macroinvertebrates
BOG	Bioaccumulation Oversight Group
Cal/EPA	California Environmental Protection Agency
CCAMP	Central Coast Ambient Monitoring Program
CCHAB	California CyanoHAB Network
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CEDEN	California Environmental Data Exchange Network
COC	chain of custody
CPAR	Corrective and Preventative Action Reports
CRAM	California Rapid Assessment Method
CSCI	California Stream Condition Index
CSU	California State University
CSULBRF	California State University, Long Beach Research Foundation
CSUSM	California State University, San Marcos
CWA	Clean Water Act
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDL	Specific to Dioxin/Furan tests and equivalent to MDL.
FHAB	freshwater harmful algal bloom
LCS	laboratory control sample
LIMS	Laboratory Information Management Systems

LOQ	Limit of quantitation Practical quantitation level = 3x MDL
MDL	method detection limit
MPSL	CDFW Marine Pollution Studies Lab
MQO	Measurement Quality Objective
MS	matrix spike
MSD	matrix spike duplicate
NCE	natural counting entity
OEHHA	Office of Environmental Health Hazard and Assessment
OIMA	Office of Information Management and Analysis
OR lab	Original Taxonomy Lab
PSA	Perennial Streams Assessment
QA	quality assurance
QC	quality control
RCMP	Reference Condition Management Program
RDL	Representative detection level The average MDL achieved by a pool of measurements using the same approach used in MACT floor setting process.
RL	reporting limit
SIP	Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California/State Implementation Policy
SOP	standard operating procedure
SPoT	Stream Pollution Trends Monitoring Program
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SCCWRP	Southern California Coastal Water Research Project
SFEI	San Francisco Estuary Institute

STE	standard taxonomic effort
STEW	Safe to Eat Workgroup
SWAMP	Surface Water Ambient Monitoring Program
SWAMP IQ	SWAMP Information Management and Quality Assurance Center
SWRCB	California State Water Resources Control Board
UCD-GC	University of California, Davis Granite Canyon
UCD-AHPL	University of California, Davis Aquatic Health Program Laboratory
UC	University of California
US EPA	United States Environmental Protection Agency

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APPENDIX C: CONTRACT LANGUAGE FOR DATA MANAGEMENT AND QUALITY ASSURANCE

The SWAMP Contract Language for Data Management and Quality Assurance can be found on the SWAMP IQ Wiki.

APPENDIX D: STATEWIDE MONITORING PROGRAM QUALITY ASSURANCE PROJECT PLAN TEMPLATE

The Statewide Monitoring Program Quality Assurance Project Plan Template can be found on the SWAMP IQ Wiki.

APPENDIX E: REGIONAL PROJECT WRITE-UPS GUIDANCE DOCUMENT

All SWAMP regional monitoring projects are required to have an approved Regional Project Write-up. Write-ups combine the core elements of the Data Quality Objectives (DQO) planning process utilized in Project Plan development, and shall be used in lieu of developing individual complete Project Plans. The information provided will be stored within the SWAMP Internal Information Management System and linked to the Project Budget Planning Modules and other modules as needed.

Step 1. What is the Project Going to Study?

The first step of the DQO process is to identify the issue the project would like to evaluate and develop a conceptual model. The conceptual model should summarize the environmental concerns and include concepts on the inputs, transport, dispersion, transformation, fate, uptake and behavioral aspects of the exposure scenario (EPA QA/G-4). The following information is needed for this step:

- Purpose of the study or problem the study will evaluate
- Brief background or context to the problem
- Length and time frame of the project
- Project Title
- Core/base Project Code.

Step 2. How are the data going to be used?

The second step of the process is to evaluate how the data from the study will be used. The information is needed to complete this step:

- Project's Intended Data Use Category. For example: Ambient, Investigation, Health, Regulatory, Other
- Regional Board, State Board, or inter-agency programs and priorities that the project will address. For example: Integrated Report, TMDL, Health Advisory, Basin Plan, Research, etc.
- Beneficial Uses the study will address
- Decision to be made from the study.

Step 3. What kind(s) of data will be collected?

The third step of the process is to identify what categories of data will be collected. The following information is needed to complete this step:

- Type of matrices that will be samples/measured/studies. For example: water, sediment, tissue, organism collection (bioassessment), habitat, other
- Measurements and/or observations that will be made
- If applicable, assessment thresholds that will be used. Assessment thresholds will be provided to the SWAMP contract laboratories to determine the best method that will achieve sufficiently sensitive reporting limits (RLs) and method detection limits (MDLs)
- Standard operating procedures (SOPs) to be used for sample collection and field measurements
- If applicable, other sources of data to be used in the study.

Step 4. What are the boundaries and limits of the study?

Step four of the process is to identify the boundaries and limits of the study. The following information is needed to complete this step:

- Environment/target population that will be studied
- Geographical area of the project
- Study schedule and sampling frequency
- Practical constraints or limitations for the project.

Step 5. How much error is acceptable?

Step five of the process is to identify how much error is acceptable for the study. The following information is needed to complete this step:

- Measurement Quality Objectives that are applicable to the study
- Required type of data validation for the project.

Step 6. How will the data be analyzed?

Step six of the process is to identify how the data will be analyzed. The following information is needed to complete this step:

- Techniques that will be employed to visualize and analyze the results.
- Will the study results be included in a report?
- Any additional information.

SWAMP IQ Evaluation Process for Regional Project Write-ups

Project Write-ups (Write-ups) must describe the following elements:

- The question, management action, problem, or activity the project will address
- The Beneficial Uses and Water Quality Objectives the study will assess
- The list of parameters the study will measure and whether lab certification is required
- The appropriate Assessment Thresholds and Reporting Limits (if applicable)
- Where and when the project will take place
- The most appropriate Data Use Category(s)
- The sampling design
- The applicable quality controls and Measurement Quality Objectives (MQOs) to be utilized.

SWAMP IQ Project Data Liaisons review submitted Project Plans and Write-ups to ensure required elements are present.

Each element, consisting of several steps, will be rated for relevance, applicability and completeness. Ratings will be designated as: “meets” or “does not meet” QAPrP requirements. If certain steps of a Write-up do not meet these requirements, a note explaining the deficiency must be added to the “what is needed to complete this section” column. In addition, an email explaining the shortcomings of the Write-up and a deadline to submit a revised draft will be sent to the Regional Project Coordinator. If all sections of a Write-up meet QAPrP requirements, a template letter confirming approval will be sent to the Regional Project Coordinator. The following table is used to describe ratings and feedback regarding the Write-ups and sent to the Regional Project Coordinator.

Table 7. Regional Write-up Rating Rubric

Step/Question	Meets	Does not Meet	What is needed to complete this section
Step 1. What is the project going to study?	☐	☐	
1.1 State the purpose of the study or problem the study will evaluate.	☐	☐	
1.2 Provide a brief background or context to the problem	☐	☐	
1.3 What is the general length and time frame of the project?	☐	☐	
1.4 Provide the project title	☐	☐	
1.5 Provide Project code	☐	☐	
1.6 Is study connected to SWAMP statewide project	☐	☐	
Step 2. How are the data going to be used?	☐	☐	
2.1 Identify the project's intended data use category	☐	☐	
2.2 Identify Regional, State Board, or inter-agency programs and priorities that the project will address.	☐	☐	
2.3 Identify the Beneficial Uses the study will address	☐	☐	
2.4 Identify the decision to be made from the study.	☐	☐	

Step/Question	Meets	Does not Meet	What is needed to complete this section
Step 3. What kind(s) of data will be collected?	☐	☐	
3.1 What type of matrices will be samples/measured.	☐	☐	
3.2 What measurements and/or observations will be made?	☐	☐	
3.3 If applicable, what assessment thresholds will be used?	☐	☐	
3.4 What SOPs will be used for sample collection and field measurements?	☐	☐	
3.5 Will other sources of data be used in this study?	☐	☐	
Step 4. What are the boundaries and limits of the study?	☐	☐	
4.1 Identify the environment/target population that will be studied.	☐	☐	
4.2 Identify the geographical area	☐	☐	
4.3 Identify the general schedule and frequency of sampling	☐	☐	
4.4 Identify the practical constraints for the project	☐	☐	

Step/Question	Meets	Does not Meet	What is needed to complete this section
Step 5. How much error is acceptable?	☐	☐	
5.1 Identify the MQOs that are applicable to each measurement.	☐	☐	
5.2 Identify validation options needed for the project based on the intended data use	☐	☐	
Step 6. How will the data be analyzed?	☐	☐	
6.1 What techniques will be employed to visualize and analyze the results?	☐	☐	
6.2 Will the study results be included in a report?	☐	☐	
6.3 Any additional information?	☐	☐	

APPENDIX F: PROGRAM TIMELINE

The SWAMP Program Timeline is available on the SWAMP Wiki.

APPENDIX G: PROJECT KICKOFF SOP AND PREPARATION MATERIALS

Meeting Procedures

● Upon notice of upcoming Kickoff Meetings the following procedures should be followed by the SWAMP IQ Project Data Liaison in receipt of the invitation.

● Make sure to invite everyone from SWAMP IQ that has interest or expertise in the topics being discussed in the meeting. Always Cc: the Field and Chemistry data managers on these invitations as they will be necessary to create relevant codes and chemistry is a component of every project. SWAMP representatives should be copied on all invitations also.

● The SWAMP IQ Project Data Liaison is responsible for updating the shared Google Project Tracking Calendar linked from the SWAMP Wiki. Add the Kickoff Meeting and sampling dates (include tentative dates) for the project. The calendar is shared for editing within the Unit in Google Docs.

● Review the Work Order associated with the project and check to see if any analytes require specifics that need to be discussed in the meeting.

● Contact Regional Coordinator establishing the meeting and provide them with the SWAMP IQ Kickoff Meeting Guidance Package.

> This guidance package will contain the Communication Plan, Kickoff Checklist, and a link to the Kickoff Outline and Materials on the SWAMP Wiki. Encourage the coordinator to use these guidance documents in order to make good use of time in the meeting and cover all the essential information. These documents can also be found on the State Water Board SWAMP website

● Request the Regional Coordinator complete the SWAMP Communication Plan and distribute it along with the agenda. The SWAMP Communication Plan is saved to the S: drive for editing and distribution. S:\OIMA\SHARED\QA&DM\KickOff Meetings\QADM Kickoff Meeting Guidance Package

● While attending meetings utilize the checklist so that all necessary materials are covered.

● After meeting, the SWAMP IQ Project Data Liaison ensures that all necessary codes are created in the database.

APPENDIX H: CORRECTIVE & PREVENTATIVE ACTION TEMPLATE

Date:

Reporting Party:

Involved Party:

Subject:

Project:

Matrix:

Analysis:

Problem Type:

Problem Description:

Proposed Corrective Action:

Impact on Data:

Sample Results:

Follow Up:

FOR INTERNAL USE:

Resolution Date:

SWAMP Quality Assurance (QA) Officer name:

SWAMP QA Signature: Date:

SWAMP Contract Manager: Date:

SWAMP Contract#

APPENDIX I: MQO FRAMEWORK TEMPLATE

Measurement Quality Objectives for [Analyte(s)] in [Matrix]

Table 1. Lab Quality Control for [XX]

Lab Quality Control	Frequency of Analysis	Measurement Quality Objective	*DQ Indicator or Reasoning*

Table 2. Lab Quality Control Corrective Actions for [XX]

Lab Quality Control	Recommended Corrective Action

Table 3. Field Quality Control for [XX]

Field Quality Control	Frequency of Analysis	Measurement Quality Objective	*DQ Indicator or Reasoning*

Table 4. Field Quality Control Corrective Actions for [XX]

Field Quality Control	Recommended Corrective Action

Table 5. Sample Handling for [X]

Matrix	Container	Holding Time

References:

APPENDIX J: PROGRAM MANAGEMENT TOOL (INFORMATION AND INSTRUCTIONS)

The instructions for the Program Management Tool can be found on the SWAMP IQ Wiki.

APPENDIX K: CITATION LIST

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