Appendix H – STAC Comment Letters

As part of the ISP's commitment to transparency, STAC members were provided an opportunity to submit final comments on this report in the form of letters to the BCDC Commissioners. Comment letters received by the date set for inclusion in this appendix are included here. It is anticipated that future comment letters may be submitted to BCDC's Commission for consideration.

Documents in this Appendix include comment letters from:

- California Coastal Commission
- Martin Marietta and Lind Marine

CALIFORNIA COASTAL COMMISSION
455 MARKET STREET, SUITE 300
SAN FRANCISCO, CA 94105-2219
VOICE (415) 904-5200

May 31, 2024

To: Chair Wasserman and Commissioners of the San Francisco Bay Conservation and Development Commission

From: Jeremy Smith, P.E., Coastal Engineer

Re: San Francisco Bay Sand Mining Studies

Thank you for the opportunity to participate on the Sand Studies Technical Advisory Committee (STAC) and comment on the final report for the San Francisco Bay Sand Mining Studies. I want to commend the staff at our sister agencies at the San Francisco Bay Conservation and Development Commission (BCDC) and the State Coastal Conservancy (SCC) for embarking on an effort to inform coastal management decisions with sound science and a transparent process guided by key stakeholders. The effort is exemplary of the State's use of science-informed coastal resource management.

For context, the California Coastal Commission is responsible for implementing the California Coastal Act and its jurisdiction includes Ocean Beach in San Francisco, immediately adjacent to the Golden Gate and part of the San Francisco Littoral Cell which extends into the Golden Gate and BCDC's jurisdiction. Sand (and its natural movement) is a protected coastal resource under the Coastal Act and the Coastal Commission has historically had significant concerns about sand mining in the California Coastal Zone and its effects on natural sand supply and marine resources.[1]

Furthermore, in recent years the Coastal Commission has been working with local governments and partner state and federal agencies to address the rapid loss of California's valuable sandy beaches, a trend which will be exacerbated by future sea level rise. One important tool to address this challenge is beach nourishment, where sand is imported or redistributed within a littoral system to restore beaches, particularly in areas where coastal processes and natural sand inputs have been altered such as by the armoring of bluffs, trapping of sand by shoreline structures or damming of coastal watersheds. There is a limited amount of beach-quality sand that can be feasibly dredged in offshore waters either due to local geology or depth-limitations of dredging technology. For example, the sands in the Central Bay have been identified as a potential backup source of sand for beach nourishment and dune creation for San Francisco's South Ocean Beach Climate Adaptation project, which may not be able to meet its sand needs from existing sand sources alone.

[1] See, for example, the Coastal Commission's Consent Settlement Agreement and Cease and Desist Order regarding RMC Pacific materials, LCC d/b/a CEMEX in 2017: th22-7-2017-report.pdf (ca.gov)

The Independent Science Panel's (ISP) Findings report titled *San Francisco Bay Sand Budget, Transport, Provenance, and Bathymetric Change Studies and Potential Physical Effects of Sand Mining Activities* summarizes the findings of the various research efforts conducted to inform the ISP's conclusions regarding a set of management questions crafted by the STAC. Of particular interest to Coastal Commission staff are the questions, and the ISP's findings, related to the potential impacts of sand mining in the San Francisco Bay on sand supply to the beaches of the open coast.

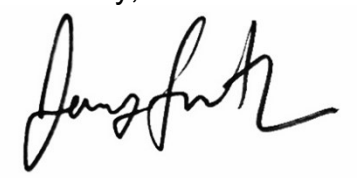
In the report, the mining areas in the Central Bay are described as part of a larger system in which sand is transported in and out of the bay by currents and waves. This larger system includes the important recreational sandy beaches on the outer coast like Ocean Beach. The ISP's findings indicated that the studies did not consider beaches specifically and that the studies did not determine to what extent the transport pathways linked mining areas to outer coast beaches. While this is unfortunate, because the question of how sand mining impacts beach sand supply is an important one for the sustainable management of coastal resources, the ISP gave a variety of recommendations on key information gaps and areas for further investigation.

Recommendations for future studies, monitoring, and data analysis in Section 4 of the ISP's report include specific ideas for how to improve understanding of the potential for sand mining in the Central Bay to impact coastal beaches, including conducting a scale-cascade analysis of the Central Bay and conducting a fifth-order micro-scale analysis to determine the pathways of sand and the mining influences on those pathways. One key information gap of particular concern for me is the sand transport pathways not included in these studies, identified as wave-induced and density-driven sand transport, but which is not well defined in the Bay. Improved identification and regular monitoring of the Bay's sandy beaches would provide valuable data to improve the understanding of sand transport in the San Francisco Bay in addition to supporting our agencies' shared goals around protecting public access and environmental stewardship of coastal resources. In your consideration of sand mining operations in the Central Bay, I encourage consideration of how we can improve the understanding of sand mining's effects on the State's sandy beaches.

Furthermore, I encourage consideration of the value of the beach-quality sands that have historically been extracted from State waters to the San Francisco Bay Area's regional adaption needs in the face of sea level rise which, particularly on the outer coast, will include beach nourishment and the use of sand in nature-based adaptation strategies.

Thank you again for the opportunity to participate and comment on the SF Bay Sand Mining Studies.

Sincerely,



Jeremy Smith, P.E.

May 31, 2024

San Francisco Bay Conservation and
Development Commission
375 Beale Street, Suite 510
San Francisco, California 94105

Re: Permittee Comments on *San Francisco Bay Sand Budget, Transport, Provenance, and Bathymetric Change Studies and Potential Physical Effects of Sand Mining Activities Report*

Dear Chair and Members of the Commission:

Thank you for this opportunity to review and provide comments on the final summary report prepared by Stantec Consulting Services Inc. for the Sand Studies Technical Advisory Committee and Independent Science Panel, entitled *San Francisco Bay Sand Budget, Transport, Provenance, and Bathymetric Change Studies and Potential Physical Effects of Sand Mining Activities* (May 17, 2024).[1] We appreciate the hard work of the individual research teams, Independent Science Panel (ISP), San Francisco Bay Conservation and Development Commission (BCDC) staff, California State Coastal Conservancy (SCC) staff, and Sand Studies Technical Advisory Committee (STAC) members to help determine the state of knowledge regarding sediment transport and supplies within San Francisco Bay, and to specifically develop the studies and this report.

While we have been involved throughout the process and provided suggestions and recommendations, several of our comments and issues remain outstanding. It is important to highlight that these sand science studies comprise one of several efforts required under previous permitting processes and intended to expand the body of knowledge about sand mining. These sand studies, together with studies investigating potential impacts to the benthic community and water quality, also build upon studies previously relied on by the State Lands Commission (SLC), BCDC and other agencies in permitting mining operations in the prior decade.

The ISP's efforts to clarify and synthesize the sand science studies are laudable, inconsistencies among the individual sand studies, ISP discussions, and ISP Summary Report remain. The Report and its underlying studies, while certainly increasing the overall knowledge base, lack key information and context necessary to fully evaluate sand mining and should avoid speculating about uncertain or unquantified effects. Four of our key areas of concern are as follows.

1) Limited "sand budget" analysis: The "sand budget" analysis presented in the ISP Summary Report and its underlying studies are limited in three key ways:

    a) The "sand budget" conceptual model cannot capture the ultimate significance of sand mining activities in the Central and Suisun Bays because the amount of relic sand (banked

[1] This letter has been prepared with technical assistance from GHD Inc and Barry Keller, PhD PG CHG, Hydrogeophysicist.

sand not in active transport) stored in the Bays (which comprises most mined sand) is largely unquantified.

b) There remains significant uncertainty as to the direction of net sand flux at the Golden Gate —including whether the overall flux is positive or negative (into or out of the Bay). The Report should disclose that resolving this uncertainty could drastically alter the Report's conclusions with respect to the Bay's "sand budget."

c) The "sand budget" analysis appears to double-count outflows caused by mining and dredging activities as both bathymetric change volumes and sand outflows (including sand removed from the system by mining and dredging), potentially resulting in dramatic overestimates of sand outflows from the Bay and necessitating more rigorous review and deliberation by the research teams.

2) Impacts beyond the lease areas are speculative: The Report confirms that sand mining impacts outside the active lease area are extremely difficult to quantify or assess. The Report moves beyond the science and errs when it speculates about theoretical impacts to resources outside the lease areas (including beaches) in the absence of such data. For example, the sand budget study's author acknowledges that the Golden Gate Bridge flux direction remains highly uncertain. Given this and other uncertainties, the studies are unable to draw any conclusions about sand mining's impact on the outer coast. Accordingly, ISP members at the 2023 ISP meetings readily acknowledged that (i) there is no evidence or expectation that sand mining would impact in-Bay beaches, and (ii) the STAC studies of in-Bay effects do not point to any conclusions about long-term effects related to coastal beaches.

3) Failure to address prior research: The ISP Summary Report omits any acknowledgment or reference to the previous body of work that informed the SLC's prior environmental review, leasing decisions, or BCDC's 2015 permitting decisions. The sand studies referenced in the Report, together with this prior research and environmental review, each indicate that quantifiable effects of sand mining are mainly isolated and localized within the lease areas. While the Report identifies potential effects beyond the lease areas, it acknowledges that effects beyond the lease areas "may be sufficiently diffuse to be negligible in any one location." . It is important to note that measurable, demonstrable, and significant impacts outside active mining areas were not observed or determined by the studies.

4) Missing critical context: While this effort focused on the "sand budget," context is critical. Sand plays a critical role in local construction and infrastructure projects. As we move forward with the BCDC working group process, it will be important to address impacts if sand for essential construction projects in and around the Bay must come from other sources, farther away. Generating sand locally avoids potential impacts to the Bay and its environs, and provides material for essential public infrastructure and commercial projects in the Bay Area.

Our subsequent comments go into further detail about these key comments and other aspects of the studies and ISP Summary Report. We would welcome the opportunity to resolve these concerns and further reconcile these and earlier study efforts at the convenience of the ISP and STAC members.

SUMMARY OF COMMENTS

Sand Budget

The ISP Summary Report and its underlying studies use the conceptual model of a sand "budget"—an accounting method that is intended to measure the overall balance between changes in sand volumes stored in a system versus volumes entering or leaving the system (e.g., sources and losses).

The Report's conclusion regarding sand mining's potential impact on the "sand budget," however, fails to account for or describe the total sand stored within the Central Bay and Suisun Bay lease areas. Without this data, the Report's sand budget analysis only assesses the 'significance' of sand mining relative to *active* sand transport and the conceptual sand budget model used for purposes of the Report. Since sand mining removes mostly relic sand stored in the Bay, the Report lacks the information needed to make any conclusions regarding sand mining's impact on the overall sand budget. The Report admits to this deficiency, stating that the size of the "the pool of relic sand," and therefore any "significance of [the] reduction" in relic sand caused by sand mining, "is unknown." (Section 3.2.2.)

The absence of this data precludes any significance assessment with respect to sand mining activities because, as the Report acknowledges, "the majority of mined sands in Suisun Bay and Central Bay are relic." (ISP Summary Report, pp. 3-4.) The Report should make clear that any conclusion as to sand mining's significance to the sand budget model is a conceptual comparison and that the Report does not assess whether any amount of sand mining would be significant relative to the total amount of sand in Central and Suisun Bays.

Moreover, the Report's sand budget analysis attributes outflows caused by human disturbances associated with mining and dredging activities in both the bathymetric change volumes and separately as sand outflows, effectively double-counting the effects of sand mining and dredging. This conflicts with the USGS report and methodology discussed in the 9th Quarterly Research Meeting in which human disturbance areas were specifically excluded from their bathymetric change volumes because such outflows are accounted for separately in the sand budget. By double-counting the effects of sand mining, the Report's overall sand budget analysis could significantly overestimate sand outflows from the Bay. See comments on the Sand Budget Study (below) for more details regarding this concern.

Inconsistent Focus on Unquantified Effects

The ISP Summary Report discloses that many potential impacts are unquantified, uncertain, and that there is not enough information to discern effects specifically caused by or related to sand mining activities. The Report nevertheless treats these unknown effects differently—spotlighting some and omitting others. For example:

- The Report's Key Observations do not disclose that the studies did not identify any feasible alternatives to sand mining in the Bay, as is acknowledged much later in the Report. (See ISP Summary Report, p. 3-6.) The Report fails to acknowledge the possibility that other, unstudied, or more intense impacts could result from situating sand mining activities at other locations in and

around the Bay. The lack of feasible alternatives to sand mining and possibility of other environmental impacts is crucial context for the Report's conclusions because sand mining is a critical activity that provides sand for essential uses throughout the Bay Area.

- *"These sands are used to supply the Bay Area construction industry, as a component of concrete asphalt, roads, bridges, and buildings, and as general fill, backfill for utility trenches, or for other construction purposes. Mined sand and gravel have been occasionally used in local beach enhancement projects."* (ISP Summary Report, pp. 1-1 & -2.)

- The Report repeatedly raises the possibility that sand mining could affect nearby beaches—even though the Report acknowledges that whether any such impacts could actually occur is uncertain or unknown:

  - *"Sands derived from the watersheds of the Sacramento and San Joaquin Rivers are no longer a significant source to the Bay and ocean, and large volumes of sand do not move through the system during times of high flows (e.g., wet winters), as was previously assumed. Effects of mining to beaches and ecologically important shoals remain unquantified."* (ISP Summary Report, p. iv.)

  - "*The unquantified bi-directional exchange of sand between the Bay and Pacific Ocean; the source and trajectory of sand supplies to Bay beaches and shallow environments; contributions of wave-induced and density-driven sand transport to the overall budget; and the uncharacterized variation of sand transport due to grain size differences are all key information gaps."* (ISP Summary Report, p. iv.)

  - *"However, beaches were not included in the study and the studies did not determine to what extent the transport pathways linked mining areas to beaches."* (ISP Summary Report, pp. 3-1 & -2.)

  - *"While this removal of sand could have effects beyond the Bay (i.e., outer coast), this potential impact is not resolved by these sand studies owing to the dynamic nature of processes coupling in-Bay and out-of-Bay sand reservoirs, the likelihood of parallel fluctuations in sand transport along the open coast, and the potential for multi-decadal time lag before effects are reliably observed."* (ISP Summary Report, p. 3-3.)

  - "*Sand mining may have an impact on the volume or characteristics of sand supplied to beaches; however, there is not enough information to assess the effect."* (ISP Summary Report, p. 3-4.)

- And while the Report is quick to speculate that sand mining "may" affect the volume or characteristics of sand supplied to beaches, this information appears to be inconsistent with the ISP's deliberations. For example, at the October 13, 2023 meeting, ISP members stated that:

  - There is no evidence that In-Bay beaches would be impacted, and no expectation that they would be—mining is not occurring in shoals in front of beaches; and

- Studies of In-bay effects did not point to any conclusions about long-term effects related to coastal beaches.

In sum, the ISP Summary Report and its underlying studies, while certainly increase the overall knowledge base, lack key information necessary to fully evaluate sand mining and should avoid speculating about uncertain or unquantified effects.

Management Questions

The overarching goal of this effort was to evaluate distinct Sand Mining Management Questions. While the ISP Summary Report provides responses to these questions, it states that full responses to these questions are included in Appendix E. However, this direction to review Appendix E for full responses to the Sand Mining Management Questions is not an appropriate designation. Appendix E includes ISP meeting summaries for use in development of the Summary Report and should not be interpreted as full responses to the management questions. Appendix E is formatted as meeting minutes rather than a synthesized and coherent full response to the applicable Management Question. We would caution readers of the document to use Appendix E only as a record of the ISP's thoughts and considerations related to the Sand Mining Management Questions.

Based on our review of the sand studies and ISP discussions, we believe the Report's response to the first and second Sand Mining Management Questions require some additional commentary. We have commentary or alternative responses below.

Is sand mining at existing lease areas, at permitted levels, having a measurable or demonstrable impact on sediment transport and supply within San Francisco Bay?

Sand mining at existing lease areas has had a measurable impact on the bathymetry and storage of sand within particular lease areas. This conclusion is not new, as prior bathymetry studies and evaluations have identified and even quantified the amount of sand removed from particular lease areas during historical mining events. However, as referenced above, the fact that mining might remove certain volumes of sand from a particular lease area does not mean that mining is having a significant or adverse effect within the lease area, particularly if substantial volumes of sand remain in storage. Likewise, the fact that mining might remove a measurable volume of sand from a particular lease area does not mean that mining is having any demonstrable impact beyond the lease areas. Indeed, the fact that the Report and prior studies have failed to identify measurable, demonstrable, and significant impacts on sediment transport and supply beyond the discrete lease areas is itself evidence that mining during a 10-year period will not have a measurable or demonstrative impact on sediment transport or supply beyond the lease areas—a key conclusion emanating from the prior modeling conducted by Coast & Harbor Engineering and the State Lands Commission's 2012 Environmental Impact Report (EIR). And again, ISP members at the 2023 ISP meetings readily acknowledged that (i) there is no evidence or expectation that sand mining would impact in-Bay beaches, and (ii) the STAC studies of in-Bay effects do not point to any conclusions about long-term effects related to coastal beaches. Thus, comments in the ISP Summary Report suggesting that sand mining

"may" have an impact on the volume or characteristics of sand supplies to beaches are unfounded.

What are the anticipated physical effects of sand mining at permitted levels on sand transport and supply within San Francisco Bay and the Outer Coast?

The anticipated effects of mining on sand transport and supply depend on mining location. Consistent with prior studies, the ISP concluded that, generally, mining sand from areas that do not replenish (e.g., lease areas within Central and Suisun Bay) might limit the potential for far-reaching effects from sand mining, although it results in pronounced local effects. Conversely, mining from areas of high replenishment or at zones of convergence (e.g., lease area 709S) may have more dispersed effects. Due to low replenishment rates, mining in Suisun Bay does not appear to have a large effect on sand supply to Suisun Bay, San Pablo Bay, and the rest of the Bay. Recovery rates vary significantly for each lease area in the Central Bay. Lease areas 2036 and 779W exhibit limited recovery; whereas 709S exhibits near complete recovery (Deltares 2.3). High recovery rates can lead to a sediment sink that causes a sediment deficit elsewhere in the Bay or in supply to the outer coast. The underlying studies conclude that Central Bay mining removes sand at a rate that is higher than the rate replenished from adjacent subembayments (0.88 metric tons per year, SFEI 1.7) and larger than the estimated net sand flux at the Golden Gate. These conclusions involve substantial uncertainty. The Report interprets this data, if accurate, to mean that sand mining might reduce sand supply to nearby beaches and sand shoals if mining occurs within an active sand transport pathway linked to nearby beaches and shoals. No such pathway is identified.

In particular, the uncertainty of sand flux at the Golden Gate creates significant uncertainty throughout the sand budget model. For example, the studies' best estimate is a loss to the ocean of 0.25 Mt/y (the figure which is cited in the Report). The studies show, however, that this figure could range between a flux into the bay of 0.66 Mt/y or a flux out of the bay at 1.1 Mt/y. This range of uncertainty as to whether there is a positive or negative net sand flux at the Golden Gate has dramatic implications for identifying possible linkages between specific sand mining lease operations, observations of beaches, and the high variability of sediment dynamics. Moreover, these conflict with findings from other studies. For example, UT Austin research indicates San Pablo Bay and Central Bay are disconnected and comprised of sand from different sources. AnchorQEA modeling indicates the magnitude of sand transport from the South Bay was small relative to other subembayments. In light of this uncertainty and inconsistent data, definitive conclusions regarding the impact of sand mining in the Central Bay cannot be made.

Best Available Science

The ISP Summary Report purports to identify the best available science on physical sand systems in the Bay and western Delta, and the potential impacts of sand mining on that system, as represented by the conclusions of specified physical sand mining studies. While we appreciate this goal, the ISP Summary Report fails to adequately include already available, published, and reviewed scientific material referenced in the prior leasing and permitting processes. The ISP Summary Report provides a useful summary of the BCDC permitting process and STAC/ISP effort to help address some of the management

questions, however, it omits any acknowledgment or reference to the studies and analysis that initially informed the SLC's environmental review and leasing decisions and BCDC's own permitting decision.

As it stands, the report appears to leave the impression that this STAC/ISP process was the first to address the subject. We believe that preexisting study and analysis is in many ways consistent with or further informative of the issues still being grappled with today. For example, Section 3.1.2 of the ISP Summary Report indicates that "Lease area 709S is located on a flood-tide shoal where sand moving along the bed from the west and east converge, creating the shoal and resulting in rapid recovery from sand mining." However, this was the one area identified in prior permitting as possibly within the sediment transport pathway to the outer coast. As a result of this, the area has stricter limits on annual and overall mining volumes. Without an explanation of this and similar previously gathered data and resulting actions, the Report paints an incomplete picture of sand mining science and activities.

Additional relevant prior studies with key information seem to be missing from the included studies and ISP Summary Report. These include past efforts to describe the three dimensional characterization of sediment mineral resources[2], observations from prior cores that can inform insights on relic deposits in Central Bay[3], and past efforts to describe the connectivity between the Central Bay, San Francisco Bar, and open coast[4].

The process to develop the best available science hinges on the ISP synthesizing and interpreting the sand science studies. While some interaction between the researchers and ISP did occur during the study development, we are concerned that very little coordination or review actually occurred during the compilation of the ISP Summary Report between the ISP and researchers. While all research teams were given the opportunity to review a draft of ISP Summary, out of 19 researchers across three teams, it appears that only a single researcher reviewed the draft ISP summary and provided substantive comments. Full reviews from the researchers and teams is necessary to refine and further develop best available science.

COMMENTS ON ISP SUMMARY REPORT

Tidal Bay Conceptual Model

Several improvements have been made to the ISP Summary Report through its iterative versions. One key component was identifying a new conceptual model for sediment transport within San Francisco

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[2] Parsons, Tom, 2002, Crustal Structure of the Coastal and Marine San Francisco Bay Region, California: U.S. Geological Survey Professional Paper 1658, 145 pp., https://pubs.usgs.gov/pp/1658/ ; [ADEC] Airfield Development Engineering Consultant. 2000. San Francisco International Airport, Airfield Development Program, Preliminary Report No. 5 (Task I), Evaluation of Potential Borrow Sites. Four volumes

[3] Keller BR. 2009. Literature review of unconsolidated sediment in San Francisco Bay and nearby Pacific Ocean Coast. San Francisco Estuary and Watershed Science [Internet]. Available from: http://repositories.cdlib.org/jmie/sfews/vol7/iss1/art2/.

[4] SAIC 2008. San Francisco Marina, West Basin Sand Deposition Conceptual Model for San Francisco Department of Public Works.

Bay as a tidal bay that interchanges sediment with the outer coast. This conceptual model deserves greater detail and definition.

For example, when describing the interchange of sediment, the ISP Summary Report groups sand transport between the Bay and the Pacific Ocean, the Bay and seaward of the Golden Gate, and the Bay and outer coastal beaches, including pathways of sand between the San Francisco Bay, Golden Gate, SF Bar, outer coastal southern beach, outer coastal northern beaches, and sediment lost from active transport pathways (i.e., beyond depth of closure). In order to describe to causal relationships relating from one specific activity (i.e., sand mining at a particular lease area), the model needs to provide additional detail and nuance about how these various transportation pathways are linked together and impact each other (if at all). For example, the figure identified in the ISP Summary Report to explain this linkage and tidal bay conceptual model (Figure 14a of Malkowski et al. 2023), only shows a shared bidirectional sediment pathway between the Central Bay and the SF Bar. A unidirectional sediment pathway is shown from outer coastal beaches feeding into the Bay along Chrissy Field. Absent more detail about these transportation pathways, the Report's tidal bay conceptual model is too generalized to draw specific conclusions about impacts from sand mining at specific locations.

Moreover, the ISP Summary Report's description of this new tidal bay conceptual model fails to adequately define and include descriptions of processes on both sides of the Golden Gate. On the outside, in the open ocean, is the ebb-tidal delta known as the San Francisco Bar—a semi-circular sand bar shallow enough that large winter waves break on it—as has been the subject of numerous studies in the available scientific literature. On the inside, in the Central Bay, is the corresponding flood-tidal delta. Its morphology is not as obvious because of its irregular bedrock configuration. Both of these tidal deltas are active parts of the present-day sediment transport regime, although the quantitative transport of sand-sized sediment is difficult to measure. The San Francisco Offshore Bar area is further complicated by the fact that it overlies the San Andreas fault zone, including the probable epicentral location of the 1906 earthquake. These critical nuances are missing from the ISP Summary Report's tidal bay conceptual model, limiting its practical accuracy.

Lack of Clear Identification of Signal from Natural Variability or Uncertainty

The ISP Summary Report seems to include an overarching assumption that changes in the larger sand transport system can detect and distinguish changes caused by mining and changes resulting from natural variability or other causes. This general premise attempts to isolate a series of activities (e.g., mining) in an extremely dynamic environment—the Bay/Delta watershed, Pacific/Bay estuary, and open coast. While this is addressed in some places in the report (see excerpt from Section 3.1 below), it deserves a clearer acknowledgement so as not to overstate any potential causal relationships. The diversity of opinion on these matters is evidenced throughout the summary and supporting studies, which are not sufficiently described in the Summary Report.

- The Draft ISP Summary Report Section 3.1- Local Findings states specifically that: *"It is very difficult, however, to establish cause and effect between sand mining and bathymetric change trends due to other confounding factors and significant anthropogenic influences (such as historical hydraulic mining), and potential long-term effects that were not analyzed in these studies."*

- The Deltares Memo 1 identifies the challenge in distinguishing effects from natural variability: *"In both, Suisun Bay and West Central Bay a relative larger volume loss was observed between 2018 and 2019. These larger losses may therefore be related to natural causes, rather than a direct response to mining."*

- The SFEI Sand Budget further provides uncertainty in discerning specific effects from broader anthropogenic activities: *"Although the Bay-scale and subembayment scale sediment budgets describe the macro level influences of sand mining in relation to other time and space-averaged elements, at present it is difficult to determine from the sediment budget how these are influenced by mining or other anthropogenic activities"*

- This is further reiterated in ISP Meeting 1: *"There are other anthropogenic influences aside from sand mining that are contributing to bathymetric change trends, including hydraulic mining. For this reason, establishing cause and effect for sand mining specifically would be difficult."*

Unnecessary Overgeneralization

Section 3.1 of the Summary Report presents a hypothetical worst-case scenario consisting of impacts to local beaches that was not observed and not a finding of any study conducted by this process. In fact, the Deltares 2.3 study indicates:

> "*The statement that sediment removal in the Bay will lead to a reduced sediment supply to the coast assumes that the entire Bay-Delta is a connected system. However, this assumption may not be accurate. Sand mining can result in a negative sediment budget locally, but it could also lead to more accumulation of silt and mud in the area, instead of it flowing offshore. If this occurs, the overall sand balance of the surrounding region or coast may not be negatively affected*."

Before relying upon a hypothetical worst-case scenario to determine potential and theoretical impacts, the Report should acknowledge and discuss the studies' findings related to the disconnected nature of the Bay transport system. Additionally, natural variability and underlying assumptions in the 'all else equal besides mining' scenario should be disclosed. For example, in 2018 and 2019—a period of lower mining volumes—Suisun Bay and West Central Bay experienced a greater loss in sand volumes. This loss of sand volumes during a period of lower mining volumes signals that the loss was potentially influenced by natural causes, rather than any direct response to sand mining (Deltares 2.1).

Recommendations for Future Studies and Monitoring

The size of the relic sand deposits in storage and tidal bay conceptual model are not described in the Report's identified data gaps. This information would be particularly useful to help address management decisions. While sand mining is a term in the sediment budget, the relic sand deposit that is being mined is not quantified or included in the sediment budget. Additionally, the tidal bay conceptual model is introduced but not defined, its boundaries are not described, and it is not quantified. The size of these two are important when making comparative descriptions about the significance of sand mining on the sand budget.

The below sections transition from comments generally and on the ISP Summary Report to comments focused on providing comments on the individual sand science studies.

San Francisco Bay Sand Budget Report - SFEI

The Sand Budget Report was finalized after the ninth and final quarterly research team meeting (April 5, 2023) and included major revisions from the draft version presented at this meeting. As a consequence, the ISP/STAC have not had the opportunity to openly discuss or address questions related to the methods and assumptions that led to the updated findings. Below are the key concerns related to this study.

Outflows attributed to human disturbances associated with mining and dredging activities are accounted for in both the bathymetric change volumes and separately as sand outflows, effectively double-counting the effects of sand mining and dredging. This conflicts with the USGS report and methodology discussed in the 9th Quarterly Research Meeting in which human disturbance areas were specifically excluded from their bathymetric change volumes for each subembayment because they are accounted for separately in the sand budget.

The USGS study of net erosion/accretion in the Bay found that *"Sand loss in permitted lease mining areas, is about half the total sand loss of the entire study area from the 1980s to 2010s."* The USGS team excluded human disturbance areas (i.e., mining & dredging) from their bathymetric change analysis since mining and dredging were accounted for separately in the budget (See Quarterly Meeting #9, minute 1:16:30 and Figure 1 below). Bruce Jaffe (USGS) said, *"We decided that it would be <u>double-counting</u> if we included it both in the bathymetric change and in the mining."*

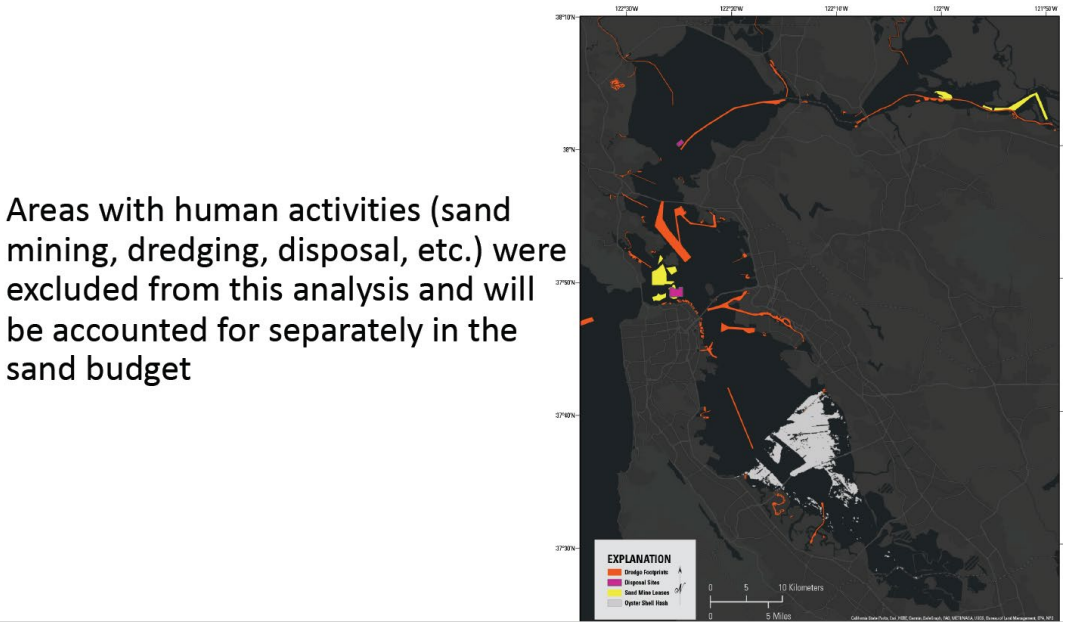

Figure 1 USGS Slide from 9th Quarterly Research Team Meeting - Human disturbed areas accounted for separately in the sand budget.

By contrast, the SFEI Sand Budget included human disturbed areas (i.e., mining & dredging) in their bathymetric volume calculations, and as separate outflows, effectively double-counting one of the largest terms of the sand budget. This error results in a significant overestimate of the net outflow of sand from the Bay, a conclusion which features prominently in the ISP Summary report. It was never explained why the SFEI team decided to include the mining and dredging in the bathymetric change volumes and separately as outflows. This factor has tremendous influence on the ultimate results and conclusions related to the Sand Budget. Thus, this accounting error must be corrected.

The Suisun Bay analysis illustrates the double-counting issue:

- All studies concluded that sand transport in Suisun Bay was negligible. There was very little bathymetric change observed in this area outside of the mined areas, as shown in Figure 2 below (adapted from Deltares 2.1 Report). However, the sand budget includes a bathymetric change volume (loss) of -0.39 Mt/y because the bathymetric change volume includes the mined area. Of the -0.39 Mt/y of bathymetric change, ~0.29 Mt/y is due to mining activities. This ~0.29 Mt/y is also accounted for a second time in the sand budget equation as sand outflow due to mining.

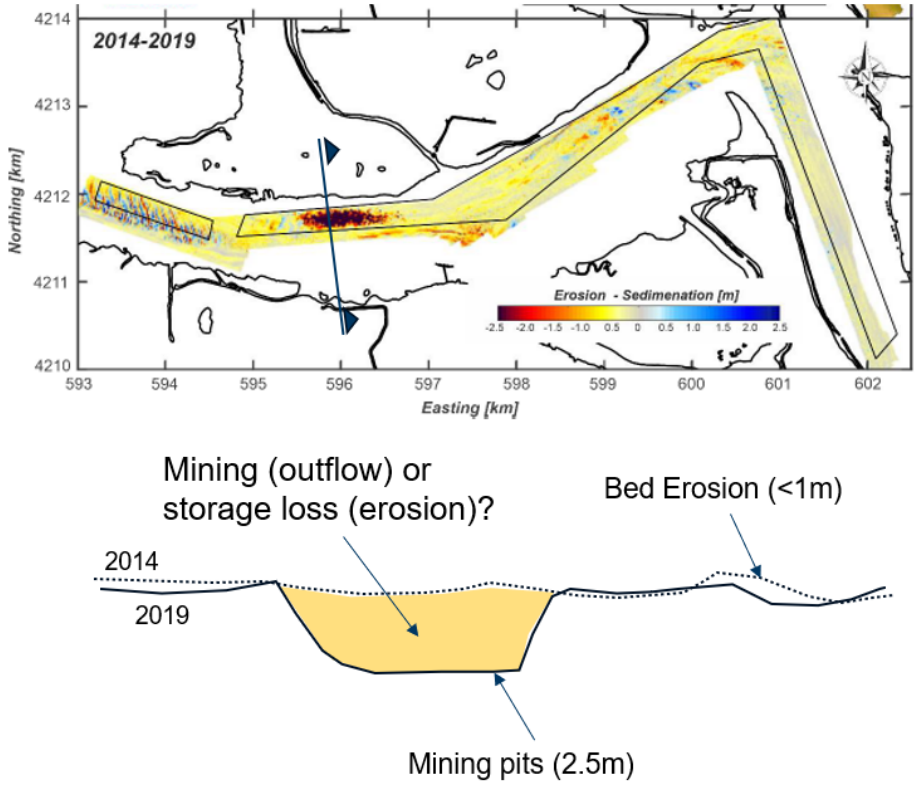

Figure 2 Bathymetric Change in Suisun Bay showing limited bed changes outside mined areas.

- If the bathymetric change rate excluded mined areas of Suisun Bay, consistent with methodology intended by the USGS researchers, this rate would instead be -0.20 Mt/y. The resulting sand flux to San Pablo Bay would then total -0.03 Mt/y, a much lower rate of sand supply and consistent with minimal observed bed changes described by Deltares. A mistakenly reduced supply of sand to San Pablo Bay results in a reduced supply of sand to Central Bay because the sand budget assumes all embayments are morphologically connected.

It is well understood that sand mining is a significant term in the overall sand budget for the Bay. If this parameter is also double-counted, then the overall sand budget results will change significantly. Figure 3 presents a revised sand budget for the overall Bay adjusted to account for mining and dredging separately from bathymetric change, as intended by the USGS researchers. The results indicate that overall flux through the Golden Gate results in a net source of sand for Central Bay. This finding would significantly alter several of the statements in the ISP Summary Report.

The conversion of bathymetric change volumes to mass from the SFEI 1.7 report are included in Figure 4. Highlights and annotations are added to illustrate how volume change affected by sand mining makes up a large part of the overall volume change in the survey area. The SFEI budget used the total mass change of the survey area (-1.33 Mt/y) in their sand budget, rather than excluding the mining and other disturbance areas because such activities were already accounted for separately as outflows from each subembayment. If volume changes affected by mining are removed, then the mass change rate becomes -0.7 Mt/y. Since the Golden Gate sand flux is calculated by difference, the results indicate the Pacific Ocean is the largest source of sand to the Bay. The following figure is provided to demonstrate precisely the shifts in inflows and outflows with the key assumptions corrected.

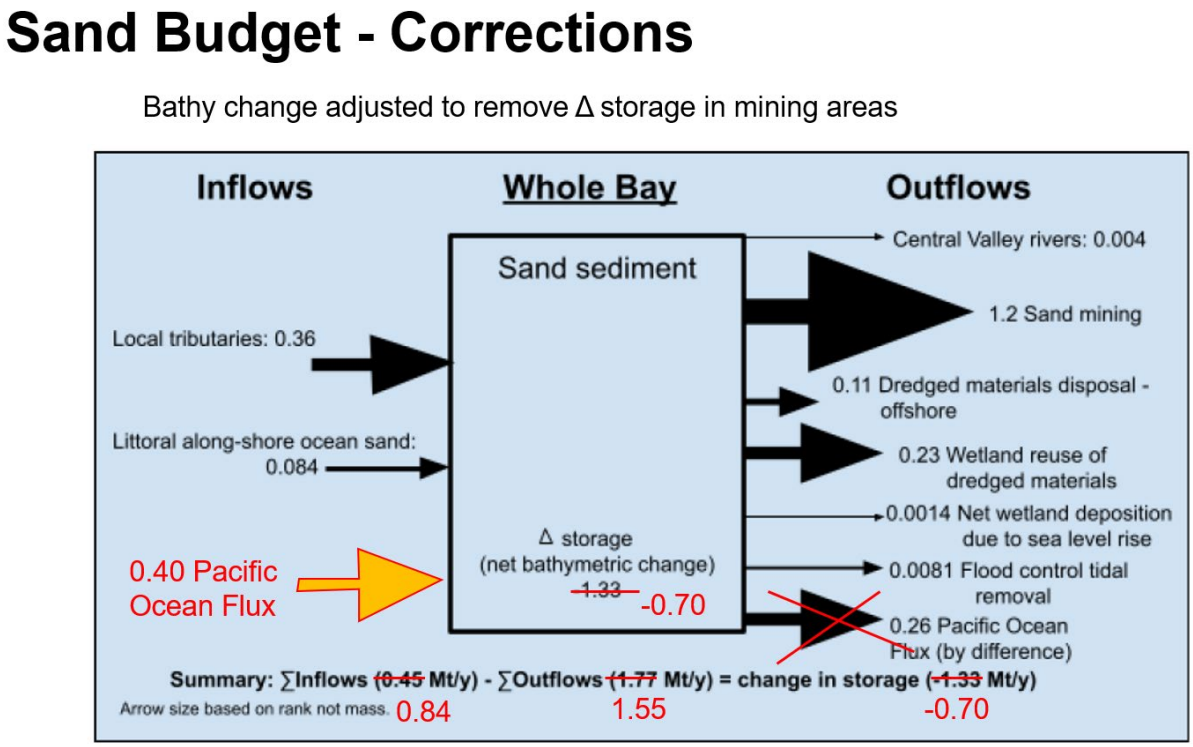

Figure 3 Revised Whole Bay Sand Budget – based on bathymetric change outside of mined areas.

Appendix 8. Conversion of bathymetric change volumes in to mass.

		Total Bay			Suisun Bay			San Pablo Bay			Central Bay			Upper South Bay			Lower South Bay		
	Units	Sand	Mud	Total	Sand	Mud	Total	Sand	Mud	Total	Sand	Mud	Total	Sand	Mud	Total	Sand	Mud	Total
Area surveyed	Km2			878			44			208			255			343			27
Total area of subembayment	Km2			1114			132			273			292			375			42
Area surveyed	%			79%			34%			76%			87%			91%			65%
Volume change excluding (mining, dredging, disposal, oyster shell)	Mm3 /y	-0.28			-0.11	-0.61	-0.72	-0.15	-0.17	-0.32	0.06	0.40	0.46	-0.11	-0.35	-0.46	0.03	0.38	0.41
Volume change affected by mining	Mm3 /y	-0.37			-0.11	0	-0.11				-0.26	0	-0.26	0	0		0	0	
Volume change affected by dredging	Mm3 /y	-0.14			-0.01	-0.07	-0.08	-0.06	-0.04	-0.10	-0.07	-0.16	-0.23	0	-0.01	-0.01	0	0	
Volume change affected by human disposal	Mm3 /y	0.03						0	0	0	0.03	0.15	0.18	0	0		0	0	
Volume change in oyster shell areas	Mm3 /y	-0.02												-0.02	-0.18	-0.20	0	0.01	0.01
Total volume change in survey area	Mm3 /y	-0.78			-0.23	-0.68	-0.91	-0.21	-0.21	-0.42	-0.24	0.39	0.15	-0.13	-0.54	-0.67	0.03	0.39	0.42
Mud volume change for non-human impacted areas	Mm3 /y	-			-	-0.61	-	-	-0.17	-	-	0.55	-	-	-0.53	-	-	0.39	-
Total mass change (excluding mining)	Mt/y	-0.7			-0.20						-0.03								
Total mass change in survey area	Mt/y	-1.33			-0.39	-0.27	-0.66	-0.36	-0.082	-0.44	-0.41	0.16	-0.25	-0.22	-0.22	-0.44	0.051	0.16	0.21
Total volume change in whole area (assuming surveyed area is representative of mud erosion and deposition only)	Mm3 /y	-0.78	-1.66	-2.44	-0.2300	-1.88	-2.11	-0.21	-0.26	-0.47	-0.24	0.47	0.23	-0.13	-0.59	-0.72	0.030	0.60	0.63
Dry Bulk density	t/m3	1.7	0.40	0.82	1.7	0.40	0.54	1.7	0.40	0.98	1.7	0.40	0.84	1.7	0.40	0.63	1.7	0.40	0.46
Total mass change in whole area (assuming surveyed area is representative of mud erosion and deposition only)	Mt/y	-1.33	-0.66	-1.99	-0.39	-0.75	-1.14	-0.36	-0.10	-0.46	-0.41	0.19	-0.22	-0.22	-0.24	-0.46	0.051	0.24	0.29

Figure 4 Appendix 8 of Sand Budget – with annotations to highlight the significant contributions of mining to the overall mass/volume change in the survey area.

Understanding Impacts of Bay Sand Mining on Sand Supply and Transport in San Francisco Bay and Outer Coast - Deltares

The comments below are ordered by first addressing the synthesis of key findings of the Deltares bedload transport analysis, then addressing the mining volume area analysis, and lastly commenting on the morphodynamic change and bedform dynamics memorandum. This organization is best suited for outlining our comments on the major takeaways of the Deltares effort that were integrated into the ISP Summary Report.

Part 3: Synthesis Report

The executive summary states: *"Limited recovery of mining areas does not significantly impact the overall sediment budget directly, it can however affect the dynamics of the Bay in the long term by altering tidal propagation, asymmetries, residual circulations, and wave breaking."*

To be clear, the influence of mining depressions on tidal propagation, asymmetries, residual circulations, and wave breaking was not evaluated by any of the studies. Process-based modeling was suggested to help identify potential effects on larger scale systems, but the studies failed to acknowledge that much of this modeling has already been performed as part of the EIR and SEIR processes. Absent such studies, the bare conclusion in the executive summary is speculative.

Moreover, the Introduction (Section 1.1) states: "*A thorough understanding of mining effects on the Bay sand transports and the Bay morphodynamics is essential to make the best possible choices that keep a balanced sediment budget and sustain the mining activities."*

This statement assumes that a balanced sand budget, which is a conceptual model adopted by the studies, is a requirement for sustainable mining activities—an assumption which lacks substantiation. The sand budget model merely represents an assessment of inflows, outflows, and bathymetric change. The size of relic sand deposits (or tidal bay conceptual model as described in ISP Summary Report) have not been quantified or included in the sand budget—even though the studies indicate most of the sand mining occurs in these relic sand deposits stored within the Bay. The volume of sand within the vast deposits of relic sand within and outside the Bay are a better indicator of sustainability than a balanced sand budget.

Part 2: Mining Volume Area Analysis

Section 2.2.1 states: "*An understanding of the potential impact of mining can then be obtained through comparison of the volume of sand in the active layer and its volumetric change, in relation to the mined volumes.*"

Comparing the mining volumes to the "active bed" within each ring area simply depicts how much mining has occurred within each ring. This analysis does not provide a comparison of mined volume to "active layer" volume and is not a useful metric for understanding potential impacts. Further, most of the mining occurs below the "active bed" within the "passive" bed. If mining depressions are included in calculating the active bed volume, they result in an over-estimate of the morphodynamic/active layer volume.

Section 2.2.2.4 states: *"Mining activity decreased between 2008 and 2014 (see Table 2-8 and Appendix A-2), allowing lease area 709S to naturally recover and to fill up most potholes."*

This statement suggests a direct link between mining "intensity" and sedimentation, but it is not supported by the data presented in Table 2-8 and Appendix A-2. Table 2-8 indicates no mining prior to 2008, pointing to an increase in mining intensity during the 2008-2014 period based on this data. Further this table shows no correlation between mining intensity and recovery. In fact, the 2008–2014 period had both the lowest mining intensity and lowest recovery percentage of the three time periods evaluated. Appendix A-2 does not separate mining volumes for lease area 709.1 which includes three different parcels. It is not clear from this data how much mining occurred in rings 5 and 6 during analysis periods.

Section 3.2 states *"Figure 3-5 and Figure 3-6 show that bed level changes within the ring polygon are an order of magnitude larger than bed level changes around the ring area. This is a clear indication that mining has significant local impacts. Regional effects of mining are harder to discern from the limited bathymetric data."*

This statement largely refers to the lowering of the Bay floor in mined areas. The study did not, however, analyze the 'significance' of this impact—i.e., how much volume is removed when compared to the overall storage in the Bay.

For a sense of magnitude, the San Francisco Airport Expansion Project in the early 2000's estimated based on exploratory testing that at least 71 million cubic yards of sand were available within two Central Bay sites (Point Knox and Presidio Shoal) down to the operational range of sand mining equipment (90 feet).[5] To put the amount of resource in greater perspective, at a Science Panel convened by BCDC in 2014, Dr. Patrick Barnard (coastal geologist) referenced the isopach map of Central Bay prepared by Florence Wong and stated that: "[T]he sediment is extremely thick. The volumes are out there. . . there are huge volumes of sediment, probably billions of cubic meters." Thus, sand supplies within Central Bay and the San Francisco Bay are vast, and will experience little depletion over a ten-year span of the current permits and leases. Further, the fact that there may be local impacts (e.g., within the mined area itself) does not necessarily mean that there is any significant impact on sand transport or supply to the Offshore Bar, coastal beaches, or in-Bay beaches. Indeed, the greater the local effect within the mined areas could signal a lack of impact elsewhere, as modeled by Coast & Harbor Engineers for the 2012 EIR and 2015 permits.

Part 1: Morphodynamic Change and Bedform Dynamics

Section 4.1 states*: "If the amount of sand in the active layer is much larger than the mining volume, impact is likely low, and vice versa if those mined volume and active layer volume are comparable the impact is likely high."*

The active bed layer concept was described in the Part 1 report in the context of evaluating impacts of sand mining relative to a sediment budget. However, it is important to note this concept was not relied upon for results presented in the Part 2 and Part 3 reports. In fact, there is no mention at all of "active bed" in the Part 3 Synthesis report.

Although the active bed analysis was not relied upon in the Synthesis Report or ISP report, it is worth noting the limitations of this analysis since it remains in the Part 1 report. The key limitation of this analysis is that the active bed calculation does not account for the large reservoir of sand that exists below the active bed. Much of the mining activity occurs within this area, described as the "passive" bed. In terms of overall sand budget, the volume of this "passive" bed is more important than the volume of the active bed. While evaluating the active bed changes provides an indication of morphodynamic activity, it does not provide an indication of the amount of sand available for mining activities, or the relative impact of mining activities.

The calculation of the active bed volume is further complicated because the mining areas are included in this calculation, despite the fact most mining occurs at depths below the active layer, as illustrated in Figure 4-1 (Part 1 Report). The active bed volumes also do not account for the uncertainties related to

[5] See Airfield Development Engineering Consultant, San Francisco International Airport, Airfield Development Program, Preliminary Report No. 5 (Task I), Evaluation of Potential Borrow Sites, 2000, 4 volumes, pp. 5-1–6-9.

survey accuracy. Given the large area included in the active bed layer calculation (~41 million m^2) even small vertical uncertainties result in large volumes. The vertical uncertainty between successive surveys ranges from 0.09 to 0.12m (Table 2-3, Part 2 Report). When applied to the large area, the volumetric uncertainty is greater than 5 Mcy, which is significant compared to the changes observed in the active bed volume which ranged from +6.1 Mcy (2008 to 2014) to -7.7 Mcy (2018 to 2019).

Modelling Sand Transport and the Effect of Sand Mining in San Francisco Bay – AnchorQEA

The AnchorQEA (AQEA) Modeling Report evaluated the effects of adding sand to the Bay floor, which is essentially the opposite of sand mining. As expected, the results indicate more sand transport occurs when sand is mounded on the Bay floor to represent a "without mining" scenario. This effect is acknowledged in Section 4.2 of the report: *"Decreasing the water depth and adding sand to the surface of the sediment bed could make the areas with sand addition more susceptible to sand transport."* This modeling technique does not signal an impact of existing and ongoing sand mining within the permitted or leased areas.

The process of sand mining is a progressive lowering of the Bay floor at the mining areas over the simulated duration. The AQEA model evaluated an instantaneous addition of sand at the beginning of the simulation period equivalent to 1.4 years' worth of mining volume. This is a fundamental assumption that reflects neither the physical process of sand mining (bed lowering) nor the timing of sand mining (relatively constant rate in discrete areas throughout the year). Therefore, the results from this report are inherently limited in their applicability to evaluate the effect of sand mining in San Francisco Bay. Additional comments on the methods, assumptions and uncertainty of sand transport modeling performed by AQEA are provided in the list below.

- UnTRIM model was calibrated based on suspended sediment concentration and turbidity data. This data is not representative of sand transported as bedload or in suspension, leading to significant uncertainty around the results presented. Section 2.3 of Final Modeling Report (AQEA) acknowledges this limitation*: "Data are not available to directly compare predicted to observed sand transport rates and the suspended transport of sand throughout the Bay. This lack of observed data on sand transport increases the uncertainty of the magnitude of the predicted sand transport rates."*

- The model approach does not include simulation of ocean waves and swell propagation at the Golden Gate entrance. This would lead to an underestimation of flood-oriented flux which would alter the relative differences between baseline and without mining scenarios.

- Several key assumptions related to the "without mining" scenario led to conservative (high) estimates of the effect of sand mining on sand transport:

    - The entire volume of mined sand was projected onto bathymetry grid based on 1.4 year period, but then added into model grid for 1-year simulation. This result in significantly more sand added back into the model than was actually mined during a 1-year period.

- The sand mining volume is added all at once in the beginning of the simulation, rather than gradually over simulation period as mining actually occurs. This is a key assumption that will increase the modeled sand transport in these areas because of the reduced depth and increased sand thickness: Section 4.2 acknowledges this assumption: *"Decreasing the water depth and adding sand to the surface of the sediment bed could make the areas with sand addition more susceptible to sand transport."*

- A porosity of 85% used to calculate sand mass added to mined areas (85% water, 15% solids). This value is based on previous model calibration to fine sediment deposition in federal navigation channels and wetlands (Section 4.2). The model does not address whether this porosity is appropriate for relic sand deposits, which represent the majority of mined areas. Porosity is a key assumption in converting from volume to mass added in the mined sands. The Final Sand Budget (SFEI) describes a wide range of dry bulk densities in Bay sediments from 200 kg/m^3 for wetlands and mudflats to 1,500 kg/m^3 for sandier areas.

- A sensitivity analysis on Bay-wide porosity indicated a 20% difference in results, based on a Bay-wide porosity of 40%. However, an analysis of the sand volume to mass calculation's sensitivity was not performed. Based on a comparison of dry bulk density for wetlands versus sandier areas, the porosity of sand should likely be a fraction of what was assumed in the final model. The following excerpt from the Sand Budget Report indicates the importance of assumptions in volume to mass conversions. According to Section 2.5 of Sand Budget Report (SFEI) *"Given the large variation in grain size and dry bulk density in the Bay, the choices made to convert between volume and mass could cause >5-fold differences in the size of individual budget terms and could cause directional changes in terms computed by difference."*

- A single grain size was applied to all sand classes though grain size is known to vary at each of the lease areas, particularly in the Central Bay. North Central Bay lease sites are known to contain coarser sand deposits than lease sites in South Central Bay and Suisun Bay. The use of a single sand size in models would overestimate sand transport in lease areas with coarse sand since larger diameter particles do not transport as easily.

  - The report acknowledges this is a conservative assumption but did not evaluate the sensitivity of this parameter. Section 4.2: "Using a single sediment class in the sediment transport model to represent the mined sand results in conservative estimates of the effect of sand mining relative to if multiple sediment classes had been used to represent the mined sand."

  - SFEI's literature review indicated the sand size/texture classifications associated with sand being mined in the Central Bay suggest that these are mostly transported as bedload rather than suspended load (Quarterly Meeting 5 Summary). However, the AEQA modeling results indicate the opposite, that most sand transport occurs as suspended load rather than bedload. This is another indication that the grain size

assumptions made in the model limit its ability to predict transport of coarse sand as bedload.

- Model results for the Central Bay area and the Golden Gate cross section (Figures 6.2-9 and 6.2-10) indicate the added sand is quickly dispersed across the model domain (over first 2-3 months) with little difference in model scenarios after that point. This is the logical result from a large and instantaneous addition of sand to the Bay floor and similar to what one would expect from a beach nourishment project. However, the relation of these effects to those of mining activities are inherently flawed for reasons mentioned above.

- There was an extensive modeling effort performed by Coast & Harbor Engineering (CHE) for the 2012 EIR which was never mentioned in the literature review or results discussion. This is surprising since the focus of this study was very much aligned with the AQEA scope of work. The EIR concluded that any mining related reduction in sediment transport, and any secondary effects on coastal morphology, would result in a less-than-significant impact.

Fingerprinting Study/Stratigraphy Report - UT Austin

The Fingerprinting Study identified sediment sources and sinks to the San Francisco Bay. SF Bay sources include: (1) the Sacramento-San Joaquin Delta; (2) Coast Range Rivers, and (3) the Outer Coast and the adjoining continental shelf. SF Bay sinks include (1) Suisun Bay, (2) San Pablo Bay and Carquinez Strait, and (3) the Central Bay. These findings conflict with the sinks identified as part of the Sand Budget. The study further identifies that outer coast and Central Bay sand is sourced from some combination of outer coast erosion, longshore transport, and tidal redistribution of relic sand originally sourced from the Sacramento-San Joaquin drainage but deposited across this portion of the bay during periods of lower sea level. The study fails to provide any indication of the size of this relic sand deposit. The study indicates that sand in Suisun Bay and likely most of San Pablo Bay is (or was) largely sourced from either local drainages or other yet-to-be-determined sources that are not the integrated Sacramento-San Joaquin Delta.

This study elaborated on potential responses to the management questions. Importantly Section 2.2 of the study outlines key takeaways including: "*Our provenance results, which suggest that Suisun and San Pablo Bays are likely locally sourced while Central Bay and the outer coast are sourced from a combination of outer coast sources and relic Sacramento-San Joaquin River deposits. These findings are not consistent with active sand transport through the entire bay. Our provenance results are most consistent with more localized sand transport pathways that do not significantly connect Suisun Bay, Central Bay, and the outer coast. This suggests that the effects of sand mining in Suisun and Central Bay lease areas should be considered separately."*

The ISP Summary Report, however, does not seem to capture the level of localized nuance indicated in this study's findings. While the ISP Summary Report does indicate it examines the Suisun Bay and Central Bay separately, it lacks the specificity and nuance available to the ISP in the sand science studies and prior research.

Thank you again for the opportunity to review and comment on the ISP Summary Report. We would welcome the opportunity to further review and discuss the various studies and findings.

Sincerely,

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