Quality Assurance Program Plan
for
The Regional Monitoring Program for Water Quality in San Francisco Bay

Prepared by
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A. **PROJECT MANAGEMENT**

Element 1 ***Title and Approval***

For

PROJECT NAME: Regional Monitoring Program for Water Quality in San Francisco Bay

Date: 12/16/19

NAME OF RESPONSIBLE ORGANIZATION : San Francisco Estuary Institute (SFEI)

APPROVAL SIGNATURES

Title:	Name:	Signature:	Signature Date:
SFEI Project Manager	Melissa Foley		
SFEI Lead Scientist	Jay Davis		
SFEI QA Officer	Don Yee		
SFEI Data Manager	Amy Franz		

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Element 4 ***Program Task/Organization***

4.1 Involved Parties and Roles

The Regional Monitoring Program for Water Quality in San Francisco Bay (RMP) is managed and operated by the San Francisco Estuary Institute (SFEI). SFEI was founded as a non-profit organization in 1986 to foster the development of the scientific understanding needed to protect and enhance the San Francisco Estuary. The governing body of SFEI is a Board of Directors composed of Bay Area scientists, environmentalists, regulators, local governments, and industries.

Melissa Foley is the RMP Project Manager. She will be responsible for all aspects of monitoring components of this project including the organization of field staff, scheduling of sampling days, management of the SFEI in-house analysis, and interactions with the contract laboratories.

Amy Franz is the SFEI Regional Data Center Manager. She will ensure that data submitted by subcontractor labs are timely, complete, and properly incorporated into the Regional Data Center database.

Don Yee is SFEI's Quality Assurance Officer (QAO). His role is to establish and oversee the quality assurance and quality control (QA/QC) procedures found in this QAPP, which include field and laboratory activities. The SFEI QAO will work with the Quality Assurance Officers for contracted analytical laboratories, reviewing and communicating all QA/QC issues contained in this QAPP to the laboratories. Contact information for laboratory staff is listed above.

SFEI contracts with a number of laboratories that provide high quality analytical services. Qualifications for our labs generally include ISO (International Organization for Standardization) registration, National Environmental Laboratory Accreditation Program (NELAP) accreditation, and/or ELAP certification by the California Department of Public Health. Table 4-1 lists the laboratories that will provide analytical services for this version of the QAPP. The analytical laboratories will act as a technical resource to SFEI staff and management. The responsible personnel and contact information are listed in Element 3.

4.2 Quality Assurance Officer Role

The SFEI QAO shall not be directly involved in generation of any laboratory or field data and will review and assess all data acquisition procedures against QAPP requirements, reporting all findings and requests for corrective action to the Project Manager. The QAO may stop all actions, including those conducted by field staff or contract laboratories, if there are significant deviations from required practices or if there is evidence of a systematic failure.

4.3 Persons Responsible for QAPP Update and Maintenance

Changes and updates to this QAPP may be made after a review of the evidence for change by SFEI's Project Manager and QAO, and with the concurrence on major changes by the RMP Technical Review Committee. SFEI's QAO will be responsible for making the changes, submitting drafts for review, preparing a final copy, and submitting the final for signature.

Table 1 Analytical Laboratories and Services for 2019 Projects

Analytical laboratory	Lab abbrev.	Matrix	Analytical Services
ALS Laboratory Group	ALS	Bay and Tributary Water, Stormwater	DOC, POC, TOC
Applied Marine Sciences, Inc.	AMS-CA	Bay and Tributary Water	Cruise logistics, field measurements
SGS AXYS Analytical Services Ltd.	SGS AXYS	Sport Fish	Dioxins, PBDEs, PCBs, Perfluoranates, % lipids, % moisture
		Stormwater	PCBs
Brooks Applied Labs	BA	Stormwater	Mercury
		Bay and Tributary Water, Sport Fish	Copper, Methyl Mercury, Selenium, Cyanide, Hardness, SSC, % moisture
Marine Pollution Studies Laboratory-DFW	MPSL-DFW	Sport Fish	Mercury, % moisture
Marine Pollution Studies Laboratory-MLML	MPSL-MLML	Sport Fish	Sample Collection
Pacific EcoRisk	PER	Bay and Tributary Water	Toxicity
US Geological Survey - Clean Water Science Center	USCS-CWSC	Stormwater	Grainsize, SSC

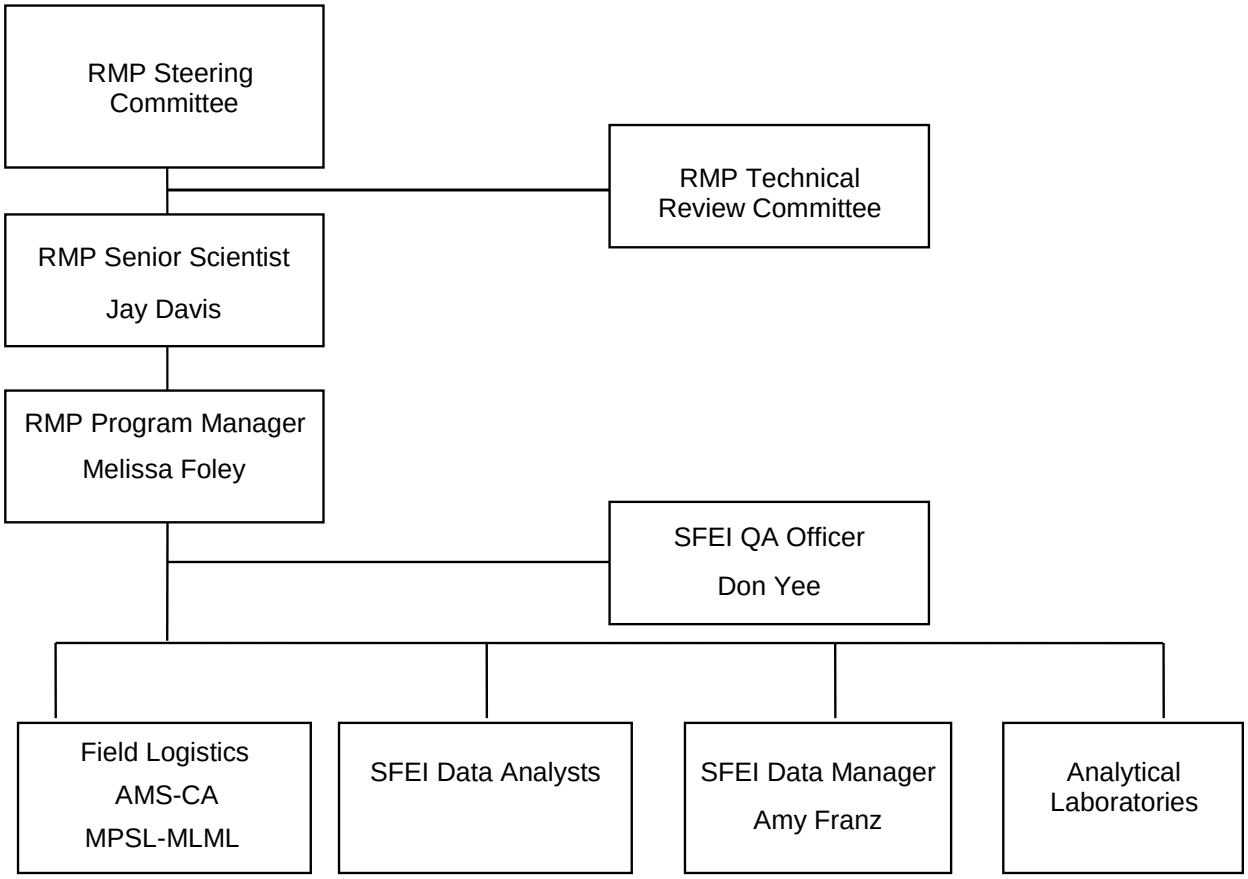

Figure 1 Organizational Chart and Responsibilities

Element 5 ***Problem Definition/Background***

5.1 Problem Statement

The Regional Monitoring Program for Water Quality in San Francisco Bay (RMP) was created to provide long-term monitoring information on ecosystem health in the Bay. The impetus for the program development was a resolution by the San Francisco Bay Regional Water Board to require dischargers in the Bay Area regulated under the National Pollution Discharge Elimination System (NPDES) program to participate in regional monitoring. Contribution to the Program constitutes compliance with the requirement to participate. Elimination of certain permit requirements for individual permits offset the requirement for continued participation.

The RMP began as a pilot study in 1989 and has been collecting water, sediment, and biological tissue data since 1993. The Status and Trends component of the RMP routinely collects monitoring data on these environmental matrices. The San Francisco Bay Regional Water Quality Control Board (Water Board) uses Status and Trends data to assist in regulatory decision-making, such as for determining impairment (303(d)) listing, NPDES permit conditions, and estimating Total Maximum Daily Loads (TMDL) of various pollutants needed to protect ecosystem and human health. The data are also useful for monitoring and modeling the effectiveness of past and planned management actions.

The overarching goal of the program is to collect data and communicate information about water quality in San Francisco Bay to support management decisions. The RMP, in consultation with its stakeholders, the Technical Review Committee, and the Steering Committee refined the management questions in May 2008.

1. Are chemical concentrations in the Bay at levels of potential concern and are associated impacts likely?
    a. Which chemicals have the potential to impact humans and aquatic life and should be monitored?
    b. What potential for impacts on humans and aquatic life exists due to contaminants in the Bay ecosystem?
    c. What are appropriate guidelines for protection of beneficial uses?
    d. What contaminants are responsible for observed toxic responses?
2. What are the concentrations and masses of contaminants in the Bay and its segments?
    a. Do spatial patterns and long-term trends indicate particular regions of concern?
3. What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Bay?
    a. Which sources, pathways, and processes contribute most to impacts?
    b. What are the best opportunities for management intervention for the most important contaminant sources, pathways, and processes?
    c. What are the effects of management actions on loads from the most important sources, pathways, and processes?
4. Have the concentrations, masses, and associated impacts of contaminants in the Bay increased or decreased?
    a. What are the effects of management actions on the concentrations and mass of contaminants in the Bay?
    b. What are the effects of management actions on the potential for adverse impacts on humans and aquatic life due to Bay contamination?

5. What are the projected concentrations, masses, and associated impacts of contaminants in the Bay?
    a. What patterns of exposure are forecast for major segments of the Bay under various management scenarios?
    b. Which contaminants are predicted to increase and potentially cause impacts in the Bay?

5.2 Decisions and Outcomes

The primary focus of the RMP is to provide information to assist the San Francisco Bay Regional Water Quality Control Board (RWQCB) and other regional stakeholders in developing plans to address potential contaminant risks in the Bay, e.g., via a TMDL determination. An improved understanding of the status, trends, loadings, and fate of contaminants in the Bay allows regional stakeholders to develop appropriate, effective, and efficient management plans. Data from these studies are made publicly available for scientific research, environmental management purposes, and public awareness.

5.3 Water Quality or Regulatory Criteria

California's water quality standards are established in (regional) Basin Plans or statewide plans. The Basin Plan for San Francisco Bay was first completed in 1975 and has been revised at least once a decade since then to reflect changing conditions as well as updated understanding of those conditions in the Bay. The water quality standards include both numeric and narrative water quality objectives (WQOs), which are usually based on federal water quality criteria. The most recent Basin Plan includes the most up-to-date WQOs.

Table 5-1 shows the sources of the WQOs in the San Francisco Bay Basin Plan for contaminants with numeric objectives as of May 4, 2017. The WQOs can differ in freshwater and marine water, defined in the Basin Plan as follows: freshwaters are those in which the salinity is equal to or less than 1 part per thousand 95% of the time, and marine waters are those in which the salinity is equal to or greater than 10 parts per thousand 95% of the time (San Francisco Bay RWQCB 2013). The stricter of the two WQOs applies for waters where the salinity falls between these definitions. The WQOs for contaminants listed in Table 5-1 apply throughout the region, except when site-specific objectives have been adopted. Site-specific objectives have been adopted for copper in all segments of San Francisco Bay, for nickel in South San Francisco Bay, and for cyanide in all San Francisco Bay segments.

Additionally, objectives for mercury, selenium, and PCBs in fish apply to San Francisco Bay (Table 5-4). The mercury objective for fish tissue only applies to marine waters. Compliance with the human health quality objective for mercury in San Francisco Bay is evaluated in the five most commonly consumed fish species. The mercury concentration in the edible portion of these five species is averaged and compared to the human health water quality objective. The selenium numeric target (also referred to as the TMDL Target) in fish applies to the North San Francisco Bay segments. The selenium numeric target is intended to ensure attainment of selenium water quality standards, including beneficial uses in the North Bay. The PCBs numeric target (also referred to as the TMDL Target) in fish applies to all segments of San Francisco Bay. The PCBs numeric target, which is intended to protect both human health and wildlife, is an average fish tissue concentration of 10 micrograms total PCBs per kilogram of typically consumed fish (on a wet weight basis). Attainment of the total PCBs fish tissue numeric target will also protect human health and wildlife for dioxin-like PCBs.

Table 2 Marine[a] Water Quality Objectives for San Francisco Bay (all values in ug/l)

Compound	4-day Average	1-hr Average	24-hr Average	Marine Waters WQO Source	Site-specific WQO in Bay?
Arsenic[b, c, d]	36	69		Basin Plan	No
Cadmium[b, c, d]	9.3	42		Basin Plan	No
Chromium III				-	No
Chromium VI[b, c, d, e]	50	1100		Basin Plan	No
Copper[c, d, f]				Basin Plan	Yes
Cyanide[g]				Basin Plan	Yes
Lead[b, c, d]	8.1	210		Basin Plan	No
Mercury[h]	0.025	2.1		Basin Plan	Yes*
Nickel[b, c, d]	8.2	74		Basin Plan	Yes
Selenium[i]				Basin Plan	Yes**
Silver[b, c, d]		1.9		Basin Plan	No
Zinc[b, c, d]	81	90		Basin Plan	No
PAHs[k]			15	Basin Plan	No
PCB[s]				Basin Plan	Yes

Source**:** San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) as of May 4, 2017**.**
https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/basinplan/web/docs/bp_ch3+tables.pdf

a. Marine waters are those in which the salinity is equal to or greater than 10 parts per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. Unless a site-specific objective has been adopted, these objectives shall apply to all marine waters except for the South Bay south of Dumbarton Bridge (where the California Toxics Rule (CTR) applies) or as specified in note h (below). For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the freshwater (Table 5-3) or marine objectives.

b. Source: 40 CFR Part 131.38 (California Toxics Rule or CTR), May 18, 2000.

c. These objectives for metals are expressed in terms of the dissolved fraction of the metal in the water column.

d. According to the CTR, these objectives are expressed as a function of the water-effect ratio (WER), which is a measure of the toxicity of a pollutant in site water divided by the same measure of the toxicity of the same pollutant in laboratory dilution water. The 1-hr and 4-day objectives = table value X WER. The table values assume a WER equal to one.

e. This objective may be met as total chromium.

f. Water quality objectives for copper were promulgated by the CTR and may be updated by U.S. EPA without amending the Basin Plan. Note: at the time of writing, the values are 3.1 µg/l (4-day average) and 4.8 µg/l (1-hr. average). The most recent version of the CTR should be consulted before applying these values.

g. Cyanide criteria were promulgated in the National Toxics Rule (NTR) (Note: at the time of writing, the values are 1.0 µg/l (4-day average) and 1.0 µg/l (1-hr average)) and apply, except that site-specific marine water quality objectives for cyanide have been adopted for San Francisco Bay as set forth in Table 5.2.

h. Source: U.S. EPA Ambient Water Quality Criteria for Mercury (1984). The 4-day average value for mercury does not apply to San Francisco Bay; instead, the water quality objectives specified in Table 3-3B apply. The 1-hour average value continues to apply to San Francisco Bay.

i. Selenium criteria were promulgated for all San Francisco Bay/Delta waters in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.0 µg/l (4-day average) and 20 µg/l (1-hr average).

j. Tributyltin is a compound used as an antifouling ingredient in marine paints and toxic to aquatic life in low concentrations. U.S. EPA has published draft criteria for protection of aquatic life (Federal Register: December 27, 2002, Vol. 67, No. 249, Page 79090-79091). These criteria are cited for advisory purposes. The draft criteria may be revised.

k. The 24-hour average aquatic life protection objective for total PAHs is retained from the 1995 Basin Plan. Source: U.S. EPA 1980.

*Site-specific WQO exists for tributaries to Bay, and Basin Plan. WQO is > EPA 1984 WQO

**Se TMDL for the North Bay was adopted in August 2016.

Table 3 Marine[a] Water Quality Objectives for Cyanide in San Francisco Bay[b] (values in µg/l)

Cyanide	Chronic Objective (4-day Average)	2.9
Cyanide	Acute Objective (1-hour Average)	9.4

Source: San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) as of May 4, 2017. https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/basinplan/web/docs/bp_ch3+tables.pdf

a. Marine waters are those in which the salinity is equal to or greater than 10 parts per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the freshwater or marine objectives.

b. Objectives apply to all segments of San Francisco Bay, including Sacramento/San Joaquin River Delta (within San Francisco Bay region), Suisun Bay, Carquinez Strait, San Pablo Bay, Central San Francisco Bay, Lower San Francisco Bay, and South San Francisco Bay.

Table 4 Freshwater[a] Water Quality Objectives for San Francisco Bay (all values in µg/l)

Compound	4-day Average	1-hr Average	Fresh Waters WQO Source	Site-specific WQO in Bay?
Arsenic[b, c, d]	150	340	**B**asin Plan	No
Cadmium[b, d]	e	e	Basin Plan	No
Chromium III[f]			Basin Plan	No
Chromium VI[b, c, d, g]	11	16	Basin Plan	No
Copper[b, c, d]	9.0[h]	13[h]	Basin Plan	Yes
Cyanide[i]			Basin Plan	Yes
Lead[b, c, d]	2.5[j]	65[j]	Basin Plan	No
Mercury[k]	0.025	2.4	Basin Plan	Yes*
Nickel[b, c, d]	52[l]	470[l]	Basin Plan	Yes
Selenium[m]			Basin Plan	Yes**
Silver[b, c, d]		3.4[n]	Basin Plan	No
Zinc[b, c, d]	120[p]	120[p]	Basin Plan	No

Source: San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) as of May 4, 2017. https://www.waterboards.ca.gov/sanfranciscobay/basin_planning.html

a. Freshwaters are those in which the salinity is equal to or less than 1 part per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. Unless a site-specific objective has been adopted, these objectives shall apply to all freshwaters except for the South Bay south of Dumbarton Bridge, where the California Toxics Rule (CTR) applies. For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the marine (Table 5-1) and freshwater objectives.

b. Source: 40 CFR Part 131.38 (California Toxics Rule or CTR), May 18, 2000.

c. These objectives for metals are expressed in terms of the dissolved fraction of the metal in the water column.

d. These objectives are expressed as a function of the water-effect ratio (WER), which is a measure of the toxicity of pollutant in site water divided by the same measure of the toxicity of the same pollutant in laboratory dilution water. The 1-hr and 4-day objectives = table value X WER. The table values assume a WER equal to one.

e. The objectives for cadmium and other noted metals are expressed by formulas where H = ln (hardness) as CaCO3 in mg/l: The four-day average objective for cadmium is e(0.7852 H - 3.490). This is 1.1 µg/l at a hardness of 100 mg/l as CaCO3. The one-hour average objective for cadmium is e(1.128 H - 3.828). This is 3.9 µg/l at a hardness of 100 mg/l as CaCO3.

f. Chromium III criteria were promulgated in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 180 ug/l (4-day average) and 550 ug/l (1-hr average). The objectives for chromium III are based on hardness. The values in this footnote assume a hardness of 100 mg/l CaCO3. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for chromium III is e(0.8190H+1.561). The 1-hour average for chromium III is e(0.8190 H+3.688).

g. This objective may be met as total chromium.

h. The objectives for copper are based on hardness. The table values assume a hardness of 100 mg/l CaCO3. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for copper is e(0.8545H-1.702). The 1-hour average for copper is e(0.9422H-1.700).

i. Cyanide criteria were promulgated in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.2 ug/l (4-day average) and 22 ug/l (1-hr average).

j. The objectives for lead are based on hardness. The table values assume a hardness of 100 mg/l CaCO3. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective is e(1.273H - 4.705). The 1-hour average for lead is e(1.273H-1.460).

k. Source: U.S. EPA Quality Criteria for Water 1986 (EPA 440/5-86-001), which established a mercury criterion of 0.012 µg/l. The Basin Plan set the objective at 0.025 based on considerations of the level of detection attainable at that time. The 4-day average value for mercury does not apply to Walker Creek and Soulajule Reservoir and their tributaries nor to waters of the Guadalupe River watershed; instead, the water quality objectives specified in Table 5-5 apply. The 1-hour average value continues to apply to waters specified in Table 5-5.

l. The objectives for nickel are based on hardness. The table values assume a hardness of 100 mg/l CaCO3. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective is e(0.8460H + 0.0584). The 1-hour average objective is e(0.8460H + 2.255).

m. Selenium criteria were promulgated for all San Francisco Bay/Delta waters in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.0 ug/l (4-day average) and 20 ug/l (1-hr average).

n. The objective for silver is based on hardness. The table value assumes a hardness of 100 mg/l CaCO3. At other hardnesses, the objective must be calculated using the following formula where H = ln (hardness): The 1-hour average objective for silver is e(1.72H – 6.52). U.S. EPA has not developed a 4-day criterion.

o. The objectives for zinc are based on hardness. The table values assume a hardness of 100 mg/l CaCO3. At other **hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for zinc is e(0.8473 H+0.884). The 1-hour average for zinc is e(0.8473 H+ 0.884).**

*Site-specific WQO exits for tributaries to Bay, and Basin Plan WQO is>EPA 1984 WQO

****Se TMDL for the North Bay was adopted in August 2016.**

Table 5 Objectives for Mercury, Selenium, and PCBs in fish

Compound	Aim	Objectives	Tissue	Species	Size class (length)
Hg	Protection of human health	0.2 mg mercury per kg fish tissue	Edible portion	trophic level 3 and trophic level 4 fish	Not Specified
Hg	Protection of aquatic organisms and wildlife	0.03 mg mercury per kg fish	Whole fish	Not specified	3 to 5 cm

Se	Protection of human health and wildlife	8 µg/g dry weight	Whole fish	Sturgeon	Not Specified
Se	Protection of human health and wildlife	11.3 µg/g dry weight	Edible portion	Sturgeon	Not Specified
PCBs	Protection of human health and wildlife	10 µg/kg wet weight	Edible portion	White croaker	20 to 30 cm
PCBs	Protection of human health and wildlife	10 µg/kg wet weight	Edible portion	Surfperch	10 to 15 cm

Source: San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) as of May 4, 2017
https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/basinplan/web/docs/BP_all_chapters.pdf

Table 6 Freshwater Water Quality Objectives for Mercury in Walker Creek, Soulajule Reservoir, and Their Tributaries; and in Waters of the Guadalupe River Watershed, Except Los Gatos Creek and its Tributaries Upstream of Vasona Dam, Lake Elsman, Lexington Reservoir, and Vasona Lake

Protection of Aquatic Organisms and Wildlife[a]	0.05 mg methylmercury per kg fish	Average wet weight concentration measured in whole trophic level 3 fish 5–15 cm in length
	0.1 mg methylmercury per kg Fish	Average wet weight concentration measured in whole trophic level 3 fish 15 – 35 cm in length

Source: San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) as of May 4, 2017
https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/basinplan/web/docs/BP_all_chapters.pdf

a. The freshwater water quality objectives for the protection of aquatic organisms and wildlife also protect humans who consume fish from the Walker Creek and Guadalupe River watersheds.

Element 6 *Program Tasks Description*

6.1 Work Statement and Produced Products

To address the management questions posed, the RMP Status and Trends component regularly conducts sampling of various environmental matrices annually or less frequently. This work is planned and performed under the guidance of the RMP Steering and Technical Review Committees, which are composed of environmental regulators and representatives of local stakeholders. Other work funded by the RMP but not covered by this QAPP includes monitoring efforts conducted and reported by partner agencies, such as suspended sediment and other water quality monitoring by the United States Geological Survey, which follow the quality assurance procedures of those agencies. Other work funded by the RMP includes special studies, which are often one-time investigations and may include development of new methods, for which appropriate data quality targets are not yet known. The targets in RMP S&T QAPP here may be used as a template for developing data quality objectives for such studies, but should be adapted in project specific QAPPs to suit the specific needs of the special studies and the capabilities of the selected labs and experimental methods as appropriate.

Data from Status and Trends monitoring efforts are made available for download via the RMP website, incorporated into RMP reports for non-technical (e.g., Pulse of the Bay) and technical audiences (e.g., Annual Monitoring Results report), and used for published manuscripts in the peer reviewed literature. These data are subsequently incorporated into statewide compilations or web portals of environmental data, such as the California Environmental Data Exchange Network (CEDEN) or the state's My Water Quality website (www.mywaterquality.ca.gov).

6.2 Constituents to be Monitored and Reported

RMP Status and Trends monitoring data will include collection, measurement, and reporting of different parameters and typically include the following information:

Station location (latitude and longitude)
Station sampling date and time
Matrix sampled (water, sediment, or biological tissue)
Parameter measurements (Table 7).
Collection and analytical methods
Qualifiers and comments (applied by analytical labs or by RMP staff in data review)

The schedule for when each matrix will be sampled is shown in Table 8.

The analyte names listed in Table 7 conform to the requirements of the California Environmental Data Exchange Network (CEDEN) and should be used when reporting results. The list of approved CEDEN analyte names can be found on their website www.ceden.org/CEDEN_Checker/Checker/DisplayCEDENLookUp.php?List=AnalyteLookUp. For help cross walking analyte names to CEDEN format, contact SFEI at DS@sfei.org.

Table 7 RMP Program Parameters and Reporting Units

Field Measures – CTD Meter (Water, Sediment and Bivalve Cruises)	Reporting Units
Backscatter	FTU
Electrical Conductivity	S/m
Temperature	DegC
Density	kg/m3
Oxygen, Dissolved	mg/L
Pressure	dbar
Salinity	psu3
Field Measures - Shipboard (Water Cruise)	**Reporting Units**
Oxygen, Dissolved	mg/L
pH	none
Salinity	ppt
Specific Conductivity	µS/cm
Temperature	Deg C
Field Measures - Shipboard (Sediment Cruise) *pH from interstitial water in undisturbed section of sediment grab	**Reporting Units**
pH*	none
Eh	mV

CTD = Conductivity, Temperature, Depth
FTU = Formazin Turbidity Unit
PSU = Practical Salinity Unit

Conventional Water Quality Parameters	Reporting Units
Chlorophyll a	mg/m3
Dissolved Organic Carbon	µg/L
Hardness as CaCO3	mg/L
Nitrate as N	mg/L
Nitrite as N	mg/L
Particulate Organic Carbon	µg/L
Phaeophytin a	mg/m3
Orthophosphate as P	mg/L
Salinity	psu
Suspended Sediment Concentration	mg/L
Conventional Sediment Quality Parameters	**Reporting Units**
Total Solids	%
Nitrogen, Total	% dw

Total Organic Carbon	% dw

[Basis codes: dw=dry weight, ww=wet weight]

Sediment Grain Size	Fraction	Reporting Units
Clay	<0.0039 mm	% dw
Silt	0.0039 to <0.0625 mm	% dw
Fine*	<0.0625 mm	% dw
Sand**	0.0625 to <2.0 mm	% dw
Sand	V. Fine 0.0625 to <0.125 mm	% dw
Sand	Fine 0.125 to <0.25 mm	% dw
Sand	Medium 0.25 to <0.5 mm	% dw
Sand	Coarse 0.5 to <1.0 mm	% dw
Sand	V. Coarse 1.0 to <2.0 mm	% dw
Granule + Pebble	2.0 to <64 mm	% dw

* Sum of Clay and Silt together
** Sum of all sand fractions

Sediment Toxicity Parameters	Reporting Units
Alkalinity as CaCO3	mg/L
Ammonia as NH3	mg/L
Ammonia as NH3, Unionized	mg/L
Growth (wt/surv indiv)	mg/ind
Hardness as CaCO3	mg/L
Oxygen, Dissolved	mg/L
pH	none
salinity	ppt
SpecificConductivity	µS/cm
Survival	%
Sediment Toxicity Parameters - Surface Water Interface	**Reporting Units**
Survival	%
Water Toxicity Parameters - Sample Water	**Reporting Units**
Biomass (wt/orig indiv)	mg/ind
Survival	%
Ammonia as NH3	mg/L
Ammonia as NH3, Unionized	mg/L
Oxygen, Dissolved	mg/L
pH	none

Salinity	ppt
Bivalve Parameters	**Reporting Units**
Total Solids [1]	%
Survival [3]	%
Dry Weight [3]	g
Dry Weight Standard Error [3]	g
Growth (weight) [3]	g
Growth Standard Error [3]	g
Lipid	% dw
Moisture [2]	% ww
Sport Fish Parameters	**Reporting Units**
Moisture1,2	**%**
Lipid[2]	**% ww**

[1] Reported with Trace Metals
[2] Reported with Trace Organics
[3] Reported for bivalves

Trace Metals						
	Bird Eggs	**Bivalve Tissue**	**Sediment**	**Sport Fish**	**Tributary Water**	**Water**
Aluminum	-	-	mg/Kg dw	-	-	-
Arsenic	-	-	mg/Kg dw	-	-	-
Cadmium	-	-	mg/Kg dw	-	-	-
Cobalt	-	-	-	-	-	-
Copper	-	-	mg/Kg dw	-	-	µg/L
Cyanide	-	-	-	-	-	µg/L
Iron	-	-	mg/Kg dw	-	-	-
Lead	-	-	mg/Kg dw	-	-	-
Manganese	-	-	mg/Kg dw	-	-	-
Mercury	ug/g ww	-	mg/Kg dw	µg/g ww	µg/L	-
Mercury, Methyl	-	-	µg/Kg dw	-	-	ng/L
Mercury, Acid Labile	-	-	-	-	-	-
Mercury(II)	-	-	-	-	-	-
Nickel	-	-	mg/Kg dw	-	-	-

Selenium	ug/g dw	ug/g dw	mg/Kg dw	µg/g ww	-	µg/L
Silver	-	-	mg/Kg dw	-	-	-
Zinc	-	-	mg/Kg dw	-	-	-

Dioxins and Furans						
	Reporting Group	**Bird Eggs**	**Bivalve Tissue**	**Sediment**	**Sport Fish**	**Water**
HpCDD, 1,2,3,4,6,7,8-	PCDD/F	-	-	-	pg/g ww	-
HxCDD, 1,2,3,4,7,8-	PCDD/F	-	-	-	pg/g ww	-
HxCDD, 1,2,3,6,7,8-	PCDD/F	-	-	-	pg/g ww	-
HxCDD, 1,2,3,7,8,9-	PCDD/F	-	-	-	pg/g ww	-
OCDD, 1,2,3,4,6,7,8,9-	PCDD/F	-	-	-	pg/g ww	-
PeCDD, 1,2,3,7,8-	PCDD/F	-	-	-	pg/g ww	-
TCDD, 2,3,7,8-	PCDD/F	-	-	-	pg/g ww	-
HpCDF, 1,2,3,4,6,7,8-	PCDD/F	-	-	-	pg/g ww	-
HpCDF, 1,2,3,4,7,8,9-	PCDD/F	-	-	-	pg/g ww	-
HxCDF, 1,2,3,4,7,8-	PCDD/F	-	-	-	pg/g ww	-
HxCDF, 1,2,3,6,7,8-	PCDD/F	-	-	-	pg/g ww	-
HxCDF, 1,2,3,7,8,9-	PCDD/F	-	-	-	pg/g ww	-
HxCDF, 2,3,4,6,7,8-	PCDD/F	-	-	-	pg/g ww	-
OCDF, 1,2,3,4,6,7,8,9-	PCDD/F	-	-	-	pg/g ww	-
PeCDF, 1,2,3,7,8-	PCDD/F	-	-	-	pg/g ww	-
PeCDF, 2,3,4,7,8-	PCDD/F	-	-	-	pg/g ww	-
TCDF, 2,3,7,8-	PCDD/F	-	-	-	pg/g ww	-

Perfluorinated Compounds (PFC)						
	Reporting Group	**Bird Eggs**	**Bivalve**	**Sediment**	**Sport Fish**	**Water**
Perfluorobutanesulfonate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorobutanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorodecanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorododecanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluoroheptanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorohexanesulfonate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorohexanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorononanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-

Perfluorooctanesulfonamide	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorooctanesulfonate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorooctanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluoropentanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluoroundecanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorotridecanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorotetradecanoate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluoropentanesulfonate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluoroheptanesulfonate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorononanesulfonate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorodecanesulfonate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluorododecanesulfonate	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Fluorotelomer Sulfonate, 4:2-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Fluorotelomer Sulfonate, 6:2-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Fluorotelomer Sulfonate, 8:2-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Methyl-perfluorooctanesulfonamide, N-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Ethyl-perfluorooctanesulfonamide, N-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Methyl-perfluorooctanesulfonamidoethanol, N-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Ethyl-perfluorooctanesulfonamidoethanol, N-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Perfluoro-2-Propoxypropanoic Acid	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Dioxa-3H-Perfluorononanoate Acid, 4,8-	Perfluoronate	ng/g ww	-	-	ng/g ww	-
Chlorohexadecafluoro-3-	Perfluoronate	ng/g ww	-	-	ng/g ww	-

Oxanonane-1-Sulfonic Acid, 9-						
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	Perfluoronate	ng/g ww	-	-	ng/g ww	-

Pesticides						
	Reporting Group	**Bird Eggs**	**Bivalve Tissue**	**Sediment**	**Sport Fish**	**Water**
Chlordane, cis-	Chlordanes	-	-	µg/kg dw	-	pg/L
Chlordane, trans-	Chlordanes	-	-	µg/kg dw	-	pg/L
Heptachlor	Chlordanes	-	-	µg/kg dw	-	pg/L
Heptachlor Epoxide	Chlordanes	-	-	µg/kg dw	-	pg/L
Nonachlor, cis-	Chlordanes	-	-	µg/kg dw	-	pg/L
Nonachlor, trans-	Chlordanes	-	-	µg/kg dw	-	pg/L
Oxychlordane	Chlordanes	-	-	µg/kg dw	-	pg/L
Aldrin	Cyclopentadienes	-	-	µg/kg dw	-	pg/L
Dieldrin	Cyclopentadienes	-	-	µg/kg dw	-	pg/L
Endrin	Cyclopentadienes	-	-	µg/kg dw	-	pg/L
DDD(o,p')	DDTs	-	-	µg/kg dw	-	pg/L
DDD(p,p')	DDTs	-	-	µg/kg dw	-	pg/L
DDE(o,p')	DDTs	-	-	µg/kg dw	-	pg/L
DDE(p,p')	DDTs	-	-	µg/kg dw	-	pg/L
DDMU(p,p')	DDTs	-	-	-	-	-
DDT(o,p')	DDTs	-	-	µg/kg dw	-	pg/L
DDT(p,p')	DDTs	-	-	µg/kg dw	-	pg/L
HCH, alpha-	HCHs	-	-	µg/kg dw	-	pg/L
HCH, beta-	HCHs	-	-	µg/kg dw	-	pg/L
HCH, delta-	HCHs	-	-	µg/kg dw	-	pg/L
HCH, gamma-	HCHs	-	-	µg/kg dw	-	pg/L
Chlorpyrifos	Other	-	-	-	-	pg/L
Dacthal	Other	-	-	-	-	pg/L
Diazinon	Other	-	-	-	-	pg/L
Endosulfan I	Other	-	-	-	-	pg/L
Endosulfan II	Other	-	-	-	-	pg/L

Endosulfan sulfate	Other	-	-	-	-	pg/L
Hexachlorobenzene	Other	-	-	µg/kg dw	-	pg/L
Mirex	Other	-	-	µg/kg dw	-	pg/L
Oxadiazon	Other	-	-	-	-	-

Fipronils						
	Reporting Group	**Bird Eggs**	**Bivalve Tissue**	**Sediment**	**Sport Fish**	**Water**
Fipronil	Fipronils	-	-	µg/kg dw	ng/g ww	-
Fipronil desulfinyl	Fipronils	-	-	µg/kg dw	ng/g ww	-
Fipronil sulfide	Fipronils	-	-	µg/kg dw	ng/g ww	-
Fipronil sulfone	Fipronils	-	-	µg/kg dw	ng/g ww	-
Fipronil detrifluoromethylsulfinyl	Fipronils	-	-	µg/kg dw	-	-

Polybrominated Diphenyl Ethers (PBDEs)						
	Reporting Group	**Bird Eggs**	**Bivalve Tissue**	**Sediment**	**Sport Fish**	**Water**
PBDE 007	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 008	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 010	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 011	PBDEs	PBDE 008	PBDE 008	PBDE 008	PBDE 008	-
PBDE 012	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 013	PBDEs	PBDE 012	PBDE 012	PBDE 012	PBDE 012	-
PBDE 015	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 017	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 025	PBDEs	PBDE 017	PBDE 017	PBDE 017	PBDE 017	-
PBDE 028	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 030	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 032	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 033	PBDEs	PBDE 028	PBDE 028	PBDE 028	PBDE 028	-
PBDE 035	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 037	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 047	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 049	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-

PBDE 051	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 066	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 071	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 075	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 077	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 079	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 085	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 099	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 100	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 105	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 116	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 119	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 120	PBDEs	PBDE 119	PBDE 119	PBDE 119	PBDE 119	-
PBDE 126	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 128	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 138	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 140	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 153	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 154	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 155	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 166	PBDEs	-	-	PBDE 138	PBDE 138	-
PBDE 181	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 183	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 184	PBDEs	ng/g ww	ng/g ww	ng/g ww	-	-
PBDE 190	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 197	PBDEs	ng/g ww	ng/g ww	µg/kg dw	-	-
PBDE 203	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 204	PBDEs	ng/g ww	ng/g ww	µg/kg dw	-	-
PBDE 205	PBDEs	ng/g ww	ng/g ww	µg/kg dw	-	-
PBDE 206	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 207	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 208	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-
PBDE 209	PBDEs	ng/g ww	ng/g ww	µg/kg dw	ng/g ww	-

	Polychlorinated Biphenyls (PCBs)						
	Reporting Group	**Bird Egg**	**Bivalve Tissue**	**Sediment**	**Sport Fish**	**Tributary Water**	**Water**
PCB 001	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 002	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 003	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 004	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 005	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 006	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 007	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 008[1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 009	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 010	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 011	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	-
PCB 012	PCBs	-	ng/g dw	µg/kg dw	PCB 013	-	pg/L
PCB 013	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 014	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 015	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 016	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 017	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 018 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 019	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 020	PCBs	-	ng/g dw	µg/kg dw	PCB 028	-	pg/L
PCB 021	PCBs	-	ng/g dw	µg/kg dw	PCB 033	-	pg/L
PCB 022	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 023	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 024	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 025	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 026	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 027	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 028 [1]	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 029	PCBs	ng/g ww	ng/g dw	µg/kg dw	PCB 026	-	pg/L
PCB 030	PCBs	-	ng/g dw	µg/kg dw	PCB 018	-	pg/L
PCB 031 [1]	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L

PCB 032	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 033 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 034	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 035	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 036	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 037	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 038	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 039	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 040	PCBs	-	ng/g dw	µg/kg dw	PCB 071	-	pg/L
PCB 041	PCBs	-	ng/g dw	µg/kg dw	PCB 071	-	pg/L
PCB 042	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 043	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 044 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 045	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 046	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 047	PCBs	-	ng/g dw	µg/kg dw	PCB 044	-	pg/L
PCB 048	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 049 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 050	PCBs	-	ng/g dw	µg/kg dw	PCB 053	-	pg/L
PCB 051	PCBs	-	ng/g dw	µg/kg dw	PCB 045	-	pg/L
PCB 052 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 053	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 054	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 055	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 056 [1]	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 057	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 058	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 059	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 060 [1]	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 061	PCBs	-	ng/g dw	µg/kg dw	PCB 070	-	pg/L
PCB 062	PCBs	-	ng/g dw	µg/kg dw	PCB 059	-	pg/L
PCB 063	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 064	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 065	PCBs	-	ng/g dw	µg/kg dw	PCB 044	-	pg/L

PCB 066 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 067	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 068	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 069	PCBs	-	ng/g dw	µg/kg dw	PCB 049	-	pg/L
PCB 070 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 071	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 072	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 073	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 074 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	PCB 070	pg/L	pg/L
PCB 075	PCBs	-	ng/g dw	µg/kg dw	PCB 059	-	pg/L
PCB 076	PCBs	-	ng/g dw	µg/kg dw	PCB 070	-	pg/L
PCB 077	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 078	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 079	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 080	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 081	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 082	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 083	PCBs	-	ng/g dw	µg/kg dw	PCB 099	-	pg/L
PCB 084	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 085	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 086	PCBs	-	ng/g dw	µg/kg dw	PCB 087	-	pg/L
PCB 087 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 088	PCBs	-	ng/g dw	µg/kg dw	PCB 091	-	pg/L
PCB 089	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 090	PCBs	-	ng/g dw	µg/kg dw	PCB 101	-	pg/L
PCB 091	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 092	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 093	PCBs	-	ng/g dw	µg/kg dw	PCB 095	-	pg/L
PCB 094	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 095 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 096	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 097 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	PCB 087	pg/L	pg/L
PCB 098	PCBs	-	ng/g dw	µg/kg dw	PCB 095	-	pg/L
PCB 099 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L

PCB 100	PCBs	-	ng/g dw	µg/kg dw	PCB 095	-	pg/L
PCB 101 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 102	PCBs	-	ng/g dw	µg/kg dw	PCB 095	-	pg/L
PCB 103	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 104	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 105 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 106	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 107	PCBs	-	ng/g dw	µg/kg dw	PCB 124	-	pg/L
PCB 108	PCBs	-	ng/g dw	µg/kg dw	PCB 087	-	pg/L
PCB 109	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 110 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 111	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 112	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 113	PCBs	-	ng/g dw	µg/kg dw	PCB 101	-	pg/L
PCB 114	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 115	PCBs	-	ng/g dw	µg/kg dw	PCB 110	-	pg/L
PCB 116	PCBs	-	ng/g dw	µg/kg dw	PCB 085	-	pg/L
PCB 117	PCBs	-	ng/g dw	µg/kg dw	PCB 085	-	pg/L
PCB 118	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 119	PCBs	-	ng/g dw	µg/kg dw	PCB 087	-	pg/L
PCB 120	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 121	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 122	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 123	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 124	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 125	PCBs	-	ng/g dw	µg/kg dw	PCB 087	-	pg/L
PCB 126	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 127	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 128 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 129	PCBs	-	ng/g dw	µg/kg dw	PCB 138	-	pg/L
PCB 130	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 131	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 132 [1]	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 133	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L

PCB 134	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 135	PCBs	-	ng/g dw	µg/kg dw	PCB 151	-	pg/L
PCB 136	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 137	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 138 [1]	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 139	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 140	PCBs	-	ng/g dw	µg/kg dw	PCB 139	-	pg/L
PCB 141 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 142	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 143	PCBs	-	ng/g dw	µg/kg dw	PCB 134	-	pg/L
PCB 144	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 145	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 146	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 147	PCBs	-	ng/g dw	µg/kg dw	PCB 149	-	pg/L
PCB 148	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 149 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 150	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 151 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 152	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 153 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 154	PCBs	-	ng/g dw	µg/kg dw	PCB 151	-	pg/L
PCB 155	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 156 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 157	PCBs	ng/g ww	ng/g dw	µg/kg dw	PCB 156	-	pg/L
PCB 158 [1]	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 159	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 160	PCBs	-	ng/g dw	µg/kg dw	PCB 138	-	pg/L
PCB 161	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 162	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 163	PCBs	-	ng/g dw	µg/kg dw	PCB 138	-	pg/L
PCB 164	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 165	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 166	PCBs	-	ng/g dw	µg/kg dw	PCB 128	-	pg/L
PCB 167	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L

PCB 168	PCBs	-	ng/g dw	µg/kg dw	PCB 153	-	pg/L
PCB 169	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 170 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 171	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 172	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 173	PCBs	-	ng/g dw	µg/kg dw	PCB 171	-	pg/L
PCB 174 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 175	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 176	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 177 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 178	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 179	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 180 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 181	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 182	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 183 [1]	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 184	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 185	PCBs	-	ng/g dw	µg/kg dw	PCB 183	-	pg/L
PCB 186	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 187 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 188	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 189	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 190	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 191	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 192	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 193	PCBs	-	ng/g dw	µg/kg dw	PCB 180	-	pg/L
PCB 194 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 195 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 196	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 197	PCBs	-	ng/g dw	µg/kg dw	PCB 200	-	pg/L
PCB 198	PCBs	ng/g ww	ng/g dw	µg/kg dw	PCB 199	-	pg/L
PCB 199	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 200	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 201 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L

PCB 202	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 203 [1]	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	pg/L	pg/L
PCB 204	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 205	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 206	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 207	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 208	PCBs	-	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 209	PCBs	ng/g ww	ng/g dw	µg/kg dw	ng/g ww	-	pg/L
PCB 028/31	PCBs	ng/g ww	-	-	ng/g ww	-	-
PCB 056/60	PCBs	ng/g ww	-	-	ng/g ww	-	-
PCB 138/158	PCBs	ng/g ww	-	-	ng/g ww	-	-

[1] Used in Sum of 40 PCBs (SFEI)

Polycyclic Aromatic Hydrocarbons (PAHs)						
	Reporting Group	**Bird Eggs**	**Bivalve Tissue**	**Sediment**	**Sport Fish**	**Water**
Acenaphthenes, C1-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Benz(a)anthracene	ALK PAHs	-	ng/g dw[1]	µg/kg dw	-	-
Benz(a)anthracenes/Chrysenes, C1-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Benz(a)anthracenes/Chrysenes, C2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Benz(a)anthracenes/Chrysenes, C3-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Benz(a)anthracenes/Chrysenes, C4-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Benzofluoranthenes/Benzopyrenes, C1-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Benzofluoranthenes/Benzopyrenes, C2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Biphenyls, C1-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Biphenyls, C2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dimethylfluorene, 1,7-	ALK PAHs	-	ng/g dw[1]	µg/kg dw	-	-
Dibenzothioph	ALK PAHs	-	ng/g dw	µg/kg dw	-	-

enes, C1-						
Dibenzothiophenes, C2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dibenzothiophenes, C3-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dibenzothiophenes, C4-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dimethylchrysene, 5,9-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dimethyldibenzothiophene, 2,4-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dimethylnaphthalene, 1,2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dimethylphenanthrene, 1,7-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dimethylphenanthrene, 1,8-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dimethylphenanthrene, 2,6-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Dimethylphenanthrene, 3,6-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Fluoranthene/Pyrenes, C1-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Fluoranthenes/ Pyrenes, C2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Fluoranthenes/ Pyrenes, C3-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Fluoranthenes/ Pyrenes, C4-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Fluorenes, C1-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Fluorenes, C2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Fluorenes, C3-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Methylbenzo(a)pyrene, 7-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Methylchrysene, 1-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Methylchrysene, 5/6-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Methyldibenzothiophenes, 2/3-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Methylfluoranthene, 3-/Benzo(a)fluorene	ALK PAHs	-	ng/g dw	µg/kg dw	-	-

Methylfluorene, 2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Methylphenanthrene, 2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Methylphenanthrene, 3-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Methylphenanthrene, 9/4-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Methylanthracene, 2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Naphthalenes, C1-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Naphthalenes, C2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Naphthalenes, C3-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Naphthalenes, C4-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Phenanthrene/ Anthracene, C1-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Phenanthrene/ Anthracene, C2-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Phenanthrene/ Anthracene, C3-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Phenanthrene/ Anthracene, C4-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Retene	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Tetramethylnaphthalene, 1,4,6,7-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Trimethylphenanthrene, 1,2,6-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Trimethylnaphthalene, 2,3,6-	ALK PAHs	-	ng/g dw	µg/kg dw	-	-
Benzo(a)pyrene	HPAH	-	ng/g dw[1]	µg/kg dw	-	-
Benzo(b)fluoranthene	HPAH	-	ng/g dw[1]	µg/kg dw	-	-
Benzo(b/j/k)fluoranthene	HPAH	-	ng/g dw[1]	µg/kg dw	-	-
Benzo(e)pyrene	HPAH	-	ng/g dw[1]	µg/kg dw	-	-
Benzo(g,h,i)pe	HPAH	-	ng/g dw[1]	µg/kg dw	-	-

rylene						
Benzo(j/k)fluoranthene	HPAH	-	ng/g dw[1]	µg/kg dw	-	-
Chrysene	HPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Dibenz(a,h)anthracene	HPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Fluoranthene	HPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Indeno(1,2,3-c,d)pyrene	HPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Perylene	HPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Pyrene	HPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Acenaphthene	LPAH	-	ng/g dw[1]	µg/kg dw	-	-
Acenaphthylene	LPAH	-	ng/g dw[1]	µg/kg dw	-	-
Anthracene	LPAH	-	ng/g dw[1]	µg/kg dw	-	-
Biphenyl	LPAH	-	ng/g dw	µg/kg dw	-	-
Dibenzothiophene	LPAH	-	ng/g dw[1]	µg/kg dw	-	-
Dimethylnaphthalene, 2,6-	LPAH	-	ng/g dw[1]	µg/kg dw	-	-
Fluorene	LPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Methylnaphthalene, 1-	LPAHs	-	ng/g dw	µg/kg dw	-	-
Methylnaphthalene, 2-	LPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Methylphenanthrene, 1-	LPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Naphthalene	LPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Phenanthrene	LPAHs	-	ng/g dw[1]	µg/kg dw	-	-
Trimethylnaphthalene, 2,3,5-	LPAHs	-	ng/g dw[1]	µg/kg dw	-	-

[1] Used in Sum of 25 PAHs (SFEI).
[2] Some labs report benzo(k)fluoranthene, some benzo(j/k) and some benzo(b/j/k)fluoranthene, since these are all HPAHs any combo of b/j/k (whether all as one analyte, or split out as singles or pairs) are included in both the "Sum of 25 PAHs (SFEI)" and the "Sum of 12 HPAHs (SFEI)"

Table 8 Proposed Project Schedule

Element	2017	2018	2019	2020	2021	2022	2023
In-Bay Surface Water and aquatic toxicity	x		x		x		x
Bivalve Monitoring		x		x		x	
Bird Egg Monitoring		x			x		

Surface Sediment*		x				x	
Sport Fish Monitoring			x				
Tributary Loading	x	x	x	TBD	TBD	TBD	TBD

* Monitoring for sediment toxicity and benthic community assessments during the sediment cruise is on-hold until the TRC decides otherwise.

6.3 Geographical Scope

Status & Trends: Water and Sediment Sampling

The surface sediment and in-Bay surface water samples are collected from probabilistically distributed stations throughout the Bay, with the majority of stations changing each sampling year, and a few fixed historical and probabilistically selected stations repeated in subsequent years. These locations have been selected from a sampling frame of open water areas of the Bay (e.g., not including local rivers and streams, harbors, and marinas) with a minimum water depth of one foot at Mean Lower Low Water (MLLW). Probabilistically assigned stations planned in any given year may be skipped due to access limitations or safety reasons, e.g., military sensitive areas, shallow water access difficulties or underwater hazards, treacherous waves, or currents. Sediment samples are collected during the middle of either the wet season (January through March) or dry season (July through September) in alternate years.

As an example, Figures 6-1 and 6-2 show the sampling location distributions for one recent year for each matrix. Locations of past sampled stations can be obtained in queries of historical data from the RMP on the SFEI website. Planned locations for future sampling can be obtained on request.

Status & Trends: Biota

Transplanted and resident bivalves are collected biennially from 9 fixed locations, 3 of which are back-up deployment sites, during the dry season (Figure 4). Sport fish are collected quinquennially from popular fishing locations in the Bay (Figure 5). Cormorant and tern eggs are collected triennially from colonies around the Bay (Figures 6) to assess piscivorous wildlife risk integrated over large areas of the Bay.

Loadings: Tributaries (Stormwater)

The RMP Small Tributaries Loading Strategy workgroup monitors watershed stations as part of the implementation of the stormwater Municipal Regional Permit (MRP) (Figure 6-7). Sites were selected based on information from a reconnaissance study of potential locations. The criteria used for site selection include:

1. Watersheds are representative,
2. Management opportunity to implement Pollutants of Concern load reduction actions,
3. Existing permit requirements, and
4. Feasibility of sampling

6.4 Constraints

In addition to the logistical constraints to sampling some areas of the Bay as noted previously, the ability to measure some of the target compounds at the ultra-trace levels found in the ambient environment may be constrained by the detection limits routinely achievable by contract laboratories. Target detection limits in this document represent those achieved by laboratories contracted by the RMP in the past and/or levels needed to obtain quantitative measurements of ambient concentrations in a majority of samples.

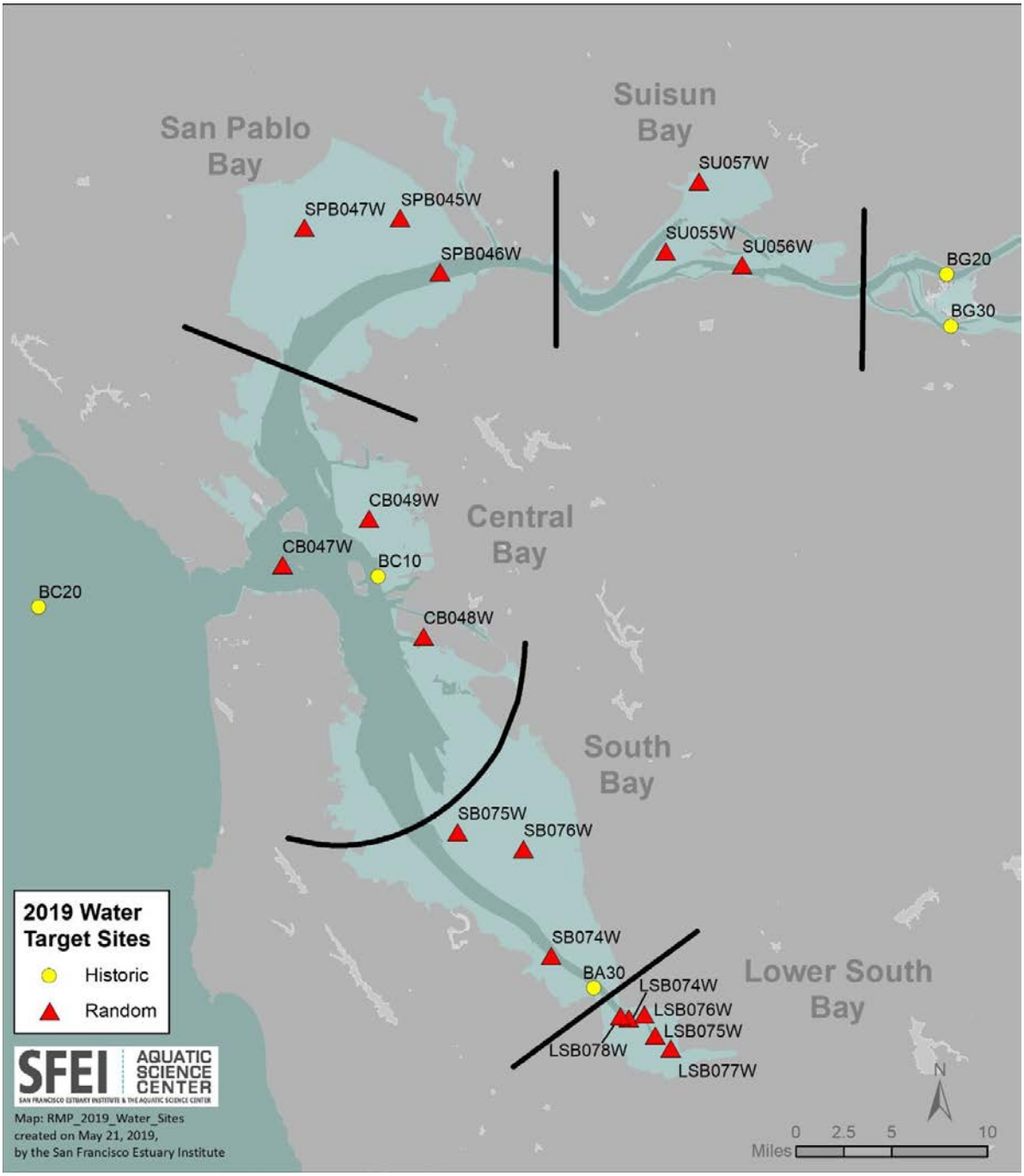

Figure 2 2019 Target Water Sampling Sites

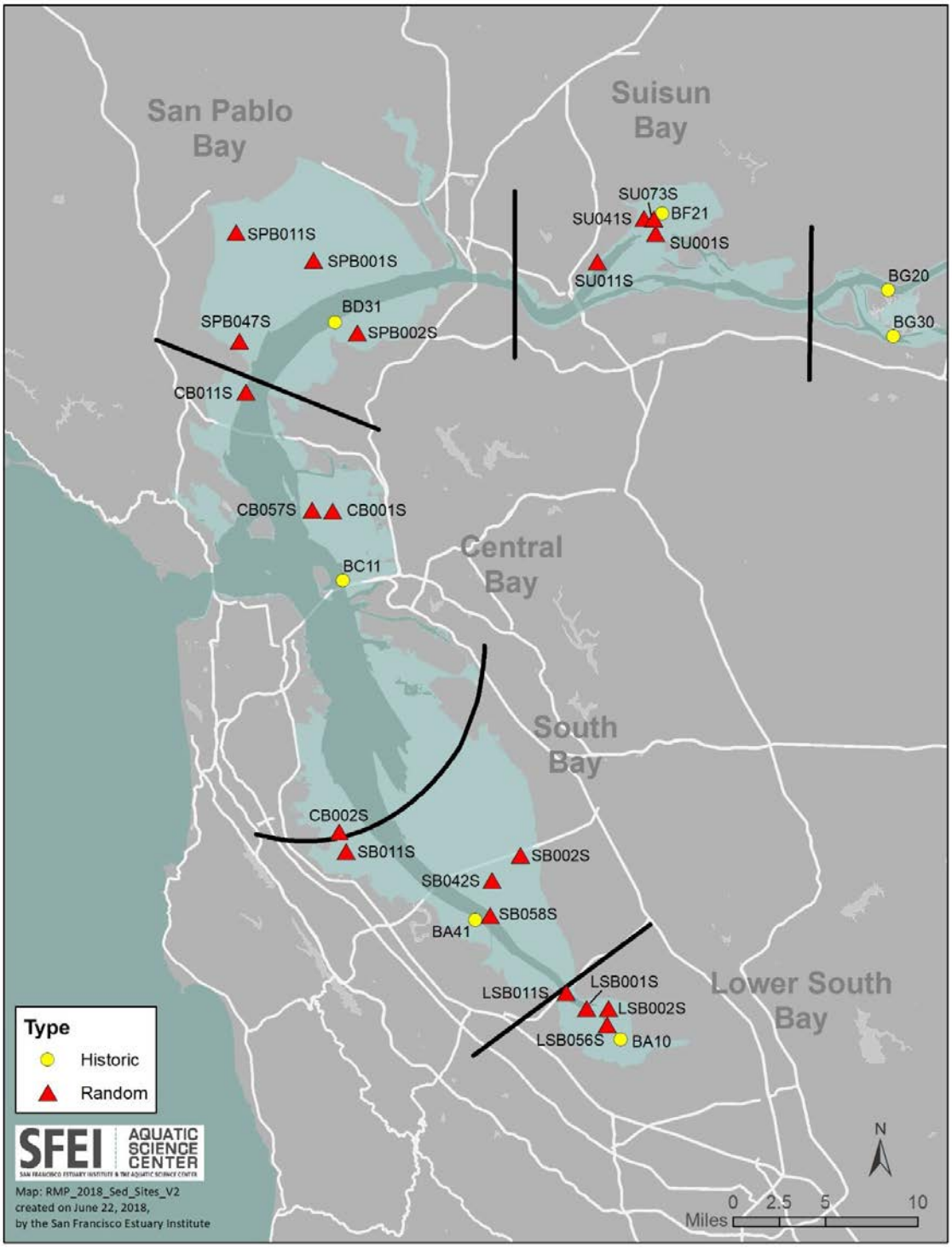

Figure 3 2018 Target Sediment Sampling Sites

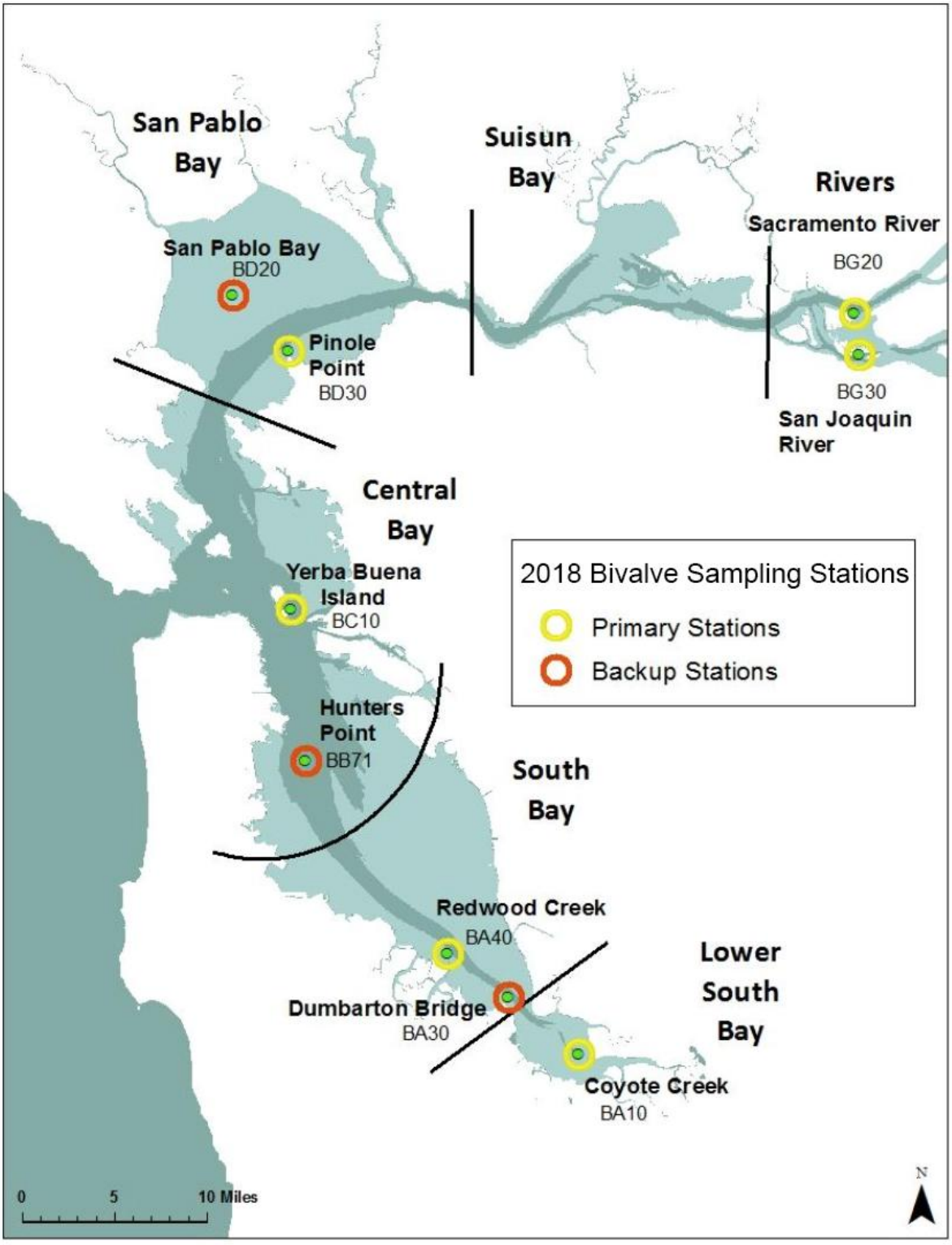

Figure 4 Bivalve Sampling Sites

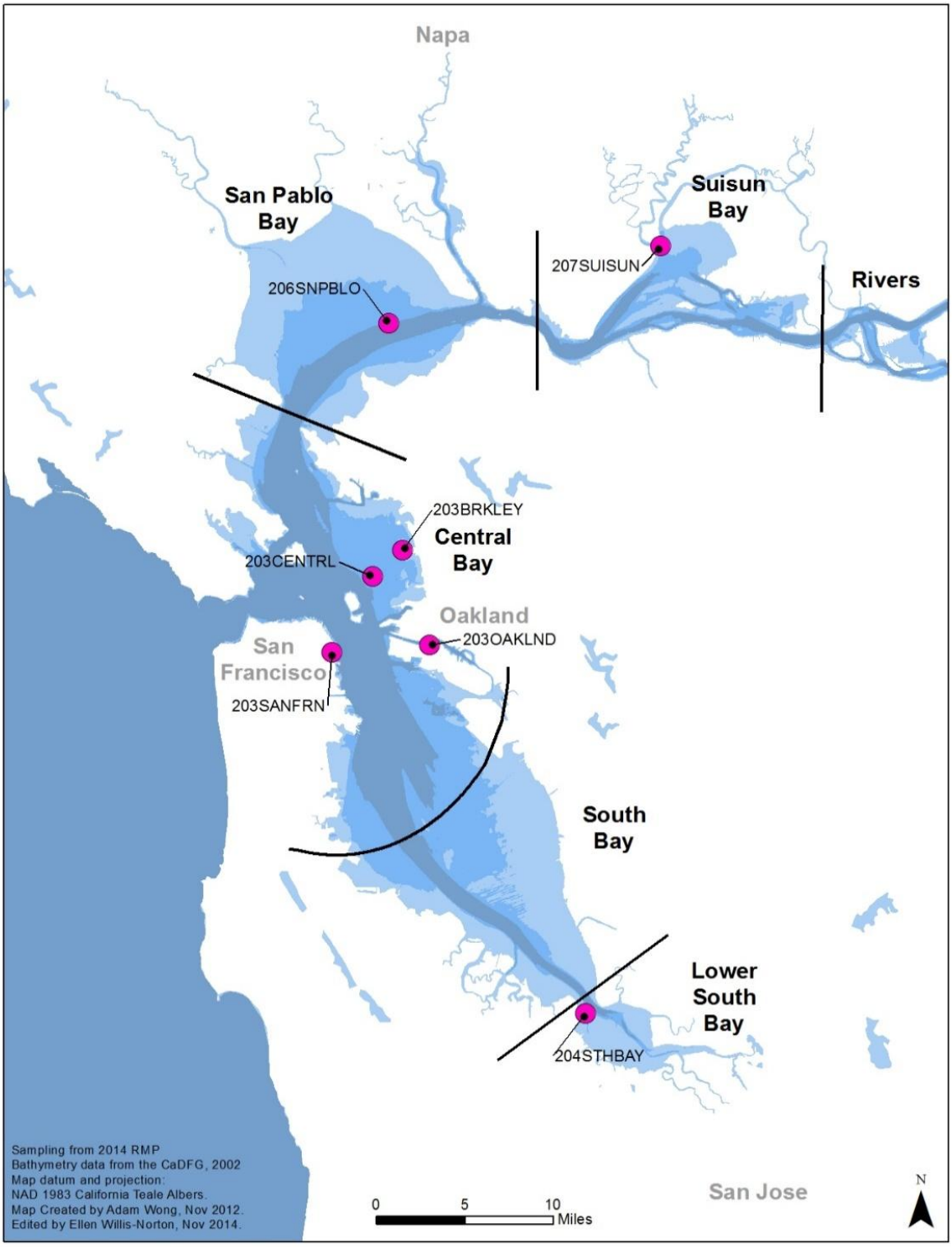

Figure 5 2014 Sport fish Sampling Sites

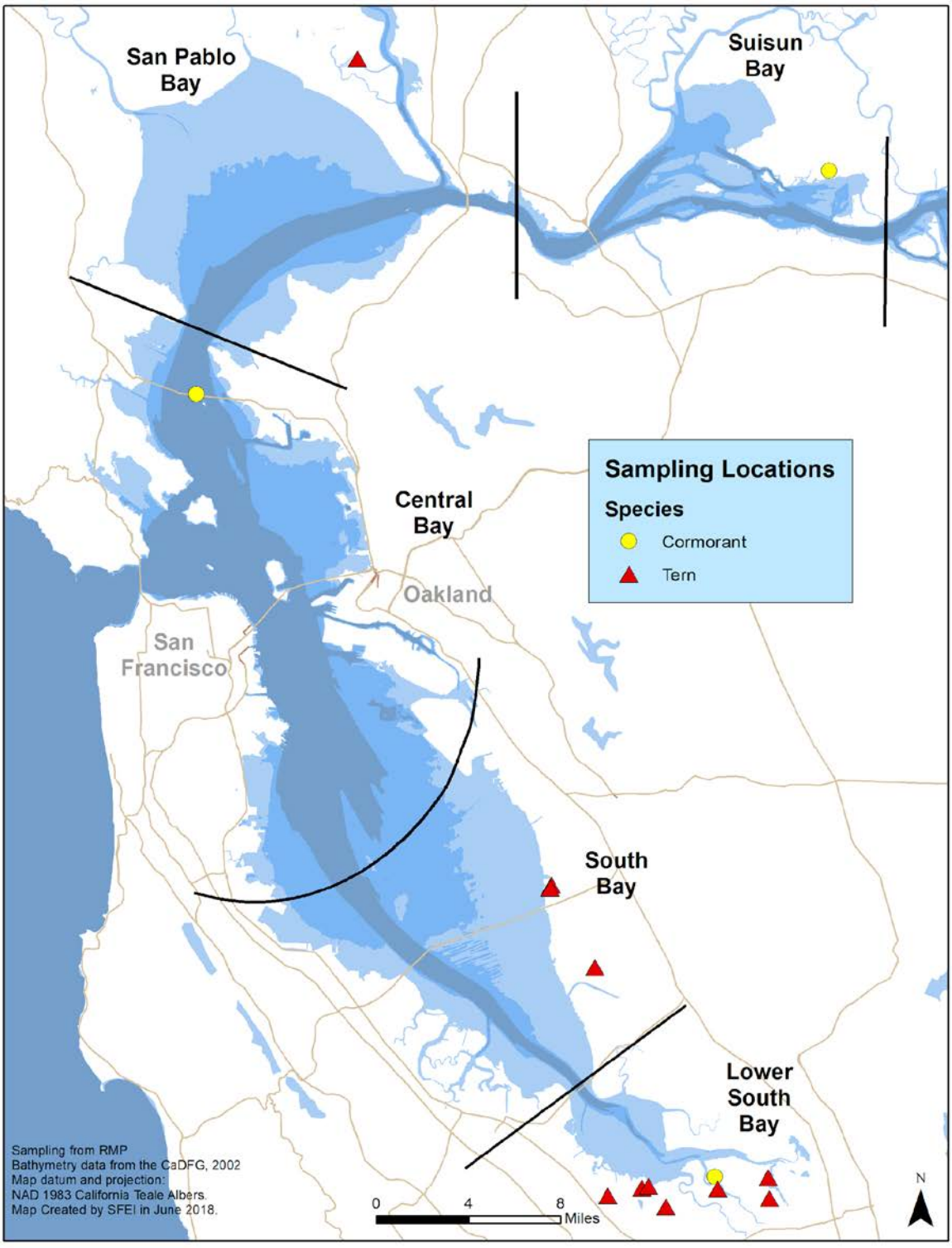

Figure 6 RMP Bird Egg Sampling Sites

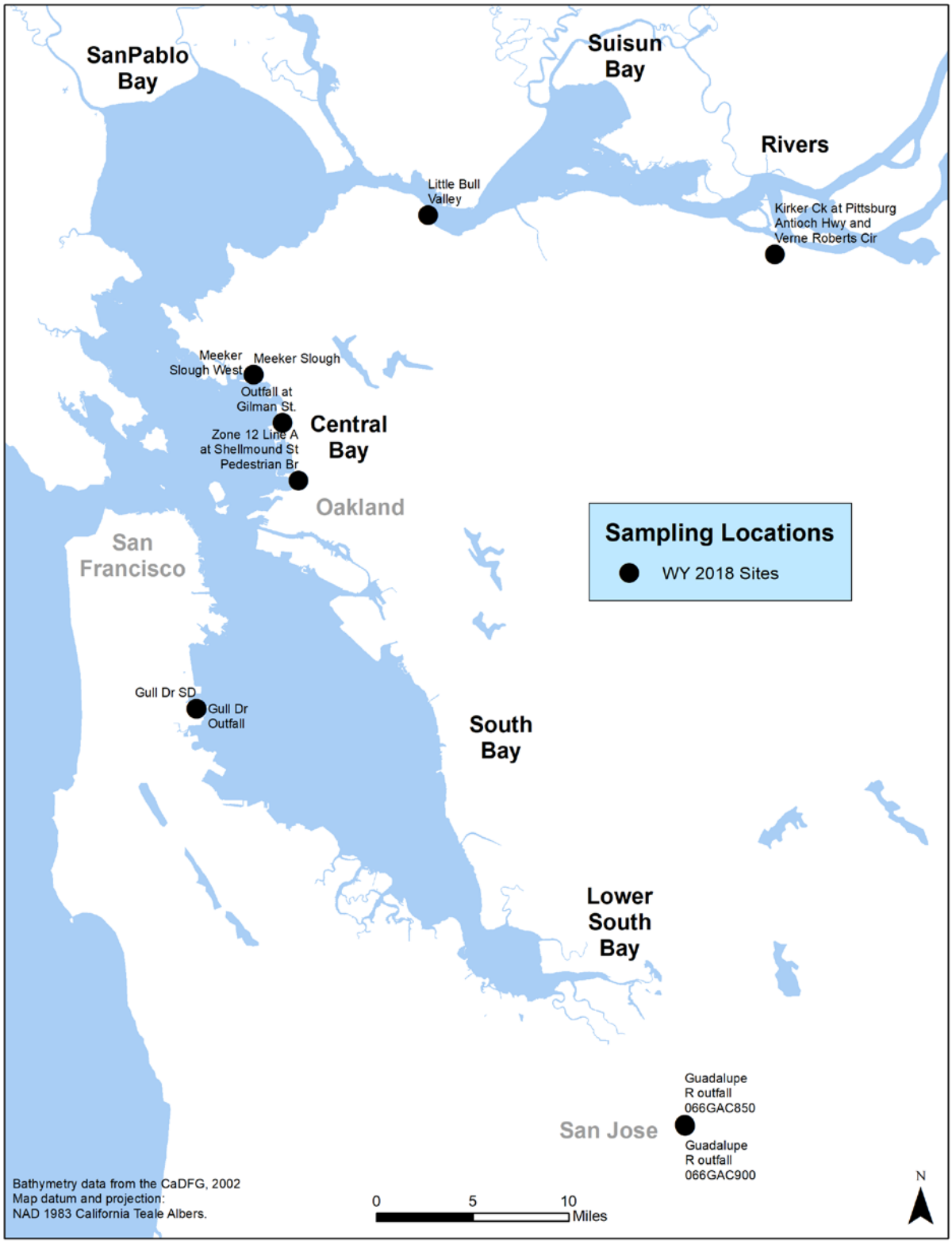

Figure 7 Water Year 2018 Pollutants of Concern Stormwater Sampling Sites

Element 7 *Quality Objectives and Criteria for Measurement Data*

Data quality objectives for field and laboratory measurements evaluate the following:

- Field measurements – sensitivity, precision, accuracy, completeness
- Laboratory chemical analyses – sensitivity, precision, accuracy, completeness, contamination

The discussion in this section reviews the measurements and procedures expected to demonstrate the quality of reported data.

7.1 Field Performance Measurements

Sensitivity of field measurements is generally fixed by the output of the analytical instrument. Appropriate instruments and/or instrument settings should be chosen that generally allow differences between sites or within a site at different times to be reported. Resolution on the order of approximately 1% of the maximum or range of measurements likely to be encountered is desired.

Precision of field measurements is determined by repeated measurement of the same parameter within a single sample, or samples taken in rapid succession (only when conditions are not dynamically variable). Approximately 10% of measurements, a minimum of one measurement per event, should be repeated for all measured parameters. Repeated measurement may also be accomplished by continuous logging of *in situ* probes or meters.

Accuracy of field measurements is established by periodic measurement of known standards or by recalibration to known standards. Instrument recalibration should be performed prior to each sampling day or event for user-calibrated instruments (e.g., daily for handheld field meters: pH, conductivity, DO), or at the manufacturer-specified interval for instruments requiring factory servicing or otherwise incapable of field recalibration.

Completeness of field measurement is evaluated as a percentage of usable measurements out of the total number of measurements desired. More than 90% of field measurements should be usable. If a lower percentage is achieved for any sampling event or time period, causes shall be investigated and fixed where possible, through instrument maintenance (e.g., defouling), recalibration, repair, or replacement (with the same or different instrument type).

If completeness targets are not achieved, instrument choice, settings, deployment method, maintenance, and/or other activities shall be adjusted to improve measurement reliability before the next sampling event or measurement period.

7.2 Laboratory Performance Measurements

Laboratory performance measurements are included in the analysis stream to check if measurement quality objectives are met. These performance measurements are briefly defined below. Results of analyses of QC samples are to be reported with results of field samples. Minimum frequencies and target performance requirements (aka Measurement Quality Objectives or MQOs) for QC measures of reported analytes are specified in Tables in Section 14. The specific list of analytes to be measured and the QA/QC program used is in the individual

scopes that are part of contracts. QC measures typically used for evaluation of lab and field sampling performance include the following:

1. Method and Field Blanks: samples of a clean or null (e.g., empty container) matrix taken through the entire analytical procedure, including preservatives, reagents, and equipment used in preparation and quantitation of analytes in samples; including the field sampling procedures for field blanks. Field blanks are not part of tissue QC.
2. Surrogate (or internal) Standards: analytes (often isotopes or other substituted analogues of target compounds) introduced to samples to measure and correct for losses and errors introduced during analysis, with recoveries and corrections to reported values generally reported for each sample individually.
3. Matrix Spike Samples/Duplicates: field samples to which known amounts of target analytes are added, indicating potential analytical interferences present in field samples and errors or losses in analyses not accounted for by surrogate or internal standard correction.
4. Certified Reference Materials (CRM): CRMs are created or collected samples previously characterized for one or more analytes of interest, with reported "certified" or "reference" values (often reported with uncertainty/acceptance bands). Certified analytes have a higher degree of certainty in reported values due to external validation.
5. Lab Reference Materials/Laboratory Control Samples: materials collected or created by a laboratory as internal reference samples, sufficiently homogeneous and stable for target analytes to track performance across batches. Unlike CRMs, LRMs and LCSs seldom have external validation (i.e., measurement by another method or another lab) and are thus less certain as measures of accuracy, but are good for day-to-day indication of process control.
6. (Instrument) Replicates: replicate analyses of extracted material or standards that measure the instrumental precision.
7. Laboratory Replicates: replicate analyses of sub-samples of field samples, certified reference materials, lab reference materials, matrix spike samples, or laboratory control samples, taken through the full analytical procedure including all lab processes combined, used to evaluate overall measurement method precision.

These types of QC samples serve to evaluate and diagnose errors introduced during analysis. The remainder of this chapter will provide guidance for general laboratory requirements and protocols for checking and tracking possible sources of errors (outlined above) in the analytical process. Results of both field and lab QC samples will be reviewed by the SFEI QA Officer or designees for conformance with the reporting and data quality requirements.

Sensitivity of lab measurements, expressed as detection or reporting limits, are determined by a combination of factors, often including sample size, extraction efficiency, background contamination, matrix interferences, and instrument sensitivity. Appropriate methods should be chosen that generally allow significant differences between sites or within a site at different times to be reported. For chemical analyses, the ability to detect an analyte at concentrations at least 10 times below any applicable criterion or toxicity threshold, and preferably detected in at least half of all collected samples is generally desired. Such low detection limits are sometimes not achievable due to limitations on currently available instrumentation as well as other practical

constraints such as maximum extractable sample size, ubiquitous background contamination, and other factors. In such cases, analyses may proceed with the best currently available methodology, as long as the analyses provide information usable by the RMP (e.g., non-detects or semi-quantitative results providing estimates for upper bounds of possible concentrations), with attention to advances in instruments or methods that can overcome some of these obstacles.

Contamination of samples during field collection and/or during lab preparation and analytical procedures often provides a challenge to detection and quantitation of pollutants in environmental samples. Sources of blanks contamination include: the environment the analysis (or sampling) is performed in, reagents used, apparatus used, and the personnel involved with sampling or analysis. Method blanks are taken through the entire analytical procedure to evaluate cumulative contamination introduced by all the steps. Follow-up work investigating these steps individually can be used to isolate and correct or manage the contamination source. Field blanks are taken through the collection procedures using sampling equipment in the field to identify sources of contamination in field collections that may affect collected samples but not seen in lab method blanks. If field contamination is found, individual elements of the sample collection process can similarly be isolated to identify and fix causes of sample contamination.

Accuracy of lab measurements is evaluated by measurement of known standards or samples containing the appropriate analytes. Calibration standards and calibration-check samples establish the adequacy of instrument performance, but measurements of accuracy incorporating all preparation, extraction, and cleanup steps are required for evaluating the entire analytical process. When available, certified reference materials in an appropriate similar matrix and concentration range are most preferred, as the certified or reference values provide an external confirmation of the expected concentrations for those samples. However, in some cases, particularly for low level measurements (e.g., hydrophobic organics in water samples) or for newer contaminants of interest reported by relatively few labs, such materials are not available in many or any matrices, so recoveries for other sample types with expected or known values (e.g., LRMs, MSs, LCSs) may be used, but their use as exclusive indicators of measurement accuracy should be discussed with and agreed to by the Project Manager and QAO. In other cases, reference material may be available, but concentrations are much higher than those typically seen locally, so good accuracy on such reference materials provides less assurance of accuracy at lower concentrations. For such instances, other recovery sample types (i.e., LRMs, MSs, LCSs) may supplement to provide a better indication of ongoing measurement accuracy than high concentration certified reference materials alone.

Precision of lab measurements is determined by repeated measurement of an analyte within a single sample (e.g., via lab replicates sub-sampling a homogenous collected sample), or by measurement of field replicates collected simultaneously, in rapid succession, and/or close proximity in a homogenous location. For evaluation of lab performance, lab replicates are preferable, as uncertainty introduced by heterogeneity in the environment by field replicates is minimized. However, for some matrices (e.g., hydrophobic organic compounds in water), low ambient concentrations and consequent large sample size requirements do not allow sub-sampling for lab replicates without loss of measurement sensitivity, requiring use of separately collected field replicates for precision evaluation instead. In other cases where sample size and available material may be limited, other sample types may be used in place of locally field-collected samples as replicates. Such samples can include matrix or blank (LCS) spike replicates (at low levels within ~10x of those typically seen in field samples), larger field samples collected from other locations for other projects, and/or CRMs and LRMs for similar matrices. General

constraints for other sample types used for replicate analyses are that 1) the samples be taken through all the same analytical procedures (reagent additions, extractions, drying, etc.) and 2) that concentrations be similar in magnitude (at maximum 100x, preferably 10x or lower) to average project samples.

Completeness of laboratory measurement is evaluated as a percentage of usable measurements out of the total number of measurements desired. At least 90% of measurements should be usable. If a lower percentage is achieved for any sampling event or time period, the cause(s) shall be investigated and fixed where possible, through instrument maintenance, recalibration, repair, or replacement, and reanalysis of samples as needed. If completeness targets are not achieved, instrumentation and/or laboratory procedures and analytical methods shall be adjusted or changed to improve measurement reliability before the next sampling event or measurement period.

7.3 Laboratory Quality Control Procedures

Performance-based measures for chemical analyses consist of two basic elements: initial demonstration of laboratory capability (e.g., documentation that samples analyses can be performed within the measurement quality objectives) and on-going demonstration of capability during analysis of project samples. Prior to the initial analyses of samples for the project, each laboratory will demonstrate capability and proficiency.

7.3.1 Initial Demonstration of Capability

Initial documentation of method detection limits

Analytical chemists have coined a variety of terms to define "limits" of detection. Keith et al. (1983) and Keith (1991) provide definitions for some of the more commonly used terms. The method detection limit (MDL) represents a quantitative estimate of lowest-level response detectable at the maximum sensitivity of a method. The Code of Federal Regulations (40 CFR Part 136) gives the following definition:

> The MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

The American Society of Testing and Materials (ASTM) defines the limit of detection as:

> A concentration of twice the criterion of detection...when it has been decided that the risk of making a Type II error is to be equal to a Type I error.

In order to compare MDLs in quantitative terms by different laboratories participating in analyses, MDLs will initially be determined according to 40 CFR 136.2 (f) and Appendix B of 40 CFR 136 (current version) ***OR*** by a similar exercise of repeated analyses of blank or low-level samples taken through the full analytical process (all steps using all equipment and reagents).

Determining the MDL by statutory procedures is often painstaking and elaborate; however, for RMP purposes, they do not need to strictly follow statutes exactly, as the main objective is to estimate thresholds for quantitative measurement. Thus exceptions may be made to this general approach for determination of detection limits, particularly for analytes found at ultra-trace levels

(e.g., organic contaminants in ambient water), where MDLs derived by standard procedures above would typically show no detects in ambient samples, if sensitivity and high specificity of the method (e.g., HRMS detection) provide high confidence in the identification and low-level quantitation of analytes. Use of alternative methods for detection limit determination shall be discussed with the Project Manager and QAO for approval beforehand on a case-by-case basis.

The matrix and the amount of sample (e.g., dry weight of sediment or volume of water) used in calculating the MDL will match as closely as possible the matrix and typical sample amount of the actual field samples. In order to ensure the utility of results, MDL average values are provided (see Tables 7-1 through 7-13). These MDL averages have been derived empirically from previously reported literature or local monitoring and research efforts (e.g., previous RMP results), with the aim of obtaining semi-quantitative or quantitative results for most samples in the monitored matrices. These tables do not provide required maximum MDLs, but in concert with past analytical results provide targets for MDL ranges needed to obtain quantitative results on a regular basis.

The laboratory shall provide documentation/confirmation of the ability to analyze low-level samples. This shall be accomplished by analyzing a method blank spiked at about 10 times the method detection limit or a reference material in the appropriate range. Recoveries for analyses shall be within ±50% of the target value for 70% or more of the analytes. Exceptions may be granted for some high sensitivity and high specificity methods (e.g., HRMS/isotope dilution) where misidentification is unlikely, as approved by the RMP PM and QAO.

Limits of Quantitation

Taylor (1987) states “a measured value becomes believable when it is larger than the uncertainty associated with it”. The uncertainty associated with a measurement is calculated from the standard deviation of replicate measurements of a low concentration standard or a blank. Normally, the MDL is set at three times the standard deviation of replicate measurements, where the uncertainty of a measurement is approximately ±100% at the 95% level of confidence. Values at the MDL may not reflect a signal much above zero, and therefore are quantitatively not very robust. The limit of quantitation (LOQ), as established by the American Chemical Society, is normally ten times the standard deviation of replicate measurements (about 3 times the MDL), which corresponds to a measurement uncertainty of ±30% (Taylor 1987). By these standard definitions, measurements below the MDL are not believable, measurements between the MDL and the LOQ are only semi-quantitative, and confidence in measurements above the LOQ is high. Average or expected values on QC samples below 3 times the MDL therefore shall not be used in evaluation of laboratory measurement accuracy or precision.

Initial Analysis of Representative Samples

As appropriate, representative sample matrices that are uncompromised, homogeneous, and contain target analytes at relevant (e.g., near typical ambient) concentrations may be used to evaluate performance of analytical laboratories prior to routine analysis of field samples for the RMP. The samples used for this initial demonstration of laboratory capability can be splits used in laboratory inter-comparison exercises, or splits of samples previously or simultaneously analyzed by laboratories with known acceptable performance, or of CRMs with known values. A

new laboratory's performance generally will be considered acceptable if its submitted values are within accuracy and precision MQOs (Table 14-1) for target analytes at concentrations at least three times the project target MDL (~LOQ). If the results for the initial analysis fail to meet these criteria, the laboratory may be required to perform corrective actions to meet the performance criteria.

Laboratory inter-comparisons or split sample analyses may not be practical or feasible for some analytes and matrices (e.g., few capable labs, no consensus on expected concentrations). Another option would be a more limited evaluation of selected samples that represent the expected range of values. Results would be compared to an expected range of values obtained from the literature or from similar local/regional studies of comparable sample matrices and locations.

7.3.2 On-going Demonstration of Capability

Participation in Laboratory Inter-comparison Exercises

Laboratories analyzing applicable contaminants may be requested by the RMP Project Manager or QAO to participate in inter-comparison exercises conducted jointly by the U.S. National Institute of Standards and Technology (NIST), the National Research Council Canada (NRCC), InterCinD, or similar parties where available. The RMP PM & QAO will discuss with the laboratory potential intercomparison exercises to participate in; the laboratory may provide results from recent exercises as an alternative. These exercises provide a tool for validation and improvement of laboratory measurements by helping analysts identify and resolve problems in methodology and/or QA/QC. The results of these exercises are also used to evaluate both the individual and collective performance of the participating analytical laboratories on a continuing basis and to insure that ongoing measurements are meeting MQOs.

In a typical exercise, conducted on an annual or less frequent basis, the coordinating agency will distribute performance evaluation samples of an "unknown" sample and an existing CRM to each laboratory, along with detailed instructions for analysis. Laboratories then analyze the sample(s) and submit their results in a timely manner to the agency (as instructed). At the end of each exercise, coordinating personnel at the agency present and discuss the comparison exercise results, with participating laboratories strongly encouraged to participate in subsequent discussions of analytical problems and challenges identified in the inter-comparison exercises.

Routine Analysis of Certified or Laboratory Reference Materials

Certified reference materials generally are considered the most useful QC samples for assessing the accuracy (i.e., measurement relative to a "true" value) of a given analysis. CRMs are desirable because they have "certified" concentrations of the analytes of interest, as determined through replicate analyses by a reputable certifying agency, and/or multiple labs, using two or more independent measurement techniques for verification. In addition, the certifying agency may provide "reference" or "informational" values for other analytes of interest. Such values are determined using a single measurement technique, or a limited number of labs, which may have unrecognized bias and/or large uncertainty. Therefore, non-certified reference values must be used with caution as measures of laboratory performance. A second caution is that "certified" values in some cases are premised on a complete extraction the sample matrix (e.g., HF extraction of a sediment mineral phase), and a partial or less aggressive extraction is unlikely to

produce the certified result. In such cases, a CRM may be more equivalent to a laboratory internal reference material described below. CRMs desired for specific matrices and analytes will be discussed among the RMP PM, QAO, and the laboratory at the project/contract start.

A laboratory reference material (LRM) is similar to a certified reference material in that it is a homogeneous matrix that closely matches the samples being analyzed but is typically only used in-house by a single laboratory or small group of laboratories. Unlike CRMs, concentrations of the analytes of interest in LRMs are not certified, and may be analyzed only by a single method over time. In practice, this material is best used to assess the precision (i.e., consistency) of a single laboratory's performance over time but may be useful for evaluating accuracy, if the previous result has been shown to be accurate (e.g., in batches with CRMs reported accurately). Thus, if available, LRMs may be preferred for routine (i.e., day to day) analysis because CRMs are relatively expensive.

Routine analyses of CRMs (when available) or LRMs represent a valuable aspect of "performance-based" QC. Where available, certified and reference concentrations of target analytes known to the analyst(s) can be used to provide quick checks of batch performance before proceeding with analyses of subsequent batches. If the laboratory fails to meet precision and/or accuracy MQOs for a CRM or LRM, results for the sample batch may be suspect. Calculations and instruments should be checked; selected samples and the CRM or LRM may have to be reanalyzed to confirm the results. Some minor deviations outside MQOs may be expected, particularly at concentrations near the MDL and for analytes with wide confidence intervals in certified values. However, if MQOs are not achieved in consecutive samples, the laboratory should consult with the SFEI QAO and other parties to identify and correct possible source(s) of the problem. The results of the CRM or LRM analysis should never be used by the laboratory to "correct" the data for a given sample batch.

CRM (or LRM) samples should be analyzed at a minimum frequency of 1 per batch (or one per 20 samples for larger batches) when samples in an appropriate matrix (similar to samples) are available. Multiple CRM sources and/or replicate CRM analyses may help diagnose problems if deviations from desired MQOs or control limits are found. CRM or LRM recovery is calculated as:

$$\text{Recovery} = \frac{\text{Laboratory measurement}}{\text{Certified or Consensus Value}} \times 100\%$$

Accuracy control limits for individual compounds are listed in Table 14-1. We have adapted a modification of the IUPAC Harmonized Protocol for proficiency testing "z-scores" for normalizing performance relative to objectives, converting a result to a z-score:

$$z = |\text{result} - \text{expected value}|/\text{acceptable deviation}$$

which is converted into recovery percentages (normalizing everything to the expected value):

$$z = |\text{recovery} - 100\%|/\text{MQO}\%$$

where the MQO% is the accepted deviation (as %) from the expected value (e.g., ± 35% of expected value for most organics, ± 25% for most trace elements). For each class of analytes (i.e., a group of analytes reported by a single method), at least 70% of the individual analytes should be within the MQO (i.e., a z-score ≤ 1); no individual analyte value should be grossly outside the MQO (z-score > 2, e.g., ±70% for organics) more than once in consecutive analyses without appropriate documentation and consultation with

the SFEI QAO. Due to the inherent variability in analyses near the method detection limit, these limits only apply to analytes with expected values >3 times the MDL.

Concentrations of some analytes are provided only as (uncertified) reference values in some commonly used CRMs, and in some cases the acceptance range (e.g., 95% confidence interval) even for certified values of specific analytes may include z-scores > 2. In such cases, results may still be flagged for large deviations from expected values and uncertainty in quantitation, but should not be censored due to substantial uncertainty in what the underlying "true" expected values are.

Each laboratory is expected to maintain control charts for use by analysts in monitoring the overall accuracy and precision of the CRM or LRM. The relative standard deviation (RSD) will be calculated for each analyte of interest in the CRM based on the last seven or more CRM analyses. Upper and lower control chart limits (e.g., warning limits and control limits) should be based on 7 or more recent results (or initially, the confidence interval/acceptance limits of the CRM issuer) and will be periodically updated (at least annually, or more frequently if half or more of the data in the control chart can be replaced sooner, e.g., 10 new results for a 20 result chart); control limits for individual measurements based on 99% confidence intervals around the mean are recommended.

Laboratory Replicates for Precision

Precision is the reproducibility of an analytical method and can be evaluated for any sample that is analyzed in replicate. Replicates of field samples are most representative of local concentrations and conditions and thus are preferred indicators of analytical precision. However, analyte concentrations in local ambient samples are often non-detect or near MDLs. If all results are non-detect, precision is clearly not calculable, and if true values are near the MDL, a mix of non-detects and results slightly above MDL may be expected. However, if the average value (substituting a value of zero for any non-detects) for a set of replicates falls into a quantitative range at least 3 times the MDL (e.g., a non-detect and a value 100 times MDL, with an average value 50 times the MDL), the disparity in results represents a lack of precision and should be considered an indication of either poor precision or an underestimate of the MDL.

In general, laboratory replicates of field samples are preferred as measures of precision, but in cases where average values for field samples are expected (based on historical or literature results) to fall in a non-quantitative range, other samples such as CRMs, LRMs, matrix spikes, or blank spikes can be analyzed in replicate to determine precision. Samples of a similar matrix, with concentrations of a similar order of magnitude (but at least high enough to be quantitative), are most relevant and thus preferred for evaluating precision. If samples other than field samples are used to evaluate precision, target concentrations should be less than 100 times those in field samples, as precision in high concentration samples is not likely representative for much lower ambient samples.

A minimum of one field sample (or alternative sample type, e.g., MS or CRM/LRM, where sample material is insufficient or concentrations are largely not detected in field samples) per batch of samples submitted to the laboratory (minimum one per 20, or 5%, in large batches) will be processed and analyzed in replicate for precision. Previously analyzed material (e.g., from the same project in prior years, or from other projects) may also be analyzed as replicates to help ensure results in a quantitative range. The relative percent difference (RPD) or relative standard deviation (RSD) among replicate samples will be less than the MQO listed in Table 14-1 for

each analyte of interest. RSD and RPD are calculated as:

$$\text{RSD} = \frac{\text{Standard Deviation (all replicate samples)}}{\text{Average (all replicate samples)}} \times 100\%$$

$$\text{RPD} = \frac{\text{Difference (between replicate samples)}}{\text{Average (replicate samples)}} \times 100\%$$

Similar to z-scores for accuracy, precision may be expressed relative to an MQO as a p-score:

$$p = |\text{RPD or RSD}|/\text{MQO}\%$$

If results for any analytes do not meet the MQO for precision (p-score > 1), calculations and instruments will be checked. Repeat analyses may be required to confirm the results and reduce uncertainty in the measurement. Results that repeatedly fail to meet the criteria indicate sample heterogeneity, unusually high contamination of analytes, or other causes of poor laboratory precision. If the variability is not reduced, the laboratory is obligated to halt the analysis of samples, identify the source of the imprecision, and notify the SFEI Project Manager and QAO before proceeding with further analysis. In some cases when the causes of imprecision cannot be corrected (particularly for less abundant or less important analytes in a large group reported by a single analytical method), and with the approval of the Project Manager and QAO, the results can be reported as-is and flagged for poor precision (p-score > 1) or censored if extremely poor (p-score > 2).

Field Replicates and Field Split Samples

As part of the regular quality assurance program of the Project, field replicate samples may be collected, homogenized, and placed in separate sample containers for subsequent chemical analysis as funds allow. Some of the sample containers may be submitted as blind field replicates to the primary analytical laboratory. Others, considered field splits, may be sent to additional laboratories to conduct inter-laboratory comparisons, or for development and testing of laboratory methods. The analysis of field replicates and field splits will provide an assessment of both inter-and intra-laboratory precision and variability in the sample matrix and collection and homogenization methods. In many cases, variability in field replicates represents spatial and/or temporal variability in the environmental matrix being sampled, so field replicates should not be used in place of lab replicates to assess laboratory measurement performance unless the laboratory is in agreement that past results are sufficiently consistent for such use.

Matrix Spike and Matrix Spike Duplicate

A laboratory-fortified matrix sample (commonly called a matrix spike, or MS) and a laboratory-fortified sample matrix duplicate (commonly called a matrix spike duplicate, or MSD) will be used for both evaluating the effect of the sample matrix on the recovery of the compound(s) of interest and providing an estimate of analytical precision. For matrices without appropriate CRMs or LRMs, MSs become the preferred measure of accuracy. Even when CRMs or LRMs are available, MSs should be run as secondary confirmation of accuracy where possible. Around 5% of the total number of samples (and at least one per analytical batch) will be included for

analysis as MS/MSDs, where other recovery sample types (e.g., CRM and/or LRM) are not available/appropriate.

To create an MS and MSD, a field sample is first homogenized and then split into three subsamples. Two of these subsamples are fortified with the matrix spike solution, and the third subsample is analyzed to provide a background concentration for each analyte of interest. If there is sufficient material, a split into four subsamples may be preferred (with the unfortified sample also analyzed in duplicate). The matrix spike solution should contain as many analytes from the target list as is feasible and appropriate for the analysis. The final spiked concentration of each analyte in the sample should be at least 3x the MDL for the analyte and at least double (but preferably also within 10x) the expected concentrations in unspiked samples. Choosing an appropriate spiking level may be difficult when field sample concentrations are highly variable, because the initial concentration of the sample to be spiked is generally not known. However, spiking around 10x the 75^{th} to 90^{th} percentile of previous or nearby results for a site provides a reasonable likelihood of MS/MSD results being sufficiently above the unspiked result to calculate recovery. Recovery (in percent) is calculated as follows:

$$\text{Recovery} = \frac{[(\text{Matrix plus spike result}) - (\text{Matrix result})]}{\text{Spike amount}} \times 100\%$$

The spike amount is the expected final concentration minus the (unspiked) matrix result (written in expanded form in the Table 9-1 notes on calculating percent recovery for LabResultComment). If the percent recovery for any analyte in a usable quantitative range (i.e., at least 3x the MDL and at least 2x the concentration in the unspiked sample; MQO deviations below this range are disregarded) in the MS or MSD is not within target MQOs (Table 14-1), the chromatograms or other raw data quantitation reports will be reviewed to identify possible errors in quantitation (e.g., calculation errors, poor peak separation, etc.). If an explanation for low recovery value is not discovered, the instrument response should be rechecked with calibration standards. If the poor recovery occurs in both the MS and MSD, and the other QC samples in the batch (e.g., CRMs) indicate that the analysis was “in control”, further instrument response checks may not be warranted. An explanation for poor recovery values in MS/MSD results and investigations or corrective actions taken will be discussed in the narrative and/or lab batch comments (limited length database field, include further comments in submission letter as needed for details) accompanying the data package. If causes of poor recovery cannot be identified and fixed, results for affected analytes may need to be qualified (z-score > 1), or even censored if extremely poor (z-score > 2)

As mentioned previously in the section on precision, analysis of the MS/MSD can also be useful for assessing laboratory precision, particularly when unspiked field samples are near or below the MDL. When final expected values in the MS and MSD are exactly equal, the precision calculation can be made on their concentration results directly. However, in many cases, the MS and MSD will have slightly different expected values (e.g., due to variations in sample size; for example, addition of 10 ng of spike will result in different final expected concentrations if the subsample used for the MS is 9.5 g and the MSD 10 g). In cases where the MS/MSDs have slightly different values, precision should be calculated as the RPD or RSD of their respective recoveries. The RPD or RSD between MS/MSD results should be less than the target criterion listed in Table 14-1 for each analyte of interest, although replicate measurements for unspiked sample types are generally preferred as an indicator of precision at the lower concentration of ambient field samples.

Calibration Checks

Initial calibration check samples that are traceable to a recognized organization must be inserted as part of the sample stream. As an indicator of calibration accuracy, the source of the initial calibration check sample shall be independent from the standards used for the calibration and contain all the analytes of interest, and should be at a concentration in the middle of the calibration range.

Continuing calibration checks should also be included as an indication of measurement stability. The source of the continuing checks can be that used in the initial calibration check or the same standards as used for the calibration (including calibration blanks, to track baseline drift), as required or recommended by the analytical method. Either may be suitable for demonstrating continued stability of measurement so long as the result is consistent (for either check sample source). The frequency of these checks is dependent on the type of instrumentation and analytical method used and, therefore, requires considerable professional judgment. All analyses shall be bracketed by acceptable calibration checks.

If the calibration check control limits (set by the laboratory) are not met, the initial calibration will have to be repeated. If possible, any samples analyzed since the last successful calibration check will be reanalyzed following recalibration. If reanalyses of all potentially impacted samples is not planned, reanalyses of samples should progress in reverse order until it is determined that the precision between initial and reanalysis results is within MQOs (Table 14-1). The laboratory will begin by reanalyzing the last sample (or subset of samples) analyzed before the failed calibration check. If the RPD or RSD between the results of this reanalysis and the original analysis exceeds precision MQOs (Table 14-1), the analytical process is likely to have been out of control during the original analysis. The laboratory will report only results from analyses while the process is in control (i.e., within calibration, or in agreement with other subsequent results obtained while within calibration). If it is not possible to perform reanalysis of samples, all earlier data (i.e., since the last successful calibration control check) are suspect. In this case, the laboratory will flag the data and prepare a narrative explanation to accompany the submitted data.

Laboratory Method Blank

Laboratory method blanks (also called extraction blanks, procedural blanks, or preparation blanks) are used to assess laboratory contamination during all stages of sample preparation and analysis. For laboratory analyses, at least one laboratory method blank will be run in every sample batch. The method blank will be processed through the entire analytical procedure in a manner identical to the samples (i.e., using the same reagents and equipment). Method blanks should contain analyte concentration less than the MDL or 30% of the lowest reported sample concentration. Upon discovery of blank contamination in any batch, the RMP QAO should be notified before additional batches are analyzed. A method blank concentration > 2× the MDL or > 30% of the lowest reported sample concentration for any analytes of interest may require corrective action (e.g., checking of reagents, re-cleaning and re-checking of equipment) to identify and eliminate the source(s) of contamination before proceeding with further analysis; in cases where blank contamination accounts for 30% or more of the result for a third or more of

the samples, re-extraction of analyzed batches may be requested. If eliminating the blank contamination and reanalysis is not possible, results for all impacted analytes in the analytical batch shall be flagged. In addition, a detailed description of the contamination sources and the steps taken to identify and eliminate/minimize them shall be included in the transmittal letter. Subtracting method blank results from sample results is not permitted, except where 3 × STDEV of the mean blank measurement can be demonstrated to be less than or equal to the MDL.

Completeness

Completeness is defined as "a measure of the amount of data collected from a measurement process compared to the amount that was expected to be obtained under the conditions of measurement" (Stanley and Verner 1985). The goal is to achieve >95% completeness for all analyses.

Surrogates

The usage of the terms "surrogate", "injection internal standard", and "internal standard" varies considerably among laboratories and is clarified here.

Surrogates are non-target analytes chosen to simulate the analytes of interest for estimating analyte losses during the extraction and cleanup process and must be added to each sample, including QA/QC samples, prior to extraction. Typically, isotopically labeled versions of target compounds are used as surrogates in organic compound analyses. The reported concentrations of corresponding analytes are adjusted to correct for the recoveries of surrogate compounds, as done in the National Status & Trends (NS&T) Program of the National Oceanic and Atmospheric Administration (NOAA), although it is left to the discretion of the lab as to the suitability of surrogate correction, especially for those that are not just isotopically labeled targets. The surrogate recovery data will be carefully monitored and each laboratory must report the percent recovery of surrogates along with the target analyte data for each sample. If possible, isotopically labeled analogs of the analytes will be used as surrogates.

Each laboratory will set its own warning limit criteria based on the experience and best professional judgment of the analyst(s). It is the responsibility of the analyst(s) to demonstrate that the analytical process is always "in control" (i.e., highly variable surrogate recoveries are not acceptable for repeat analyses of the same certified reference material and for the matrix spike/matrix spike duplicate). The target analytes to which specific surrogates correspond and the warning limit criteria used by the laboratory will be provided in the standard operating procedures submitted.

Internal Standards

Organic and inorganic chemical analyses commonly use the term "internal standard" but often use them in different ways. For organic analyses, internal standards (also referred to as "injection internal standards") are added to each sample extract just prior to injection to enable optimal quantitation, particularly of complex extracts subject to retention time shifts or instrument interferences relative to the analysis of standards. They are essential, if the actual recovery of the surrogates typically added prior to extraction is to be calculated. Internal standards can also be used to detect and correct for problems in the injection port or other parts of the instrument. Internal standard analytes must be different from surrogate analytes. The analyst(s) will monitor

internal standard retention times and recoveries to determine if instrument maintenance or repair or changes in analytical procedures are needed. Corrective action will be initiated based on the judgment of the analyst(s). Instrument problems that may have affected the data or resulted in the reanalysis of samples will be documented properly in logbooks and internal data reports and used by the laboratory personnel to take appropriate corrective action.

For inorganic analysis methods, "internal standards" can be added at various points in the sample preparation process (not just immediately preceding instrument quantitation). For diagnostic purposes injection internal standards are sometimes also used to distinguish whether quantitation errors occur primarily in the instrument measurement or in prior steps (e.g., sample extraction or dilution). Internal standards added to calibration checks and other unextracted samples can also help differentiate problems with instrument performance versus sample processing. At a minimum, internal standards specified in the analytical method should be used; other internal standards may be added at the discretion of the laboratory for diagnosing performance in different portions of the analytical process.

Confirmatory Analysis

For analyses in which important specific analytes may not be positively isolated or quantified (e.g., for 2,3,7,8-TCDF in dioxin analysis), confirmatory analyses (using a different detector, or different analytical separations) are often employed to minimize erroneous identification and quantitation. In analytical methods for which confirmatory analysis is prescribed, confirmatory results should agree within the limits specified in the method. If the method does not include limits for confirmation results, the MQO for replicate precision for the analyte may be used as a control limit indicating agreement. If results are not in agreement, the cause of the discrepancy should be investigated and corrected, with samples reanalyzed if needed. When both primary and confirmatory results are in agreement, the result that most positively identifies and quantifies the analyte without interference should be reported as the final measurement. Generally, if neither of the methods is specified as being more reliable for quantitation, lower values suggest less interference, unless the analyst has experience or evidence of negative interferences that are likely to bias the signal low (e.g., matrix constituents causing signal quenching).

Representativeness

Sampling locations, times, frequencies, and matrices are selected to capture and describe spatial and temporal variations of interest to the RMP. The sampling and analytical methods were chosen in accordance with approved and well-documented procedures that best meet the RMP's objectives. Through selection of relevant media (water, sediment, and biota) with sampling distributed over time throughout the estuary, a representative characterization of the sampling site and the parameters investigated will be achieved. Representativeness will be assessed through post hoc analysis of the temporal and spatial distribution and variability in the collected data.

7.4 Project-specific action limits

As this is a research project rather than a compliance monitoring effort (i.e., individually results do not trigger enforcement actions, but collectively the data may guide management actions by other parties through planning), there are no project-specific actions limits required for the data.

7.5 Target MDL Tables

MDL averages presented here are from the 3 most recent sampling events conducted by the RMP for each given matrix and analyte group and may not be applicable for a particular lab and analytical method. The target MDLs presented here are typically achieved MDLs based on historic results. MDLs are generally inversely proportional to the analyzed subsample. Where subsample masses differ significantly from the summarized analyses (Tern organics), target MDL values will vary.

Table 9 Target MDLs for ancillary parameters in analyses of sediment and water

Matrix - Units	**Sediment - % dw**	
	Average MDL	**Lab – Method**
Total Organic Carbon	1.00E-02	EPA 9060M - EPA 440
Nitrogen, Total	1.97E-02	EPA 440
Matrix - Units	**Water - mg/L**	
	Average MDL	**Lab – Method**
Ammonium as N	6.00E-03	EBMUD - Solorzano, L., 1969
Dissolved Organic Carbon	1.00E+02	ALS - EPA 9060 / 9060M
Particulate Organic Carbon	5.02E+01	ALS – EPA 440 - EPA 9060 / 9060M
Chlorophyll a	3.50E-02	CALTEST - SM 10200 H
Matrix - Units	**Water - mg/L**	
	Average MDL	**Method**
Suspended Sediment Concentration	9.95E-01	BR – EPA 160.2M
Silica as SiO2	5.04E-02	EBMUD - SM 4500-SiO2 C, EPA 370.1
Pheophytin a	5.82E-02	EBMUD - SM 10200 H-2aM
Hardness as CaCO3	1.17E+01	BR - EPA 1638M
Nitrate as N	7.00E-03	EBMUD - EPA 353.2
Nitrite as N	5.00E-03	EBMUD - EPA 353.2
Salinity	7.04E-01	EBMUD - 2520B
Matrix	**Water - assorted units**	
Method	AMS-CA - YSI 556 Water Quality Meter	
	Average MDL	

Oxygen, Dissolved	0.3 mg/L	
pH	1.00E-02	
SpecificConductivity	1000 uS/cm	
Temperature	0.1 Deg C	

Table 10 Target MDLs for ancillary parameters in analyses of sediment and water

Matrix	**Sediment - mg/kg dw**	
Analyte Name	**Average MDL**	**Lab - Method**
Aluminum	1.05E+01	EPA 6020AM
Cadmium	3.42E-02	EPA 6020AM
Copper	1.20E-01	EPA 6020AM
Iron	4.10E+01	EPA 6020AM
Lead	2.64E-02	EPA 6020AM
Manganese	1.84E-01	EPA 6020AM
Nickel	7.74E-02	EPA 6020AM
Silver	3.76E-03	EPA 6020AM
Zinc	4.95E-01	EPA 6020AM
Arsenic	9.41E-02	EPA 6020AM - EPA 1638M
Mercury, Methyl	2.20E-02	EPA 1630M
Mercury	4.55E-03	EPA 6020AM – EPA 1631
Selenium	2.88E-02	EPA 6020AM – EPA 1632
Matrix	**Surface Water - µg/L**	
Analyte Name	**Average MDL**	**Lab - Method**
Arsenic	3.00E-02	BA - EPA 1640
Cadmium	3.00E-03	BA - EPA 1640
Cobalt	1.64E-02	BA - EPA 1640
Copper	3.00E-02	BA - EPA 1640
Lead	2.53E-02	BA - EPA 1640
Nickel	3.00E-02	BA - EPA 1640
Selenium	4.00E-02	BA - EPA 1630M
Silver	2.43E-03	BA - EPA 1640
Zinc	8.51E-02	BA - EPA 1640
Mercury, Methyl	1.01E-02	BA - EPA 1630M

Mercury	1.91E-04	BA - EPA 1631EM
Iron	5.46E+00	BA - EPA 1638M
Manganese	5.09E-01	BA - EPA 1638M
Cyanide	9.10E-01	BA - BA-4400 Rev 001
Matrix	**Stormwater - µg/L**	
Analyte Name	**Average MDL**	**Lab - Method**
Mercury, Methyl	2.00E-02	CALTEST - EPA 1630
Mercury	2.50E-04	CALTEST - EPA 1631E
Copper	7.00E-02	CALTEST - EPA 1638
Selenium	6.00E-02	CALTEST - EPA 1638
Matrix	**Bivalves - µg/g dw**	
Analyte Name	**Average MDL**	**Lab - Method**
Selenium	4.22E-02	EPA 6020AM - EPA 1638M
Matrix	**Bird Eggs - µg/g ww**	
Analyte Name	**Average MDL**	**Lab - Method**
Mercury	4.00E-03	MPSL-DFW - EPA 7473
Matrix	**Bird Eggs - µg/g dw**	
Analyte Name	**Average MDL**	**Lab - Method**
Selenium	9.60E-01	MPSL-DFW - EPA 200.8
Matrix	**Sport fish - µg/g ww**	
Analyte Name	**Average MDL**	**Lab - Method**
Mercury	1.20E-02	MPSL-DFW - EPA 7473
Selenium	1.50E-01	BA - BAL-5000 Rev 001a

Table 11 Target MDLs for alkylated polycyclic aromatic hydrocarbons (AlkPAHs) in analyses of sediment, waters and tissues

The gray shade indicates that there were >25% ND results, and
gray shade with italic text indicates that there were >50% ND results.

Matrix	**Sediment - µg/kg dw**	**Water -pg/L**	**Stormwater - pg/L**	**Bivalves - ng/g dw**	**Bird Eggs - ng/g ww**	**Sport fish - ng/g ww**
Method	EPA 8270M	AXYS - MLA-021 Rev 07-08	None (Not Analyzed)	EPA 8270M	None (Not Analyzed)	None (Not Analyzed)
	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
Benz(a)anthracenes/Chrysenes, C1-		3.84E+01		9.46E-02		
Benz(a)anthracenes/Chrysenes, C2-		5.80E+01		9.13E-02		
Benz(a)anthracenes/Chrysenes, C3-		2.31E+01		7.48E-02		
Benz(a)anthracenes/Chrysenes, C4-		2.45E+01		8.11E-02		
Chrysenes, C1-	1.39E+00					
Chrysenes, C2-	*1.40E+00*					
Chrysenes, C3-	*1.40E+00*					
Chrysenes, C4-	*1.40E+00*					
Dibenzothiophenes, C1-	*1.40E+00*	4.05E+01		1.97E-01		
Dibenzothiophenes, C2-	*1.40E+00*	5.42E+01		4.12E-01		
Dibenzothiophenes, C3-	*1.40E+00*	5.39E+01		2.26E-01		
Fluoranthene/Pyrenes, C1-	1.39E+00	5.42E+01		1.11E-01		
Fluorenes, C1-	*1.40E+00*	1.86E+02		2.93E-01		
Fluorenes, C2-	*1.40E+00*	1.22E+02		1.73E-01		
Fluorenes, C3-	*1.40E+00*	1.64E+02		1.73E-01		
Naphthalenes, C1-	1.41E+00	5.38E+01		1.23E-01		
Naphthalenes, C2-	1.40E+00	1.03E+02		2.74E-01		
Naphthalenes, C3-	1.39E+00	7.39E+01		1.41E-01		
Naphthalenes, C4-	*1.40E+00*	1.10E+02		3.09E-01		
Phenanthrene/Anthracene, C1-	1.40E+00	4.03E+01		8.13E-02		
Phenanthrene/Anthracene,	1.40E+00	5.95E+01		2.13E-01		

C2-						
Phenanthrene/ Anthracene, C3-	1.40E+00	7.22E+01		3.68E-01		
Phenanthrene/ Anthracene, C4-	*1.40E+00*	1.64E+02		6.29E-01		

Table 12 Target MDLs for PAHs in analyses of sediment, waters and tissues

Matrix	**Sediment - µg/kg dw**	**Water -pg/L**	**Bivalves - ng/g dw**	**Stormwater - pg/L**	**Bird Eggs - ng/g ww**	**Sport fish - ng/g ww**
Method	EPA 8270M	SGS-AXYS - MLA-021 Rev 07-08	EPA 8270M	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)
	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
Acenaphthene	1.68E+00	5.50E+01	8.82E-02			
Acenaphthylene	1.54E+00	3.48E+01	6.74E-02			
Anthracene	1.16E+00	4.00E+01	9.09E-02			
Benz(a)anthracene	5.33E-01	2.34E+01	*2.07E-01*			
Benzo(a)pyrene	2.10E+00	5.31E+01	1.79E-01			
Benzo(b)fluoranthene	2.94E+00	3.35E+01	1.20E-01			
Benzo(e)pyrene	2.38E+00	4.68E+01	1.51E-01			
Benzo(g,h,i)perylene	1.07E+00	5.80E+01	*1.77E-01*			
Benzo(j/k)fluoranthene	3.22E+00	4.17E+01	3.15E-01			
Biphenyl	7.43E-01	3.93E+01	7.50E-02			
Chrysene	1.29E+00	2.83E+01	9.00E-02			
Chrysenes, C1-	1.39E+00					
Chrysenes, C2-	*1.40E+00*					
Chrysenes, C3-	*1.40E+00*					
Dibenz(a,h)anthracene	1.34E+00	5.94E+01	1.66E-01			
Dibenzothiophene	1.26E+00	3.66E+01	*6.37E-02*			
Dibenzothiophenes, C1-	*1.40E+00*	4.05E+01	1.97E-01			

Dibenzothiophenes, C2-	*1.40E+00*	5.42E+01	4.12E-01			
Dibenzothiophenes, C3-	*1.40E+00*	5.39E+01	2.26E-01			
Dimethylnaphthalene, 2,6-	2.80E+00	8.34E+01	1.53E-01			
Fluoranthene	1.41E+00	3.35E+01	6.10E-02			
Fluoranthene/Pyrenes, C1-	1.39E+00	5.42E+01	1.11E-01			
Fluorene	1.82E+00	4.48E+01	5.91E-02			
Fluorenes, C1-	*1.40E+00*	1.86E+02	2.93E-01			
Fluorenes, C2-	*1.40E+00*	1.22E+02	1.73E-01			
Fluorenes, C3-	*1.40E+00*	1.64E+02	1.73E-01			
Indeno(1,2,3-c,d)pyrene	1.29E+00	5.95E+01	1.48E-01			
Methylnaphthalene, 1-	1.37E+00	5.70E+01	2.91E-01			
Methylnaphthalene, 2-	7.21E-01	5.39E+01	1.23E-01			
Methylphenanthrene, 1-	1.39E+00	4.05E+01	8.13E-02			
Naphthalene	2.24E+00	1.01E+02	2.10E-01			
Naphthalenes, C1-	1.41E+00	5.38E+01	1.23E-01			
Naphthalenes, C2-	1.40E+00	1.03E+02	2.74E-01			
Naphthalenes, C3-	1.39E+00	7.39E+01	1.41E-01			
Naphthalenes, C4-	*1.40E+00*	1.10E+02	3.09E-01			
Perylene	1.96E+00	5.65E+01	1.76E-01			
Phenanthrene	7.01E-01	3.99E+01	6.98E-02			
Phenanthrene/Anthracene, C1-	1.40E+00	4.03E+01	8.13E-02			
Phenanthrene/Anthracene, C2-	1.40E+00	5.95E+01	2.13E-01			
Phenanthrene/Anthracene, C3-	1.40E+00	7.22E+01	3.68E-01			
Phenanthrene/Anthracene, C4-	*1.40E+00*	1.64E+02	6.29E-01			
Pyrene	2.24E+00	3.32E+01	1.80E-01			

Trimethylnaphthalene, 2,3,5-	2.10E+00	7.14E+01	*1.12E-01*			

Table 13 Target MDLs for PBDEs in analyses of sediment, waters and tissue

The gray shade indicates that there were >25% ND results, and
gray shade with italic text indicates that there were >50% ND results.

Matrix	**Sediment - µg/kg dw**	**Water - pg/L**	**Stormwater - pg/L**	**Bivalves - ng/g dw**	**Bird Eggs - ng/g ww**	**Sport fish - ng/g ww**
Method	EPA 1614M	None (Not Analyzed)	None (Not Analyzed)	EPA 1614M	EPA 8081BM	EPA 1614A
	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
PBDE 007	8.64E-03			1.94E-03		
PBDE 008	*2.48E-02*			2.25E-03		
PBDE 010	*1.55E-02*			*1.86E-03*		
PBDE 012	*7.19E-02*			1.68E-03		
PBDE 015	1.72E-02			1.14E-03		
PBDE 017	1.53E-02			6.48E-03	*4.84E-02*	1.22E-01
PBDE 025	1.53E-02				4.84E-02	1.47E-01
PBDE 028	*2.61E-02*			2.80E-03	*4.84E-02*	1.46E-01
PBDE 030	*1.04E-02*			*5.61E-03*	*4.84E-02*	1.20E-01
PBDE 032	*2.33E-02*			*3.99E-03*		
PBDE 033	2.61E-02				4.84E-02	9.62E-02
PBDE 035	*1.25E-02*			*4.43E-03*		
PBDE 037	*1.29E-02*			3.17E-03		
PBDE 047	1.71E-02			9.81E-04	4.84E-02	2.23E-01
PBDE 049	7.59E-03			1.10E-03	4.84E-02	1.33E-01
PBDE 051	*1.75E-02*			9.52E-04		
PBDE 066	5.34E-03			1.10E-03	*4.84E-02*	1.69E-01
PBDE 071	*1.15E-02*			1.19E-03		
PBDE 075	*1.75E-02*			1.08E-03		
PBDE 077	*1.89E-02*			*1.00E-03*		
PBDE 079	*9.61E-03*			*1.00E-03*		
PBDE 085	*2.16E-02*			8.97E-03	*9.69E-02*	2.59E-01
PBDE 099	2.58E-02			5.33E-03	9.69E-02	
PBDE 100	1.28E-02			3.66E-03	9.69E-02	1.22E-01

PBDE 105	*3.04E-02*			*1.10E-02*		
PBDE 116	*1.64E-02*			*1.55E-02*		
PBDE 119	*2.93E-02*			1.18E-02		
PBDE 126	*2.33E-02*			*5.60E-03*		
PBDE 128	*4.99E-02*			*1.39E-02*		
PBDE 138	*6.61E-02*			4.90E-03	*9.69E-02*	1.33E-01
PBDE 140	*1.51E-02*			3.06E-03		
PBDE 153	7.98E-03			3.11E-03	9.69E-02	1.23E-01
PBDE 154	8.00E-03			1.74E-03	9.69E-02	1.50E-01
PBDE 155	*1.48E-02*			2.23E-03		
PBDE 179					*1.94E-01*	2.10E-01
PBDE 181	*2.30E-02*			*2.77E-03*		
PBDE 183	*9.30E-03*			*6.05E-03*	*1.94E-01*	3.42E-01
PBDE 184					*1.94E-01*	1.12E-01
PBDE 188					*1.94E-01*	1.51E-01
PBDE 190	*6.75E-02*			*2.28E-03*	*1.94E-01*	2.59E-01
PBDE 196	*1.75E-02*					
PBDE 197	*1.75E-02*			5.75E-03		
PBDE 200					1.94E-01	1.56E-01
PBDE 201					*1.94E-01*	1.36E-01
PBDE 202					*1.94E-01*	2.46E-01
PBDE 203	*4.19E-02*			*1.00E-02*	1.94E-01	2.93E-01
PBDE 204	*8.31E-02*					
PBDE 205	*5.51E-02*			*3.58E-03*		
PBDE 206	1.10E-02			*1.46E-02*	*4.84E-01*	5.99E-01
PBDE 207	*4.64E-02*			1.48E-02	*4.84E-01*	1.06E+00
PBDE 208	*5.99E-02*			*1.83E-02*	*4.84E-01*	8.35E-01
PBDE 209	1.09E-01			2.14E-01	*1.94E+00*	2.64E+00

Table 14 Target MDLs for PCBs in analyses of sediment, waters and tissues

The gray shade indicates that there were >25% ND results, and
gray shade with italic text indicates that there were >50% ND results.

*DO### - indicates that the analyte coelutes and the ### represents the anlayte that SFEI reports the data with.

Matrix	**Sediment -**	**Water -pg/L**	**Stormwater -**	**Bivalves - ng/g**	**Bird Eggs -**	**Sport fish -**

	µg/kg dw		**pg/L**	**dw**	**ng/g ww**	**ng/g ww**
Method	EPA 1668A	AXYS - MLA-010 Rev 08-10	AXYS MLA-010 Rev 11	EPA 1668A	EPA 8082M	DFG-WPCL - EPA 8082M
	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
PCB 001	4.32E-04	3.44E-02		1.36E-03		
PCB 002	3.84E-04	3.56E-02		1.71E-03		
PCB 003	3.54E-04	3.71E-02		2.18E-03		
PCB 004	1.22E-03	1.16E-01		7.36E-03		
PCB 005	7.64E-04	7.54E-02		*5.53E-03*		
PCB 006	7.57E-04	6.60E-02		5.42E-03		
PCB 007	8.37E-04	6.73E-02		*5.38E-03*		
PCB 008	7.02E-04	1.68E-01	1.38E+00	2.08E-03	*1.94E-01*	1.98E-01
PCB 009	7.84E-04	6.59E-02		*4.83E-03*		
PCB 010	8.01E-04	6.20E-02		*4.78E-03*		
PCB 011	8.30E-04	9.09E-02	0.00E+00	5.48E-03		
PCB 012	DO013*	DO013*	DO013*	DO013*		
PCB 013	7.98E-04	9.05E-02		*6.27E-03*		
PCB 014	8.49E-04	6.92E-02		*5.12E-03*		
PCB 015	8.43E-04	7.56E-02		6.21E-03		
PCB 016	3.68E-04	3.51E-02		8.71E-03		
PCB 017	2.82E-04	3.21E-02		5.66E-03		
PCB 018	1.95E-04	3.42E-02	4.82E-01	4.18E-04	*1.94E-01*	1.98E-01
PCB 019	3.69E-04	3.72E-02		3.72E-03		
PCB 020	DO028*	DO028*	DO028*	DO028*		
PCB 021	DO033*	DO033*	DO033*	DO033*		
PCB 022	3.03E-04	4.00E-02		1.76E-03		
PCB 023	*3.03E-04*	3.76E-02		*1.66E-03*		
PCB 024	2.25E-04	3.38E-02		*1.64E-03*		
PCB 025	3.01E-04	3.39E-02		1.40E-03		
PCB 026	3.01E-04	4.76E-02		1.62E-03		
PCB 027	2.09E-04	3.34E-02	0.00E+00	3.00E-03	*1.94E-01*	1.98E-01
PCB 028	1.85E-04	3.85E-02	6.02E-01	6.94E-04	1.94E-01	1.98E-01
PCB 029	DO026*	DO026*	DO026*	DO026*	*2.36E-01*	1.25E-01
PCB 030	DO018*	DO018*	DO018*	DO018*		
PCB 031	1.70E-04	3.68E-02	5.65E-01	6.40E-04	1.94E-01	1.98E-01

PCB 032	2.03E-04	3.61E-02		1.52E-03		
PCB 033	1.86E-04	3.75E-02	5.72E-01	6.57E-04	*1.94E-01*	1.98E-01
PCB 034	3.05E-04	3.83E-02		*1.99E-03*		
PCB 035	4.47E-04	4.18E-02		2.77E-03		
PCB 036	5.39E-04	3.74E-02		*2.23E-03*		
PCB 037	4.61E-04	4.09E-02		2.46E-03		
PCB 038	5.43E-04	3.79E-02		*1.61E-03*		
PCB 039	4.88E-04	3.81E-02		*2.81E-03*		
PCB 040	4.12E-04	3.12E-02		2.88E-03		
PCB 041	0.00E+00					
PCB 042	4.24E-04	3.13E-02		2.51E-03		
PCB 043	6.08E-04	3.38E-02		5.69E-03		
PCB 044	3.63E-04	3.63E-02	5.53E-01	5.56E-04	*1.94E-01*	1.98E-01
PCB 045	3.89E-04	3.11E-02		2.30E-03		
PCB 046	4.49E-04	3.37E-02		5.10E-03		
PCB 047	DO044*	DO044*	DO044*	DO044*		
PCB 048	3.99E-04	3.12E-02		3.57E-03		
PCB 049	3.18E-04	3.49E-02	5.32E-01	5.17E-04	1.94E-01	1.98E-01
PCB 050	DO053*	DO053*	DO053*	DO053*		
PCB 051	DO045*	DO045*	DO045*	DO045*		
PCB 052	3.59E-04	3.73E-02	5.71E-01	5.90E-04	1.94E-01	1.98E-01
PCB 053	3.72E-04	3.06E-02		2.13E-03		
PCB 054	2.46E-04	2.82E-02		1.80E-03		
PCB 055	*7.50E-04*	5.56E-02		*5.18E-03*		
PCB 056	4.53E-04	8.35E-02	1.05E+00	4.94E-03	1.94E-01	1.98E-01
PCB 057	6.87E-04	5.38E-02		*4.95E-03*		
PCB 058	6.89E-04	5.47E-02		*5.10E-03*		
PCB 059	2.98E-04	2.71E-02		1.56E-03		
PCB 060	4.50E-04	8.42E-02	1.02E+00	5.00E-03	1.94E-01	1.98E-01
PCB 061	DO070*	DO070*	DO070*	DO070*		
PCB 062	DO059*	DO059*	DO059*	DO059*		
PCB 063	6.41E-04	5.20E-02		6.66E-03		
PCB 064	3.03E-04	2.64E-02	0.00E+00	1.56E-03	*1.94E-01*	1.98E-01
PCB 065	DO044*	DO044*	DO044*	DO044*		

PCB 066	4.44E-04	7.77E-02	9.64E-01	6.27E-03	6.19E-01	1.98E-01
PCB 067	6.71E-04	4.82E-02		6.06E-03		
PCB 068	5.98E-04	5.34E-02		6.04E-03		
PCB 069	DO049*	DO049*	DO049*	DO049*		
PCB 070	4.30E-04	7.93E-02	9.48E-01	4.87E-03	2.91E-01	2.98E-01
PCB 071	DO040*	DO040*	DO040*	DO040*		
PCB 072	6.60E-04	5.18E-02		1.27E-02		
PCB 073	*DO043**	DO043*	DO043*	*2.15E-03*		
PCB 074	DO070*	DO070*	DO070*	DO070*	5.17E-01	1.25E-01
PCB 075	DO059*	DO059*	DO059*	DO059*		
PCB 076	DO070*	DO070*	DO070*	DO070*		
PCB 077	5.14E-04	5.63E-02	0.00E+00	5.76E-03	*1.94E-01*	1.98E-01
PCB 078	*7.58E-04*	5.65E-02		*4.82E-03*		
PCB 079	6.02E-04	4.77E-02		8.22E-03		
PCB 080	*6.15E-04*	5.04E-02		*4.38E-03*		
PCB 081	*5.13E-04*	5.94E-02		*6.34E-03*		
PCB 082	8.30E-04	4.84E-02		6.15E-03		
PCB 083	0.00E+00		0.00E+00			
PCB 084	5.62E-04	4.81E-02		6.91E-03		
PCB 085	6.05E-04	3.90E-02		4.71E-03		
PCB 086	DO087*	DO087*	DO087*	DO087*		
PCB 087	3.81E-04	4.65E-02	9.43E-01	2.45E-03	2.91E-01	2.98E-01
PCB 088	DO091*	DO091*	DO091*	DO091*		
PCB 089	5.15E-04	4.55E-02		9.67E-03		
PCB 090	DO101*	DO101*	DO101*	DO101*		
PCB 091	4.68E-04	4.37E-02		6.07E-03		
PCB 092	4.99E-04	4.45E-02		8.20E-03		
PCB 093	0.00E+00		0.00E+00			
PCB 094	4.97E-04	4.67E-02		7.28E-03		
PCB 095	3.76E-04	5.06E-02	1.08E+00	2.65E-03	*2.91E-01*	2.98E-01
PCB 096	3.26E-04	2.89E-02		2.42E-03		
PCB 097	DO087*	DO087*	DO087*	DO087*	*2.36E-01*	1.25E-01
PCB 098	DO095*	DO095*	DO095*	DO095*		
PCB 099	3.51E-04	5.29E-02	1.11E+00	2.95E-03	1.65E+00	1.98E-01

PCB 100	DO093*	DO093*	DO093*	DO093*		
PCB 101	3.64E-04	4.72E-02	9.50E-01	2.46E-03	1.18E+00	5.01E-01
PCB 102	0.00E+00		0.00E+00		0.00E+00	0.00E+00
PCB 103	4.49E-04	4.02E-02		7.41E-03		
PCB 104	*3.05E-04*	3.03E-02		*2.30E-03*		
PCB 105	4.86E-04	9.27E-02	1.63E+00	7.58E-03	8.00E-01	0.00E+00
PCB 106	*5.88E-04*	6.53E-02		*1.11E-02*		
PCB 107	DO124*	DO124*	DO124*	DO124*		
PCB 108	DO124*	DO124*	DO124*	DO124*		
PCB 109	5.97E-04	6.54E-02		1.14E-02		
PCB 110	3.63E-04	4.20E-02	7.92E-01	2.06E-03	2.91E-01	2.98E-01
PCB 111	5.13E-04	3.65E-02		9.55E-03		
PCB 112	*3.75E-04*	3.55E-02		*4.37E-03*		
PCB 113	DO101*	DO101*	DO101*	DO101*		
PCB 114	5.48E-04	7.29E-02	0.00E+00	1.33E-02	1.94E-01	1.98E-01
PCB 115	DO110*	DO110*	DO110*	DO110*		
PCB 116	DO085*	DO085*	DO085*	DO085*		
PCB 117	DO085*	DO085*	DO085*	DO085*		
PCB 118	4.53E-04	9.50E-02	1.55E+00	7.33E-03	4.28E+00	3.66E-01
PCB 119	DO087*	DO087*	DO087*	DO087*		
PCB 120	5.37E-04	3.57E-02		3.91E-03		
PCB 121	*3.53E-04*	3.66E-02		*5.25E-03*		
PCB 122	6.10E-04	7.31E-02		1.31E-02		
PCB 123	5.37E-04	7.39E-02		1.67E-02		
PCB 124	5.90E-04	6.88E-02		1.85E-02		
PCB 125	DO087*	DO087*	DO087*	DO087*		
PCB 126	6.29E-04	8.54E-02	0.00E+00	*1.51E-02*	1.94E-01	1.98E-01
PCB 127	*5.68E-04*	6.99E-02		*1.19E-02*		
PCB 128	4.36E-04	9.32E-02	2.52E+00	1.96E-02	1.32E+00	1.98E-01
PCB 129	DO138*	DO138*	DO138*	DO138*		
PCB 130	5.42E-04	1.03E-01		2.60E-02		
PCB 131	4.97E-04	9.61E-02		2.71E-02		
PCB 132	3.76E-04	1.16E-01	3.12E+00	2.55E-02	0.00E+00	1.98E-01
PCB 133	4.80E-04	9.27E-02		3.18E-02		

PCB 134	5.03E-04	9.57E-02		2.47E-02		
PCB 135	DO151*	DO151*	DO151*	DO151*		
PCB 136	2.44E-04	3.04E-02		2.32E-03		
PCB 137	3.95E-04	9.55E-02	0.00E+00	2.69E-02	1.94E-01	1.98E-01
PCB 138	3.33E-04	9.35E-02	2.49E+00	1.97E-02	7.74E+00	3.29E-01
PCB 139	4.42E-04	8.72E-02		2.54E-02		
PCB 140	DO139*	DO139*	DO139*	DO139*		
PCB 141	3.77E-04	1.01E-01	2.77E+00	2.15E-02	1.94E-01	1.98E-01
PCB 142	*4.99E-04*	9.52E-02		*2.46E-02*		
PCB 143	DO134*	DO134*	DO134*	DO134*		
PCB 144	4.49E-04	3.69E-02		3.60E-03		
PCB 145	*2.40E-04*	3.13E-02		*2.89E-03*		
PCB 146	4.28E-04	8.13E-02	0.00E+00	2.12E-02	1.49E+00	1.98E-01
PCB 147	DO149*	DO149*	DO149*	DO149*		
PCB 148	4.40E-04	3.77E-02		6.00E-03		
PCB 149	3.01E-04	1.01E-01	2.67E+00	2.13E-02	1.94E-01	1.98E-01
PCB 150	2.36E-04	3.05E-02		5.47E-03		
PCB 151	2.28E-04	3.68E-02	8.48E-01	5.66E-04	1.94E-01	1.98E-01
PCB 152	2.27E-04	2.99E-02		3.98E-03		
PCB 153	2.94E-04	8.39E-02	2.23E+00	1.77E-02	1.17E+01	1.12E+00
PCB 154	0.00E+00		0.00E+00		0.00E+00	0.00E+00
PCB 155	*1.68E-04*	2.84E-02		3.53E-03		
PCB 156	4.51E-04	1.09E-01	2.49E+00	1.89E-02	0.00E+00	1.98E-01
PCB 157	DO156	DO156	DO156	DO156	2.36E-01	1.25E-01
PCB 158	2.69E-04	7.47E-02	1.94E+00	1.55E-02	1.41E+00	
PCB 159	*6.52E-04*	7.24E-02		*1.82E-02*		
PCB 160	0.00E+00		0.00E+00		0.00E+00	0.00E+00
PCB 161	*3.66E-04*	7.01E-02		*1.70E-02*		
PCB 162	6.06E-04	7.39E-02		2.27E-02		
PCB 163	DO138*	DO138*	DO138*	DO138*		
PCB 164	DO137*	DO137*	DO137*	1.78E-02		
PCB 165	4.09E-04	7.84E-02		2.07E-02		
PCB 166	DO128*	DO128*	DO128*	DO128*		
PCB 167	4.49E-04	7.25E-02		1.66E-02		

PCB 168	DO153*	DO153*	DO153*	DO153*		
PCB 169	*4.39E-04*	9.09E-02	0.00E+00	*1.77E-02*	1.94E-01	1.98E-01
PCB 170	3.77E-04	4.06E-02	1.00E+00	7.10E-04	1.96E+00	1.98E-01
PCB 171	5.44E-04	4.43E-02		3.68E-03		
PCB 172	5.43E-04	4.53E-02		5.37E-03		
PCB 173	DO171*	DO171*	DO171*	DO171*		
PCB 174	3.32E-04	3.74E-02	8.18E-01	6.67E-04	0.00E+00	1.98E-01
PCB 175	5.70E-04	4.02E-02		4.78E-03		
PCB 176	2.00E-04	3.18E-02		2.85E-03		
PCB 177	2.97E-04	3.78E-02	9.01E-01	7.67E-04	1.38E+00	1.98E-01
PCB 178	2.78E-04	4.15E-02		3.24E-03		
PCB 179	2.09E-04	3.14E-02		2.40E-03		
PCB 180	2.93E-04	3.37E-02	8.01E-01	5.65E-04	7.38E+00	1.98E-01
PCB 181	4.88E-04	4.30E-02		*4.81E-03*		
PCB 182	*5.29E-04*	3.91E-02		*3.75E-03*		
PCB 183	2.90E-04	3.73E-02	8.21E-01	6.64E-04	1.84E+00	1.98E-01
PCB 184	2.17E-04	3.14E-02		4.42E-03		
PCB 185	DO183*	DO183*	DO183*	DO183*		
PCB 186	*2.13E-04*	3.31E-02		*2.48E-03*		
PCB 187	2.92E-04	3.57E-02	7.92E-01	6.41E-04	4.91E+00	1.98E-01
PCB 188	1.84E-04	3.09E-02		3.22E-03		
PCB 189	4.85E-04	4.38E-02	0.00E+00	3.85E-03	1.94E-01	1.98E-01
PCB 190	4.34E-04	3.56E-02		2.26E-03		
PCB 191	4.21E-04	3.46E-02		2.36E-03		
PCB 192	*4.37E-04*	3.80E-02		*2.64E-03*		
PCB 193	DO180*	DO180*	DO180*	DO180*		
PCB 194	4.56E-04	4.00E-02	9.70E-01	9.78E-04	1.38E+00	1.98E-01
PCB 195	4.88E-04	4.25E-02	1.06E+00	9.89E-04	3.88E-01	1.98E-01
PCB 196	4.42E-04	5.16E-02		5.09E-03		
PCB 197	DO200*	DO200*	DO200*	DO200*		
PCB 198	DO199*	DO199*	DO199*	DO199*	1.93E-01	1.98E-01
PCB 199	4.65E-04	5.24E-02	0.00E+00	6.29E-03	*1.94E-01*	1.98E-01
PCB 200	3.18E-04	3.77E-02	0.00E+00	6.60E-03	1.94E-01	1.98E-01
PCB 201	1.96E-04	3.06E-02	7.04E-01	3.91E-04	1.46E+00	1.98E-01

PCB 202	4.24E-04	4.33E-02		1.29E-02		
PCB 203	2.77E-04	3.81E-02	9.55E-01	4.40E-04	1.44E+00	1.98E-01
PCB 204	*3.31E-04*	3.78E-02		*2.26E-03*		
PCB 205	6.39E-04	4.13E-02		2.81E-03		
PCB 206	8.21E-04	6.68E-02	0.00E+00	3.49E-03	1.94E-01	1.98E-01
PCB 207	6.04E-04	4.93E-02		3.32E-03		
PCB 208	6.23E-04	4.92E-02		4.46E-03		
PCB 209	4.71E-04	5.28E-02	0.00E+00	3.00E-03	1.94E-01	1.98E-01

Table 15 Target MDLs for dioxins and furans in analyses of sediment, waters and tissues

The gray shade indicates that there were >25% ND results, and
gray shade with italic text indicates that there were >50% ND results.

Matrix	**Sediment - µg/kg dw**	**Water -pg/L**	**Bivalves - ng/g dw**	**Stormwater - pg/L**	**Bird Eggs - pg/g ww**	**Sport fish - pg/g ww**
Method	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	EPA 1613BM	AXYS MLA-017 Rev 20
	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
TCDD, 2,3,7,8-					5.53E-02	4.97E-02
PeCDD, 1,2,3,7,8-					5.52E-02	5.05E-02
HxCDD, 1,2,3,4,7,8-					5.60E-02	5.17E-02
HxCDD, 1,2,3,6,7,8-					5.61E-02	5.17E-02
HxCDD, 1,2,3,7,8,9-					5.60E-02	5.17E-02
HpCDD, 1,2,3,4,6,7,8-					5.63E-02	4.95E-02
OCDD, 1,2,3,4,6,7,8,9-					1.05E-01	4.96E-02
TCDF, 2,3,7,8-					8.51E-02	5.98E-02
PeCDF, 1,2,3,7,8-					6.24E-02	5.27E-02
PeCDF, 2,3,4,7,8-					5.45E-02	5.27E-02
HxCDF, 1,2,3,4,7,8-					1.07E-01	5.02E-02
HxCDF, 1,2,3,6,7,8-					5.51E-02	5.02E-02
HxCDF, 1,2,3,7,8,9-					*5.48E-02*	5.02E-02
HxCDF,					6.42E-02	5.02E-02

2,3,4,6,7,8-						
HpCDF, 1,2,3,4,6,7,8-					7.68E-02	4.95E-02
HpCDF, 1,2,3,4,7,8,9-					5.88E-02	4.95E-02
OCDF, 1,2,3,4,6,7,8,9-					*7.45E-02*	5.09E-02

Table 16 Target MDLs for perfluorinated compounds in analyses of sediment, waters and tissues

Matrix	**Sediment - µg/Kg dw**	**Water - pg/L**	**Bivalves - ng/g dw**	**Stormwater - pg/L**	**Bird Eggs - ng/g ww**	**Sport fish - ng/g ww**
Method	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	AXYS – MLA-043 Rev 06	AXYS – MLA-110
	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Method MDL
Perfluorobutanesulfonate					*9.89E-01*	0.097
Perfluorobutanoate					*4.95E-01*	0.551
Perfluorodecanoate					4.94E-01	0.116
Perfluorododecanoate					4.94E-01	0.156
Perfluoroheptanoate					*4.94E-01*	0.170
Perfluorohexanesulfonate					1.06E+00	0.153
Perfluorohexanoate					*4.94E-01*	0.203
Perfluorononanoate					4.94E-01	0.129
Perfluorooctanesulfonamide					*5.98E-01*	0.152
Perfluorooctanesulfonate					4.87E+00	0.354
Perfluorooctanoate					4.94E-01	0.162
Perfluoropentanoate					*5.28E-01*	0.192
Perfluoroundecanoate					4.94E-01	0.151
Perfluorotridecanoate						0.398
Perfluorotetradecanoate						0.309
Perfluoropentanesulfonate						0.129
Perfluoroheptanesulfonate						0.154
Perfluorononanesulfonate						0.155
Perfluorodecanesulfonate						0.207
Perfluorododecanesulfonate						0.291

Fluorotelomer Sulfonate, 4:2-						0.234
Fluorotelomer Sulfonate, 6:2-						0.404
Fluorotelomer Sulfonate, 8:2-						0.670
Methyl Perfluorooctane Sulfonamido Acetic Acid, N-						0.304
Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-						0.143
Methyl-perfluorooctanesulfonamide, N-						0.288
Ethyl-perfluorooctanesulfonamide, N-						0.248
Methyl-perfluorooctanesulfonamidoethanol, N-						3.357
Ethyl-perfluorooctanesulfonamidoethanol, N-						1.447
Perfluoro-2-Propoxypropanoic Acid						0.460
Dioxa-3H-Perfluorononanoate Acid, 4,8-						0.884
Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-						0.708
Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-						0.889

Table 17 Target MDLs for chlordane pesticides in analyses of sediment, waters and tissues

The gray shade indicates that there were >25% ND results, and
gray shade with italic text indicates that there were >50% ND results.

Matrix	**Sediment - µg/Kg dw**	**Water -pg/L**	**Water -pg/L**	**Bivalves - ng/g dw**	**Stormwater - pg/L**	**Bird Eggs - ng/g ww**	**Sport fish - ng/g ww**
Method	EPA 1668AM	AXYS - MLA-028 Rev 03	AXYS - MLA-035 Rev 05	AXYS MLA-028 Rev 05	None (Not Analyzed)	EPA 8081BM	None (Not Analyzed)

	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
Chlordane, cis-	3.85E-04	2.80E-01	1.55E+01	4.01E-02		*4.34E-01*	
Chlordane, trans-	3.07E-04	2.49E-01	1.50E+01	3.56E-02		*4.68E-01*	
Heptachlor	*4.65E-04*	2.24E-01	2.00E+00	*5.30E-02*		*4.04E-01*	
Heptachlor epoxide	*3.51E-04*	1.13E+00	1.20E+01	6.99E-02		2.48E-01	
Nonachlor, cis-	6.02E-04	5.10E-01	9.64E+00	2.48E-01		3.14E-01	
Nonachlor, trans-	2.43E-04	2.91E-01	1.52E+01	1.19E-01		*2.13E-01*	
Oxychlordane	*5.29E-04*	8.82E-01	1.91E+01	*1.06E-01*		8.05E-01	

Table 18 Target MDLs for cyclopentadiene pesticides in analyses of sediment, waters and tissues

The gray shade indicates that there were >25% ND results, and
gray shade with italic text indicates that there were >50% ND results.

Matrix	**Sediment - µg/Kg dw**	**Water -pg/L**	**Water -pg/L**	**Bivalves - ng/g dw**	**Stormwater - pg/L**	**Bird Eggs - ng/g ww**	**Sport fish - ng/g ww**
Method	EPA 1668AM	AXYS - MLA-028 Rev 03	AXYS - MLA-035 Rev 05	AXYS MLA-028 Rev 05	None (Not Analyzed)	EPA 8081BM	None (Not Analyzed)
	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
Aldrin	*1.02E-03*	2.47E-01	3.35E+00	*4.07E-02*		*4.44E-01*	
Dieldrin	1.24E-03	1.23E+00	1.05E+01	5.70E-02		1.08E+00	
Endrin	*1.51E-03*	2.03E+00	7.75E+00	8.22E-02		*2.85E-01*	

Table 19 Target MDLs for DDT pesticides in analyses of sediment, waters and tissues

The gray shade indicates that there were >25% ND results, and
gray shade with italic text indicates that there were >50% ND results.

Matrix	**Sediment - µg/Kg dw**	**Water -pg/L**	**Water -pg/L**	**Bivalves - ng/g dw**	**Stormwater**	**Bird Eggs - ng/g ww**	**Sport fish - ng/g ww**
Method	EPA 1668AM	AXYS - MLA-028 Rev 03	AXYS - MLA-035 Rev 05	AXYS MLA-028 Rev 05	None (Not Analyzed)	EPA 8081BM	None (Not Analyzed)
	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
DDD(o,p')	1.39E-03	1.63E+00	1.35E+01	8.41E-02		*1.46E-01*	
DDD(p,p')	3.40E-04	1.63E+00	1.04E+01	1.04E-01		1.88E-01	

DDE(o,p')	8.06E-04	5.91E-01	2.52E+01	3.71E-02		*2.02E-01*	
DDE(p,p')	1.41E-03	6.71E-01	3.04E+01	4.24E-02		3.18E+01	
DDT(o,p')	2.33E-03	2.23E+00	1.75E+01	1.51E-01		*3.09E-01*	
DDT(p,p')	2.16E-03	2.33E+00	1.45E+01	1.65E-01		2.68E-01	
DDMU(p,p')						2.36E-01	

Table 20 Target MDLs for hexachlorohexane pesticides (HCH) in analyses of sediment, waters and tissues

The gray shade indicates that there were >25% ND results, and
gray shade with italic text indicates that there were >50% ND results.

Matrix	**Sediment - µg/Kg dw**	**Water -pg/L**	**Water -pg/L**	**Bivalves - ng/g dw**	**Stormwater**	**Bird Eggs - ng/g ww**	**Sport fish**
Method	EPA 1668AM	AXYS - MLA-028 Rev 03	AXYS - MLA-035 Rev 05	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)
	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
HCH, alpha	5.54E-04	6.03E-01	3.56E+00				
HCH, beta	7.67E-04	8.08E-01	4.57E+00				
HCH, delta	7.90E-04	1.01E+00	3.99E+00				
HCH, gamma	6.30E-04	6.01E-01	3.62E+00				

Table 21 Target MDLs for other pesticides in analyses of sediment, waters and tissues

The gray shade indicates that there were >25% ND results, and
gray shade with italic text indicates that there were >50% ND results.

Matrix	**Sediment - µg/Kg dw**	**Water -pg/L**	**Bivalves - ng/g dw**	**Stormwater - ug/L**	**Bird Eggs - ng/g ww**	**Sport fish - ng/g ww**
Method	Not Recorded	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)
Pesticides of Concern	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
Fipronil	*4.01E-03*					
Fipronil Desulfinyl	4.29E-03					
Fipronil Sulfide	4.42E-03					
Fipronil Sulfone	4.11E-03					

Method	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)
Carbamates	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
Carbaryl						
Methiocarb						
Oxamyl						
Method	EPA 1668A	AXYS - MLA-035 Rev 06	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)
Organochlorines	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
Methoxychlor						
Endosulfan I		1.38E+02				
Hexachlorobenzene		1.63E-02				
Mirex	*2.00E-02*	8.07E+00				
Method	DFG-WPCL - EPA 8081BM	AXYS - MLA-035 Rev 06	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)
Organophosphates	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL	Average MDL
Chlorpyrifos		6.20E+01				
Diazinon		1.42E+02				
Method	None (Not Analyzed)	AXYS - MLA-035 Rev 06	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)	None (Not Analyzed)
Herbicides	Average MDL	Average MDL	Average MDL		Average MDL	Average MDL
Diuron						
Dacthal		2.64E+01				
Oxadiazon						

Element 8 *Special Training Needs and Certification*

8.1 Specialized Training or Certifications

Because the RMP uses performance-based methods for lab evaluation, laboratory certifications (e.g., by NELAP/ELAP[1]) for the analyses planned are preferred but not required. The laboratory providing analytical support to the RMP must have a designated on-site QA Officer for the particular analytical component(s) performed at that laboratory. This individual will serve as the point of contact for the SFEI QA staff in identifying and resolving issues related to data quality.

To ensure that the samples are analyzed in a consistent manner throughout the duration of the program, key laboratory personnel will participate in an orientation session conducted during an initial site visit or via communications with SFEI staff. The purpose of the orientation session is to familiarize key laboratory personnel with this QAPP and the RMP QA/QC program. Participating laboratories may be required to demonstrate acceptable performance before analysis of samples can proceed, described in subsequent sections. Laboratory operations will be evaluated on a continual basis through technical systems audits, and by participation in laboratory intercomparison programs. Meetings shall be held with participating laboratories at regular intervals to continually review QA/QC procedures and to revise/update the QAPP as needed.

Personnel in any laboratory performing analyses will be well versed in good laboratory practices (GLPs), including standard safety procedures. It is the responsibility of the analytical laboratory manager, and/or safety staff to ensure that all laboratory personnel are properly trained. Each laboratory is responsible for maintaining a current safety manual in compliance with the Occupational Safety and Health Administration (OSHA) or equivalent state or local regulations. The safety manual will be readily available to laboratory personnel. Proper procedures for safe storage, handling, and disposal of chemicals will be followed at all times; each chemical will be treated as a potential health hazard and GLPs will be implemented accordingly.

SFEI personnel using field collection equipment must be trained in its use and care. Initial training needs to be conducted for eight hours, and retraining or frequent use of the equipment for various projects is necessary to stay eligible for fieldwork assignments. All staff involved in field sampling must also undergo safety training prior to working in the field.

8.2 Training Certification and Documentation

No special training certification is necessary for operating the sampling equipment for water quality and sediment samples, but staff collecting biological samples should be trained and/or accompanied by trained personnel (who may be from organizations other than SFEI). In all cases, personnel involved in any kind of sample collection should have appropriate documentation (access and collection permits, where needed). The SFEI Field Operations Manager or designee is responsible for providing field equipment operation and safety instruction to all staff that attend field trips. SFEI field staff training is documented and filed at

[1] Environmental Laboratory Accreditation Program (ELAP). ELAP provides evaluation and accreditation of environmental testing laboratories to ensure the quality of analytical data used for regulatory purposes to meet the requirements of the State's drinking water, wastewater, shellfish, food, and hazardous waste programs

SFEI. Documentation consists of a record of the training date, instructor, and material covered.

Contractors performing sampling are responsible for providing training to their staff and maintaining records of all trainings. Those records can be obtained if needed from contractors through their respective QA or Safety Officers.

8.3 Training Personnel

The SFEI Field Operations Manager and the QAO are responsible for providing training to staff that collect samples in the field or who process and ship samples to analytical laboratories.

Each contract laboratory's QA Officer and Safety Officer shall provide and/or designate staff to provide training to their respective personnel.

Element 9 ***Documents and Records***

SFEI will collect records for sample collection, field analyses, and laboratory chemical analyses. Samples sent to analytical laboratories will include a Chain of Custody form. The analytical laboratories will maintain records of sample receipt and storage, analyses, and reported results.

SFEI maintains hard copy or scanned files of field notes and measurements, as well as laboratory submitted documentation and results at the SFEI main office. The SFEI Data Manager Amy Franz (email: amy@sfei.org; telephone: 510-746-7394) is responsible for the storage and organization of information. Contract laboratories are responsible for maintaining copies of project documentation originating from their respective laboratories, with backup archival storage offsite where possible.

9.1 Quality Assurance Documentation

All laboratories will have the latest revision of the RMP QAPP. In addition, the following documents and information will be current and available to all laboratory personnel participating in the processing of Project samples, as well as to SFEI program officials:

1. Laboratory QA Plan: Clearly defined policies and protocols specific to a particular laboratory, including personnel responsibilities, laboratory acceptance criteria and corrective actions to be applied to the affected analytical batches, qualification of data, and procedures for determining the acceptability of results.
2. Laboratory Standard Operating Procedures (SOPs): Containing instructions for performing routine laboratory procedures.
3. Laboratory Analytical Methods: Step-by-step instructions describing exactly how a method is implemented in the laboratory for a particular analytical procedure. Contains all analytical methods utilized in the particular laboratory for the RMP.
4. Instrument Performance Information: Information on instrument baseline noise, calibration standard response, analytical precision and bias data, and detection limits, etc. This information should be reported for the periods during which RMP samples are analyzed.
5. Control Charts: Control charts are useful in evaluating internal laboratory procedures and are helpful in identifying and correcting systematic error sources. Contract laboratories are encouraged to develop and maintain control charts whenever they may serve in determining sources of analytical problems.

Copies of laboratory methods, SOPs, and QA plans are available by request from the SFEI QA Officer. Some laboratory methods and SOPs may be edited to exclude proprietary details about the analyses. Quality assurance documents are reviewed to assure conformance to program needs by the RMP Project Manager and QAO or their designees.

Copies of all records will be maintained at SFEI and at the laboratory for a minimum five years after project completion, after which they may be destroyed, except for the database at SFEI, which will be maintained without destruction. All data will be backed up and secured at a remote location (i.e., separate from the SFEI office). As needed, data recovery can be initiated by contacting the back-up facility for restoration and this will be covered through SFEI overhead.

All participants listed in Element 3 will receive the most current version of the RMP QAPP, with signed copies only to the Approval Sheet (Element 1) signatories, and electronic copies provided

to the remainder.

9.2 Report Package Information

Analytical results, including associated quality control samples, will be provided to SFEI by the analytical laboratory. Laboratory standard turnaround time is usually 90 days. Exceedances should be discussed with and approved by the RMP Program Manager and QAO.

The digital data generated from sample analyses will be provided to SFEI in CEDEN database format. SFEI personnel check data for conformance to Project MQOs. Verification of all individual quantitative results submitted by analytical laboratories will generally not be undertaken due to the high level of effort that would be required. However, analytical results will be spot checked for consistency and validity between laboratory hardcopy/electronic reports and the RMP database via verification of sums, range checking, and other aggregating methods. Anomalies in data sets received will be identified and reported to the lab as needed for correction.

Laboratory personnel will verify, screen, validate, and prepare all data, including QA/QC results, in accordance with the RMP's QAPP and will provide (upon request) detailed QA/QC documentation that can be referred to for an explanation of any factors affecting data quality or interpretation. Any detailed QA/QC data not submitted as part of the reporting package (see below) should be maintained in the laboratory's database for future reference.

Laboratories will provide electronic copies of the cover letter and tabulated analytical data (including associated QA/QC information outlined below) in a format agreed upon with the RMP Project/Data Manager or designee.

Each Electronic Data Deliverable (EDD) report will consist of the following: Analytical and QA data results, Case Narrative/Letter (as needed to address details and comments not fitting in database reporting fields), and SOPs.

9.2.1 Analytical and QA data results

Results will be submitted in the electronic data deliverable (EDD) template supplied by SFEI. Tabulated data will include the following information for each sample (when applicable):

1. Sample identification: Unique sample ID, site code, collection date, collection time, analysis date, sample type (field or QC types), and matrix (water, sediment, tissue (include species code)).
2. Analytical methods: Preparation, extraction, and quantitation methods (codes should reference SOPs submitted with the data submission package). Also include preparation, extraction, and analysis dates.
3. Analytical results: Analyte name, result, unit, method detection limit (MDL), and reporting limit (RL) for all target parameters. The appropriate data qualifiers should be submitted with the results. Contact Data Manager/QAO for appropriate CEDEN equivalents for qualifiers not previously used.

Required additional data include:

% Solids or % moisture (for sediment and tissue samples, respectively)
Control results (for toxicity tests)

Lab replicate results (and field replicates, when sent for analysis)
Quality assurance information for each analytical chemistry batch:
CRM or LRM results: absolute concentrations measured, certified value, and % recovery relative to certified or expected value.
Matrix (or blank) spike results: include expected value (native + spike) for each analyte, actual recovered concentrations, and calculated % recovery.
Method blank sample results in units equivalent to field sample results (e.g., if the field samples are reported as ng/g, method blanks are given in the same units).
Field and lab replicate results and calculated %RPD or %RSD.

All results, including QC samples, should be reported in the same reporting units and basis (See Table 14-1), to allow direct comparison of QC results to those for field samples. Although QC run with solid (e.g., sediment or tissue) samples for example often have no actual solid mass (e.g., for blanks and LCS samples), solid concentration equivalents should be calculated (e.g., based on a typical or average solid mass per analysis for a field sample, extraction volume, and instrument aliquot/mass). Exceptions may be granted IF sufficient information to easily independently derive the same concentration equivalents are provided in the case narrative (details provided buried in bench worksheets, are insufficient)

9.2.2 Case Narrative

The following topics will be addressed in the narrative when not included in database reporting fields:

A. Overview of Work Performed, Summary of DQO deviations

● Number of samples received and analyzed, indicate reasons if not all samples analyzed.

● Issues with sample holding time or condition on receipt

● If DQOs are not met, what if any corrective actions were taken, and reasons for actions and/or acceptance or rejection of results as reported (e.g., insufficient material, matrix spike too low relative to measure difference from native sample, CRM provides measure of accuracy despite unusable MS results, etc.), and future corrective actions planned to avoid recurrence.

B. Details not captured in EDD or SOPs

The following items should be included in narrative if not already in the SOPs. If SOPs give options (e.g., for extractions, or types of blanks), options used for reported data should be specified. These details will seldom change between analysis batches.

● Indicate type/origin of detection and reporting limits (e.g., detection limit from 3x instrument baseline noise, or from 3x stdev in 7 blank samples, or from 3x stdev in 7 low level spikes at 1ng/g, reporting limit is from lowest calibration point, or 5x detection limit)

● Indicate if results were blank and/or surrogate recovery corrected.

● Describe type(s) of blanks analyzed (e.g., material used for blank samples (pre-cleaned sand, empty sample boat, vegetable oil), taken through full extraction or not, etc.).

C. Batch specific details

● Indicate if samples for precision analysis not from project field samples (other project field samples, only on CRMs, etc.)

● If QC from shared batches with other projects/clients, describe those samples (e.g., lab replicates from other client samples, freshwater sediments)

● Describe other details that are not captured in database or SOPs (e.g., lot number for CRMs, matrix spike amount).

9.2.3 Electronic Data Deliverable (EDD) Template

SFEI is a Regional Data Center (RDC) for the state of California and uses templates, standardized vocabulary and business rules developed and maintained by the California Environmental Data Exchange Network (CEDEN) to manage data for field collection, chemistry, taxonomy, tissue, toxicity, and bioassessment sampling. SFEI will provide training and guidance to collection agencies and laboratories on how to use the CEDEN templates.

Prior to field collection, SFEI will provide the field collection agency a copy of the CEDEN Stations and Locations templates to be populated with information about the sample collection.

Prior to analyses, SFEI will provide the laboratory with a copy of the appropriate CEDEN template and documentation for the sample type being analyzed. The documentation details attributes of each field including field name, data type, whether the field is required or not, the appropriate lookup list for approved vocabulary and a description of each field. The CEDEN templates and documentation are available on-line from CEDEN at www.ceden.org/ceden_datatemplates.shtml. Lookup list values are available on the CEDEN Controlled Vocabulary website ceden.org/CEDEN_checker/Checker/LookUpLists.php.

9.2.4 Standard Operating Procedures (SOPs)

The laboratory's Standard Operating Procedures for preparation, digest extraction, and analytical methods will be submitted along with the analytical results. *The QA Officer/Project Manager will need to approve major changes in methods from previous years.*

9.3 Data Reporting Requirements

As previously indicated, laboratory personnel shall verify that the measurement process was "in control" (i.e., all specified measurement quality objectives were met or acceptable deviations explained) for each batch of samples before proceeding with the analysis of any subsequent batch. In addition, each laboratory shall establish a system for detecting and reducing transcription and calculation errors prior to reporting data.

Only data that have met MQOs or that have deviations explained appropriately will be accepted from the laboratory. When QA requirements have not been met, the samples will be reanalyzed when possible. Only the results of the reanalysis should be submitted, provided they are acceptable.

Reporting turnaround times for submission of results from sample analyses are specified in contracts with the analytical laboratories. These (reporting) turnaround times are independent of holding time requirements for samples; in all cases samples should be extracted and analyzed within the holding times specified for the analytical methods used. Turnaround time

requirements specified in subcontracts are generally 90 days or less.

B. DATA GENERATION AND ACQUISITION

Element 10 *Sampling Process Design*

10.1 Study Area and Period

Sample collection points and a justification for site selection for the different elements are described in the specific project plans for each of the RMP monitoring elements. Although this QAPP only outlines plans for the next ten years, it is expected that monitoring under the RMP will continue so long as water quality issues are of concern to the Bay. The RMP water and sediment monitoring stations are located in six hydrographic regions of the Bay (Figures 6-1 and 6-2). Random design stations are located in five of those regions: Suisun Bay, San Pablo Bay, Central Bay, South Bay, and Lower South Bay. Historic stations are also located in each of those five regions, and additionally at the confluence of the Sacramento and San Joaquin Rivers in the freshwater Rivers region of the Estuary. Sampling timing and frequency varies for the different elements of the monitoring program (shown in Table 6-2).

10.2 Inaccessible Sampling Sites

Issues of site inaccessibility will be evaluated and resolved by different means depending on the project element. RMP Status and Trends ambient water and surface sediment sites that cannot be accessed will be replaced with next oversample site in the region. If there are access issues for cormorant and tern colonies, the researchers will consult with the RMP Exposure and Effects Workgroup (EEWG) and Technical Review Committee (TRC) to evaluate available options (e.g., alternative colonies and delaying sampling). Sport fish sites are popular fishing locations and therefore unlikely to have accessibility issues. Furthermore, because the fishing sites are general areas and fish are mobile, it is possible to move sites slightly while retaining the site names. Tributary loading sites have been selected with input from relevant agencies and landowners; however, if sites are rendered inaccessible (through change of ownership, finding endangered species, etc.), RMP staff will consult with the RMP Sources Pathways and Loadings Workgroup (SPLWG) and TRC to resolve the issue.

10.3 Critical Versus Informational Project Data

Data critical to this project are those that assist with the evaluation of concentrations and loads of contaminants of concern to the Bay, i.e., concentrations of contaminants and ancillary characteristics of analyzed matrices (TOC, lipid, grain size, % solids) needed to interpret measured concentrations and potential impacts (e.g., uptake, toxicity). Informational data (notes on site conditions during and/or preceding sampling events) may help in evaluating the comparability of sites and identifying the causes of variability but are not needed for establishing the validity or representativeness of the reported data. These informational data provide details on site characteristics that may be useful for the scientific interpretation of results but are not always critical for the evaluation of contaminant distribution or loads and impacts.

Element 11 ***Sampling Methods***

The quality of samples collected in the field is addressed through a number of procedures. Proper selection of equipment and supplies and training for use of those items ensures that collection procedures and materials minimally affect samples. Collection and analyses of appropriate quality control samples allows for measurement and assessment of artifacts or influences of sampling on sample characteristics, and to differentiate uncertainties and assess variability introduced by the sampling process from those inherent in the monitored system. This section will provide a brief overview of sampling methods used during field collection of RMP monitoring. All SFEI field staff will use the Field Operations Manual for the Regional Monitoring Program for Trace Substances as a guideline for standard water quality measurements and the collection of water, sediment, and bioassessment samples.

11.1 Sampling Guidelines

Detailed Sampling and Analysis Plans will be developed for each field sampling effort to organize specifics for each monitoring effort, i.e., target analytes, sampling locations, personnel, analytical methods, handling requirements, etc. Field personnel will strictly adhere to RMP sampling protocols (Shimabuku et al., 2018) to ensure the collection of representative, uncontaminated, and uncompromised samples. Briefly, the key requirements for sample collection are as follows:

1. Field personnel will be thoroughly trained in the proper use of sample collection gear and will be able to distinguish acceptable versus unacceptable samples in accordance with pre-established criteria.
2. Field personnel will be thoroughly trained to recognize and avoid potential sources of sample contamination (e.g., engine emissions, winch wires, surfaces, ice used for cooling).
3. Samplers and utensils which come in direct contact with the sample will be made of inert materials that do not contaminate for the particular analytes measured in that sample and will be thoroughly cleaned between sampling stations.
4. Sample containers will be pre-cleaned and of the recommended type for minimizing contamination for the analytes measured.
5. Samples will be sealed, labeled, preserved as needed, and stored under appropriate conditions as soon as practicable.

Table 11.1 describes all matrices collected by the RMP program. The schedule outlining when a particular matrix will be collected is in Table 6.1. The analytical labs, matrices and analyte groups to be analyzed for the current QAPP are listed in table 4-1.

Table 22 RMP Program Field Sampling Methods and Sample Size, and Preservation

Matrix collected	Parameter Group	Analytical Parameter	Fraction	Sampling Method	Target Sample Size	Container Type, size
Bird egg	ORG	Dioxins/ Furans	Total	Hand collected from nests	7 homogenized eggs	Egg, Whirlpack
Bird egg	ORG	PBDE	Total	Hand collected from nests	7 homogenized eggs	Egg, Whirlpack
Bird egg	ORG	Pesticides	Total	Hand collected from nests	Individual Egg	Egg, Whirlpack
Bird egg	ORG	PFC	Total	Hand collected from nests	7 homogenized eggs	Egg, Whirlpack
Bird egg	TE	Mercury	Total	Hand collected from nests	Individual Egg	Egg, Whirlpack
Bird egg	TE	Selenium	Total	Hand collected from nests	7 homogenized eggs	Egg, Whirlpack
Bivalve	ANC	Growth & Survival	None	Transplanted bivalves deployed in unmaintained cages at fixed mooring	30 individuals	Wrapped in Ziploc ® bags
Bivalve	ORG	PAH	None	Transplanted bivalves deployed in unmaintained cages at fixed mooring	100 individuals	Aluminum foil and Ziploc® bags
Bivalve	ORG	PBDE	None	Transplanted bivalves deployed in unmaintained cages at fixed mooring	0 individuals	Aluminum foil and Ziploc® bags
Bivalve	ORG	PCB	None	Transplanted bivalves deployed in unmaintained cages at fixed mooring	0 individuals	Aluminum foil and Ziploc® bags
Bivalve	TE	Selenium	Total	Transplanted bivalves deployed in unmaintained cages at fixed mooring	100 individuals	Double wrapped in two Ziploc ® bags
Sediment	ANC	Eh	None	Surface Sediment (0-5cm)	None	Measurement on board vessel

Sediment	ANC	Grainsize	various	Surface Sediment (0-5cm)	---	Whirl-pak bags
Sediment	ANC	pH	None	Surface Sediment (0-5cm)	None	Measurement on board vessel
Sediment	ANC	TOC/CHN	Total	Surface Sediment (0-5cm)	60mL	Glass 60 mL
Sediment	ORG	Dioxins/ Furans	Total	Surface Sediment (0-5cm)	100 g	Glass 250mL Teflon lid
Sediment	ORG	Fipronil	Total	Surface Sediment (0-5cm)	250 mL	Amber glass 250 mL
Sediment	ORG	PAH	Total	Surface Sediment (0-5cm)	250 mL	Amber glass 250 mL
Sediment	ORG	PBDE	Total	Surface Sediment (0-5cm)	250 mL	Amber glass 250 mL
Sediment	ORG	PCB	Total	Surface Sediment (0-5cm)	250 mL	Amber glass 250 mL
Sediment	ORG	Pesticides	Total	Surface Sediment (0-5cm)	250 mL	Clear glass 250 mL
Sediment	ORG	Pyrethroids	Total	Surface Sediment (0-5cm)	250 mL	Clear glass 250 mL
Sediment	TE	Trace Element Suite (Al, Ag, Cd, Cu, Fe, Pb, Mn, Ni, Zn)	Total	Surface Sediment (0-5cm)	250 mL	HDPE 250 mL
Sediment	TE	Trace Element Suite (As, Se, Hg, MeHg, % Solids)	Total	Surface Sediment (0-5cm)	250 mL	HDPE 250 mL
Sediment, elutriate	TOX	Toxicity	None	Surface Sediment (0-5cm)	4 L	Plastic 1 L
Sediment, overlying water	TOX	Toxicity	None	Surface Water Interface Cores (SWICs)	3” Cores	3” Cores
Sport fish	ORG	Dioxins/ Furans	Total	Fish caught in San Francisco Bay	Varies by species	Wrapped in aluminum or Teflon sheets and placed into zipper closure bags

Sport fish	ORG	Fipronils	Total	Fish caught in San Francisco Bay	Varies by species	Wrapped in aluminum or Teflon sheets and placed into zipper closure bags
Sport fish	ORG	PBDE	Total	Fish caught in San Francisco Bay	Varies by species	Wrapped in aluminum or Teflon sheets and placed into zipper closure bags
Sport fish	ORG	PCB	Total	Fish caught in San Francisco Bay	Varies by species	Wrapped in aluminum or Teflon sheets and placed into zipper closure bags
Sport fish	ORG	PFC	Total	Fish caught in San Francisco Bay	Varies by species	Wrapped in aluminum and double bagged
Sport fish	TE	Mercury	Total	Fish caught in San Francisco Bay	Varies by species	Wrapped in aluminum or Teflon sheets and placed into zipper closure bags
Sport fish	TE	Selenium	Total	Fish caught in San Francisco Bay	Varies by species	Wrapped in aluminum or Teflon sheets and placed into zipper closure bags
Water, bay	ANC	Dissolved Organic Carbon	Dissolved	Surface Water dissolved (1m depth)	250 mL	HDPE 250 mL
Water, bay	ANC	DO, Conductivity, pH, temp, OBS	None	CTD Deployment	None	Measurement on board vessel
Water, bay	ANC	DO, Conductivity, pH, temp, Sal	None	Grab Measurement on board vessel	None	Measurement on board vessel
Water, bay	ANC	Hardness as CaCO3	Dissolved	Surface Water (1m depth)	60 mL	HDPE 60 mL
Water, bay	ANC	Particulate Organic Carbon	Particulate	Surface Water (1m depth)	1-2 filters	Place filter into foil and place in ziplock bag
Water, bay	ANC	Suspended Sediment Concentration	Total	Surface Water (1 m depth)	1 L	HDPE 1 L
Water, bay	ANC	Chlorophyll a	Total	Surface Water	3 L	Amber HDPE

				(1 m depth)		3 L
Water, bay	TE	Copper RedPrecip	Dissolved	Surface Water (1m depth)	1 L	HDPE 1 L
Water, bay	TE	Copper ColChelation	Dissolved	Surface Water (1m depth)	60 mL	HDPE 60 mL
Water, bay	TE	Copper	Particulate	Surface Water (1m depth)	1 filter	Place filter into 50 mL tube.
Water, bay	TE	Cyanide	Weak Acid Dissociable	Surface Water (1m depth)	125 mL	HDPE 125 mL
Water, bay	TE	Methyl Mercury	Dissolved	Surface Water (1m depth)	250 mL	FLPE 250 mL
Water, bay	TE	Methyl Mercury	Particulate	Surface Water (1m depth)	1 filter	Place filter into 50 mL tube.
Water, bay	TE	Selenium	Dissolved	Surface Water (1m depth)	125 mL	Glass 125 mL
Water, bay	TE	Selenium	Particulate	Surface Water (1m depth)	1 filter	Place filter into 50 mL tube.
Water, bay	TOX	Toxicity	None	Surface water (1m depth)	20L	20L Carboy
Water, tributary	ANC	Suspended Sediment Concentration	Total	Not Recorded	Not Recorded	1.8 L plastic
Water, tributary	ANC	Total Organic Carbon	Total	Not Recorded	Not Recorded	2.5 L amber glass
Water, tributary	ANC	Grain Size	Total	Not Recorded	Not Recorded	2.0 L Plastic
Water, tributary	ORG	PCB	Total	Not Recorded	Not Recorded	2.5 L amber glass
Water, tributary	TE	Mercury	Total	Not Recorded	Not Recorded	FLPE 125 mL

Element 12 ***Sample Handling and Custody***

12.1 Field Sample Handling and Shipping Procedures

Samples are maintained chilled on ice in coolers or refrigerators or frozen on dry ice or in freezers, if required. Appropriate preservation conditions and holding times for various sample types and analyses are given in Tables 11-1 and 12-1. Samples will be checked periodically to ensure that samples are appropriately protected and ice is added as needed. Container lids are checked for tightness and sealed with tape if necessary. Immediately upon return from the field, the samples will be packed with more ice or dry ice as appropriate, and then protectively wrapped and shipped to the respective laboratories via overnight carrier, or placed into appropriate storage (refrigerator or freezer, or kept in coolers on wet or dry ice), if shipping that day is not possible. For sampling events occurring on Thursdays or Fridays, staff should consider the potential for shipping delays (e.g., customs, bad weather) and the laboratory work schedule, which could allow samples to thaw or warm. Consult with laboratory staff as needed to determine whether holding time or storage condition is a more critical factor to sample integrity for the analyses to be performed.

All shipped samples will be accompanied by a 'Chain of Custody' form that serves as a shipping record and indicates the pertinent sample identification information and analyses requested for each sample (Figure 12-1). Chain of custody (COC) forms are filled out, copied, and stored each time control of samples is transferred (e.g., from the field to a receiving laboratory or between laboratories). In addition to standard shipping information, the following information is required: sampling event number, site name and code, collection date, sample type, analysis required, preservatives added, and other remarks as needed. If the field crew is identical to the laboratory analysts, COCs are not required, but are recommended to document sample identification and handling information.

The Project Manager at SFEI is responsible for sample handling, tracking, and chain of custody forms. Copies of all COCs are maintained in SFEI records.

12.2 Sample Disposal Procedures

Project samples will not be disposed of until all analyses are complete and analytical and QC results have been reviewed and approved by the RMP Project Manager and QAO. The laboratory should notify SFEI when samples are planned for disposal, in case remaining sample is needed for other analyses.

Chain of Custody Record

Page of

Results to: San Francisco Estuary Institute 4911 Central Ave Richmond, CA 94804 Phone: 510-746-7334 Fax: 510-746-7300	Invoice to: San Francisco Estuary Institute 4111 Central Ave Richmond, CA 94804	Ship to:
Sampled by [Print Name(s)] / Affiliation	Analyses Requested	Project Name: 2015 Bay Margins Sediment Study
Sampler(s) Signature(s)		Billing Code: 3015.00/ 6 / I / 531.10

Sample ID	Sampled Date	Sampled Time	Matrix	Container Type/#	Notes
			Sed		
			Sed		
			Sed		
			Sed		
			Sed		
			Sed		
			Sed		
			Sed		
			Sed		
			Sed		
			Sed		
			Sed		
			Sed		

← Total number of containers

Relinquished by (Signature) / Affiliation	Date	Time	Received by (Signature) / Affiliation	Date	Time

Shipping Information	Additional Comments
Shipping Date:	
Courier:	
Number of Coolers:	
Cooler Temperature (C):	

Figure 8 Chain of Custody Form

Element 13 *Analytical Methods*

13.1 Field Analytical/ Measurement Methods

Measurements performed in the field are recorded in field logs (electronic or paper) for subsequent entry in the RMP database. Samples collected in the field are be placed in containers and stored under conditions appropriate for the analyses to be performed. Any unusual sample characteristics or circumstances preventing normal sample handling will also be noted in the field log. On return from the field, the sampling crew will prepare samples for immediate shipping to analytical laboratories or store them under appropriate conditions for subsequent shipping

Equipment will be deployed continuously only at tributary sampling sites, where a boom is deployed in the water for monitoring of turbidity. The turbidity probe has an automatic wiper that clears the lens of any possible fouling every five minutes. No modifications to the method described in the Field Sampling Manual are necessary.

Operation of any field instruments should be checked at least one day before sampling. If failure of an instrument should occur, a backup instrument should be checked and calibrated. All sampling and measurement modifications or failures that occur in the field due to instrument malfunction will be recorded on the Field Form and the Field Reference Sheet. The SFEI Project Manager, Field Operations Manager, and the QAO will be responsible for ensuring that staff document all deviations from planned operations and schedule repairs and/or additional training as needed.

13.2 Laboratory Analytical Methods

A Performance-Based Measurement System (PBMS) is a flexible approach wherein the data quality needs, mandates or limitations of a program or project are specified, rather than prescribing particular methods for analyses. Although methods for laboratory analyses are listed in Table 23, in a PBMS approach they only document the methods currently or previously used or planned for Project studies rather than prescribing particular analytical methods. The SFEI QAO will consult with the Project Manager to apply systematic planning utilizing the Monitoring Plan, the Project Assessment and Evaluation Plan (PAEP), and the QAPP to establish the goals and data quality needs for the particular project. Key questions must be addressed through these three planning documents to determine the appropriateness of methods to be used.

For the methods selected for a particular application, the Laboratory Project Manager must be able to demonstrate and document that the methods performance meets the data quality requirements of the project. Two separate factors are involved in demonstrating method applicability: First, demonstrating that the laboratory can perform the method properly in a clean matrix with the analytical system under control, and second, demonstrating that the method selected generates “effective data” in the matrix of concern. The former addresses lab or operator training and proficiency, while the latter demonstrates that the selected method performs with the appropriate selectivity, sensitivity, bias and precision, in the actual analytical matrix, to achieve project goals.

13.2.1 Laboratory SOPs

All analytical methods SOPs will be requested from the respective analytical laboratories. Copies of laboratory SOPs are also stored at SFEI but cannot be released to any external parties without prior consent of the laboratory.

13.2.2 Corrective Actions Procedures

Corrective actions for laboratory analytical failures will be specified in the laboratory analytical method SOPs.

13.3 Non-Standard Methods Used

Due to extremely low surface water concentrations of many organic analytes, a non-standard method for pre-concentration of large (~100 L) water samples through use of wound fiberglass filters and adsorbent resin (XAD-2) columns is employed to allow detection of some of the less abundant congeners. This method provides concentrations that often bias (~30-40%) low relative to results from whole water grab samples collected at the same time for various organic analytes (PCBs and PAHs), so results generally represent likely minimum concentrations of those compounds in water. Large (2 to 10L) whole water samples may also be collected for some analytes (e.g., for some legacy and current use pesticides), which will also deviate slightly from a laboratory's or EPA's standard methods, as standardized methods often describe procedures for extraction and analysis of 1 L samples. These latter modifications of sample size (rather than of sampling method) are generally considered inconsequential unless QA/QC data included with reporting of samples indicate otherwise.

Element 14 ***Quality Control***

14.1 Field QC Procedures

14.1.1 Field QC Measurements

Calibration of any field meters (e.g., hand-held pH, temperature, conductivity, DO, or other measurements) should be checked in the field at least once daily and recalibrated using certified standards where possible. Instruments will be recalibrated when significant drift or miscalibration is found.

Beyond initial calibration of handheld field instruments and periodic calibration checks in the field, QC measures taken for field instrument measurements should include replicates at a frequency of one per day or per 20 measurements, taken on a spatial and temporal scale at which measurements are expected to be relatively invariant, as the goal is to establish the precision of a measurement, rather than just characterize the variability of the ecosystem.

14.1.2 Field QC Samples

Field QC samples that are frequently collected for later lab analysis in sampling protocols are listed below. Some of these samples only need to be taken when an established procedure is changed or when problems are identified, whereas others need to be taken at intervals throughout the sampling process. These may include:

1. Travel/bottle Blanks: These account for contaminants introduced during the transport process between the laboratory and field site, in addition to any contamination from the source solution and container.
2. Equipment Blanks: These account for contamination introduced by the field sampling equipment in addition to the above sources.
3. Field Blanks: These account for all of the above sources of contamination that might be introduced to a sample, as well as those due to the immediate field environment. Field blanks are generated under actual field conditions and are subjected to the same aspects of sample collection, field processing, preservation, transport, and laboratory handling as the environmental samples.
4. Field Replicates: These account for variability in the field collection and laboratory analysis combined.

Routine preparation, collection, and analysis of all the field performance samples mentioned above are generally not necessary. Of the possible blank samples, only field blanks will routinely be collected and analyzed, as they will encompass all the possible contamination sources in container and equipment preparation, transport, handling, and sampling methodology. If problems are found with field blanks, other blank sample types may be collected in follow-up sampling to try and determine the source of contamination.

Field blanks for water will be generated under actual field conditions at a minimum frequency of one per field effort (e.g., a set of samples collected by the same methods over the duration of a sampling cruise) or approximately per 20 sites. They will be treated in both the field and

laboratory procedures in as similar a manner as possible as the environmental field samples. Whole water field blanks will be taken by exposing sampling containers through a simulated process of collecting samples, without adding any water matrix, as "clean" lab water that might be used in a field blank could introduce contamination not present in any field samples taken (i.e., lab water is not normally mixed with site water in a sample). Field blanks for integrated (Infiltrex-collected) water samples will be generated through simulated loading and unloading of the Infiltrex system, again without pumping any water through the collection filter or columns. Collection of true sediment field blanks is similarly logistically difficult and has been deemed unnecessary due to precautions taken that minimize contamination of the samples, previously outlined in section 11.3 of this QAPP.

In studies performed for other SFEI projects, travel/bottle blanks analyzed usually showed that they are not a significant source of contamination, so travel blanks are seldom collected. Labs generally send sample containers that have already been checked for contamination, and transport of unopened bottles is unlikely to introduce contamination. Possible contamination during the transport between the laboratory and field site will be mitigated by measures taken to keep the sample bottles in an enclosed microenvironment (e.g., double bagging). Travel and equipment blanks will rarely be collected unless field blanks or field sample results indicate potential problems.

Field replicates of all types of samples to be analyzed will be routinely collected at a minimum frequency of 1 per 20 samples to evaluate variability including performance of the sampling system and methodology. Short-term environmental variability, most notably due to changing currents and heterogeneous suspended sediment loads, can affect the sampling reproducibility, although water is generally more easily mixed and thus often consistent between field replicates. In contrast, sediment contaminant concentrations can vary greatly within small distances. Therefore, much of the variability captured in sediment field replicates reflects spatial variability of the sampling scheme rather than of performance of the collection and analytical methods.

14.2 Laboratory QC Procedures

14.2.1 Laboratory QC Samples

Sample types and MQOs for laboratory analyses were previously specified in Section 7 of this QAPP. Data to be provided to the project manager for evaluation for the full QA/QC program used is in the individual scopes that are part of contracts but should include at the least the following QC data:

1. Surrogate Recovery (for all field and QC samples, if applicable)
2. Method Blank
3. Matrix Spike Recovery
4. Certified/Lab Reference Material (CRM) Recovery
5. Replicate precision (field, CRM, matrix spike, blank matrix spike samples)

Surrogate spikes should be included in all samples where appropriate for the analysis. Although surrogate spike recoveries can be used to estimate and correct for losses of the target analytes in the analytical process, unusually low or high recoveries reflect analytical issues that are not overcome simply by surrogate correction, because at low recoveries, surrogate correction factors

become inversely larger. It is generally left to the professional judgment of the lab's QAO to set appropriate control/acceptance limits and corrective actions for surrogate recoveries. Results for organic analytes should generally be reported as surrogate-corrected, unless specific issues are identified (e.g., analytical interference for the surrogate, but not the target compound) that would render the surrogate-corrected result less accurate than the uncorrected result. The results for individual surrogates should also be reported, as percent recoveries (i.e., not just applied to correct target analyte results).

Method blanks should be run at a minimum frequency of one per batch or per 20 (field) samples for larger analytical batches. Results for laboratory method blanks, combined with those for field blanks, can help identify whether probable causes of sample contamination originated in the field or in laboratory analyses. If both field and lab method blanks have similar levels of contamination, it is likely caused primarily in lab procedures. If field blanks have higher contamination, sample collection methods are likely the cause. Raw results for method blanks should be reported, even (and especially) when field sample results are reported as blank-corrected. Batches with a single method blank measurement cannot be reported as blank-corrected, as in such cases there is no data on the variability (and thus appropriateness) of the subtracted blank value.

Matrix spikes (MS) should be run at a minimum frequency of one per batch or per 20 samples. Matrix spike results are to be reported, along with the expected result (unspiked sample concentration + spike concentration), and a recovery estimate (Section 7.3.2). The spiking concentrations should be high enough to produce an expected result sufficiently over the analytical variability in quantifying the unspiked sample to quantify recovery (at least ~3 times the unspiked result), but also low enough to be a relevant accuracy indicator in the concentration range of field samples (below 100x and preferably nearer 10x the unspiked result). In cases where analytes are mostly not detected in unspiked samples, a concentration range of that magnitude (10-100x) over the MDL may be appropriate to use instead.

Precision can be determined with all sample types analyzed and reported in replicate. Lab replicates (split and analyzed in the laboratory) of field samples are generally the preferred indicator of precision for typical field samples, as the target analyte concentration range, matrix, and interferences are most similar to previous analyzed samples or samples from nearby sites. However, sometimes field sample concentrations are below detection limits for many analytes, so replicate results on CRMs, LRMs, MS/MSDs, or blank spikes (LCSs) may be needed to supplement and obtain quantitative precision estimates. These alternative sample types, in particular LCSs, should not serve as the primary or exclusive indicator of measurement precision without prior approval by the Project Manager and QAO. LCSs are often created from a clean laboratory matrix, so they are likely not representative of the measurement precision routinely achievable in more complex matrices of real field-originated samples. RPDs or RSDs should be calculated as described previously and reported for all samples analyzed in replicate.

Certified reference material (CRM) or other externally established performance testing samples should be run at a frequency of one per 20 samples, a minimum of one per set (e.g., reported for one sampling season) of samples analyzed, with results reported along with the expected values and recoveries (as % of the expected value), where available for target analytes in appropriate matrices. In some cases, no widely available reference materials have been established and laboratories maintain internal lab reference materials (LRM) to track the relative internal accuracy of an analytical method. CRMs are likely the most robust indicators of measurement

accuracy, given requirements for consensus among labs as well as validation through different methods of measurement. Reference values for CRMs or internal LRMs, although less rigorous (fewer labs in consensus, or only one analytical method provided), provide at least some indicator of measurement accuracy. Although poor recoveries on these uncertified values may be used to flag potentially unreliable data for use in data analyses and decision-making, they should not be used to cite or sanction a lab for "failing" to meet MQO requirements.

Table 23 provides specific minimum laboratory analytical QC requirements for each parameter but the full QA/QC program used by each laboratory is in the individual scopes that are part of the contracts. Table 23 represents the matrices and analytes collected by the RMP program and are not specific to the matrices and analytes collected in any particular sampling year. In the table below, ">5% (min 1 per batch)" indicates a minimum of 1 sample per 20 (field samples) in larger batches, or 1 in each batch of less than 20 samples. In contrast, a frequency of ">5% (min 1 per set)" indicates 1 sample per 20 (field samples) analyzed, regardless of analytical batch size, with a minimum of 1 for each set of project samples reported (e.g., from one sampling cruise). Labs are free to use higher frequencies as desired for any QC measures.

Table 23 General Laboratory Analytical QC

(+) Lab Duplicates – although duplicates of field samples are preferred, in all the tables below, lab duplicates of other sample types (e.g., CRMs, LRMs, MSs) may be used to supplement (e.g., where field sample concentrations are variable and include non-detects) or to replace duplicates of field samples (e.g., where concentrations are expected to be all non-detects based on past monitoring). Such substitutions of duplicate sample types should be discussed with and approved by the Project Manager and QAO beforehand.

Cormorant and Tern Bird Eggs		
Matrix: Tissue (Cormorant/Tern Bird Eggs)		
Sampling SOP: USGS Egg Collection Report		
Analytical Parameter(s): Cognates – Lipids and Moisture		
Analytical Method/SOP Reference: AXYS MLA-010 Rev 11, AXYS MLA-021 Rev 12		
# Sample locations: All Bivalve Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <20%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±20%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±20%
Surrogates	NA	

Others:	NA	
Matrix: Cormorant/Tern Bird Eggs		
Sampling SOP: USGS Egg Collection Report		
Analytical Parameter(s): Trace Metals – Mercury (Total)		
Analytical Method/SOP Reference: EPA 7473		
Field Preservation: Frozen		
Hold Time: 1 year		
# Sample locations: All In-Bay Nesting Colonies		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Cormorant/Tern Bird Eggs		
Sampling SOP: USGS Egg Collection Report		
Analytical Parameter(s): Trace Metals – Selenium		
Analytical Method/SOP Reference: EPA 200.8		
Field Preservation: Frozen		
Hold Time: 1 year		
# Sample locations: All In-Bay Nesting Colonies		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%

Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Cormorant Bird Eggs		
Sampling SOP: USGS Egg Collection Report		
Analytical Parameter(s): Dioxins		
Analytical Method/SOP Reference: EPA 1613BM		
Field Preservation: Chilled on wet ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Nesting Colonies		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate+	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per EPA 1613BM
Others:	NA	
Matrix: Cormorant/Tern Bird Eggs		
Sampling SOP: USGS Egg Collection Report		
Analytical Parameter(s): PBDEs		
Analytical Method/SOP Reference: SGS AXYS MLA-033 Rev.6 (EPA 1614AM)		
Field Preservation: Chilled on wet ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Nesting Colonies		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	

Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-033 Rev.6 (EPA 1614AM)
Others:	NA	
Matrix: Cormorant Bird Eggs		
Sampling SOP: USGS Egg Collection Report		
Analytical Parameter(s): PCBs		
Analytical Method/SOP Reference: SGS AXYS MLA-010 Rev.12 (EPA 1668AM)		
Field Preservation: Chilled on wet ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Nesting Colonies		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-033 Rev.6 (EPA 1614AM)
Others:	NA	
Matrix: Cormorant Bird Eggs		
Sampling SOP: USGS Egg Collection Report		
Analytical Parameter(s): Perfluorinated Compounds (PFCs)		
Analytical Method/SOP Reference: SGS AXYS MLA-110		
Field Preservation: Chilled on wet ice		
Hold Time: 90 days when frozen. All samples should be frozen.		

# Sample locations: All In-Bay Nesting Colonies		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-043 Rev 08
Others:	NA	
Matrix: Cormorant Bird Eggs		
Sampling SOP: USGS Egg Collection Report		
Analytical Parameter(s): Pesticides		
Analytical Method/SOP Reference: SGS AXYS Method MLA-028 or MLA-035		
Field Preservation: Chilled on wet ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Nesting Colonies		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per EPA 8081BM
Others:	NA	
Tissue - Bivalves		
Matrix: Tissue (Bivalves)		

Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Cognates – Survival, Dry Weight, and Growth (weight)		
Analytical Method/SOP Reference: None		
Field Preservation: Frozen on dry ice		
Hold Time: Not Available		
# Sample locations: All Bivalve Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	NA	
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	NA	
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD NA
Lab. Matrix Spike/Duplicate	NA	Expected Value NA
Lab./Cert. Ref. Material	NA	Expected Value NA
Surrogates	NA	
Others:	NA	
Matrix: Tissue (Bivalves)		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Cognates – Lipids and Moisture		
Analytical Method/SOP Reference: AXYS MLA-010 Rev 11, AXYS MLA-021 Rev 12		
# Sample locations: All Bivalve Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <20%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±20%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±20%
Surrogates	NA	
Others:	NA	

Matrix: Tissue (Bivalves)		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Cognates – Total Solids		
Analytical Method/SOP Reference: SM 2540 G		
# Sample locations: All Bivalve Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	NA	
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <20%
Lab. Matrix Spike/Duplicate	NA	
Lab./Cert. Ref. Material	NA	
Surrogates	NA	
Others:	NA	
Matrix: Tissue (Bivalves)		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Trace Metals - Selenium		
Analytical Method/SOP Reference: EPA 1638M		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All Bivalve Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	

Others:	NA	
Matrix: Tissue (Bivalves)		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): PAHs		
Analytical Method/SOP Reference: SGS AXYS MLA-021 Rev.12 (EPA 8270M)		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-021 Rev 12 (EPA 8270M)
Others:	NA	
Matrix: Tissue (Bivalves)		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): PBDEs		
Analytical Method/SOP Reference: AXYS MLA-033 Rev 06 (EPA 1614M)		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All Bivalve Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab

Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per AXYS MLA-033 Rev 04 (EPA 1614M)
Others:	NA	
Matrix: Tissue (Bivalves)		
Analytical Parameter(s): PCBs		
Analytical Method/SOP Reference: AXYS MLA-010 Rev 11 (EPA 1668AM)		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All Bivalve Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per AXYS MLA-010 Rev 09
Others:	NA	
Sediment		
Matrix: Sediment		
Analytical Parameter(s): Cognates – Clay, Fine, Granule + Pebble, Sand, Silt		
Analytical Method/SOP Reference: ASTM D422 (Wentworth scale)		
Field Preservation: Dark, 4°C		
Hold Time: 6 months		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits

Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <20% of total mass or volume
Lab. Matrix Spike/Duplicate	NA	Expected Value NA
Lab./Cert. Ref. Material	>5% (min 1 per set)	Set by lab
Surrogates	NA	
Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): Cognates - Total Nitrogen		
Analytical Method/SOP Reference: EPA 440		
Field Preservation: Freeze at end of day		
Hold Time: 100 days		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <15%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±15%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±15%
Surrogates	NA	
Others:	NA	
Matrix: Sediment		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Cognates - Total Organic Carbon		
Analytical Method/SOP Reference: EPA 440		
Field Preservation: Freeze at end of day		
Hold Time: 28 days		

# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <10%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±10%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±10%
Surrogates	NA	
Others:	NA	
Matrix: Sediment		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Trace Metals – Total Solids		
Analytical Method/SOP Reference: EPA 160.3, EPA 1684, EPA 6020AM/BM, SM 2540 G, WPCL SOP 67 (EPA 8081BM)		
Field Preservation: Place on dry ice		
Hold Time: NR		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD NA
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value NA
Lab./Cert. Ref. Material	NA	
Surrogates	NA	
Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): Trace Metals - Arsenic		

Analytical Method/SOP Reference: EPA 1638M		
Field Preservation: 0-4°C during shipment and then <4°C in lab		
Hold Time: 1 year		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): Trace Metals – Aluminum, Cadmium, Copper, Iron, Lead, Manganese, Nickel, Silver, and Zinc		
Analytical Method/SOP Reference: EPA 6020AM/BM		
Field Preservation: Frozen on dry ice		
Hold Time: 30 days @ 4C, 1 year @< -15C		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours / per 10 samples	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <25%%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±25%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±25%
Surrogates	NA	
Others:	NA	

Matrix: Sediment		
Analytical Parameter(s): Trace Metals - Mercury		
Analytical Method/SOP Reference: BR-0002 Rev 010 (EPA 1631M)		
Field Preservation: 0-4°C during shipment and then <4°C in lab		
Hold Time: 1 year		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): Trace Metals – Methyl Mercury		
Analytical Method/SOP Reference: EPA 1630M		
Field Preservation: 0-4°C for up to 7 days and then < -15°C in lab		
Hold Time: 1 year if frozen within 7 days of collection		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	

Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): Trace Metals - Selenium		
Analytical Method/SOP Reference: EPA 1638M		
Field Preservation: 0-4^{o}C during shipment and then <4^{o}C in lab		
Hold Time: 1 year		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): Dioxins		
Analytical Method/SOP Reference: EPA 1613B	AXYS MLA-017	
Field Preservation: Dark, frozen		
Hold Time: 1 year		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%

Surrogates	Every sample	Per EPA 1613B
Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): PAHs		
Analytical Method/SOP Reference: SGS AXYS MLA-021 Rev.12 (EPA 8270M)		
Field Preservation: wet ice at 4 deg C (cooler must be at 0-4 deg C)		
Hold Time: 1 year		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-021 Rev.12 (EPA 8270M)
Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): PBDEs		
Analytical Method/SOP Reference: SGS AXYS MLA-033 Rev.6 (EPA 1614AM)		
Field Preservation: wet ice at 4 deg C (cooler must be at 0-4 deg C)		
Hold Time: 1 year		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%

Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-033 Rev.6 (EPA 1614AM)
Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): PCBs		
Analytical Method/SOP Reference: SGS AXYS MLA-010 Rev.12 (EPA 1668AM)		
Field Preservation: wet ice at 4 deg C		
Hold Time: 1 year		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-010 Rev.12 (EPA 1668AM)
Others:	NA	
Matrix: Sediment		
Analytical Parameter(s): Pesticides		
Analytical Method/SOP Reference: SGS AXYS Method MLA-028 or MLA-035		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All Surface Sediment Sites		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	

Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS Method MLA-028 or MLA-035
Others:	NA	
Sport Fish		
Matrix: Sport fish – Striped Bass, Shiner Surfperch, and Leopard Shark		
Analytical Parameter(s): Trace Metals – Mercury		
Analytical Method/SOP Reference: EPA 7473		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Waters		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Sport fish – All Target Species		
Analytical Parameter(s): Trace Metals – Selenium		
Analytical Method/SOP Reference: EPA 200.8		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Waters		
Laboratory QC	Frequency/Number	Target Limits

Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Sport fish – White Croaker and Shiner Surfperch		
Analytical Parameter(s): Dioxins		
Analytical Method/SOP Reference: AXYS MLA-017 Rev 20		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Waters		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate+	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per AXYS MLA-017 Rev 20
Others:	NA	
Matrix: Sport fish – All Target Species		
Analytical Parameter(s): PBDEs		
Analytical Method/SOP Reference: SGS AXYS MLA-033 Rev.6 (EPA 1614BM)		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Waters		

Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-033 Rev.6 (EPA 1614BM)
Others:	NA	
Matrix: Sport fish – All Target Species		
Analytical Parameter(s): PCBs		
Analytical Method/SOP Reference: SGS AXYS MLA-010 Rev.12 (EPA 1668AM)		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Waters		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per EPA SGS AXYS MLA-010 Rev.12 (EPA 1668AM)
Others:	NA	
Matrix: Sport fish – All Target Species except Jacksmelt		
Analytical Parameter(s): Perfluorinated Compounds (PFCs)		
Analytical Method/SOP Reference: SGS AXYS MLA-110		

Field Preservation: Frozen on dry ice		
Hold Time: Not Available		
# Sample locations: All In-Bay Waters		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-043 Rev 08
Others:	NA	
Matrix: Sport fish – All Target Species		
Analytical Parameter(s): Pesticides		
Analytical Method/SOP Reference: SGS AXYS Method MLA-028 or MLA-035		
Field Preservation: Frozen on dry ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Waters		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS Method MLA-028 or MLA-035
Others:	NA	
Tributary Water		

Matrix: Tributary Water		
Analytical Parameter(s): Cognates - Ammonium as N		
Analytical Method/SOP Reference: Solorzano, L., 1969		
Field Preservation: H2S04		
Hold Time: 28 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <15%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±15%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±15%
Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Analytical Parameter(s): Cognates - Hardness as CaCO3/Total Hardness (calc)		
Analytical Method/SOP Reference: SM 2340 C and EPA 1638M		
# Sample locations: All In-Bay Tributary Water		
Field Preservation: HNO3		
Hold Time: 180 days		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <5%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±5%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±5%
Surrogates	NA	
Others:	NA	

Matrix: Tributary Water		
Analytical Parameter(s): Cognates - Nitrate as N		
Analytical Method/SOP Reference: EPA 300.1 and SM 4500-NO3 F		
Field Preservation: Ice		
Hold Time: 48 hours		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <15%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±15%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±15%
Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Cognates - Nitrite as N		
Analytical Method/SOP Reference: EPA 300.1 and SM 4500-NO2 B		
# Sample locations: All In-Bay Tributary Water		
Field Preservation: Ice		
Hold Time: 48 hours		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <15%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±15%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±15%

Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Cognates - Nitrogen, Total Kjeldahl		
Analytical Method/SOP Reference: SM 4500-N org C and SM 4500-NH3 C v20		
Field Preservation: H2S04		
Hold Time: 28 Days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <15%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±15%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±15%
Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Cognates - Orthophosphate as P		
Analytical Method/SOP Reference: EPA 300.1 and SM 4500-P E		
Field Preservation: Ice		
Hold Time: 48 hours		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	

Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <10%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±10%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±10%
Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Cognates – Phosphorus as P		
Analytical Method/SOP Reference: SM 4500-P E		
Field Preservation: H2SO4		
Hold Time: 28 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <10%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±10%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±10%
Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Cognates - Suspended Sediment Concentration		
Analytical Method/SOP Reference: ASTM D3977		
Field Preservation: Ice		
Hold Time: 7 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits

Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <10%
Lab. Matrix Spike/Duplicate	NA	NA
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±10%
Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Cognates - Total Organic Carbon		
Analytical Method/SOP Reference: SM 5310 B and SM 5310 C		
Field Preservation: HCL		
Hold Time: 28 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <10%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±10%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±10%
Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Trace Metals – Copper and Selenium		
Analytical Method/SOP Reference: EPA 1638 and EPA 1638M		

Field Preservation: Ice		
Hold Time: 180 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD Cu <25%; Se <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value Cu ±25%; Se ±35
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value Cu ±25%; Se ±35
Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Trace Metals – Mercury		
Analytical Method/SOP Reference: EPA 1631, EPA 1631E, and EPA 1631EM		
Field Preservation: Ice		
Hold Time: 90 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	
Others:	NA	

Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Trace Metals – Mercury, Methyl		
Analytical Method/SOP Reference: EPA 1630 and EPA 1630M		
Field Preservation: HCL, Ice		
Hold Time: 90 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Carbaryl		
Analytical Method/SOP Reference: EPA 632M		
Field Preservation: Ice		
Hold Time: 7 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%

Surrogates	Every sample	Per EPA 632M
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): Fipronil		
Analytical Method/SOP Reference: EPA 619M		
Field Preservation: Ice		
Hold Time: 7 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per EPA 619M
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): PAHs		
Analytical Method/SOP Reference: AXYS MLA-021 Rev 10 (EPA 8270M)		
Field Preservation: Ice		
Hold Time: 7 days		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab

Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per AXYS MLA-021 Rev 10 (EPA 8270M)
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): PBDEs		
Analytical Method/SOP Reference: AXYS MLA-033 Rev 06 (EPA 1614M)		
Field Preservation: Ice		
Hold Time: One year		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per AXYS MLA-033 Rev 06 (EPA 1614M)
Others:	NA	
Matrix: Tributary Water		
Sampling SOP: Internal Field Sampling Manuals		
Analytical Parameter(s): PCBs		
Analytical Method/SOP Reference: SGS AXYS MLA-010 Rev.12 (EPA 1668A)		
Field Preservation: Ice		
Hold Time: 1 year		
# Sample locations: All In-Bay Tributary Water		
Laboratory QC	Frequency/Number	Target Limits

Method Blank	>5% (min 1 per batch)	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>5% (min 1 per batch)	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±35%
Lab./Cert. Ref. Material	>5% (min 1 per set)	Expected Value ±35%
Surrogates	Every sample	Per SGS AXYS MLA-010 Rev.12 (EPA 1668A)
Others:	NA	
Water		
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Cognates - Dissolved Organic Carbon		
Analytical Method/SOP Reference: EPA 9060		
Field Preservation: 1-2 mL H2SO4		
Hold Time: 28 days		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	1 per batch; >5% for batches over 20	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	1 per 20	RPD or RSD <10%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±10%
Lab./Cert. Ref. Material	1 per 20	Expected Value ±10%
Surrogates	NA	
Others:	NA	
Matrix: Water		

Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Cognates - Hardness as CaCO3		
Analytical Method/SOP Reference: EPA 1638M		
Field Preservation: Dark, 4°C; Add HNO3 in lab within 14 days of collection		
Hold Time: 180 days		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	1 per batch; >5% for batches over 20	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	1 per 20	RPD or RSD <5%
Lab. Matrix Spike/Duplicate	1 per 20	Expected Value ±5%
Lab./Cert. Ref. Material	1 per 20	Expected Value ±5%
Surrogates	NA	
Others:	NA	
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Cognates - Particulate Organic Carbon		
Analytical Method/SOP Reference: EPA 9060		
Field Preservation: Store and ship at 4 Deg C.		
Hold Time: 100 days		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	1 per batch; >5% for batches over 20	<MDL
Reagent Blank	NA	
Storage Blank	NA	

Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>1 per 20 (>5%). A simultaneously collected split.	RPD or RSD <10%
Lab. Matrix Spike/Duplicate	>5% (min 1 per batch)	Expected Value ±10%
Lab./Cert. Ref. Material	1 per 20	Expected Value ±10%
Surrogates	NA	
Others:	NA	
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Cognates - Suspended Sediment Concentration		
Analytical Method/SOP Reference: ASTM D3977M		
Field Preservation: Store on wet ice immediately; Dark, 4°C		
Hold Time: 7 days		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	1 per batch; >5% for batches over 20	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	>1 per 20 (>5%). A simultaneously collected split.	RPD or RSD <10%
Lab. Matrix Spike/Duplicate	NA	NA
Lab./Cert. Ref. Material	1 per 20	Expected Value ±10%
Surrogates	NA	
Others:	NA	
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Field Measures – CTD Meter – Backscatter, Density, Dissolved Oxygen, Electrical Conductivity, Pressure, Salinity, and Temperature		

Analytical Method/SOP Reference: SeaBird SB-19		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	NA	
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	NA	
Lab. Duplicate	NA	
Lab. Matrix Spike/Duplicate	NA	
Lab./Cert. Ref. Material	NA	
Surrogates	NA	
Others:	NA	
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Field Measures - Shipboard – Dissolved Oxygen, pH, Salinity, Specific Conductivity, and Temperature		
Analytical Method/SOP Reference: YSI 556 Water Quality Meter		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	NA	
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	NA	
Lab. Duplicate	NA	
Lab. Matrix Spike/Duplicate	NA	
Lab./Cert. Ref. Material	NA	
Surrogates	NA	
Others:	NA	
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Trace Metals –Copper and		

Selenium		
Analytical Method/SOP Reference: EPA 1640		
Field Preservation: Dark, 4°C until filtered, if separate total & dissolved reported		
Hold Time: 6 months after lab acidified with nitirc acid pH <2.		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	1 per batch; >5% for batches over 20	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	1 per 20	RPD or RSD <25%; As and Se <35%
Lab. Matrix Spike/Duplicate	1 per 20	Expected Value ±25%; As and Se ±35
Lab./Cert. Ref. Material	1 per 20	Expected Value ±25%; As and Se ±35
Surrogates	NA	
Others:	NA	
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Trace Metals – Cyanide		
Analytical Method/SOP Reference: BA-4400 Rev 001		
Field Preservation: Pre-preserved containers with 130 uL of 50% NaOH to pH >10; ship and store at 0-4 degrees C		
Hold Time: 14 days if preserved		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	1 per batch; >5% for batches over 20	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	1 per 20	RPD or RSD <25%

Lab. Matrix Spike/Duplicate	1 per 20	Expected Value ±25%
Lab./Cert. Ref. Material	1 per 20	Expected Value ±25%
Surrogates	NA	
Others:	NA	
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Trace Metals – Mercury		
Analytical Method/SOP Reference: EPA 1631EM		
Field Preservation: Dark, 4°C until filtered, if separate total & dissolved reported		
Hold Time: 90 days after preservation in lab with BrCl		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits
Method Blank	1 per batch; >5% for batches over 20	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	1 per 20	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	1 per 20	Expected Value ±35%
Lab./Cert. Ref. Material	1 per 20	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Trace Metals – Methyl Mercury		
Analytical Method/SOP Reference: EPA 1630M		
Field Preservation: 1-2 ml 50% H2SO4		
Hold Time: 6 months		
# Sample locations: All In-Bay Surface Water		
Laboratory QC	Frequency/Number	Target Limits

Method Blank	1 per batch; >5% for batches over 20	<MDL
Reagent Blank	NA	
Storage Blank	NA	
Instrument Blank	12 hours	Set by lab
Lab. Duplicate	1 per 20	RPD or RSD <35%
Lab. Matrix Spike/Duplicate	1 per 20	Expected Value ±35%
Lab./Cert. Ref. Material	1 per 20	Expected Value ±35%
Surrogates	NA	
Others:	NA	
Matrix: Water		
Sampling SOP: Field Sampling Manual for the Regional Monitoring Program for Trace Substances		
Analytical Parameter(s): Toxicity – Americamysis bahia – Survival and Growth		
Analytical Method/SOP Reference: EPA 1007.0		
Field Preservation: Dark, 0-6°C		
Hold Time: 36 hours		
# Sample locations: All In-Bay Surface Water Sites		
Laboratory QC	Frequency/Number	Target Limits
Lab. Duplicate	As specified in method	*for significance testing, not RPD limits
Test acceptability ranges:		
Control survival	1 per batch	80%
Control weight (dry weight average)		0.2 mg/survivor
Reference toxicant response	1 performed with first batch	LC50 ±2stdev of lab control chart mean
Test water quality limits:		
Temp		26±1 Deg C (temperature must not vary more than 3˚ over the course of the test)
pH		6.0 – 9.0
salinity		± 1 ppt of test salinity
DO		≥4.0 mg/L
Ammonia		NA

Element 15 *Instrument/Equipment Testing, Inspection, and Maintenance*

Field measurement equipment will be checked for operation in accordance with the manufacturer's specifications. This includes battery checks, routine replacement of membranes, and cleaning of electrodes. All equipment will be inspected for damage or malfunction when first handed out and when returned from use by the field sampling crew. Needed repairs or operational problems are to be reported to the Field Supervisor. The Field Supervisor will also (or instruct appropriate staff to) examine equipment at least quarterly for operational status, even if no sampling using that equipment is immediately planned.

Operating manual for the SFEI field instruments can be found at the following links:

YSI 556: http://www.ysi.com/media/pdfs/655279-YSI-556-Operations-Manual-RevD.pdf

WTW Multi 340i: http://www.wtw.de/en/home.html

Hach 2100p: http://www.iwinst.org/wp-content/uploads/2012/04/Hach_2100p_Calibration_and_Use_2012.pdf

Instruments delivered through a manufacturer were equipped with a corresponding accessory case including spare parts and maintenance supplies. All spare parts will be transported to the site and will be available for replacing malfunctioning parts. Additionally, two extra sets of batteries will be available in the field.

If any instrument deficiency should occur, troubleshooting can be conducted on site utilizing the instrument manual and experience of the field staff, making any necessary repairs, and re-calibration. All incidents and issues regarding the proper functioning of the equipment will be recorded on the Field Form and reported to the SFEI Field Supervisor.

Contract laboratories maintain equipment in accordance with their respective SOPs, which include those specified by the manufacturer and those specified by the method. Under the performance-based approach, the adequacy of contract laboratory testing, inspection, and maintenance procedures are determined through regular review of results for analysis of field and QC samples for all submitted data.

Recommended frequencies for equipment testing, inspection, and maintenance activities are listed in Table 15-1.

Table 24 General criteria for testing, inspection and maintenance of field equipment and laboratory instruments for the RMP Program

Equipment / Instrument	Maintenance, Testing, or Inspection Activity	Responsible Person	Frequency	SOP Reference
HRGC/HRMS	1. Checking 2. Replacing consumables	Chemist	Daily	SIN-005 and SIN-004
Campbell Scientific CS450 (stage)	1. Cleaning 2. Factory calibration	1. Field operator(s) 2. Manufacturer	1. Monthly 2. Semi-annually	CS450 Instruction Manual

Campbell Scientific OBS-500 (turbidity)	1. Cleaning 2. Factory calibration	1. Field operator(s) 2. Manufacturer	1. Monthly 2. Annually	OBS-500 Operators Manual
DH-81	1. Cleaning 2. Testing operation	Field operator(s)	Before storm event	2014 POC Monitoring Field Instructions
FISP D-95	1. Cleaning 2. Testing operation	Field operator(s)	Before storm event	2014 POC Monitoring Field Instructions
FTS DTS-12 (turbidity)	1. Cleaning 2. Factory calibration	1. Field operator(s) 2. Manufacturer	1. Monthly 2. Annually	DTS-12 Instruction Manual
Hach 2100p (turbidity)	1. Cleaning 2. Testing	Field operator(s)	1. After use 2. Quarterly or ~14 days before use	Hach 2100p Operating Manual 7th ed. (Aug2001)
Infiltrex	1. Cleaning 2. Testing operation	Field operator(s)	1. After use 2. Prior to use	See below
ISCO 6712	1. Cleaning 2. Testing operation	Field operator(s)	Before storm event	2014 POC Monitoring Field Instructions
TE-525 (rainfall)	1. Cleaning 2. Calibration	Field operator(s)	1. Monthly 2. Annually	TE525 Instruction Manual
van Veen	1. Cleaning 2. Testing operation	Field operator(s)	1. After use 2. Prior to use	See below
WTW Multi 340i (pH, Specific Conductivity, DO)	1. Cleaning 2. Testing	Field operator(s)	1. After use 2. Quarterly or ~14 days before use	WTW operating manual Mar2004
YSI 556 Multimeter	1. Cleaning 2. Testing	Field operator(s)	1. After use 2. Quarterly or ~14 days before use	YSI 556 operations manual (2004)

Element 16 *Instrument/Equipment and Calibration Frequency*

Prior to use in the field (typically several days before), handheld water quality instruments are calibrated against appropriate standards and, if possible, checked against a standard from a different source. For some measurements such as dissolved oxygen, probes are often calibrated to ambient conditions (water-saturated air) rather than to known standards. In such cases, the field staff should verify appropriate qualitative instrument response (e.g., in water deoxygenated by sparging, sodium sulfite addition, or other means). All calibrations are documented on a calibration checklist on the individual instrument or its case with date, time, and operator name. If an instrument cannot be calibrated or is not reading correctly, a backup instrument will be used to measure water quality parameters. If possible, problems with an instrument are addressed by field staff, who will also notify the Field Supervisor and other staff trained in troubleshooting and/or repair. For instruments that cannot be repaired in-house, the Field Supervisor in consultation with the Program Manager will choose an appropriate course of action, either sending the instrument for repair, or purchasing a replacement as necessary.

For single or multiparameter water quality meters, the following standards are typically used to calibrate:

1. pH – commercially available standards pH 4, 7, 10. Perform at least a 2-point calibration covering the range of expected measurements. Use the 3rd pH standard (or standard supplied by another manufacturer) to verify calibration accuracy.
2. Conductivity – use KCl or other standard with known specific conductivity (often ~1.4 mS/cm). Verify instrument response with DI water or other standard of lower or higher concentration.
3. Dissolved oxygen – use calibration procedure recommended by manufacturer, typically in water-saturated air. Check response in deoxygenated water or site water with either higher or lower DO than at saturation.
4. Temperature – check against thermometer of known accuracy at least yearly (preferably quarterly). An ice water bath of approximately 0°C, can be used to semi-quantitatively verify temperature probe response but may vary due to uncontrolled factors such as container size and geometry, ice/water disequilibrium, or the presence of melting point-lowering contaminants.
5. Turbidity – calibrate Hach 2100p using appropriate dilutions of manufacturer-recommended standard (Formazin stock solution or Gelex secondary standards)

Laboratories maintain calibration practices as part of their method SOPs. Calibration procedures are described generally below.

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 (e.g., a certified solution). 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, must be re-analyzed. All calibration standards will be traceable to an organization that is recognized for the preparation and certification of QA/QC materials (e.g., NIST, NRCC, US EPA).

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. If the instrument response is demonstrated to be linear over the entire concentration range 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. Otherwise, only data within the working calibration range (above the MDL) should be reported (i.e., extrapolation is not acceptable). Samples outside the calibration range will be diluted as appropriate, and reanalyzed.

Table 25 Calibration of equipment and analytical instruments

Equipment / Instrument	Testing Activity or Inspection Activity	Responsible Person	Frequency	SOP Reference
3-Point balance	Calibration	Professional	Annually	EPA 1640
Analytical Balance	Calibration	Lab Operator	Every day	ASTM D3977M
AQ2 computer controlled multi-chemistry discrete analyzer	Initial Calibration	Lab Operator	Daily before use	SM 4500-NO3 F
AQ2 computer controlled multi-chemistry discrete analyzer	Initial Calibration Verification	Lab Operator	Before every analytical run	SM 4500-NO3 F
AQ2 computer controlled multi-chemistry discrete analyzer	Continuing Calibration	Lab Operator	Every 10 Samples	SM 4500-NO3 F
Atomic Absorption Spectrophotometer	Primary Calibration	Lab Operator	Initially	EPA 7473
Atomic Absorption Spectrophotometer	Daily Calibration	Lab Operator	Before each run	EPA 7473
Atomic fluorescence spectrophotometer	Calibration	Lab Operator	Initially	EPA 1631E
Atomic fluorescence spectrophotometer	Calibration	Lab Operator	Every day and whenever CCV recovery falls outside criteria	EPA 1631EM
Bran & Luebbe AA3 Flow Injection Analyzer and Data System	Establish Calibration Curve	Lab Operator	Not specified	EPA 353.2
Bran & Luebbe AA3 Flow Injection Analyzer and Data System	Calibration Verification	Lab Operator	Every analysis	EPA 353.2
Conductivity Meter	Check Standard	Lab Operator	Before every	SM 2520B

			analytical run	
Conductivity Meter	Calibration	Lab Operator	Monthly or if check standard is outside of acceptance range	SM 2520B
GC/MS	Initial Calibration	Lab Operator	Before every analytical run	EPA 8270M
GC/MS	Daily Calibration	Lab Operator	Every 12 hours	EPA 8270M
GC-ECD/GC-MSMS	Calibration Standards	Lab Operator	Before every analytical run	EPA 8081BM
GC-ECD/GC-MSMS	Second Source Check Standards	Lab Operator	Before every analytical run	EPA 8081BM
GC-ECD/GC-MSMS	Initial Calibration	Lab Operator	Before every analytical run	EPA 8081BM
GC-ECD/GC-MSMS	Initial Calibration Verification	Lab Operator	Before every analytical run	EPA 8081BM
GC-ECD/GC-MSMS	Continuing Calibration	Lab Operator	Every 10 Samples	EPA 8081BM
GC-ECD/GC-MSMS	Initial Calibration	Lab Operator	Before every analytical run	EPA 8082M
GC-ECD/GC-MSMS	Initial Calibration Verification	Lab Operator	Before every analytical run	EPA 8082M
GC-ECD/GC-MSMS	Continuing Calibration	Lab Operator	Every 10 Samples	EPA 8082M
GC-ECD/GC-MSMS	Calibration Standards	Lab Operator	Before every analytical run	EPA 8082M
UPLC-MS/MS	Initial Calibration	Lab Operator	Initially and as required to maintain verification daily	AXYS MLA-110
HRGC/HRMS	Initial Calibration	Lab Operator	Initially and as required to maintain verification daily	AXYS MLA-010, MLA-028, MLA-035, MLA-043, MLA-046, MLA-017, MLA-033, EPA1614M
HRGC/HRMS	Calibration Verification	Lab Operator	Every 12 hours	AXYS MLA-010, MLA-028, MLA-035, MLA-046, MLA-017, MLA-033, EPA1614M

HRGC/HRMS	PFK Calibration	Lab Operator	Initially and as required to maintain verification	EPA 1668A, EPA 1668AM
HRGC/HRMS	Ion abundance ratios	Lab Operator	Every analysis	EPA 1668A, EPA 1668AM
HRGC/HRMS	Isotope Dilution Calibration	Lab Operator	Every analysis	EPA 1668A, EPA 1668AM
HRGC/HRMS	Internal Standard Calibration	Lab Operator	Every analysis	EPA 1668A, EPA 1668AM
HRGC/LRMS	Sensitivity Check	Lab Operator	Before every analytical run	AXYS MLA-021
HRGC/LRMS	Initial Calibration	Lab Operator	Initially and as required to maintain verification daily	AXYS MLA-021
HRGC/LRMS	Calibration Verification	Lab Operator	Every 12 hours for PAHs, Every 12 to 14 hours for alkanes.	AXYS MLA-021
ICP-MS	Instrument Performance Check	Lab Operator	Before the start of each analytical run	EPA 200.8
ICP-MS	Continuous Calibration	Lab Operator	Run calibration blank and standards following each calibration routine, after every 10 samples and at the end of each run	EPA 200.8
ICP-MS	Instrument Performance Check	Lab Operator	Before the start of each analytical run	EPA 1638M
ICP-MS	Dual Detector Cross Calibration	Lab Operator	Before the start of each analytical run	EPA 1638M
ICP-MS	Internal Standard Calibration	Lab Operator	Before the start of each analytical run	EPA 1638M
ICP-MS	Initial Calibration	Lab Operator	Daily	EPA 6020AM
ICP-MS	Initial Calibration Verification	Lab Operator	Every analysis	EPA 6020AM
ICP-MS	Continuing Calibration Verification	Lab Operator	At the end of each run and after every 10 samples	EPA 6020AM
ICP-MS	Low Level Continuing Calibration Verification	Lab Operator	At the end of each run, optionally after every 10 samples if low-level sample concentrations are expected	EPA 6020AM
ICP-MS	Interference Check	Lab Operator	At the beginning of each run or once	EPA 6020AM

			every 12 hours, whichever is more frequent	
ICP-MS	Linear Dynamic Range	Lab Operator	Initial setup or after significant maintenance	EPA 6020AM
Ion chromatograph	Initial Calibration Check	Lab Operator	Before start of each analytical run	EBMUD 300.1
Ion chromatograph	Continuous calibration	Lab Operator	Every 10 samples and at the end of every fun	EBMUD 300.1
Lachat QuikChem AE Flow Injection Analyzer and Data System	Establish Calibration Curve	Lab Operator	Not specified	EPA 353.2
Lachat QuikChem AE Flow Injection Analyzer and Data System	Calibration Verification	Lab Operator	Every analysis	EPA 353.2
MERX Methylmercury Autoanalyzer	Initial Calibration	Lab Operator	Initially	EPA 1630
MERX Methylmercury Autoanalyzer	Calibration	Lab Operator	Used to establish initial calibration	EPA 1630M
MERX Methylmercury Autoanalyzer	Continuous Calibration	Lab Operator	After 10 runs	EPA 1630M
Model 1010 Total Organic Carbon Analyzer	Infrared detector linearization	Lab Operator	Before every analytical run	EPA 9060
Model 1010 Total Organic Carbon Analyzer	Infrared detector linearization verification	Lab Operator	Before every analytical run	EPA 9060
Model 1010 Total Organic Carbon Analyzer	Independent Calibration Verification	Lab Operator	Before every analytical run	EPA 9060
Model 1010 Total Organic Carbon Analyzer	Continuing Calibration	Lab Operator	Every 10 Samples	EPA 9060
Perkin Elmer model 2400 or LECO Micro Truspec CHN	Initial Calibration	Lab Operator	Every analysis	EPA 440
Perkin Elmer model 2400 or LECO Micro Truspec CHN	Calibration Verification	Lab Operator	Every analysis	EPA 440

Perkin Elmer model 2400 or LECO Micro Truspec CHN	Continuing Calibration	Lab Operator	Every analysis	EPA 440
Shimadzu TOC_VCSH Analyzer	Initial Calibration	Lab Operator	Annually	SM 5130 B
Shimadzu TOC_VCSH Analyzer	Initial Calibration Verification	Lab Operator	Before every analytical run	SM 5130 B
Shimadzu TOC_VCSH Analyzer	Continuing Calibration	Lab Operator	Every 10 Samples	SM 5130 B
Spectrophotometer	Calibration	Lab Operator	Daily	EBMUD 437
Spectrophotometer	Calibration	Lab Operator	With every analyte	EBMUD 488 Phosphorus
Spectrophotometer	O-Phos and T-Phos Calibration	Lab Operator	Every analysis	EPA 365.3
Spectrophotometer	Calibration Verification	Lab Operator	Every analysis	EPA 365.3, SM 4500-P E
Spectrophotometer	Continuing Calibration	Lab Operator	3 times per 17 samples	SM 4500-SiO2 C, EPA 370.1
Spectrophotometer	Zero with DI Water		Before every analytical run	SM 4500-CN
Spectrophotometer	Performance Evaluation		Annually	SM 4500-CN
Spectrophotometer	Wavelength Check		Annually	SM 4500-CN
Spectrophotometer	Method Detection Limit		Annually	SM 4500-CN
Spectrophotometer	Initial Calibration	Lab Operator	Annually	SM 4500-NO2 B
Spectrophotometer	Initial Calibration Verification	Lab Operator	Before every analytical run	SM 4500-NO2 B
Spectrophotometer	Continuing Calibration	Lab Operator	Every 10 Samples	SM 4500-NO2 B
Spectrophotometer	Initial Calibration	Lab Operator	Annually	SM 4500-P E
Spectrophotometer	Initial Calibration Verification	Lab Operator	Before every analytical run	SM 4500-P E
Spectrophotometer	Continuing Calibration	Lab Operator	Every 10 Samples	SM 4500-P E
Spectrophotometer	Zero with 90% Methanol		Before every analytical run	SM 10200 H-2bM
Spectrophotometer	Calibration		Before every analytical run	SM 10200 H-2bM

Spectrophotometer	Calibration		Daily	Solorzano, L., 1969
Spectrophotometer	Continuing Calibration		Minimum 1 calibration blank and 3 calibration standards per workgroup	Solorzano, L., 1969
Tecator auto analyzer	Initial Calibration	Lab Operator	Initially	SM 4500-NH3 C
UV-Persulfate TOC Analyzer, Dohrmann Phoenix8000	Calibration	Lab Operator	Before each run	SM 5130 C

Element 17 *Inspection/Acceptance of Supplies and Consumables*

Supplies are examined for completeness, damage, and/or suitability for use as they are received whenever possible, and upon use for supplies that should remain sealed (e.g., Infiltrex wound fiberglass filters are wrapped in foil and cannot be opened and viewed without risking contamination). The Project Manager or designated staff (e.g., Field Supervisor, or field sampling personnel) will be responsible for inspecting supplies for damage and suitability for use. Checks should include the following:

1. Sample containers – should be appropriately sealed (e.g., double bagged), of the correct/expected materials, with appropriate documentation of cleaning or testing (batch numbers, residue tests), visibly clean, and intact (no evidence of degradation, damage).
2. pH, conductivity, and other standards are to be checked by comparing their measurements with those generated by the current lot of standards, unless the current lot is expired or is suspected to have been compromised. Standards must agree within 1%. If results disagree, the instruments should be checked with standards from another source.
3. Other supplies such as gloves, coolers, and ice packs should be checked for condition and integrity before use in the field. Supplies should be of appropriate materials both to avoid contaminating samples (e.g., powder free gloves) and to protect field staff from chemicals to which they might be exposed during sampling (methanol washes, preservative acids)

Missing, damaged, or incorrect field supplies should be noted and immediately reported to the SFEI Project Manager and Field Supervisor, who will then contact the appropriate suppliers and laboratories to replace damaged items. Chemical supplies and calibration standards should be checked at least quarterly to meet the required criteria (e.g., expiration date) and to assure that decreasing and missing supplies are reordered. The SFEI staff responsible for ordering laboratory supplies and chemicals are Linda Russio and Melissa Foley.

The analytical laboratory maintains internal SOPs for inspection and quality checking of supplies. Under a PBMS approach, these procedures are presumed to be effective unless field and QC data from analyses or issues noted by SFEI staff receiving supplies indicate otherwise (e.g. container damage, visible contamination). SFEI will then work with the laboratory to identify the causes and address deficiencies in the SOPs that resulted in those problems. If the problem is serious and cannot be corrected by the laboratory, the SFEI Project Manager and

QAO will discuss and identify alternatives, including changing the sampling materials and methods, the extraction and analytical methods, the laboratory, or any combination of these.

Element 18 ***Non-direct Measurements (Existing Data)***

Non-direct measurements, in the form of data from previously conducted studies by SFEI and other parties in the region, may be used in determining ranges of expected concentrations in field samples, characterizing average conditions (e.g., temperature, barometric pressure) for calculations, and other purposes. These data will be reviewed against the data quality objectives stated in Element 7 and used only if they meet all of the specified criteria. Data not meeting MQOs should be used only in a qualitative manner for developing conceptual models and prioritizing future data needs.

Element 19 ***Data Management***

Data Formatting and Transfer

The collection agencies and laboratories provide data to SFEI in appropriate CEDEN templates (as provided by SFEI) within the timeframe stipulated in the contract, usually 90 days or less. The laboratories should use the current on-line data checker to review data for vocabulary and business rule violations prior to submitting to SFEI using the SFEI Data Submittal Portal https://rdcdataupload.sfei.org/ (contact DS@sfei.org for the current login and password). SFEI will work with the labs to address vocabulary and business rule issues identified from using the data checker. SFEI will work with CEDEN to populate the lookup lists with new values as identified by the labs from using the on-line data checker.

Data are maintained as established in Section 9.

SFEI will require data to be corrected and resubmitted if any of the following issues are encountered:

- Data submittal is missing target analytes listed in the contract
- Results not reported in the units and basis requested in the contract
- Field and QC samples not reported in equivalent units and basis for a given analyte (rationale provided in Section 9.1.1)
- Grain size fractions not summing to 100%

SFEI tracks each data set, from submittal to final upload to the Regional Data Center (RDC) database. Once all expected data have been received, expert staff on SFEI's Data Services team process the data using a series of queries designed to identify any issues remaining with the format of the data. The QA Officer or designee then reviews data for quality assurance and quality control and appropriate QA codes are applied to the dataset. The QAO or designee writes a report for each dataset outlining the quality of the data. This report highlights any issues that need to be addressed by the laboratory, project manager, or data management staff. In addition, specialized senior scientists further review organics datasets such as PCBs, PBDEs, and pesticides. Data are then compiled into the RDC database and distributed to the project managers. Data that are approved for public release are available through SFEI's Contaminant Data Display and Download tool (CD3) cd3.sfei.org/, usually within one year of sample collection. Select data will also be made available through CEDEN's Advanced Query tool ceden.waterboards.ca.gov/AdvancedQueryTool. The contact individual responsible for steps and tasks of data management is Amy Franz (email: amy@sfei.org; telephone: 510-746-7394).

SFEI maintains regular backups of their enterprise databases both to disk and tape, nightly and

weekly, respectively. The RDC database, specifically, is also backed up hourly. As a further protective measure, copies of the tapesets are stored both onsite and offsite. The lifetime of the backup files on tape is about two -three weeks. Additionally, a backup of the RDC database from the first of every month is stored on disk indefinitely allowing for quick restore and review of archived data as the need warrants.

C. ASSESSMENT AND OVERSIGHT

Element 20 *Assessment and Response Actions*

Laboratory Performance Audits/Corrective Action

Initially, a desktop or on-site performance audit will be performed by the QAO and designated staff to determine if each laboratory can meet the requirements of the QAPP and to assist the laboratory where needed. Review of current NELAP and/or state ELAP certification of a laboratory for the analyses performed for the RMP may be accepted in some cases in lieu of an on-site audit. Reviews may be conducted at any time during the scope of the study. Results will be reviewed with participating laboratory staff and corrective action recommended and implemented, where necessary. Furthermore, laboratory performance may be assessed on through laboratory intercomparison studies (round robins) when requested by SFEI, such as those conducted by the National Institute of Standards and Technology (NIST).

The progress of the work conducted on RMP studies will be evaluated monthly. If data quality issues are identified, a preliminary meeting will be held between SFEI's QAO and the Project Manager to discuss possible solutions. If necessary, a corrective action plan will be developed in consultation with the appropriate lab(s), the corrective actions taken, and the issue and its resolution summarized in a brief report or memorandum. A summary of these issues will be maintained in the Project files, and will be noted in any reporting that includes affected data.

Element 21 ***Reports to Management***

RMP data are publicized through RMP Annual Monitoring or/and Pulse of the Bay reports, which are available online via the SFEI website (sfei.org) or as printed hardcopies, as well as in downloadable data tables. Reporting of pilot and special study results are included in reports for those components, e.g., in triennial reports on contaminants in fish and bird egg monitoring.

Following general goals for RMP reporting, data from monitoring samples are reviewed and available for dissemination within one year of the sample collection. More detailed analyses such as statistical analyses and/or modeling of temporal and spatial trends follow the specific reporting timelines of those program elements. Reporting goals may be modified as study plans are further developed.

The QAO is responsible for summarizing potential QA issues with reported data and communicating those issues to the Project Manager. The QAO also reviews any SFEI analyses and reports generated from the data, to ensure that QA issues are appropriately acknowledged and addressed.

Table 26 Project Deliverables and Timeframes

Deliverable	Deliverable Due Date
Collection Information Templates	Within 30 days of sample collection
Sample receipt at the laboratory	Within holding times requirements, <1 month for holding time ≥6 months
Data package submission by lab	90 days after sample receipt or as stipulated by contract
Data reviewed and approved, or QC issues identified and corrective action planned	1 month after data package receipt
Corrective actions taken (e.g., reanalysis)	1 month after corrective action planned
Final Report	1 year after sampling complete

D. DATA VALIDATION AND USABILITY

Element 22 *Data Review, Verification, and Validation*

After data are submitted, SFEI staff examine the data set for completeness (e.g., correct numbers of samples and analyses, appropriate QC sample data included) and accuracy (e.g., in sample IDs). The SFEI QAO or designee will examine submitted QA data for conformance with MQOs, specified previously (Elements 7 and 14). Data that are incomplete, inaccurate, or failing MQOs without appropriate explanation will be referred back to the laboratory for correction or clarification. The QAO will discuss data failing MQOs with laboratory staff to determine whether modifications to analytical methods can be made to improve results on reanalysis. If problems cannot be readily corrected (insufficient sample, irremovable interferences, or blank contamination based on past attempts with the lab), results outside the MQOs may be flagged to alert data users to uncertainties in quantitation. Results greatly outside the target MQO range (z-scores or p-scores > 2) may be censored and not reported.

In addition to contamination and other artifacts introduced by sampling and analytical methods, errors may arise at many points in the processing and transmittal of data generated for the RMP. Characteristics of reported data are examined to identify possible problems in the generation and transmission of data. Organic data submitted to the RMP are compared to values in the literature for comparable environments and from previous SFEI monitoring to evaluate their environmental coherence. Simple statistics (e.g., minimum, maximum, mean, median) may be generated to quickly identify data sets or individual data points greatly outside of their expected range. Anomalous individual points will be examined for transcription errors. Unit conversions and sample quantitation calculations may be reviewed to identify larger and systematic errors.

Where groups of analytes or results in different environmental phases are or can be summed to generate totals (e.g., % gravel + sand + fines = 100%, dissolved + particulate = total), data sets or individual samples will be further checked for internal consistency. For example, total water concentrations of contaminants should generally be greater than dissolved concentrations. Gross deviances may be used to identify problems in sampling, analysis, quantitation, or data transcription and transmission. Problems found by SFEI staff will be relayed to the appropriate laboratory and field sampling staff to address. However, in some cases (particularly where the differences are on the order of the MDL), total results less than dissolved or other deviations from expected ratios may indicate the uncertainty typical for the analytical method and apparent anomalies will be evaluated on a case-by-case basis.

Element 23 ***Verification and Validation Methods***

Data are submitted to SFEI in an electronic tabulated format. The Project Manager or designated project staff verify that results for appropriate field and QC samples are reported by comparing the sample types and numbers provided against those specified in the detailed project plan, chain of custody forms, and/or contracts. SFEI's QA Officer or a designee/and designated trained staff perform all QA reviews. The contract laboratory's QA Officer (QAO) performs checks of all of its records and with the laboratory's Director or Project Manager should verify consistency among lab records, submitted reports (hardcopy and/or pdf and other fixed formats), and electronic data deliverables. As data are formatted and QA reviewed at SFEI, issues are noted in a narrative list and communicated to the field or laboratory teams as needed to correct any problems found (e.g., unanalyzed samples left in storage, transcription errors).

Reported QC sample data are compared to measurement quality criteria specified previously (Element 7). Exceedances of MQOs not already noted by the laboratory are flagged in any electronic databases and communicated to the analyzing laboratory for possible recalculation and/or reanalysis. Reconciliation and correction of errors in reported data will be addressed by consultation among SFEI's Project Manager, QAO, Field Supervisor, and Analyst(s) with the Laboratory's QAO, Laboratory and/or Project Manager, and appropriate lab personnel. The involved parties will agree upon any corrections.

Analyses sometimes produce results that fail MQOs and may not be possible to overcome for a small number of analytes within a large group of related compounds. For example, there may be contamination that is impossible to eliminate for all analytes when analyses are conducted at ultra-trace levels. With agreement of the SFEI Project Manager and QAO in consultation with the Laboratory, results for sample groups with data outside of MQOs may be flagged, to indicate the greater uncertainty in the quantitation of those data. Results on individual analytes that are greatly outside the target MQO range (e.g., z-scores > 2) will be censored as needed rather than subjected to repeated analysis. Reports, graphs, tables, or summary statistics generated from datasets with censored data should note their exclusion or other handling.

Repeated analysis may not fix any issues but rather just mask variability, creating a false impression of the quantitative certainty of results. Contamination of method blanks can sometimes represent a temporary source of contamination, and flagging results of batches in which contamination is found in blanks is appropriate. However, consider for example a batch of samples in which the odds of an airborne microparticulate contaminant in the lab falling into an individual sample is 10%. In a batch of samples, 1 in 10 times that contamination enters the blank sample, raising alarm and perhaps triggering reanalysis. Repeated blank analysis in various batches will apparently pass muster 90% of the time, but contamination may in reality still affect 10% of the non-blank field samples. By eliminating the "failed" batches with contamination in blanks, all that remain are the seemingly good batches, with no indication of the level of contamination that is truly still present in many (10%) of the samples. As a good practice, sample results in batches with detected blank contamination will be flagged (for field samples with

analyte concentration > 3x those found in method blanks) or censored (for results < 3x those in blanks) by SFEI, but data users should be aware of the possible influence of sporadic contamination in other batches analyzed around the same time, particularly for samples with low concentrations similar to those in blanks.

Similar analogies can be made with failures of precision or accuracy QC measurements. Individual failures may fall within the range of the true variance in the measurement, e.g., NIST acceptance ranges are sometimes in excess of ±50% of the mean values, and while reporting only successful reanalysis batches may appear to produce more consistent and certain results, without fundamental changes to the analytical process, the underlying uncertainty may only have been masked/censored rather than truly reduced for the reported field samples. This is not to say that reanalyses are never warranted or desirable, but rather to underscore that improved results on QC measurements, which can sometimes be achieved simply by repeat analysis and discarding previous failed results, should not be confused with improved measurements, which are only achieved by making real substantive changes to the sampling and/or analytical methods. If reanalyses are to be attempted, it is therefore imperative that the Project Manager and QAO work in consultation with laboratory staff to identify and change the factors that may have led to MQO deviances, rather than simply repeat the analyses until the QC passes. For MQO deviations (z-score or p-score > 1) for which causes are not identified and that are not fixed by corrective actions, field sample results may be qualified, or censored if grossly deviating (z-score or p-score > 2). The QC data used for determination of flagging is subject to the availability of data on various QC sample types and the professional judgment of the QAO, but where possible, data for flagging recovery should be 1) in a similar matrix as samples, 2) with externally validated expected values, 3) in a quantitative range, and 4) in a similar concentration range as field samples. Thus for evaluating recovery, the order of preference is generally CRM > LRM > MS > LCS, with exceptions and changes in preference made for factors such as non-certified values, certified values with wide uncertainty bands, and concentrations greatly different from those in field samples. Similarly, for evaluation and flagging of lab precision, QC samples should: 1) be in the same matrix as field samples, 2) isolate lab variation from other causes, 3) be in a quantitative range, and 4) be in a similar concentration range as field samples, where available. For evaluating precision then, the preferred sample types for replicates are: lab > field > MS ~ CRM > LCS, again with exceptions made depending on the available sample types, their inherent variability, concentration ranges, and other factors.

The QA/QC requirements presented in the preceding sections are intended to provide a common foundation for each laboratory's protocols; the resultant QC data will enable assessment of the comparability and uncertainty of results generated by different laboratories and analytical procedures. It should be noted that the QC requirements specified in this plan represent the minimum requirements for any given analytical method; labs are free to perform additional QC in accordance with their standard practices.

In addition to performance on required QC measures and samples (i.e., MDLs, blanks, matrix spikes, CRM, replicates), data are also examined for internal and external consistency to ensure that reported values are realistic and representative for the locations and matrices of collected samples. This review may include but is not limited to:

1. Comparison of reported values to those from previous years for the same locations and matrices, where available; large differences from previously reported values may not necessarily indicate analytical issues and may simply reflect natural spatial and temporal

variability of the ecosystem.

2. Comparison of reported values to those in the published literature, where available; differences from other regions and/or species may merely indicate differences in resident species and ecosystem structure, but very large (e.g., 2-3 orders of magnitude) differences may sometimes help identify errors in analysis or reporting (e.g., unit conversions).

3. Internal checks of relative analyte abundance – variations in concentrations of one compound or isomer in a class of chemical contaminants are often tightly linked to those of related compounds, such as a compound and its degradation products or manufacturing byproducts, or various congeners in a commercial mixture. Deviations in these relative abundances can sometimes indicate matrix interferences or other analytical problems, although care should be taken to not disregard results that might reveal atypical sources and/or ecosystem processes.

4. Relative abundance in sample fractions or matrices – contaminants often partition between phases in predictable ratios, depending on their chemical properties and ambient conditions such as dissolved organic carbon and sediment organic carbon content. Big differences from expected ratios in dissolved versus particulate phases for water samples or sediment versus porewater concentrations may indicate problems with extraction or analysis for individual samples or sets of samples. In particular, sample concentrations for filtered (dissolved phase) water samples should always be lower than results for whole (dissolved and particulate phase) water, although at low concentrations, the variability in quantitation may be sufficient for some total water results to be reported at concentrations lower than those for dissolved phase alone.

Element 24 ***Reconciliation with User Requirements***

RMP studies need sufficient numbers of data points, as represented by the completeness data quality objective, in order to characterize ambient condition, conduct trend analyses, and evaluate the potential impact on water quality. A failure to achieve the numbers of data points cited could mean an inability to provide these assessments.

All data are reviewed by the QAO to determine if the results have met the RMP MQOs of completeness, sensitivity, precision, and accuracy. Limitations of the data, including uncertainty of validated data, are reported to the data users by a QA code or qualifier. The RMP has adopted the California Data Exchange Network's (CEDEN) standard list of codes to flag data at the result and analytical batch level; the RMP uses a subset of the available codes to flag various QC issues as needed.

The data will be stored and maintained in the Regional Data Center database structure and will follow RMP adaptations of CEDEN's business rules.

Measurement quality objectives listed previously (Section 14) establish targets to be routinely achieved by the analytical laboratory. However, it is uncertain whether obtained data, even when meeting all stated MQOs, will be sufficient to answer the RMP management questions with sufficient certainty, as the relative contributions of environmental variability and analytical uncertainty to overall uncertainty (e.g., for use in modeling, comparisons to guidelines, or other functions) cannot be known *a priori* until sufficient data have been collected. However, as RMP

studies proceed, the ability of collected data to answer these management questions should be periodically re-evaluated for study design and budget planning in subsequent years.

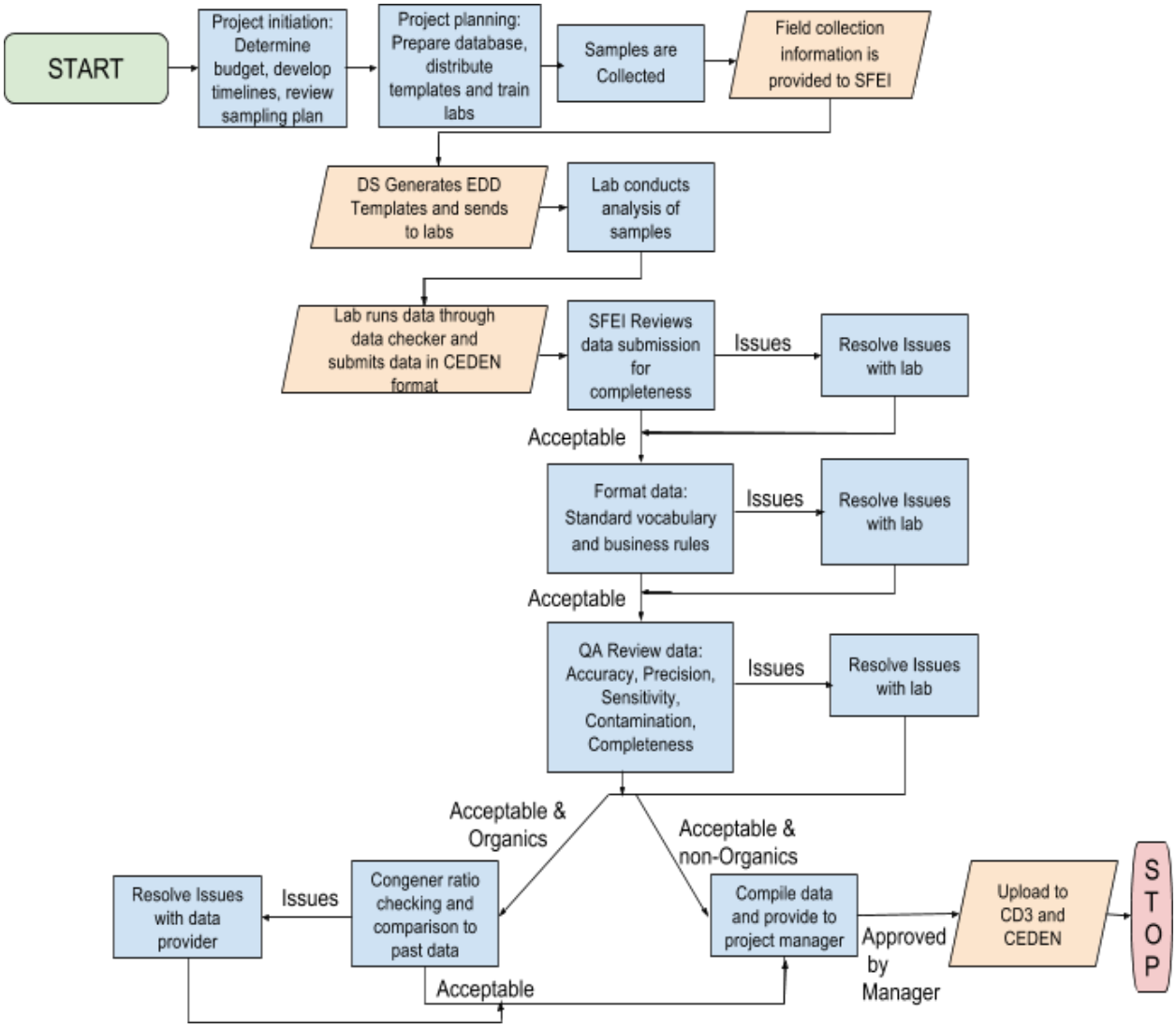

Figure 9 RMP Data Flow Diagram

Element 25 ***References***

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Element 26 ***Appendix***

Abbreviations

Abbreviation	Meaning
ASTM	American Society of Testing and Materials
AXYS	AXYS Analytical Services, Ltd.
BPTCP	Bay Protection and Toxic Cleanup Program
CEDEN	California Environmental Data Exchange Network
CDFG	California Department of Fish and Game
COC	Chain of Custody
CRM	Certified Reference Material
DOC	Dissolved Organic Carbon
DO	Dissolved Oxygen
MQO	Measurement Quality Objective
EC_{50}	Effect concentration of toxicant that produces a specific measurable effect in 50% of the test organisms within stated study time
EPA	Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FOM	Field Operations Manual
GC	Gas Chromatography
GC-ECD	Gas Chromatography-Electron Capture Detection
GLP	Good Laboratory Practice
GPS	Global Positioning System
LC_{50}	Concentration at which a toxicant is lethal to 50% of test organisms
LRM	Laboratory Control Material
LOEC	Lowest Observable Effects Concentration
LOQ	Limit of Quantitation
MDL	Method Detection Limits
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOEC	No Observable Effect Concentration

NPDES	National Pollutant Discharge Elimination System
NRCC	National Research Council Canada
NS&T	National Status and Trends Program
OSHA	Occupational Safety and Health Administration
ORP	Oxidation Reduction Potential
PMSD	Percent Minimum Significant Difference
QA/QC	Quality Assurance/Quality Control
QAO	Quality Assurance Officer
QAPP	Quality Assurance Program Plan
RDC	Regional Data Center
RMP	Regional Monitoring Program for Water Quality in San Francisco Bay
RSD	Relative Standard Deviation
SFEI	San Francisco Estuary Institute
SOP	Standard Operating Procedure
SSC	Suspended Sediment Concentration
STDEV	Standard Deviation
SWRCB	(California) State Water Resources Control Board
SWAMP	(California) Surface Water Ambient Monitoring Program
TEQ	Toxic Equivalent
TOC	Total Organic Carbon
USGS WERC	United States Geological Survey Western Ecological Research Center

Appendix 2. Archive Sample Bank Protocol

[Procedures for the Collection and Storage of Environmental Samples in the RMP Specimen Bank]

http://www.sfei.org/sites/default/files/biblio_files/Report_628_Archive_Protocol.pdf