RMP Sediment Workgroup Meeting

May 20, 2021
10:00 AM – 3:00 PM

REMOTE ACCESS ONLY

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AGENDA

1.	**Introduction and Goals for Today's Meeting** The goals for today are to: • Review findings from completed Sediment Workgroup study • Discuss special study proposals and study ideas for funding in 2022 • Rank special study proposals and study ideas and decide which study ideas should be developed into full proposals	10:00 am Melissa Foley (SFEI)

2.	**Information: Review of March 18 Meeting** On March 18, 2021, the Sediment Workgroup had a 3-hr meeting focused on discussing the proposals to submit for 2021 funding. This item is a brief summary of the meeting discussion and outcomes. Meeting materials: March 18 Meeting Notes [pgs 5 - 12 in the meeting packet] Desired outcome: Informed workgroup	10:15 am Scott Dusterhoff (SFEI)
3.	**Information: Presentation on 2021 Sediment Workgroup Study** USGS scientists will give a short presentation on the completed San Francisco Bay Bathymetric Change Analysis that was funded by the Sediment Workgroup. This will be an opportunity for Workgroup members to be informed about this study and ask questions. Meeting materials: USGS Data Release Desired outcome: Informed workgroup	10:30 am Bruce Jaffe & Theresa Fregoso (USGS)
4.	**Information: Overview of Special Study Proposals** List of proposals being considered with budget amounts as compared to the likely total budget available for 2022 Special Studies.	11:00 am Scott Dusterhoff (SFEI)
5.	**Information: Overview of Sediment Monitoring and Modeling Workplan** Brief presentation of the Sediment Monitoring and Modeling Workplan that will be developed with 2022 workgroup strategy funds. Meeting materials: Workplan Description [pgs 13 - 14 in the meeting packet] Desired outcome: Informed workgroup	11:15 am Scott Dusterhoff (SFEI)
	LUNCH (meeting break)	11:30 am

6.	**Information: Presentations of 2022 Special Study and SEP Proposals** The special study proposals being considered for 2022 funding will be presented to the Workgroup. Meeting materials: [*page numbers refer to the meeting packet*] ● Special Study Proposal - Upload Data to Dredged Material Management Office (DMMO) Database (SFEI) [pgs. 15 - 18] ● Special Study Proposal - Watershed sediment loads into Whale's Tail Marsh (SFEI) [pgs. 19 - 25] ● Special Study Proposal - Continuous Suspended Sediment and Wave Monitoring in South and Lower South San Francisco Bay (SFEI) [pgs. 26 - 36] ● Special Study Proposal - Temporal variability in sediment delivery to a North and a Central San Francisco Bay salt marsh (USGS) [pgs. 37 - 46] ● SEP Proposal - Estimation of future sediment loadings from local tributaries [pgs. 47 - 48] Desired outcome: Opportunity for clarifying questions about the proposals	Noon Cristina Grosso (SFEI) Lester McKee (SFEI) Derek Roberts (SFEI) Jessie Lacy and Karen Thorne (USGS) Tan Zi (SFEI)
7.	**CLOSED SESSION** **Decision: Ranking of 2022 Special Studies Proposal** RMP Special Studies are identified and funded through a three-step process. Workgroups recommend studies for funding to the Technical Review Committee (TRC). The TRC weighs input from all the workgroups and then recommends a slate of studies to the Steering Committee. The Steering Committee makes the final funding decision. During this agenda item, the Workgroup will rank the special study proposals and study ideas, and recommend the special study ideas that should be developed into proposals. To avoid an actual or perceived conflict of interest, the Principal Investigators for study proposals and study ideas proposed special studies are expected to leave the room during this agenda item. RMP Stakeholders will be asked to do the ranking. Meeting Materials: (Linked files) ● RMP Charter (describes process for funding decisions) ● RMP Multi-Year Plan that includes the Sediment Workgroup Multi-Year Plan (p. 31-34) ● Sediment Monitoring and Modeling Strategy Desired Outcome: Ranking of the Sediment Workgroup proposed 2022 Special Study Ideas that will move forward toward proposals for the TRC	1:25 pm Bridgette DeShields (TRC Chair)
8.	**Report Out of Proposal Idea Ranking and Recommendations to Principal Investigators**	2:10 pm Bridgette DeShields (TRC Chair)

9.	**Information: Overview of Bay Sediment Efforts** Workgroup members will provide information on new efforts focusing on the science and management of Bay sediment	2:20 pm
10.	**Wrap Up: Review Action Items and Decisions**	2:50 pm Scott Dusterhoff (SFEI)
	Adjourn	3:00 pm

RMP Sediment Workgroup Meeting

March 18, 2021
1:00 pm to 4:00 pm

San Francisco Estuary Institute
4911 Central Avenue, Richmond, CA
REMOTE

Meeting Summary

Attendees

Name	Affiliation
Scott Dusterhoff	SFEI
Sam Shaw	SFEI
Lester McKee	SFEI
Melissa Foley	SFEI
Jeremy Lowe	SFEI
Theresa Fregoso	USGS
Bruce Jaffe	USGS
Sarabeth George	SFBRWQCB
Paul Work	USGS
Carole Foster	Valley Water
Setenay Bozkurt Frucht	SFBRWQCB
Julie Beagle	USACE
Tom Hall	EOA Inc.

Tan Zi	SFEI
Brian Garrity	USACE
Derek Roberts	SFEI
Renee Spenst	Ducks Unlimited
Jessie Lacy	USGS
Aaron Bever	Anchor QEA
Craig Jones	Integral Consulting
Donna Ball	SFEI
Dave Halsing	South Bay Salt Pond Restoration Project
David Schoellhamer	USGS. ret. (technical advisor)
Don Yee	SFEI
Patricia Wiberg	University of Virginia (technical advisor)
Rachel Allen	USGS
Scott Bodensteiner	BPC and Haley & Aldrich
Luisa Valiela	EPA Region 9
David Hart	USGS
Sanda Scoggin	SF Bay Joint Venture
Bridgette DeShields	Integral Consulting (Technical Review Committee Chair)
Karen Thorne	USGS
Michael MacWilliams	Anchor QEA
Tom Mumley	SFBRWQCB (Steering Committee Chair)
Xavier Fernandez	SFBRWQCB
Christina Toms	SFBRWQCB
Judy Nam	Valley Water
Brenda Goeden	BCDC
Cristina Grosso	SFEI

1. Meeting Overview & Introductions

Scott Dusterhoff started the meeting by welcoming workgroup participants, and stated that the goal of the day's meeting was to develop proposal ideas for RMP funding for 2022. These proposals will be presented at the May workgroup meeting. He then reviewed the meeting agenda, which consisted of the following items:

1. Meeting overview and introductions;
2. A presentation by Bruce Jaffe (USGS) on the nearly-finalized Bay bathymetry update study, and a discussion on remaining data gaps and estimated costs for filling them;
3. A breakout group session for workgroup members to discuss their prioritized study areas for 2022 funding;
4. A discussion of breakout group priorities and overall desired directions for 2022 special study proposals; and
5. Wrap-Up: A review of decisions and action items, as well as announcements from workgroup members.

Scott then introduced workgroup members by their affiliations as RMP stakeholders, government agencies, consultants, SFEI staff, and other groups. He then reviewed the goals and purpose of the RMP Sediment Workgroup, and it's mission *to provide technical oversight and stakeholder guidance on RMP studies addressing questions about sediment delivery, sediment transport, dredging, and beneficial reuse of sediment.*

He then presented the workgroup multi-year plan (MYP) for review. The MYP shows work that has been done in the past, and some prioritized funding efforts for the future. He also reminded workgroup members of the recent and ongoing sediment studies funded by the RMP and Supplemental Environmental Projects (SEP):

2020 Special Studies:
- Development of the Sediment Monitoring and Modeling Strategy (SMMS)
- Golden Gate flux modeling study
- Bathymetric Change analysis (year 2)
- Sediment bioaccumulation threshold study

2020 SEP studies:
- Bay Sediment Conceptual Model
- Quantifying flow and sediment flux from selected tributaries
- Suspended sediment settling velocity study, South SF Bay
- Benicia Bridge sediment flux and flocculation study

2021 Special Studies:
- Temporal variability in sediment delivery to a South SF Bay salt marsh
- DMMO San Francisco Bay Floating percentile method update
- DMMO database enhancements

Scott then reminded attendees that the goal of the meeting was to choose projects like those listed above and write proposals for consideration by the workgroup in May, to then be

considered by the Technical Review Committee (TRC) for selection in June, and consideration by the Steering Committee (SC) in July. He reminded the workgroup that completed and published studies can be found at the RMP website:

https://www.sfei.org/programs/sf-bay-regional-monitoring-program

2. Discussion: Bathymetric Data Gaps

Bruce Jaffe then presented updates to the SF Bay bathymetry map. He emphasized this is a first step, and that his presentation consists of a high-level overview of data gaps. He noted that Theresa Fregoso is the main worker behind this effort.

Bruce displayed a digital elevation map (DEM) of the updated bathymetry, with grey areas showing where no data have been collected around the fringes of San Pablo Bay, in large parts of Suisun Bay, and some eastern Central Bay and eastern peninsula margins. The DEM is 1 m resolution and can be found at the following DOI: https://doi.org/10.5066/P9TJTS8M

He then showed a map of different types of bathymetric data gaps in the Bay. Areas with zero coverage were mainly located in Suisun Bay and along the eastern SF peninsula, while northern San Pablo Bay margins had 2010 lidar coverage. Costs associated with filling these data gaps are dependent on water depth (shallower water leads to thinner survey swaths, which requires more boat runs and higher costs), boat speed, and swath overlap. Cost estimates are based on an assumed cost of $8000 per boat day. For total coverage and complete data processing, Bruce Jaffe estimated the following costs for filling SF Bay bathymetric data gaps:

- Suisun Bay: $650K-675K +
- San Pablo Bay: $250K-400K +
- Central Bay: $350k-450K+
- South Bay: $275K-425K +

Bruce then introduced several guiding questions to guide the group decision of whether and where to fund addition bathymetric surveys:

- How will bathymetric data be used?
- Is total coverage needed?
- Does lidar meet our data needs?
- What are high priority areas?
- What are next steps?

Prompted by questions from workgroup members, Bruce Jaffe and Theresa Fregoso made the following clarifications:

- The cost estimates for most spatial data gaps are not directly comparable to the 2015 bathymetric survey because they are in shallower water and would have higher costs associated with equivalent areal coverage. The 2015 survey also did not have 100% coverage -- there was some elevation interpretation between swaths. The amount of coverage would scale directly with the cost of surveying: if filling data gaps required only 50% coverage, for example, then cost would be 50% of the above estimates.
- LiDAR data may not suffice because low slopes in shallow areas make for a high possibility of mismatch between datasets, leading to miscalculations of net storage change on the order of megatons.
- The last complete survey of Suisun bay was in the early 1990s, making it nearly 30 years old.

Further discussion by workgroup members highlighted the importance of filling data gaps in Suisun Bay. Calculations point to a high amount of net erosion from Suisun, but there is no bathymetric data to back up those results. Vegetation corrected lidar for Suisun marshes and other SF Bay marshes have been released by the USGS, and there was much enthusiasm for the possibility of creating a seamless DEM of shallow water bathymetry and baylands. Workgroup members agreed that resolving sediment budgets and transport mechanisms in Suisun Bay in particular is highly desirable due to focus on marsh resilience there.

Overall, it was determined that the costs associated with filling bathymetric data gaps in Suisun were too high for the Sediment Workgroup to sponsor alone. Smaller data gaps can be funded in conjunction with other geographically related projects. There was also a suggestion to collaborate with the WRMP, the Delta Science Program, and Department of Water Resources (DWR) to leverage studies and grants towards filling necessary gaps.

Since the scale of funding bathymetric surveys alone by the Sediment workgroup is too great, it was decided to leave further bathymetric surveys on the SEP list, but entertain the idea of filling smaller, high-leverage data gaps in conjunction with other studies.

3. Discussion: Priorities for 2022 Special Studies

Scott Dusterhoff introduced the next agenda item, which was to get input from workgroup members on special study priorities for 2022 funding. Many priorities are outlined in the newly completed Sediment Monitoring and Modeling Strategy (SMMS) and the Multi-year Plan (MYP). The sediment workgroup is tasked with creating and prioritizing proposals before submitting them to the TRC, with ~70% of available funds likely to be awarded. Studies not funded would go onto the SEP list for potential later funding.

Scott displayed the MYP, which highlighted previously identified priorities for workgroup funding by year. For 2022, the MYP highlights several possible studies and their costs:

- $40,000 for refinement of toxicity reference values
- $75,000 for beneficial sediment reuse placement and planning studies
- $100,000 for monitoring sediment fluxes into the Bay at key tributaries
- $60,000 for monitoring deposition at key locations (already funded through a marsh accretion study by Karen Thorne and Jessie Lacy at USGS)
- $100,000 for modeling of current and future deposition dynamics in the Bay

Priorities detailed in the SMMS consisted of:

- Sediment flux on the shoals and wetlands: modeling changes in suspended sediment flux, modeling changes in sediment delivery for future conditions
    - Tan Zi (SFEI) noted that the Sources, Pathways and Loadings Workgroup (SPLWG) is working on the regional watershed sediment model this year, which could be used as a tool to estimate the future sediment delivered to the Bay.
- Golden Gate Bridge flux: Develop a proxy for estimating long term suspended sediment flux at GG
    - Anchor QEA and the USGS just published reports on sediment flux at the Golden Gate Bridge, which identify additional work to be done
- Whole Bay: developing tools to track pathways, sinks and sources
- Sinks and reservoirs: filling bathymetric data gaps
- Sediment character: improving bed erodibility estimates across the bay
    - Jessie Lacy noted that the USGS has a project measuring bed erodibility in San

Pablo and Grizzly Bays funded by the Priority Ecosystem Program for SF Bay

- Bay water column characteristics:
    - Derek Roberts (SFEI) explained that the NMS is supporting three monitoring stations on the eastern shoal of the South Bay (north of the San Mateo Bridge). Stations include turbidity measurements, and SSC samples are being collected during monthly servicing. There are not yet sufficient samples for a solid turbidity-to-SSC calibration, and these signals don't directly represent fluxes, but they may be of value in guiding thinking about channel-shoal sediment exchange.

- Bay water column: Using satellite imagery to analyze turbidity
- Beneficial Reuse and strategic placement: Julie Beagle (USACE) summarized a new Army Corps study on strategic placement:
    - Pilot study section 1122: Brenda Goeden (BCDC) and the Coastal Conservancy put together a proposal on how to investigate ways to get dredged sediment onto marshes.
    - The USACE made it into a smaller project looking at shallow water placement in nearshore areas next year. It will be used to encourage the Corps to use clean dredged materials in the Bay, and would benefit from leveraging and partnership with other studies.

The workgroup then split into Zoom breakout groups of 5-6 people, facilitated by RMP staff, in order to determine highest priorities for 2022 Special Study funding, based on the suite of potential studies detailed above.

3B. Discussion: Report back on 2022 Special Study Priorities

After 30 minutes of discussion and a 10 minute break, workgroup members reconvened to report back overall priorities for 2022 Special Studies funding.

After all groups reported, several study themes emerged as preferences across the workgroup:

- Modeling sediment transport from the deeper bay axis to bay shallows and marshes
- Predicting sediment delivery to the bay for future conditions
- Continuous suspended sediment monitoring in the shallows to support model calibration and verification
- Bed erodibility estimates across the Bay to support model calibration and verification
- Flux at Golden Gate and between subembayments

The group also discussed potentially supporting the USACE strategic placement study with special study funding. However, it was determined that the RMP funding was very small in comparison to the $2.6M USACE budget. The Workgroup was supportive of funding special studies regarding monitoring and modeling the movement of sediment from the Bay onto marshes, whose findings could be used to answer a range of questions and also help address key knowledge gaps associated with strategic placement. The Workgroup also suggested that the Corps should be open to study input from other expert groups like the RMP, which is not the current dynamic.

4. Discussion: Proposal Logistics and Timing

The workgroup heard input from the two technical advisors, David Schoellhamer and Pat

Wiberg. David Schoellhamer asked if the ongoing study by Karen Thorne and Jessie Lacy would be useful for modeling sediment transport from the Bay axis to shallows. They clarified that data collection is ongoing and won't be available until June 2022 at the earliest, but it would be potentially useful. Dave also pointed out that filling bathymetric data gaps seems like an important topic that could be addressed in some way with studies. Finally, he noted that with regards to the USACE beneficial reuse project, the Corps has to recognize it is in their interest to collect a large amount of data to justify further pilots or disposal programs for the Bay.

Pat Wiberg offered that the modeling efforts that would be most valuable are those that leverage monitoring and extrapolate the results from a single study. There should be an emphasis on monitoring efforts that could inform future models as well.

Some modelers in the workgroup (Michael MacWilliams, Craig Jones) pointed out that for large complex models that would estimate sediment transport from the Bay axis to shallows, there needs to be more data for validation, or results may have non-unique solutions. There is a need for more suspended sediment concentration and grain size distribution data in key areas throughout the Bay.

Lester McKee (SFEI) suggested that workgroup priority special studies should be aimed at collecting more monitoring data for sediment transport modeling validation. Workgroup members largely agreed that more data is necessary to support future modeling. Scott Dusterhoff offered that SFEI staff would follow up with discussions with workgroup members to prioritize monitoring special studies with the aim of supporting future modeling.

Scott reminded workgroup members of the timeline for proposal writing and submission:
Proposal Development Timeline:

- Between now and mid-April, decide upon and develop proposals
- April 15-29, proposals will be reviewed by Scott Dusterhoff, Melissa Foley, and Jay Davis
- April 30 - May 12, Draft proposals will be revised
- May 13, Final proposals are sent to WG members to review before May 20 meeting

5. Wrap up: Review Action Items and Decisions, Announcements

Workgroup members then made announcements on ongoing actions and projects, which are summarized below:

Bruce Jaffe:
PG&E is replacing towers in Lower South Bay (200 towers). One of the next places is pond A18 in the Alviso slough complex. Bruce has been asked if there's interest in a complete survey of that area since it's within that scope of work. PG&E will likely replace footings as well as towers.

Brenda Goeden:
During the 2015 sand mining permitting period, BCDC required funds for studies on sand mining. BCDC has accepted proposals from three different entities that include some members of the SedWG. There are three scopes of work:

1. A literature review and sand budget with focus on tributary as well as Golden Gate sand contributions
2. Using existing sediment cores to assess in-bay sand sources
3. Using modeling to determine how sand mining affects coarse transport through the Golden Gate

Also, Brenda Goeden, Jessie Lacy, and others working on a tech transfer workshop for those interested in the marsh edge and how marshes accrete during sea level rise (NERR funding).

Brian Gerrity:
USACE is embarking on a Regional Dredged Material Management Plan (DMMP). Five charrettes were held last fall. A Program Management Plan will be finalized in the next month. USACE is contracting out for gap analysis. The aim is to get a baseline of the state of the science.

Jessie Lacy:
The Bay-Delta Science Conference (BDSC) is being held Tuesday 4/6 to Friday 4/9. The full program is online. Maureen Downing-Kunz and Jessie Lacy are convening a session on 4/8 from 10-12 pm on sediment. Poster presentations are on 4/6.

Scott Dusterhoff:
SFEI is releasing a report on sediment supply and demand in the Bay for marshes. “Sediment for Survival” will be released Tuesday April 13, and results will be presented at the BDSC conference on Thursday April 8.

6. Adjourn

RMP Sediment Workgroup:

Sediment Monitoring and Modeling Workplan

In 2020, the SedWG completed the sediment Monitoring and Modeling Strategy (SMMS) which laid out a series of data and information gaps and generally recommended the use of both empirical data collection and modeling tools to answer management questions. Consistent with that, the SedWG multi-year plan (MYP) includes a line item to support modeling of current and future sediment deposition dynamics in the Bay. Ideally, in the next few years we'd like to have the modeling capacity within the RMP to simulate how sediment accretion/erosion might vary within/around different habitats/Bay regions under a range of changing conditions (e.g., climate related watershed flow and sediment loads and sea level rise, shifting Bay hydrologic regime, and changing in-Bay sediment management such as strategic placement).

But each model option has limited capability and unique uncertainties such that there is no one model for all sediment-related questions. In addition, models may be used to describe a point in space, a profile or an area. Models may be subdivided by the processes they simulate such as sediment transport, morphodynamics, or vegetation dynamics and may be run at timesteps raging from intra-tidal, tide-averaged models, or longer time scales. It is important to be clear, however, that we are not proposing to focus in the short term on slower, more rigorous, finer, and more certain modeling at the expense of making more informed management decisions sooner. So what is the balance between sophistication and simpler, faster, coarser, and less precise modeling, and data collection, that provides us with directionally correct answers even if laden with greater uncertainty?

To figure all this out, we plan to convene a small group of empiricists and modelers to help us make decisions about the suite of models to support and how to efficiently couple limited monitoring resources with the chosen models. Currently, whole- or sub-Bay-scale sediment transport models are calibrated with water column suspended sediment concentrations and are used to tell us how sediment moves around the Bay and to a limited degree where it erodes and deposits. But these models, while possibly providing input data into finer scales models, will not work well for describing sediment transport and deposition/erosion processes at the scale of single marshes or marsh systems. Since we are interested in erosion and deposition rates in marshes and mudflats, ultimately we need those types of data sets at the spatial and temporal scales of interest to develop and verify the finer scale morphodynamic models that are able to predict these aspects of our Bay well enough.

In addition, the models will also need empirical data on flocculation and settling, and grain size and erodibility, and a more general understanding about how these change in space and time in relation to sediment sources and season and measurements and modeled estimates of supply from local tributaries to marshes and to the Bay. To that end, we need to develop a coupled sediment monitoring-modeling work plan that lays out a proposed multi-year-plan for the effort on each of these elements and strategic order to attain the modeling capacity to simulate how sediment accretion/erosion to answer the RMP questions. As a starting point for consideration, we lay out the following elements which might be repeated in triplicate for marsh locations representing different geographies and process that are, in concert, representative of the Bay:

1. Marsh studies areas to explore sources of sediment to a marsh via sloughs and frontal inundation due to tidal processes and the depositional rates and processes in relation to vegetation age and structure (this was funded last year for Whales Tail Marsh) and will be ongoing in the winter of 2021/22,

2. Watershed studies to measure sediment input to each marsh from the local watershed. Data collection would be sufficient to estimate supply for a single year and support a watershed model calibration to estimate sediment supply during other years (the proposal for this year is Old Alameda Creek upstream from Whales Tail Marsh),

3. Studies in the Bay adjacent the marshes to make measurements of continuous turbidity (calibrated to suspended sediment (SSC) and wave characteristic monitoring, in shallow areas (shoals and sloughs) (the proposal for this year is for adding this monitoring capacity in the south Bay including a station out from Whales Tail Marsh), and

4. Coupled Watershed-Bay modeling studies to explore sediment transport processes in the scale of single watershed-marsh-mudflat-shoal-Bay axis continuum.

A systematic modeling-monitoring program like this repeated at three locations could form the basis of the SedWG activities over the medium term. Given the approximate costs for implementing each element for a single Marsh system add to about $500k, it would take about 6 years to complete three Marsh locations at a rate of $25k/year.

The product of this planning effort will be a refined multiple year work plan that includes short paragraph descriptions of each work plan element and the rationale for it and linkage to other elements, a recommended rough budget for each element for each year, and the proposed calendar year(s) for completing the work elements. This work would necessarily have to coordinate with the WRMP planning process so that marshes are selected with reference to their planning framework.

RMP Special Study Proposal: Upload Data to Dredged Material Management Office (DMMO) Database

Summary: In 2018, SFEI began hosting and managing the DMMO database and website (www.dmmosfbay.org). A DMMO Project Team with representatives from the partner agencies USEPA, USACE, SFBRWQCB, and BCDC convene regularly to set priorities for SFEI. SFEI is also responsible for uploading testing results to the DMMO database. Due to the limited budget, SFEI has focused on uploading testing results provided in the standardized data template format, since there are established procedures and documentation for uploading these results to the database. However, since providing results in the data template format is currently not a requirement, there is a backlog of data that have been provided in a PDF report that needs to be transcribed to the template format and uploaded to the database.

This proposed project will work through the backlog of datasets pending upload to the DMMO database and make these results accessible to researchers, managers, and the DMMO user community. Tasks include (1) coordinating with the DMMO Project Team to prioritize the list of approximately 80 datasets that are pending upload; (2) transcribe the results to the data template format and upload the results to the DMMO database; and (3) make the results available on the DMMO website to support DMMO data mining and synthesis efforts.

Estimated Cost: $40,000

Oversight Group: RMP Sediment Workgroup

Proposed by: Cristina Grosso (SFEI)

Proposed Deliverables and Timeline

Deliverable	Due Date
Identify prioritized list of datasets to upload	January 2022
Transcribe and upload backlog of datasets	December 2022
Make testing results accessible on the DMMO website	December 2022

Background

The DMMO database stores testing results for sediment quality and bioaccumulation in organism tissues for permitted navigational dredging projects in the San Francisco Bay. The database supports the primary goal of the DMMO interagency group to foster a comprehensive and consolidated approach to handling dredged material management issues. The group uses the DMMO data to make suitability determinations for material proposed for disposal or beneficial reuse in and around the San Francisco Bay area.

Contractors are required to submit their testing results as a table in a PDF report or in the established data templates. Due to the limited maintenance budget, SFEI has focused on uploading data results provided in the standardized data template format, since there are automated procedures and documentation for uploading these results into the database. Results provided in a PDF format require the extra time-consuming step of transcribing the data into the data templates and preparing the data for uploading to the database. This has created a backlog of approximately 80 datasets provided as a PDF report that have not been uploaded to the DMMO database or made available for data synthesis and decision-making.

The DMMO Project Team has been working to add language to new suitability letters to require the use of the data templates. This requirement will greatly assist with preventing the backlog to grow in the future.

Study Objectives and Applicable RMP Management Questions

The study will provide information essential to understanding and analyzing dredged material in the San Francisco Bay. Table 1 shows the objectives of the project and how the information will be used relative to the management questions of the RMP Sediment Workgroup.

Table 1. Study objectives and questions relevant to the Sediment Workgroup management questions.

Management Question	Study Objective	Example Information Application
1) What are acceptable levels of chemicals in sediment for placement in the Bay, baylands, or restoration projects?	Provide access to dredged material testing data to synthesize with other datasets.	The DMMO database can be used to explore options for updating the draft beneficial use sediment screening guidelines.
2) Are there effects on fish, benthic species, and submerged habitats from dredging or placement of sediment?		Review of toxicity data can help inform appropriate management thresholds for dredge sediment placement and disposal.
3) What are the sources, sinks, pathways, and loadings of sediment and sediment-bound contaminants to and within the Bay and		

subembayments?		
4) How much sediment is passively reaching tidal marshes and restoration projects and how could the amounts be increased by management actions?		
5) What are the concentrations of suspended sediment in the Estuary and its segments?		

Approach

While there are established data templates for dredged material testing results, contractors are not currently required to submit their results in this standardized format. This has created a backlog of testing results that have not been uploaded to the DMMO database or made available for data synthesis and decision-making.

The tasks for this project include:

1. **Prepare a prioritized list of datasets to upload**
   SFEI staff will coordinate with the DMMO Project Team to review the backlog of approximately 80 pending datasets and prioritize a list of studies for uploading to the DMMO database.

2. **Transcribe and upload backlog of datasets**
   Based on input from the DMMO Project Team, SFEI staff will transcribe data from the high priority datasets into the data templates. These templates will then be uploaded to the DMMO database, following the established procedures. Guidance documentation will be updated as needed.

3. **Make testing results accessible on the DMMO website**
   SFEI staff will make the testing results available on the DMMO website for querying and download so they can be used to inform decision-making.

Budget

The following budget represents estimated costs for this proposed study (Table 2).

Table 2. Proposed Budget.

Expense	Estimated SFEI Hours	Estimated Cost
Task 1: Prepare a prioritized list of datasets to upload	8	$1,357
Task 2: Transcribe and upload backlog of datasets	310	$36,718

Task 3: Make testing results accessible on the DMMO website	13	$1,925
Subcontracts		$0
Direct Costs		$0
Grand Total	**331**	**$40,000**

Budget Justification
Labor costs include SFEI staff time to coordinate with the DMMO Project Team, transcribe and upload testing results, and make the data available on the DMMO website.

Reporting

Decisions and notes from meetings with the DMMO Project Team will be summarized. SFEI will use their Atlassian JIRA system to track the decisions and status for each dataset. The uploaded testing results will be made available on the public DMMO website (www.dmmosfbay.org).

References

Not Applicable

RMP Special Study Proposal: Watershed sediment loads into Whale's Tail Marsh

Summary: Salt marshes provide critical habitat as well as coastal protection against sea level rise (SLR). But is sediment supply to our marshes sufficient for marshes to keep up with SLR? A SedWG study is currently exploring the influence of tides, waves, and water levels on sediment delivery from the Bay to and deposition on the Whale's Tail Marsh in South Bay. Data collection for that study will be during the 2021/2022 wet season with a report due later in 2022. Although this study is a great step forward, a key and remaining question is how sediment supply from the Bay to Whales Tail Marsh compares to the supply from its local watershed. To address that question, this proposed study will measure suspended sediment flux (SSF) from Old Alameda Creek that drains to the marsh for a range of storms during the 2021/22 wet season. In addition to direct estimates of watershed sediment supply to the marsh, this study will result in a data set for supporting calibration of the RMP-funded regional dynamic watershed sediment model for estimating sediment loads during other water years for this local scale watershed.The project will piggyback on an existing SEP-funded hydrology and sediment loads project in four other Bay Area Watersheds, and is consistent with recommendations documented in the SedWG sediment monitoring and modeling strategy (SMMS), and the SEP-funded conceptual model development project.

Estimated Cost: $53,510.

Time sensitive: Yes, to align with the existing Whales Tail Marsh Bay sediment supply and deposition rates study (Lacy and Thorne in progress).

Oversight Group: Sediment Workgroup

Proposed by: Lester McKee, Tan Zi, Sarah Pearce, and Alicia Gilbreath (SFEI)

Proposed Deliverables and Timeline

Deliverable	Due Date
Field equipment purchase and installation	September 30th, 2021
Wet season storm monitoring and equipment servicing	October 1st - April 30th, 2022
Laboratory analysis	January 1st - May 31st, 2022
Quality Assurance, data management, data upload to CD3	June 1st - August 31st, 2022
Short technical metadata report and presentation to RMP SedWG	Winter/Spring 2022/2023

Project Background and Overview

Sediment is a basic building block of Bay geography and habitats, acting as the physical foundation for tidal marshes, which must vertically accrete to keep pace with SLR to continue functioning as natural filters for nutrients and pollutants. The physics of Bay sediment dynamics

have been studied and the Bay has been monitored and modeled for decades (e.g., the compilations of Conomos, 1979; Hollibaugh, 1996; Barnard et al., 2013a, b) and sediment supply at the regional and subregional scales and for 10-15 watersheds (mostly the larger ones) is also quite well understood (McKee et al., 2013; Schoellhamer et al., 2018). Sediment processes and dynamics of tidal channel processes on the Bay margin have been studied less comprehensively but information now exists for selected systems such as the Napa/Sonoma sloughs, Petaluma River, Meeker Slough near Richmond, CCC, Corte Madera Creek mouth, and Alviso Slough (see the review in the Sediment Modeling and Monitoring Strategy (SMMS): McKee et al., 2020). Still fewer studies have been conducted on sediment dynamics on the shoals and mudflats.

Based on the collective knowledge generated by the sediment studies in the Bay, we know that resuspension in the Bay is driven by tidal currents in the deeper channels and predominantly by wind waves in the shallows. Wind waves are more effective at resuspending sediment at low water each tide, so SSC in the shallows is generally higher during flood tides, particularly when persistent winds are present in the summer and fall. But how these processes vary throughout the Bay and how these influence transport into tidal wetlands (across either the frontal marsh edge or via sloughs) and wetland deposition rate in relation to vegetation species and structure is still to be learned (see Lacy et al., 2020 and the SMMS: McKee et al., 2020). A recent regional scale study compared watershed sediment supply projections based on downscaled climate modeling and local watershed sediment load rating curves with sediment demand by marsh accretion due to sea level rise and marsh restoration expectations and concluded that there will be a net deficit through to 2100 (Dusterhoff et al., 2021). But there have been no local scale case studies that directly compare watershed sediment to Bay sediment supply to marshes and how that may change with changing climate and sea level. Yet this is a fundamental question for sediment management in the Bay McKee et al., 2020; Dusterhoff et al., 2021).

To begin to address these remaining questions on sediment transport, the RMP funded a study in 2021 by Jessie Lacy (USGS-PCMSC) and Karen Thorne (USGS-WERC) to investigate the influence of tides, waves, and water levels on sediment delivery to and deposition on a tidal marsh surface. The work focuses on measurements of suspended sediment flux (SSF), a product of suspended sediment concentration (SSC) and velocity, in the shallows adjacent to Whales Tail Marsh, SSF into the Marsh from the Bay through a tidal creek, deposition and accretion on the Marsh, and the variation in deposition with elevation and vegetation density and type. The study will include wet and dry season observations to better understand the seasonal dynamics in a system with a wave-exposed edge and large wind fetch.

This proposal addresses the other remaining question: how much sediment is supplied to Whale's Tale Marsh from its attending watershed. We propose to set up a sediment monitoring station in Old Alameda Creek upstream of head of tide to measure suspended sediment concentration (SSC), stage, and discharge, in order to compute suspended sediment flux (SSF) to the Marsh during a range of storms during the 2021/22 wet season. In addition to providing data to compare with supply from the tidal Bay system to Whales Tail Marsh, this data set could be useful for calibrating numerical models that could then be used to help answer management questions regarding sediment transport to and deposition on tidal marshes more generally. We anticipate such a modeling effort to be part of the Sediment Monitoring and Modeling Workplan that will be developed in 2022 (see Sediment Monitoring and Modeling Workplan description).

Study Objectives and Applicable RMP Management Questions

The study will provide information essential to understanding suspended sediment supply to Whales Tail Marsh that would support the future development and application of a coupled watershed-Bay model aimed at answering key management questions. Table 2 shows the objectives of the study and how the information will inform RMP Sediment Workgroup management questions, WRMP questions, and BCDC questions.

Table 2. Study objectives relevant to the Sediment Workgroup management questions.

Stakeholder group	Management Question	Study Objective	Example Information Application
RMP	3) What are the sources, sinks, pathways, and loadings of sediment and sediment-bound contaminants to and within the Bay and subembayments?	Generate a suspended sediment flux dataset for the 2021/22 wet season for Old Alameda Creek Watershed, perform quality assurance checks on the data, and make it freely available to the RMP and Bay community.	Use the dataset to support a local calibration of the Regional Watershed Model (sediment module funded by the RMP in 2021). Generate estimates of sediment supply for 2021 to compare with supply to Whales Tail Marsh from the Bay. Use the data to support the development of a coupled watershed-Bay model to explore our key management questions, such as how would the Marsh change in relation to changing climate, sea level, and sediment placement.
BCDC	W2 - What do we estimate to be the change in sediment supply/erosion of our watersheds into the future?		
RMP	4) How much sediment is passively reaching tidal marshes and restoration projects and how could the amounts be increased by management actions?		
WRMP	2B - What are the regional differences in the sources and amounts of sediment available to support the accretion and tidal marshes and adjacent habitats?		

Approach

Task 1: Field equipment purchase and installation

Equipment to be installed:

Lockbox (need)

ISCO pumping sampler (need) / data logger (already have)

Pressure transducer (already have)

Center mounted articulating boom to support the ISCO intake (need)

Marine grade battery (need)

Solar panel mounted on a pole (already have)

Tubing and conduit for connecting all the pieces of equipment (need)

In preparation for this proposal, several potential field locations were reconnoitered. From past work we estimate that the urban area of Old Alameda Creek supplies about 20% of the sediment whereas the Ward Creek tributary that drains from the east Bay hills is estimated to supply about 80% of the annual average load (SFEI-ASC, 2017). Therefore, we focused on finding a safe and samplable location on Ward Creek, Shepherd Avenue being one option (Figure 1). A final decision on the sampling location will be made in consultation with Alameda County Flood Control and Water Conservation District.

Figure 1. Proposed sampling location in Old Alameda Creek. Ward Creek tributary at Shepherd Avenue. There were a number of other options explored but 6-feet high fences provent sampling at most locations. At this location the gates provide access during high flows.

Task 2: Wet season storm monitoring and equipment servicing

Although it is impossible to predict the number of storms and the number of samples needed to adequately characterise those storms, experience in many other locations in the Bay Area provides us with a reasonable framework. We have designed the project to plan for seven samplable storms over the winter each requiring seven samples per storm to describe the variation in suspended sediment concentration in relation to discharge. Seven may seem a lot (we don't typically get seven large storms and the winter seasons have been very dry recently) but it covers a typical year of small, medium and larger storms that transport the majority of sediment loads during a single winter season.

The storms will be sampled using an ISCO automated pumping sampler. The ISCO sampler will be programmed to take samples in relation to the raising and falling stage during storms. The sampler has 24 sample bottles in its carousel. After each storm, stage data and sample metadata will be downloaded from the ISCO and stored in duplicate on laptop and thumb drive. Samples will be transported to SFEI on ice in a cooler and immediately measured for turbidity in the lab prior to storage (4^{o}C and dark).

Since the ISCO can take up to 24 samples per storm, even though for smaller or shorter duration storms there will be fewer samples, a subset of samples will need to be selected. Sample timing in relation to the changing stage will be used along with turbidity (and a visual assessment of the amount of sand in the sample) to make a first assessment of potential discards. This exercise will be repeated after each storm over the season. The aim would be to get a reasonable coverage of samples for each storm including several of the larger storms, without exceeding the overall total number for the season. If we were to observe a very wet season, we would make sure that we analyse the samples from the largest storms as a priority but include a range of storms from early, mid, and later in the season so as to provide the best data set for loads estimation for the season as well as for supporting model calibration.

Task 3: Laboratory analysis

All samples will be analysed for suspended sediment concentration (SSC) following method ASTM D3977 and sand-silt split grain size (GS) following the USGS GS method.

Task 4: Quality Assurance, Data Management, data upload to CD3

Quality assurance of the continuous stage data will be carried out following the protocols developed for the RMP ("Quality assurance methods for continuous rainfall, run-off, and turbidity data": McKee et al., 2015). The SSC and GS data will be reviewed using the quality assurance program plan (QAPP) developed for the San Francisco Bay Regional Monitoring Program for Water Quality (Yee et al., 2019). The QAPP specified a hold time for SSC of 7 days and this is particularly important for sites where organic carbon is a large portion of the SSC (e.g in an estuary with an algal bloom) but for watersheds where organic carbon is <4% of the sediment load, and the samples are agitated before being filtered, the hold time of 7 days can be exceeded without detriment to the results. Due to the need to make progressive decisions during the field season about which samples to retain from each storm and send to the lab for analysis, most samples are expected to exceed the 7-day hold time. Once QA is completed, SSC data will be uploaded to the Web and made available via the CD3 tool. The continuous stage and discharge data will be made available with the report.

Task 5: Short technical metadata report and presentation to RMP SedWG

A short technical report will be written that describes the field and lab methods and basic results (concentrations, grain size, stage data, flow data, and estimate loads). The report will not include extensive interpretation or contextual information with the exception of a comparison of the data to an existing loads estimate for the watershed that was based on a regional annual scale rating curve between peak annual runoff and annual sediment loads for pervious areas and a impervius sediment yield coefficient for urban areas (SFEI-ASC, 2017).

Budget

Task	Staff hours	Staff cost	Equipment and lab cost	Total
Field equipment purchase and installation	74	$10,640	$8,300	$18,940
Wet season storm monitoring and equipment servicing	80	$10,800		$10,800
Laboratory analysis	0	$0	$5,930	$5,930
Quality Assurance, Data Management, data upload to CD3	64	$7,920		$7,920
Short technical metadata report and presentation to RMP SedWG	72	$9,920		$9,920
	290	$39,280	$14,230	$53,510

Budget justification

The budget is based on recent experience with the Watershed Hydrology and Sediment Monitoring (WHSM) SEP project. This current project will also benefit from the use of existing equipment that the RMP or SFEI already owns (purchased with previous project budgets, grants or contracts), an existing QA/QC protocol for continuous data that was written for the RMP back in 2015, and existing data management systems for flood sampling data collected during winter storms. The short report will be written using the same structure and format as designed for the WHSM SEP project and the continuous stage and flow data will be made publicly available using the webpage and download structure developed for the WHSM SEP project.

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RMP Special Study Proposal: Continuous Suspended Sediment and Wave Monitoring in South and Lower South San Francisco Bay

Summary: The proposed project would expand continuous suspended sediment (SSC) monitoring, and optionally add wave characteristic monitoring, in shallow areas (shoals and sloughs) of South and Lower South San Francisco Bay (SB and LSB respectively). Continuous SSC data are essential to both empirical and model-based sediment studies but are currently only available at one SB/LSB station at the Dumbarton Narrows. The SB/LSB shoals play an important but understudied role in SB/LSB sediment dynamics, and these dynamics are strongly influenced by wind waves. This project would generate continuous SSC time-series data at an additional nine stations in SB and LSB, and would include calibration of turbidity-to-SSC relationships at seven existing turbidity stations (several of which have been collecting turbidity data since 2015). The existing turbidity stations are supported by the Nutrient Management Strategy (NMS); parallel SSC sampling is already underway at four of these seven stations but not enough data have been collected to generate a turbidity-SSC calibration. This project would include:

1) Deployment of two new SSC stations on the SB shoal.
2) Collection and processing of SSC samples at the two new stations and at three existing stations where samples are not currently collected by the NMS.
3) Development of site-specific turbidity-to-SSC relationships at all nine stations.
4) Curation and public sharing of resulting SSC time series from all nine stations.
5) Optional deployment of wave height and period sensors at two shoal sites, and associated data curation and public sharing

By leveraging existing NMS instrumentation and field servicing, this project would significantly expand available SSC data in SB and LSB (from one station to ten) at a considerably lower cost than independently implementing additional sediment monitoring stations.

Estimated Cost: $45,728/$55,194 (first year, without/with wave sensors)

$27,230/$30,590 (subsequent years without/with wave sensors)

Oversight Group: Sediment Workgroup

Proposed by: Derek Roberts (SFEI)

Proposed Deliverables and Timeline

Deliverable	Due Date
Publically available 15-minute SSC time series from nine stations in the South and Lower South Bay	As calibrations come online, beginning late 2022
Report detailing data collection, turbidity-to-SSC calibrations, and limited, descriptive interpretation.	Winter/Spring 2023
Presentation to RMP Sediment workgroup on “state of the project”	Winter/Spring 2023
Publically available wave height and period data from two stations in South Bay (optional)	Beginning as data become available, mid 2022.

Project Background and Overview

Suspended sediment dynamics are relevant to a diversity of San Francisco Bay (SFB) water quality and morphological processes. Despite decades of studies pointing to the importance of sediment dynamics to South and Lower South SFB (SB and LSB) management concerns, continuous suspended sediment concentration (SSC) data are currently available at only a single station (DMB in Figure 1). Calibrating models to simulate complex sediment dynamics requires knowledge of time-varying SSC spanning morphological regions. Sediment-related empirical studies may directly rely on continuous SSC measurements, leverage output from sediment transport models calibrated to SSC measurements, and/or benefit from well-characterized background SSC conditions. The expansion of continuous SSC monitoring is therefore essential to advancing SFB planning and management related to a range of concerns, including contaminant transport, sea-level-rise resilience, and biogeochemical/nutrient cycling. Historical contaminant loading, a heavily urbanized bayfront, and severe nutrient enrichment make these concerns particularly relevant in South and Lower South Bay.

This project will cost-efficiently fill SSC data gaps in SB and LSB by leveraging existing sensor stations and servicing associated with the San Francisco Bay Nutrient Management Strategy (NMS; Table 1 and Figure 1). The NMS currently supports nine continuous monitoring sites throughout SB and LSB. We propose including seven of these sites (listed in Table 1) in this project. We exclude the NMS Dumbarton station (redundant to the USGS California Water Science Center (USGS-CAWSC) sediment station) and the NMS Pond A8 Outlet station (may be of less interest to the sediment community).

The four South Bay NMS stations at and north of the San Mateo Bridge (HAY, SHL, SLM, SMB) are serviced monthly as part of a collaboration with the USGS-CAWSC. Turbidity data collection at SMB dates back to 2015; turbidity sensors were deployed at the other three sites in 2020. Monthly SSC sampling began at all four stations in late 2020 and is ongoing. This project would support turbidity-to-SSC calibrations at these four sites, and the public sharing of the resulting SSC time series.

The three existing project-relevant Lower South Bay stations (ALV, GUAD, NW) have been deployed since 2015 and are serviced monthly as part of a collaboration between the NMS and the USGS Pacific and Coastal Marine Facility (USGS-MarFac). This project would support SSC sample collection, turbidity-to-SSC calibrations, and public data sharing of data from these three sites.

Site	Program	Date Range	SSC Sampling	Turbidity-to-SSC Calibration	Instrument Orientation	Instrument	Latitude	Longitude
Alviso Slough (ALV)	SFEI/NMS	2015-Present	Proposed	Proposed	50 cm above botom	YSI EXO2	37.440	-121.998
Guadalupe Slough (GUAD)	SFEI/NMS	2015-Present	Proposed	Proposed	50 cm above botom	YSI EXO2	37.435	-122.026
Newark Slough (NW)	SFEI/NMS	2015-Present	Proposed	Proposed	1 m above bottom	YSI EXO2	37.513	-122.082
Hayward (HAY)	SFEI/NMS	2020-Present	Current	Proposed	50 cm above botom	YSI EXO2	37.612	-122.201
San Leandro Marina (SLM)	SFEI/NMS	2020-Present	Current	Proposed	1.3 m above bottom	YSI EXO2	37.674	-122.218
Shoal Buoy (SHL)	SFEI/NMS	2020-Present	Current	Proposed	80 cm below surface	YSI EXO2	37.631	-122.243
San Mateo Bridge (SMB)	SFEI/NMS	2015-Present	Current	Proposed	10 m above bottom	SeaBird HydroCat	37.584	-122.249
Dumbarton Bridge (DMB)	USGS-CAWSC	2010-Present	Current	Current	1.2, 7.6 m above bottom	YSI EXO2	37.504	-122.119
Proposed_1	SFEI/RMP/NMS		Proposed	Proposed	50 cm above botom	PME/Turner Cyclops7		
Proposed_2	SFEI/RMP/NMS		Proposed	Proposed	50 cm above botom	PME/Turner Cyclops7		

Table 1 – Summary of existing and proposed suspended sediment monitoring stations in South and Lower South San Francisco Bay. All stations measure turbidity at a 15-minute time step; the SSC sampling interval is approximately monthly. Expanded efforts associated with this proposal are highlighted in yellow. Note that exact locations of proposed new stations remain to be determined but suggested locations are shown in Figure 1.

We propose two additional monitoring sites between the Dumbarton and San Mateo Bridges (proposed stations in Figure 1). At least one of these stations will be located directly offshore from the Eden Landing “Whale’s Tail” area, the site of an ongoing study of sediment accretion and erosion in intertidal marsh. Exact station locations can be tailored to RMP Sediment Workgroup priorities. Proposed orientations include: a) a cross-shore transect immediately offshore from Whale’s Tail; b) an along-shore transect, with one station adjacent to Whale’s tail. These stations would be serviced during existing monthly NMS servicing trips. In addition, bursting pressure sensors could be deployed to measure wave height and period at one of the two proposed sites and at HAY. A pilot wave-sensor deployment is currently underway at HAY; initial data (Figure 2) and published studies (e.g., May et al. 2003, Thompson et al. 2008) point to the importance of wind waves to shoal dynamics.

Note that this project relies on calibrating optical-sensor turbidity signals to SSC, and that a minimum number of samples (dependent on the range of sampled conditions) is needed to generate a reliable calibration (Rasmussen et al. 2009). Collecting sufficient samples for a reliable calibration will likely require more than one year of sampling. Thus, we recommend that this proposal be considered in light of the possibility of support beyond one year. The budget section (below) includes costs associated with both first-year and subsequent-years project support.

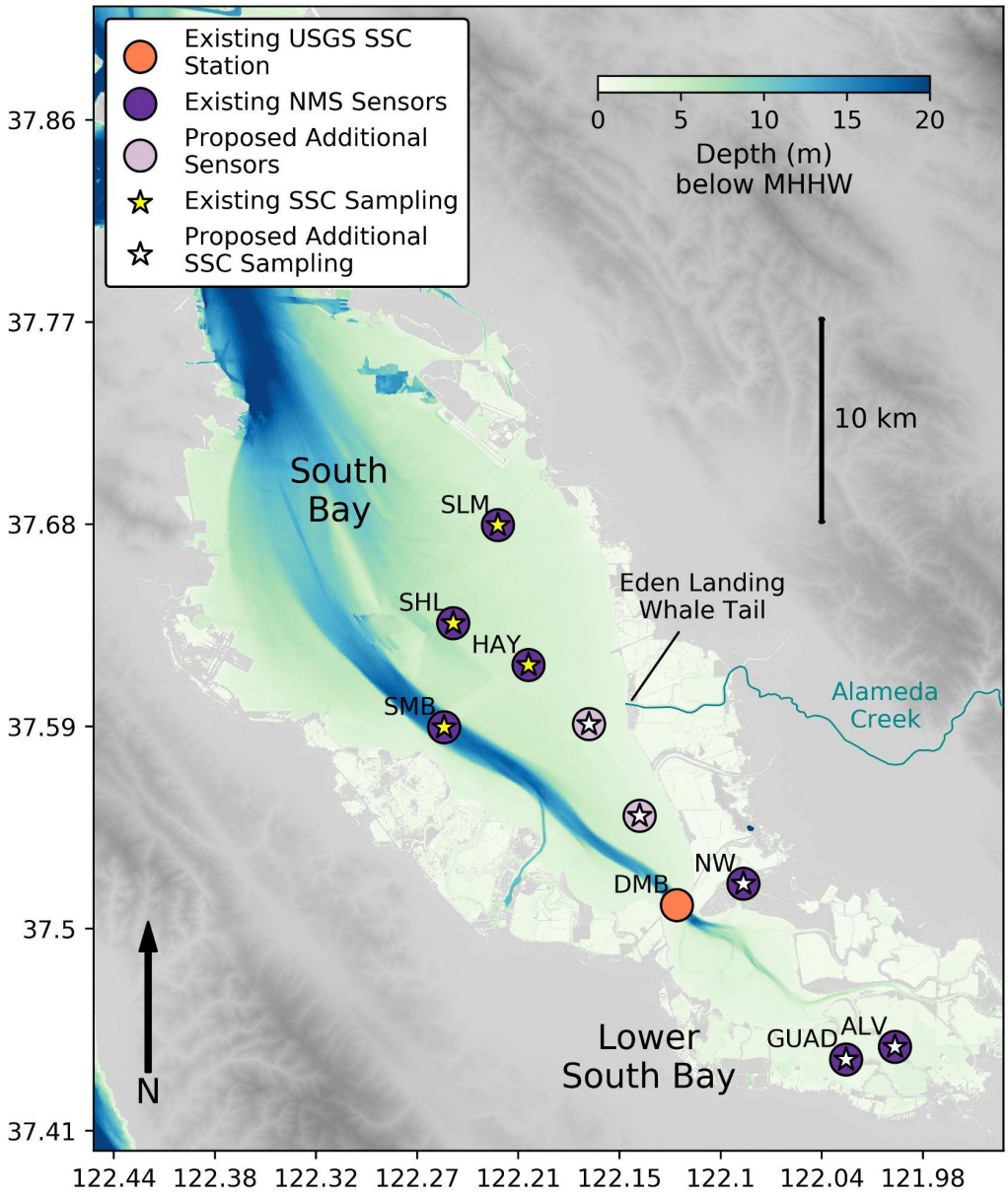

Figure 1 – Map of existing turbidity sensors and SSC sampling in South and Lower South Bay, and proposed additional turbidity sensor stations and SSC sampling. Note that the USGS Dumbarton Bridge Station (DMB) has an existing turbidity-to-SSC calibration; SSC concentrations are reported from the turbidity sensor at https://waterdata.usgs.gov/ca/nwis/inventory/?site_no=373015122071000. See Table 1 for site details and abbreviation reference. The approximate location of the Eden Landing "Whale's Tail" shown for spatial reference to existing sediment studies. Note that locations of proposed stations are not final; this figure shows an example configuration.

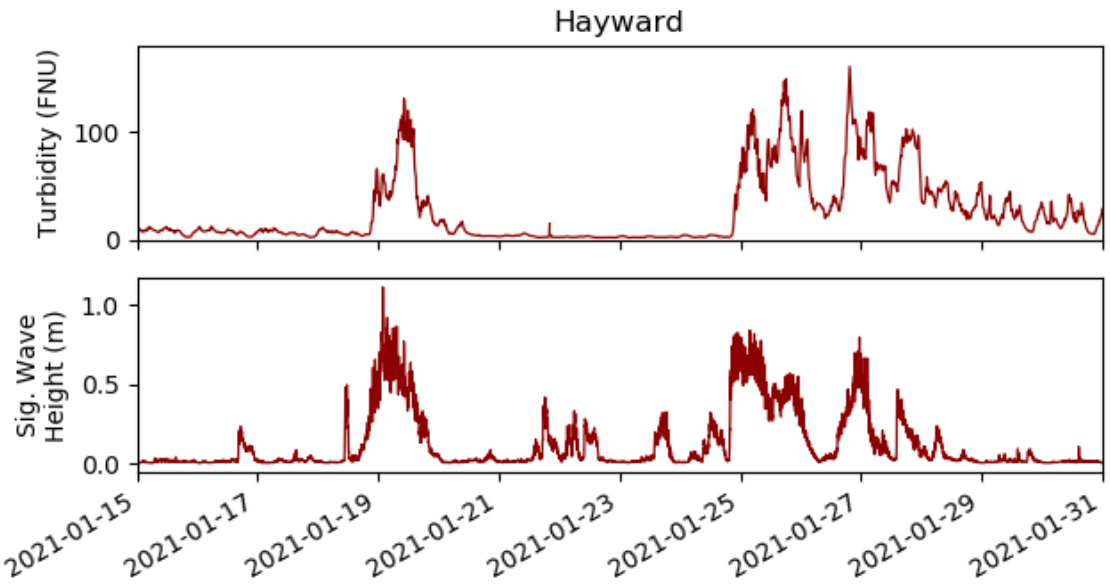

Figure 2 – Example turbidity and significant wave height data from the HAY station.

Study Objectives and Applicable RMP Management Questions

The study will provide information essential to understanding suspended sediment dynamics in South Bay and Lower South Bay. Table 2 shows the objectives of the study and how the information will inform RMP Sediment Workgroup management questions.

Table 2. Study objectives relevant to the Sediment Workgroup management questions.

Management Question	Study Objective	Example Information Application
1) What are acceptable levels of chemicals in sediment for placement in the Bay, baylands, or restoration projects?		
2) Are there effects on fish, benthic species, and submerged habitats from dredging or placement of sediment?		
3) What are the sources, sinks, pathways, and loadings of sediment and sediment-bound contaminants to and within the Bay and subembayments?		

4) How much sediment is passively reaching tidal marshes and restoration projects and how could the amounts be increased by management actions?	• Expand continuous monitoring of suspended sediment concentrations in South and Lower South San Francisco Bay	• Empirical studies of marsh accretion/erosion requiring knowledge of SSC in adjacent water column.
5) What are the concentrations of suspended sediment in the Estuary and its segments?	• Expand continuous monitoring of suspended sediment concentrations in South and Lower South San Francisco Bay • Optionally measure wave height and period at two South Bay shoal stations • Curate and publically share SSC and optional wave data with the San Francisco Bay sediment community	• Calibration of any sediment transport models and associated applications. • Empirical studies of marsh accretion/erosion requiring knowledge of SSC in adjacent water column.

Approach

Task 1 - Continue to maintain existing turbidity stations

Estimated date(s): Ongoing

Eight of nine existing NMS monitoring stations use YSI EXO2 sondes to measure turbidity at a 15-minute interval. The SMB station measures turbidity every 15-minutes using a SeaBird Hydrocat CTD. These stations will continue to be maintained monthly as part of standard NMS station servicing protocols with collaborators from USGS-CAWSC and USGS-MarFac. During each servicing trip, 3-5 stations are “swapped” for instruments that have been lab-cleaned and calibrated in the preceding week. The remaining stations are field serviced, including thorough cleaning, calibration checks, and battery replacement. SSC sampling is underway at the four existing SB stations and will continue indefinitely.

Task 2 – Deploy new shoal monitoring stations and begin monthly maintenance

Estimated date(s): Winter 2022 - Ongoing

Turbidity sensors will be Turner Designs Cyclops7 optodes mounted to a PME datalogger housing with integrated optode wipers. Turner Designs sensors are industry standard. Sensors will log turbidity measurements at a 15-minute interval (standard for other SFEI and USGS sensor stations). Optional wave sensors will be RBR SoloD 16 Hz pressure sensors. The

pressure sensors will be set to burst at 4-16 Hz for 1-3-minute intervals every 10-30 minutes. Final settings will be determined through discussion within the research community.

Both sensors will be mounted to steel frames produced by the USGS-MarFac, consistent with the design used for existing NMS sites. These frames will position the instruments 50 cm above the bed. Frames will be connected to 45-lb weights via 20-ft marine-grade line, and the weight will be connected to a surface float via a similar-length line.

The new stations will be maintained during monthly servicing trips to NMS LSB stations with USGS-MarFac. One of two stations will have its turbidity sensor swapped with a recently lab-cleaned and calibrated instrument, while the other station will be field-serviced (a rotation of three instruments through two stations). Optional wave sensors would be cleaned during monthly servicing. We would not rotate the wave sensors for lab servicing because pressure sensors are generally robust to fouling and are able to maintain consistent calibrations. Data will be offloaded from all sensors during each servicing trip.

Task 3 – Begin SSC sampling at new shoal sites and existing LSB sites (Winter 2022)

Estimated date(s): Winter 2022

SFEI field staff will collect SSC samples at LSB and new SB sites as part of monthly servicing trips with USGS-MarFac. Samples will be collected at the approximate instrument elevation using a Van Dorn sampler (or similar) following standard USGS procedure. SSC sampling is already performed by USGS-CAWSC staff during SB servicing trips at SMB, SHL, HAY, and SLM stations. All SSC samples will be processed at the USGS Santa Cruz Sediment Laboratory.

Task 4 - General data processing and curation

Estimated date(s): Winter 2022 - Ongoing

Turbidity data from the seven existing NMS turbidity sites are processed through a four-level QAQC procedure that includes statistical filtering and manual review. A similar multi-level data pipeline will be developed for the stand-alone turbidity sensors. The NMS has already developed multi-level data processing for wave data from bursting pressure sensors as part of a pilot study in winter 2021.

Task 5 – Generate site-specific turbidity-to-SSC calibrations

Estimated date(s): As sufficient SSC data become available; Fall 2022 - ongoing

Site-specific turbidity-to-SSC calibrations will be developed based on sensor turbidity and SSC sample data following Rasmussen et al. (2009). Note that SSC samples will be collected at monthly intervals. Sufficient variability in observed SSC will be needed to generate reliable calibrations. We estimate that at least 20 SSC samples may be needed to generate a reliable calibration (20 project months).

Task 6 – Create and iteratively update a public repository with SSC time-series data

Estimated date(s): Winter 2023 - Ongoing

As sample data become sufficient to generate reliable calibrations, we will develop (and iteratively expand) a report detailing the site-specific calibrations. This report will be posted to a

public repository with regularly updated (every 2-4 months) SSC time series, and optional shoal data.

Task 7 - Presentation and report to RMP Sediment Group

Estimated date: Winter/Spring 2023

Budget

See tables below. Note significant cost-share from NMS; this proposal "piggybacks" on existing NMS servicing trips and, accordingly, is a cost-efficient approach to expanding SSC monitoring in the South Bay. Because of the need for sufficient samples for reliable turbidity-to-SSC calibrations, this project should only be funded for year-one if funding is expected to continue through at least one additional year. Unique budget tables show first-year costs, subsequent-year costs (fixed upfront costs subtracted from first-year costs), and NMS cost-share. The NMS cost-share is consistent year to year.

Year 1 (includes fixed equipment costs)		
Item	**Total Cost**	**Note**
Project coordination/management	$5,040.00	Coordinating with external field teams, development of field SOPs, management of internal field staff, communicaiton/coordination with RMP, development and oversight of data handling.
Final report and presentation	$4,480.00	Preperation of final report to accompany data publications. Presentation to RMP.
Data management, turbidity-to-SSC calibration, data publication	$8,400.00	Turbidity data from existing NMS stations (7 of 9 project sites) are already processed as part of ongoing NMS monitoring efforts. Additional funding is requested for processing of data from additional sensors. This item will also support site-specific turbidit-to-SSC calibration (once enough samples are available), and iterative data publication (as data are offloaded from instruments).
Reconnaisance trip for siting new stations (one project manager day, and one boat baptain/boat day)	$2,920.00	Boat trip to transit South Bay shoal between Dumbarton and San Mateo Bridges to locate sites that provide ideal location and water depth range.
Field technician (SFEI; extended days from NMS work)	$3,960.00	This cost represents a time extension for servicing and sampling at additional stations during existing monthly NMS field trips in LSB. Fixed costs associated with field mobilization are quantified as an NMS cost share below.
Boat and boat captain (USGS MarFac; extended days from NMS work)	$3,250.00	This cost represents a time extension for servicing and sampling at additional stations during existing monthly NMS field trips in LSB. Fixed costs associated with field mobilization are quantified as an NMS cost share below.
Sample processing (USGS Sediment Lab, Santa Cruz)	$2,700.00	This cost is for shipping and lab processing of samples from 5 of 9 project stations (Alviso, Guadalupe, Newark, and two net shoal stations). Sampling at the 4 northern sites (San Mateo Bridge at channel, shoal buoy, shoal at Hayward, shoal at San Leandro Marina) is already performed by USGS-WSC field staff as part of ongoing NMS work. The existing sampling efforts are quantified as an NMS cost share below.
Bottom mounting cages with rigging	$2,600.00	The NMS paid for mounting frame design as part of ongoing monitoring work. This frame type has been successfully deployed at both slough and shoal sites in South Bay. Frames to be fabricated by USGS MarFac.
PME Cyclops-7 Logger and Turner Turbidity with wiper	$11,258.22	Turner Designs turbidity sensor is industry standard. Compare cost at $3752 to cost for wiped turbidity sensor from RBR at $5596. We budget for three sensors so that instruments can be rotated through the two new stations, with one instrument being lab serviced and calibrated each month. 7 of 9 stations have existing turbidity sensors; the associated costs are partially quantified as an NMS cost share below.
Miscellaneous additional field and lab supplies	$500.00	Misc. hardware and equipment needs come up as part of all field efforts
250 mL sample bottles	$420.00	Sampling bottles. Enough to have a rotation between trips.
Turbidity standard solution	$200.00	Calibration solution for the two additional stations. Cost of calibration solution for 7 of 9 stations covered as part of ongoing NMS monitoring program.
Wave sensors (RBR 16 Hz SoloD) [OPTION B ONLY]	$6,106.00	Optional addition of bursting pressure sensors at any 2 shoal sites. Sensors estimate wave height and period. Note that SF Bay tidal variability will mean that the high-frequency wave spectrum will be attenuated at high tides.
Additional data processing time for wave sensors [OPTION B ONLY]	$3,360.00	Post-processing of wave sensor (wave height and period) data
Total Funding from RMP (Option A - no wave sensors)	$45,728.22	
Total Funding from RMP (Option B - two wave sensors)	**$55,194.22**	

NMS Cost Share		
Item	**Total Cost**	**Note**
Servicing existing "upper" South Bay stations with USGS-WSC	$83,868.00	This includes boat mobilization from Sacramento, boat captain, USGS technician, SFEI technician, SSC sample collection and processing at 5 of 9 project sites.
Servicing existing Lower South Bay stations	$47,250.00	This includes boat mobilization from Santa Cruz, boat captain, SFEI technician, SSC sample collection and processing. Note that RMP project cost is only a two-hour extension of this existing mobilization.
Project management for the 7 existing stations of the 9 that will be included as part of this project.	$45,000.00	Overall project management costs for NMS moored sensors program, representing the 7 existing of 9 project sites.
Technician field prep, lab time, and data handling for the 7 existing stations of the 9 project stations.	$40,500.00	Existing field preperation, lab calibration, and data processing time associated with 7 of 9 project sites, plus the extension of these activities to the 2 new project sites.
Existing instrumentation, mounting frames, and field equipment.	$200,000.00	Rough estimate for 10 EXO2s (at ~$23k/each), discounting a bit for age, plus many additional pieces of equipment, deployment frames, etc.
Total NMS Cost Share	**$416,618.00**	

Year 2+ (no/minimal fixed equipment costs)		
Item	**Total Cost**	**Note**
Project coordination/management	$5,040.00	Coordinating with external field teams, development of field SOPs, management of internal field staff, communicaiton/coordination with RMP, development and oversight of data handling.
Final report and presentation	$4,480.00	Preperation of final report to accompany data publications. Presentation to RMP.
Data management, turbidity-to-SSC calibration, data publication	$8,400.00	Turbidity data from existing NMS stations (7 of 9 project sites) are already processed as part of ongoing NMS monitoring efforts. Additional funding is requested for processing of data from additional sensors. This item will also support site-specific turbidit-to-SSC calibration (once enough samples are available), and iterative data publication (as data are offloaded from instruments).
Field technician (SFEI; extended days from NMS work)	$3,960.00	This cost represents a time extension for servicing and sampling at additional stations during existing monthly NMS field trips in LSB. Fixed costs associated with field mobilization are quantified as an NMS cost share below.
Boat and boat captain (USGS MarFac; extended days from NMS work)	$1,950.00	This cost represents a time extension for servicing and sampling at additional stations during existing monthly NMS field trips in LSB. Fixed costs associated with field mobilization are quantified as an NMS cost share below.
Sample processing (USGS Sediment Lab, Santa Cruz)	$2,700.00	This cost is for shipping and lab processing of samples from 5 of 9 project stations (Alviso, Guadalupe, Newark, and two net shoal stations). Sampling at the 4 northern sites (San Mateo Bridge at channel, shoal buoy, shoal at Hayward, shoal at San Leandro Marina) is already performed by USGS-WSC field staff as part of ongoing NMS work. The existing sampling efforts are quantified as an NMS cost share below.
Miscellaneous additional field and lab supplies	$500.00	Misc. hardware and equipment needs come up as part of all field efforts
Turbidity standard solution	$200.00	Calibration solution for the two additional stations. Cost of calibration solution for 7 of 9 stations covered as part of ongoing NMS monitoring program.
Additional data processing time for wave sensors [OPTION B ONLY]	$3,360.00	Post-processing of wave sensor (wave height and period) data
Total Funding from RMP (Option A - no wave sensors)	**$27,230.00**	
Total Funding from RMP (Option B - two wave sensors)	**$30,590.00**	

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Temporal variability in sediment delivery to a North and a Central San Francisco Bay salt marsh

Summary: Salt marshes provide critical habitat as well as coastal protection. One of the key sediment management questions for San Francisco Bay is whether available sediment is sufficient for marshes to keep pace with sea-level rise. We propose to investigate the influence of tides, waves, and water levels on near-marsh suspended sediment concentration (SSC) and deposition on tidal marsh surfaces. At two marsh sites, we will measure SSC in intertidal and subtidal shallows adjacent to the marsh, deposition and accretion on the marsh (monthly), and the variation in deposition with elevation and vegetation density and type. Data collection will take place over 12 months to determine seasonal effects. We propose two sites: San Pablo Bay National Wildlife Refuge, and Corte Madera Bay in Central Bay. Final site selection will depend on site accessibility and suitability for the study. Our overall objectives are to investigate 1) the relationship between SSC adjacent to the marsh edge and deposition in the marsh, 2) the relationship between SSC adjacent to the marsh edge, in subtidal shallows, and at long-term channel monitoring stations; 3) the influence of tides, waves, Delta outflow, and water levels on SSC adjacent to a marsh and sediment deposition in the marsh; and 4) to produce data sets for testing numerical models of sediment transport between the Bay and marshes. Results will be useful for prioritizing marsh restoration sites, assessing restoration actions, and understanding mechanisms of sediment delivery to marshes.

Estimated Cost: $133,000 (6 month data collection) to $235,000 (12 month data collection)

Oversight Group: RMP Technical Review Committee (TRC)

Proposed by: Jessie Lacy[1] and Karen Thorne[2]
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Proposed Deliverables and Timeline

Based on 12 month data collection: March 2022 to February 2023

Deliverable	Due Date
Data release: time-series data (PCMSC)	September 2023
Data release: deposition, accretion and vegetation characteristics (WERC)	September 2023
Report (draft paper) investigating the relationship between SSC in the shallows, SSC at long-term channel stations, and sediment accretion on marshes	December 2023
Final Presentation to RMP	Fall 2023
Presentation to Bay Delta Science or State of the Estuary Conference	2023

Background

Salt marshes provide critical endangered species habitat as well as coastal protection for communities. The combination of sea-level rise and declining sediment supply to San Francisco Estuary in recent decades (Schoellhamer 2011) present the threat of marsh loss due to drowning. In addition, lateral erosion of wave-exposed marsh edges, which can occur in vertically accreting marshes, can be a significant cause of marsh loss (Leonardi et al. 2016). One of the key sediment management questions for San Francisco Bay is whether available sediment is sufficient for marshes to build elevation to keep pace with relative sea-level rise (SLR), and to support planned marsh restoration goals. Sediment availability varies spatially, and in a general sense depends on the magnitude of suspended sediment concentration (SSC) in adjacent shallows. However, variation in processes that deliver sediment from Bay channels into the shallows and marshes, including tides, wave-driven resuspension, edge erosion, and vegetative trapping, can influence marsh accretion. These processes vary spatially, with proximity to sediment source (Delta or tributary), wave exposure, marsh type, and marsh topography, and temporally, due to variation in physical forcing on spring-neap, storm event, and seasonal time scales, as well as seasonal variation in vegetation (Buffington et al. 2020, Lacy et al. 2018).

Elevation-based modeling of San Francisco Bay marshes predicts significant marsh loss by 2100, but the extent of loss depends strongly on both the rate of SLR and the magnitude of sediment supply (Takekawa et al. 2013, Schile et al. 2014, Swanson et al. 2014). In these models, mineral sediment accretion is either directly related to ambient SSC, which is treated as a constant, or is based on historic accretion. We propose data collection to test the relationship between SSC and mineral sediment deposition, and to determine the best statistical representation of ambient SSC (e.g., mean, median, high tide, 90^{th} percentile) for such a relationship. We will also investigate the relationship between SSC adjacent to the marsh edge, SSC in subtidal shallows, and SSC at long-term channel monitoring stations to determine whether such sites can be used to predict marsh mineral accretion. We will investigate the influence of tides, waves, Delta outflows, weather, and water levels on SSC adjacent to a marsh and sediment deposition in the marsh. We will also investigate the relationships between sediment deposition in the marsh by vegetation type, elevation, and distance from sediment source (Buffington et al. 2020). The data sets will be suitable for validation of process-based models of sediment exchange between shallows and marshes. Here we propose data collection at two sites. Analysis will include comparison with data collected at Whale's Tail marsh in South San Francisco Bay slated for 2021-22.

Study Questions and Applicable RMP Management Questions

The proposed work aims to address the following questions:

1. How is SSC in the subtidal shallows related to the closest long-term channel SSC monitoring station?
2. How is SSC in the subtidal shallows related to marsh deposition?
3. How does mineral deposition on the marsh surface vary by a) distance from sediment source, b) vegetation composition characteristics, and c) amount of time the marsh is flooded (i.e. elevation relative to tidal datums).
4. Are these relationships related to tides, wave energy, local watershed discharge, Delta outflow, or seasons?

This project addresses San Francisco Bay Regional Monitoring Program (RMP) Sediment Workgroup Management questions 4 and 5 (Table 1). It also informs the *Flux on shoals and into wetlands* priority identified in the Sediment Workgroup's Sediment Monitoring and Modeling Strategy.

Table 1: RMP Sediment Workgroup management questions and associated study questions.

Management question	Study question	Example information application
MQ4: How much sediment is passively reaching tidal marshes and restoration projects, and how could the amounts be increased by management actions?	1, 2, 3, 4	● Understanding sediment availability for restoration ● Prioritizing restoration sites ● Informing timing of management actions such as sediment placement ● Understanding and predicting marsh vulnerability to SLR
MQ5: What are the concentrations of suspended sediment in the Estuary and its subembayments?	1	● Relating SSC near marsh edges to SSC at long-term monitoring stations in deeper water ● Provide data for model calibration

Approach

Task 1. Site selection

We will study two marsh sites, one in San Pablo Bay and one in Central Bay. Proposed sites are described below. Final site selection is subject to review of existing data and field reconnaissance, as well as feasibility of access permissions, endangered species restrictions, input from RMP, and funding.

Site A: San Pablo Bay

We propose a marsh site on the San Pablo Bay NWR which would be collocated with existing Surface Elevation Table-Marker Horizon (SET-MH) locations (deployed in 2014) so that we can link short term measurements with long-term accretion monitoring. This marsh has a low slope with a gradual gradient of spartina in the low intertidal zone to a pickleweed high marsh

platform. It is influenced by southerly wind and waves, tides, Delta discharge, and Petaluma river outflow. Adjacent restorations include Sonoma Baylands and Sear's Point Restoration. Thorne has an existing USFWS Special Use Permit for this site. Data previously collected by USGS in San Pablo Bay shallows will inform the data analysis (MacVean and Lacy 2014, Lacy and MacVean 2016, Allen et al. 2019, Lacy et al. 2020).

Figure 1. San Pablo Bay NWR marsh fringes San Pablo Bay and is influenced by the Petaluma River and Delta flows.

Figure 2. San Pablo Bay NWR marshes have a gradual slope into San Pablo Bay

Site B: Central Bay

Corte Madera Marsh (Heerdt and Muzzi Marshes) is located in Marin County along Central Bay at the mouth of Corte Madera Creek and is part of the Corte Madera Ecological Reserve, managed by California Department of Fish and Wildlife. Historically this area was diked, and like many Bay area marshes, was heavily impacted by human activities (Carkin et al. 2020). Tidal inundation was restored in the 1970s and 1980s. It has a scarped edge and lower marsh plain elevation than many other San Francisco Bay marshes (Takekawa et al. 2013). Marsh vegetation is dominated by pickleweed, with areas of fringing *Spartina* in channels. Wave exposure is less than at the San Pablo NWR site but is nonetheless significant (Lacy and Hoover 2011). The marsh shoreline has retreated 0.48 to 0.72 m/year from 1992 to 2016 (Carkin et al. 2020). The distance from the marsh to the Bay channel is about 1/3 that at the San Pablo NWR site, which could result in a stronger link between channel SSC and marsh accretion.

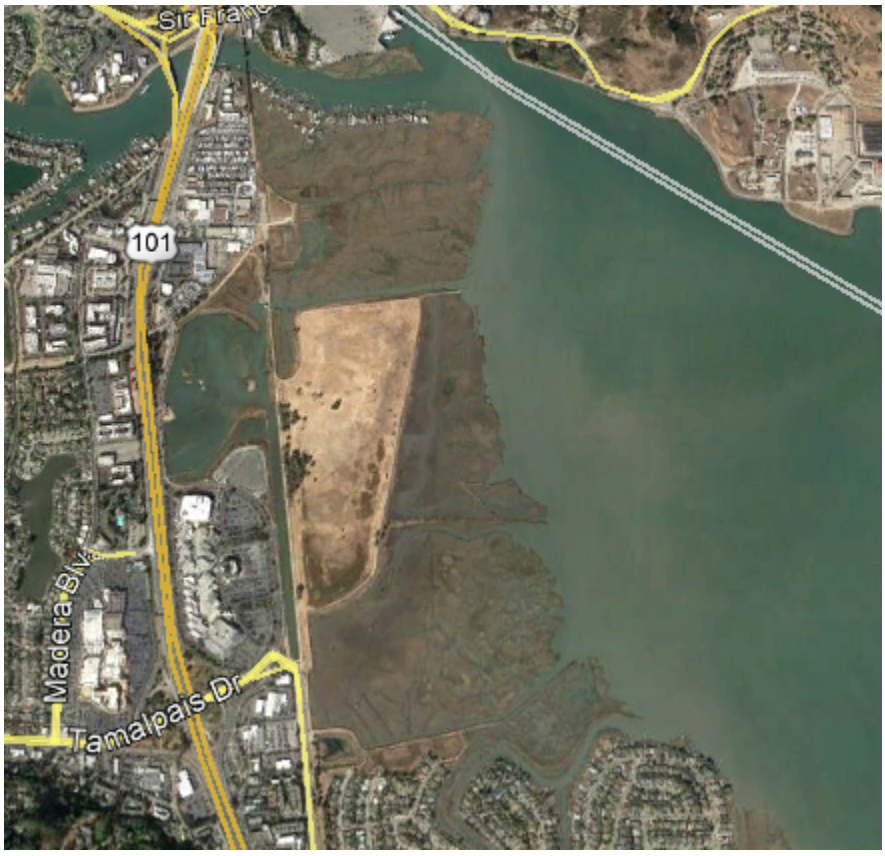

Figure 3. Corte Madera marsh is a low marsh elevation that is experiencing edge erosion.

Figure 4. Corte Madera marsh experiences a different wave and tidal climate which will impact marsh accretion.

Task 2. Data collection

Overview
We will collect time-series data (detailed in 2a) in the bay shallows and sediment deposition data (detailed in 2b) on the marsh.

a. Data collection in the shallows
We will collect time-series data at two shallows stations associated with each marsh site: one in subtidal waters (approximately 1.5 m MLLW), and a second in intertidal shallows within 50 m of the marsh edge. The subtidal station is intended to mimic a long-term shallows monitoring station, whereas the intertidal station will more directly capture sediment concentrations transported on to the marsh. At both stations, we will measure water level, SSC, and wave properties. At the subtidal station we will also measure tidal currents, salinity, and temperature.

Data will be collected continuously at all stations over the study period. We will visit the stations every 60 days to maintain equipment, change batteries, download data, and collect calibration samples. During each site visit we will collect bed sediment samples adjacent to the stations and analyze the surficial centimeter of sediment for bulk density, grain size distribution, and organic matter, all of which can influence the erodibility of sediment.

At all shallows stations, we will collect turbidity data with optical backscatter sensors (OBS) and convert the OBS data to SSC based on calibration relationships derived from SSC measured in

water samples collected in the study area. Calibration samples will be pumped from the shallows before and after the deployment from an apparatus on which several OBS sensors are mounted adjacent to the pumping port. Additional water samples for calibration will be collected during site visits.

b. Marsh sediment deposition and accretion measurements

In each marsh we will establish four transects extending onshore from the bay-marsh interface for sediment deposition rate measurements. Transects will be oriented perpendicular to the marsh edge to evaluate the influence of distance from source on deposition.

The four deposition transects will be stratified by elevation gradients and vegetation type (see Buffington et al. 2020 for details). Transect length will vary from 30-50 m with 5-10 sediment deposition sampling locations per transect depending on length. At each sampling location we will deploy glass filter pads that collect mineral and organic matter deposited on the marsh surface using ceramic tiles. Sediment pads will be collected monthly over the funded study period. Sediment pad samples will be analyzed in the lab for mineral mass and organic matter. For all sampling locations, elevation and location will be measured with RTK GPS and distance to the nearest marsh creek will be measured. Percent time flooded and depth will be calculated for sampling locations from water level and elevation data.

To translate deposition into accretion rates we will collect small soil plugs adjacent to sediment traps to analyze for bulk density and organic matter.

Where applicable (e.g., San Pablo Bay NWR), existing Surface Elevation Tables -Marker Horizons (SET-MH) will be read to compare total elevation change with sediment tile deposition amounts. SETs (n = 4) provide total elevation change and incorporate below- and above ground processes. Marker Horizons (n = 12) are feldspar plots that were deployed in 2014 and can provide a comparison between this short-term study and long-term trends..

c. Vegetation characterization

We will conduct vegetation surveys to inventory dominant plant species, density, and elevations to determine how vegetation affects sediment deposition. Along transects we will use point intercept method on 1x1 m grid at each sediment pad location. We will determine species, % cover, average height, and density by vertical strata. Results will be used to estimate cross-sectional area and volume of the vegetation per unit area. Vegetation will be surveyed during the growing season and again during winter senescence.

Task 3. Data processing and publication

Time-series data will be reviewed to remove low-quality data and converted to a non-proprietary format (NetCDF) for publication. OBS data will be converted to SSC based on instrument-specific calibration relationships from *in-situ* samples. Wave statistics will be calculated from high-frequency bursts of pressure and velocity collected at the shallows stations and bed shear stress due to currents and waves will be determined. From the accretion/deposition data we will evaluate the influence of time, season, flooding and elevation, distance from source, and vegetation type on accretion across the marsh surface.

The data will be published as USGS data releases, one produced by WERC and one by PCMSC, within six months after data collection is completed.

Results will connect SSC in the shallows and at long-term channel monitoring stations to deposition and accretion rates across the marsh surface by elevation and vegetation type.

Task 4. Presentation of results

Results of the study will be presented to the RMP Technical Review or Steering Committee and either the Bay-Delta Science Conference or the State of the Estuary Conference. We will also keep the RMP SWG and WRMP Technical Advisory Committee informed of progress.

Task 5. Data analysis and report

With results from these two sites and Whale's Tail South, we will investigate the relationship between SSC at channel stations, SSC in the shallows, and marsh accretion. We will investigate time lags in these relationships as well as seasonal variation in them. If supportable, we will develop predictive relationships for marsh accretion from SSC.

Previous work suggests that the relationship between SSC and deposition varies seasonally (Buffington et al 2020, Lacy et al 2020), and that increases in deposition may lag increases in sediment supply (Buffington et al, 2020). We will examine the new data sets for similar responses, and investigate the extent to which such variations and temporal lags can be explained by vegetation characteristics, wave climate, local watershed discharge, and Delta outflow. Twelve months of data will allow examination of the full annual variation in vegetation characteristics, hydrology, and wave conditions. In the Mediterranean climate of San Francisco Bay, annual hydrologic variation is a critical driver. Understanding the influence of critical drivers will help inform modeling approaches for assessing sea-level rise and climate change scenarios. A shorter data collection period will limit the ability to test for lagged responses, in addition to excluding part of the annual cycle.

For the 12 month data-collection project, the final report will be a draft paper for submittal to a peer-reviewed journal, to be completed by December 2023. The paper will investigate the relationships between SSC at channel stations, SSC in the shallows, and marsh accretion, and their seasonal variation.

Budget

PCMSC

Expense	6 mo data collection	9 mo data collection	12 mo data collection
Task 1	$1,000	$1,000	$1,000
Task 2a	$23,100	$34,600	$40,900
Task 3	$7,100	$10,600	$14,200
Task 4	$1,000	$1,000	$1,000
Task 5	$14,100	$15,900	$17,700
Subtotal	$46,300	$63,100	$74,800
Indirect	$26,817	$36,548	$43,324
Total	**$73,117**	**$99,648**	**$118,124**

WERC

Expense	6 mo data collection	9 mo data collection	12 mo data collection
Task 1	$1,000	$1,000	$1,000
Task 2b	$20,000	$30,000	$40,000
Task 3	$8,500	$12,750	$17,000
Task 4	$1,000	$1,000	$1,000
Task 5	$9,000	$13,500	$18,000
Subtotal	$39,500	$58,250	$77,000
Indirect	$20,540	$30,290	$40,040
Total	**$60,040**	**$88,540**	**$117,040**

Grand total:	**$133,157**	**$188,188**	**$ 235,164**

In-kind and leveraged contributions:

USGS PCMSC will provide in-kind all instrumentation for time series data collection (valued at more than $100k), use of vessels, vehicles, and laboratories, and $45k in salary for Lacy and technicians.
USGS WERC will provide in-kind all major field and lab equipment (boats, trucks, RTK GPS, muffle furnace, balance), and $25K in salary for Thorne. WERC will also be leveraging existing data ($60K, Thorne et al. 2019) and methodology ($30K, Buffington et al. 2020).

Reporting

Data will be published as USGS data releases within six months after data collection is completed. For 12 months of data collection. the final report will be a draft paper for submittal to a peer-reviewed journal by December 2023. The draft paper will be provided to the RMP Sediment Workgroup and TRC for review before submittal to the journal.

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SEDWG SEP proposal
Estimation of future sediment loadings from local tributaries

Sediment is a critical resource that is essential for sustaining San Francisco Bay tidal marshes and mudflats (or baylands) under a changing climate. Currently, there are approximately 80,000 acres of baylands that will need an increased sediment supply to keep pace with sea-level rise. In addition, tens of thousands of acres of restored tidal marsh planned throughout the Bay will need sediment to fill subsided areas and maintain tidal marsh elevation into the future. There is therefore a critical need to determine if there will be enough sediment delivered to the Bay from the Delta and local Bay tributaries to support baylands over the long-term.Thus, understanding the sediment flux to tidal wetlands is one of the priority recommendations for additional sediment studies identified by the RMP Sediment Modeling and Monitoring Strategy (McKee et al., 2020). Modeling changes in suspended sediment flux and sediment delivery for future conditions can help predict sediment delivery to the Bay under future conditions and contribute to our understanding of how sediment from watersheds helps baylands keep pace with sea-level rise. Recently, Dusterhoff et al. (2021) provided estimates of future Bay tributary sediment supply over the next several decades. However, those estimates account for only two future climate scenarios and were calculated at an annual time step, thereby “smoothing out” the impacts of discrete large storm events on sediment transport dynamics. More work is therefore needed to understand watershed sediment delivery dynamics to the Bay at temporal and spatial scales that are useful for effective watershed and baylands sediment management.

With the development of the Bay regional watershed model (Zi et al., 2021), future erosion and sediment transport processes in watersheds that drain to the Bay can now be represented and simulated in a dynamic manner. The model predicts sediment loadings at event scale for tributaries based on the physically-based processes representation. The erosion and transport of sediment are driven by instantaneous rainfall intensity and transport capacity of flow. Thus the model can evaluate the impact of total rainfall changes in the future, as well as the impact of the rainfall pattern changes (i.e., more extreme rainfall events). We propose to use the dynamic sediment model with downscaled climate model predictions to estimate future sediment loadings to the Bay from local tributaries. The downscaled predictions from four climate models (HadGEM2-ES (Warm/Drier), CNRM-CM5 (Cooler/Wetter), CanESM2 (Average), MIROC5 (Complement)) will be used to derive an ensemble result of the future sediment loading. The future prediction will be centered on two periods: the mid-Century(2040-2059) and the end-Century (2070-2099). The future sediment loadings will be generated for 83 pour points of the local tributaries (pour points details can be found in the modeling report (Zi et al., 2021)).

The proposed work can be completed in one year with an estimated cost of $70K. The expected deliverable is a final report about future sediment loadings predictions from the dynamic model.

Reference

Dusterhoff, S.; McKnight, K.; Grenier, L.; Kauffman, N. 2021. Sediment for Survival: A Strategy for the Resilience of Bay Wetlands in the Lower San Francisco Estuary. SFEI Contribution No. 1015. San Francisco Estuary Institute: Richmond, CA.

McKee, L., Lowe, J., Dusterhoff, S., Foley, M., and Shaw, S. 2020. Sediment Monitoring and Modeling Strategy. A technical report prepared for the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP) Sediment Workgroup. SFEI Contribution No. 1016. San Francisco Estuary Institute, Richmond, California.

Zi, T.; Mckee, L.; Yee, D.; Foley, M. 2021. San Francisco Bay Regional Watershed Modeling Progress Report, Phase 1. SFEI Contribution No. 1038. San Francisco Estuary Institute: Richmond, CA.