

## **2019 Special Study Proposal: Selenium in Clams and Water**

**Summary:** The proposed clam monitoring would continue a long-running USGS monitoring program for selenium in clam tissue. The RMP approved funding in 2017 that enabled monitoring to continue through September 2017, but monitoring currently is on hold. This proposal would support one year of monitoring following a modified monitoring design optimized for early detection of changes in selenium trends in clams. Clam and concurrent water samples would be collected at two locations every other month for one year.

### **Estimated Cost:**

Part I, Monitoring: \$75,000

Part II, Data Management & Reporting: \$40,000

**Oversight Group:** RMP Selenium Workgroup

**Proposed by:** Jennifer Sun and Jay Davis

### **PROPOSED DELIVERABLES AND TIMELINE**

<b>Deliverable</b>	<b>Due Date</b>
Task 1. Collect water and clam samples	2019-2020
Task 2A. Analyze water samples	Monthly, 2019-2020
Task 2B. Analyze clam samples	Summer 2019, Spring 2020
Task 3. Data Management	Summer 2020
Task 4. Draft Report	Fall 2020
Task 5. Final Report	Winter 2020

### **Background**

In 2016, the State Water Resources Control Board approved a selenium TMDL for North San Francisco Bay. The TMDL established a target concentration of 11.3 ug/g dw in white sturgeon muscle tissue as the basis for evaluating impairment (SFBRWQCB 2015). In June 2016 the USEPA published proposed aquatic life and aquatic-dependent wildlife criteria for selenium in the Bay and Delta. The proposal includes criteria for fish tissue (muscle and whole body), clam tissue, and water (dissolved and particulate phases).

Following up on discussions surrounding the North Bay TMDL, the San Francisco Water Board asked the Selenium Workgroup to develop a robust monitoring design for the North Bay. The goal is to identify leading indicators of change to allow prompt management response to signs of increasing impairment. The Workgroup convened a technical workshop on this topic on July 27, 2016. At this workshop, participants reached a consensus that monitoring of sturgeon, clams, and water are all needed to answer management questions. Recommendations for long-term monitoring of these three matrices are presented in the North Bay Monitoring Design document (Grieb et al. 2018) and will be discussed and further refined at the 2018 Selenium Workgroup meeting.

USGS has been conducting monthly clam monitoring at multiple locations in North Bay for over 20 years, but USGS funding for this work was ended in 2016. In 2016, the RMP approved the use of Undesignated Funds to support continuation of the USGS monitoring, which covered monitoring through September 2017. Since October 2017, clams have not been monitored in North Bay, creating the first gap in this long-term time series. This proposal would support one year of monitoring following a modified monitoring design optimized for early detection of changes in selenium trends in clams. Following the recommendations in the North Bay Monitoring Design document (Grieb et al. 2018), this monitoring is proposed to be continued on an annual basis.

There is currently no systematic monitoring program for dissolved and particulate selenium in the water column in North Bay. Previously, studies of selenium speciation across the estuarine salinity gradient were conducted only periodically in 1999-2000, 2010, and 2012; currently, only dissolved selenium is collected at randomly selected sites in North Bay once every two years through the RMP's Status and Trends Water Cruise. Recommendations in Grieb et al. (2018) for future water monitoring included monthly water sampling at the two clam stations in North Bay for three years.

### **Study Objectives and Applicable RMP Management Questions**

The objective of this monitoring element is to continue long-term monitoring of *Potamocorbula amurensis* and begin long-term monitoring of water in North Bay, to track long-term interannual trends and provide an indication of changes in sources or environmental processes influencing food web selenium exposures in North Bay. This study addresses key questions identified by the Selenium Strategy and the RMP (Table 1).

**Table 1.** Study objectives and questions relevant to RMP management questions.

<b>RMP Management Question</b>	<b>Priority Management Question for Selenium</b>	<b>Priority Management Question for Selenium in North Bay</b>	<b>Study Objective</b>	<b>Example Information Application</b>
1) Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely?	2. Are the beneficial uses of north San Francisco Bay impaired by selenium?	1. Are the beneficial uses of north San Francisco Bay impaired by selenium?	Compare measured concentrations to the North Bay TMDL target for water and USEPA selenium criteria for water and clams.	Do the data indicate a need for management actions?  What factors are influencing the observed selenium concentrations?
2) What are the concentrations and masses of contaminants in the Estuary and its segments?	3. What is the spatial pattern of selenium impairment?		Compare measured concentrations across two sites in North Bay.	Are there distinct differences in selenium concentrations and patterns across sites?  What do these differences indicate about selenium sources and bioaccumulation in different regions of North Bay?
4) Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased?	2. Are changes occurring in selenium concentrations that warrant changes in management actions?	2. Are changes occurring in selenium concentrations that warrant changes in management actions?	Compare measured concentrations to clam and water concentrations measured during past studies.  Evaluate trends using change point and normal range analyses.	Are selenium concentrations increasing or decreasing?  What factors may be influencing these trends?

## Approach

### Field Sample Collection

*Potamocorbula amurensis* and water samples will be collected from two long-term USGS monitoring locations in northern San Francisco Bay: (1) station 4.1 near the confluence of the Sacramento and San Joaquin Rivers, and (2) station 8.1 at the mouth of the Carquinez Strait in Suisun Bay. Samples will be collected and processed by Applied Marine Sciences aboard the *RV Questuary*. Clam sampling will take place six months each year. The recommended sampling design includes two key three-month periods of monthly sampling preceding fall muscle plug monitoring (July-September) and the spring pre-spawning period (December-February).

Each month, approximately 80-100 clams will be collected from each site using a benthic ponar grab and depurated for 48 hours prior to being measured and divided into 5 composite replicates representing a range in clam lengths from 8-15 mm. Groups of composite clam samples will be shipped to the analytical laboratory for further sample processing and analysis. QA/QC samples will be analyzed at a rate of one laboratory blank, one laboratory duplicate, one matrix spike, one matrix spike duplicate, and one certified reference material for every 20 samples.

Water sampling will take place at a reduced frequency of six months each year, concurrent with clam sampling. Samples will be collected from the same two sites, in both the dissolved and particulate phase, using a peristaltic pump. Sample collection methods, including sample volumes and filter sizes, will be established during a proposed laboratory intercomparison study conducted prior to the sampling.

### Laboratory Analyses

Clams will be dissected and homogenized into 5 composite samples by the analytical lab. A wet weight will be recorded before the samples are oven dried at < 40 °C, after which a dry weight will be recorded and samples will be analyzed for Se concentrations. Samples will also be prepared for analysis of carbon and nitrogen stable isotopes by UC Davis stable isotope facility.

Clams will be analyzed in two batches, one for each sampling round. At least one method blank, one standard reference material, two laboratory duplicates, and two matrix spikes will be analyzed with every 20 samples. The analytical laboratory will be determined following the proposed laboratory intercomparison study.

The analytical laboratory for dissolved and particulate water samples, and corresponding sample processing and analytical methods, will similarly be determined following the proposed laboratory intercomparison study. Ancillary parameters, including total suspended material, total organic carbon, and chlorophyll a, will also be collected with each selenium sample.

## Budget

The proposed budget for Part I is \$75,000. Part I includes project planning, sample collection, laboratory analyses, and preliminary data review.

The proposed budget for Part II is \$24,000. Part II will include complete RMP data management and reporting, including data upload to CEDEN.

**Table 2A. Part I Budget (Monitoring)**

<b>Task</b>	<b>Estimated Cost</b>
<b><i>Labor</i></b>	
Project Planning & Coordination	\$5,000
Data Management	\$4,000
<i>Subtotal</i>	<i>\$9,000</i>
<b><i>Subcontracts</i></b>	
AMS – clam and water sample collection & processing, 6 months	\$44,000
BAL <sup>1</sup> – 60 clam samples processed & subsampled @ \$80/sample	\$4,800
BAL <sup>1</sup> – 60 selenium & total solids analyses in clams @ \$100/sample	\$6,000
BAL <sup>1</sup> – 6 months of dissolved & particulate selenium analyses in water @ \$880/month <sup>2</sup>	\$5,280
TBD <sup>1</sup> – 12 samples of TSS, TOC, chl a @ \$80, \$85, \$180/sample	\$4,140
UCD – 60 <sup>13</sup> C, <sup>15</sup> N stable isotope analyses in clams @ \$9/sample	\$540
<i>Subtotal – With Water</i>	<i>\$64,760</i>
<b><i>Direct Costs</i></b>	
Equipment – included in AMS cost estimate	\$0
Shipping	\$1,000
Travel	\$240
<i>Subtotal</i>	<i>\$1,240</i>
<b><i>Grand Total</i></b>	<b><i>\$75,000</i></b>

1 – These cost estimates are preliminary and may change depending on the laboratory selected following the laboratory intercomparison study. BAL has a minimum sample size of 8 samples per batch, at \$110 per sample. Cost efficiencies may arise if samples from the Delta are analyzed at the same time, funded separately.

**Table 2B. Part II Budget (Data Management & Reporting)**

<b>Task</b>	<b>Estimated Cost</b>
<i>Labor</i>	
Data Management – Clam	\$12,000
Data Management – Water	\$12,700
Data Report*	\$15,300
<i>Subtotal</i>	<i>\$40,000</i>
<b><i>Grand Total</i></b>	<b><i>\$40,000</i></b>

**Data Management and Reporting**

Preliminary data review of the data will be conducted by RMP staff as part of Part I, including preparation of data tables that can be available for internal RMP review. Complete RMP data management and reporting, including CEDEN upload, will be conducted as part of Part II.

**References**

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 2015. Total Maximum Daily Load Selenium in North San Francisco Bay: Staff Report for Proposed Basin Plan Amendment. Report prepared for the California Regional Water Resources Control Board, San Francisco Bay Region, November 2015. San Francisco Bay Regional Water Quality Control Board, Oakland, CA. [http://www.waterboards.ca.gov/sanfranciscobay/board\\_info/agendas/2015/November/6\\_appendix\\_c.pdf](http://www.waterboards.ca.gov/sanfranciscobay/board_info/agendas/2015/November/6_appendix_c.pdf)