Surface Water Ambient Monitoring Program

# BIOACCUMULATION MONITORING PROGRAM QUALITY ASSURANCE PROJECT PLAN

Version 1

July 2023

SWAMP
Surface Water
Ambient Monitoring
Program

## Group A: Project Management

A.1 Title

**Program Title** SWAMP Bioaccumulation Monitoring Program

**Lead Organizations** SJSURF Marine Pollution Studies Lab
7544 Sandholdt Road
Moss Landing, CA 95039

San Francisco Estuary Institute
4911 Central Avenue
Richmond, CA 94808

**Primary Contact** Autumn Bonnema, Project Manager
SJSURF Marine Pollution Studies Lab
(831) 771-4175

Jay Davis, Lead Scientist
San Francisco Estuary Institute
(510) 746-7368

**Effective Date** This Quality Assurance Project Plan (QAPP) is effective from January 2023 to December 2025 unless otherwise revised, approved and distributed accordingly at an earlier date.

**Citation for QAPP** State Water Resources Control Board. 2023. SWAMP Bioaccumulation Monitoring Program Quality Assurance Project Plan. Surface Water Ambient Monitoring Program. Sacramento, CA.

### QAPP Preface

This Quality Assurance Project Plan (QAPP) document defines procedures and criteria that will be used for the Surface Water Ambient Monitoring Program (SWAMP) Bioaccumulation Monitoring Program (Program) in association with the Moss Landing Marine Labs Marine Pollution Studies Laboratory (MPSL), the San Francisco Estuary Institute-Aquatic Science Center (SFEI-ASC), and Babcock Laboratories (Babcock) and their subcontractors. The purpose of this Project Plan is to establish quality assurance (QA) and quality control (QC) standards and procedures to be applied to the Program in order to produce data that are scientifically valid and defensible, and to document their quality. This QAPP is focused on the primary monitoring projects of the Program: Lakes and Reservoirs, Coastal Waters, Rivers and Streams, and Realignment. However, this

QAPP is also applicable to other projects associated with the Program, including bioaccumulation monitoring projects directed and funded by Regional Water Boards.

This QAPP includes criteria for data quality acceptability, procedures for sampling, testing (including deviations) and calibration, preventative and corrective measures, and the roles and responsibilities of MPSL, Babcock, SGS-Axys, and SFEI-ASC. This QAPP meets the SWAMP Statewide Project Planning requirements within the 2022 SWAMP Quality Assurance Program Plan (SWAMP QAPrP).

This work is funded through the US EPA F106 SWAMP Bioaccumulation funding. The Program coordinates and collaborates with each Regional Water Quality Control Board (RWQCB), as well as other entities, in developing the monitoring plans for each year.

## A.2 Approvals

The approvals below were submitted via DocuSign or separately, preventing their inclusion in this signature block. They can be viewed online on the SWAMP IQ Wiki website.

**Jay Davis**
Lead Scientist

_____ **Date**_____

**Andrew Hamilton**
SWRCB Quality Assurance Officer

_____ **Date**_____

**Tessa Fojut**
SWAMP Program Quality Assurance Officer

_____ **Date**_____

**Autumn Bonnema**
Project Manager/ MPSL Quality Assurance Officer

_____ **Date**_____

**Julia Sudds**
Babcock Laboratories Interim Quality Division Leader

_____ **Date**_____

**Sean Campbell**
SGS-Axys Quality Assurance Manager

_____ **Date**_____

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A copy of this Quality Assurance Project Plan (QAPP), in hardcopy or electronic format, is to be received and retained by at least one person from each participating entity. At least one person from each participating entity shall be responsible for receiving, retaining and distributing the QAPP to their respective staff within their own organization. Contact information for the primary contact person (listed first) for each participating organization is provided in Table 1.

**Table 1. Contact Information**

Name, agency, address, phone number (where applicable) and email address for primary contact from each participating agency. When two names are listed, the first is the primary contact. The person responsible for receiving, retaining and distributing the QAPP to their respective staff within their own organization are designated with an asterisk (*).

| Contact Name | Agency | Contact Information |
|---|---|---|
| Jay Davis* | San Francisco Estuary Institute / Aquatic Science Center | 4911 Central Avenue<br>Richmond CA 94804<br>530-304-2308<br>jay@sfei.org |
| Autumn Bonnema*<br>Billy Jakl | Marine Pollution Studies Lab | 7544 Sandholdt Road<br>Moss Landing CA 95039<br>831-771-4175<br>autumn.bonnema@sjsu.edu |
| Allie Guerra<br>Julia Sudds* | Babcock Laboratories | 6100 Quail Valley Court<br>Riverside CA 92507<br>951-653-33351 x 149<br>aguerra@babcocklabs.com |
| Sean Campbell* | SGS-Axys | 2045 Mills Road West<br>Sidney BC V8L 5X2<br>250-655-5800<br>Sean.campbell@sgs.com |
| Andrew Hamilton* | State Water Resources Control Board | 1001 I Street, 19th Floor<br>Sacramento CA 95814<br>andrew.hamilton@waterboards.ca.gov |
| Tessa Fojut* | State Water Resources Control Board | 1001 I Street, 19th Floor<br>Sacramento CA 95814<br>tessa.fojut@waterboards.ca.gov |

## A.5 Project Organization

The lines of communication between the participating entities, project organization and responsibilities are outlined in Table 2 and Figure 1.

**Table 2. Positions and duties**

Responsibilities of individuals directly involved in the program.

| Position | Name | Responsibilities |
|---|---|---|
| Region 9 EPA Surface Water Standards Coordinator | Eric Dubinsky (USEPA) | Oversees SWAMP federal funding and Program outputs |
| State Board Management | Greg Gearhart (SWRCB)<br>Ali Dunn (OIMA) | Program planning and oversight, project budget allocation and reconciliation with program objectives |
| Contract Manager | Chad Fearing (OIMA) | Approves invoices for MPSL and Babcock contracts |
| Contract Manager | Devan Burke (OIMA) | Approves invoices SFEI-ASC contract |
| Program Coordinator | Anna Holder (OIMA) | Communication and coordination liaison with the Lead Scientist and Project Manager and SWRCB/OIMA, reviews contract deliverables, general Program and Safe to Eat Workgroup coordination and support |
| Lead Scientist | Jay Davis (SFEI-ASC) | Monitoring design, data analysis and reporting; oversee development and submission of contract deliverables in coordination with the Project Manager (e.g., monitoring plans, QAPP, reports); technical coordination with the Safe to Eat Workgroup |

| Position | Name | Responsibilities |
|---|---|---|
| Project Manager | Autumn Bonnema (MPSL) | Project coordination, ensures all activities are completed within proper timeframes, oversees project deliverables in coordination with the Lead Scientist, entry of field and laboratory data generated by MPSL into SWAMP formats |
| State Board QA Officer | Andrew Hamilton (OIMA) | Approves QAPP, reports to EPA and SWRCB management |
| Program QA Officer, Database Manager, SWAMP IQ | Tessa Fojut (OIMA) | Review and approve project QAPP, oversees Data Quality Managers, establishes program level quality objectives and requirements for project, reports to EPA and SWRCB management and coordinates with SWRCB QAO |
| SWAMP IQ Data Quality Manager | Jennifer Salisbury (OIMA) | Reviews, verifies, validates and loads tissue chemistry and composite data to SWAMP database; reports to Program QAO |
| Laboratory QA Officer | Autumn Bonnema (MPSL)<br>Julia Sudds (Babcock)<br>Sean Campbell (SGS-Axys) | Ensures that the laboratory quality assurance plan and quality assurance project plan criteria are met through routine monitoring and auditing of the systems, review and approve data prior to submission to SWAMP IQ, investigate and conduct laboratory corrective action |
| Sample Collection Coordinator | Billy Jakl (MPSL) | Sampling coordination, operations, and implementing field-sampling procedures |

| Position | Name | Responsibilities |
|---|---|---|
| Laboratory Director | Wes Heim (MPSL)<br>Caroline Sangari (Babcock)<br>Sean Campbell (SGS-Axys) | Supervises laboratory staff; oversees data verification, data management and reporting |
| Sample Custodian | Autumn Bonnema (MPSL)<br>Sean Campbell (SGS-Axys)<br>Additional staff | Sample storage, not responsible for any deliverables, may oversee Technicians |
| Technicians | Technical Staff<br>MPSL<br>SGS-Axys | Conduct tissue dissection, digestion, and chemical analyses; verify field and lab datasheet entry; responsible for chemistry data submission to Laboratory QAO |

**Involved Parties and Roles**

***Project Management***

Chad Fearing and Devan Burke of the Office of Information Management and Analysis (OIMA) are the Contract Managers (CM), who are responsible for approving invoices and ensuring the Contractors meet the contract terms.

Anna Holder of OIMA is the Program Coordinator and will (1) serve as communication and coordination liaison with the Lead Scientist and Project Manager, (2) serve as the Safe to Eat Workgroup (STEW) Water Boards internal communication liaison for the Program, (3) review contract deliverables in coordination with the Contract Manager, and (4) provide general Program and STEW coordination and support.

Jay Davis of San Francisco Estuary Institute-Aquatic Science Center (SFEI-ASC) is the Lead Scientist (LS) and primary contact of this project. The LS will (1) generate the annual monitoring plan, (2) approve the QAPP, and (3) provide the State Water Board with a final report on completion of this project and present the results to the STEW.

Autumn Bonnema of MPSL will serve as the Project Manager (PM). The PM will (1) ensure all laboratory activities are completed within the required timelines, (2) review, evaluate and document project reports, and (3) verify the completeness of all tasks. In addition, the PM may assist field crew in preparation and logistics.

Billy Jakl of MPSL directs fish collection for this project. He will (1) oversee preparation for sampling, including vehicle and vessel maintenance and (2) oversee sample and field data collection, field data entry and submission to the SWAMP Information Management and Quality Assurance Center (SWAMP IQ).

### *Laboratory*

Sean Campbell is responsible for sample storage and custody at SGS-Axys. Autumn Bonnema will do the same for samples processed at MPSL, in addition to overseeing compositing of tissue samples.

Babcock Laboratories, Inc. is the contract laboratory that subcontracts analyses for all tissue organics analyses. Julia Sudds is the Interim Quality Division Leader at Babcock and Allie Guerra is the Babcock project manager. Allie Guerra will ensure samples are tracked and all data are submitted for this project within the proper timelines. The counterpart for these roles at subcontracted SGS-Axys is Sean Campbell.

Wes Heim will serve as the LD for the MPSL component of this project. His specific duties will be to (1) provide oversight for metals analyses on fish tissues to be done for this project, and (2) ensure that all MPSL activities are completed within the proper timelines.

### *Advisory*

Members of the STEW provide input and advice on the monitoring plans and long-term strategy and are not responsible for any deliverables. The members are also the end users of the data generated by the Program projects, with the primary objectives of the data used to answer Management Questions laid out in previous monitoring plans. STEW representatives include, but are not limited to, individuals from the following organizations: United States Environmental Protection Agency (USEPA), Office of Environmental Health Hazard Assessment (OEHHA), SWAMP Regional Coordinators, and the Water Boards Statewide Mercury Control Program.

Members of the Peer Review Panel review monitoring plans and technical reports. This panel consists of Bruce Monson (Minnesota Pollution Control Agency (retired), St. Paul, Minnesota), Chris Schmitt, (United States Geological Survey (retired), Columbia, Missouri) and Harry Ohlendorf (CH2M HILL (retired), Sacramento, California).

### *Quality Assurance Officer (QAO) Role*

Autumn Bonnema is the MPSL Laboratory QAO (LQAO), Julia Sudds is the Babcock Laboratories LQAO, and Sean Campbell is LQAO at SGS-Axys. The role of the LQAO is to ensure that quality control for sample processing and data analysis procedures described in this QAPP are maintained throughout the project.

The LQAOs will review and approve all quality control data prior to submission. They will review and assess all procedures during the life of this project against QAPP requirements and assess whether the procedures were performed according to protocol. The LQAOs will report all findings (including qualified data) to the Program QAO (Tessa Fojut, SWAMP IQ) and the PM, including all requests for corrective action. The Laboratory and Program QAOs have the authority to stop all actions if there are significant deviations from required procedures or evidence of a systematic failure.

SWAMP IQ serves as the project quality assurance and data management team. The SWAMP IQ Data Quality Managers review, verify, validate, and load the composite and chemistry data to the SWAMP database. Jennifer Salisbury is the tissue composite and tissue chemistry Data Quality Manager. Deviations from the project QAPP are flagged and reported to the PM and Program QAO prior to loading. The Program QAO assesses the data for compliance with the project and SWAMP and ensures that the project meets USEPA requirements for projects receiving federal EPA funds. The Program QAO also works with the State Board QA Officer, Andrew Hamilton, to ensure that the project and data meet the requirements of the SWRCB's Quality Management Plan.

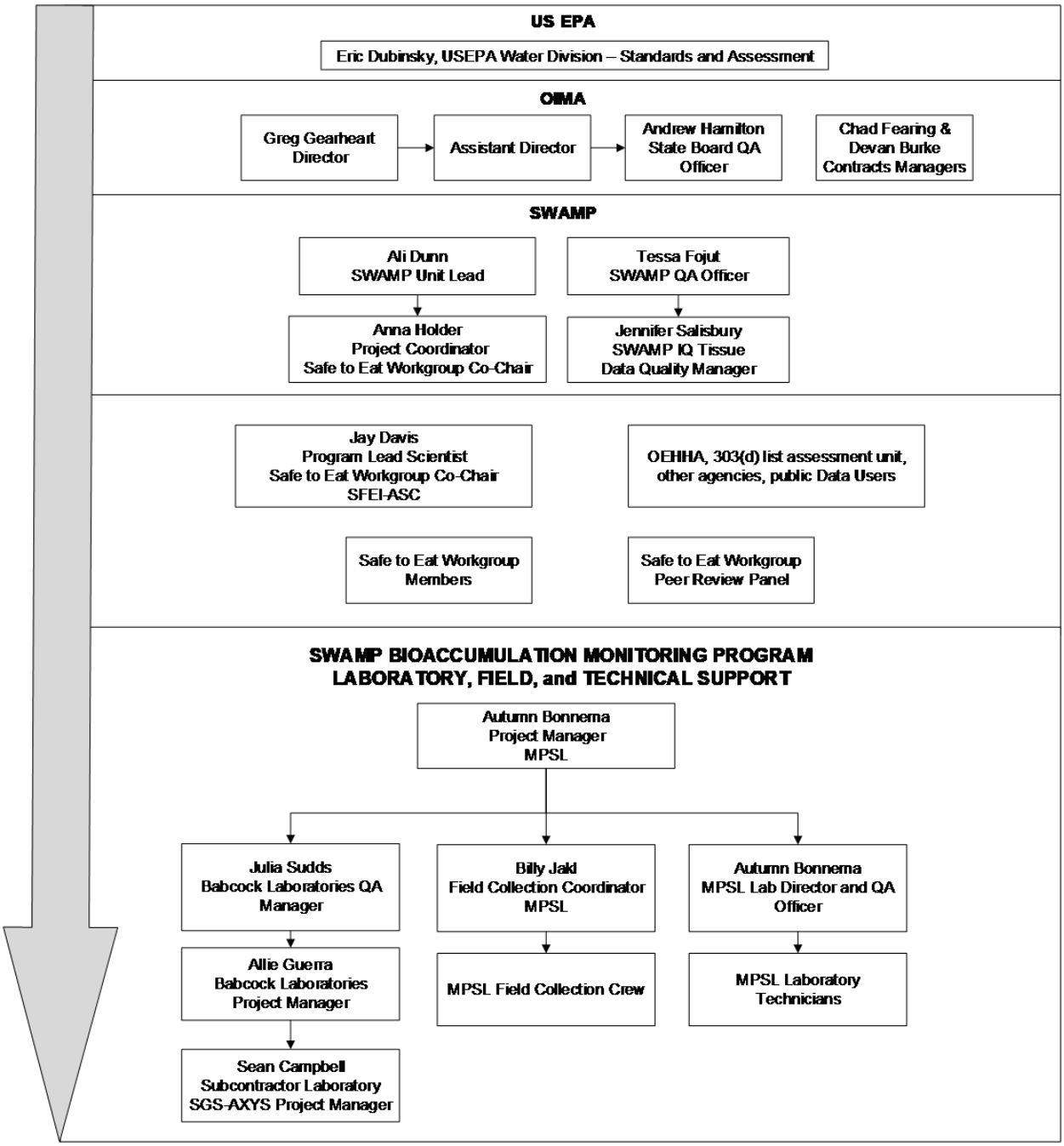
### *QAPP Update and Maintenance Responsibilities*

Revisions and updates to this QAPP will be carried out by Autumn Bonnema, with technical input from the Laboratory and Program QAOs. All changes will be considered draft until reviewed and approved by the PM, the Program QAO, and SWRCB QAO.

The QAPP must be reviewed at least annually and amended as necessary. It must meet USEPA, SWRCB and SWAMP quality system requirements to be approved.

Copies of this QAPP will be distributed to all parties involved in the project. Any future amended QAPPs will be held and distributed in the same fashion. All originals of these first and subsequent amended QAPPs will be held on site at SFEI-ASC, Babcock, SGS-Axys, and MPSL.

## Figure 1. Organizational Chart



## A.6 Project Background, Overview and Intended Use of Data

### Project Background

The preservation, enhancement, and restoration of California's water resources is vital to the health and well-being of all Californians, including California Native American Tribes (tribes) and other subsistence fishers, the economy, and natural lands for present and future generations. The mission of the Program is to provide statewide monitoring data and information that is used to:

1. Assess and contribute to the protection and restoration of fishing and aquatic life beneficial uses that are impacted by the bioaccumulation of pollutants in California's waterbodies, and
2. Assess the human health risks associated with the consumption of contaminated fish and shellfish in California's freshwater and coastal ecosystems and use that information to support the development of advisories that would inform consumers of significant health risks associated with the consumption of particular species.

In September 2006, the Surface Water Ambient Monitoring Program (SWAMP) formed a subcommittee, the Bioaccumulation Oversight Group (BOG), now known as the Safe to Eat Workgroup (STEW) implementation of SWAMP bioaccumulation monitoring.

The California Water Quality Monitoring Council designated STEW as its workgroup for assessing "Is it safe to eat fish and shellfish from our waters?" and directed this workgroup to develop the Safe to Eat Portal, which is devoted to this theme.

Since the Program and STEW began conducting bioaccumulation monitoring in 2007, several rounds of monitoring have been implemented and corresponding reports generated. Data from these bioaccumulation monitoring surveys have been used to categorize waterbodies for the Integrated Report (Clean Water Act Section 303(d) List and 305(b) Report), develop statewide plans for the control of mercury, and to develop fish consumption advisories. Efforts are underway to ensure bioaccumulation monitoring continues to be aligned with the public's needs, particularly in areas where tribes and communities rely on fishing for consumption, subsistence, sustenance, and cultural purposes. More information on the history of the SWAMP Bioaccumulation Monitoring Program is available on the Program website.

### Projects Overview

The Program consists of several projects, referred to as surveys, that are focused on monitoring fish and shellfish in different types of waterbodies and aligning the monitoring with the public's needs.

### *Lakes and Reservoirs*

The Program's lake and reservoir surveys focus 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. The Long-term Monitoring Survey was initiated in 2015 and will continue to monitor long-term trends in mercury concentrations in lakes dominated by black bass (fish species known to accumulate high levels of mercury). The continuation of this survey will provide updated information on the status of these lakes and a statewide perspective on long-term trends to support the evaluation of management action effectiveness (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 for the Long-term Monitoring Survey in 2015, 2017, 2019, and 2021 and is planned for 2023.

### *Coastal Waters*

The Program's statewide coastal screening surveys have focused on screening bioaccumulation in sport fish on the California coast. These surveys evaluate two closely associated habitat types (the coast, and 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 waterbodies and has occurred approximately every 10 years. The first Statewide Coastal Screening Survey occurred in 2009-2010. Part of the second Statewide Coastal Screening Survey occurred in 2018 (Southern California Bight) and 2020 (Central California), and the rest of the survey is planned for 2024 (Northern and Central California).

### *Rivers and Streams*

The Program's river and stream surveys have focused on screening surveys of bioaccumulation in sport fish in California rivers and streams. The surveys aim to provide reasonable coverage of popular fishing locations. The first Statewide River and Stream Screening Survey occurred in 2011, a second small survey focused on Central Valley Region sites occurred in 2022.

### *Realignment*

The Bioaccumulation Monitoring Program has realized several successes, such as forming the Safe to Eat Workgroup and establishing comprehensive, statewide bioaccumulation monitoring methodologies and assessments that began to answer the question: "Is it safe to eat fish and shellfish from our waters?" since its inception in 2006. However, STEW members and Program staff recognize that the original Program plans were ambitious given the limited resources, and addressing two key issues could better achieve the original mission.

First, although data collected by the Program is sufficiently comprehensive to assess bioaccumulative pollutants at a statewide level, the connections, collaboration, and beneficial symbiotic relationships among the Program and other Water Boards Divisions, Regions, and programs are not fully realized. The Program data are valuable

as a complementary dataset and help to identify issues for further study; however, on their own the data make a limited contribution to the protection and restoration of fishing and aquatic life beneficial uses that are impacted by the bioaccumulation of pollutants in California's waterbodies.

Second, while data have been generated and used to inform health advisories for fish throughout the state, significant data and information gaps remain regarding the question: "Is it safe to eat fish and shellfish from our waters?" A particularly important information gap exists for waterbodies or species that are important for subsistence by historically underrepresented communities, as well as Tribal tradition, culture, and subsistence.

Through the realignment efforts described in the Program Realignment Plan, the Program is actively working to ensure bioaccumulation monitoring is better aligned with the public's needs, particularly in areas where communities rely on fishing for consumption, subsistence, sustenance, and cultural purposes. The Realignment effort is being implemented as a statewide project, where additional samples will be collected during regional Realignment cycles to align with tribal and local community interests and needs. There will be one Realignment cycle per regional board, for a total of nine cycles. The first Realignment cycle is focused in the San Diego Region from 2021-2023; monitoring took place in 2022 (see the Monitoring and Analysis Workplan for more details). The next Realignment cycle will begin in 2024 in the San Francisco Bay region - the monitoring plan will be developed in 2024 and monitoring will be conducted in 2025. The information and data gathered in each regional Realignment cycle will also be used to inform the planning for the three statewide surveys described above.

**Monitoring Objectives and Assessment Framework**

The Program and STEW have developed a set of monitoring objectives and assessment questions related to several beneficial uses. The assessment framework is consistent with frameworks developed for other components of SWAMP (Bernstein 2010) and is intended to guide the Program over the long-term. The four objectives can be summarized as (1) status; (2) trends; (3) sources and pathways; and (4) effectiveness of management actions.

Over the long-term, the primary emphasis of the statewide Program will be on evaluating status and trends. Monitoring status and trends in bioaccumulation will provide some information on sources and pathways and effectiveness of management actions at a broader geographic scale. However, other types of monitoring (i.e., water and sediment monitoring) and other programs (e.g., regional Total Maximum Daily Load [TMDL] programs) are also needed for addressing sources and pathways and effectiveness of management actions.

The monitoring objectives and assessment questions aim to evaluate the impacts of bioaccumulation on beneficial uses related to harvesting of wild fish and shellfish for consumption. The primary statewide beneficial uses that apply to the harvesting of wild-caught species for consumption are "commercial and sport fishing" (COMM) and "shellfish harvesting" (SHELL). Additional beneficial uses relating to harvesting fish were

established by the State Water Board in 2017: Water Contact Recreation (REC-1), Native American Culture (CUL), Tribal Subsistence Fishing (T-SUB) and Subsistence Fishing (SUB) (State Water Resources Control Board Resolution 2017-0027). Program data will be used to evaluate the status of all beneficial uses related to harvesting of wild fish (i.e., COMM, CUL, REC-1, T-SUB and SUB, and any new uses that are adopted).

Since the adoption of Resolution 2017-0027, each region has started the process of adopting the new Tribal beneficial use (TBU) definitions into their respective Basin Plans and undergoing the beneficial use designation process which varies from region to region. The Water Boards' Tribal Affairs Unit tracks and publishes the status of TBUs within Regional Basin Plans on a quarterly basis.

**Bioaccumulation monitoring assessment framework.**

| **Objective 1. Determine the status of beneficial uses throughout the State with respect to bioaccumulation of toxic pollutants** |
|---|
| D.1.1 What are the extent and location of waterbodies with sufficient evidence to indicate that beneficial uses are at risk due to pollutant bioaccumulation? |
| D.1.2 What are the extent and location of waterbodies with some evidence indicating beneficial uses are at risk due to pollutant bioaccumulation? |
| D.1.3 What are the extent and location of waterbodies with no evidence indicating beneficial uses are at risk due to pollutant bioaccumulation? |
| D.1.4 What are the proportions of waterbodies in the State and each region falling within the three categories defined in questions D.1.1, D.1.2, and D.1.3? |
| **Objective 2. Assess trends in the impact of bioaccumulation on beneficial uses throughout the State** |
| D.2.1 Are waterbodies improving or deteriorating with respect to the impact of bioaccumulation on beneficial uses? |
| D.2.1.1 Have waterbodies fully supporting the beneficial uses become impaired? |
| D.2.1.2 Has full support of beneficials use been restored for previously impaired waterbodies? |
| D.2.2 What are the trends in proportions of waterbodies falling within the three categories defined in questions D.1.1, D.1.2, and D.1.3 regionally and statewide? |
| **Objective 3. Evaluate sources and pathways of bioaccumulative pollutants impacting beneficial uses** |

| |
|---|
| D.3.1 What are the magnitude and relative importance of pollutants that bioaccumulate and indirect causes of bioaccumulation throughout each Region and the state as a whole? |
| D.3.2 How is the relative importance of different sources and pathways of bioaccumulative pollutants that impact beneficial uses changing over time on a regional and statewide basis? |
| **Objective 4. Provide the monitoring information needed to evaluate the effectiveness of management actions in reducing the impact of bioaccumulation on beneficial uses** |
| D.4.1 What are the management actions that are being employed to reduce the impact of bioaccumulation on beneficial uses regionally and statewide? |
| D.4.2 How has the impact of bioaccumulation on beneficial uses been affected by management actions regionally and statewide? |

**Management Questions**

Management questions are defined for each element of the Program: (1) Lakes and Reservoirs, (2) Coastal Waters, (3) Rivers and Streams, and (4) Realignment.

***Lakes and Reservoirs***

To answer the management questions for Lakes and Reservoirs, a long-term cycle for sampling was established for 187 priority bass lakes and reservoirs. Sampling of the entire group of lakes and reservoirs will occur in five biennial rounds of sampling over a 10-year period. This effort ensures that each of these lakes is sampled once every 10 years to provide updated information on concentrations of priority contaminants. By creating five randomly selected subsets (or "rotating panels") of the overall population, each round of sampling yields a representative estimate of the statewide average mercury concentration that will add to a long-term time series to allow evaluation of the statewide trend in food web mercury. The panel assignments for the lakes included in the long-term sampling program are described in the 2015 Monitoring Plan.

Management Question 1

*What are the recent average concentrations of contaminants of concern in each priority bass lake or reservoir?*

Answering this question will address the critical need of managers and the public for timely, high-quality information on the status of contaminant bioaccumulation in priority waterbodies. This information will be useful to the State and Regional Water Boards in impairment assessments and 303(d) list updates. The State Water Board has an established policy for placing waterbodies on the 303(d) list. A list of priority bass lakes to include in this monitoring has been developed with input from the regional boards.

Mercury has been identified as the contaminant of greatest concern in most bass lakes and will be the primary focus of this monitoring. However, PCBs and organochlorine pesticides also reach levels of concern in a small subset of these lakes and will be monitored in those situations. Other emerging contaminants of concern (e.g., Per- and Polyfluoroalkyl Substances (PFAS), cyanotoxins) have been identified in recent years and may be monitored as resources allow.

The data needed to answer this question are average concentrations of contaminants of concern in the species with a tendency to accumulate high concentrations. For mercury, top predators such as black bass tend to accumulate relatively high concentrations. Furthermore, black bass have been established as an excellent quantitative mercury bioaccumulation indicator for California because they are amenable to size-standardization. High-lipid, bottom-feeding species such as catfish, carp, and sucker tend to accumulate relatively high concentrations of organic contaminants of concern (PCBs and legacy pesticides) and will be targeted in lakes/reservoirs where PCB or organochlorine pesticide concentrations will be monitored.

Management Question 2

*What is the trend in statewide average bass mercury concentrations in fish in priority bass lakes and reservoirs?*

The State Water Resources Control Board developed the Statewide Mercury Provisions and the Statewide Mercury Control Program for Reservoirs and mercury TMDLs also have been developed for other waterbodies, including the Sacramento-San Joaquin River Delta, San Francisco Bay, and some lakes and reservoirs. For all the mercury control plans in the state, it is critically important to know whether food web mercury concentrations are trending up or down on a regional or statewide scale. A statewide increasing trend could obscure the beneficial effects of management actions to reduce mercury bioaccumulation. In the absence of awareness of such a trend, false conclusions could be drawn that actions are not having the desired effect. On the other hand, the existence of a general declining trend could give the impression that actions are more effective than they actually are.

It is plausible to hypothesize that food web mercury could be increasing across the state, either due to increasing atmospheric mercury emissions in Asia (Chen et al. 2012, Drevnick et al. 2015) or due to climate change (Schneider et al. 2009). Hypothesized causes of these regional trends include global atmospheric emissions, climate change, invasive species, and changes in food web structure.

The data needed to answer this question are measurements of statewide average concentrations of mercury that are repeated over time. The large number and wide distribution of bass lakes that have been identified as priorities for sampling provide a population of waterbodies that can be sampled to assess statewide and regional trends in food web mercury over time. Repeated rounds of sampling of randomly selected subsets of these lakes would yield a time series of representative, average statewide concentrations of mercury. These statewide averages would be based on concentrations in black bass, which have been demonstrated to be indicator species

that are representative of conditions in the waterbody where they are collected and that yield data that are comparable across waterbodies and over time.

Secondary Management Question 1

*What fractions of the lakes show decreases, increases, or no change in mercury concentration in fish?*

Monitoring of mercury in clusters of lakes in other regions of North America have shown that temporal trends in fish mercury levels commonly vary among lakes, with some lakes showing decreases, some showing increases, and some showing no change. Examination of fish mercury levels from the small number of California lakes that have been sampled twice (first in 2007-2008 and again in 2012 or 2013) suggest that this outcome can be expected in California as well.

Secondary Management Question 2

*What factors appear to be driving changes in mercury concentrations in fish?*

Environmental managers will want to know what causal factors of processes are contributing to such variability in temporal trends among lakes. The monitoring data obtained in this program will be used to develop hypotheses regarding factors and processes causing observed trends. The development of hypotheses may stimulate focused investigations by scientists in academic, state, and federal sectors.

### *Coastal Waters*

Management Question 1

*Status: What is the status of contaminants in representative fish species in popular fishing areas?*

Answering this question is critical to determining the degree of impairment of the fishing beneficial uses (COMM, REC-1, CUL, T-SUB, SUB, etc.) across the state due to bioaccumulation. This question places emphasis on characterizing the status of the fishing beneficial use through monitoring of the predominant pathways of exposure – representative fish species and popular fishing areas. This focus will provide information on the resources that water quality managers and people care most about.

The data needed to answer this question are average concentrations in representative fish species from popular coastal fishing locations. Inclusion of as many species as possible is important to understanding the nature of impairment in any areas with concentrations above thresholds. In some areas, some fish may be safe for consumption while others are not, and this is valuable information for anglers. Monitoring species that accumulate high concentrations of contaminants (“indicator species”) is valuable in answering this question: if concentrations in these species are below thresholds, this is a strong indication that an area has low concentrations.

Management Question 2

*Regional Distribution: What is the distribution of contaminant concentrations in fish within regions?*

Answering this question will provide information that is valuable in formulating management strategies for observed contamination problems. This information will allow managers to prioritize their efforts and focus attention on the areas with the most severe problems. Data on regional distribution will also provide information on contaminant sources and fate that will be useful to managers.

This question can be answered with different levels of certainty. For a higher and quantified level of certainty, a statistical approach with replicate observations in the spatial units to be compared is needed. In some cases, managers can attain an adequate level of understanding for their needs with a non-statistical, non-replicated approach. With either approach, reliable estimates of average concentrations within each spatial unit are needed.

Management Question 3

*Trends: What are the trends in contaminant concentrations in representative fish species in popular fishing areas?*

Information on trends is essential to effective management of contaminants that bioaccumulate in sport fish. It is critically important to know whether the problem is getting better or worse; in other words, whether food web mercury concentrations are trending up or down on a local, regional, or statewide scale. A statewide increasing trend could obscure the beneficial effects of management actions to reduce bioaccumulation. On the other hand, evidence of a general declining trend could give the impression that actions are more effective than they actually are.

The data needed to answer this question are measurements that are repeated over time to derive average concentrations for indicator species in popular fishing areas. Striving for consistency in the sampling design (e.g., species and locations within zones) over time will maximize the utility of the data for long-term trend analysis. With a 10-year cycle for statewide sampling, this approach will establish a foundation for and gradually build a long-term time series for trend evaluation.

Management Question 4

*Need for Further Sampling: Should additional sampling of bioaccumulation in sport fish (e.g., more species or larger sample size) in an area be conducted for the purpose of developing more comprehensive consumption guidelines?*

Consumption guidelines provide a mechanism for reducing human exposure to bioaccumulated contaminants in the short-term. Based largely on the data generated in the SWAMP coastal survey of 2009-2010, OEHHA issued a statewide consumption advisory for the entire coast in 2016 (Smith et al. 2016). In developing consumption advice, it is valuable to have information not only on the species with high concentrations, but also the species with low concentrations so anglers can be encouraged to target them. The diversity of species on the coast, rivers, and streams demands a relatively large effort to characterize interspecific variation. The present

round of coastal sampling will address data gaps identified by OEHHA in the process of developing the statewide coastal advisory. After the results of this round are reviewed, OEHHA will be able to further refine the list of data gaps related to advisory development.

### *Rivers and Streams*

Management Question 1

*What are the recent average concentrations of contaminants of concern in each priority river and stream sampling location?*

Answering this question will address the critical need of managers and the public for timely, high-quality information on the status of contaminant bioaccumulation in priority river and stream monitoring stations. This information will be useful to the State and Regional Water Boards in impairment assessments and 303(d) list updates. The State Water Board has an established policy for placing waterbodies on the 303(d) list. A list of priority stations to include in this monitoring has been developed with input from the regional boards.

As with Lakes and Reservoirs, mercury has been identified as the contaminant of greatest concern and will be the primary focus of this monitoring in Rivers and Streams. However, PCBs and organochlorine pesticides also reach levels of concern in a small subset of these stations and will be monitored in those situations.

The data needed to answer this question are average concentrations of contaminants of concern in the species with a tendency to accumulate high concentrations. For mercury, top predators such as black bass tend to accumulate relatively high concentrations. Furthermore, black bass have been established as an excellent quantitative mercury bioaccumulation indicator for California because they are amenable to size-standardization. High-lipid, bottom-feeding species such as catfish, carp, and sucker tend to accumulate relatively high concentrations of organic contaminants of concern (PCBs and legacy pesticides) and will be targeted in lakes/reservoirs where PCB or organochlorine pesticide concentrations will be monitored.

### *Realignment*

Management Question 1

*What are the bioaccumulation data and information gaps in each region - particularly in areas where tribes and communities rely on fishing for consumption, subsistence, and cultural purposes?*

Answering this question is critical to advancing equity and environmental justice outcomes, and operationalizing equity and justice into the Program. The first year of the Realignment Process involves establishing a Regional Advisory Committee and discussing which places, species and pollutants are of concern to Committee Members. Each Regional Advisory Committee is composed of representatives from Tribal Governments and community-based organizations with an interest in bioaccumulation,

fish advisory development, and statewide bioaccumulation monitoring efforts. After discussions of interest and prioritization, a monitoring plan is developed to capture Committee interests and to guide the implementation of monitoring and analysis in the second year of the Realignment.

Realignment monitoring is not centered on any one waterbody type and the Advisory Committee in each Region may decide to focus on one or more of the waterbody types (i.e., lakes and reservoirs, coastal waters, rivers and streams) to answer the Realignment Management Question. When waterbodies are selected by an Advisory Committee, we will address the waterbody-specific management questions as we implement the Realignment process and analyze the resulting data. For example, if a Region prioritizes monitoring of lakes and reservoirs during their Realignment cycle, the relevant Lake and Reservoir Management Questions above will be addressed.

The San Diego Region was the first to go through the Realignment Process (2021 - 2023). The San Diego Region Monitoring and Analysis Workplan was developed in 2021 and implemented in 2022. Results will be analyzed in 2023. While we anticipate the structure of each Region's Monitoring and Analysis Workplan to be similar, the specifics of each Region's Monitoring and Analysis Workplan will likely be substantially different to capture and address the specific needs and priorities of Tribes and communities in that region.

**Intended Data Use**

Of the four intended data use categories described in the SWAMP QAPrP, Program data belongs in both the Ambient and Public Health classifications.

Public Health data uses include fish consumption advisories and water quality regulations related to human health. Since 2005, the Office of Environmental Health Hazards Assessment (OEHHA) has released over 140 fish consumption advisories based wholly, or in part, on data collected through the Program, including statewide advisories for eating fish from California's waterbodies without site-specific advice: lakes and reservoirs (updated in 2021), coastal locations (developed in 2016), rivers, streams, and creeks (updated in 2022), and an advisory for fish that migrate (updated in 2022).

Ambient data uses are to support Water Quality Control Plans, Integrated Report development, policy development, and other beneficial use assessments. Data from these bioaccumulation monitoring surveys were used, in whole or in part, to categorize 5,173 water bodies for the 2020-2022 California Integrated Report (Clean Water Act Section 303(d) List and 305(b) Report), which was published in June 2021, adopted by the State Board in January 2022, and approved by US EPA in May 2022. Program data were the primary basis for the placement of 173 lakes and reservoirs, 88 coastal locations, and 558 river and stream segments on the 2020-2022 California Integrated Report's Clean Water Act Section 303(d) List of Impaired Waterbodies for metals (e.g. mercury, selenium). These listings led to the Statewide Mercury Provisions (consisting

of mercury water quality objectives and new beneficial use definitions) and a Statewide Mercury Control Program for Reservoirs.

## Geographical Setting and Sample Sites

### *Lakes and Reservoirs*

A pool of 187 priority bass lakes for long-term monitoring was developed based on several factors, including that the lakes are dominated by black bass or other bass species, which are known to accumulate mercury, and that they are popular fishing locations. The pool of lakes considered for sampling consisted primarily of those included in the 2007-2008 SWAMP lakes survey, with the addition of others sampled from 2002-2012. The list of priority bass lakes was also reviewed by the regional boards who identified priority lakes based on their local knowledge of their regions. Each lake will be sampled once on an approximately ten-year rotation, in five panels, which are described in the 2015 Monitoring Plan. Panel 5 will be sampled in 2023. Precise dates for collection at each lake are not known and will be scheduled with cooperation from lake managers and documented in a monitoring plan.

### *Coastal Waters*

California has over 3000 miles of coastline that span a diversity of habitats and fish populations. Along the coast and bays there are dense human population centers with a multitude of popular fishing locations. To sample this vast area, the coast was initially divided into 69 spatial units called “zones,” which are described in the 2009 BOG Coastal QAPP and 2009 Monitoring Plan. Due to access issues and other sampling constraints, some zones were combined in the 2009-2010 effort, resulting in 65 zones as described in the 2018 Monitoring Plan. All zones will be sampled over the course of multi-year surveys that occur approximately every ten years, making a probabilistic sampling design unnecessary.

Sampling will focus on nearshore areas, including bays and estuaries, in waters not exceeding 200 m, and mostly less than 60 m deep.

### *Rivers and Streams*

California has over 211,000 miles of rivers and streams (Davis et al. 2007) that span a diversity of habitats and fish populations, and dense human population centers with a multitude of popular fishing locations. For the initial statewide survey in 2011, 56 stations were monitored. These stations were chosen because they were identified as popular fishing locations by stakeholders or Stienstra (2004). Stienstra (2004) rated fishing spots on a scale of 1 to 10 based on three elements: number of fish, size of fish, and scenic beauty. The 2011 survey monitored all stations that ranked as a 6 or higher by Stienstra (2004). Five stations in the Central Valley were sampled in the 2022 survey. These priority stations were identified by the Central Valley Regional Board to inform mercury watershed control programs and TMDLs in development in Central Valley Rivers. The Central Valley Regional Board also provided supplemental funding to monitor these sites. The 2022 survey sites are listed in Table A of the 2022 Monitoring

and Analysis Plan (Appendix II). Future Rivers and Streams monitoring locations may be identified in regional Realignment efforts based on factors identified in each regional Realignment process.

### Constituents to be Analyzed and Measurement Techniques

The constituents analyzed in each of the surveys are summarized in Table 3. Individual analytes, laboratory reporting limits and analytical methods and laboratories for each analyte group are described in section B.4. Additional constituents may be monitored in the Realignment project, which are included in section B.4. All tissue chemistry data are reported on a wet weight basis. Fish attributes (Table 4) are physical measurements or observations of the fish and are not covered in section B.4.

**Table 3. Overview of constituents analyzed for each Bioaccumulation Monitoring Program project.**

| | **Lakes and Reservoirs** | **Coast** | **Rivers and Streams** |
|---|---|---|---|
| **Constituents measured in previous surveys** | Fish attributes<br>Total Mercury<br>Total Selenium<br>PCBs*<br>Organochlorine pesticides* | Fish attributes<br>Total Mercury<br>Total Selenium<br>PCBs<br>Organochlorine pesticides*<br>Polybrominated diphenyl ethers (PBDEs)*<br>Dioxins (Humboldt Bay (Zone 64) & Bay RMP samples only) | Fish attributes<br>Total Mercury<br>Total Selenium<br>PCBs<br>Organochlorine pesticides*<br>Algal toxins (limited sites) |
| **Constituents to be measured in 2022-2025 surveys** | Fish attributes<br>Total Mercury<br>Total Selenium<br>PCBs<br>Organochlorine pesticides* | Fish attributes<br>Total Mercury<br>Total Selenium<br>PCBs<br>Organochlorine pesticides* | Fish attributes<br>Total Mercury<br>Total Selenium<br>PCBs |

***** As requested by State and Regional representatives

**Table 4. Fish attributes and tissue characteristics measured**

| Fish Attributes |
|---|
| Total length (mm) |
| Fork Length (mm) |
| Standard Length (mm; small fish only) |
| Weight (g) |
| Sex (sport fish only) |
| Moisture (%) |
| Lipid (%; only when organics are analyzed) |
| Age (for black bass)* |
| Collection Location (Universal Transverse Mercator (UTMs)) |

* Black bass scales will be archived for potential future age analysis

**Project Schedule**

Program monitoring (sometimes referred to as surveys) occurs during each calendar year. Planning for an upcoming monitoring season begins in Fall of the previous year, with creation of a monitoring plan. The Program QAPP will then be reviewed and revised, if necessary, each year prior to sampling. Kickoff Meetings are held in early Spring in preparation for sampling that begins in Spring and ends in Fall. The exact monitoring schedule may vary each year depending on the monitoring plan and may be extended or shortened based on resources, waterbody access, or other issues that may affect timing of sampling. Chemical analyses and data submissions to SWAMP IQ are estimated to be completed by no later than September of the following year. Tissue dissection, processing and compositing occurs by November of each sampling year, followed by creation of sample composites by December. Metals analysis is typically completed by the following March, whereas organics analysis may not be complete until September of the year following sampling. Chemical analysis data are submitted to SWAMP within 40 days of analysis. STEW provides input at approximately quarterly meetings throughout the year on monitoring plan development, data interpretation, and other topics. The Bioaccumulation Peer Review Panel provides input at STEW meetings and as requested.

Key tasks in the project and their expected due dates are outlined in Table 5.

**Table 5. Project schedule timeline**

| Item | Activity and/or Deliverable | Timeline or Deliverable Due Date |
|---|---|---|
| **1** | **Annual Monitoring Plan(s) for each Project** | |
| 1.1 | Discussion and Feedback from STEW and Review Panel | August - October preceding each sampling year |

| Item | Activity and/or Deliverable | Timeline or Deliverable Due Date |
|---|---|---|
| 1.2 | Monitoring Requests | September 1 preceding each sampling year |
| 1.3 | Draft Monitoring Plan(s) | October preceding each sampling year |
| 1.4 | Final Monitoring Plan(s) | November preceding each sampling year |
| 1.5 | Review and update QAPP accordingly | March of each sampling year (prior to sampling) |
| **2** | **Sample Collection** | April-October of each sampling year (unless the Monitoring Plan specifies a different timeline) |
| **3** | **Sample Preparation and Chemical Analysis** | |
| 3.1 | Selection of Tissue for Analysis | 6 weeks after completion of Sample Collection |
| 3.2 | Creation of Sample Composites | 4 weeks after completion of Tissue Selection |
| 3.3 | Chemical Analysis | Metals: 120 days after creation of Sample Composites<br>Organics: 6 months after sample shipment to laboratory |
| 3.4 | Data Reported to SWAMP | Within 40 days of sample analysis |
| **4** | **Data Management** | |
| 4.1 | SWAMP Quality Assurance Review, Verification and Validation Process | Within 9 months of receipt of data |
| 4.2 | SWAMP IQ reviewed data is submitted to the SWAMP Database, CEDEN Database, and the California Open Data Portal | 1 month after completion of SWAMP Quality Assurance Review, Verification and Validation Process |
| **5** | **Data Report** | |
| 5.1 | Draft Report | 3 months after data are available in SWAMP Database |
| 5.2 | Final Report | 5 months after data are available in SWAMP Database |

**Coordination**

The Program coordinates with other efforts through the STEW to leverage the SWAMP statewide monitoring funds available for these surveys. The SWAMP Bioaccumulation Program coordinates with all regional boards for lake and reservoir surveys, and coordinates with San Francisco Bay Regional Monitoring Program (Bay RMP), the

Southern California Bight Program, RWQCB1, RWQCB2, RWQCB3, RWQCB4, RWQCB8, and RWQCB9 for surveys on the coast. For the rivers and streams surveys, the Program coordinates with the Central Valley Regional Water Quality Control Board (CVRWQCB). For each Realignment cycle, the Program coordinates with the Regional Board that is on cycle. When cyanotoxin monitoring is occurring, the Program coordinates with the SWAMP Freshwater Harmful Algal Blooms Program, including regional staff, such as a collaboration with RWQCB6 to obtain information on microcystin in fish fillets.

The Regional Boards will be contacted prior to each round of sampling to explore opportunities for coordinated sampling, in-kind support, or direct funding of this sampling program.

### Project Constraints

*Environmental Constraints*
Extreme wet weather or wind can affect sampling by making it unsafe to be out in a boat on the water. When fires are burning at or near sampling sites, crews may need to evacuate the area to remain safe from the fire or smoke. In particularly dry years, low water levels can impact the ability to access or monitor within the intended waterbody. Sampling sites may be excluded in a given year if there was a recent fish kill at that site.

*Access Constraints*
Access to sampling sites may be limited for this project because of unexpected topographical features or legal restrictions. If a site is not accessible, then an alternate site location may be chosen. These alternate locations will be determined on an as-needed basis at the time of sample collection.

*Financial Constraints*
Funding constraints have reduced the number of sites sampled or analytes measured for the Program compared to earlier surveys.

## A.7 Program Quality Objectives, Data Quality Indicators, and Measurement Quality Objectives

### Program Quality Objectives

The data collection for this Program are intended to support the management questions as well as to assist in the development of fish consumption advisories by OEHHA. Therefore this Program is categorized under the Public Health; Fish Consumption Advisories, Intended Data Use Category of the 2022 SWAMP QAPrP.

“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" (2022 SWAMP QAPrP).

The tissue data collected by this Program will follow consistent fish sampling and analysis protocols to ensure that data collected are useful in the development of advisories. The data collected are aligned with 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 size
- sample timing
- collection method
- sample preparation
- and chemical analysis.

### *Fish Assessment Thresholds*

The State Water Board adopted statewide tissue water quality objectives for methylmercury in fish in 2017. The objectives document states that "For any of the mercury fish tissue water quality objectives, measurements of total mercury concentrations in fish tissue may be substituted for methylmercury concentrations in fish tissue." Measurement of total mercury is more straightforward, so this is the approach used by SWAMP. A suite of objectives was adopted to protect different beneficial uses: a sport fish water quality objective of 200 ppb applicable to trophic level (TL) 3 or 4 fish; a tribal subsistence fishing water quality objective of 40 ppb for TL 3 or 4 fish; and a prey fish water quality objective of 50 ppb (Table 6). SWAMP data should be usable for comparison to these objectives. The statewide tissue WQOs are being used by the Water Boards in the latest round of 303(d) listing determinations.

OEHHA has established two sets of thresholds - fish contaminant goals (FCGs; Table 7) and advisory tissue levels (ATLs; Table 8) that are relevant to the Program (Table 8 of Klasing and Brodberg, 2008). FCGs are health protective values for lifetime exposure and consider only the toxicity of the contaminants. They were developed by OEHHA to assist other agencies to establish fish tissue-based criteria for cleanup.

The FCG for mercury (220 ppb) is of the same magnitude as the statewide tissue objective of 200 ppb, based only on toxicity and one serving per week of consumption. STEW has opted to use the statewide tissue objective in lieu of FCGs, but it is important to be aware how similar these two numbers are.

For organics, given their use in 303(d) listing determinations, the FCGs are a relevant benchmark to use in assessing the degree of contamination. To be confident that a waterbody truly has organics concentrations below FCGs, it is desirable to have measured concentrations in species such as catfish, carp, or sucker that are known to accumulate high concentrations.

ATLs consider both the toxicity of contaminants and the health benefits of fish consumption. They are used to develop sport fish consumption advice for the public.

They will also be used to communicate results of the study to the public via the Safe to Eat Portal and via reports and fact sheets. OEHHA has developed ATL ranges for one to seven servings per week. One serving is defined as 8 ounces (227 g) prior to cooking. A comparison of the same consumption frequency (one serving per week), shows that, for mercury, the low end of the ATL range (150 to 440 ppb) for the sensitive population (children and women of child-bearing age) encompasses the statewide tissue objective (200 ppb). For PCBs, the low end of the ATL range (21 ppb) for a two servings per week consumption rate was also considered as a lake selection criterion. The FCGs and ATLs shown below are for the most sensitive population (i.e., women aged 18 to 49 years and children aged 1 to 17 years).

Data collected for this Program will be as sensitive as possible to be evaluated against the SWRCB statewide water quality objectives for mercury, and ATLs and FCGs developed by OEHHA.

**Table 6. SWRCB Statewide Mercury Objectives (ppb)**

All values given in ng/g (ppb) on a wet weight basis.

| Pollutant | SWRCB Statewide Sport Fish Water Quality Objective | SWRCB Statewide Tribal Subsistence Fishing Water Quality Objective | SWRCB Statewide Prey Fish Water Quality Objective |
|---|---|---|---|
| Mercury | 200 | 40 | 50 |

**Table 7. OEHHA Fish Contaminant Goals (ppb)**

All values given in ng/g (ppb) on a wet weight basis.

| Pollutant | Fish Contaminant Goals |
|---|---|
| Mercury | 220 |
| Selenium | 7400 |
| Chlordanes | 5.6 |
| DDTs | 21 |
| Dieldrin | 0.46 |
| PCBs | 3.6 |

**Table 8. OEHHA Advisory Tissue Levels (ppb)**

All values given in ng/g (ppb) on a wet weight basis.

| Pollutant | Advisory Tissue Level | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 7 servings per week | 6 servings per week | 5 servings per week | 4 servings per week | 3 servings per week | 2 servings per week | 1 serving per week | No Consumption |
| Mercury | ≤31 | >31-36 | >36-44 | >44-55 | >55-70 | >70-150 | >150-440 | >440 |
| Selenium | ≤1000 | >1000-1200 | >1200-1400 | >1400-1800 | >1800-2500 | >2500-4900 | >4900-15000 | >15000 |
| Chlordanes | ≤80 | >80-90 | >90-110 | >110-140 | >140-190 | >190-280 | >280-560 | >560 |
| DDTs | ≤220 | >220-260 | >260-310 | >310-390 | >390-520 | >520-1000 | >1000-2100 | >2100 |
| Dieldrin | ≤7 | >7-8 | >8-9 | >9-11 | >11-15 | >15-23 | >23-46 | >46 |
| PBDEs | ≤45 | >45-52 | >52-63 | >63-78 | >78-100 | >100-210 | >210-630 | >630 |
| PCBs | ≤9 | >9-10 | >10-13 | >13-16 | >16-21 | >21-42 | >42-120 | >120 |
| Toxaphene | ≤87 | >87-100 | >100-120 | >120-150 | >150-200 | >200-300 | >300-610 | >610 |

## Data Quality Indicators

Data quality indicators are the quantitative measures and qualitative descriptors used to set limits of acceptable levels of data error. The principal data quality indicators used for this program are precision, accuracy, bias, representativeness, completeness, comparability, and sensitivity. The quantitative measures include precision, bias, and sensitivity, while accuracy (in general), representativeness, and comparability are qualitative descriptors. Completeness is unique and can be described by both quantitative measures and qualitative descriptors. The quality control samples used by the program to inform data quality based on acceptance criteria established for each data quality indicator are summarized in Table 9.

**Table 9. Data Quality Indicators for laboratory measurements in tissue**

| Parameter | Inorganics (including mercury, selenium) | Synthetic Organics (including PCBs, pesticides, PBDEs, PFAS and dioxins) |
|---|---|---|
| **Precision** | Laboratory Duplicate<br>Matrix Spike Duplicate | Laboratory Duplicate<br>Matrix Spike Duplicate (not required for isotope dilution methods) |
| **Bias** | Analyte-specific bias: CRM<br><br>Matrix-specific bias: Matrix Spikes | Analyte-specific bias: Laboratory Control Sample<br><br>Matrix-specific bias: Matrix Spikes or Isotope Dilution Analogues<br><br>Sample processing bias: Recovery Surrogate or Isotope Dilution Analogues |
| **Accuracy** | Certified Reference Material (CRM) | CRM or Laboratory Control Sample |
| **Completeness** | Number of samples and analyses completed | Number of samples and analyses completed |
| **Sensitivity** | Laboratory Reporting Limits (Table 14) | Laboratory Reporting Limits (Tables 15-20) |

### *Precision*

Precision is the degree of agreement among repeated measurements of the same property under identical conditions (EPA QA/G-5, 2002). Laboratory duplicates are used to evaluate the precision of an analytical process, and for some analyses, a matrix spike duplicate is used to assess the matrix-specific precision. To prepare a laboratory

duplicate, a field sample is selected and digested or extracted in duplicate. Field duplicates are not collected for any analytes because true field duplicates cannot be collected due to the disparate nature of individual fish. Following analysis, the results from the duplicate samples are evaluated by calculating the Relative Percent Difference (RPD):

$$\mathrm{RPD} = \left|\frac{\mathrm{V_{sample}} - \mathrm{V_{duplicate}}}{\mathrm{mean}}\right| \mathrm{x100}$$

Where:

$V_{sample}$: the concentration of the original sample digest
$V_{duplicate}$: the concentration of the duplicate sample digest
mean: the mean concentration of both sample digests

A minimum of one laboratory duplicate per analytical batch will be analyzed for inorganics and synthetic organics analyzed with isotope dilution methods. For synthetic organics analyzed by traditional (surrogate) methods, a laboratory duplicate is not required because precision will be evaluated based on the matrix spike duplicate (MSD).

The RPD between the matrix spike (MS) and MSD is calculated, if applicable, to evaluate how the matrix affects precision:

$$\mathrm{RPD} = \left|\frac{\mathrm{V_{MS}} - \mathrm{V_{MSD}}}{\mathrm{mean}}\right| \mathrm{x100}$$

There are two different ways to calculate this RPD, depending on how the samples are spiked.

1) Samples of equal mass are spiked with the same amount of analyte. In this case,

   $V_{MS}$: the concentration for the matrix spike
   $V_{MSD}$: the concentration of the matrix spike duplicate
   mean: the mean of the two concentrations (MS and MSD)

2) Samples of differing mass (<10% different) are spiked with the same amount of analyte. In this case,

   $V_{MS}$: the recovery associated with the matrix spike
   $V_{MSD}$: the recovery associated with matrix spike duplicate
   mean: the mean of the two recoveries ($recovery_{MS}$ and $recovery_{MSD}$)

When there are more than two sample digests, the method of evaluating precision is by calculation of the relative standard deviation (RSD). Expressed as a percentage, the RSD is calculated as follows:

$$\mathrm{RSD} = \left(\frac{\mathrm{Stdev}(\mathrm{v_1}, \mathrm{v_2}, \ldots \mathrm{v_n})}{\mathrm{mean}}\right) \mathrm{x100}$$

Where:

Stdev ($v_1$, $v_2$,…, $v_n$): the standard deviation of the values (concentrations) of the replicate analyses.

mean: the mean of the values (concentrations) of the replicate analyses.

***Bias***

Bias is the systematic or persistent distortion of a measurement process that skews data in one direction. Reference materials (certified reference materials (CRM) or laboratory control samples (LCS)) and MS or isotope dilution analogues (IDA; used in isotope dilution methods) are used to determine the bias associated with each analytical laboratory. CRM or LCS are used to determine analyte-specific bias, and MS or IDA are used to determine the bias associated with the tissue matrix. Field blanks and travel blanks are not collected for any analytes because only the unexposed fillet tissue of each fish is utilized, eliminating contamination from field sources.

The reference materials selected are similar in matrix and concentration range to the samples being prepared and analyzed. Analyte-specific bias is assessed through the calculation of a percent recovery for the CRM or LCS:

$$\%\ \text{recovery} = \left(\frac{V_{\text{analyzed}}}{V_{\text{certified}}}\right) x100$$

Where:

$V_{analyzed}$: the analyzed concentration of the reference material (CRM or LCS)

$V_{certified}$: the certified concentration of the reference material (CRM or LCS)

An MS will be prepared by adding a known concentration of the target analyte to a field sample, which is then subjected to the entire analytical procedure. If the ambient concentration of the field sample is known, the amount of spike added is within a specified range of that concentration. Matrix spikes will be analyzed in order to assess the magnitude of matrix interference and bias present. Matrix-specific bias is assessed through the calculation of a percent recovery for the MS, and MSD if applicable:

$$\%\ \text{recovery} = \left(\frac{V_{MS} - V_{\text{ambient}}}{V_{\text{spike}}}\right) x100$$

Where:

$V_{MS}$: the concentration of the spiked sample

$V_{ambient}$: the concentration of the original (unspiked) sample

$V_{spike}$: the concentration of the spike added

In order to properly assess the degree of matrix interference and potential bias, the spiking level will be approximately 2-5 times the ambient concentration of the spiked sample but at least 3 times the reporting limit. If the MS or MSD is spiked too high or too low relative to the ambient concentration, the calculated recoveries are no longer an acceptable assessment of analytical bias. In order to establish spiking levels prior to

analysis of samples, the laboratories will review any relevant historical data. In many instances, the laboratory will be spiking the samples blind and will not meet a spiking level of 2-5 times the ambient concentration. However, the results of affected samples will not be automatically rejected and will be reviewed on a case-by-case basis to determine if a different matrix spike will need to be performed.

For isotope dilution methods, isotope dilution analogues (IDA) are used rather than MS/MSD to assess matrix-associated bias. IDA are isotopically-labeled analogues of the target analytes, and they are added to every sample and the response of IDAs is used in the quantification of the target analytes so that the reported concentrations reflect matrix effects. IDA percent recovery will be analyzed in order to assess whether the method performance is acceptable and the magnitude of matrix interference and bias present. However, if the method quantifies specific compounds using a non-analogous isotopically labeled compounds, the analysis of matrix spike samples may help diagnose matrix interferences for these specific compounds.

Laboratory method blanks (also called extraction blanks, procedural blanks, or preparation blanks) are used to assess bias from laboratory contamination during all stages of sample preparation and analysis. At least one laboratory method blank will be run in every sample batch of 20 or fewer field samples. The method blanks will be processed through the entire analytical procedure in a manner identical to the samples.

Surrogates are compounds chosen to simulate the analytes of interest in organic analyses to assess accuracy and bias. Surrogates are used to assess analyte concentrations for losses during the extraction and clean-up process, and must be added to each sample, including QC samples, prior to extraction. If possible, isotopically-labeled analogs of the analytes will be used as surrogates. Surrogates are not required for isotope dilution methods because the IDA recovery is used to correct for sample processing bias.

### *Accuracy*

Accuracy is a measure of the agreement of a measurement to a known value, and includes both random error (precision) and systematic error (bias) of analytical operations (EPA QA/G-5, 2002).

Evaluation of the accuracy of laboratory procedures is achieved through the preparation and analysis of reference materials (CRM or LCS) and spiked samples with each analytical batch. For inorganic analyses, accuracy is measured by reference materials and matrix spikes. For mercury analysis, MPSL primarily uses the CRM of NRCC-DORM5 (or most recent version), which is dogfish filet. The CRM NRCC-DOLT5 (dogfish liver) is used when the sample matrix is liver. For organics analyses, accuracy is measured by LCS and either surrogates and MS or IDA.

The reference materials selected are similar in matrix and concentration range to the samples being prepared and analyzed. The accuracy of the results is assessed through the calculation of a percent recovery, as described in the Bias section.

### *Representativeness*

Representativeness is the degree to which measurements correctly represent the environmental condition, target organism population, and/or watershed to be studied. The representativeness of the data is mainly dependent on the sampling locations and the sampling procedures adequately representing the true condition of the sample site. Requirements for selecting sample sites are described in the 2009 Monitoring Plan (p. 9-13) for Coastal Waters and the 2015 Monitoring Plan (p. 7-12) for Lakes and Reservoirs. Sample site selection, sampling of relevant media (water, sediment and biota), and use of only approved/documented analytical methods will determine that the measurement data does represent the conditions at the investigation site, to the extent possible.

### *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 data quality objectives 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 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. A minimum of 90 percent completeness of the planned sampling and analyses is the goal for the Program.

### *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). For this Program, the methodologies for site selection and sampling design were developed to ensure data comparability across years. All sample collection, analyses, and data reporting will be carried out with procedures and methodologies consistent with past Program data collection efforts and applicable SWAMP Measurement Quality Objectives. This will ensure that the data collected by the Program will be comparable to the data collected throughout the lifetime of the Program. Additionally, the Program coordinates with OEHHA to ensure that the Program data can be combined with other sources of data to develop Fish Advisories.

### *Sensitivity*

Analytical sensitivity for chemistry analyses is defined as the lowest value an instrument or method can measure with reasonable statistical certainty. MPSL and Babcock Laboratories and their subcontractors must utilize analytical methods with laboratory-determined method detection limits (MDL) and reporting limits (RL) that meet the level

of sensitivity required to meet the thresholds of the Program Data Quality Objectives. The laboratory RLs for the Program are given in section B.4.

### Measurement Quality Objectives

Measurement quality objectives (MQOs) are the acceptance criteria for the quality control samples that are used to assess the data quality indicators. SWAMP has programmatic MQOs that are used to assess Program data. The Program MQOs for each quality control sample used to inform each of the data quality indicators are given in Table 10 and Table 11. For definitions of all quality control terms, please see the SWAMP QAPrP.

**Table 10. Measurement Quality Objectives - inorganic analytes in tissue**

(Applicable to mercury and selenium)

| Laboratory Quality Control | Frequency of Analysis | Measurement Quality Objective |
|---|---|---|
| Laboratory Blank | Per 20 samples or per batch, whichever is more frequent | <RL for target analyte |
| Reference Material | Per 20 samples or per batch, whichever is more frequent | 75-125% recovery |
| Matrix Spike | Per 20 samples or per batch, whichever is more frequent | 75-125% recovery |
| Matrix Spike Duplicate | Per 20 samples or per batch, whichever is more frequent | 75-125% recovery, RPD ≤25% |
| Laboratory Duplicate | Per 20 samples or per batch, whichever is more frequent | RPD <25%; not applicable if concentration of either sample <RL |

**Table 11. Measurement Quality Objectives - synthetic organic compounds in tissue (Applicable to PCBs, pesticides, PBDEs, and dioxins)**

| Laboratory Quality Control | Frequency of Analysis | Measurement Quality Objective |
|---|---|---|
| Laboratory Blank | Per 20 samples or per analytical batch, whichever is more frequent | < RL for target analytes |
| Laboratory Control Sample or Certified Reference Material | Per 20 samples or per analytical batch (preferably blind) | LCS: 50-150% recovery<br>CRM: 70-130% recovery |
| Matrix Spike[1] | Per 20 samples or per analytical batch, whichever is more frequent. Not required for isotope dilution methods. Not required for isotope dilution methods. | 50-150% or based on historical laboratory control limits (average ± 3 SD) |
| Matrix Spike Duplicate[1] | Per 20 samples or per analytical batch, whichever is more frequent. Not required for isotope dilution methods. | 50-150% or based on historical laboratory control limits (average±3SD); RPD<25% |
| Laboratory Duplicate | Only required for isotope dilution methods: Per 20 samples or per analytical batch, whichever is more frequent. | RPD <25% (not applicable if native concentration of either sample <RL) |
| Surrogate | Included in all samples and all quality control samples. Not required for isotope dilution methods. | Based on historical laboratory control limits<br>(50-150% or better) |
| Isotope Dilution Analogues | For isotope dilution methods only: Included in all samples and all quality control samples. | Based on historical laboratory control limits<br>(50-150% or better) |

[1] MS/MSD are generally not required for isotope dilution methods because any matrix effects should be evident in the IDA recoveries. However, if the method quantifies specific compounds using a nonanalogous isotopically labeled compounds, the analysis of matrix spike samples may help diagnose matrix interferences for these specific compounds.

## A.8 Special Training Requirements/Safety

### Specialized Training and Safety Requirements

All laboratory staff are required to maintain training per field and laboratory specific requirements and follow the safety protocols established in each of their respective laboratories and applicable SOPs. The California Water Boards Environmental Laboratory Accreditation Program (ELAP) does not offer accreditation for analyses in the tissue matrix, so the participating laboratories are not accredited for the specific analyses performed in tissue for the Program. However, all participating laboratories are ELAP-accredited for analyses in other matrices and have quality assurance systems that apply to all analyses in their laboratories, whether or not they are accredited.

### Training Provided

Field and laboratory personnel are trained to conduct a wide variety of activities using standard protocols to ensure samples are collected and analyzed in a consistent manner. Training of each person includes the use of specialized field and/or laboratory equipment and conducting collection or analytical protocols, and other general processes including sample handling, glassware cleaning, sampling preparation and processing, hazardous materials handling, storage, and disposal. All staff must demonstrate proficiency in all the aforementioned and required laboratory activities that are conducted, as certified by the supervisor or LQAO. Training records are retained by individual supervisors or the LQAO as appropriate and available upon request.

### Personnel Responsible for Ensuring Training

The Babcock, SGS-Axys, and MPSL Lab Director (LD) trains or appoints senior staff to train personnel within each lab. The LQAO ensures that training is given according to standard laboratory methods, maintains documentation and conducts performance audits to ensure that personnel have been trained properly.

#### *Field Safety*

Field personnel receive task specific safety training as needed by senior staff. Employees are required to review the safety program, and to have relevant safety equipment with them. This equipment may be related to vehicular, boating, or other work, and is task specific.

#### *Laboratory Safety*

New laboratory employees receive training in laboratory safety and chemical hygiene prior to performing any tasks in the laboratory. Employees are required to review the laboratory's safety program and chemical hygiene plan and acknowledge that they have read and understood the training. An experienced laboratory employee or the laboratory safety officer is assigned to the new employee to provide additional information and answer any questions related to safety that the new employee may have.

On-going safety training is provided by quarterly safety meetings conducted by the laboratory's safety officer, or an annual laboratory safety class conducted by the Babcock Safety Officers and MLML Chemical Safety Officer.

### *Technical Training*

New employees and employees required to learn new test methods are instructed to thoroughly review the appropriate standard operating procedure(s) (SOP) and are paired with a staff member who is experienced and qualified to teach those test methods and observe and evaluate performance. Employees learning new test methods work with experienced staff until they have demonstrated proficiency for the method both by observation and by obtaining acceptable results for QC samples. This demonstration of proficiency is documented and certified by the section leader, LQAO and the laboratory director prior to the person independently performing the test method. Training records are retained on file for each employee by their supervisor or QAO. On-going performance is monitored by reviewing QC sample results.

### Training Safety and Certification Documentation

Staff and safety training is documented at Babcock, SGS-Axys and MPSL. Documentation consists of a record of the training date, instructor and signatures of completion. The LQAO will certify the proficiency of staff at chemical analyses. Certification and records are maintained and updated by the LQAO, or their designee, for all laboratory and field staff.

## A.9 Documentation and Records

### Document/Data Retention

All laboratory logs and data sheets will be maintained at the generating laboratory by the Laboratory Manager for five years following project completion and are available for review by the CM or designee during that time. Copies of reports will be maintained at SFEI for five years after project completion then discarded, except for the SWAMP database 2.5, which will be maintained without discarding. All electronic data are stored on computer hard drives and electronic back-up files are created every two weeks or more frequently.

### Planning Documents

Revisions and updates to this QAPP will be carried out by the Project Manager, with technical input from the Laboratory and SWAMP QAOs. All changes will be considered draft until reviewed and approved by the Program Coordinator, the SWAMP QAO, and the State Water Board QAO. The QAPP must be reviewed at least annually and revised where necessary. It must meet U.S. EPA, State Water Board, and SWAMP quality system requirements to be approved.

The Project Manager will distribute an electronic copy of this QAPP to all parties on the distribution list. Any future amendments to this QAPP will be distributed in the same fashion. Each version of this QAPP will be retained at MPSL and the State Water Board. The QAPP will be reviewed on an annual basis and amended as needed. The QAPP will be updated and reapproved every three years.

Each year, a monitoring plan will be prepared by the Lead Scientist and the Project Manager, with input from the Program Coordinator and STEW. The monitoring plan will be submitted to the Program Coordinator in electronic format prior to the start of sampling each year.

### Sample Collection and Handling Records

- Hardcopy field data sheets will be completed by the field crew during each field visit. The hardcopy field data sheets are retained at MPSL for 10 years and will be made available to the State and Regional Water Boards upon request.
- MPSL will maintain copies of field notebooks, raw and condensed data for analysis performed on-site, and field instrument calibration notebooks.
- Chain-of-Custody Forms, along with pre-populated EDD templates, are submitted with all samples sent to analytical laboratories and are exchanged for signatures with chemistry lab and kept on file.
- Archived Sample Sheets (internal documentation available on request)
- Lab Sample Disposition Logs (internal documentation available on request)
- Refrigerator and Freezer Logs (internal documentation available on request)

### Analytical Records

Contract laboratories must maintain all raw data, instrument or equipment maintenance logs, calibrations, and relevant measurements and records for this project. Laboratories will generate records for sample receipt and storage, analyses and reporting. All records must be retained at their respective laboratories for a minimum of 10 years from the contract's cessation (if applicable) and provided to State or Regional Water Board staff upon request.

### Laboratory Reports

Laboratory reports for organic chemical analyses are issued by the laboratories performing the analyses and are submitted to the Project Manager and SWAMP IQ. SWAMP IQ will retain the laboratory reports for a minimum of 10 years from the receipt of the reports and will make them available upon request.

### Electronic Data Deliverables

Tissue composite data, tissue chemistry data, and field data collected for the Program will be submitted electronically to SWAMP IQ, using the appropriate SWAMP data templates and following the applicable business rules. Laboratories will provide

electronic copies of tabulated analytical data (including associated QA/QC information) in the most current SWAMP database format.

## Group B: Data Generation and Acquisition

### B.1 Sample Collection and Experimental Design

The project design is described in the Monitoring Plans. When it is warranted, the same sampling locations visited in previous sampling will be visited again in the current survey(s).

Potential prey fish (<100 mm) and sport fish sampling equipment and methods can be found in MPSL-102a v5. Once samples have been identified for composite creation, they will be processed according to the timeline in Table 5.

Length measurements and all analyses to be performed in tissue, including lipids, are critical to address the Project Data Quality Objectives. Fish weight, sex, age, and moisture content are ancillary measurements. These parameters may be used to support other data gathered.

Due to potential variability of contaminant loads in individual tissue samples and to maximize information obtained with limited analytical budgets, samples will be analyzed in composites for most fish species and analytes, as outlined in the Monitoring Plans and MPSL SOPs. Mercury samples will be analyzed in individual fish for the mercury indicator species (such as black bass in freshwaters or kelp bass in marine waters), but as composite samples for other species.

Bias can be introduced by using fish of one particular species and/or total length for chemistry regressions and statistical analyses. The monitoring plan for each year is reviewed by the Scientific Review Panel to approve the inclusion of length ranges and multiple target species to reduce the associated bias.

### B.2 Sampling Procedures and Requirements

Fish will be collected in accordance with MPSL-102a v5, Section 13.4 except where noted here. Because habitats may vary greatly, field crews will evaluate each fishing site and species targeted to determine the correct method to be employed. Potential sampling methods include, but are not limited to electroshocking, seining, gill netting, and hook and line. Field Crew will determine the appropriate collection method based on physical site parameters such as depth, width, flow, and accessibility. Field crew will indicate the collection method on field data sheets.

Details on targeted fish species, number of individuals and size ranges will be found in the Monitoring Plan.

The following adaptation to MPSL-102a v5, Section 13.4.6 has been made: Collected fish may be partially dissected in the field. At the dock, the fish is placed on a measuring

board covered with a clean, clear 33-gallon trash bag where fork length, total length, and weight of the fish are recorded. Large fish such as carp will then be placed on the covered cutting board where the head, tail, and guts are removed using a clean cleaver (scrubbed with Micro™, rinsed with tap and deionized water). The fish cross section is tagged with a unique numbered ID, wrapped in aluminum foil, and placed in a clean labeled bag. When possible, parasites and body anomalies are noted. The cutting board is covered with a new bag, and the cleaver is re-cleaned with Micro™, rinsed with tap and deionized water between fish species, per site if multiple stations are sampled.

Further details on sample collection and processing can be found in the Monitoring Plans.

## B.3 Sample Handling and Custody Procedures

### Sample Documentation

The field coordinator will be responsible for ensuring that each field sampling team adheres to proper custody and documentation procedures. Field data will be collected and documented on standardized field data sheets. Samples delivered to MPSL will be logged in according to MPSL-104 v4. A master sample logbook of field data sheets shall be maintained for all samples collected during each sampling event. Samples will be dissected according to MPSL-105 v5, taking care to exclude any exposed flesh that may be contaminated for target analytes, and data retained on the lab data sheets.

### Sample Handling Requirements

Sample handling requirements are consistent with SWAMP MQOs (Table 12). Fish samples will be wrapped in aluminum foil and frozen on wet or dry ice for transportation to the storage freezer or laboratory, where they will be stored at -20°C until dissection and homogenization. Lab homogenates will be frozen until analysis is performed. Frozen tissue samples have a 12 month hold time from the date of collection. If a hold-time violation has occurred, the PM and Regional Coordinator(s) will be notified. Affected data will be flagged appropriately in the final results submitted to SWAMP IQ.

Organic compounds have 40-day hold times between extraction and analysis. Holding time violations will be flagged appropriately in the final results, and the PM and Regional Coordinator(s) will be notified. This type of hold time is not applicable to metals and metalloids.

**Table 12. Sample handling and holding times for tissue**

| Parameter | Container | Preservation | Holding Time |
|---|---|---|---|
| Lipids | Glass | Per method | Per method |
| Moisture | Glass or polyethylene | Cool to ≤6°C within 24 hours, then freeze to ≤-20°C | 1 year |
| Mercury | Wrapped in foil, zip top bag; Glass or Polyethylene | Cool to ≤6°C within 24 hours, then freeze to ≤-20°C | 1 year |
| Selenium | Wrapped in foil, zip top bag; Glass or Polyethylene | Cool to ≤6°C within 24 hours, then freeze to ≤-20°C | 1 year |
| Organics (PCBs, organochlorine pesticides, PBDEs, dioxins, PFAS) | Wrapped in foil, zip top bag; Glass | Cool to ≤6°C within 24 hours, then freeze to ≤-20°C | 1 year; samples must be extracted within 14 days of thawing and analyzed within 40 days of extraction |

### Sample Chain of Custody

Project chain of custody (COC) procedures require that the possession of samples is traceable from the time they are collected until completion and submittal of analytical results. Therefore, a complete COC form will accompany the transfer of samples to each analyzing laboratory and will be forwarded to the PM with the data reporting package (MPSL COCs; Babcock Laboratories, Inc. COC). A chain-of-custody form must be completed after sample collection and prior to sample release.

The receiving laboratory must have a sample custodian who examines the samples for proper documentation, preservation, and holding times. Contract laboratories will follow the COC procedures outlined in their respective QA plans (available upon request). Copies of the COCs will be kept by each receiving laboratory. An electronic copy of analytical COCs will be provided to the Contract Manager and SWAMP IQ Data Quality Managers within 10 business days of submission of samples to the laboratory.

### Sample Retention and Disposal

All samples must be retained for the entire duration of their required holding times and analyses. Any samples remaining after completion of analyses must be retained until the laboratory has received written confirmation from the PM that the data have been received, reviewed, and verified and that the disposal of samples is permitted.

The laboratories are responsible for complying with all Federal, State and local regulations governing waste management, particularly hazardous waste identification rules and land disposal restrictions. Chemicals must be appropriately neutralized prior to disposal or must be handled as hazardous waste.

If samples are still available, then they must be archived and retained for up to 5 years for potential future analysis. The locations of archived samples are stored in an electronic log.

## B.4 Analytical Methods Requirements

Methods and equipment for laboratory analyses are listed in Table 13. USEPA methods can be downloaded from www.nemi.gov. USEPA method numbers followed by “M” or “MLA-XXX” indicate modifications have been made. SOPs for non-USEPA methods or those outlining method modifications can be obtained by contacting the LQAO. Method validation data for method modifications and non-USEPA methods are available upon request. Turnaround times for laboratory data are specified in each contract.

**Table 13. Methods for laboratory analyses**

| Laboratory | Parameter | Matrix | Method | Instrument |
|---|---|---|---|---|
| MPSL | Mercury | Whole Body Small Fish and Sport Fish fillet muscle | EPA 7473M | Milestone DMA 80 |
| MPSL | Selenium | Whole Body Small Fish and Sport Fish fillet muscle | MPSL-120 | Perkin-Elmer NexION 1000 ICP-MS |
| SGS-AXYS | Polychlorinated Biphenyls | Sport Fish fillet muscle | EPA 1668AM (MLA-010 Rev 12) | Micromass Ultima high resolution mass spectrometer |
| SGS-AXYS | Organochlorine Pesticides | Sport Fish fillet muscle | EPA 1699 (MLA-028 Rev 08)* | Micromass Ultima high resolution mass spectrometer |
| SGS-AXYS | Organochlorine, Organophosphorus, Triazine, and Pyrethroid Pesticides | Tissue | EPA 1699 (MLA-035 Rev 07) | High resolution GC/MS |
| SGS-AXYS | Polybrominated Diphenyl Ethers | Tissue | EPA 1614A (MLA-033 Rev 06) | High resolution GC/MS |
| SGS-AXYS | Dioxins and Furans | Tissue | EPA 1613B (MLA-017 Rev 20) | High resolution GC/MS |
| SGS-AXYS | PFAS | Tissue | EPA 1633 (MLA-110) | UPLC-MS/MS |

Mercury and selenium analyses in fish tissues are conducted by MPSL and their laboratory reporting limits are given in Table 14.

**Table 14. Trace metal analytical parameters, reporting units and laboratory reporting limits in tissue**

| Parameter | Method | Laboratory RL |
|---|---|---|
| Mercury | EPA 7473M | 0.030 µg/g wet wt |
| Selenium | MPSL-120 | 0.70 µg/g wet wt |

Organic compound analyses in fish tissues are conducted by SGS-AXYS, who is subcontracted by Babcock Laboratories. RLs for the different classes of organic compounds that may be analyzed are shown in Tables 15-20. For MLA-035 Rev 07, the analytes listed in Table 17 only include those that are requested to be reported. MLA-035 includes additional organochlorine pesticide analytes, but they are not requested to be reported if EPA 1699 (MLA-028 Rev 08) is also run on the same sample, which includes many duplicate organochlorine analytes.

**Table 15. Polychlorinated biphenyl analytical parameters, reporting units, and laboratory reporting limits for tissue for Method EPA 1668AM (MLA-010)**

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| PCB 001 | CL1-PCB-1 ⁺ | 3.0 pg/g wet wt |
| PCB 002 | CL1-PCB-2 ‡ | 3.0 pg/g wet wt |
| PCB 003 | CL1-PCB-3 ‡ | 3.0 pg/g wet wt |
| PCB 004 | CL2-PCB-4 ‡ | 3.0 pg/g wet wt |
| PCB 005 | CL2-PCB-5 ⁺ | 3.0 pg/g wet wt |
| PCB 006 | CL2-PCB-6 ‡ | 3.0 pg/g wet wt |
| PCB 007 | CL2-PCB-7 ‡ | 3.0 pg/g wet wt |
| PCB 008 | CL2-PCB-8 | 3.0 pg/g wet wt |
| PCB 008 | CL2-PCB-9 ‡ | 3.0 pg/g wet wt |
| PCB 010 | CL2-PCB-10 ‡ | 3.0 pg/g wet wt |
| PCB 011 | CL2-PCB-11 | 6.2 pg/g wet wt |
| PCB 012/13 | CL2-PCB-12/13 ‡ | 3.0 pg/g wet wt |
| PCB 014 | CL2-PCB-14 ‡ | 3.0 pg/g wet wt |
| PCB 015 | CL2-PCB-15 ‡ | 3.0 pg/g wet wt |
| PCB 016 | CL3-PCB-16 ‡ | 3.0 pg/g wet wt |
| PCB 017 | CL3-PCB-17 ‡ | 3.0 pg/g wet wt |
| PCB 019 | CL3-PCB-19 ‡ | 3.0 pg/g wet wt |
| PCB 021/33 | CL3-PCB-21/33 | 3.0 pg/g wet wt |

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| PCB 022 | CL3-PCB-22 ‡ | 3.0 pg/g wet wt |
| PCB 023 | CL3-PCB-23 ‡ | 3.0 pg/g wet wt |
| PCB 024 | CL3-PCB-24 ‡ | 3.0 pg/g wet wt |
| PCB 025 | CL3-PCB-25 ‡ | 3.0 pg/g wet wt |
| PCB 026/29 | CL3-PCB-26/29 | 3.0 pg/g wet wt |
| PCB 027 | CL3-PCB-27 | 3.0 pg/g wet wt |
| PCB 020/28 | CL3-PCB-28/20 | 3.0 pg/g wet wt |
| PCB 030/18 | CL3-PCB-30/18 | 3.0 pg/g wet wt |
| PCB 031 | CL3-PCB-31 | 3.0 pg/g wet wt |
| PCB 032 | CL3-PCB-32 ‡ | 3.0 pg/g wet wt |
| PCB 034 | CL3-PCB-34 ‡ | 3.0 pg/g wet wt |
| PCB 035 | CL3-PCB-35 ‡ | 3.0 pg/g wet wt |
| PCB 036 | CL3-PCB-36 ‡ | 3.0 pg/g wet wt |
| PCB 037 | CL3-PCB-37 + | 3.0 pg/g wet wt |
| PCB 038 | CL3-PCB-38 ‡ | 3.0 pg/g wet wt |
| PCB 039 | CL3-PCB-39 ‡ | 3.0 pg/g wet wt |
| PCB 040/41/71 | CL4-PCB-41 ‡/40 ‡/71 ‡ | 3.0 pg/g wet wt |
| PCB 042 | CL4-PCB-42 ‡ | 3.0 pg/g wet wt |
| PCB 043 | CL4-PCB-43 ‡ | 3.0 pg/g wet wt |
| PCB 044/47/65 | CL4-PCB-44/47 ‡/65 ‡ | 3.0 pg/g wet wt |
| PCB 045/51 | CL4-PCB-45 ‡/51 ‡ | 3.0 pg/g wet wt |
| PCB 046 | CL4-PCB-46 ‡ | 3.0 pg/g wet wt |
| PCB 048 | CL4-PCB-48 ‡ | 3.0 pg/g wet wt |
| PCB 050/53 | CL4-PCB-50 ‡/53 ‡ | 3.0 pg/g wet wt |
| PCB 052 | CL4-PCB-52 | 3.0 pg/g wet wt |
| PCB 054 | CL4-PCB-54 ‡ | 3.0 pg/g wet wt |
| PCB 055 | CL4-PCB-55 ‡ | 3.0 pg/g wet wt |
| PCB 056 | CL4-PCB-56 | 3.0 pg/g wet wt |
| PCB 057 | CL4-PCB-57 ‡ | 3.0 pg/g wet wt |
| PCB 058 | CL4-PCB-58 ‡ | 3.0 pg/g wet wt |
| PCB 059/62/75 | CL4-PCB-59 ‡/62 ‡/75 ‡ | 3.0 pg/g wet wt |
| PCB 060 | CL4-PCB-60 | 3.0 pg/g wet wt |
| PCB 061/70/74/76 | CL4-PCB-61 ‡/70/74/76 ‡ | 3.0 pg/g wet wt |
| PCB 063 | CL4-PCB-63 ‡ | 3.0 pg/g wet wt |
| PCB 064 | CL4-PCB-64 | 3.0 pg/g wet wt |

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| PCB 066 | CL4-PCB-66 | 3.0 pg/g wet wt |
| PCB 067 | CL4-PCB-67 ‡ | 3.0 pg/g wet wt |
| PCB 068 | CL4-PCB-68 ‡ | 3.0 pg/g wet wt |
| PCB 049/69 | CL4-PCB-69 ‡/49 | 3.0 pg/g wet wt |
| PCB 072 | CL4-PCB-72 ‡ | 3.0 pg/g wet wt |
| PCB 073 | CL4-PCB-73 ‡ | 3.0 pg/g wet wt |
| PCB 077 | CL4-PCB-77 | 3.0 pg/g wet wt |
| PCB 078 | CL4-PCB-78 ‡ | 3.0 pg/g wet wt |
| PCB 079 | CL4-PCB-79 ‡ | 3.0 pg/g wet wt |
| PCB 080 | CL4-PCB-80 + | 3.0 pg/g wet wt |
| PCB 081 | CL4-PCB-81 ‡ | 3.0 pg/g wet wt |
| PCB 082 | CL5-PCB-82 ‡ | 3.0 pg/g wet wt |
| PCB 083/99 | CL5-PCB-83 ‡/99 | 3.0 pg/g wet wt |
| PCB 084 | CL5-PCB-84 ‡ | 3.0 pg/g wet wt |
| PCB 088/91 | CL5-PCB-88 ‡/91 ‡ | 3.0 pg/g wet wt |
| PCB 089 | CL5-PCB-89 ‡ | 3.0 pg/g wet wt |
| PCB 092 | CL5-PCB-92 ‡ | 3.0 pg/g wet wt |
| PCB 094 | CL5-PCB-94 ‡ | 3.0 pg/g wet wt |
| PCB 093/95/98/100/102 | CL5-PCB-95 ‡/100 ‡/93 ‡/102 ‡/98 ‡ | 3.0 pg/g wet wt |
| PCB 096 | CL5-PCB-96 ‡ | 3.0 pg/g wet wt |
| PCB 103 | CL5-PCB-103 ‡ | 3.0 pg/g wet wt |
| PCB 104 | CL5-PCB-104 ‡ | 3.0 pg/g wet wt |
| PCB 105 | CL5-PCB-105 | 3.0 pg/g wet wt |
| PCB 106 | CL5-PCB-106 ‡ | 3.0 pg/g wet wt |
| PCB 107/124 | CL5-PCB-107 ‡/124 ‡ | 3.0 pg/g wet wt |
| PCB 086/87/97/108/119/125 | CL5-PCB-108 ‡/119 +/86 ‡/97/125 ‡/87 | 3.0 pg/g wet wt |
| PCB 109 | CL5-PCB-109 ‡ | 3.0 pg/g wet wt |
| PCB 110/115 | CL5-PCB-110/115 ‡ | 3.0 pg/g wet wt |
| PCB 111 | CL5-PCB-111 ‡ | 3.0 pg/g wet wt |
| PCB 112 | CL5-PCB-112 ‡ | 3.0 pg/g wet wt |
| PCB 090/101/113 | CL5-PCB-113 ‡/90 +/101 | 3.0 pg/g wet wt |
| PCB 114 | CL5-PCB-114 | 3.0 pg/g wet wt |
| PCB 085/116/117 | CL5-PCB-117 ‡/116 ‡/85 ‡ | 3.0 pg/g wet wt |
| PCB 118 | CL5-PCB-118 | 3.0 pg/g wet wt |

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| PCB 120 | CL5-PCB-120 ‡ | 3.0 pg/g wet wt |
| PCB 121 | CL5-PCB-121 ‡ | 3.0 pg/g wet wt |
| PCB 122 | CL5-PCB-122 ‡ | 3.0 pg/g wet wt |
| PCB 123 | CL5-PCB-123 + | 3.0 pg/g wet wt |
| PCB 126 | CL5-PCB-126 | 3.0 pg/g wet wt |
| PCB 127 | CL5-PCB-127 ‡ | 3.0 pg/g wet wt |
| PCB 128/166 | CL6-PCB-128/166 + | 3.0 pg/g wet wt |
| PCB 130 | CL6-PCB-130 ‡ | 3.0 pg/g wet wt |
| PCB 131 | CL6-PCB-131 ‡ | 3.0 pg/g wet wt |
| PCB 132 | CL6-PCB-132 + | 3.0 pg/g wet wt |
| PCB 133 | CL6-PCB-133 ‡ | 3.0 pg/g wet wt |
| PCB 134/143 | CL6-PCB-134 ‡/143 ‡ | 3.0 pg/g wet wt |
| PCB 136 | CL6-PCB-136 ‡ | 3.0 pg/g wet wt |
| PCB 137 | CL6-PCB-137 | 3.0 pg/g wet wt |
| PCB 129/138/160/163 | CL6-PCB-138/163 ‡/129 ‡/160 ‡ | 3.0 pg/g wet wt |
| PCB 139/140 | CL6-PCB-139 ‡/140 ‡ | 3.0 pg/g wet wt |
| PCB 141 | CL6-PCB-141 | 3.0 pg/g wet wt |
| PCB 142 | CL6-PCB-142 ‡ | 3.0 pg/g wet wt |
| PCB 144 | CL6-PCB-144 ‡ | 3.0 pg/g wet wt |
| PCB 145 | CL6-PCB-145 ‡ | 3.0 pg/g wet wt |
| PCB 146 | CL6-PCB-146 | 3.0 pg/g wet wt |
| PCB 147/149 | CL6-PCB-147 ‡/149 | 3.0 pg/g wet wt |
| PCB 148 | CL6-PCB-148 ‡ | 3.0 pg/g wet wt |
| PCB 150 | CL6-PCB-150 ‡ | 3.0 pg/g wet wt |
| PCB 135/151/154 | CL6-PCB-151/135 ‡/154 ‡ | 3.0 pg/g wet wt |
| PCB 152 | CL6-PCB-152 ‡ | 3.0 pg/g wet wt |
| PCB 153/168 | CL6-PCB-153/168 + | 3.0 pg/g wet wt |
| PCB 155 | CL6-PCB-155 ‡ | 3.0 pg/g wet wt |
| PCB 156/157 | CL6-PCB-156 ‡/157 | 3.0 pg/g wet wt |
| PCB 158 | CL6-PCB-158 | 3.0 pg/g wet wt |
| PCB 159 | CL6-PCB-159 ‡ | 3.0 pg/g wet wt |
| PCB 161 | CL6-PCB-161 ‡ | 3.0 pg/g wet wt |
| PCB 162 | CL6-PCB-162 ‡ | 3.0 pg/g wet wt |
| PCB 164 | CL6-PCB-164 ‡ | 3.0 pg/g wet wt |

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| PCB 165 | CL6-PCB-165 ‡ | 3.0 pg/g wet wt |
| PCB 167 | CL6-PCB-167 + | 3.0 pg/g wet wt |
| PCB 169 | CL6-PCB-169 | 3.0 pg/g wet wt |
| PCB 170 | CL7-PCB-170 | 3.0 pg/g wet wt |
| PCB 171/173 | CL7-PCB-171 ‡/173 ‡ | 3.0 pg/g wet wt |
| PCB 172 | CL7-PCB-172 ‡ | 3.0 pg/g wet wt |
| PCB 174 | CL7-PCB-174 | 3.0 pg/g wet wt |
| PCB 175 | CL7-PCB-175 ‡ | 3.0 pg/g wet wt |
| PCB 176 | CL7-PCB-176 ‡ | 3.0 pg/g wet wt |
| PCB 177 | CL7-PCB-177 | 3.0 pg/g wet wt |
| PCB 178 | CL7-PCB-178 ‡ | 3.0 pg/g wet wt |
| PCB 179 | CL7-PCB-179 ‡ | 3.0 pg/g wet wt |
| PCB 180/193 | CL7-PCB-180/193 ‡ | 3.0 pg/g wet wt |
| PCB 181 | CL7-PCB-181 ‡ | 3.0 pg/g wet wt |
| PCB 182 | CL7-PCB-182 ‡ | 3.0 pg/g wet wt |
| PCB 183/185 | CL7-PCB-183/185 ‡ | 3.0 pg/g wet wt |
| PCB 184 | CL7-PCB-184 + | 3.0 pg/g wet wt |
| PCB 186 | CL7-PCB-186 ‡ | 3.0 pg/g wet wt |
| PCB 187 | CL7-PCB-187 | 3.0 pg/g wet wt |
| PCB 188 | CL7-PCB-188 ‡ | 3.0 pg/g wet wt |
| PCB 189 | CL7-PCB-189 | 3.0 pg/g wet wt |
| PCB 190 | CL7-PCB-190 ‡ | 3.0 pg/g wet wt |
| PCB 191 | CL7-PCB-191 ‡ | 3.0 pg/g wet wt |
| PCB 192 | CL7-PCB-192 ‡ | 3.0 pg/g wet wt |
| PCB 194 | CL8-PCB-194 | 3.0 pg/g wet wt |
| PCB 195 | CL8-PCB-195 | 3.0 pg/g wet wt |
| PCB 196 | CL8-PCB-196 ‡ | 3.0 pg/g wet wt |
| PCB 197/200 | CL8-PCB-197 ‡/200 | 3.0 pg/g wet wt |
| PCB 198/199 | CL8-PCB-198/199 | 3.0 pg/g wet wt |
| PCB 201 | CL8-PCB-201 | 3.0 pg/g wet wt |
| PCB 202 | CL8-PCB-202 ‡ | 3.0 pg/g wet wt |
| PCB 203 | CL8-PCB-203 | 3.0 pg/g wet wt |
| PCB 204 | CL8-PCB-204 ‡ | 3.0 pg/g wet wt |
| PCB 205 | CL8-PCB-205 ‡ | 3.0 pg/g wet wt |
| PCB 206 | CL9-PCB-206 | 3.0 pg/g wet wt |

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| PCB 207 | CL9-PCB-207 ‡ | 3.0 pg/g wet wt |
| PCB 208 | CL9-PCB-208 ‡ | 3.0 pg/g wet wt |
| PCB 209 | CL10-PCB-209 | 3.0 pg/g wet wt |

⁺New to analyte list in 2017
‡New to analyte list in 2021

**Table 16. Organochlorine pesticide analytical parameters, reporting units, and laboratory reporting limits for tissue for Method EPA 1699 (MLA-028)**

| Analyte Group | Analyte | Laboratory RL |
|---|---|---|
| Chlordanes | Chlordane, cis- | 0.4 ng/g wet wt |
| | Chlordane, trans- | 0.4 ng/g wet wt |
| | Heptachlor | 0.2 ng/g wet wt |
| | Heptachlor epoxide | 0.64 ng/g wet wt |
| | Nonachlor, cis- | 0.4 ng/g wet wt |
| | Nonachlor, trans- | 0.4 ng/g wet wt |
| | Oxychlordane | 0.4 ng/g wet wt |
| DDTs | DDD(o,p') | 0.2 ng/g wet wt |
| | DDD(p,p') | 0.2 ng/g wet wt |
| | DDE(o,p') | 0.2 ng/g wet wt |
| | DDE(p,p') | 0.2 ng/g wet wt |
| | DDMU(p,p') * | Not currently available |
| | DDT(o,p') | 0.2 ng/g wet wt |
| | DDT(p,p') | 0.2 ng/g wet wt |
| Cyclodienes | Aldrin | 0.416 ng/g wet wt |
| | Dieldrin | 0.2 ng/g wet wt |
| | Endrin | 0.3 ng/g wet wt |
| | Endrin Aldehyde | 0.3 ng/g wet wt |
| | Endrin Ketone | 0.3 ng/g wet wt |
| HCHs | HCH, alpha | 0.4 ng/g wet wt |
| | HCH, beta | 0.4 ng/g wet wt |
| | HCH, delta | 0.1 ng/g wet wt |
| | HCH, gamma | 0.4 ng/g wet wt |
| Others | Dacthal * | Not currently available |
| | Endosulfan I | 0.643 ng/g wet wt |
| | Endosulfan II | 0.6 ng/g wet wt |
| | Endosulfan Sulfate | 0.3 ng/g wet wt |

| Analyte Group | Analyte | Laboratory RL |
|---|---|---|
| | Hexachlorobenzene | 0.2 ng/g wet wt |
| | Methoxychlor | 0.328 ng/g wet wt |
| | Mirex | 0.2 ng/g wet wt |
| | Oxadiazon | Not applicable |
| | Toxaphene | 2.0 ng/g wet wt |

* Not available from SGS-Axys but STEW is still interested in analysis for future projects

**Table 17. Organochlorine, organophosphorus, triazine, and pyrethroid pesticide analytical parameters, reporting units, and laboratory reporting limits for tissue by method MLA-035 Rev 07**

| Analyte Group | Analyte | Laboratory RL |
|---|---|---|
| Organochlorine Pesticides | Captan | 5.0 ng/g wet wt |
| | Chlorothalonil | 1.0 ng/g wet wt |
| | Dacthal | 0.5 ng/g wet wt |
| | Octachlorostyrene | 0.8 ng/g wet wt |
| | Quintozene | 2.0 ng/g wet wt |
| | Tecnazene | 1.0 ng/g wet wt |
| Organophosphorus Pesticides | Azinphos-methyl | 2.5 ng/g wet wt |
| | Chlorpyrifos | 2.0 ng/g wet wt |
| | Chlorphyrifos methyl | 2.5 ng/g wet wt |
| | Chlorpyrifos-Oxon | 2.0 ng/g wet wt |
| | Diazinon | 2.0 ng/g wet wt |
| | Diazinon-Oxon | 2.0 ng/g wet wt |
| | Dimethoate | 10.0 ng/g wet wt |
| | Disulfoton | 10.0 ng/g wet wt |
| | Disulfoton Sulfone | 0.2 ng/g wet wt |
| | Ethion | 0.4 ng/g wet wt |

| Analyte Group | Analyte | Laboratory RL |
|---|---|---|
| | Fenitrothion | 2.0 ng/g wet wt |
| | Fonofos | 2.0 ng/g wet wt |
| | Malathion | 26.0 ng/g wet wt |
| | Ethyl Parathion | 2.0 ng/g wet wt |
| | Methyl Parathion | 6.0 ng/g wet wt |
| | Phorate | 2.0 ng/g wet wt |
| | Phosmet | 5.0 ng/g wet wt |
| | Pirimphos Methyl | 2.0 ng/g wet wt |
| | Terbufos | 0.5 ng/g wet wt |
| Triazine Pesticides | Ametryn | 2.0 ng/g wet wt |
| | Atrazine | 2.0 ng/g wet wt |
| | Cyanizine | 2.0 ng/g wet wt |
| | Desethyl-Atrazine | 1.0 ng/g wet wt |
| | Hexazinone | 2.5 ng/g wet wt |
| | Metribuzin | 0.5 ng/g wet wt |
| | Simazine | 2.0 ng/g wet wt |
| Pyrethroid Pesticides | Total Cypermethrin (sum of Cypermethrin A, Cypermethrin B, Cypermethrin C) | 5.0 ng/g wet wt |
| | Total Permethrin (sum of cis-Permethrin and trans-Permethrin) | 1.0 ng/g wet wt |

**Table 18. Polybrominated diphenyl ether analytical parameters, reporting units, and laboratory reporting limits for tissue by method EPA 1614A (MLA-033 Rev 10)**

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| PBDE 007 | BR2-DPE-7 | 0.1 pg/g wet wt |
| PBDE 008/11 | BR2-DPE-8/11 | 0.1 pg/g wet wt |
| PBDE 010 | BR2-DPE-10 | 0.1 pg/g wet wt |
| PBDE 012/13 | BR2-DPE-12/13 | 0.1 pg/g wet wt |
| PBDE 015 | BR2-DPE-15 | 0.1 pg/g wet wt |
| PBDE 017/25 | BR3-DPE-17/25 | 0.1 pg/g wet wt |
| PBDE 028/33 | BR3-DPE-28/33 | 0.1 pg/g wet wt |
| PBDE 030 | BR3-DPE-30 | 0.1 pg/g wet wt |
| PBDE 032 | BR3-DPE-32 | 0.1 pg/g wet wt |
| PBDE 035 | BR3-DPE-35 | 0.1 pg/g wet wt |
| PBDE 037 | BR3-DPE-37 | 0.1 pg/g wet wt |
| PBDE 047 | BR4-DPE-47 | 0.1 pg/g wet wt |
| PBDE 049 | BR4-DPE-49 | 0.1 pg/g wet wt |
| PBDE 051 | BR4-DPE-51 | 0.1 pg/g wet wt |
| PBDE 066 | BR4-DPE-66 | 0.1 pg/g wet wt |
| PBDE 071 | BR4-DPE-71 | 0.1 pg/g wet wt |
| PBDE 075 | BR4-DPE-75 | 0.1 pg/g wet wt |
| PBDE 077 | BR4-DPE-77 | 0.1 pg/g wet wt |
| PBDE 079 | BR4-DPE-79 | 0.1 pg/g wet wt |
| PBDE 085 | BR5-DPE-85 | 0.1 pg/g wet wt |
| PBDE 099 | BR5-DPE-99 | 0.1 pg/g wet wt |
| PBDE 100 | BR5-DPE-100 | 0.1 pg/g wet wt |
| PBDE 105 | BR5-DPE-105 | 0.1 pg/g wet wt |

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| PBDE 116 | BR5-DPE-116 | 0.1 pg/g wet wt |
| PBDE 119/120 | BR5-DPE-119/120 | 0.1 pg/g wet wt |
| PBDE 126 | BR5-DPE-126 | 0.1 pg/g wet wt |
| PBDE 128 | BR6-DPE-128 | 0.1 pg/g wet wt |
| PBDE 138/166 | BR6-DPE-138/166 | 0.1 pg/g wet wt |
| PBDE 140 | BR6-DPE-140 | 0.1 pg/g wet wt |
| PBDE 153 | BR6-DPE-153 | 0.1 pg/g wet wt |
| PBDE 154 | BR6-DPE-154 | 0.1 pg/g wet wt |
| PBDE 155 | BR6-DPE-155 | 0.1 pg/g wet wt |
| PBDE 181 | BR7-DPE-181 | 0.1 pg/g wet wt |
| PBDE 183 | BR7-DPE-183 | 0.1 pg/g wet wt |
| PBDE 190 | BR7-DPE-190 | 0.1 pg/g wet wt |
| PBDE 203 | BR8-DPE-203 | 0.1 pg/g wet wt |
| PBDE 206 | BR9-DPE-206 | 0.1 pg/g wet wt |
| PBDE 207 | BR9-DPE-207 | 0.1 pg/g wet wt |
| PBDE 208 | BR9-DPE-208 | 0.1 pg/g wet wt |
| PBDE 209 | BR10-DPE-209 | 0.1 pg/g wet wt |

**Table 19. Dioxins and furans analytical parameters, reporting units, and laboratory reporting limits for tissue by method EPA 1613B (MLA-017 Rev 20)**

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| TCDD, 2,3,7,8- | 2,3,7,8-TCDD | 0.05 pg/g wet wt |
| PeCDD, 1,2,3,7,8- | 1,2,3,7,8-PECDD | 0.05 pg/g wet wt |
| HxCDD, 1,2,3,4,7,8- | 1,2,3,4,7,8-HXCDD | 0.05 pg/g wet wt |
| HxCDD, 1,2,3,6,7,8- | 1,2,3,6,7,8-HXCDD | 0.05 pg/g wet wt |
| HxCDD, 1,2,3,7,8,9- | 1,2,3,7,8,9-HXCDD | 0.05 pg/g wet wt |
| HpCDD, 1,2,3,4,6,7,8- | 1,2,3,4,6,7,8-HPCDD | 0.05 pg/g wet wt |
| OCDD, 1,2,3,4,6,7,8,9- | OCDD | 0.05 pg/g wet wt |
| TCDF, 2,3,7,8- | 2,3,7,8-TCDF | 0.05 pg/g wet wt |
| PeCDF, 1,2,3,7,8- | 1,2,3,7,8-PECDF | 0.05 pg/g wet wt |
| PeCDF, 2,3,4,7,8- | 2,3,4,7,8-PECDF | 0.05 pg/g wet wt |
| HxCDF, 1,2,3,4,7,8- | 1,2,3,4,7,8-HXCDF | 0.05 pg/g wet wt |
| HxCDF, 1,2,3,6,7,8- | 1,2,3,6,7,8-HXCDF | 0.05 pg/g wet wt |
| HxCDF, 1,2,3,7,8,9- | 1,2,3,7,8,9-HXCDF | 0.05 pg/g wet wt |
| HxCDF, 2,3,4,6,7,8- | 2,3,4,6,7,8-HXCDF | 0.05 pg/g wet wt |
| HpCDF, 1,2,3,4,6,7,8- | 1,2,3,4,6,7,8-HPCDF | 0.05 pg/g wet wt |
| HpCDF, 1,2,3,4,7,8,9- | 1,2,3,4,7,8,9-HPCDF | 0.05 pg/g wet wt |
| OCDF, 1,2,3,4,6,7,8,9- | OCDF | 0.05 pg/g wet wt |

**Table 20. PFAS analytical parameters, reporting units, and laboratory reporting limits for tissue by method EPA 1633 (MLA-110)**

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| Perfluorobutanoate | Perfluorobutanoate (PFBA) | 1.6 ng/g wet wt |
| Perfluoropentanoate | Perfluoropentanoate (PFPeA) | 0.8 ng/g wet wt |
| Perfluorohexanoate | Perfluorohexanoate (PFHxA) | 0.4 ng/g wet wt |
| Perfluoroheptanoate | Perfluoroheptanoate (PFHpA) | 0.4 ng/g wet wt |
| Perfluorooctanoate | Perfluorooctanoate (PFOA) | 0.4 ng/g wet wt |
| Perfluorononanoate | Perfluorononanoate (PFNA) | 0.4 ng/g wet wt |
| Perfluorodecanoate | Perfluorodecanoate (PFDA) | 0.4 ng/g wet wt |
| Perfluoroundecanoate | Perfluoroundecanoate (PFUnA) | 0.4 ng/g wet wt |
| Perfluorododecanoate | Perfluorododecanoate (PFDoA) | 0.4 ng/g wet wt |
| Perfluorotridecanoate | Perfluorotridecanoate (PFTrDA) | 0.4 ng/g wet wt |
| Perfluorotetradecanoate | Perfluorotetradecanoate (PFTeDA) | 0.4 ng/g wet wt |
| Perfluorobutanesulfonate | Perfluorobutanesulfonate (PFBS) | 0.4 ng/g wet wt |
| Perfluoropentanesulfonate | Perfluoropentanesulfonate (PFPeS) | 0.4 ng/g wet wt |
| Perfluorohexanesulfonate | Perfluorohexanesulfonate (PFHxS) | 0.4 ng/g wet wt |
| Perfluoroheptanesulfonate | Perfluoroheptanesulfonate (PFHpS) | 0.4 ng/g wet wt |
| Perfluorooctanesulfonate | Perfluorooctanesulfonate (PFOS) | 0.4 ng/g wet wt |
| Perfluorononanesulfonate | Perfluorononanesulfonate (PFNS) | 0.4 ng/g wet wt |
| Perfluorodecanesulfonate | Perfluorodecanesulfonate (PFDS) | 0.4 ng/g wet wt |
| Perfluorododecanesulfonate | Perfluorododecanesulfonate (PFDoS) | 0.4 ng/g wet wt |
| Fluorotelomer Sulfonate, 4:2- | 4:2 fluorotelomersulfonate (4:2 FTS) | 1.6 ng/g wet wt |
| Fluorotelomer Sulfonate, 6:2- | 6:2 fluorotelomersulfonate (6:2 FTS) | 8.7 ng/g wet wt |
| Fluorotelomer Sulfonate, 8:2- | 8:2 fluorotelomersulfonate (8:2 FTS) | 1.6 ng/g wet wt |
| Methyl Perfluorooctane Sulfonamido Acetic Acid, N- | N-Methylperfluorooctanesulfonamido acetic acid (N-MeFOSAA) | 0.4 ng/g wet wt |
| Ethyl Perfluorooctane Sulfonamido Acetic Acid, N- | N-Ethylperfluorooctanesulfonamidoacetic acid (N-EtFOSAA) | 0.4 ng/g wet wt |
| Perfluorooctanesulfonamide | Perfluorooctanesulfonamide (PFOSA), a.k.a FOSA | 0.4 ng/g wet wt |
| Methyl-perfluorooctanesulfonamide, N- | N-Methylperfluorooctanesulfonamide (N-MeFOSA) | 0.4 ng/g wet wt |

| SWAMP/CEDEN Analyte Name | Laboratory Analyte Name | Laboratory RL |
|---|---|---|
| Ethyl-perfluorooctanesulfonamide, N- | N-Ethylperfluorooctanesulfonamide (N-EtFOSA) | 0.4 ng/g wet wt |
| Methyl-perfluorooctanesulfonamido ethanol, N- | N-Methylperfluorooctanesulfonamido ethanol (N-MeFOSE) | 11.0 ng/g wet wt |
| Ethyl-perfluorooctanesulfonamido ethanol, N- | N-Ethylperfluorooctanesulfonamidoethanol (N-EtFOSE) | 4.0 ng/g wet wt |
| Perfluoro-2-Propoxypropanoic Acid | Perfluoro-2-propoxypropanoate (HFPO-DA) | 1.6 ng/g wet wt |
| Dioxa-3H-Perfluorononanoate Acid, 4,8- | 4-dioxa-3H-perfluorononanoate (ADONA) | 1.6 ng/g wet wt |
| Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9- | 9-chlorohexadecafluoro-3-oxanonane-1-sulfonate (9Cl-PF3ONS) | 1.6 ng/g wet wt |
| Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11- | 11-chloroeicosafluoro-3-oxaundecane-1-sulfonate (11Cl-PF3OUdS) | 1.6 ng/g wet wt |
| Fluorotelomer Carboxylic Acid, 3:3- | 3:3 perfluorohexanoic acid (3:3 FTCA) | 1.6 ng/g wet wt |
| Fluorotelomer Carboxylic Acid, 5:3- | 5:3 perfluorooctanoic acid (5:3 FTCA) | 10.0 ng/g wet wt |
| Fluorotelomer Carboxylic Acid, 7:3- | 7:3 perfluorodecanoic acid (7:3 FTCA) | 10.0 ng/g wet wt |
| Perfluoro(2-ethoxyethane)sulfonic Acid | Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA) | 0.4 ng/g wet wt |
| Perfluoro-4-methoxybutanoate | Perfluoro-4-methoxybutanoate (PFMBA) | 0.4 ng/g wet wt |
| Perfluoro-3-methoxypropanoate | Perfluoro-3-methoxypropanoate (PFMPA) | 0.8 ng/g wet wt |
| Perfluoro-3,6-dioxaheptanoate | Perfluoro-3,6-dioxaheptanoate (NFDHA) | 0.8 ng/g wet wt |

## B.5 Quality Control Requirements

MPSL and SGS-Axys conduct quality control through several activities and methods. These methods of quality control are performed to identify possible contamination problem(s), matrix interference and the ability to duplicate/repeat results. The results of quality control sample analyses are compared to the Program MQOs to ensure compliance, given in Table 10 and Table 11. Additional minimum quality control requirements are given in Table 21 and Table 22. If the method being used specifies

more stringent requirements, the method requirements must be followed. For synthetic organic compounds, all detected analytes must be confirmed with a second column, second technique, or mass spectrometry. For definitions of all quality control terms, please see the SWAMP QAPrP.

### Method Blanks

The acceptance criterion for method blank analysis is that the blanks must be less than the Reporting Limit (<RL) for target analytes. If blank values exceed the RL, the sources of the contamination must be determined and corrected, and the previous samples associated with the blank must be re-analyzed. All blank analysis results will be reported. If it is not possible to eliminate the contamination source, all impacted analytes in the analytical batch will be qualified. In addition, a detailed description of the contamination sources and the steps taken to eliminate/minimize the contaminants shall be included in data reports.

### Surrogates

Surrogate recoveries for each sample will be reported with the target analyte data for organics methods that are not isotope dilution methods. The surrogate is considered acceptable if the percent recovery is within method acceptance criteria.

### Mercury and Selenium Analyses

ASTM Type II water and analytical grade chemicals will be used for all standard preparations. A continuing calibration verification (CCV) will be performed after every 10 samples. Initial and continuing calibration verification values must be within ±20% of the true value, or the previous 10 samples must be reanalyzed. For mercury analyses, three blanks, a CRM (DORM-5 or similar), a method duplicate, and an MS pair will be run with each analytical batch of samples. For selenium analyses, two blanks, a certified reference material (NIST 2976, NRCC DORM-5 or similar), as well as a method duplicate, and an MS pair will be run with each set of samples.

**Table 21. Quality Control Requirements - inorganic analytes in tissue**

(Applicable to mercury and selenium)

| Laboratory Quality Control | Frequency of Analysis | Measurement Quality Objective |
|---|---|---|
| Calibration Standard | Per analytical method or manufacturer's specifications | Per analytical method or manufacturer's specifications |
| Continuing Calibration Verification | Per 10 analytical runs | 80-120% recovery |
| Internal Standard | Accompanying every analytical run when method appropriate | 60-125% recovery |
| Laboratory Blank | Per 20 samples or per batch, whichever is more frequent | <RL for target analyte |
| Certified Reference Material | Per 20 samples or per batch, whichever is more frequent | 75-125% recovery |
| Matrix Spike | Per 20 samples or per batch, whichever is more frequent | 75-125% recovery |
| Matrix Spike Duplicate | Per 20 samples or per batch, whichever is more frequent | 75-125% recovery, RPD ≤25% |
| Laboratory Duplicate | Per 20 samples or per batch, whichever is more frequent | RPD <25%; not applicable if concentration of either sample <RL |

**Table 22. Quality Control Requirements - synthetic organic compounds in tissue (Applicable to PCBs, pesticides, PBDEs, dioxins, PFAS)**

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

| Laboratory Quality Control | Frequency of Analysis | Measurement Quality Objective |
|---|---|---|
| Matrix Spike Duplicate[2] | Per 20 samples or per analytical batch, whichever is more frequent. Not required for isotope dilution methods. | 50-150% or based on historical laboratory control limits (average±3SD); RPD<25% |
| Laboratory Duplicate | Only required for isotope dilution methods: Per 20 samples or per analytical batch, whichever is more frequent. | RPD <25% (not applicable if native concentration of either sample <RL) |
| Surrogate | Included in all samples and all quality control samples. Not required for isotope dilution methods. | Based on historical laboratory control limits (50-150% or better) |
| Isotope Dilution Analogues | For isotope dilution methods only: Included in all samples and all quality control samples. | Based on historical laboratory control limits (50-150% or better) |

[1] Only required for mass spectrometry
[2] MS/MSD are generally not required for isotope dilution methods because any matrix effects should be evident in the IDA recoveries. However, if the method quantifies specific compounds using a nonanalogous isotopically labeled compound, the analysis of matrix spike samples may help diagnose matrix interferences for these specific compounds.

**Table 23. SGS-AXYS Laboratory Acceptance Criteria for Synthetic Organic Compounds**

| Analyte Group | Calibration Standard | Laboratory Blank |
|---|---|---|
| PCBs | For 6- or 7-point calibration, a relative standard deviation of the relative response factors (RRFs) ≤20% for all compounds.<br>Ion ratios for all congeners must be within ±15% of theoretical for CS-0.5.<br>Minimum S:N ratio 10:1 for all calibration standards. For CS-0.5, S:N ratio may be as low as 3:1 for di-PCBs and nona-PCBs. | Congeners 77, 81, 114, 123, 126, 169: 2 pg/sample<br>Congeners 156, 157, 167 and 189: 10 pg/sample<br>Congener PCB 11: 150 pg/sample<br>All other congeners: 50 pg/sample<br>**Total PCBs (sum of 209 congeners)**<br>1100 pg/sample<br>Higher levels are acceptable where sample concentrations exceed 10 times the blank levels. |
| Pesticides | For opening and closing Cal Vers concentrations of native compounds must be within ±20% of expected values for targets with a labeled analog present, and within ±35% for targets with no labeled analog present.<br>For opening Cal Vers concentrations of labeled compounds must be within ±35% of expected values. | Acceptance criteria are analyte specific. Allowable limits are between 1 ng/sample and 0.1 ng/sample or <10% of analyte value. |

## B.6 Instrument/Equipment Testing, Calibration, Inspection, and Maintenance

Field equipment such as boats, nets, traps, etc., are inspected prior to each sampling event and are maintained throughout the field season and prior to storage during the off-season.

Laboratory instruments are inspected and maintained in accordance with lab SOPs, which include those specified by the manufacturer and those specified by the method

(Table 24). These SOPs have been reviewed by each respective LQAO and found to be in compliance with SWAMP criteria. Analysts are responsible for equipment testing, inspection, and maintenance. Appendices III and IV list the referenced SOPs. SGS-Axys and MPSL SOPs are available upon request, see contact information in Table 1.

Electronic laboratory equipment usually has recommended maintenance prescribed by the manufacturer. These instructions will be followed as a minimum requirement. Due to the cost of some laboratory equipment, back up capability may not be possible. But all commonly replaced parts will have spares available for rapid maintenance of failed equipment. Such parts include, but are not limited to batteries, tubes, light bulbs, tubing of all kinds, replacement specific ion electrodes, electrical conduits, glassware, pumps, etc.

The lead chemist, or designee, is responsible for the testing, inspection, and maintenance of equipment. Each instrument has its own logbook where the results of tests, inspections, maintenance and repairs are documented. When an instrument's test results fail to meet accuracy and/or precision criteria after the lead chemist has performed maintenance, the manufacturer will be contacted.

**Instrument/Equipment Calibration and Frequency**

Laboratory instruments (listed in Table 24) are calibrated, standardized and maintained according to procedures detailed in the laboratory Quality Assurance Manuals. Instrument manuals identify step-by-step calibration and maintenance procedures. If analytical instrumentation fails to meet performance requirements, the instrument(s) will be checked according to their respective manuals or SOP(s) and recalibrated. If the instrument(s) still does not meet specifications, it will be repaired and retested until performance criteria are achieved. The maintenance will be entered in the instrument log. If sample analytical information is in question due to instrument performance, the PM will be contacted regarding the proper course of action including reanalyzing the sample(s).

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

Upon initiation of an analytical run, after each major equipment disruption, and whenever on-going calibration checks do not meet recommended MQOs, the system will be calibrated with a full range of analytical standards. Immediately after this procedure, the initial calibration must be verified through the analysis of a standard obtained from a different source than the standards used to calibrate the instrumentation, prepared in an independent manner, and ideally having certified concentrations of target analytes of a CRM or certified solution. Frequently, calibration

standards (CCVs) are included as part of an analytical run, interspersed with actual samples. However, this practice does not document the stability of the calibration and is incapable of detecting degradation of individual components, particularly pesticides, in standard solutions used to calibrate the instrument. The calibration curve is acceptable if it has an $R^2$ of 0.990 or greater for all analytes present in the calibration mixtures. If not, the calibration standards, as well as all the samples in the batch are re-analyzed. All calibration standards will be traceable to a recognized organization for the preparation and certification of QC materials (e.g., National Institute of Standards and Technology [NIST], National Research Council Canada [NRCC], US EPA, etc.).

Calibration curves will be established for each analyte and batch analysis from a calibration blank and a minimum of three analytical standards of increasing concentration, covering the range of expected sample concentrations. Only data which result from quantification within the demonstrated working calibration range may be reported (i.e., quantification based on extrapolation is not acceptable). Alternatively, if the instrumentation is linear over the concentration ranges to be measured in the samples, the use of a calibration blank and one single standard that is higher in concentration than the samples may be appropriate. Samples outside the calibration range will be diluted or concentrated, as appropriate, and reanalyzed.

**Table 24. Equipment maintenance and calibration frequency**

| Instrument | Inspection/Maintenance Frequency | Calibration Frequency |
|---|---|---|
| Milestone DMA-80 Direct Mercury Analyzer (MPSL) | As needed | At least once every 2 weeks |
| Perkin-Elmer NexION 1000 Inductively Coupled Plasma - Mass Spectrometer (MPSL) | As needed | At least once daily |
| Micromass Ultima high resolution mass spectrometer equipped with an HP 6890 gas chromatograph using an SPB-Octyl column (30 m, 0.25 mm I.D., 0.25 µm film thickness | As needed | If the 12-hour calibration verification test does not meet specification and this cannot be corrected by performing Minor Instrumental Maintenance Procedures. |

| Instrument | Inspection/Maintenance Frequency | Calibration Frequency |
|---|---|---|
| Micromass Ultima high resolution mass spectrometer equipped with an HP 6890 gas chromatograph using a DB-5 column (60 m, 0.25 mm i.d., 0.10 µm film thickness) | As needed | If the 12-hour calibration verification test does not meet specification and this cannot be corrected by performing Minor Instrumental Maintenance Procedures.<br><br>After all Major Instrumental Maintenance Procedures.<br><br>If more than 180 days have elapsed since the last verified Initial Calibration |

Calibration verification solutions traceable to a recognized organization are inserted as part of the sample stream. The sources of the calibration verification solutions are independent from the standards used for the calibration. Calibration verification solutions used for the CCV will contain all the analytes of interest. The frequency of these verifications is dependent on the type of instrumentation used and, therefore, requires considerable professional judgment. The required frequencies for this project are listed in Tables 10-11. All analyses are bracketed by acceptable calibration verification; all samples not bracketed by an in control CCV should be reanalyzed. If the control limits for analysis of the calibration verification solution are not met, the initial calibration will be repeated. All samples analyzed before the calibration verification solution that failed the MQOs will be reanalyzed following the recalibration. Only the re-analysis results will be reported. If it is not possible or feasible to perform reanalysis of samples, all earlier data (i.e., since the last successful calibration control verification) are suspect. In this case, the LQAO will contact the PM to determine proceedings, and will flag the data and note the issue in interim and final reports.

**Inspection/Acceptance of Supplies and Consumables**

All supplies will be examined for damage as they are received. Laboratory ordering personnel will review all supplies as they arrive to ensure the shipment is complete and intact. All chemicals are logged in to the appropriate logbook and dated upon receipt. All supplies are stored appropriately and are discarded upon expiration date. Table 25 indicates items that are considered for accuracy, precision, and contamination. If these

items are not found to be in compliance with the acceptance criteria, they will be returned to the manufacturer.

**Table 25. Inspection/acceptance testing requirements for consumables and supplies**

| Project-Related Supplies (source) | Inspection / Testing Specifications | Acceptance Criteria | Frequency | Responsible Individual |
|---|---|---|---|---|
| Nitrile Gloves (Fisher Scientific or similar) | Carton seal is visually inspected for damage or tampering | Carton is intact and gloves within are clean and intact | At receipt date of shipment | MSPL or SGS-Axys personnel |
| Polyethylene Gloves (Fisher Scientific or similar) | Carton seal is visually inspected for damage or tampering | Carton is intact and gloves within are clean and intact | At receipt date of shipment | MSPL or SGS-Axys personnel |
| Polyethylene Jars (Nalgene or similar) | Carton seal is visually inspected for damage or tampering | Carton is intact and gloves within are clean and intact | At receipt date of shipment | MSPL or SGS-Axys personnel |
| Glass Jars (IChem, Qorpak or similar) | Carton seal is visually inspected for damage or tampering | Carton is intact and gloves within are clean and intact | At receipt date of shipment | MSPL or SGS-Axys personnel |
| Analytical Standards (Perkin-Elmer, VWR, Fisher Scientific or similar) | Solution bottles are inspected to verify factory seal | Manufacturer's seal intact | At receipt date of shipment | MSPL or SGS-Axys personnel |
| Certified Reference Materials (NIST, NRCC or similar) | Bottles are inspected to verify factory seal | Manufacturer's seal intact | At receipt date of shipment | MSPL or SGS-Axys personnel |

## B.7 Data Management

### Field Observations and Measurements

Field data will be collected and documented on field data sheets and entered into a SWAMP shell database version 2.5 upon return to the laboratory. Field crews will check the entered data for typos and errors before the Laboratory QAO and PM verify the data to ensure proper flagging for equipment failures and impossible values. When field data have been entered into the SWAMP shell database, then the PM uploads it to the SWAMP FTP site where the data contained therein are automatically transferred to the SWAMP Database. Original field sheets will be retained in a logbook, and copies of the COCs will be kept by each receiving laboratory.

### Laboratory Data

All data generated by SGS-Axys will be maintained as described in SGS-Axys SOP titled SAD-022 Record Management and the SGS-Axys Quality Assurance Manual titled QDO-001 QAQC Policies and Procedures. The Babcock QAO will be responsible for oversight of the collection of all organic chemical analysis data and submission of verified data to SWAMP IQ.

Likewise, all MPSL data will be generated and maintained according to the Marine Pollution Studies Laboratory Quality Manual (2022). The MPSL QAO will be responsible for oversight of the collection of all dissection and metals analysis data and submission of verified data to SWAMP IQ.

All data collected will be entered into electronic spreadsheets that are SWAMP compatible. Each data element is checked at a minimum by the technician that entered the data and verified by the technician's signature on the data sheet. Tissue data will be submitted to SWAMP IQ in Microsoft Excel spreadsheets through the SWAMP online data checker. Data will be reviewed by the submitter to ensure they are consistent with the format of the database and other data records.

All raw and statistical analysis data are subject to a 100% check for accuracy by the PM, LQAOs, and SWAMP IQ. The SWAMP IQ Data Quality Managers will review the data for accuracy, and then verify and validate the data against the QAPP, MQOs and contract requirements before loading the data to the SWAMP database. SWAMP IQ Data Quality Managers contact the submitting laboratory if there are any questions or issues with submitted EDDs to resolve during the data verification process. Completeness of the data will be tracked through the SWAMP Database version 2.5.

Original hard copies of the data are filed in a secure cabinet until requested by the PM and/or inclusion into the Final Report. Electronic copies are stored and backed up by each analyst and respective laboratory internal project manager. SWAMP IQ stores EDDs as they were originally received and a separate copy if any modifications were made prior to loading to the database. EDDs are stored on the Water Boards shared network drive.

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

Validated data are made available to users via the SWRCB CEDEN Advanced Query Tool, the California Open Data Portal, and the Safe to Eat Portal.

## Group C: Assessment and Oversight

### C. 1 Assessments and Response Actions

#### Audits

All reviews of QA data will be made by the LQAO prior to submission of each batch to the PM and SWAMP IQ. Reviews of the sampling procedures will be made by the Field Collection Coordinator and the Project Coordinator in case problems occur. As SOPs are updated and refined, additional reviews will be made. When SOPs are updated, it will be documented in a QAPP Amendment signed by the SWAMP QAO. Each data technician is responsible for flagging all data that does not meet established QA/QC criteria.

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

Assessments by the LQAO will be oral; if no discrepancies are noted and corrective action is not required, additional records are not required. If discrepancies are observed, the details of the discrepancy and any corrective action will be reported and appended to the report.

All assessments will be conducted as data is received by the LQAO in accordance with the timeline in Table 5.

#### Deviations and Corrective Actions

##### *Field*

In the event field samples cannot be collected, the Sample Collection Coordinator will determine if corrective actions are appropriate. Table 26 describes action to take in the event of a collection failure. In the event field documentation is incomplete, datasheets will be returned to the collection crew for amendment.

**Table 26. Field collection corrective actions**

| Collection Failure | Corrective Action |
|---|---|
| Target Species not present | Collect secondary target; it is advisable to consult with OEHHA prior to choosing secondary target species; document the occurrence. |
| No Fish present | Inform PM and move on to another location; document the occurrence; PM and Lead Scientist may replace with next waterbody or station on the alternate list. |
| Waterbody not able to be sampled | Replace with the next waterbody or station on the alternate list. |

***Laboratory***

Analyses are conducted according to procedures and conditions recommended by the US EPA and described in laboratory SOPs, except for those reported herein. Beyond those identified, deviations from these recommended conditions are reported to the LQAO. It is the responsibility of each laboratory analyst to take corrective action upon instrument failure. When control limits are exceeded the LQAO will review with appropriate laboratory staff to ascertain the possible cause of the exceedance. A review of SOPs will be conducted, and any deficiencies will be identified, documented, and corrected. Corrective action will be conducted according to manufacturer, method specifications, or SWAMP specifications (see SWAMP MQO documents). The PM and Program QAO will be notified within 48 hours of these deviations.

In the event of a SOP/QAPP deviation, a Corrective and Preventative Action Report will be prepared, completed, signed and the PM and Program QAO notified. Best professional judgment will be used in interpretation of results obtained when deviations in the test conditions have occurred and appropriate data qualifiers must be used, if necessary. All deviations and associated interpretations will be reported in interim and final reports. Protocol amendments will be submitted to the LQAO, Program QAO and PM. Upon approval, protocol amendments will be employed.

In the event laboratory documentation is incomplete, datasheets will be returned to the dissector for amendment. Occasionally digestates or extracts are rendered unusable for various reasons in the preparation process. If this occurs, the sample(s) affected will be re-processed if there is sufficient tissue to re-digest or re-extract.

## C.2 Reports to Management

Each LD, or designee, shall regularly brief the LS and PM on the progress of all on-going chemical analyses in emails or conference calls. When deemed necessary for decision making, other STEW participants will also be notified of progress.

The LS will provide regular updates to the Program Coordinator, State Water Board Management, and the Region 9 US EPA representative, usually during SWAMP Round Table meetings, other meetings, or providing Technical Memos, when requested. In

addition, when interpretative data reports are planned, a Draft and Final Data Report will be distributed to the Scientific Review Panel, STEW Members, the Program Coordinator, State Water Board Management and Region 9 US EPA representative for comment. The Final Data Report, once agreed upon by all participants, will be made available to the public by inclusion on the State Board website. These documents will be generated and released in accordance with the dates listed in Table 5.

The following documents, records, and electronic files will be produced:

- Quarterly Progress Reports (oral format to CM)
- Draft Data Report (produced in electronic format)
- Final Data Report (in electronic format)
- Data Appendix (submitted to Program Coordinator and CM electronic spreadsheet formats)
- Corrective Action Reports (submitted to Program QAO in electronic format upon request)

The Final Data Report will include summary data tables and an appendix that contains all project data in electronic SWAMP compatible spreadsheet format.

## Group D: Data Validation and Usability

### D.1 Data Review, Verification and Validation Requirements

#### Primary Verification

All data reported for this project will be checked for errors in transcription, calculation and computer input by the laboratory internal project manager and/or LQAO. Additionally, the LQAO will review sample logs and data forms to ensure that requirements for sample preservation, sample integrity, equipment calibration, and data quality have been met. At the discretion of the LD, data that do not meet these requirements will either not be reported or will be reported with qualifiers which serve as an explanation of any necessary considerations.

#### Secondary Verification

Because this Program is a statewide SWAMP monitoring program, all project data are required to go through the secondary verification process performed by SWAMP IQ Data Quality Managers, as described in the SWAMP QAPrP. For secondary data verification, SWAMP IQ Data Managers verify that submitted data are in the correct format, use standardized vocabulary, follow the SWAMP business rules, adhere to the MQOs, and are appropriately qualified prior to loading the data to the SWAMP database.

## D.2 Verification and Validation Methods

Field Data will be submitted electronically to the SWAMP database using either SWAMP field data templates or data entry shell databases. Field crews, after data entry, will check 100% of the data entered for typos and errors to ensure proper flagging for equipment failures and impossible values. Discrepancies will be communicated to the PM and field crew coordinator before finalizing the records.

Laboratory data will be reported electronically to SWAMP IQ for verification, validation, and inclusion in the SWAMP Database version 2.5, or current version. SWAMP IQ will follow the SWAMP SOPs when reviewing submitted data and determining compliance with the applicable MQOs. Discrepancies in laboratory data flagging noted during data verification will be communicated to the Program QAO, LQAO and PM prior to loading. Excessive amounts of data discrepancies may warrant corrective action, as described in section C.1.

Program data undergo a further step of validation to determine usability of the data prior to assessment for human health concerns or 303(d) listing. It is particularly important to identify and remove data that may be unduly influenced by analytical blank contamination, poor accuracy or poor precision based on the data quality indicators as compared with the MQOs following Program Data Validation Standard Operating Procedures. All tissue data will be validated according to the Program Data Validation SOP, which contains the complete descriptions and validation steps, as well as examples of potential QC failures.

Validated data are made available to users via the SWRCB CEDEN Advanced Query Tool.

## D.3 Reconciliation with User Requirements

Data will be reported in the SWAMP Database and will be publicly available via CEDEN. Data that do not meet the MQOs in Tables 10-11 will be flagged accordingly as discussed in Section D.2. Rejected data will not be included in data analyses, while data flagged as qualified will be evaluated for inclusion on a case-by-case basis in conjunction with the associated QA data and program objectives.

PCBs will be summed for comparison with threshold values in Tables 7 and 8. It is possible that some of the parameters that comprise each summation may be flagged as rejected through the Validation process. When this occurs, the rejected results will not be included in the summation used for comparison. However, the difference between summations with and without rejected values will be compared to each other. If the rejected values comprise more than 30% of the total sum for a sample, and the concentration prior to censoring was above the threshold levels in Tables 7 and 8, then the sample will be designated for reanalysis. Samples with censoring of more than 30% but with uncensored sums below the threshold level will not be designated for reanalysis. Over the history of this project, the list of PCBs analyzed and resolved (vs. co-eluted) has changed, however, the differences in sums of PCB congeners over time

due to variation in the congener list are relatively minor. When this affects interpretation of the data, it will be explicitly discussed in interpretive reports.

The project needs sufficient data, as represented by the completeness objective, to address the management questions laid out in this QAPP. A failure to achieve the number of data points cited could mean an inability to answer these questions.

All management questions will be assessed by the LS, with input as needed from STEW.

For Lakes and Reservoirs, management question 1 will be assessed by comparing the concentrations of the length-adjusted means for individual black bass and lake-wide composites, as well as any location composites analyzed, to the STEW-adopted thresholds listed in Tables 6-8. Management question 2 will be assessed by establishing time series of representative, average statewide concentrations. These time series will be assessed for a) decreases, increases, or no changes in mercury concentration in fish and b) factors that appear to be driving changes (if any) in mercury concentration in fish.

For Coastal Waters, management question 1 will be assessed by comparing the average concentrations of representative fish species in popular fishing locations to the thresholds listed in Tables 6-8. Management question 2 will be assessed by comparing average concentrations of fish species within zones. More in-depth statistical analyses may be made in zones with replicate observations. The Coastal Water management question 3 will be assessed by comparing average concentrations measured in this cycle to those from the previous cycle and other projects with data of high level of known quality. Management question 4 will be assessed by OEHHA to determine if further sampling is needed to minimize data gaps related to advisories.

For Rivers and Streams, the concentrations from all length-adjusted means for individual black bass and composites will be compared with the thresholds in Tables 6-8 to address management question 1. To answer management question 2, the analytical results will be compared to the thresholds (Tables 6-8). For each analyte the percent of locations that have fish that exceeded the threshold will be calculated.

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