

RMP Special Study Proposal: Sediment Bulk Density Study

Summary: The definition of sediment bulk density and the conversion between sediment bulk mass to bulk volume is an important step in many sediment calculations. It is used in dredging operations, sediment modeling studies, in the design of wetland restoration projects. The proposal is to create guidance on the definition of bulk density for use in San Francisco Bay projects, to provide typical values for different environments, and protocols for measuring and reporting bulk density in the future.

Estimated Cost: \$30,000

Oversight Group: RMP Technical Review Committee

Proposed by: Jeremy Lowe, Lester McKee

Proposed Deliverables and Timeline

Deliverable	Due Date
2 small working group meetings/calls	Oct-February 2018
Draft framework to share with local experts	February 2019
Draft report for RMP Sediment Working Group review	May 2019
Final report	August 2019

Background

Monitoring programs measure sediment concentrations or sediment mass fluxes to and within the Bay yet many aspects of Bay beneficial use and management either record sediment removal as a volume or require information about sediment volume. Therefore, the definition of sediment bulk density and the conversion between sediment bulk mass to bulk volume is an important step in many sediment calculations. It links observations and modelling of sediment transport and morphology to dredging operations and wetland restoration projects. For sediment transport calculations the transport rate is usually expressed in terms of a mass. For morphological calculations, accretion or erosion usually expressed as a volume or depth per unit area. The choice of bulk mass or volume also depends upon the activity or the study - dredgers report by volume dredged; marsh accretion models report by volume as accreted. The actual value of bulk density varies over time whether newly deposited or long deposited; it varies with depth due to consolidation; it varies with type of sediment and degree of sorting - poorly sorted sediments may have higher density. Sediment bulk density also varies substantially among marshes and mudflats and within marshes and mudflats. There are also a number of variables used to define bulk density - bulk density (partially and fully

saturated), dry density, bulk weight density (partially and fully saturated), and dry weight density. These all have specific uses and definitions but these are not always adequately reported. The presently available conversion factors lack specificity of application and are dated potentially leading to inconsistent or inappropriate use and the potential for large errors that may lead to less optimal decision making.

Study Objectives and Applicable RMP Management Questions

The objective is to develop bulk density estimates that help with converting between 1) mass and volume of sediment entering and moving around the Bay; and 2) mass and volume of sediment deposited in the subtidal, mudflats and marshes, accounting for the effects of consolidation and subsidence over time. This information would be helpful to link dredgers and restoration managers as one group uses mass and the other uses volume. It would also be more efficient to have an agreed on methods for this complicated conversion.

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

Management Question	Study Objective	Example Information Application
MQ4: How much sediment is passively reaching tidal marshes and restoration projects and how could the amounts be increased by management actions?	Develop bulk density estimates that help with converting between 1) mass and volume of sediment entering and moving around the Bay; and 2) mass and volume of sediment deposited in the subtidal, mudflats and marshes,	Restoration managers and dredgers both need this information to relate sediment loads in mass units to volume of sediment for habitat restoration projects.

Approach

The proposal is to create guidance on the definition of bulk density for use in San Francisco Bay projects, to compile a database of existing observations of bulk density with known location; to determine typical ranges of values for a variety situations (mudflat, marsh, tidal channel); examples of typical conversions (from sediment transport rate to accretion rate); protocols for measuring and reporting bulk density in the future; and recommendations for maintaining and extending the database of observations.

This work would be undertaken in two phases. **Phase 1** would create a guidance document summarising existing knowledge of bulk density in the Bay. This would be undertaken by a subset of the RMP Sediment Workgroup. It would rely on existing observations and methodologies but would provide recommendations for any further data collection as needed. **Phase 2** would occur after the completion of Phase 1 with stakeholders implementing the standard methodology each time they do a sediment removal exercise. This data would be entered into the database set up in Phase 1. This database would be reanalyzed for patterns and trends when sufficient samples from different environments had been collected.

Phase 1 Scope

1) Small working group meetings

A small working group meeting will be held to discuss the definition of bulk density, its common uses in studies, determine the current state of knowledge regarding bulk density estimates for sediment delivered to and transported around the Bay and for marsh and mudflat soils, and agree the scope of the study, design of the database, and outline of the guidance report. This meeting would also identify sources of measured bulk density to be collated and entered into a database. The working group will be formed by members of the RMP Sediment Work group (ca. 3-5 people).

A second small working group meeting will be held to review and summarise the database of measured bulk densities in terms of range of values for different environments. This meeting would also draft protocols for standard sampling, analysis, reporting and recording of bulk density observations in the future.

2) Draft and final guidance

A short document (10-12 pages) will be drafted based on the small working group meetings. This will define bulk density for use in San Francisco Bay projects, include a database of existing observations of bulk density; provide typical ranges of values for a variety situations (mudflat, marsh, tidal channel and different Bay segments if data suggest this is warranted); provide examples of typical conversions (from sediment transport rate to accretion rate); give protocols for measuring and reporting bulk density in the futures; and recommendations for maintaining and extending the database.

The draft guidance will be reviewed by the RMP Sediment Workgroup and finalised by the small working group.

Budget

The following budget represents estimated costs for Phase 1 of this proposed special study (Table 2).

Table 2. Proposed Budget for Phase 1.

Expense	Estimated Cost
Labor	\$30,000
Grand Total	\$30,000

Phase 1 Budget Justification

Labor Costs

The majority of the work in Phase 1 will be completed by Lester McKee and Jeremy Lowe (52 hours each) with research and review assistance from Scott Dusterhoff (28 hours). Some budget has also been set aside for database support and guidance report figures (68 hours). The total labor cost for this level of effort is \$30,000.

Direct costs for the small working group meetings in Task 1, including lunches and travel for technical advisors, is assumed to be covered by the Sediment Workgroup general budget.

Reporting

The final report will be reviewed by the RMP Sediment Workgroup and Technical Review Committee and published by SFEI as an RMP Technical Contribution.

References

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