Special Study Proposal: Support for Dredging Project Bioaccumulation Evaluations, Part 2

Summary: The Dredged Material Management Office (DMMO) is responsible for approving millions of cubic yards of routine dredging projects in the San Francisco Bay to maintain safe navigation. Dredged sediment and the remaining residual sediment are evaluated to ensure projects do not produce adverse environmental impacts. We propose to support these sediment bioaccumulation evaluations through two targeted studies. The first is to review all the PCB bioaccumulation test results to assess the performance of current bioaccumulation testing trigger thresholds. The results of this review may be used to support reassessing total PCB bioaccumulation trigger threshold. The second is to review and recommend a standard set of values for bioaccumulation modeling. This information would ensure that bioaccumulation evaluations use the best available science and are consistent within the region. The recommendations from this study will save dredgers and regulators time and money by improving the efficiency and consistency of dredging project evaluations.

Estimated Cost: $45,000

Oversight Group: EEWG

Proposed by: Ila Shimabuku and Diana Lin (SFEI)

PROPOSED DELIVERABLES AND TIMELINE

Deliverable	**Due Date**
Task 1: Kickoff Meeting with DMMO Stakeholders	October 2018
Task 2: Compilation of Preliminary Results (PCB bioaccumulation test results and bioaccumulation model parameters)	January 2018
Task 3: Mid-Project Meeting with DMMO Stakeholders	February 2019
Task 4: Draft Report	April 2019
Task 5: Final Report	August 2019

Background

Every year, millions of cubic yards of sediment are dredged in and around San Francisco Bay to maintain safe navigation. The Dredged Material Management Office is an interagency group, led by the U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency Region 9 (USEPA), the San Francisco Bay Conservation and Development Commission, the San Francisco Bay Regional Water Quality Control Board, and the State Water Resources Control Board. It is responsible for approving routine dredging projects in an economically and environmentally sound manner. Both the dredged sediment and the remaining residual sediment (post-dredge surface sediment) are systematically evaluated for negative impacts to aquatic organisms and human health from potentially bioaccumulative compounds. The evaluation process requires sequential analysis of bioaccumulative compounds in sediment, benthic organisms, and fish. The potential for bioaccumulation in fish is evaluated using a model if sediment and benthic organism screening criteria are exceeded.

The regulatory evaluation involves a weight of evidence approach, which includes the following comparisons:

1. Sediment concentrations are below the bioaccumulation triggers (BT): in-Bay sediment disposal of dredged sediment is acceptable
2. Sediment concentrations are above BTs but below TMDL in-Bay disposal limits (for mercury and PCBs): detected compounds are evaluated using sediment bioaccumulation tests and analyses to determine whether in-Bay disposal is acceptable
3. Sediment concentrations exceed TMDL in-Bay disposal limits (for mercury and PCBs): in-Bay disposal is not allowed

In 2012, the DMMO eliminated Step 2: evaluating mercury exposures for navigational dredging that will be discharged back into the Bay at designated unconfined aquatic disposal sites. The decision was due to findings from an analysis (EFH Consultation, 2011) that found none of the sediments for which the mercury bioaccumulation tests were conducted because the sediment concentrations were between the BT and TMDL limit would have exceeded thresholds for evaluating the bioaccumulation tests ("toxicity reference values") and "failed" in-Bay placement tests (Ross, 2012). After this decision, dredged sediments with mercury concentrations below the TMDL have been cleared for disposal at in-Bay locations and dredgers and the DMMO have not spent time and money on mercury bioaccumulation tests. To date, there have been approximately 30 studies that have included PCB bioaccumulation tests between 2011 and 2017. Similar to the process for mercury, analysis of these data is likely to provide the information needed to evaluate the efficacy of the total PCB bioaccumulation testing threshold.

Potential negative impacts to benthic organisms from dredged sediment are evaluated by comparing bioaccumulation test (using benthic organisms) results with toxicity reference values (TRVs) that are chosen based on published studies showing "effects" at these concentrations. Transfer through the food chain is further evaluated using the BRAMS model which contains two separate modules: the Trophic Trace model (TT) and the Bioaccumulation Evaluation Screening Tool (BEST). For organic compounds, the sediment-based food web Trophic Trace model predicts fish concentrations using either user-specified

sediment concentrations or tissue concentrations from bioaccumulation tests. For sediment dredging evaluations, the food web is typically modeled with the TT tool by specifying parameters for modeled fish, e.g., lipid content and weight, and their benthic diet. Currently, there are no established fish tissue thresholds with which to compare outputs from the BRAMS model. Because Bay shiner surfperch and white croaker are reported by the RMP, dredging evaluations typically involve modelling biomagnification in these species and comparing the model outputs, i.e., predicted fish concentrations, with RMP-reported ambient fish tissue concentrations. Currently, the modeling method and process for evaluation of results is not standardized and is conducted by dredgers on a case-by-case basis.

This two-part study would be in support of the DMMO evaluation framework. First, this study will synthesize and evaluate available PCB bioaccumulation test results in the DMMO database to provide insight into the performance of the PCB bioaccumulation trigger as a tool for assessing the impact of dredged sediment. Second, this study would develop a recommended, standardized list of input data for bioaccumulation modeling for fish tissue concentrations based on a literature review. Determining whether bioaccumulation testing of PCBs can be appropriately omitted and developing regionally standardized BRAMS model inputs and use-methodology will result in substantial savings for both dredgers and LTMS managers. Furthermore, these two studies would significantly streamline DMMO's evaluations which would not only improve efficiency but also improve consistency of decision-making across dredging projects.

Study Objectives and Applicable RMP Management Questions

This study will provide information and methods essential for evaluating bioaccumulation test results for dredging projects. This information is directly relevant to the following management questions for the RMP.

From the latest revised list of EEWG management questions:

- What are appropriate criteria to manage ecological exposure to chemicals in dredged material?

Overarching RMP Management Questions:

- 1: Are chemical concentrations in the Estuary potentially at levels of concern and are associated impacts likely?
    - 1.1: Which chemicals have the potential for impacts?
    - 1.2: What is the potential for impacts due to contamination?
    - 1.3: What are appropriate guidelines?

Approach

We propose to support sediment bioaccumulation testing through two targeted studies. The first is to evaluate all the PCB bioaccumulation test results to assess the performance of current bioaccumulation trigger thresholds. The second is to review and recommend a standard set of values used for bioaccumulation modeling.

1. Sediment Bioaccumulation Evaluation

The first part of this study is to evaluate the PCB bioaccumulation trigger by collecting, synthesizing, and analyzing results from PCB bioaccumulation testing reported to DMMO for projects between 2011 and 2017. With guidance from the DMMO, we will identify all bioaccumulation testing projects and extract all relevant PCB data points. Data will be extracted from the DMMO database as well as from reports with results that are not currently included in the database. Results from these reports will be added to the DMMO database as part of the this study's data compilation task. Initial data analysis will include calculating total PCB concentrations from congener data as well as evaluating quality of tissue data analyses (e.g. detection of PCBs in control samples, evaluate detection limits). Similar to Figure 1, we will compare these bioaccumulation test results with relevant PCB thresholds, including TRVs for benthic organisms; TMDL targets for aquatic resources, wildlife, and human health; and ambient fish tissue concentrations for shiner surfperch and white croaker from the RMP. We will also use the bioaccumulation results as inputs to the BRAMS model (using standard model inputs recommended from the second part of this study described below) in order to estimate bioaccumulation of PCBs in fish. We will compare the resulting fish tissue concentration model outputs with the applicable thresholds, i.e., TMDL targets and ambient fish concentrations.

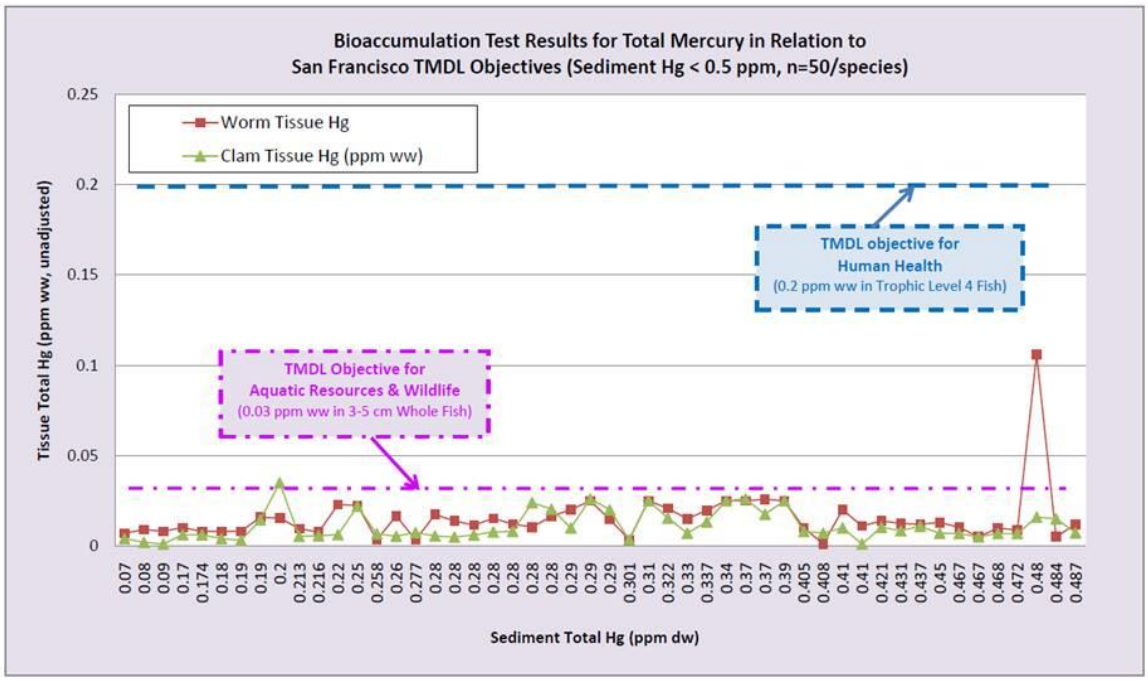

Figure 1 displays findings from the mercury bioaccumulation-testing-analysis study mentioned in the background of this proposal. (Ross, 2012).

2. Bioaccumulation Model Inputs

The second part of this study is to provide support for evaluations of food web transfer associated with contaminants in dredged sediments. We will review the latest literature from peer-reviewed studies, DMMO testing data, and RMP data and evaluations to develop a recommended list of standard bioaccumulation model inputs for food web modeling in BRAMS. This list will include parameters for modeled fish, composition of diet, and the

physical and chemical parameters listed in Table 1. We will evaluate the sensitivity of predicted fish tissue concentrations to uncertainties or potential ranges in model input parameters as a basis for recommending standard values that are appropriate for screening level evaluations of San Francisco Bay sediment. The list of partition coefficients will include a recommended value to represent total PCBs, total DDT, total PAHs, total DDTs, total chlordane, dieldrin, and dioxins/furans.

Table 1: Model input parameters

Modeled fish lipid content
Modeled fish weight
Modeled fish diet lipid content
Composition of diet (sums to 100%)
Sediment TOC concentration
Particulate organic carbon
Dissolved organic carbon
Water temperature
Contaminant organic carbon-water partitioning coefficient
Contaminant octanol-water partition coefficient

This study will also summarize the most recently published ambient fish tissue concentration data for the Bay from the RMP (Sun et al., 2017). This summary of ambient fish tissue concentrations will clarify the values to which modeled fish concentrations should be be compared.

Budget

The following budget represents estimated costs for this proposed special study (Table 2). Efforts and costs can be scaled back by reducing the number of compounds evaluated.

Table 2. Proposed Budget.

	Estimated Staff Hours	**Estimated Budget**
Sediment Bioaccumulation Evaluation	200	$21,000
Bioaccumulation Model Inputs	175	$24,000
Total	**375**	**$45,000**

Budget Justification - staff costs based on estimated time required to:

1. **Sediment Bioaccumulation Evaluation**
    - Compile complete DMMO PCB bioaccumulation testing results from DMMO database and add any additional missing results from other reports. (79 hrs)
    - Analyze and evaluate data: compare sediment, benthic tissue, and predicted fish tissue PCB concentrations with relevant thresholds; discuss with DMMO. (56 hrs)
2. **Bioaccumulation Model Inputs**
    - Review literature on bioaccumulation model parameters. (46 hrs)
    - Implement model to test sensitivity to uncertainties in model inputs. (30 hrs)
    - Develop recommendations for standard values for model inputs and summarize ambient fish concentrations. (30 hrs)
3. **Reporting and Meetings** (The reporting costs are split between the two tasks in Table 2. Reporting costs will be a higher if the tasks are funded independently)
    - Kickoff and mid-project meetings with DMMO stakeholders (20 hrs)
    - Draft Report (70 hrs)
    - Finalize Report (40 hrs)

Reporting

The primary deliverable will be a final technical report due in August 2019. The report will be reviewed by the LTMS Program Managers, EEWG, and the TRC. The report will 1) summarize evaluations of PCB bioaccumulation testing results, 2) provide standard list of values to support bioaccumulation trophic modeling evaluations for fish in the Bay.

References

Kendall, T. and Brush, J. EFH Consultation Letter to NOAA's National Marine Fisheries Service. San Francisco, CA. 12 March 2012.

Sun, J.; Davis, J. A.; Bezalel, S. N.; Ross, J. R. M.; Wong, A.; Fairey, R.; Bonnema, A.; Crane, D. B.; Grace, R.; Mayfield, R. 2017. Contaminant Concentrations in Sport Fish from San Francisco Bay, 2014. SFEI Contribution No. 806.

Ross, 2012. Summary and Evaluation of Bioaccumulation Tests for Total Mercury Conducted by San Francisco Bay Dredging Projects Prepared in Support of Modifying the June 9, 2011 Programmatic Essential Fish Habitat (EFH) Consultation Agreement for San Francisco Bay Maintenance Dredging Projects. Long-Term Management Strategy. (http://www.sfei.org/sites/default/files/project/EFH%20Hg%20modification%20agreement%20%26%20report%2003-06-2012.PDF)