

Humboldt Bay SEDflume Study

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ACRONYMS AND ABBREVIATIONS

Integral	Integral Consulting Inc.
LISST	laser <i>in situ</i> scattering and transmissometry
Pa	pascal

1 INTRODUCTION

Integral Consulting Inc. (Integral) performed a SEDflume study to determine erodibility parameters of mudflats within Humboldt Bay, California. Integral tested three samples collected by the SHN Engineers & Geologists, Inc. (SHN) team. Collection occurred on June 1, 2021, during low tide when the mudflats were exposed. Sample locations are highlighted on the map in Appendix A. The SHN team collected two samples at each of the three study locations and securely shipped all six to Integral's laboratory in Santa Cruz, California. Samples were delivered on June 8, 2021, and one sample from each location was chosen for testing. The longer of the two samples was analyzed using SEDflume to measure erosion rates, determine critical shear stresses, and quantify particle size distributions and bulk densities.

The following sections of this report describe the methods used during the SEDflume testing and supplemental analyses (Section 2) and provide findings for each of the three samples, including a description of the core, observations during erosion testing, and results (Section 3). Data from particle size distribution via laser diffraction is included in Appendix B. Appendix C includes data generated from the SEDflume study in a MATLAB ".mat" file labeled "H_Bay_SEDflume_data.mat". A "readme" is also included outlining the variables within the file.

2 EXPERIMENTAL PROCEDURES

Detailed descriptions of SEDflume analysis and its application are given in McNeil et al. (1996), Jepsen et al. (1997), and Roberts et al. (1998). The following sections supplement those reports with a general description of the SEDflume analysis procedures used in this study. Supplemental analyses of grain size distribution using laser diffraction (ISO Standard 13-320), water content (ASTM Method D2216-05), bulk density (ASTM Method D2216-10; Håkanson and Jansson 1983), and loss on ignition (ASTM Method D7348-13) were also implemented at the beginning of each depth interval to quantify physical sediment characteristics.

2.1 SEDFLUME SETUP

A SEDflume is essentially a straight flume with an open bottom section through which a rectangular, cross-sectional core barrel containing sediment can be inserted (Figure 1). The main components of the flume are the water tank, pump, inlet flow converter (which establishes uniform, fully developed, turbulent flow), the main duct, test section, hydraulic jack, and the core barrel containing sediment (Figure 2). The core barrel, test section, flow inlet section, and flow exit section are made of transparent acrylic so that the sediment–water interactions can be observed visually. The core barrel has a rectangular cross section, 10 by 15 cm, and a length of 60 cm.

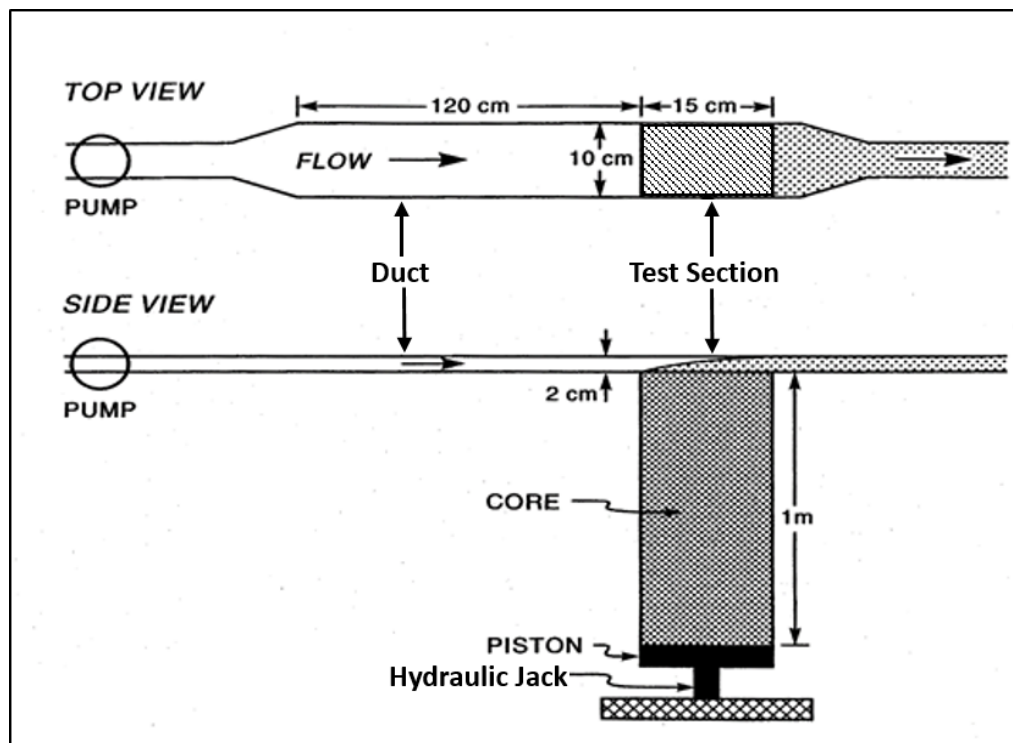


Figure 1. Schematic of SEDflume Setup Showing Top and Side Views (McNeil et al. 1996)

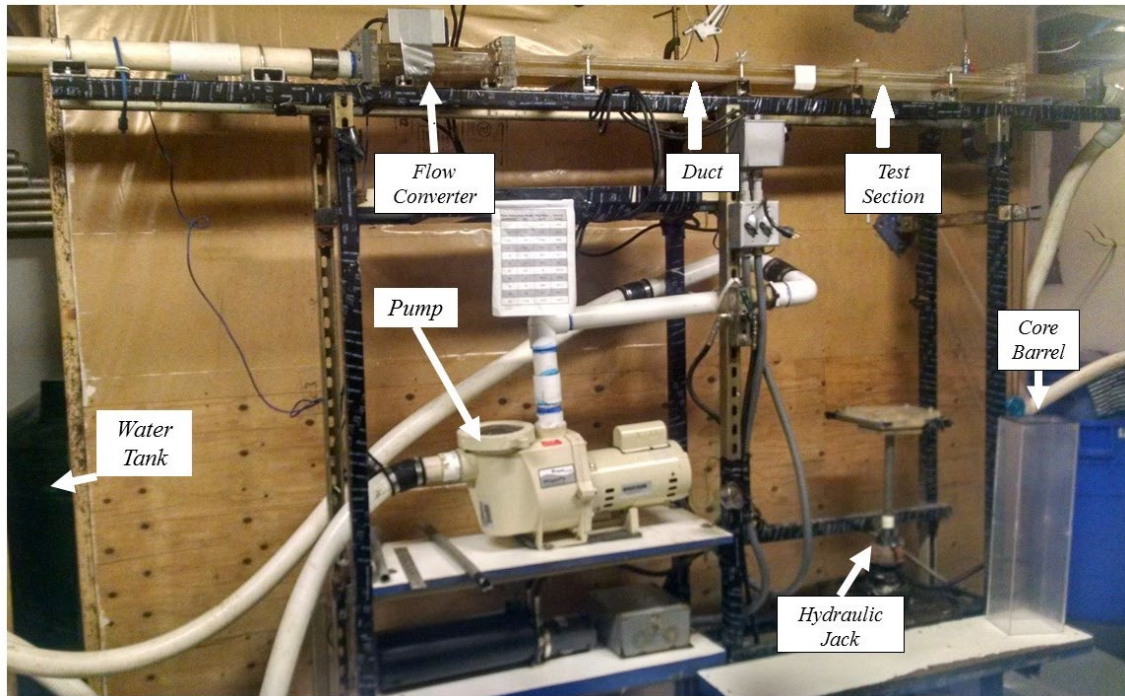


Figure 2. SEDflume in Integral's Laboratory, Santa Cruz, California

Water is pumped from a 300-gallon storage tank into a 5-cm-diameter pipe and then through the flow converter into the main duct. The duct is rectangular, 2 cm in height, 10 cm in width, and 120 cm in length; it connects to the test section, which has the same cross-sectional area (2 by 10 cm) and is 15 cm long. The flow converter changes the shape of the cross section from circular to rectangular while maintaining a constant cross-sectional area. A ball valve regulates the amount of water entering the flume so that the flow rates can be carefully controlled. The flume also has a small valve immediately downstream from the test section that opens to the atmosphere, preventing a pressure vacuum from forming and enhancing erosion.

At the start of each test, a core barrel and the sediment it contains are inserted into the bottom of the test section. The sediment surface is aligned with the bottom of the SEDflume channel. When fully enclosed, water is forced through the duct and test section over the surface of the sediment. The shear stress produced by the flow and imparted on the particles causes sediment erosion. As the sediment on the surface of the core erodes, the remaining sediment in the core barrel is slowly moved upward so that the sediment–water interface remains level with the bottom of the flume.

An operator moves the sediment upward using a hydraulically controlled piston that is inside the core barrel. The jack is driven by a release of pressure that is regulated with a switch and valve system. In this manner, the sediment can be raised and made level with the bottom of the test section. The movement of the hydraulic jack can be controlled for measurable increments as small as 0.5 mm.

2.2 MEASUREMENTS OF SEDIMENT EROSION RATE

At the start of each core analysis, an initial reference measurement is made of the starting core length. The flume is then operated at a specific flow rate corresponding to a particular shear stress, and sediment is eroded (McNeil et al. 1996; Jepsen et al. 1997). As erosion proceeds, the core is raised, if needed, to keep the core's surface level with the bottom of the flume. This process is continued until either 10 minutes has elapsed or the core has been raised roughly 2 cm. The erosion rate for the applied shear stress is then calculated as:

$$E = \frac{\Delta z}{T} \quad [1]$$

Where:

- E = erosion rate
- Δz = distance that sediment is raised during a particular measurement period
- T = measurement time interval

Because material is eroded and the core structure is broken down, repetitive erosion measurements at a given depth are not possible. The following procedures were performed for all cores to best determine the erosion rate at several different shear stresses and depths using only one core:

1. The core was inserted into the bottom of the SEDflume test section.
2. The total length of sediment in the core barrel was measured and recorded.
3. Two 5 g (approximately) subsamples of sediment from the core surface were collected using a clean spoon to be used in particle size distribution and bulk density measurements. Sediment sampling was constrained to the downstream (relative to the SEDflume flow direction) end of the sediment surface, to minimize potential scour effects.
4. Shear stresses (from low to high) were applied to the core's surface, and sediment erosion was measured (if it occurred; 0.5 mm of erosion in 10 minutes was considered quantifiable). Applied shear stresses started at 0.1 pascal (Pa) and were sequentially doubled until a given shear stress caused approximately 2 cm of erosion in 20 seconds, or a maximum of 5 cm was eroded in a given interval (defined as a continuous succession of increasing shear stress cycles where erosion is measured). Each shear stress cycle was applied for a minimum of 20 seconds and a maximum of 10 minutes. To the extent possible, no more than 2 cm of sediment was allowed to erode at a single shear stress.
5. Once the threshold—2 cm of erosion in 20 seconds, or a maximum of 5 cm of erosion in a single interval—was met, a new depth interval was started and the testing process of

Steps 3 and 4 was repeated.¹ Depth intervals are defined as a set of applied shears with an associated set of aliquots for physical parameter testing. Also, if the sediment composition changed noticeably in appearance or erosion properties, the depth interval was stopped, sediment subsamples were collected, and a new depth interval was started (Step 4).

6. Where practicable, at least three and up to five depth intervals were tested per core.

2.2.1 Determination of Critical Shear Stress

The critical shear stress of a sediment bed, τ_{cr} , is the applied shear stress at which sediment motion is initiated. In this study, it is operationally defined as the shear stress required to produce 0.001 mm of erosion in 1 second. This represents an erosion rate of 10^{-4} cm/s, or roughly 1 mm of erosion in 15 minutes.²

Because it is difficult to measure τ_{cr} exactly at the 10^{-4} cm/s threshold, erosion was instead measured over a range of shear stresses designed to bracket the initiation of erosion threshold. The highest applied shear stress where erosion *did not occur* is defined by τ_{no} , and τ_{first} is the lowest applied shear stress where erosion *did occur*.

Using the measured erosion rate data in each depth interval, a power law regression analysis (described below) was employed to determine the shear stress (τ_{power}) required to cause 10^{-4} cm/s of erosion. The bracketed shear stress values (τ_0 and τ_1) and τ_{power} were assimilated, and the critical shear stress of each interval was then chosen according to the following criteria (where τ_{no} and τ_{first} are determined directly from the SEDflume measurements):

- If $\tau_{no} \leq \tau_{power} \leq \tau_{first}$, then τ_{power} was the selected critical shear stress, τ_{cr} , for the interval.
- If $\tau_{no} \geq \tau_{power}$, then τ_{no} was the selected critical shear stress for the interval.
- If $\tau_{power} \geq \tau_{first}$, then τ_{first} was the selected critical shear stress for the interval.
- If $r^2 < r^2_{thresh}$, then τ_{linear} was selected as the critical shear stress for the interval.

The τ_{cr} criteria allowed for selection of critical shear stresses using the power law results where the regression analysis was in agreement with measured erosion rate data.

¹ If a particular shear stress did not cause any observable erosion over a 10-minute period for consecutive depth intervals (e.g., less than 0.5 mm eroded in 10 minutes), that shear stress was removed from subsequent testing cycles; higher shear stresses were added, as appropriate, to attempt to measure at least three erosion rates.

² Though other definitions of critical shear stress erosion rate thresholds can be argued (and considered valid), the value of 10^{-4} cm/s threshold is used here for consistency with previous SEDflume efforts and to keep testing times to a practical duration.

2.2.2 Power Law Regression

Following the methods of Roberts et al. (1998), the erosion rates for sediment can be approximated by the power law regression:

$$E = A\tau^n\rho^m \quad [2]$$

Where:

- E = erosion rate (cm/s)
- τ = bed shear stress (Pa)
- ρ = sediment bulk density (g/cm³)
- $A, n, \text{ and } m$ = constants that depend on sediment characteristics

The equation used in the present analysis is an abbreviated variation of Equation 2:

$$E = A\tau^n \quad [3]$$

where the constant A is a function of the sediment bulk density and other difficult properties to measure, such as sediment geochemistry and biological influences. The variation of erosion rate with density typically cannot be determined for field sediment because of natural variation in other sediment properties (e.g., mineralogy, particle size, and electrochemical forces). Therefore, the density term from the equation above, for a particular interval of approximately constant density, is incorporated into the constant A .

For each depth interval, the measured erosion rates (E) and applied shear stresses (τ) were used to determine the A and n constants that provide a best-fit power law curve to the data for that interval. Good regression fits of these parameters, where they existed, were then used to estimate the critical shear stress for the respective intervals. A coefficient of determination (r^2) of 0.70 was used as a threshold criterion for acceptance.³

2.3 MEASUREMENT OF SEDIMENT BULK PROPERTIES

In addition to the measurement of erosion rates during the analysis, sediment subsamples were periodically collected at depth to determine the water content, particle size distribution, and loss on ignition of the sediment in each core. Water content and loss on ignition values are

³The coefficient of determination, r^2 , is a function of Pearson's r , which is a measure of the linear dependence (correlation) between two variables. Pearson's r can be positive or negative, and is a value between -1 and $+1$. The more common usage of the correlation coefficient is to square Pearson's r , r^2 , and report that value.

incorporated into the determination of wet and dry bulk densities. Subsamples were collected from the undisturbed core surface (prior to analysis) as well as the sediment surface at the beginning of each subsequent depth interval. Samples were weighed, dried, and reweighed to determine the mass of water. Samples were then subjected to sufficient heat to ignite the organic material to determine loss on ignition.

Wet bulk density was determined by first measuring the wet and dry weight of the collected sample to determine the water content (W) as described in Håkanson and Jansson (1983):

$$W = \frac{M_w - M_d}{M_w} * 100\% \quad [4]$$

Where:

- W = water content
- M_w = wet weight of sample
- M_d = dry weight of sample

For the determination of wet bulk density, water content in this formulation has a value from 0 to 1. Wet bulk densities were then determined using the method described by Håkanson and Jansson (1983):

$$\rho_{wet} = \frac{(100 * \rho_s)}{100 + (W + IG)(\rho_s - 1)} \quad [5]$$

Where

- ρ_w = density of water (assumed 1 g/cm³)
- ρ_s = density of sediment particle (assumed 2.65 g/cm³)
- IG = % loss on ignition based on wet weight (ASTM Method D7348-13)

Dry bulk densities are based on the moisture content (MC) defined by ASTM D2216-05 as

$$MC = \frac{M_w - M_d}{M_d} \quad [6]$$

This formulation represents the ratio of water to solids. Using the moisture content value, dry bulk densities were calculated using the following relationship:

$$\rho_{dry} = \frac{\rho_{wet}}{1 + MC} \quad [7]$$

Particle size distributions were determined using laser diffraction analysis at Integral’s laboratory in Santa Cruz, California. Sediment samples were screened with a 2,000-µm sieve to remove large pieces of organic material, dispersed in water, and inserted into a Beckman Coulter LS 13-320 laser diffraction analyzer. Each sample was analyzed in three 1-minute intervals, and the results of the three analyses were averaged automatically by the instrument. The Beckman Coulter LS 13-320 measures volumetric distribution of particles from 0.4 to 2,000 µm. Caution should be taken when comparing directly to more narrowly ranged instruments such as a laser *in situ* scattering and transmissometry (LISST) instrument or traditional mass-based sieve and hydrometer studies. A LISST measures aggregated particles in the natural environment and has detection ranges different from that of the desktop instrument. Use of the Beckman Coulter involves the disaggregation of particles, so any direct comparison must consider these factors.

The relationships used to determine sediment bulk properties are summarized in Table 1.

Table 1. Parameters Measured and Computed during the SEDflume Analysis

Measurement	Definition	Units	Detection Limit	Internal Consistency
Water Content	$W = \frac{M_w - M_d}{M_w}$	Dimensionless	0.001 g in sample weight ranging from 1 to 50 g	$0 < W < 1$
Moisture Content	$MC = \frac{M_w - M_d}{M_d}$	Dimensionless	0.001 g in sample weight ranging from 1 to 50 g	
Wet Bulk Density	$\rho_{wet} = \frac{(100 * \rho_s)}{100 + (W + IG)(\rho_s - 1)}$	g/cm ³	0.001 g in sample weight ranging from 1 to 50 g	$\rho_w < \rho_{wet} < 2.6 \rho_w$
Dry Bulk Density	$\rho_{dry} = \frac{\rho_{wet}}{1 + MC}$	g/cm ³	0.001 g in sample weight ranging from 1 to 50 g	$\rho_w < \rho_{dry} < \rho_{wet}$
Particle Size Distribution below 2,000 µm	Distribution of particle sizes by volume percentage using laser diffraction	µm	Method specific	1 µm < grain size < 2,000 µm

Notes:

M_w = wet weight of sample

M_d = dry weight of sample

ρ_w = density of water (assumed 1 g/cm³)

ρ_s = density of sediment particle (assumed 2.65 g/cm³)

3 RESULTS

This section contains both qualitative and quantitative findings from the SEDflume analysis. Results are provided on a core-by-core basis. Appendix B contains additional grain size statistics and distribution plots for each interval in each core. As well as raw data from the grain size analysis.

Results are presented both graphically and in tabular form. Erosion rates at applied shear stresses are shown with depths adjacent to an image of the core. The indication of no erosion measured refers to the thin dotted line at 10^{-5} cm/s. As described in the previous sections, values of 10^{-4} cm/s are defined as the erosion rate related to minimum measurable critical shear stress.

A table of median particle sizes, wet and dry bulk densities, loss on ignition, greatest applied shear with no erosion measured, first applied shear with erosion measured, and two derived critical shears are presented. The power law-derived critical shear was determined using the A and n values described in Section 2.2.2, and linear fit results are provided. Tables of the derived constants A and n resulting from the power law fit, along with the r^2 value for each interval are also included for reference. Values of A can vary by orders of magnitude. Values of n typically range from 1 to 4, and values outside of this range may also indicate a spurious data fit. A column labeled "Recommended Critical Shear" provides the value based on the criteria outlined in Section 2.2.1.

Qualitative descriptions of the type of erosion are included when necessary to highlight changing processes. Erosion of the core surface generally occurs via individual particles becoming suspended, aggregated clumps of sediment (clump erosion) breaking off causing an uneven surface, or sheets of material peeling off the sediment bed. Non-cohesive materials such as sands will erode as individual particles. Fine-grained sediment such as silts and clays can bind together and will move together under an applied shear. Cracks and uneven sedimentation may cause this bonded sediment to move together as clumps. Sediment deposited cyclically may deposit in uniform layers and can erode as thin sheets.

3.1 CORE A1

Core A1 was collected on June 1, 2021, by SHN Engineering staff. The core contains dark-olive gray to dark-gray fat clay with traces of biotic activity and organic matter, including very thin red worms, fibrous plant matter, and small twigs and leaf detritus. A dark-orange oxidized layer is present 1–2 cm below the surface, and dark-gray to black patches of soil are common 20–23 cm below the surface. A photograph of Core A1 aligned vertically with the corresponding erosion rate data is presented in Figure 3.

Shear stresses ranging between 0.1 and 12.8 Pa were applied to the core in five test intervals. Derived critical shear stresses generally increased with depth, ranging from 0.27 Pa at the surface to 1.6 Pa in the fifth interval 16.6 to 23.2 cm from the surface. Fibrous organic matter may have contributed to soil cohesion in intervals four and five (Figure 4). The interval average critical shear stress was 0.88 Pa (Table 2). Disaggregated grainsize distributions ranged from clay to coarse silt with a predominantly fine silt composition (Figure 5). Particle size distributions decreased slightly throughout the core while bulk density generally increased (Figure 6, Table 2).

Sediment generally eroded in small 0.25–0.5 cm clumps and mats during various intervals, while occasionally experiencing large (>2 cm depth) failure events, primarily along weak fractured layers within the sediment core, as well as adjacent to clumps of fibrous organic matter. Power law fit parameters relating shear stress and erosion rate are provided for four of the five intervals and fall within typical ranges for cohesive sediment (Table 3). Data collected in Interval 4 resulted in a low r^2 value, and coefficients and derived critical shear stresses are not reported.

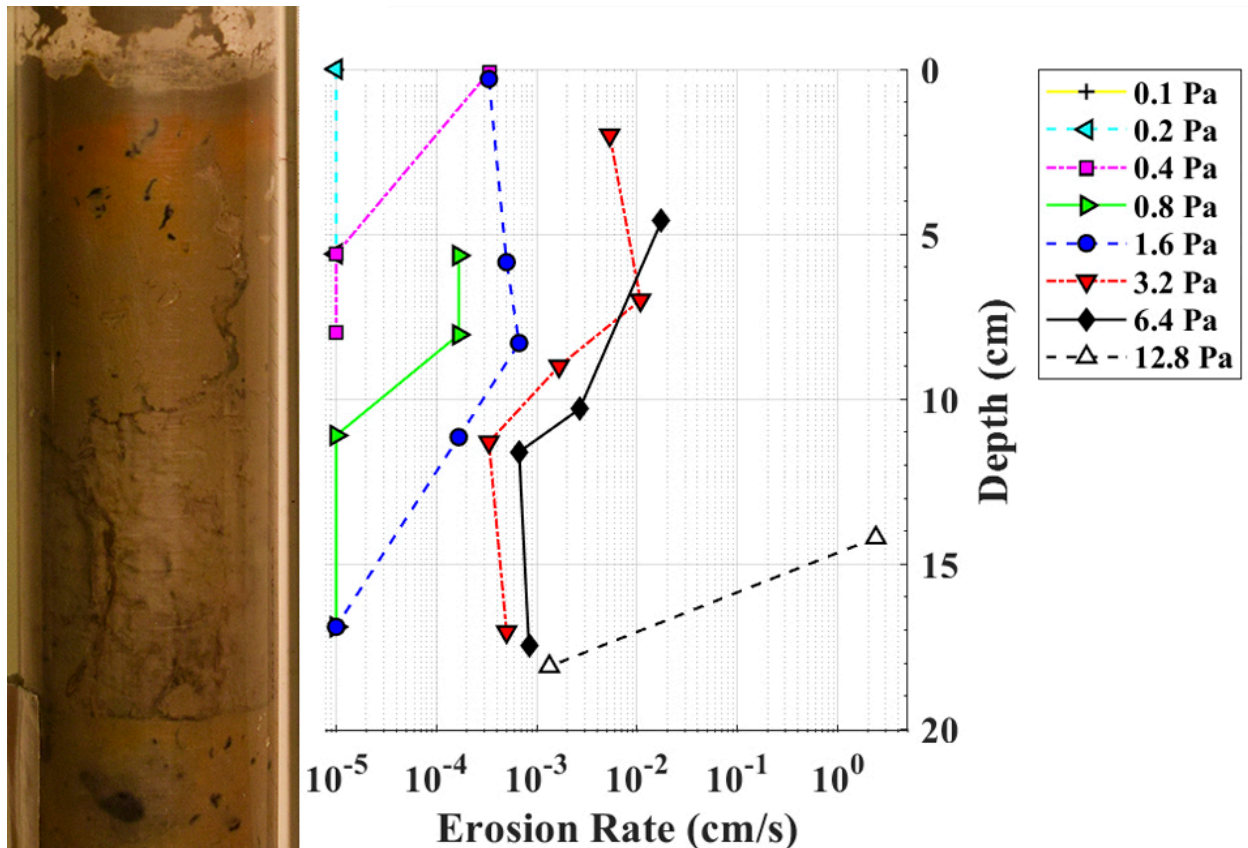


Figure 3. Photograph of Core A1 Aligned Vertically with Corresponding Erosion Rates.

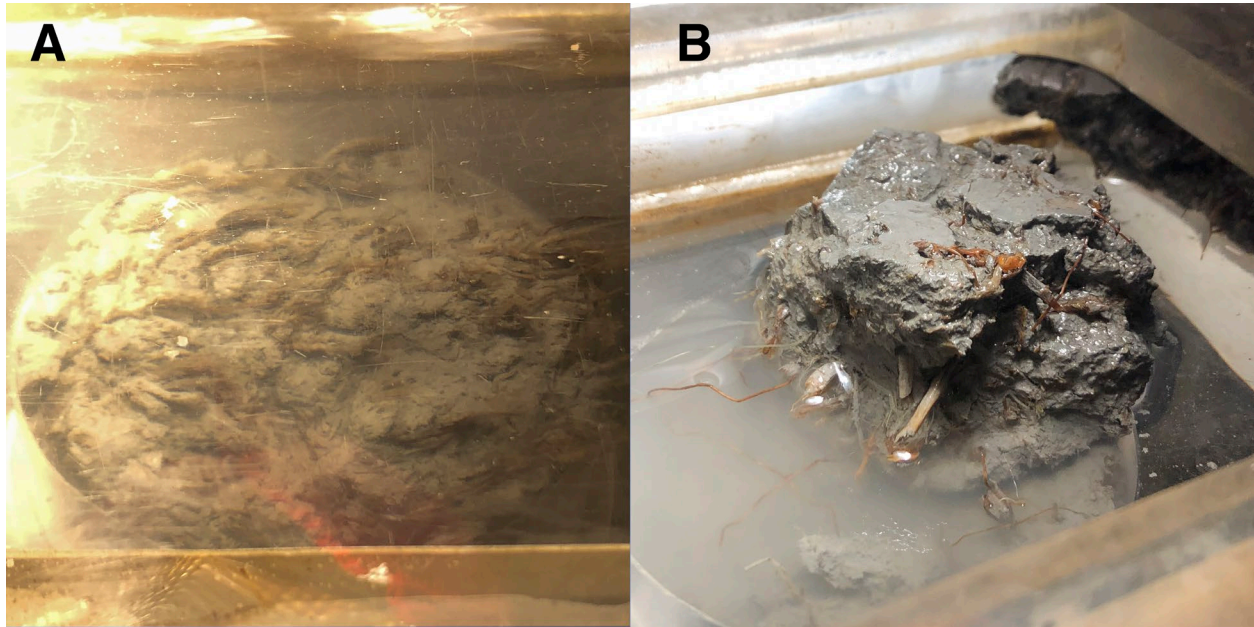


Figure 4. Fibrous Organic Matter Contributing to Soil Cohesion While Test Is Underway (A); Following Large Failure Erosion Event (B).

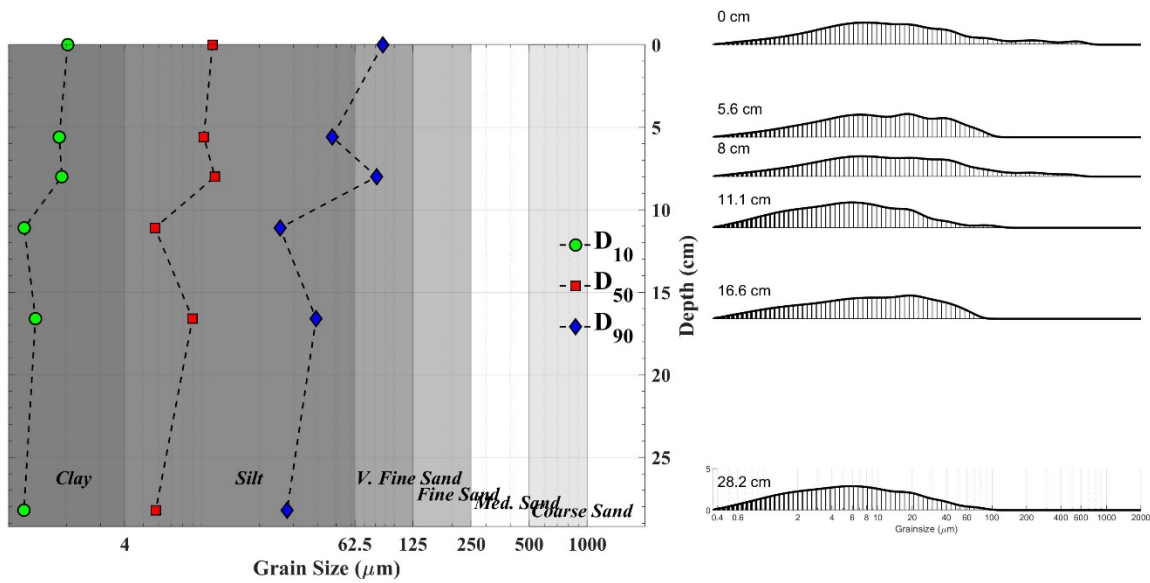


Figure 5. Core A1 Particle Size Distribution with Depth.

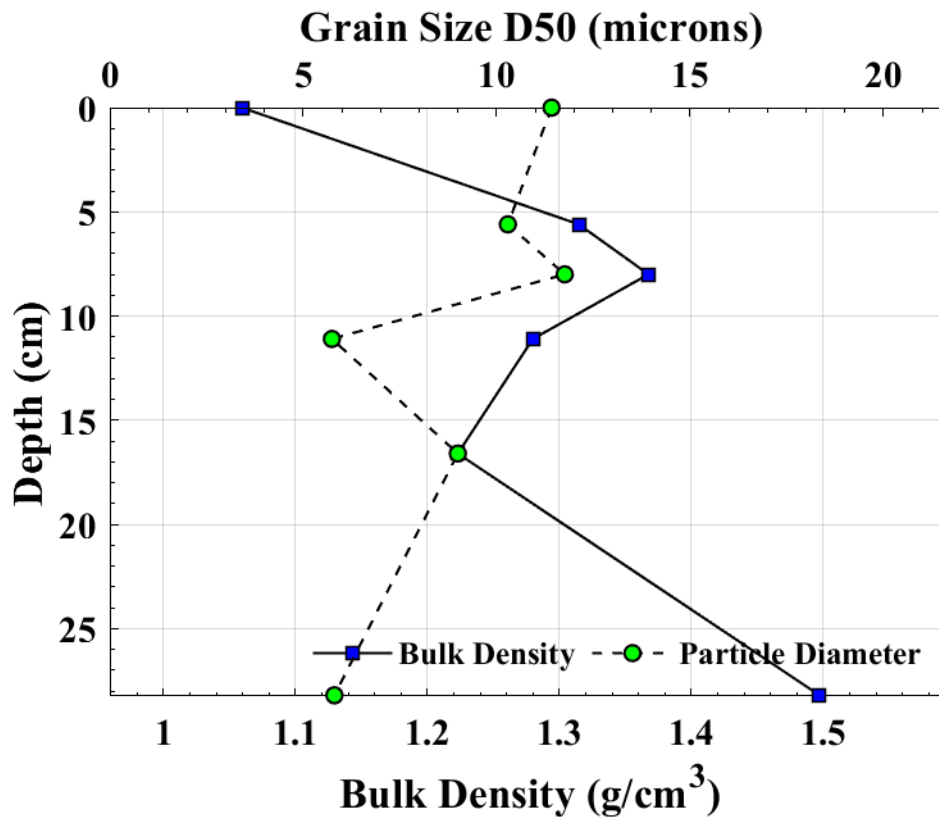


Figure 6. Wet Bulk Density and Median Particle Size (D₅₀) with Depth for Core A1.

Table 2. Median Particle Size, Bulk Density, and Critical Shear Stress with Depth for Core A1

Sample Depth (cm)	Median Grain Size (um)	Wet Bulk Density (g/cm ³)	Dry Bulk Density (g/cm ³)	Loss on Ignition (%)	T _{no} (Pa)	T _{first} (Pa)	T _{Crit} Linear (Pa)	T _{Crit} Power (Pa)	Recommended Critical Shear (Pa)
0	11.42	1.06	0.18	7.7%	0.2	0.4	0.26	0.27	0.27
5.6	10.29	1.31	0.59	6.1%	0.4	0.8	0.64	0.69	0.69
8	11.76	1.37	0.67	6.1%	0.4	0.8	0.64	0.55	0.55
11.1	5.74	1.28	0.55	7.6%	0.8	1.6	1.28	---	1.28
16.6	9	1.22	0.45	7.3%	1.6	3.2	1.92	1.35	1.6
28.2	5.81	1.51	0.87	4.9%	---	---	---	---	---
Mean	9.00	1.29	0.55	6.6%	0.68	1.36	0.95	0.72	0.88

Notes:

--- = No measurement taken or value computed

Table 3. Power Law Best-Fit Variables for Specified Depth Intervals in Core A1

Interval	Depth Start (cm)	Depth Finish (cm)	A	n	r ²
1	0	5.6	2.37E-05	1.47	0.85
2	5.6	8	4.44E-07	2.8	0.94
3	8	11.1	8.48E-06	1.45	0.96
4	11.1	16.6	---	---	0.44
5	16.9	18.5	3.75E-06	1.26	0.85

Notes:

--- = No value computed

3.2 CORE B1

Core B1 was collected on June 1, 2021, by SHN Engineering staff. The core contains yellowish-orange light-gray to dark-gray fat clay with traces of biotic activity and organic matter throughout, including very thin red worms, and small twig and leaf detritus (Figure 7). Dark-gray to black 0.5–1 cm patches are present 4–8 cm below the surface, typically with a dark-orange outline. At 18 cm below the surface, a layer of organic debris including shell fragments, twig and leaf detritus, and small worms was exposed (Figure 8). A photograph of Core B1 aligned vertically with the corresponding erosion rate data is presented in Figure 7.

Shear stresses ranging between 0.1 and 6.4 Pa were applied to the core in four test intervals. Derived critical shear stresses generally increased with depth, ranging from 0.4 Pa at the surface to 0.8 Pa in the fourth interval 10.0 to 15.5 cm from the surface. The interval average critical shear stress was 0.61 Pa (Table 4). Sediment grain sizes ranged from clay to very fine sand with a D50 consisting of silty sediment (Figure 9). Particle size distributions increased slightly throughout the core, as did the bulk density (Figure 10, Table 4).

Sediment generally eroded in small 0.25–0.5 cm clumps and mats during various intervals, while occasionally experiencing medium (>0.5 cm depth) failure events primarily along weak fractured layers within the sediment core. Power law fit parameters relating shear stress and erosion rate are provided for the four intervals and fall within typical ranges for cohesive sediment (Table 5).

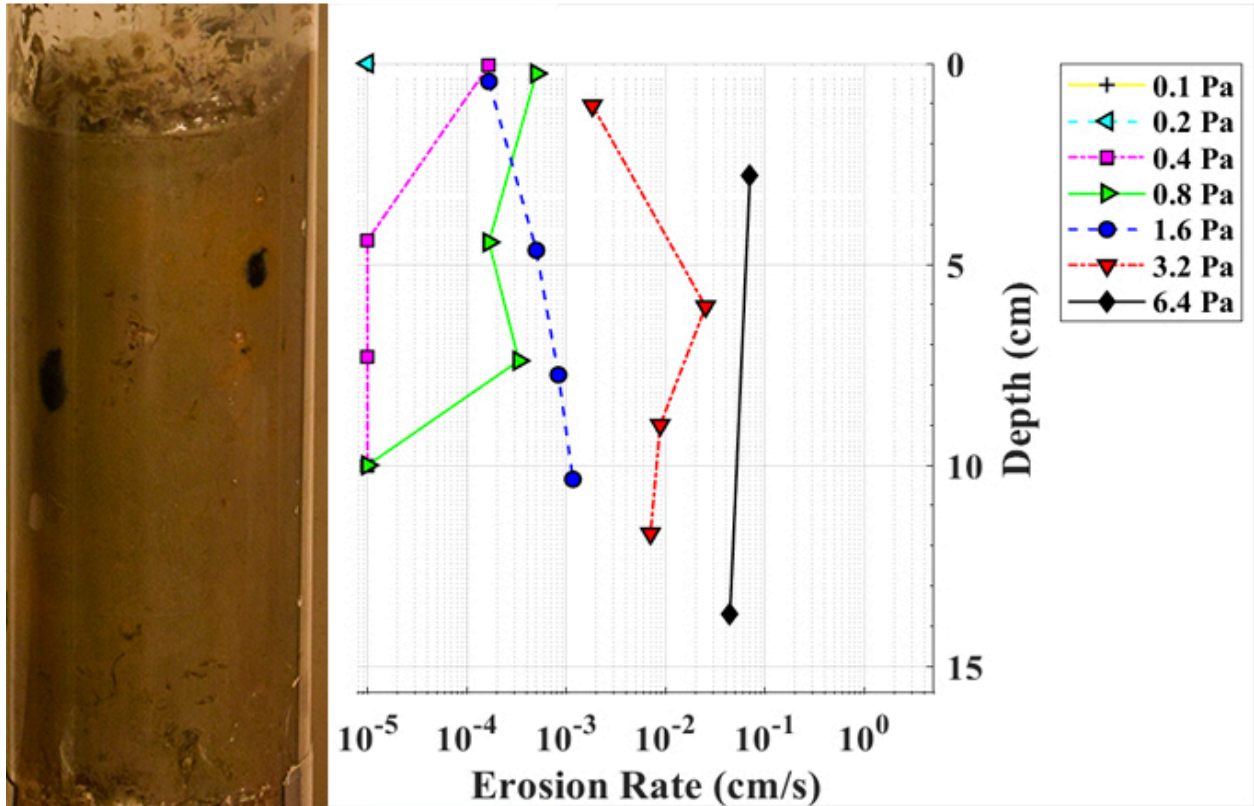


Figure 7. Photograph of Core B1 Aligned Vertically with Corresponding Erosion Rates.



Figure 8. Layer of Organic Detritus in Core B1, Including Shells, Leaves, and Worms Located 18 cm from the Surface.

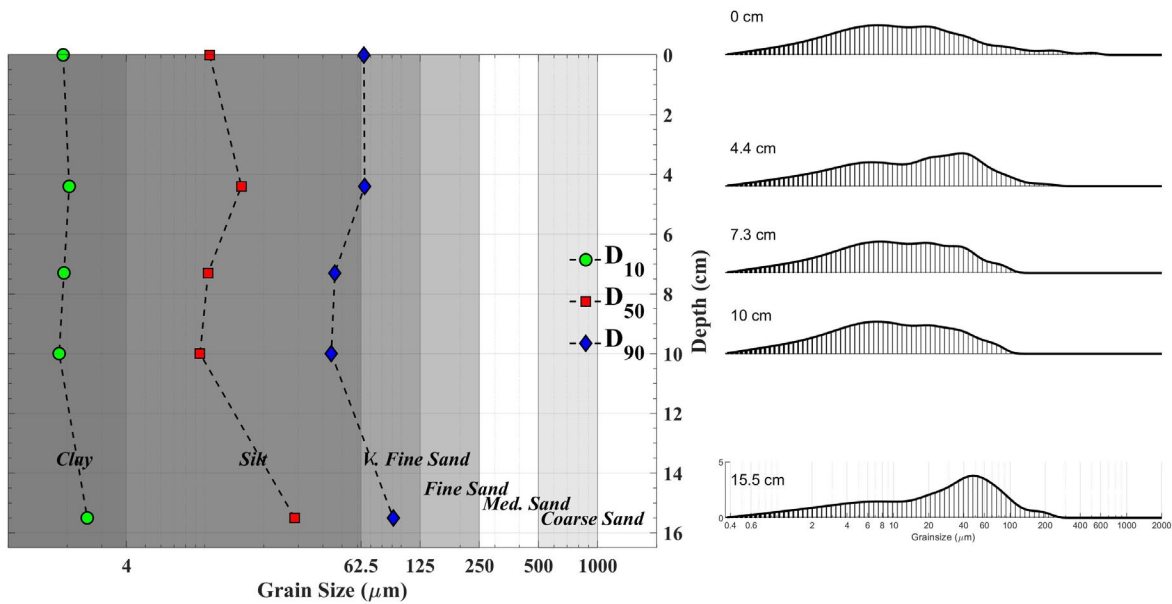


Figure 9. Core B1 Particle Size Distribution with Depth.

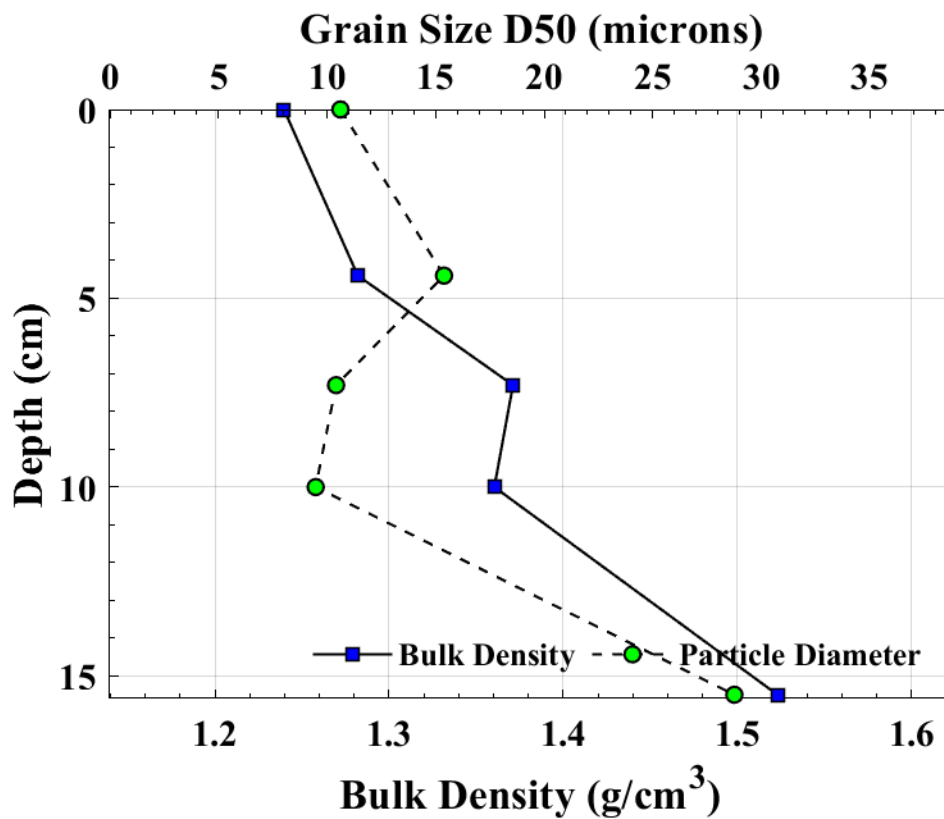


Figure 10. Wet Bulk Density and Median Particle Size (D_{50}) with Depth for Core A1.

Table 4. Median Particle Size, Bulk Density, and Critical Shear Stress with Depth for Core B1

Sample Depth (cm)	Median Grain Size (um)	Wet Bulk Density (g/cm ³)	Dry Bulk Density (g/cm ³)	Loss on Ignition (%)	T _{no} (Pa)	T _{first} (Pa)	T _{Crit} Linear (Pa)	T _{Crit} Power (Pa)	Recommended Critical Shear (Pa)
0	10.62	1.24	0.47	6.9%	0.2	0.4	0.32	0.4	0.4
4.4	15.39	1.28	0.53	6.2%	0.4	0.8	0.64	0.71	0.71
7.3	10.42	1.37	0.68	6.2%	0.4	0.8	0.52	0.52	0.52
10	9.48	1.36	0.66	6.3%	0.8	1.6	0.87	0.79	0.8
15.5	28.76	1.52	0.9	3.7%	---	---	---	---	---
Mean	14.93	1.35	0.65	5.9%	0.45	0.90	0.59	0.61	0.61

Notes:

--- = No measurement taken

Table 5. Power Law Best-Fit Variables for Specified Depth Intervals in Core B1

Interval	Depth Start (cm)	Depth Finish (cm)	A	n	r ²
1	0	4	8.28652E-06	1.8	0.75
2	4.4	7.3	1.57279E-07	3.29	0.92
3	7.3	10	2.07454E-06	2.34	0.97
4	10	14.7	2.00902E-07	3.00	0.99

3.3 CORE C2

Core C2 was collected on June 1, 2021, by SHN Engineering staff. The core contains light to olive gray fat clay with traces of biotic activity and organic matter including very thin red worms, fibrous plant matter, and small twigs and leaf detritus. Patches of dark-orange oxidized soil are present 0-2 cm below the surface. A void, likely formed during core collection, between sediment and the inner core casing is observed 7–18 cm below the surface. A photograph of Core C2 aligned vertically with the corresponding erosion rate data is presented in Figure 11.

Shear stresses ranging between 0.1 and 12.8 Pa were applied to the core in five test intervals. Derived critical shear stresses generally increased with depth, ranging from 1.3 Pa at the surface to 3.22 Pa in the fifth interval (Table 6). The interval average critical shear stress was 2.28 Pa (Table 6). Average median grain size and wet bulk density was 11.07 μm and 1.23 g/cm³, respectively (Figure 12, Table 6). Particle size distributions generally decreased slightly throughout the core along with bulk density, though in the second interval both parameters increased (Figure 13).

Sediment generally eroded in small 0.25–0.5 cm clumps and mats during intervals one, two and three. A very large (>3 cm depth) failure event occurred in interval 4 during the application of 6.4 Pa. The failure event appeared to occur along weak fractured layers within the sediment core. The shear stress test was redone and data from the failure event was not included in the analysis. Power law fit parameters relating shear stress and erosion rate are provided and fall within typical ranges for cohesive sediment (Table 7).

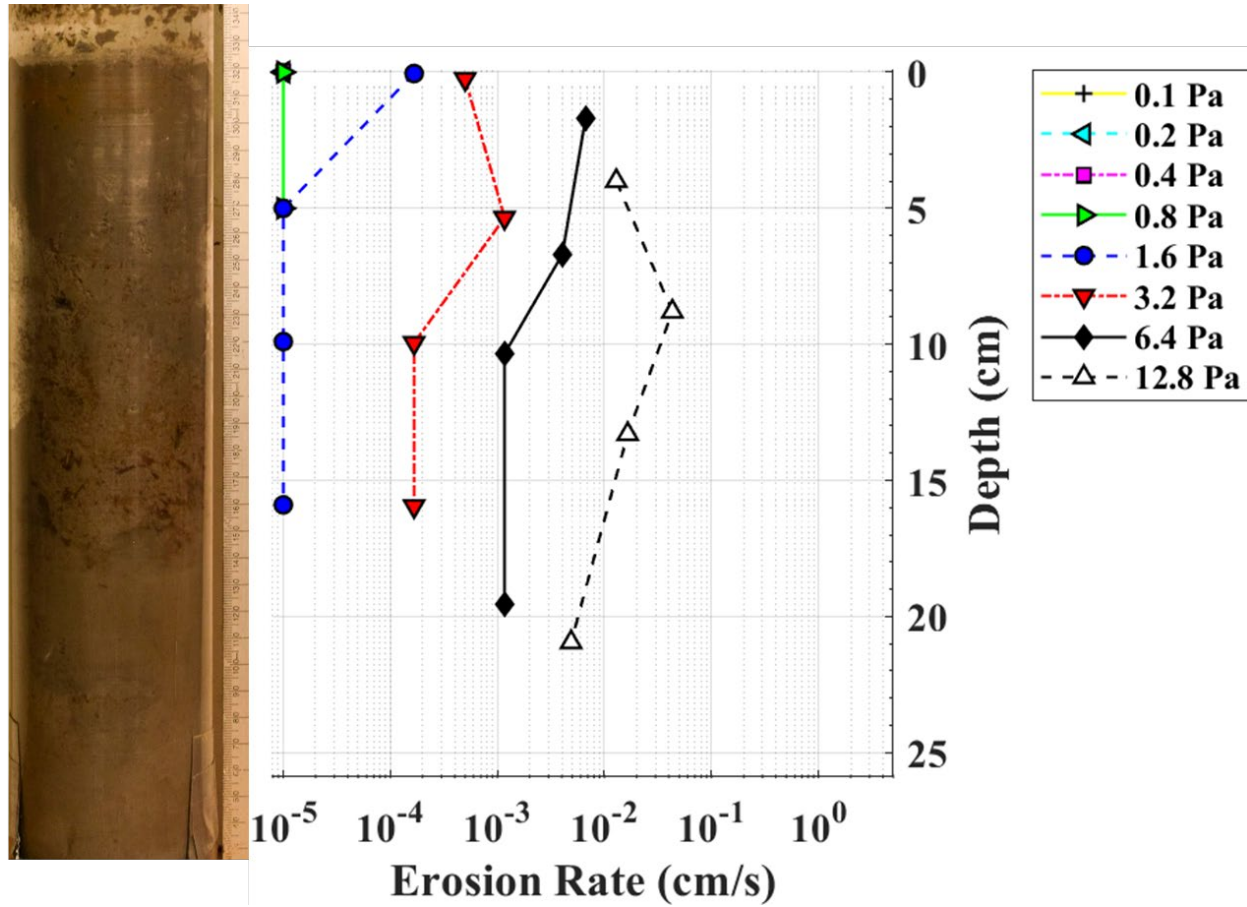


Figure 11. Photograph of Core C2 Aligned Vertically with Corresponding Erosion Rates.

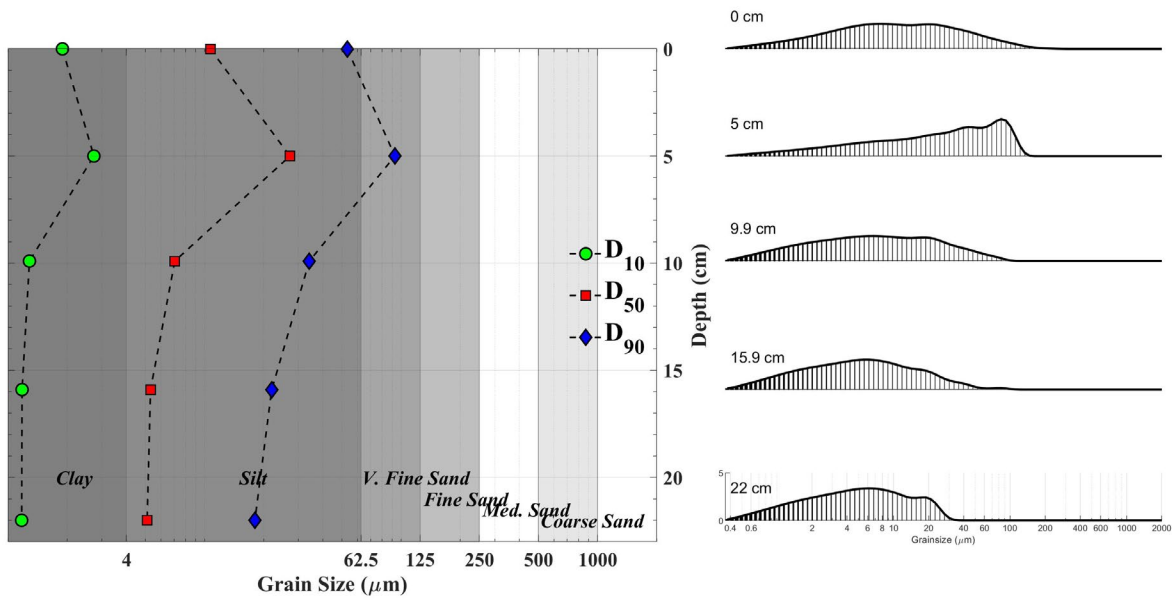


Figure 12. Core C2 Particle Size Distribution with Depth.

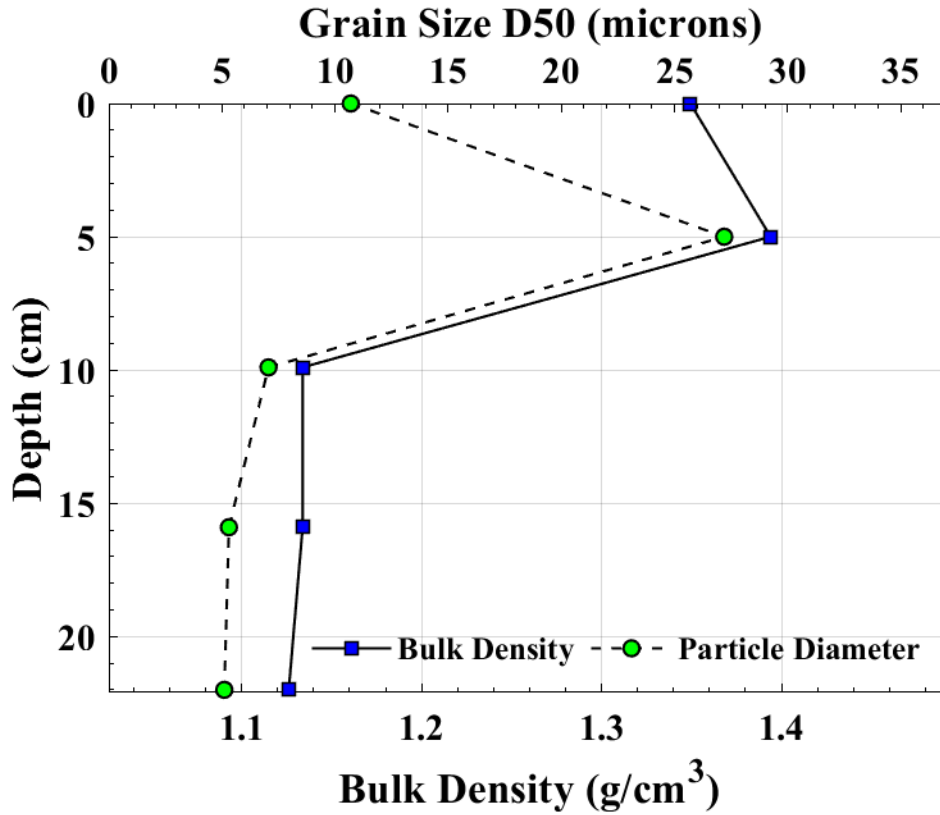


Figure 13. Wet Bulk Density and Median Particle Size (D₅₀) with Depth for Core C2.

Table 6. Median Particle Size, Bulk Density, and Critical Shear Stress with Depth for Core C2

Sample Depth (cm)	Median Grain Size (um)	Wet Bulk Density (g/cm ³)	Dry Bulk Density (g/cm ³)	Loss on Ignition (%)	T _{no} (Pa)	T _{first} (Pa)	T _{Crit} Linear (Pa)	T _{Crit} Power (Pa)	Recommended Critical Shear (Pa)
0	10.69	1.35	0.64	5.6%	0.8	1.6	1.28	1.3	1.3
5	27.19	1.39	0.71	5.4%	1.6	3.2	1.74	1.61	1.61
9.9	7.06	1.13	0.33	10.5%	1.6	3.2	2.56	2.69	2.69
15.9	5.31	1.13	0.32	9.6%	1.6	3.2	2.56	2.54	2.54
22	5.1	1.13	0.3	8.4%	---	---	---	---	---
Mean	11.07	1.226	0.46	7.9%	1.4	2.8	2.04	2.04	2.04

Notes:

-- = No value computed

Table 7. Power Law Best-Fit Variables for Specified Depth Intervals in Core C2

Interval	Depth Start (cm)	Depth Finish (cm)	A	n	r ²
1	0	5	3.21E-07	2.24	0.97
2	5	9.9	3.12E-08	2.9	0.98
3	9.9	15.9	2.98E-09	3.17	0.99
4	15.9	22	3.52E-08	2.46	1.00

Notes:

-- = No value computed

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