# RMP Sediment Workgroup Meeting

May 11, 2023
10:00 AM – 4:00 PM

## MEETING SUMMARY

| | | |
|---|---|---|
| **1.** | **Introduction and Goals for Today's Meeting** | 10:00 am |
| **2.** | **Information: Presentation on Sediment Dynamics at Bay Marshes** | 10:20 am |
| **3.** | **Information: Presentation on Bay Sediment Conceptual Model** | 10:50 am |
| **4** | **Information: Overview of Bay Sediment Efforts** | 11:20 am |
| **5.** | **Information: Overview of Workgroup Planning Efforts** | 12:30 am |
| **6.** | **Information: Presentations of 2024 Special Study Proposals** | 1:00 pm |
| **7.** | **CLOSED SESSION**<br>**Decision: Ranking of 2024 Special Studies Proposals** | 2:30 pm |
| **8.** | **Report Out of Proposal Idea Ranking and Recommendations to Principal Investigators** | 3:45 pm |

## Attendees

| **Name** | **Affiliation** |
|---|---|
| Aaron Bever | Anchor QEA |
| Alex Braud | SFEI |
| Allie King | SFEI |
| Amy Kleckner | SFEI |
| Angela Stiegler | ORISE EPA |
| Brenda Goeden | BCDC |
| Bruce Jaffe | USGS |
| Caitlin Crain | SFEI |
| Christina Toms | Water Board |

| | |
|---|---|
| David Hart | USGS |
| David Peterson | SFEI |
| David Schoelhammer | USGS ret., Technical Advisor |
| Don Yee | SFEI |
| Donna Ball | SBSPRP/SFEI |
| Jay Davis | SFEI |
| Jazzy Graham-Davis | Water Board |
| Jeremy Lowe | SFEI |
| Jessie Lacy | USGS |
| Julie Beagle | USACE |
| Karen Thorne | USGS |
| Katie McKnight | SFEI |
| Lester McKee | SFEI |
| Letitia Grenier | SFEI |
| Lilia Mourier | SFEI |
| Luisa Valiela | EPAR9 |
| Martin Trinh | SFEI |
| Maya McInerney | BCDC |
| Melissa Foley | SFEI |
| Michael MacWilliams | Anchor QEA |
| Pat Wiberg | UVA, Technical Advisor |
| Rachel Allen | USGS |
| Renee Spenst | DU |
| Richard Looker | Water Board |
| Ryan Dougherty | EPAR9 |
| Scott Bodensteiner | BPC and Haley & Aldrich |
| Scott Dusterhoff | SFEI |

| | |
|---|---|
| Seteney Bozkurt Frucht | Water Board |
| Tom Mumley | Water Board, RMP Steering Committee Chair |
| Xavier Fernandez | Water Board |

## 1. Introduction and Goals for Today's Meeting

Melissa Foley welcomed attendees to the 2023 San Francisco Bay Regional Monitoring Program (RMP) Sediment Workgroup (SedWG or WG) annual meeting. She offered guidelines for inclusive conversations as well as the following land acknowledgement.

The San Francisco Estuary Institute (SFEI) and many members of the RMP are on the ancestral territory of the native peoples of the San Francisco Bay, including the numerous villages and tribes of the Ohlone, Patwin, Coast Miwok, and Bay Miwok. We recognize that through a violent history of colonization and dispossession that today as guests, we benefit from living and working on the ancestral homeland of these native people. We wish to show respect to them and their ancestors by acknowledging the injustices inherent in this history, and by affirming their sovereign rights and their current efforts to achieve restorative justice. (Statement developed through the collaborative efforts of the original native peoples of the San Francisco Bay.)

Melissa introduced the SedWG advisors, Pat Wiberg, coastal oceanographer from the University of Virginia, and Dave Schoellhammer, research hydrologist retired from USGS, as well as WG members that included stakeholders, government agencies, consultants, academics, analytical partners, SFEI staff, and others.

The goals for the meeting were to review findings from SedWG studies, get updates on related projects happening in the Bay that are not funded by the RMP, review SedWG Management Questions and Multi-Year Workplan, and discuss and rank 2024 Special Study proposals.

Melissa reviewed the structure of the RMP and current workgroup efforts that include:

- Develop a Sediment Monitoring and Modeling Workplan (funded 2023)
- Develop a sediment conceptual model for the Bay (funded 2021)
- Update and enhance the DMMO database (funded 2022)
- Measure the temporal variability in sediment delivery to Whale's Tail marsh (funded 2021-2022) and North Bay and Central Bay marshes (funded 2022-2023)
- Monitor suspended sediment and wave monitoring in South and Lower South Bay (funded 2022-2023)
- Monitor sediment flux at Richmond/San Rafael Bridge (funded 2023, starting 2024)

## 2. Information: Presentation on Sediment Dynamics at Bay Marshes

Jessie Lacy gave a presentation on two studies focused on factors that influence both the timing and magnitude of sediment delivery to several San Francisco Bay salt marshes. USGS scientists Karen Thorne (Western Ecological Research Center) and Jessie Lacy (Pacific and Coastal Marine Science Center) are the principal investigators on these projects, along with collaborators from UC Berkeley. The projects are largely funded by the RMP, and there is funding from other USGS programs to add components to the research.

The first study focused on Whale's Tail in the South Bay. This marsh was chosen because it has a large wave fetch, providing an extreme case to study the influence of wave delivery of sediment to marshes. There is a steep scarp with an erosional edge and is close to ongoing restoration work. For this study, they were interested in the processes and timing that leads to deposition. This is a detailed study with a shorter study duration.

The second study was developed to address questions on a larger range of marshes and marsh types. The expectation is that relative importance of factors (e.g., sed supply, waviness) on marshes varies depending on proximity to the delta and local sediment sources, wave exposure, marsh edge type, and vegetation type. In addition to Whale's Tail, they chose to study the San Pablo Bay National Wildlife Refuge and Corte Madera Marsh, which is the oldest restoration site in SF Bay. The idea was to do less intensive data collection, but for a longer duration to capture the full hydrologic cycle over the course of a year.

These sites have a range of edge types. The San Pablo National Wildlife Refuge Marsh has a ramped edge with fringing *Spartina foliosa* vegetation. Corte Madera has a scarped edge that is relatively low (0.5 meters). Whale's Tail has a higher scarped edge (close to 2 meters). Vegetation composition varies between sites. Vegetation is characterized because it is instrumental in dampening waves and trapping sediment.

At each site they are measuring suspended sediment concentration (SSC), water level, currents, and wave statistics in the Bay shallows. SSC and water level are measured at one site on each marsh. Deposition and accretion are being measured monthly on sediment pads at a number of locations. Accretion is being measured with marker horizon plots, and vegetation is being characterized at multiple locations. At Corte Madera Marsh, additional measurements include suspended sediment flux in one tidal creek, and the marsh edge was surveyed to track erosion throughout the year.

Data collection in San Pablo Bay National Wildlife Refuge and Corte Madera Marsh began in April 2022, and will go to July 2023. They now have data from a spring following a very dry winter and a spring following a very wet winter.

Whale's Tail had two study periods in the summer and winter seasons in 2021 and 2022, chosen to span the largest tides of the year. Deposition and accretion rates were measured every 14 days rather than every month at this site. There were also more marsh top stations capturing SSC and water level. Suspended sediment flux (SSF) was measured in three tidal creeks. There was also a more detailed marsh edge erosion evaluation.

Jessie then shared results from the ongoing work, stating that these studies are in progress, so they don't yet have full conclusions.

Whale's Tail lateral erosion was assessed using high resolution aerial imagery, which bracketed seasons. They used structure from motion techniques to develop high resolution digital surface models from high resolution aerial photos. They measured erosion between five individual surveys in May 2021, Sept 2021, Nov 2021, Feb 2022, and May 2022. The median annual lateral retreat rate was 1.5 meters per year. Lateral and volumetric retreat varied seasonally, with the greatest occurring in spring and summer due to daily wind waves common in the Bay.

Because the data covered only summer and winter months, they used those data to calibrate the SWANN wave model, to hindcast wave conditions for the entire year. It is commonly found that erosion is a function of wave power, although relationships vary between sites, likely due to marsh characteristics.

In tidal creeks they are measuring water discharge, SSC, water depth, and then calculating SSF at three sites in Whale's Tail Marsh and one in Corte Madera Marsh. Velocity is being measured continuously, and an index velocity relationship has been developed for these creeks.

At Whales' Tail, during the large spring tides (a.k.a. king tides), they saw a significant export of sediment. This is an accreting marsh, but the net flux over the two largest spring tidal cycles was over 80 tons of sediment exported through the main tidal creek. There is import of sediment during weaker tides and storms. This is exported from the creek and not necessarily from the marsh surface. This is something Jessie and Karen  are thinking about in the analysis. Jessie clarified that these are tidal creeks that go dry at low tide.

In Corte Madera Marsh, they saw a clear net import of sediment over eight months. The rate varies month to month, but the sign stays the same. Cumulative SSF is the opposite sign of Whale's Tail (net import rather than export). They are investigating why that is.

Deposition was measured using sediment pads and marker horizon plots. The sediment pads were deployed in transects perpendicular to the tidal creek. The pads were collected every 14 days at Whale's Tail or every 30 days at other sites and the material that was deposited was weighed and organic content was also measured.

They found that deposition is much greater during summer than winter at all sites. There is a clear pattern of big spring tides of the month having higher deposition than the small spring tides. This indicates that deposition is a function of inundation time.

Sediment deposition transects were placed perpendicular to the Bay edge, the main tidal channel, and in the interior of the marsh. The greatest deposition was at the channel transect, and the lowest was at the Bay transect. There is a decline in deposition moving away from the

source (the Bay), but in the Bay transect, the peak is removed from the edge because the edge is influenced by wave erosion.

Jessie showed example plots to demonstrate how they would like to explore the data. As each station gets inundated, there is a pulse of sediment brought onto the marsh, and the concentration is affected by waves. During the inundation period it slowly settles out. Because of this pattern, spatial gradients in SSC can be used to infer deposition or erosion between stations. Individual tidal cycles can be evaluated this way instead of using deposition pads. They can explore whether wave conditions explain conditions between individual tidal cycles.

Waves in Corte Madera are much smaller, as it's more wave protected. Of the three marsh systems, Corte Madera is the most consistent, and other stations have more complicated relationships. Once they have more months of data, they will look at which SSC measurement is the best predictor of what's on the marsh and if they can relate sediment concentration measurements to each other.

At all stations they also collect sediment in the shallows. They measure sediment bulk density as a predictor of erodibility. Over the past decade, they measured particle size and bulk density around the Bay. They have been controlling where in the sediment column they are measuring, mainly the surficial level because that is important for erodibility. They are looking at the relationship between mud content and erodibility. Organic carbon is an important predictor of bulk density, so that is being evaluated as well in an ongoing project.

When asked for clarification, Jessie informed the group that they usually take measurements of the top two centimeters, but sometimes 1 or 0.5 cm. They plot the data by depth, so they see decreases in bulk density near the top. Tom Mumley suggested giving further thought to a standardized method. Jessie noted that for a standardized method, the purpose of data collection needs to be determined (e.g., for dredge material or numerical models).

Key points from Jessie's presentation are as follows:

- There has been successful data collection at Corte Madera Marsh and San Pablo Bay NWR for 12 months so far, capturing a wide range of hydrologic conditions.
- At Whale's Tail, there is clear seasonal and spring-neap variation in deposition, consistent with variation in wave energy and inundation
- The greater deposition at Whale's Tail in summer coincides with higher SSC and greater edge erosion than in winter, suggesting eroded edge as a source.

Jessie noted that the edge erosion as a source of deposition around the marsh can be referred to as "cannibalization," and it is something they have been noticing and expecting.

Pat Wiberg opened the discussion. She asked if Jessie thinks the summer deposition being higher than the winter is due to the tidal range or if there was a storm surge component. Jessie did not think it was tidal range. She said that in the winter period it was very calm for a month, so no sediment was in the water. However, winter king tides are the highest in the year,

so it has more to do with sediment concentration in the shallows. Pat wanted to clarify that inundation depths were not higher or longer in summer and that there was no significant storm surge component. Jessie said tides are higher in winter. The summer wind wave pattern is caused by pressure patterns created by hot temperatures in the Central Valley, not from storms. Storms are not the most important factor.

Pat asked whether they know where the currents are going in flux-based deposition work, and whether the assumption is that they're going along the transect. Jessie said that it is a volume-based estimate of the flux using the volume of water that floods over the marsh edge. They are assuming that the direction changes with the tide. She noted there are a lot of assumptions, and will be looking for feedback in the future.

Christina Toms asked Jay Davis if work he's doing measures bulk density and particle size at mudflats and if those data could be aggregated with Jessie's data. Don Yee said they don't usually measure bulk density, but could. Bruce Jaffe suggested that because there is a lot of interest in bulk density, this WG could come up with a plan to improve our understanding of bulk density variation in the Bay. Karen added that they also measure bulk density in the marsh at all sites.

Angela Stiegler asked what the contribution of erosion from the edge/face versus the vegetated surface itself. This may have implications for interpretation of bulk density measurements at the surface versus vertically deeper in the scarp face. Christina believed Brian Fulfrost has looked at this specifically and she thought the answer is "yes." The WRMP is going to look at this as well.

Lester McKee asked if scarp erosion at Whale's Tail is a recent process or if it has been going on for a decade or more. Jessie responded that they've quantified it for 20 years, and from historical imagery it's clear that it has been eroding for much longer - there's evidence of an eroded scarp in the 1940s.

Dave Schoellhamer asked if there is export from the channel and flux from the channel to the marsh at large spring tide. He asked if the channel stores sediment during neap tide and then removes it to the Bay and marsh during spring tide. If so, he asked if including tidal channels in marsh restoration is a key lesson. Jessie responded that both deposition and export are greatest during big spring tides at Whale's Tail. She thinks the role of tidal creeks in storing sediment is very important at the marsh site level.

Jay Davis asked what the plan is for the draft report. Jessie said a data release was published a couple of weeks ago for part of the Whale's Tail study. There will be products for Whale's Tail and for the two or three sites combined. The timeline is not yet set.

## 3. Information: Presentation on Bay Sediment Conceptual Model

Katie McNight presented updates to the conceptual model of fine sediment transport in the San Francisco Bay.

The model has three main considerations:

- Baylands - sediment is important in building vertical elevations in baylands (mudflats and marshes), helps to keep pace with sea level rise, and protects the shoreline from erosion and overtopping
- Contaminants - fine sediment transports contaminants around the Bay
- Primary Productivity - sediment in suspension attenuates sunlight and minimizes algal growth and prevents eutrophication.

There are questions of how much sediment is passively reaching baylands and restoration projects as well as how management actions can increase the amount of sediment reaching these habitats.

The project's objective is to capture a narrative of how fine grain sediment moves around the Bay at different scales and highlight key knowledge gaps. The goal is to organize information in easy to digest visuals as a tool for managers and others. This project synthesizes current data to help with restoration planning, creating a digestible communication tool that focuses on magnitudes and uncertainties, and clarifies where to focus limited RMP funds to address questions regarding sediment loading to the Bay and sediment delivery to marshes.

The approach focused on sediment transport at two scales: the Bay and subembayment scale, and baylands scale.

Katie showed results of data compilation for wet season fluxes in wet and dry years, as well as dry season fluxes in wet and dry years. The fluxes presented were between tributaries and the Bay, and between subembayments.

Wet season flux is larger between subembayments than flux from the tributaries. Flux is also greater at all points in wet years compared to dry years, especially for tributaries. Suisun Bay changes from a net loss in wet years to a net gain in dry years.

In the dry season, tributary flux is negligible, and magnitudes of flux between subembayments are similar for wet and dry years. The same pattern of direction change for Suisun Bay is seen in the dry season as the wet season. There are no data available for wet year dry seasons at the Golden Gate.

Katie showed net loss or accumulation for each subembayment for the different hydrologic conditions. South Bay and San Pablo Bay tended to have net sediment loss under most conditions, while Central Bay and Lower South Bay had net accumulation. Suisun Bay showed a net loss during wet years, and net accumulation during dry years.

Future condition findings show annual net flux between wetter futures and drier futures. Findings suggested that sediment delivery to the North Bay could be higher in wetter futures

than drier. There are no model predictions between subembayments or at the Golden Gate, and that's something to consider prioritizing.

Katie identified priority actions to address key knowledge gaps, including: update and refine estimates of flux from the delta by improving estimates of suspended and bedload sediment at Mallard Slough; update and refine future flux estimates through the Golden Gate and between subembayments; and refine modeling of regional suspended sediment concentrations to account for more dynamic processes.

At the bayland scale, the conceptual model is organized into four main pathways:

- Uplands to tributaries
- Tributaries to marshes, mudflats, and erodible sediment pools
- Erodible sediment pools to mudflats and deep bay
- Mudflats to marshes

The main takeaway is that sediment transport at the bayland scale isn't linear. Limited data exist on these processes, and there is a need to fill in critical data gaps.

There are four priority actions to fill data gaps for these pathways: 1) model effects of shifting rainfall patterns and landscape changes on watershed flow-sediment load relationship for all Bay and Delta tributaries; 2) estimate the proportion of tributary sediment compared to sediment from erodible sediment pools that deposits onto mudflats/marshes;3) estimate the size, location, and rate of depletion of current erodible sediment pools at the regional and local scales; and 4) assess ways to increase sediment resuspension near marshes and maximize sediment deposition into marshes using restoration design features and techniques.

When considering future conditions, factors to consider are how a deepening bay will change deposition or the effect of wildfires on sediment load.

The plan is to release the memo in June 2023. The idea is that it will be a living document able to be updated as new information becomes available.

Dave Schoellhamer began the discussion and asked if temporary sediment storage in tidal channels adjacent to the marsh should be included in the bayland scale conceptual model. Jessie does think temporary storage in tidal creeks is important, but may not be volumetrically important. Jessie observed inches of new sediment in tidal channels after winter storms in Corte Madera Marsh. Karen Thorne has observed that San Pablo bay mudflats store sediment after storms and that later gets resuspended and moves onto the marsh in the spring. That's another temporary storage mechanism that could be considered in the conceptual model. It is important to acknowledge temporary storage.

Pat Wiberg asked how the team will approach estimating future fluxes. Katie noted that in this project methods weren't covered, and they focused on identifying knowledge gaps. The idea was to leave it to sediment experts to discuss methods once those knowledge gaps were

identified. Scott Dusterhoff mentioned that there is a Bay scale hydrodynamic and sediment transport model that is being developed with RMP funding. It could be used for contaminant and sediment transport under changing climatic conditions and climate regimes.

Brenda asked if results shown are consistent across decades. She thought there was some switching of at least Central Bay by decade on erosion/deposition, supported by some of their bathymetric work. Scott replied the numbers show a synthesis of all data for the 1995-2016 time period. They were not able to tease out any trends by decade. Bruce Jaffe added for those interested, the report on bathymetric change from the 1980s to 2010s is online. This report has sediment volume change by subembayment. Fregoso, Theresa A., Foxgrover, Amy C., and Jaffe, Bruce E., 2023, Sediment deposition, erosion, and bathymetric change in San Francisco Bay, California, 1971–1990 and 1999–2020, U. S. Geological Survey Open-File Report 2023–1031, 19 p., https://doi.org/10.3133/ofr20231031

Setenay Bozkurt Frucht said she was trying to think about how to evaluate the seasonality of different pathways in the conceptual model and how it affects the spatial considerations. We use wet/dry season typically for fluvial processes, where wet season is where sediment fluxes happen- Pathway 1/Bay and subembayment scale. But per Jessie, spring/summer is when most deposition/erosion happened at the bayland scale - Pathways 2 and 4. She asked about Pathway 3 and how to reconcile all this. Scott said that yes, it is complicated. For this phase of the conceptual model they tried to tell a high-level story. He thinks handling those details should be included in the next phase.

Aaron Bever asked if there was a term or an arrow for marsh edge erosion contributing to the erodible sediment pool bayward of the marsh. On a bay-wide sediment budget it might not be relevant, but may be on a local scale near some marshes. In another system with more extensive marshes the erosion of marsh edge has been shown to be important to the erodible sediment pool. Scott replied that yes, it is there but the arrow is not super prominent. Marsh edge erosion is discussed in the report.

Michael MacWillams noted that for their recent work with SCC and BCDC for the sand transport studies they simulated full bay sediment transport fluxes of both sand and fine fractions throughout the Bay. They provided the modeled sediment fluxes between embayments for both the dry and wet years to SFEI for their sediment budget analysis, so there may be some straightforward comparisons that could be made between those modeled sediment fluxes and the fine sediment conceptual model that could be done without running any additional simulations.

Setenay asked Scott if it would be possible to incorporate conceptual dynamics of wave power change with climate change (SLR and winds, etc.) into the conceptual model for Bay sediment. Scott thought that was a great idea that could be included in the next phase.

Tom said this is an impressive effort, but he wants to push for even better understanding of these mechanisms. That way critical margin areas can be identified. This is a start, a living

document to inspire a lot of dialog. He was wary of jumping the gun on the future until the current status is sufficiently understood. Models referred to by Scott have lots of uncertainty.

Tom noted that the project says there is limited data between Suisun and San Pablo bays. He would argue the opposite because flux has been measured at that pathway. Estimates between the South Bay and Central Bay are modeled and infer data richness. He wanted to be sure that's a flux that can be validated.

Julie suggested an obvious next step would be to input Jessie's initial findings to the conceptual model and try to capture what might be missing in the model. Jessie said the group needs to think about the role and purpose of the conceptual model. It doesn't have to describe all variability that exists. Letitia agreed with Jessie and pointed to the example of temporary sediment storage. That nuance may not matter volumetrically. It's important to think about who would find that useful and why it matters when considering the point of the conceptual model.

Brenda Goeden agreed with Tom that it's great to have a living document. She questioned that only fine grain sediment is considered. Suspended sediment isn't 100% fine, there is sand too. She encouraged the group to think holistically and not be limited to fine grain.

## 4. Information: Overview of Bay Sediment Efforts

Three RMP partners gave updates on sediment-related projects funded outside RMP.

*Presentation 1*

Julie Beagle presented about strategic shallow-water placement using dredged sediment in San Francisco Bay. The project is led by the U.S. Army Corps of Engineers in partnership with the Coastal Conservancy, Bay Conservation and Development Commission (BCDC), SF Bay Regional Water Quality Control Board, and Anchor QEA. The goal is to boost sediment deposition on marshes where needed to address sea level rise as an innovative way to reuse sediment. They selected two sites and modeled 12 simulations to understand effects of different volumes, seasons, and footprints. They are balancing that with logistical constraints of working in the shallow bay and equipment needed for that type of work. That has been pushing construction folks out of their comfort zone of where to take equipment to place material as close to shore as possible.

One of the simulated sites was Whale's Tail Marsh. The model showed some deposition on the marsh and in ponds up the tidal creeks. Julie noted this was a good site to practice new techniques. Modeled deposition thickness was on the order of less than millimeter, so it will be very hard to measure but mimics natural processes.

There is an extensive program in place to monitor water depth and elevation, SSC, wave conditions, eelgrass, sediment transport rates, and background marsh/mudflat gain or loss. Post-project monitoring will also include a benthos impact study and a magnetic particle tracking

study. The pre- and post-placement surveys of eelgrass will be important and Julie has a proposal to look at the influence of dredge material on eelgrass.

Placement will occur in September and October. After that there is a lot of coordination of studies. Julie shared that they have all their environmental permits! The NEPA/CEQA document is complete and the FONSI approval will be signed this month. The contract has to be connected to the Redwood City dredging contract, and that was difficult, but accomplished.

Pat Wiberg asked if dredge material is distinct enough to be able to tell if observed deposition is from dredge material. Bruce asked if short-lived isotopes are being used to discriminate between deposition of dredged and already in-bay sediment. Julie said they are trying to match material to minimize impacts, and the magnetic tracing study will help. They are characterizing bathymetry then doing coring to see deposition. Jessie said they are worried about whether it can be done, but they are looking for differences in bulk density. A big problem is that bathymetric surveys would need 10 cm of deposition, but that's unlikely. Julie noted that they are taking an adaptive management approach, so this is a pilot and experiment, and they can adjust and learn from the process.

Dave Schoellhamer gave congratulations for making this happen after a decade or more of effort. He is glad to see a full year of monitoring after placement. Xavier Fernandez asked if one year of monitoring is sufficient to answer the question because that seems too short. Julie said that a lot of people have said this can't be monitored, and she acknowledged that it will be difficult. It has taken a long time to get to these methods, and Karen and Jessie have been supportive in making this effort.

Xavier Fernandez noted that eelgrass grows sparsely in this area. It's important not to overstate what this project will do. He questioned if this study has the capability to show what impacts to eelgrass would occur because it is so sparse and comes and goes frequently. Julie responded that eelgrass experts have said that this area is not critical for eelgrass. They will do due diligence and follow protocols. It's an important piece to continue to understand. In other places around the Bay that do have eelgrass, modeling shows that they would be good for placement based on shear stress. This site was chosen because it has little to no eelgrass.

*Presentation 2*

Brenda Goeden presented on two ongoing efforts, the first was on new sediment management policies for wetland restoration and climate change resilience in San Francisco Bay.

BCDC won an EPA Wetlands Development Grant to figure out ways to increase sediment and soil placement in restoration projects for resilience to sea level rise through updated management and policy. The project will run January 2023 through December 2025. This study

is a springboard off the Sediment for Survival report. This work is also aligned with the LTMS program.

They are trying to address sediment and soil reuse, habitat restoration, climate adaptation, and support vulnerable communities. It is a three phase process. The first is to engage stakeholders in the region, including those involved in agencies, habitat restoration, dredging, construction, flood protection, adaptation, and environmental justice. It's a large group, and it will take work leading up to a two day workshop to identify roles and responsibilities. The goal of that workshop is to create a road map with written roles and responsibilities to increase sediment management.

The second phase is the Bay Plan Amendment that is in an information and education phase to bring stakeholders up to speed on management sectors and sediment science. The Commissioner Working Group, which includes BCDC commissioners and seven BCDC staff, will then turn to identifying key policies and potentially proposing a Bay Plan Amendment. This workgroup is open to the public and is meeting every other month.

The third phase is a financing strategy. Beneficial reuse costs more than any other kind of disposal of sediment and the dredging community has been bearing the cost. There is a need to find ways to better and more consistently fund beneficial reuse. There needs to be support for both placement and restoration communities.

The project started work in January and BCDC hired Maya McInerney in February, who will work full time on this project for two years. She has developed a workplan and coordinated a Core Team. A request for proposal is out for the facilitator for the stakeholder workshop and that has been a challenge.

Brenda then presented an update on sand supply, budget, and transport studies.

In 2015, BCDC issued three sand mining permits and the total amount of sand mining authorized was 1.426M cubic yards per year over 10 years. There was a requirement for $1.2M to support research on impacts of sand mining to the Bay and the coast.

Sand mining occurs in Suisun channel and middle ground shoal, and the major part is the Central Bay between Alcatraz Island, Angel Island, and the Golden Gate bridge. Sand mined in Suisun is fine, and sand in the Central Bay tends to be coarse.

The Sand Technical Advisory Committee (STAC) took on scope and management questions for studies. An Independent Science Panel reviewed management questions, helped scope studies and refined proposals.

One study has been done by Anchor QEA and involves transport hydrodynamic modeling with and without sand mining. The draft report is in review. SFEI, Deltares, and USGS developed a sand budget, watershed model, literature review, bathymetric and volume change analysis, and

Bruce Jaffe added a component called Sed Trails, that he will share in the future. Draft reports are in review for those studies as well. The University of Texas at Austin and USGS are doing optical stimulated luminescence and sand parent analysis to determine if sand is newly coming into the system or relic sand that has been there for decades.

All of the studies will be completed this summer and the Independent Science Panel will write a findings report that will be shared publicly. Brenda thought that it may be time for a new State of Sediment workshop to present the technical side of work. CEQA permit applications are anticipated in 2024 to request additional mining in the future.

Christina asked if any of the studies would specifically assess shoreline change in near historical and current dredging areas. Brenda said the studies are specific to sand mining, which is in deep water and not near shore. They do analyze bathymetric change in the mining areas and adjacent to them. Christina said she was specifically thinking of the sand shoals that Lind mines in Suisun which aren't super deep and are near Ryer/Roe/Middle Ground islands. Brenda replied that mining on middle ground shoal is interesting. Most of the lease area is super shallow and isn't mined. The only area they mine is in the deeper water area. Brenda's team has been concerned about slumping from the shallow shoal into the deeper water area and then being mined. There is some evidence that that may have been happening. As a result of that potential, in 2015 they significantly reduced the potential mining on that lease and moved the mining more over to the Suisun Associates since then. There is some bathymetry for comparison and tracking, but there are less of those due to the slower development and availability of shallow water survey equipment since they started requiring the surveys in 2004. Christina suggested they discuss this in the WRMP hydrogeomorphic (HGM) workgroup. It would be interesting to compare bathymetric change to shoreline change in the region.

*Presentation 3*

Lester McKee continued where Brenda left off to present a technical update on the Bay sand sediment budget.

The objective was to develop an average annual sediment budget, focusing on sand, with resolution at subembayment scale. The primary driver of the study is sand mining in the Bay. The question attempting to be answered is how is the regional sand budget influenced by sand mining. They reported units in mass because bulk density varies across the Bay, so the same volume in one area is not an equal mass as the same volume somewhere else. Reporting in mass is more consistent.

They evaluated the entire Bay below the head of tide, bounded by Mallard Island and Golden Gate. The accounting period was 2001-2020, chosen because it falls after the step change in sediment concentrations that Dave Schoellhamer reported in his 2011 paper. This is a relatively short period for sediment budgets, and a 30-40 year period would be better, but after changes made in 1999, this 20 year period is best.

The conceptual model has three main inflows: Central Valley rivers, local tributaries, and littoral along-shore ocean sand transport. Outflows include sand mining, dredged material disposal offshore, wetland reuse of dredged material, wetland deposition due to sea level rise, and flood control tidal channel removal. There is also exchange between the Bay and the Pacific Ocean.

Quality assurance efforts considered the question: does it all make sense based on our conceptual model? Although this was focused on sand, outcomes were reconciled against the mud budget and ultimately compared with previous budgets. They will also compare flux estimates with models and compare directional transport with existing empirical observations and provenance work.

The work is being developed to support the next sand mining permits, but there are also ramifications for the sediment budget related to RMP work. Once the budget is developed it can be used, for example, for PCB work. It will be best used as a comparison for the Bay sediment model as it is being developed. It is also relevant to WRMP work by providing context for sediment sources to wetlands as well as help estimate the vulnerability of beaches.

A draft report will be submitted in early June 2023. They are anticipating a lot of interest and will have many comments to address. It will be very well peer reviewed with 6-10 individual reviewers. The final report will be completed around July 2023 and will be publicly available. It will also include data used to support the budget. The goal is to submit to a peer reviewed journal and present at conferences such as Bay-Delta Science and SOE conferences.

Jessie kicked off the discussion by asking if it is possible that direction of flux of sand could be different at given cross sections than finer material. She asked for clarification whether this is a total sediment budget or just for sand. Lester said it's known that the flux of fine sediment is in the opposite direction of sand in some cross sections. The analysis was for particles both greater and less than 53 microns, so they will present a budget for both fine sediment and for sand sediment for the average period of 20 years. It will describe the average directional fluxes in each cross section.

Brenda gave her appreciation to everyone working on this because sand in San Francisco Bay has not been studied. This is cutting edge in figuring out how transport is happening for both bedload and suspended load in the Bay.

## 5. Information: Overview of Workgroup Planning Efforts

Scott reviewed the workgroup organizational efforts including the Sediment Monitoring and Modeling Workplan development, evaluation of SedWG Management Questions, and development of the Multi-Year Plan.

RMP Sediment Workgroup Management Questions

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?
5. What are the concentrations of suspended sediment in the Estuary and its segments?

The WG has been revisiting the Management Questions (MQs) to ensure they continue to serve the needs of this WG. Review of MQs 1-2 will be a 2024 effort. Review of MQs 3-5 began in January 2023. The review of these questions, along with the Sediment Monitoring and Modeling Strategy and Sediment Conceptual Model will go into the Sediment Monitoring and Modeling Workplan. This Workplan will inform the update of the Multi Year Plan, which will be completed by October.

Lester gave a report on the efforts to create the Sediment Monitoring and Modeling Workplan. There is an 18 page draft that will be ready for review in a few weeks. The hope is for this to be a living document because the WG may want to modify priorities and budget allocations. MQs range outside the spatial and temporal monitoring domain, so models need to be developed for those areas.

Lester reviewed the timeline for reviewing the MQs 3-5. The effort began by compiling 30+ sediment science management questions and after an initial meeting and ranking of these questions, the group reduced and condensed those to 16 questions. A second meeting was held to discuss those 16 questions and revised the wording, coordinated workflow, and discussed coordination with WRMP. They now have a full draft of the document that's under internal review. Agency review will be done before bringing it to the entire WG for review because that will allow local coordination and management wrinkles to be worked out and then the full WG can focus on the science aspect of the questions.

Lester showed tables for each MQ's subquestions that address modeling and monitoring and their estimated cost each year between 2024 and 2028. A more detailed table will be available in the report that will be released. He noted that some subquestions are currently funded, although future fluxes are not funded. The WRMP is developing a monitoring workplan and there's a possibility that the RMP would want to provide further funding to improve or expand those monitoring programs. There is a lot of uncertainty about bed erodibility and a literature review could be done next year to look at methods to learn about bed erodibility. The modeling team will be identifying where monitoring efforts are needed as those models continue to be developed.

Modeling funds will be necessary in later years 2027-2028, and in earlier years, monitoring will need to be more heavily funded to fill data gaps while models begin to be developed and tuned. This will take a lot more funds than Lester presented, but the numbers he presented are shown thinking of them as pilot studies.

Dave Schoellhmaer began the discussion by asking if the Multi Year Plan might pose a danger of straightjacketing the WG into funding studies that were planned instead of adjusting when potentially better opportunities or needs emerge over next 5 years. He asked if instead it would be a living document that could allow for flexibility. Lester responded that the planning meeting will be held every year to make slight adjustments to drop, shift, or add studies. There is plenty of room for adjustment on a yearly basis.

Dave noted that all three proposals this year are continuations of RMP work, and that's good, but he expressed a general concern about whether there are opportunities for proposals to be put out to public RFPs or to bring in outside proposals, for instance a new assistant professor in the area. Have proposals been solicited from outside this group? It seems healthy in the long term. Lester said it has not been done this year. The WG used to have a more open process that got a bigger group of proposals. That has the advantage of bringing in innovation. The disadvantage was that lots of people put effort into proposals that wouldn't be funded, which potentially caused a lot of time wasting. He asked the group what would be a healthy way to bring new ideas into the group. Tom Mumley added that there used to be an open competition for special study money. The RMP made a concerted effort to use funding based on strategies and plans. There are opportunities for external proposals in some cases. It's implicit, but not explicit. By design this WG and this plan is bigger than the RMP, because the RMP has limited resources that can go to sediment monitoring and modeling needs. The Sediment WG is creating a platform that invites collaboration (with the Corps for instance), because there are RMP funds for this WG, but less than what is needed. Tom encouraged the group to think bigger when commenting on the Workplan and thinking of the timing and level of efforts within it.

Dave advocated for striking a balance between following a well-developed workplan and bringing in outside ideas that can be better than those. Jay Davis agreed that the WG is open to good ideas from outside this circle. A good way to get them involved is to participate in WG meetings and put those ideas in discussion. There isn't any active soliciting, but the RMP certainly welcomes anyone that works in this field to participate. Tom noted that one of the projects Lester listed is academic, so there has been some discussion with professor Oliver Fringer from Stanford. He emphasized the draft plan is the beginning and everyone needs to weigh in when it is released. Scott Dusterhoff also encouraged the group to take the opportunity to influence the document when it is released. Tom added that it needs to be done well in advance of next year's meeting so the WG will have that bigger picture to evaluate and inspire and leverage outside interests.

Karen Thorne added that open competition is a healthy thing for science. She had been reached out to a while ago and that's how she got involved in the WG.

Brenda Goeden discussed the emphasis over time switching between monitoring and modeling. She said she sees the logic in this for sure, although was wondering, given the diversity of the marshes and shoreline, if it's possible to get enough information to feed the models (if that's part of the purpose of the monitoring) on the diverse sites. Or is monitoring going to need to continue to capture that diversity as the model grows over time. It seems the WRMP might be able to help with this too. Melissa Foley replied that the RMP generally sees the modeling and monitoring as being integrated activities going forward so that they are both informing the other. Because of funding limitations for the RMP alone, that likely means that there will be some switching between modeling and monitoring over years.

## 6. Information: Presentations of 2024 Special Study Proposals

*Presentation 1*

Karen Thorne presented a proposal for a study on Spatial Variability of Sediment Accretion in San Francisco Bay restorations.

Tidal marsh restoration is an important goal for the Bay. The magnitude of the sediment sink produced by wetland restoration is unknown, as is how restoration sinks may influence overall sediment budgets of the Bay or individual subembayments. She pointed out that accretion can vary across all time scales, even decadal.

This study questions are:

- What are the accretion rates in marsh restorations?
- What is the volume and mass of sediment in marsh restorations?
- Are these values related to restoration age, location, vegetation, distance from sediment source?
- Will sediment accretion in restorations be adequate to create and support emergent tidal marsh?

These address Sediment WG MQ 4 in that it will help understand the magnitude of sediment sinks produced by marsh restorations, prioritizing restoration sites, and predict marsh evolution with future modeling.

Karen and Jessie Lacy proposed five marsh restoration sites across the Bay. Site selection criteria include restoration sites that did not receive fill before breaching, a range of geographic locations/embayments, a range of age of restoration, and availability of data either pre-restoration or at least 10 years ago. They proposed a shortlist of 12 sites from which the five study areas will be chosen after discussion with the WG about priorities. Monitoring will be done for only a couple of years, so they chose sites where they felt there was enough additional information.

Sites span a range of settings in the Bay and they want to discuss with the WG to narrow sites down to five. First, they need to dig further into what data exists, including LiDAR, and use that existing data to inform field collection methods.

In the study they will conduct elevation surveys to build DEMs to compare to preconditions, collect soil cores, measure bulk density and organic matter, and conduct vegetation surveys (because vegetation can be indicators for certain topography). Data synthesis will compare historic with new and estimate accretion rates, volumes and characteristics of sediment sinks.

The project budget was split up into tasks with Karen's center doing a lot of field work, and Jessie's center doing most of the historical evaluations and spatial analysis. They proposed a two year project beginning April 2024 and concluding March 2026. They will have data releases for soil properties and the DEMs. They also plan to present at conferences.

Pat Wiberg began the discussion by asking if there is large-scale regional subsidence that would affect change in elevation over the time scale in this study. Karen said all sites experience land loss from dyking. It's common to fill them before they're restored. The Bay Area has more tectonic activity, but subsidence is not as much of a factor as seen in the Gulf.

Pat asked about site selection. Do they have criteria based on historical use of sites and do they want a distribution among as many subembayments as possible or cluster them? Karen hadn't thought about preconditions because they tend to be very similar such as diked agriculture for hay production or historical salt pods. They are proposing more sites than they can do, so they wanted to pose that question to the group. Is it better to scatter around the Bay or cluster? The twelve sites proposed are old enough to measure change and preconditions are documented.

Dave Schoellhamer brought up that qualitatively we now know that Lower South Bay and San Pablo Bay are the best places to do restoration work based on the health of marshes. This study would give a quantification of the deposition restoration projects over years or a decade and that would inform numerical modeling projects that could predict the effects of restoration. There is a question of whether opening up ponds would take away mud from mudflats. In the Workplan that Lester presented there was some modeling, and Dave asked if some of those modeling projects would be follow ups for this project? Without modeling this project isn't as useful. Karen replied that this data would be relevant to scientists and managers, helping to answer questions like: is there enough sediment for restoration? We think so. This is an opportunity to quantify how much of a sink these areas have been. Then the data could be used to model feasibility of other restorations. Dave asked that Lester confirm the follow up is included in the Workplan. Lester agreed that he could be sure to make that clear in the Workplan.

Dave then asked about site selection, asking if having no sites in Suisun bay is a shortcoming. He asked whether there are no adequate sites or that someone else was studying that area. Karen said there are restorations in Suisun Bay, but that's a question for the RMP on whether they want it in there. Jessie noted that there are different vegetation and soil properties in fresh and brackish marshes, which could make it difficult to compare to salt marshes. There is an entire site selection task in the proposal, so it can be discussed further. Tom Mumley noted there are other entities, such as DWR, interested in funding work there.

Brenda Goeden asked if the Faber site included was Faber Tract because that was a dredge sediment placement site, and possibly Outer Muzzi was too. Karen said Outer Muzzi did not have dredge sediment. They looked at Faber-Laumeister and there are multiple parcels within that site, and there may be a parcel that didn't have dredge material.

Brenda asked how they might address consolidation. Karen said that bulk density, particle size, and carbon can address that question. They're analyzing everything by depth in order to address that.

Tom brought up funding and timing, asking if it would be possible to fund this over two years. That may not be desirable, but possible. He also asked when results will be available for use, hoping data would be available before the final report in 2026. Karen said they plan to do data releases as soon as they've been QA/QC'd. Jessie said data will be available, but the most useful information will be in the comparison with older datasets. They won't re-publish old datasets, but someone could find and use them as they're publicly available.

Luisa Valiela asked about the number of sites and if it costs the same to study each site? Karen said they can do a budget division by site, some do cost more than others. Lester suggested additional selection criteria using Bruce Jaffe's bathymetric change map. Luisa asked if Julie's talk on sediment placement influences selection criteria around that area? Jessie noted this is a completely different type of monitoring, at a decadal scale, so it won't impact site selection.

Jay Davis asked how this meshes with plans for WRMP. Christina Toms said most of these sites overlap with priority sites identified by the WRMP. The main exceptions are Outer Muzzi and Faber/Laumeister (which are considered "secondary priority" by the WRMP). Bahia, Carl's Marsh, Tubbs Setback, and Tolay are in a bit of a WRMP gray area; they're not technically in the priority Gallinas/Novato networks but could be considered within a "west San Pablo Bay crescent" that incorporates those networks and the most bayward portions of the Petaluma and western Napa-Sonoma networks. The main question is whether or not they fall under priority

sites for monitoring. Some do not fall under priority because there aren't any near-term restoration plans. Karen noted those details are included in the scope of work in the agenda package. Karen confirmed that if funded, they will meet with the WRMP for thoughts and suggestions.

Dave asked if the study will include determining the timing of colonization/evolution/succession of plant species at the site. This could affect accretion rates with time. A vegetation survey would only tell what the present vegetation is now. Karen said that she plans to use historical imagery to identify plant colonization. She will use Google Earth Engine to evaluate NDVI and hopefully species from imagery. Christina added that interpretation of older Carl's Marsh, Tolay/Tubbs, and Napa ponds imagery can likely be enhanced by the IRWM data, which were calibrated and maybe validated.

*Presentation 2*

Tan Zi presented a proposal on modeling future sediment load to Operational Landscape Units (OLUs)

The study design would use the existing Watershed Dynamic Model (WDM) to predict sediment load to OLUs. The focus is on the first two pathways of the sediment conceptual model, uplands to tributaries, and tributaries to marshes, mudflats, and erodible sediment pools. Key knowledge gaps addressed by this study are the effects of shifting rainfall patterns and land use/land cover changes on watershed flow-sediment load relationships and the proportion of tributary sediment verses sediment from the erodible sediment pool that deposits onto mudflats and marshes and the drivers determining location and timescale.

The motivation for this study is to understand the sediment flux from tributaries to tidal wetlands, understand the changes in flux under varying future conditions, and provide boundary conditions for the in-Bay sediment model.

This effort will address Sediment WG MQs 3 and 4, particularly how watershed load to the Bay will change in relation to changing climate, vegetation cover and land use, as well as quantifying local sediment supply relevant to marsh accretion. It will also address management questions of BCDC and WRMP.

The general approach is to use existing WDM to provide sediment supply from tributaries and use downscaled climate change models (GCMs) output to drive the model and give estimates of future loading. This would use five different GCMs from California's fifth climate change assessment to get an ensemble result of predictions.

The approach is in 3 steps: climate data collection and analysis, setting the WDM for two OLUs over two time periods and two future scenarios, and finally a sensitivity analysis of sediment loads in relation to land use and vegetation cover.

They will focus on two of the 30 OLUs in the Bay: Napa-Sonoma and Alameda. Both are large sediment contributors to the Bay. Alameda is a calibration watershed for the WDM and has strong data support with the longest sediment monitoring record. Napa-Sonoma is the largest local sediment supply to the Bay, and has lots of old historical data that will be used to generate rating curves. A future rating curve will be developed and compared to this historical rating curve.

For each OLU there will be 20 model settings that account for five GCMs in four future conditions: mid-century medium and high and end-century medium and high. Mid-century predicts conditions for 2040-2059, and end-century predicts 2070-2099.

Land cover and vegetation change is not covered in the model, so they want to do a sensitivity analysis to have a comparison of sediment load due to both land cover change and climate change.

Outcomes will be estimates of sediment flux from tributaries to the two OLUs for three sediment size classes, projected changes of fluxes in response to climate change, projected changes of the rating curves for Napa River and Sonoma Creek, and sensitivities of land cover relevant parameters.

This will be a one year study. There will be a WG presentation in spring 2024 and a report ready in winter 2025.

Pat Wiberg began the discussion and asked what time scale they are trying to resolve, for example multi-year trends or changes in extreme events. Tan said the mid-century and late-century time scale can provide average annual change, and by addressing the rating curves the model can also provide projections of extreme events in the future.

Dave Schoellhamer recapped his understanding of the WDM summarizing that within the OLU it uses land cover and slope to determine infiltration and runoff into streams and uses sediment routing to quantify total loading of sediment to the stream and down to the baylands. It's dynamic, not just based on rating curves. Because it considers land cover, slope, precipitation, infiltration, and runoff, it can predict future rating curves. Tan said yes, it has upland erosion related to land cover, and sediment routing in streams. The reason they proposed to address the rating curve is because only one year of data is available for Napa-Sonoma in 2018. Historical data is from 1950-1970. The model can provide concentration and discharge for comparison with historical data.

Tom Mumley expressed extreme reservation for this project. The existing sediment WDM is a start and it's a stretch to say it's calibrated. There is a lot of uncertainty and these watersheds are undergoing significant changes, for instance hydromodification for vineyard management. There is interest in the future, but we need to understand the present. It might not make a difference in the short term to compare future predictions to uncertain simulations of the present. Tom would prefer to emphasize improvements on the ability to model loading from the watersheds in the short term in conjunction with better understanding of the sediment pool in the OLUs.

Tan said it is a good point that we must consider current uncertainties while adding other uncertainty in the future. The Napa and Sonoma calibration in the model had one year of data. They compared average annual loadings to TMDL studies and got a comparable amount. Studies of the future will get at trends and how large change will be in the future. When they try to separate the drivers in this study, they can see what will be the possible change due to climate or land cover, and that will provide insight into how to consider management actions like hydromodification.

Lester McKee noted that requests for funding to monitor sediment further have not been funded. There isn't much opportunity to improve the calibration and verification of the model. The

modeling team will consistently make improvements, but they won't be monumental. Waiting a year or two won't see a vastly improved model. As we use the tool for answering broader questions we'll learn more about its strengths and weaknesses and be able to prioritize improvements of parameterization or calibration. $80k is a small price tag and we are now using the model to answer management questions. Around $300k was used to develop the model. This is an example of how we've invested in this model and here is a question we can use it to answer. Also, in building the Bay model to predict sediment supply to marshes and mudflats, Tan's team will have to provide boundary conditions. It's a coupling of a broader process. This is an element that we'll want to do next year or the year after so it's a question of when, rather than if.

Julie Beagle added that we have to think about multiple time scales and time periods to push forward. These are good watersheds to do that. She asked if there are other watersheds that could be expanded to that don't have existing data. Tan said similar to Karen and Jessie's site selection, they want feedback from the group on which OLUs would be most important. The modeling part is flexible because the local tributaries are modeled.

Dave had a minor comment that task five says products include a local science talk and a peer-reviewed article, but the deliverables section does not. He asked if they should be added to deliverables? Tan said a deliverable will be a technical report for the group, and they hope to have it ready to be published.

*Presentation 3*

Lilia Mourier presented a proposal on year three of continuous SSC monitoring in South and Lower South San Francisco Bay.

Motivations are to capture continuous SSC measurements for sediment model validation, characterizing background conditions for pointed empirical studies, and characterizing light attenuation conditions for biogeochemical studies.

There is one USGS monitoring station at Dumbarton Bridge and seven SFEI-NMS moored stations monitoring turbidity (without turbidity-to-SSC calibration) and four stations with monthly SSC sampling. These are located in channels, shoals, and sloughs.

The project will expand the SSC time series data at eight stations, curation of resulting SSC time series and data sharing for RMP related applications, and a short report detailing site-specific turbidity-to-SSC calibrations. The study will help answer Sediment WG MQs 4 and 5.

Lilia summarized progress made in the last two years. In year one a new moored turbidity station was deployed in Eden Landing. She noted that the station was lost for two months due to a possible boat strike. They also installed a wave sensor and conducted monthly servicing trips to collect SSC samples at four stations. The samples were analyzed for percent sand and fines. Data collected was used in ongoing SSC-turbidity relationship development.

In year two, there was further effort in developing calibrations and it took time to get results back from SSC samples. SSC-turbidity calibration effort is underway using a Linear Mixed Effects Model for EXO turbidity sensor stations and linear regression for the PME C7 turbidity sensor station in Eden Landing. Initial results have been developed. To date, 27 SSC samples have

been collected, but USGS protocols suggest using a minimum of 30-34 samples for calibration, and so funding is needed to continue data gathering in 2024.

Lilia presented three proposed tiers of work. Tier one is geared towards data gathering and calibration. Seven more months of gathering will get to 34 total calibration points and calibration could be completed. This lower budget tier would not include any in-depth analysis.

Tier two would include all tier one tasks, and would fund a dedicated field task to target peak turbidity/SSC at project sites in four targeted trips. High turbidity samples have a big effect on calibration based on how the linear mixed model works, but they are not being captured in the current monitoring work.

Tier three would allow comparison of multiple model types and investigation of spatial and temporal patterns in the data. This tier would fund more comprehensive reporting, synthesis, and interpretation of the data.

Regardless of which tier is funded, the timeline is the same. Deliverables will change depending on the tier funded. Data and reports will become available in summer and fall of 2024.

Pat Wiberg began the discussion and remarked that this seems worthwhile primarily if the tier two idea to target high turbidity for calibration is included. The statistical method doesn't matter if only the lower turbidity range is captured. High turbidity events may be what controls marsh deposition. Capturing high turbidity is the most important factor. She also asked how the wave data are being used. Lilia said they would like to incorporate wave data into the synthesis, but there hasn't been funding available. Tier three could fund that. Currently there is only one wave sensor and it's providing a separate dataset to be used when possible.

Dave Schoellhamer disagreed with Pat about tier two. Periods of high SSC are likely to be during wavy conditions during low tides, when it is very difficult to go out to collect data. The samples are precious, but difficult to collect safely or at all. Perhaps there are ways to do it with auto samplers, but there's a challenge for them to sample at the right time.

Dave also noted that it seems this effort should be funded from the status and trends funding pool rather than as a special study. He asked if this is the last year of funding this project. Lilia said that based on calibration, a minimum of seven more months of collection is needed. It is up to the group to continue data collection beyond that. In July the plan is to pull the Eden Landing sensor and end discrete SSC monitoring. Turbidity would still be monitored at the rest of the stations. Calibrations for sites would be established, so in the future ongoing monitoring could be a minimal effort, but funding would need to be discussed in conjunction with the NMS.

Dave asked whether SSC data would be available online as a public resource. Lilia said they haven't built in a shiny app to share data. Right now it would be available upon request. They would like more brainstorming on permanent publication. Ariella Chelsky added that there are no resources to make data publicly available. This proposed budget considers the QA/QC effort needed for calibration. Dave asked if the NMS data are available online. Ari said that NMS data are available upon request, not online yet.

Jessie Lacy asked where in the water column turbidity is being monitored. Lilia said at the shoal and slough sites, 0.45 m above bottom (shallow), at San Mateo bridge it's deeper and USGS has other EXOs there. Jessie said a good effort would be to work toward a standard operating

procedure for monitoring in the shallows so everyone is measuring at similar elevations above the bed and in similar water depths. Lilia said they are happy to share SFEI's internal SOPs.

Tom Mumley heeded Dave's point about status and trends funding. It exists to date because the RMP historically funded USGS sediment monitoring work using the Army Corps contribution to the RMP. This project augments and expands SSC monitoring as a special study. The RMP should be thinking long term about what ongoing monitoring is needed and at what cost. It is a valid suggestion from Dave, and he will put it on the RMP to-do list. Melissa Foley added that the RMP has for the last 4-6 yrs contributed $250k to maintain these moored sensors. She posed a question to the group about whether data collection at these sites should be continued or other data collection explored.

Brenda Goeden asked if these data could be added to the WRMP database. Tom said these are public resources so data must be made available. It may be a stretch for the WRMP to take on. Christina Toms said they are developing a monitoring plan and may have a platform that could incorporate these data. This project is well off shore of the marshes, but they are important data.

*Presentation 4*

Tom Mumley presented an idea for a Supplemental Environmental Project. He proposed to advance the conceptual model. He could envision writing a modular plan to advance the model. For instance, a logical next step would be to develop conceptual models for the major subembayments. If the group deems it valuable, it could be put on the candidate list for SEP projects. It won't be competing for 2024 special study funds.

Luisa Valiela asked Tom to clarify if it would be improving the Bay conceptual model or improving the conceptual model at the subembayment level. Tom said it could be both, but at least the subembayment. It can be scoped however the group wants.

Julie Beagle  asked if it could incorporate sand into the model. She expressed support for the proposal. The contract for the current project is almost over. Tom said we got a lot out of the first round, but we want more.

Jessie Lacy wondered if it makes sense to do this immediately, or allow knowledge to accumulate for a few years and integrate that. She asked Tom to clarify that there were things not addressed in the current effort that could have been. She asked if it could be a permanent commitment to update every five years. Tom said yes, but there is a lot more that could be done now. It could address the most critical unknowns. It would be in addition to, not in competition with, existing knowledge and dovetail with the current workplan.

Letitia Grenier noted that for influencing management, we aren't getting enough traction on helping decision makers decide what to do with sediment. There needs to be more specificity. She expressed support for workshops with Jessie and others to translate knowledge being built now to the management level.

Jessie noted that the group should discuss more about what is meant by conceptual model. Letitia's comments were great, but not what she had thought of as included in a conceptual model. She would be excited to participate in outreach like that.

Jay Davis said there is an argument for doing this now. Work on numerical models for in-Bay dynamics should be in alignment with conceptual models that can lay out the details now.

## 7. CLOSED SESSION Decision: Ranking of 2024 Special Studies Proposal

Those involved with the proposed special studies left the room while the rest of the WG prioritized projects. Scott Bodensteiner abstained from the closed session as a member of the Bay Planning Committee with interest and more technical understanding of MQs 1 and 2.

## 8. Report Out of Proposal Idea Ranking and Recommendations to Principal Investigators

Luisa Valiela reported the results of the closed session to the entire WG. These recommendations will go to the Technical Review Committee for prioritization of all projects across workgroups, then to the Steering Committee for final funding decisions. Decisions tried to stretch money as far as possible, though it is likely that not all proposals will receive funding.

The Sediment Workgroup's proposal moving forward is to allocate $130k to the number one-ranked proposed special study from Jessie Lacy and Karen Thorne on spatial variability of sediment accretion in San Francisco Bay restorations. The group would like to fully fund them, so proposes funding the remaining $75k in the following year. The WG would like to adjust the SSC proposal to fully fund the tier one proposal and add the synthesis report from tier three and fund that at $80-85k. The WG would like to fund the tier two effort of high turbidity sampling, but explore other methods to do so in the future, likely with automated samplers. For the sediment modeling, the WG stakeholders are in strong support of this project idea but want to work out a viable next version of funding for the work. Many managers reflected that they are using this model. There is a need for improvement and there just weren't enough funds for this year. After discussions a new proposal can be built for next year.

Melissa Foley asked Karen Thorne if the adjusted budget over two years would work. Karen said that year one would be project planning and data collection, and year two would be primarily analyzing and reporting out, so those numbers look correct. She thanked the group for the opportunity.

Melissa also asked Lillia if the adjustments are possible. Lillia said yes, and asked for clarification following the meeting on what the WG wants out of tier 3.

Tan Zi could not attend this portion of the meeting, but has scheduled meetings to discuss the proposal and modeling efforts further with Tom Mumley and others.

Jay Davis asked that proposals be revised to reflect the WG's ideas and sent to this group for confirmation in the following two weeks.