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Evaluation of Resuspension from Propeller Wash in Pearl Harbor and San Diego Bay

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Propeller wash induces disturbances to the bottom sediment in Department of Defense (DoD) harbors in multiple ways. Resuspension of bottom sediment, which is often contaminated, by propeller wash in DoD harbors is a phenomenon constantly observed and occasionally reported. While these resuspension events occur frequently, their effects on potential for erosion, transport, re-deposition, and re-contamination of bottom sediments have not been rigorously studied or quantified. This study aims to demonstrate and validate an innovative quantitative method that integrates information from state-of-science measuring devices/tools with predictive methods, including models. These measuring devices have been used to measure and evaluate critical parameters that govern propeller wash resuspension and subsequent fate and transport of the eroded sediments in DoD harbors. Accurate model results helped to reduce the uncertainty associated with propeller wash hydrodynamics and shear stress and resuspension potential of the sediment bed. Field data were used to support the fate and transport model, CH3D, which was successfully calibrated for San Diego Bay, CA; Pearl Harbor, HI; and Sinclair Inlet, WA. Once validated with the field data, CH3D was used to predict footprints (deposition) of the sediment plume and re-contamination potential from propeller wash. We have further extended the model?s simulation and prediction capabilities on both the resuspension potential and fate and transport of the plume far and beyond the scenarios when the data were measured.

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EXECUTIVE SUMMARY

A study was conducted to investigate resuspension potential and fate and transport from propeller wash in Pearl Harbor. This study included two study components, including the field study and a modeling study. The field study was conducted 20–28 August 2012. Fate and transport of sediment plumes resuspended by a tugboat operating at the designed propeller speeds were conducted at Bravo Pier and Oscar Pier on 28 August and 29 August 2012, respectively. A resuspension potential study was conducted at Bravo Pier on 30 August 2012. For the fate and transport measurement study, measured sediment plumes show that silt particles were the dominant particle group (~ 70% of the total suspended solids [TSS] mass), followed by sand particles (~ 20%) and clay (less than 10%). Concentrations of metals varied among the different metals. For Bravo Pier, silver, nickel and chromium concentrations were ~ 80% in dissolved phase and ~ 20% in particle-bound phase, of which silt-particle-bound dominated over the other two particle sizes, sand and clay. For Oscar Pier, chromium has the highest dissolved phase proportion (~ 70% of total chromium mass) followed by nickel with 65% in dissolved phase. Ninety percent of copper was in dissolved phase and only 10% in particulate phase, of which clay particle-bound copper dominated.

Erosions of sediment beds during the propeller wash were measured through Sediment Profiling Imagery (SPI). The bottom sediment bed profiles were recorded at a frequency of 3 sec and over 1500 images were produced. A time series of sediment bed erosion was produced for both Bravo Pier and Oscar Pier. A sediment layer 15-cm thick was eroded during the 1.5-hour study period at Bravo Pier, whereas only a 4 cm of sediment layer was eroded at Oscar Pier. The weak and reduced sediment bed erosion at Oscar Pier was also observed from the sediment plume measurement study. The primary reason of this difference is because depth at Oscar Pier was about 48 feet, compared to about 31 feet at Bravo Pier. At the deeper Oscar Pier, the propeller jet would decay more when it reached the bottom, with weaker velocities and shear stress to the bottom. Therefore, water depth may be one of the most critical parameters that determine whether propeller wash would cause sediment bed erosion.

Disturbances near the sediment bed are the key factor to determine whether propeller wash strength and sediment erosion potential. Correlation between the near-bottom disturbances and propeller wash is complex and field measurement is challenging. The combined use of an acoustic doppler velocimeter (ADV) and a particle image velocimeter (PIV) has recorded and revealed these characteristics near the bottom. The high-frequency ADV and PIV data recorded both mean velocity profiles and turbulent kinetic energy near the bottom from the propeller wash, from which bottom shear stresses were estimated by three different theories, including the covariance (COV), turbulent kinetic energy (TKE), and Modified TKE methods. Results from these three theories were similar in characteristics, but with TKE performing most consistent when compared with field data. The combined use of shear stress calculated by ADV and PIV and the erosion rate calculated by SPI has produced the empirical values for the critical shear stress (~ 3 to 4 dyne/cm^2) and the erosion rate (15.7 g/(m^2-s-Pa)).

Concentrations of the water samples measured during fate and transport plume study were used to set up and validate the fate and transport model, CH3D. The measured sediment plumes were used to drive the CH3D model. Fate and transport of silt-particle-bound and dissolved copper were simulated for both Bravo Pier and Oscar Pier. Model results show that, although propeller wash resuspension took place locally at Bravo Pier or Oscar Pier, dissolved copper would be transported and dispersed to other regions. For the Bravo Pier resuspension, dissolved copper was transported and dispersed to Southeast Loch and East Loch continuously following the resuspension. At the end of 5^{th} day (120 hours), the majority of the entire Pearl Harbor was mixed to the various extents with the sediment

plume water, except a small portion of West Loch and Middle Loch. Silt-particle bound copper was more restricted in the resuspension area, with complete deposition to the bottom mostly in the sub-base channel inside of the Bravo Pier in 5 days. For the Oscar Pier, dissolved copper from the plume mixed with water along the main navigation channel, due to the weaker resuspension plume, compared to the stronger resuspension plume at Bravo Pier. Silt particles along deposited along the main navigation channel, with hot spots at the resuspension region and both north and south of the Oscar Pier resuspension region.

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ACRONYMS

2D	Two Dimensional
ADV	Acoustic Doppler Velocimeter
ADCP	Acoustic Doppler Current Profiler
Ag	Silver
CCC	Criterion Continuous Concentration
CERLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH3D	Curvilinear Hydrodynamics in 3D
CMC	Criterion Maximum Concentration
CoC	Contaminants of Concern
COV	Covariance
CW	Continuous Wave
DoD	Department of Defense
ERDC	Environmental Research and Development Center
FANS	Finite Analytical Navier-Stoker Solver
FOV	Field of View
ICP-MS	Inductively Coupled Plasma with Detection by Mass Spectrometry
LISST	Laser Particle Size Analyzer
MDL	Method Detection Limit
NAVFAC	Naval Facilities Engineering Command
NOAA	National Oceanic and Atmospheric Administration
OBS	Optical Backscatter Sensor
PCBs	Polychlorinated Biphenyls
PHNSY&IMF	Pearl Harbor Naval Ship Yard and Intermediate Maintenance Facility
PIV	Particle Imaging Velocimeter
QA/QC	Quality Assurance/Quality Control
RMS	Root Mean Square
RPM	Revolutions per Minute
SPI	Sediment Profiling Imagery
SRM	Standard Reference Material
TKE	Turbulent Kinetic Energy
TMDL	Total Maximum Daily Load
TSSL	Total Suspended Sediment Load
USEPA	United States Environmental Protection Agency
UVMPIV	Under Water Miniature PIV

1. INTRODUCTION

Propeller wash induces disturbances to the bottom sediment in Department of Defense (DoD) harbors in multiple ways. Resuspension of bottom sediment, which is often contaminated, by propeller wash in DoD harbors is a phenomenon constantly observed and occasionally reported. While these resuspension events occur frequently, their effects on potential for erosion, transport, re-deposition, and re-contamination of bottom sediments have not been rigorously studied or quantified. At this point, we do not fully understand at what conditions a propeller would erode and resuspend bottom sediment and how the eroded sediment plume is dispersed, re-distributed, and re-deposited with re-contamination potential in hydrodynamically energetic DoD harbors. This study aims to demonstrate and validate an innovative quantitative method that integrates information from state of science measuring devices/tools with predictive methods, including models. These measuring devices have been used to measure and evaluate critical parameters that govern propeller wash resuspension and subsequent fate and transport of the eroded sediments in DoD harbors. Specifically, the measuring devices were calibrated and validated under laboratory conditions before they were deployed for field measurements. The resuspension of bottom sediment by propeller wash was measured, and sediment plumes measured and tracked down for their fate and transport. For the resuspension potential, the Maynord's model (1984) and the Finite Analytical Navier-Stoker Solver (FANS) model (Chen et al., 2003) were set up to simulate and evaluate flow velocities and bottom shear stress from propeller wash. Accurate model results helped to reduce the uncertainty associated with propeller wash hydrodynamics and shear stress and resuspension potential of the sediment bed. Field data were used to support the fate and transport model, Curvilinear Hydrodynamics in 3D (CH3D), which was successfully calibrated for San Diego Bay, CA; Pearl Harbor, HI; and Sinclair Inlet, WA. Once validated with the field data, CH3D was used to predict footprints (deposition) of the sediment plume and re-contamination potential from propeller wash. We have further extended the model's simulation and prediction capabilities on both the resuspension potential and fate and transport of the plume far and beyond the scenarios when the data were measured.

1.1 BACKGROUND

Under the Federal Clean Water Act, Section 303(d), states are required to identify all water bodies that do not meet water quality standards. Identified impaired water bodies are included in the 303(d) list, and remedial strategies, water cleanup plans, or total maximum daily loads (TMDLs) must be developed to bring the water body back into compliance. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), federal agencies are liable for releases of hazardous material (contaminated sediments) and are required to take short-term removal of the material and/or long-term remedial actions.

Over the past decade, we have witnessed significant progress in identifying the scope and locations of contaminated sediments in DoD harbors and waters. Equal amount of effort has been taken in remediation of these contaminated sediments. The remedial actions include, in general, dredging and capping (active or passive). However, there is a lack of understanding on how effective these remedial efforts are in both the short and long term. It has been observed and reported that dredging, propeller wash and extreme events (e.g., hurricanes) resuspended significant bottom sediments in U.S. harbors, most of which are contaminated (Stortz and Sydor, 1980; Kerfoot et al., 2004). These resuspension events occur at different time intervals, with dredging occurring most likely at contaminated sediment sites every few years, extreme storms taking place every several years, and propeller wash occurring daily around navigation channels and piers. These events have a significant effect on the loading of particles to the water column. For example, a field study shows that berthing/docking at three naval piers in San Diego Bay resuspended a total of 26 tons/day of bottom sediments into the water column (Wang, Sutton, Richter, and Chadwick, 2000). A modeling study shows that propeller wash from DoD vessels in transit resuspends ~ 54 tons/day of bottom sediments in Pearl Harbor (Wang et al., 2009a, 2009b), which is more than 10% of the total suspended sediment load (TSSL) from the entire Pearl Harbor watershed.

Sediment remediation is costly and often requires both short- and long-term monitoring to demonstrate effectiveness. Potential of resuspension, transport and re-contamination of sediment from propeller wash in DoD harbors must be examined more rigorously.

Propeller wash produces significant disturbances of flow near the bottom. Based on observation and reports, these disturbances would induce resuspension of bottom sediment. Maynord's model (1984) is one of the few models that have been used to predict the shear at the sediment bed induced by a propeller. The model was developed for single-screw propeller operating in infinite flow domain and is approximated for deep water applications. For the current study, most traffic and propeller wash for Navy/DoD vessels are shallow water, high-energy activities, and Maynord's model has been implemented for this environment.

Once resuspended from sediment into the water column, contaminated sediment is subject to a number of physical and chemical processes. The transport process is governed by the hydrodynamics, including current velocity and water volume variations, with turbulent mixing in the wake of the propeller. In addition to the hydrodynamic transport and turbulent mixing, contaminants (metals) and sediments are subject to settling. In addition, partitioning of metals is also associated with the loss rate of metals from the transport and settling.

For this study, we have applied both field study and modeling study to simulate, and evaluate fate and transport of contaminated sediments resuspended from propeller wash in San Diego Bay, CA, and Pearl Harbor, HI. The field work collected key data for analysis as well as for supporting the modeling study. The SSC Pacific model, CH3D is a 3-D hydrodynamic and contaminant fate and transport model that has been calibrated for a number DoD harbors, including fate/transport of contaminated sediments in San Diego Bay, CA (Wang et al., 2000; 2004), sediment transport for Pearl Harbor, HI (Wang et al., 2009a; 2009b) and TMDL for fecal coliform and Combined Sewage Discharges for Sinclair Inlet, WA (Wang and Richter, 1999; Wang et al., 2005). Recently, CH3D was successfully applied to the study of fate and transport of contaminated sediments that enter into San Diego Bay from the three creeks, including Chollas, Switzer, and Paletta Creek (Wang, Choi, and Chadwick, 2009). Fate and transport of both sediments and contaminants including metals were studied by the combination of field survey study and the use of the CH3D model. Deposition of sediment and contaminants (e.g., metals) in San Diego Bay is simulated and contamination potential from the riverine loads is simulated and evaluated. The current propeller wash study is very similar to the study of sediment/creek load in San Diego Bay, except that, in this study, the sediment and metals loads are from resuspension by propeller wash, instead of from the creek loads.

For this project, we have concentrated our study on the source term of resuspension and transport and re-contamination potential of sediment by propeller wash in DoD harbors. The study includes several components: instrument calibration and validation in laboratory, field data measurement, and analysis and modeling study using the state-of-the-science models. Field study was conducted at two DoD harbors, including San Diego Bay, CA, and Pearl Harbor, HI.

Benefits of the proposed study include (1) improved understanding of resuspension by propeller wash and its impact on bottom sediment in DoD harbors, (2) predictive capabilities for potential re-contamination of contaminated sediment remedial sites, and (3) better information-based decision making in managing propeller wash induced sediment resuspension, transport and re-contamination potential. This report summarizes both the field study and modeling study for Pearl Harbor.

2. TECHNOLOGY

2.1 TECHNOLOGY DESCRIPTION

The study includes both field and modeling studies. Field studies concentrated on measuring and tracking turbidity and chemical (metals) plumes of the water column from resuspension by propeller wash. Propeller wash induced flow velocities were also measured to support the propeller wash models.

The field study was designed to measure the turbidity and chemical plumes from erosion by propeller wash and track down the fate and transport of the plume during different tidal and hydrodynamic conditions. The transport and dispersal of the plume were tracked down and water samples of the plume were collected at approximately nine locations downstream, each at surface and mid-depth. Concentrations of TSS, particle size distributions (clay, silt and sand fractions), and 13 priority pollutant metals associated with each particle size were measured. Characteristics of the plume, such as partitioning, settling of particulate metals, and transport of metals were estimated from the data.

Data collected from the propeller wash events was used to compare with the CH3D model. CH3D is a far-field model, which assumes that sediment and contaminate that is resuspended into the water column from propeller wash can be identified in its location and measured in its quantity, which were assigned as the initial conditions for the model. The source term of sediment and contaminants are subject to tidal and local riverine freshwater hydrodynamic forcing during their transport in the region. The CH3D model receives tidal forcing from the mouth with an average tidal range of about 1 meter. Our previous studies show that water column transport in Piers 4 and 5 is in the southward, in-bay direction during the flooding tide, and in the northward, out-of-the-bay direction during the ebbing tide. Therefore, the plume is expected to be dispersed and advected possibly in both directions, depending on the tidal conditions. During the transport, particulate metals deposited by settling with dissolved species tend to remain in the water column. We have run the model for more than 5 days, at least, before the majority of the metals and sediment from the original plumes either gets deposited to the bottom or is flushed out of the bay through the mouth. The depositional footprint of the sediment and particulate metals were calculated and time series of sediment and metal concentrations in the water column were predicted, providing an exposure time series and re-contamination potential estimate. The application of CH3D can extend our understanding on the fate and transport processes beyond the data and the scenarios where the data are to be measured. The model can also simulate and predict re-contamination potential (footprints) from propeller wash. For the propeller wash model, results from the Maynord's model were evaluated and the erosion potential has helped determine the operational conditions for the propellers to erode the bottom sediment.

Other instruments that were deployed to measure the flow velocities and shear stress included an acoustic doppler velocimeter (ADV and acoustic doppler current profiler (ADCP. While ADV measures current velocity (amplitude and direction) near the tip of the instrument probe, which is a fixed point, ADCP measured the current velocities (both amplitudes and directions) at various pre-configured distances and frequencies within an acoustic cone. As such, ADCP can measure velocity profiles (x-y in horizontal plane) at various depths (z-depth). In general, ADCP can be either mounted at the bottom with acoustic signals sent upward (upward looking) and current profiles in the horizontal plane (x-y) at various depths can be measured. Alternatively, a downward-looking ADCP can be installed on board the boat measuring current velocities (both amplitudes and directions) in the horizontal plane (x-y) at various depths. Both ADV and ADCP measured velocity profiles were used to estimate the bed shear stress at the sediment bed induced by the propeller wash. Bed shear stress is the most important parameter that determines both the inception of resuspension (the critical shear stress) and the entrainment rate. Existing models for propeller wash, i.e., Maynord's model (1984, 1998, 2006), predicts the near bed velocity, which is then converted to a bed shear stress. Such a conversion is based on the theory of turbulent boundary layer in channel flows, usually under a uniform and steady flow condition. Similarly, SedFlume has been applied to establish the relation between the erosion rate and the varying near-bed flow velocity in a confined channel where flow is relatively uniform. Almost all existing sediment entrainment models are obtained through laboratory flume studies with well-defined flow conditions. The flow field behind a propeller is extremely turbulent and unsteady, which differs significantly from that in a channel or river, or flows induced by tidal current, flood flow, wind wave, etc.

The proposed underwater PIV can measure instantaneous velocity field at high-frequency and high spatial resolution near the bottom, including the bottom boundary layer region. A number of fluid parameters, including the fluctuating velocity, energy dissipation rate, and the Reynold's stress (as a surrogate to the bottom shear stress) can be directly measured (Liao et al., 2009). There are no other existing methods that can measure these parameters simultaneously in the field. Simultaneous deployment with the SPI and ADCP has provided a relation among the sediment erosion rate, bed stress and the mean near-bed velocity distribution, specifically for the propeller wash. To establish this relation, we may also explore higher statistical moments of the measured Reynolds stress or energy dissipation rate (i.e., variance, skewness) that accounts for peak bed stress in addition to the mean value. The main purpose of these measurements is to provide "ground-truth" data that does not exist yet. These results were used to modify and calibrate existing models, such as the Maynord's model.

2.2 OVERALL TECHNICAL APPROACH

Figure 1 and Figure 2 show the overall technical approach for the study, with Figure 2 showing the configuration of the CH3D model grids. We have calibrated and validated the instruments, including PIV, ADV, and ADCP for current speed measurement at the bed boundary near bottom, and water column respectively, a laser particle size analyzer (LISST) for particle size distributions and SPI for imagery of bottom sediment profiles before, during and after sediment erosion by propeller wash. During 2012, field study were conducted in San Diego Bay, CA, and Pearl Harbor to measure sediment and metal plumes in the water column from propeller wash and track down the fate and transport of the plume over tidal cycles. Water samples were taken from a mesh that has been pre-determined from results from model simulations and knowledge from previous studies. The propeller was first allowed to run at the designed speed for 3–5 minutes to allow adequate resuspended materials. Water samples were collected at 10–20 mesh points (sampling locations), which include suspended solids concentrations of sand and fine particles, dissolved and particulate metals bounded with sand and fine particles, and settling velocities. Only water sampling was measured. Deposited sediment and metals were not measured, but have been estimated by the CH3D model.

For resuspension study, Maynord's model was set up to estimate resuspension potential and the amount. The calibrated fate and transport model, CH3D was set up to simulate the transport pattern, re-migration and re-contamination potential of the sediment and metal plumes. Simulations have been conducted at least 5 days following a resuspension event until most of the plumes either get settled to the bottom or is flushed out of the Bay. CH3D simulates both the time series of sediment and metals (dissolved, particulate and total) in the water column and footprint (deposition) of particulate metals and sediment to the bed during the 5+ days of simulation. Model results were compared with the measured data for demonstration of its predictive capabilities.

In addition to the fate/transport study, we measured a minimal number of parameters that are useful in supporting the propeller wash model, both the Maynord's model and/or FANS. These parameters include current speed by ADCP and PIV. Measured data was analyzed and compared with the results from Maynord's model. Through these efforts, we have demonstrated the characteristics and predictive capability of either or both models for navigating (including U.S. Navy) vessels in Pearl Harbor.

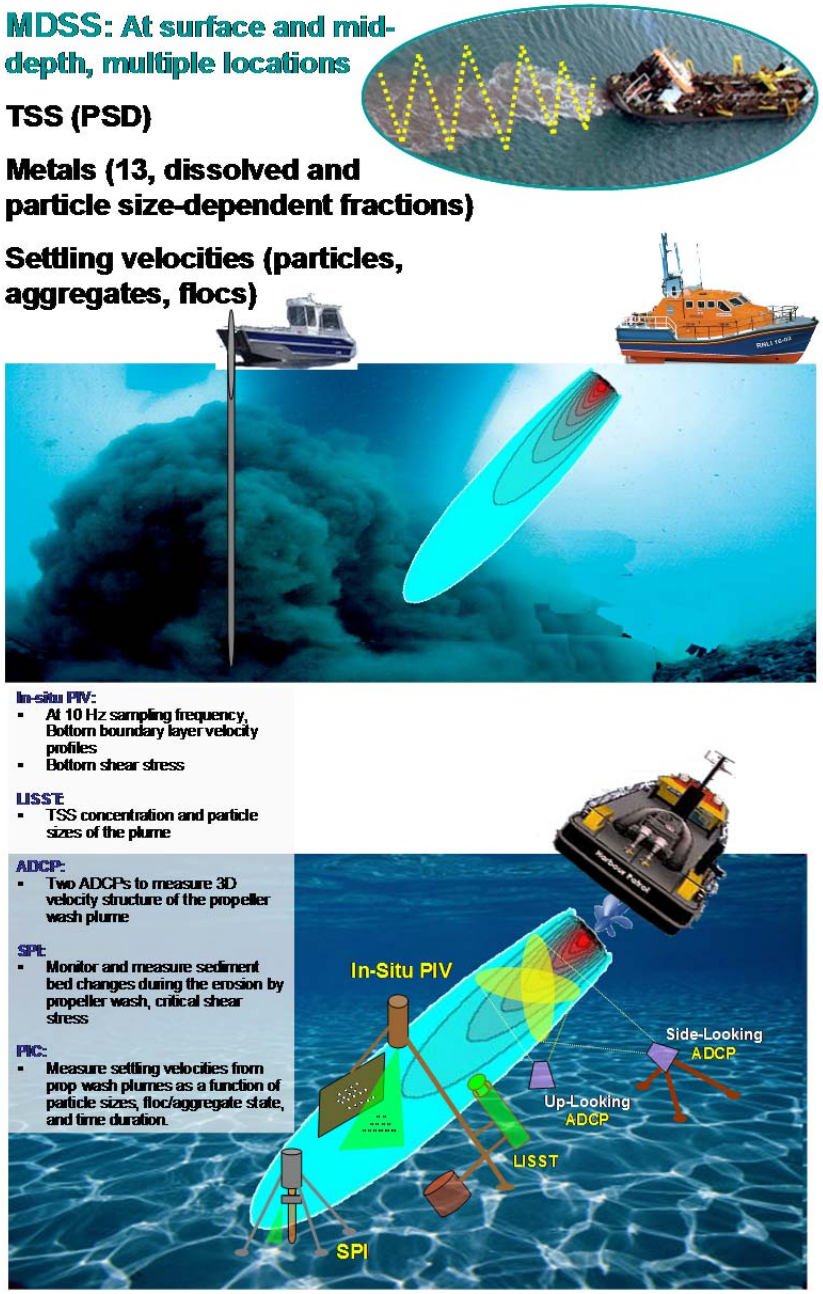


Figure 1. Field study to measure and track fate and transport of plume from propeller wash (above) and to measure the propeller wash-flow disturbances (below).

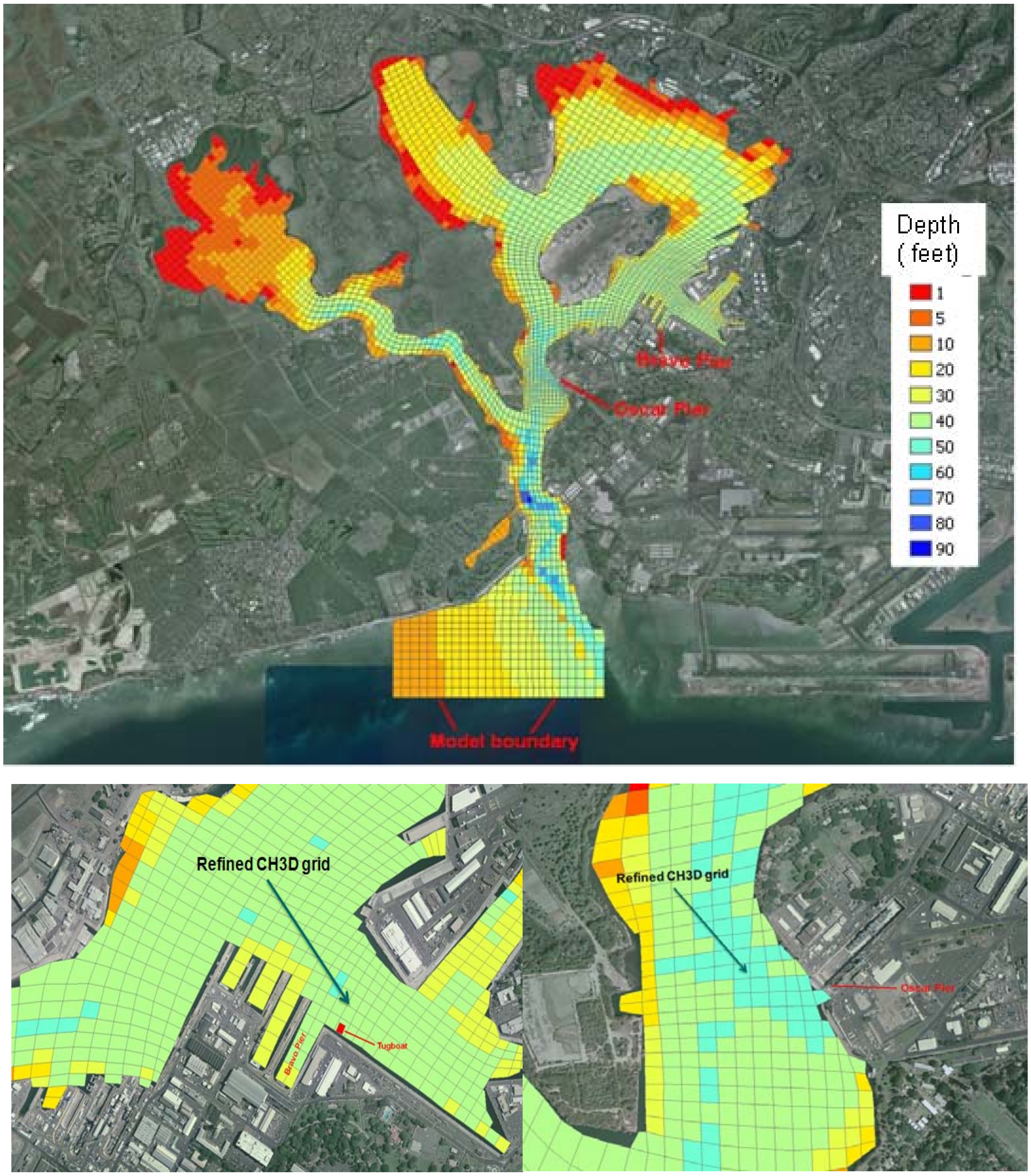


Figure 2. Fate and transport CH3D model for Pearl Harbor (model grid above, and local grid at Bravo Pier, and Oscar Pier, below left and right, respectively.

3. FIELD STUDY

This report summarizes the analytical results of the quantification of contaminants of concern (CoC) and the associated metal and organic contaminant load, in a suite of sediment fractions associated to resuspension induced by propeller wash in Department of Defense (DoD) harbors. Three propeller wash resuspension events were conducted as part of the project, "Evaluation of Resuspension from Dredging, Extreme Storm Events, and Propeller Wash in DoD Harbors," which was jointly supported by Naval Facilities Engineering Command (NAVFAC) Pacific and the Environmental Security Technology Certification Program (ESTCP) (ER-201031). One event took place on 4 April 2012 in San Diego Bay, CA, while the other two events were conducted 28 August and 29 August 2012 in Pearl Harbor, HI. The overall objective of NAVFAC Pacific and ESTCP joint project is to demonstrate and validate innovative methods to quantify resuspension and recontamination potential resulting from the resuspension of bottom contaminated sediments by propeller wash, and application of the validated methods to evaluate and quantify the resulting effects from propeller wash on the effectiveness and stability of sediment capping. Use of these methods has led to more informed evaluation of remedial options and to improve the predictive capabilities for potential recontamination of sediment remedial sites.

3.1 OVERALL OBJECTIVES OF FIELD WORK

The objective of the field work component is the collection of discrete seawater samples, representative of background and conditions within the resuspended sediment plume generated by a tug-boat propeller. These samples are manipulated in the laboratory for quantification of the load of metal and organic CoC associated with a suite of sediment-size fractions, information that have been used for parameterization of predictive hydrodynamic models.

3.2 FIELD AND LABORATORY PROCEDURES

The logic of the sampling plan and data analysis perhaps can best be presented by following the United States Environmental Protection Agency (USEPA) suggested seven-step data quality objectives (USEPA, 2006; Plumb 1981). Our reasoning follows and is the basis for this study plan. The problem statement is whether resuspended sediment plumes result in transport of bottom sediment contamination away from the source, and to what degree. The decision as to whether it does could be determined by the CoC load level in the resuspended sediments, and to what degree could be determined by the load of the COC in the different size-fractions of particles (or dissolved) that would be susceptible for transporting by advective forces. Among the inputs necessary to make such a decision would include measuring background water column contaminant concentrations and subsequent contaminant concentrations in the resuspended plume, which are quantified in this component of the project.

Tracking of metal and suspended solid concentrations is done by sampling the plume generated by a tug-boat. This tracking is done on a neap tide to have enough time to take a significant number of samples on the plume. The plume is tracked by a boat equipped with a pump fast enough to fill up a 22-L carboy in a couple of minutes. Samples are pumped from about 1 m (3 ft) below the water surface, and from mid-depth (~ 5 m or 15 ft). Samples from bottom waters are avoided as the sampling pump could induce resuspension from bottom sediments, affecting the concentrations in the plume.

The samples are sub-sampled in our laboratory facilities following the same procedure for each carboy. Figure 3 shows the CoC (i.e., metals and organic contaminants) analysis in a flow chart. Note that the numbers used in the figure are also displayed in the tables with data for identification. The green boxes represent the CoC concentration measured in the filtered seawater sample with particles for each size-fraction. CoC concentrations for each fraction (green boxes) are determined by subtracting the concentration derived from the next finer filter. The mass of particles retained by the 60-µm mesh (sand), 5.0- and 0.4-µm filters (brown boxes), is quantified as dry weight by the difference between tare and dry weight. For practicality, the original water sample collected in the field may be sub-sampled to allow parallel filtrations for CoC concentrations and particle mass. Only total and dissolved CoCs are determined for the background water concentrations.

Fractionation is done by filtering through sieves, meshes, or filters of the indicated pore-size. Each carboy is agitated manually following the same pattern, and a 1-L sample is collected in a graduated cylinder as soon as possible using the spigot. This aliquot is then filtered through a clean, pre-weighed (i.e., tared) 60-µm mesh. Enough aliquots are filtered (about 5 L) to accumulate a measurable mass of sand on the mesh. The filtered sample is then used for filtration/quantification in the other two smaller pore-size filters, filtering enough sample volume to accumulate a measurable amount of sediment in each phase. All the filters are tared and the mass of retained sediment is quantified after drying. Subsamples of 125 mL filtrated seawater are collected for each fraction and acidified to pH ≤ 2.0 with quartz-still grade nitric acid (Q-HNO_3) for metal quantification by inductively couple plasma with detection by mass spectrometry (ICP-MS). Alternatively, 1-L samples are collected from selected samples in amber glass bottles for quantification of organic contaminants.

The proposed sample design for collection of background and resuspended information is shown in Table 1. The metals of interest and the analytical methods used for quantification are listed in Table 2.

Quality assurance/quality control (QA/QC) for these quantifications is as follows. A duplicate sub-sample is obtained from a sample for each event. QA/QC for metal quantification includes calibration curves with correlation coefficients ≥ 0.999, blank analyzed every five samples with a concentration within ±10% of background, a standard reference material (SRM) every five samples with a recovery of ±15% of certified concentration, a spiked sample per run with a recovery of ±15% of spiked concentration.

Table 3 summarizes the QA/QC for the ICP-MS work performed for this effort. The two SRMs included were 1643e, Trace Elements in Water, from the National Institute of Standards and Technology, and CASS 4, Nearshore Seawater Reference Material for Trace Metals, from the National Research Council Canada. Note that silver concentration is not certified for CASS4.

3.3 FIELD RESUSPENSION EVENTS

A similar process is used to create and sample for each resuspension event. Background samples of sediment and water are collected prior to any resuspension event. A C-14 Tractor and slightly smaller Tiger tug-boats were used in San Diego Bay and Pearl Harbor, respectively. Both vessels have 360°-rotation twin-ducted propellers of approximately the same size, located at the bottom of the boat. The revolution (rpm) of the propellers is adjusted to make about the same water advection force during the studies at San Diego Bay and Pearl Harbor. In each place, the tug-boat is moored adjacent and pointing into a fixed location, quay wall, or pier. The starting time for each resuspension event is predetermined based on tide times. Once the time is achieved, the tug-boat operates the engines at a predetermined time and power, or rpm, sufficient to generate a visible surface plume of resuspended sediments. Once the tug-boat engine stops, then the sampling boat(s) start tracking and sampling the plume for about 2 hrs. A diagram of the resuspension event procedure, including a schematic of the mapping is shown in Figure 4.

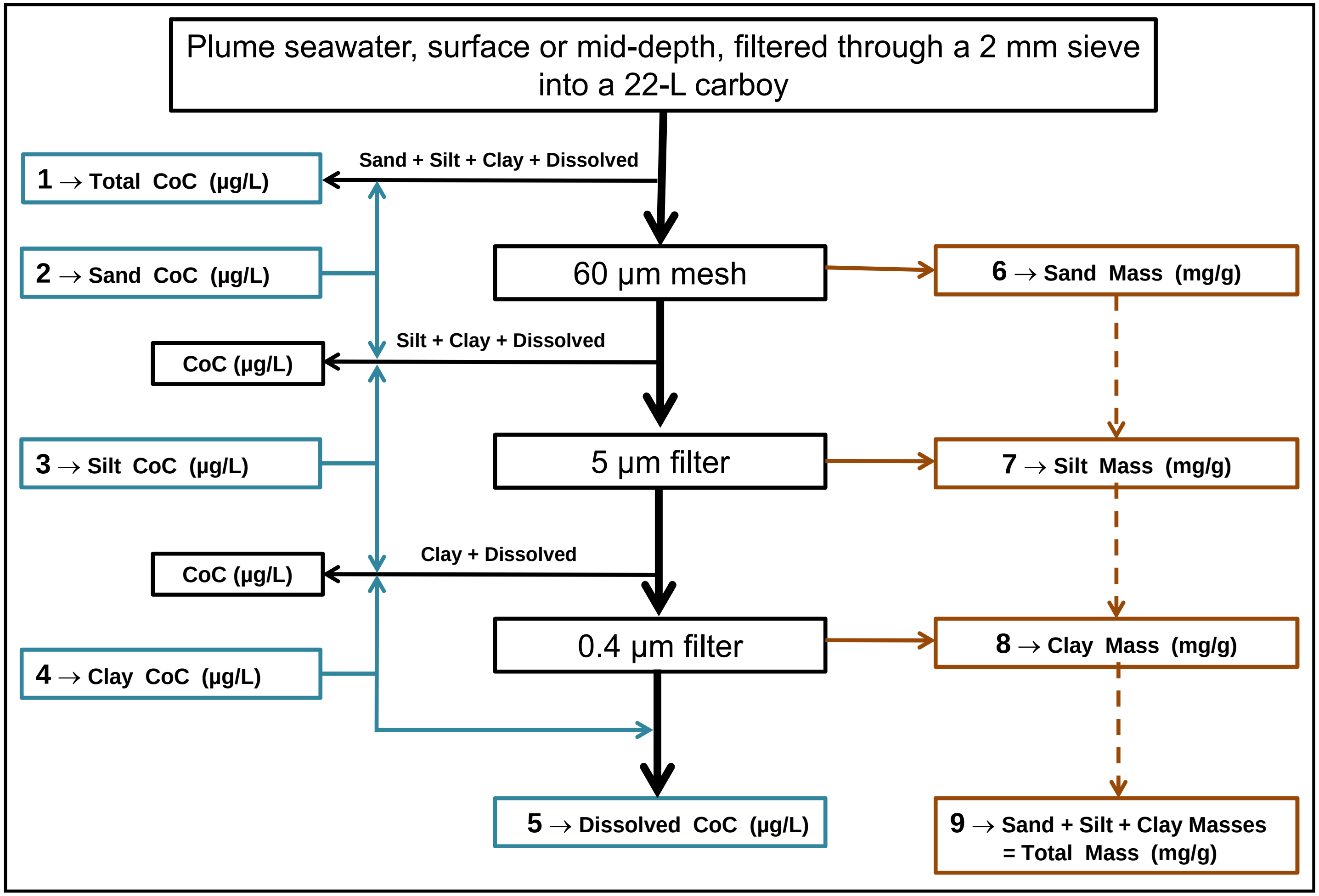


Figure 3. Flowchart of laboratory processing and analysis of the field samples for determination of CoC (i.e., metals or organic contaminants) concentrations in the total, sand, silt, clay, and dissolved fractions. Information in the middle represents the filtration sequence, information to the left are concentrations measured in the filtrated seawater, and information to the right are masses retained by the respective filter.

Table 1. Number and type of analytical samples.

Task	Matrix	Location	Number of Sites	Analytes	Fractions
Background levels	Water	Resuspension site mid-depth	3	Metal and organic CoCs	Total and dissolved
	Sediment	Resuspension site surface sediments	3	Metal and organic CoCs	Total, sand, silt, clay
Plume levels	Water	Plume surface	Site & event dependent	Metal and organic CoCs	Total, sand, silt, clay, dissolved
	Water	Plume mid-depth	Site & event dependent	Metal and organic CoCs	Total, sand, silt, clay, dissolved

Table 2. Metal analysis in seawater samples, following methods suggested by USEPA (1994, 1999). Q-HNO3 is quartz-still grade nitric acid.

Metal	Method	Matrix	Preservation/ Digestion	MRL	MDL	Units
Arsenic	6020/200.8	Seawater	Q-HNO_3 pH ≤2.	**0.5**	**0.04**	µg/L
Cadmium	6020/200.8	Seawater	Q-HNO_3 pH ≤2.	**0.02**	**0.002**	µg/L
Chromium	6020/200.8	Seawater	Q-HNO_3 pH ≤2	**0.2**	**0.03**	µg/L
Copper	6020/200.8	Seawater	Q-HNO_3 pH ≤2	**0.1**	**0.004**	µg/L
Lead	6020/200.8	Seawater	Q-HNO_3 pH ≤2	**0.02**	**0.009**	µg/L
Nickel	6020/200.8	Seawater	Q-HNO_3 pH ≤2	**0.2**	**0.04**	µg/L
Silver	6020/200.8	Seawater	Q-HNO_3 pH ≤2	**0.02**	**0.004**	µg/L
Zinc	6020/200.8	Seawater	Q-HNO_3 pH ≤2	**0.5**	**0.06**	µg/L

3.4 PEARL HARBOR FIELD DATA

The two resuspension events in Pearl Harbor were performed in the waters surrounding Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility (PHNSY&IMF). One event was by Bravo Pier on 28 August 2012, and the other was by Oscar Pier on 29 August 2012 (Figure 5). At each site, three background sediment and water samples were collected prior to any resuspension, and there were three separate resuspension events. The first resuspension event was with the tug-boat forcing resuspension for 90 sec, after which water samples are collected at three stations from surface and mid-depth. The second resuspension event was a repetition of the first one. In the third resuspension event, the tug-boat forced resuspension of bottom sediment for 5 min, and samples were collected from eight stations at mid-depth only. Twenty samples were collected at each site. Sample identification, location, and time, as well as measured mass fractions for each of the two events in Pearl Harbor are shown in Table 4 and Table 5. All of these samples were fractionated and quantified for metal concentration and mass of sediment. In the same fashion, all the total samples, and the four size-fractions from selected samples were quantified for polychlorinated biphenyls (PCBs) and pesticides, CoCs present in Pearl Harbor.

Table 3. Summary of QA/QC information for the analysis of metals by ICP-MS. Std. Dev. is standard deviation, NC means concentration is not certified or reported, N/A is not applicable.

		Units	Chromium	Nickel	Copper	Zinc	Arsenic	Silver	Cadmium	Lead
Plume samples										
Plume Samples Blanks	Mean	µg/L	0.157	0.030	0.083	0.230	0.073	0.015	0.044	0.039
	Std. Dev.	µg/L	0.014	0.148	0.099	0.210	0.249	0.014	0.002	0.041
Limit of Detection		µg/L	0.042	0.445	0.297	0.631	0.747	0.041	0.006	0.124
Limit of Reporting		µg/L	0.14	1.48	0.99	2.10	2.49	0.14	0.02	0.41
SRM1643e Certified concentration	Mean	µg/L	20.40	62.41	22.76	78.50	60.45	1.062	6.568	19.63
	Std. Dev.	µg/L	0.24	0.69	0.31	2.20	0.72	0.08	0.073	0.21
SRM 1643e Recovery	Mean	%	99	106	97	97	107	110	96	100
	Std. Dev.	%	11.4	3.6	8.1	7.7	4.9	8.4	3.0	3.0
Duplicate sample recovery	Mean	%	98	95	88	88	86	99	96	97
	Std. Dev.	%	0.9	22.5	17.7	9.9	10.1	4.9	3.9	2.0
Spiked sample recovery	Mean	%	93	108	106	100	107	103	102	103
	Std. Dev.	%	16.7	15.7	13.6	11.9	14.7	11.0	19.6	11.7
Ambient Samples										
Ambient Samples Blanks	Mean	µg/L	0.467	0.202	0.237	0.481	0.99	-0.535	0.014	0.191
	Std. Dev.	µg/L	0.360	0.189	0.062	0.438	0.70	0.392	0.012	0.110
Limit of Detection		µg/L	1.079	0.567	0.185	1.314	2.09	1.175	0.036	0.331
Limit of Reporting		µg/L	3.598	1.890	0.616	4.379	6.96	3.916	0.120	1.102
CASS 4 Certified concentration	Mean	µg/L	0.144	0.314	0.592	0.381	1.11	NC	0.026	0.0098
	Std. Dev.	µg/L	0.029	0.030	0.055	0.057	0.16	NC	0.003	0.0036
CASS 4 Recovery	Mean	%	1146	109	90	104	89	N/A	96	1205
	Std. Dev.	%	1254	3.1	6.9	45.1	22.2	N/A	44.0	631
Duplicate sample recovery	Mean	%	25	86	97	76	109	159	99	87
	Std. Dev.	%	63	7.7	9.8	13.1	21.1	193	11.5	18.8
Spiked sample recovery	Mean	%	297	101	85	18	93	128	113	96
	Std. Dev.	%	180	8.3	6.9	17.0	67.4	337	7.2	8.7

3.4.1 Resuspension Particle Size Fractionation

In general, the silt-size fraction (5 to 60 µm) was predominant in the plume generated in each of the three resuspension events (Figure 6 and Figure 7). This particle size distribution is similar to the size-fraction distribution measured in background sediments sampled prior to the resuspension events (Table 6; Figure 7). These measurements in background sediments show the predominance of the silt fraction in sediments of the studied areas.

The predominance of the silt (5 to 60 µm) fraction is more conspicuous for the resuspension events in Pearl Harbor, where the silt fraction is between 50 and 90% of the total mass fraction. While the silt fraction in the resuspension event from San Diego Bay, 30 to 80% of the total mass fraction, had some locations where the sand (> 60 µm) and clay (5 to 0.4 µm) fractions are predominant, and provide between 60 to 70% of the total mass (Figure 6).

The particle size-fraction distribution has implications on the effect of advection of resuspended sediments. The area and the extent of contaminant effects depend on both the predominant resuspended particle size-fraction, and the distribution of contaminants between these particle size-fractions. In general, the smaller particle size-fraction, clay (5 to 0.4 µm), should stay longer in the water column, and should be transported for a longer distance. The opposite is for the largest size-fraction measured, sand (> 60 µm), which should settle back to the sediment much faster, covering a relatively smaller area than the smaller particle sizes.

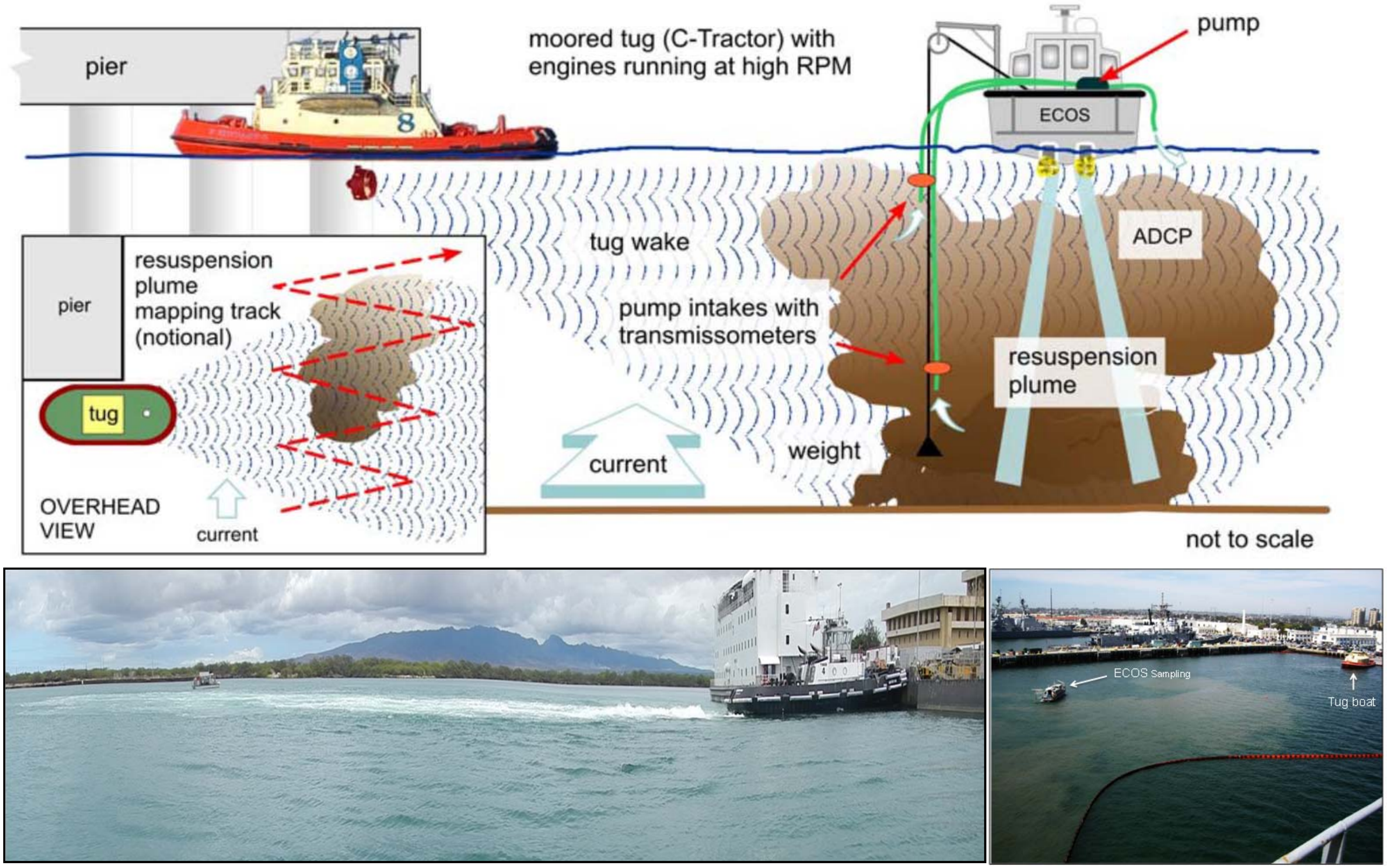


Figure 4. Diagram and views of the resuspension event procedure, including the tug-boat-induced bottom sediment resuspension, sampling of the plume, and mapping track on the plume.

3.4.2 Metal Size-Fraction Quantification and Potential Contaminant Concern

Metal concentrations were determined for the five size-fractions shown in Figure 3. These fractions are the total metal (1 in Figure 3), sand fraction (> 60 μm; 2 in Figure 3) silt fraction (5 to 60 μm; 3 in Figure 3), clay fraction (0.4 to 5 μm; 4 in Figure 3) and dissolved fraction (< 0.4 μm; 5 in Figure 3).

To provide an idea of the potential contaminant concern generated by the resuspension events, the metal quantification data reported here is compared to the USEPA Nationally recommended water quality criteria for the protection of aquatic life and human health (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm), which is provided in Table 7. And, to provide the most conservative comparison, the chronic water quality criterion is used in the comparisons.

3.4.3 Background Sediment Metal Concentrations

An important parameter is the metal concentration in the suite of size-fractions in the sediment that is resuspended. To assess this parameter, sediment samples were collected at each site prior to the resuspension event. These sediment samples were wet-sieved and filtered in the laboratory to separate the different size-fractions, which then were digested with aqua regia and the diluted digestates were analyzed by ICP-MS. The concentrations measured in the dry sediment for San Diego Bay are given in Table 8 and those for Bravo Pier and Oscar Pier in Table 9.

3.4.4 Pearl Harbor Field Data

Information similar to the one described above for San Diego Bay was collected at the multiple resuspension events of Bravo Pier and Oscar Pier in Pearl Harbor. Note that the resuspension events in Pearl Harbor were done in triplicate at each site, and even with this replication, the metal distribution between the different particle size-fractions depends on the metal as well. Chromium, nickel, and silver are mostly (~ 80%) present in the dissolved (< 0.4 μm) fraction in both resuspension sites (Figure 8 and Figure 10); although, there were some instances when their distributions were dominated by the sand (> 60 μm) or clay (0.4 to 5 μm) size-fractions during the resuspension events at Oscar Pier (Figure 10). Cadmium also appears dominated by the dissolved (< 0.4 μm) fraction; however, its distribution shows a significant time when the distribution is dominated by the sand (> 60 μm) or the clay (0.4 to 5 μm) fractions, especially in the Bravo Pier resuspension events (Figure 9). Lead distribution in both Pearl Harbor sites is dominated by the particle fractions, with minimal contribution by the dissolved (< 0.4 μm) fraction (Figure 9 and Figure 11). Copper, arsenic and zinc are distributed more evenly between the four size-fractions. This is more evident in the distributions from Bravo Pier (Figure 8 and Figure 9) than in those from Oscar Pier (Figure 10 and Figure 11).

Most metals were present at levels considered with low potential for concern as compared to accepted water quality criteria. Zinc, arsenic, silver, and cadmium were present at concentrations below the USEPA water quality criteria (Figure 12, Figure 13, Figure 14, and Figure 15). Copper is above the USEPA water quality criteria in the resuspension events of Bravo Pier (Figure 13); but below or similar in Oscar Pier (Figure 15). Lead had few concentrations similar to the USEPA water quality criterion in Bravo Pier (Figure 13); but below this criterion in Oscar Pier (Figure 15). Only chromium and nickel were consistently over their respective water quality criteria in the six resuspension events performed in Pearl Harbor (Figure 12 and Figure 14).

Once again, resuspension events caused by propeller wash in Pearl Harbor can affect metal concentrations above ambient conditions. Similar to the San Diego Bay resuspension event, all the metals had concentrations above ambient levels in all the resuspension events in Pearl Harbor (Figure

12, Figure 13, Figure 14 and Figure 15). The only metal with concentration at the same levels than ambient was cadmium in the resuspension events out of Bravo Pier (Figure 13).

Concentrations of organic COCs were undetectable to the laboratory methods used. Selected PCBs and pesticides measured in samples from the resuspension events from both Pearl Harbor sites were below the laboratory method detection level (Tables 10 and 11). These results indicate that concentrations of these organic COCs should be of no concern with respect to sediment resuspension events, at least for the two sites tested.

3.5 PARTICLE IMAGE VELOCIMETRY (PIV)

3.5.1 Instrumentation and Deployment

The in-situ UnderWater Miniature PIV (UWMPIV) system was recently developed at the University of Wisconsin–Milwaukee. The UWMPIV was successfully deployed to characterize the hydrodynamics of the bottom boundary layer of Lake Michigan (Liao et al., 2009). Meanwhile, a second-generation UWMPIV was developed for high-speed flow measurement with a dual-beam, dual camera configuration (Wang, Liao, Bootsma, and Wang, 2012). The current design of the UWMPIV is flexible. Primarily, it consists of two submersible units:

1. A laser unit with one or two continuous wave (CW) DPSS lasers and a galvanometer (scanning mirror) that scans the laser beam into an effective laser “sheet.” The power-supply unit that includes high-capacity lithium-ion batteries is also housed along with the laser unit .

2. A camera unit with a CCD camera, a compact computer for streaming image data, and a signal control unit. The power consumption of the entire system is about 30 W when running at the full rate.

In this study, the two units were mounted on a steel frame. The laser unit was oriented vertically with the laser “sheet” shooting downward, parallel to the main direction of the flow generated by the propeller. The body of the camera housing was parallel to the sea bottom, taking images of the laser “sheet.” Figure 19 shows the configuration of the PIV frame. An ADV probe (Nortek Victrino) was also mounted along on the PIV frame. The sample volume of the probe was about 12 to ~ 13 cm above the sediment bed, as obtained through the bottom check function of the probe. It is about 10 cm downstream (for the propeller-induced current) of the central point of the PIV image frame, and 10 cm offside from the laser “sheet,” so it did not disturb the flow in the field of view (FOV) of PIV measurements. Four 1- x 2-ft aluminum plates were mounted on the four legs of the steel frame to prevent the system from sinking down into the mud. During the deployment, a scuba diver inserted four 2-ft steel bars into the sediment bed through each plate, which helped hold the entire system from being blown down by the high-speed current generated by the propeller.

PIV data was acquired at a rate of 8 Hz, i.e., eight image pairs per second. Each data set recorded 1000 image pairs, or 125 sec. The image size was set to 1360 (vertical) × 800 (horizontal) pixels. With a resolution of 0.118 mm per pixel, that mapped to a physical size of 16.0 × 9.4 cm. The imaging system was adjusted such that the sediment/water interface was always visible in the FOV. The width of the laser sheet varies as it fans out from top to bottom. Eventually, the two-dimensional (2D) velocity field measured by PIV was about 11.5 × 7.8 cm, smaller that the image FOV. A multi-pass PIV interrogation algorithm with anti-aliasing method (Liao and Cowen, 2005) was applied to reconstruct the 2D velocity field. The sub-window image size of the final pass was set to 40 × 40 pixels, or 4.7 × 4.7 mm, with a 50% overlap. Therefore, the “effective” PIV resolution was about 2.4 mm. Figure 20 shows a sample PIV image and the 2D velocity field revealed by PIV. The vector field represents the actual velocity field subtracting the mean stream-wise velocity averaged over the entire measurement field at that moment, with the intention to present vertical structures of the turbulent flow field. Note that a sediment plume was stirred up by the flow, forming a slope that was about 45^{o}, suggesting a typical boundary layer turbulence structure. In the analysis presented later, we denote such a moment as the critical point for sediment resuspension, and the corresponding shear stress measured through PIV was assumed to be the "critical shear stress" for sediment entrainment.

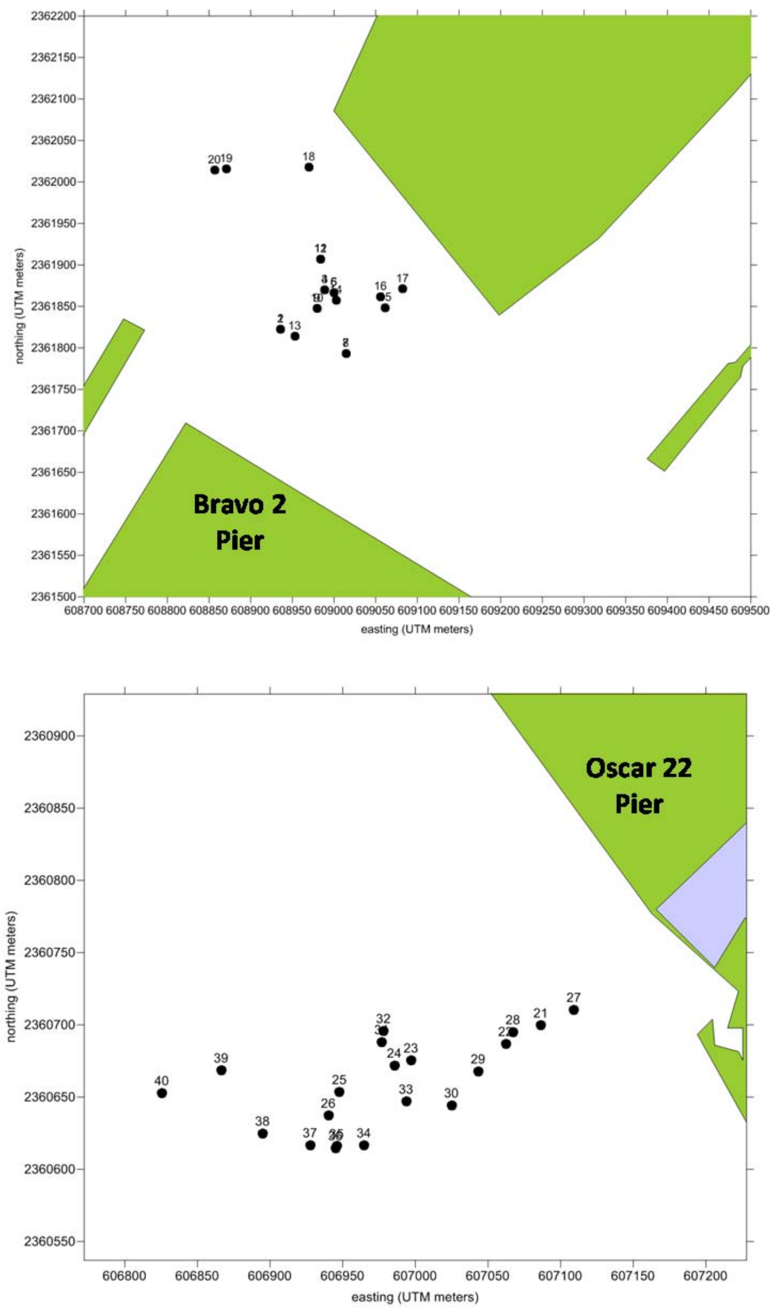


Figure 5. Sampling locations for the two bottom sediment resuspension events in Pearl Harbor, HI, Bravo Pier on 28 August 2012 (top), and Oscar Pier on 29 August 2012 (bottom).

Table 4. Sample identification, location and time, as well as mass fractions of the different particle sizes measured in samples from the Pearl Harbor resuspension events of 28 August 2012 at Bravo Pier. Note that the top header numbers and mass fractions correspond to those in Figure 1.

Sample ID	Time	Longitude	Latitude	Temp (°C)	Salinity	Transmission (%)	6 Sand 60 µm Mass Fraction (mg/L)	7 Silt 5 µm Mass Fraction (mg/L)	8 Clay 0.4 µm Mass Fraction (mg/L)	**9 Total Mass Fraction (mg/L)**
1S	14:14	-117.12663	32.68013	17.51	33.19	65.23	0.20	2.48	5.33	8.01
1M	14:15	-117.12662	32.68009	17.51	33.19	64.89	3.70	11.60	9.41	24.71
2S	14:19	-117.12680	32.67958	17.34	33.20	14.21	20.19	32.80	5.56	58.54
2M	14:19	-117.12682	32.67953	17.39	33.20	7.78	14.89	45.60	8.24	68.73
3S	14:21	-117.12700	32.67989	17.48	33.19	66.40	-0.02	2.04	4.27	6.29
3M	14:22	-117.12702	32.67994	17.45	33.20	65.91	0.29	2.71	4.27	7.27
4S	14:24	-117.12721	32.68015	17.47	33.19	60.74	1.61	3.40	3.29	8.30
4M	14:25	-117.12717	32.68019	17.46	33.19	60.75	-0.18	4.42	3.81	8.05
5 S	14:28	-117.12752	32.67976	17.48	33.19	63.13	0.57	14.50	6.05	21.12
5 M	14:28	-117.12753	32.67958	17.48	33.19	52.43	3.65	36.92	7.56	48.13
6 S	14:31	-117.12770	32.67902	17.42	33.19	24.75	5.16	17.33	3.10	25.59
6 M	14:31	-117.12773	32.67899	17.41	33.19	24.31	10.43	39.20	5.83	55.46
7 S	14:34	-117.12777	32.67849	17.43	33.20	32.31	3.68	2.80	3.24	9.72
7 M	14:35	-117.12768	32.67845	17.36	33.20	21.32	1.55	6.06	4.44	12.05
8S	14:38	-117.12831	32.67825	17.46	33.19	26.47	2.37	19.00	5.57	26.95
8M	14:38	-117.12827	32.67825	17.46	33.19	28.71	8.59	16.15	3.46	28.20
9S	14:44	-117.12898	32.67863	17.47	33.19	53.73	0.59	6.42	4.29	11.30
9M	14:45	-117.12900	32.67857	17.51	33.18	51.65	-0.32	5.75	4.07	9.50
10S	14:48	-117.12939	32.67741	17.51	33.20	7.53	0.01	22.22	5.79	28.02
10M	14:49	-117.12948	32.67746	17.50	33.20	8.28	8.25	53.33	12.50	74.08
11S	14:53	-117.12805	32.67723	17.55	33.18	42.15	1.49	7.67	3.10	12.26
11M	14:54	-117.12799	32.67729	17.57	33.17	46.22	0.99	11.00	2.33	14.33
12S	14:57	-117.12757	32.67675	17.60	33.16	53.13	0.05	3.20	0.77	4.02

Table 4. Continued.

Sample ID	Time	Longitude	Latitude	Temp (°C)	Salinity	Transmission (%)	6 Sand 60 μm Mass Fraction (mg/L)	7 Silt 5 μm Mass Fraction (mg/L)	8 Clay 0.4 μm Mass Fraction (mg/L)	**9 Total Mass Fraction (mg/L)**
12M	14:57	-117.12753	32.67669	17.62	33.16	57.99	3.46	1.86	0.00	5.32
13S	15:00	-117.12819	32.67643	17.65	33.16	57.68	1.46	2.17	2.00	5.62
13M	15:01	-117.12820	32.67651	17.63	33.16	56.92	1.80	6.67	3.64	12.10
14S	15:04	-117.12713	32.67731	17.61	33.16	57.95	0.08	2.83	1.60	4.52
14M	15:05	-117.12700	32.67736	17.64	33.16	59.26	0.02	8.71	3.09	11.83
15S	15:07	-117.12650	32.67818	17.69	33.16	54.41	0.44	2.04	1.00	3.49
15M	15:08	-117.12641	32.67814	17.72	33.16	56.96	0.32	2.00	1.84	4.15
16S	15:21	-117.12786	32.67601	17.54	33.19	48.04	0.20	6.25	1.59	8.04
16M	15:22	-117.12789	32.67607	17.50	33.19	47.90	1.05	9.60	2.57	13.23
17S	15:27	-117.12703	32.67797	17.61	33.17	51.29	0.47	5.20	2.68	8.35
17M	15:28	-117.12691	32.67793	17.60	33.17	51.40	3.90	3.52	1.40	8.81

Table 5. Sample identification, location and time, as well as mass fractions of the different particle sizes measured in samples from the Pearl Harbor resuspension events of 29 August 2012 at Oscar Pier. Note that sample IDs are from 21 to 40 in consecutive order. Note that the top header numbers and mass fractions correspond to those in Figure 1.

Sample ID	Time	Longitude	Latitude	Temp (°C)	Salinity	Transmission (%)	6 Sand 60 μm Mass Fraction (mg/L)	7 Silt 5 μm Mass Fraction (mg/L)	8 Clay 0.4 μm Mass Fraction (mg/L)	9 Total Mass Fraction (mg/L)
1S	14:14	-117.12663	32.68013	17.51	33.19	65.23	0.20	2.48	5.33	8.01
1M	14:15	-117.12662	32.68009	17.51	33.19	64.89	3.70	11.60	9.41	24.71
2S	14:19	-117.12680	32.67958	17.34	33.20	14.21	20.19	32.80	5.56	58.54
2M	14:19	-117.12682	32.67953	17.39	33.20	7.78	14.89	45.60	8.24	68.73
3S	14:21	-117.12700	32.67989	17.48	33.19	66.40	-0.02	2.04	4.27	6.29
3M	14:22	-117.12702	32.67994	17.45	33.20	65.91	0.29	2.71	4.27	7.27
4S	14:24	-117.12721	32.68015	17.47	33.19	60.74	1.61	3.40	3.29	8.30
4M	14:25	-117.12717	32.68019	17.46	33.19	60.75	-0.18	4.42	3.81	8.05

Table 5. Continued.

Sample ID	Time	Longitude	Latitude	Temp (°C)	Salinity	Transmission (%)	6 Sand 60 µm Mass Fraction (mg/L)	7 Silt 5 µm Mass Fraction (mg/L)	8 Clay 0.4 µm Mass Fraction (mg/L)	9 Total Mass Fraction (mg/L)
5 S	14:28	-117.12752	32.67976	17.48	33.19	63.13	0.57	14.50	6.05	21.12
5 M	14:28	-117.12753	32.67958	17.48	33.19	52.43	3.65	36.92	7.56	48.13
6 S	14:31	-117.12770	32.67902	17.42	33.19	24.75	5.16	17.33	3.10	25.59
6 M	14:31	-117.12773	32.67899	17.41	33.19	24.31	10.43	39.20	5.83	55.46
7 S	14:34	-117.12777	32.67849	17.43	33.20	32.31	3.68	2.80	3.24	9.72
7 M	14:35	-117.12768	32.67845	17.36	33.20	21.32	1.55	6.06	4.44	12.05
8S	14:38	-117.12831	32.67825	17.46	33.19	26.47	2.37	19.00	5.57	26.95
8M	14:38	-117.12827	32.67825	17.46	33.19	28.71	8.59	16.15	3.46	28.20
9S	14:44	-117.12898	32.67863	17.47	33.19	53.73	0.59	6.42	4.29	11.30
9M	14:45	-117.12900	32.67857	17.51	33.18	51.65	-0.32	5.75	4.07	9.50
10S	14:48	-117.12939	32.67741	17.51	33.20	7.53	0.01	22.22	5.79	28.02
10M	14:49	-117.12948	32.67746	17.50	33.20	8.28	8.25	53.33	12.50	74.08
11S	14:53	-117.12805	32.67723	17.55	33.18	42.15	1.49	7.67	3.10	12.26
11M	14:54	-117.12799	32.67729	17.57	33.17	46.22	0.99	11.00	2.33	14.33
12S	14:57	-117.12757	32.67675	17.60	33.16	53.13	0.05	3.20	0.77	4.02
12M	14:57	-117.12753	32.67669	17.62	33.16	57.99	3.46	1.86	0.00	5.32
13S	15:00	-117.12819	32.67643	17.65	33.16	57.68	1.46	2.17	2.00	5.62
13M	15:01	-117.12820	32.67651	17.63	33.16	56.92	1.80	6.67	3.64	12.10
14S	15:04	-117.12713	32.67731	17.61	33.16	57.95	0.08	2.83	1.60	4.52
14M	15:05	-117.12700	32.67736	17.64	33.16	59.26	0.02	8.71	3.09	11.83
15S	15:07	-117.12650	32.67818	17.69	33.16	54.41	0.44	2.04	1.00	3.49
15M	15:08	-117.12641	32.67814	17.72	33.16	56.96	0.32	2.00	1.84	4.15
16S	15:21	-117.12786	32.67601	17.54	33.19	48.04	0.20	6.25	1.59	8.04
16M	15:22	-117.12789	32.67607	17.50	33.19	47.90	1.05	9.60	2.57	13.23
17S	15:27	-117.12703	32.67797	17.61	33.17	51.29	0.47	5.20	2.68	8.35
17M	15:28	-117.12691	32.67793	17.60	33.17	51.40	3.90	3.52	1.40	8.81

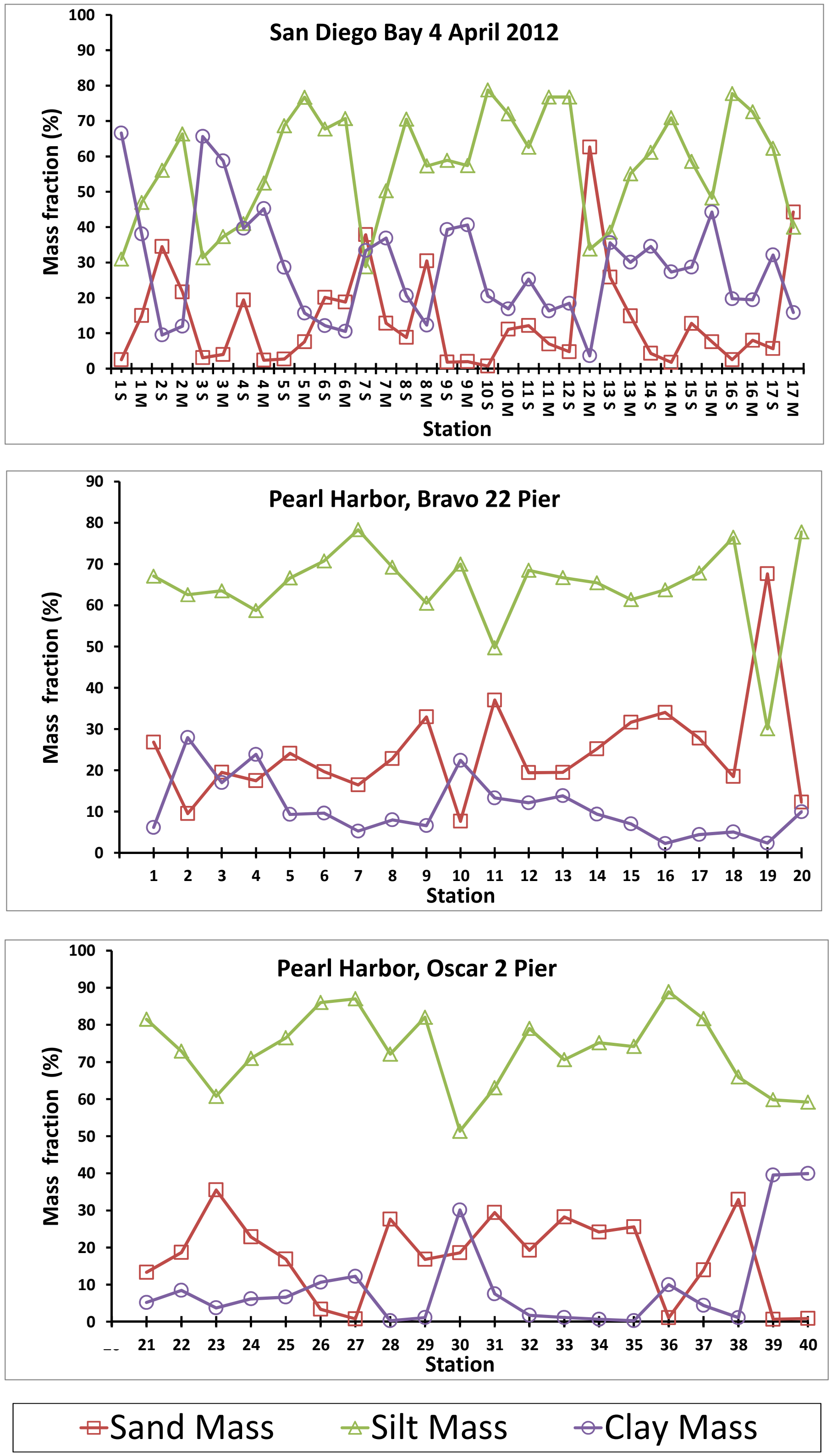


Figure 6. Mass fraction (%) of the sand, silt, and clay fractions sampled in the three resuspension events.

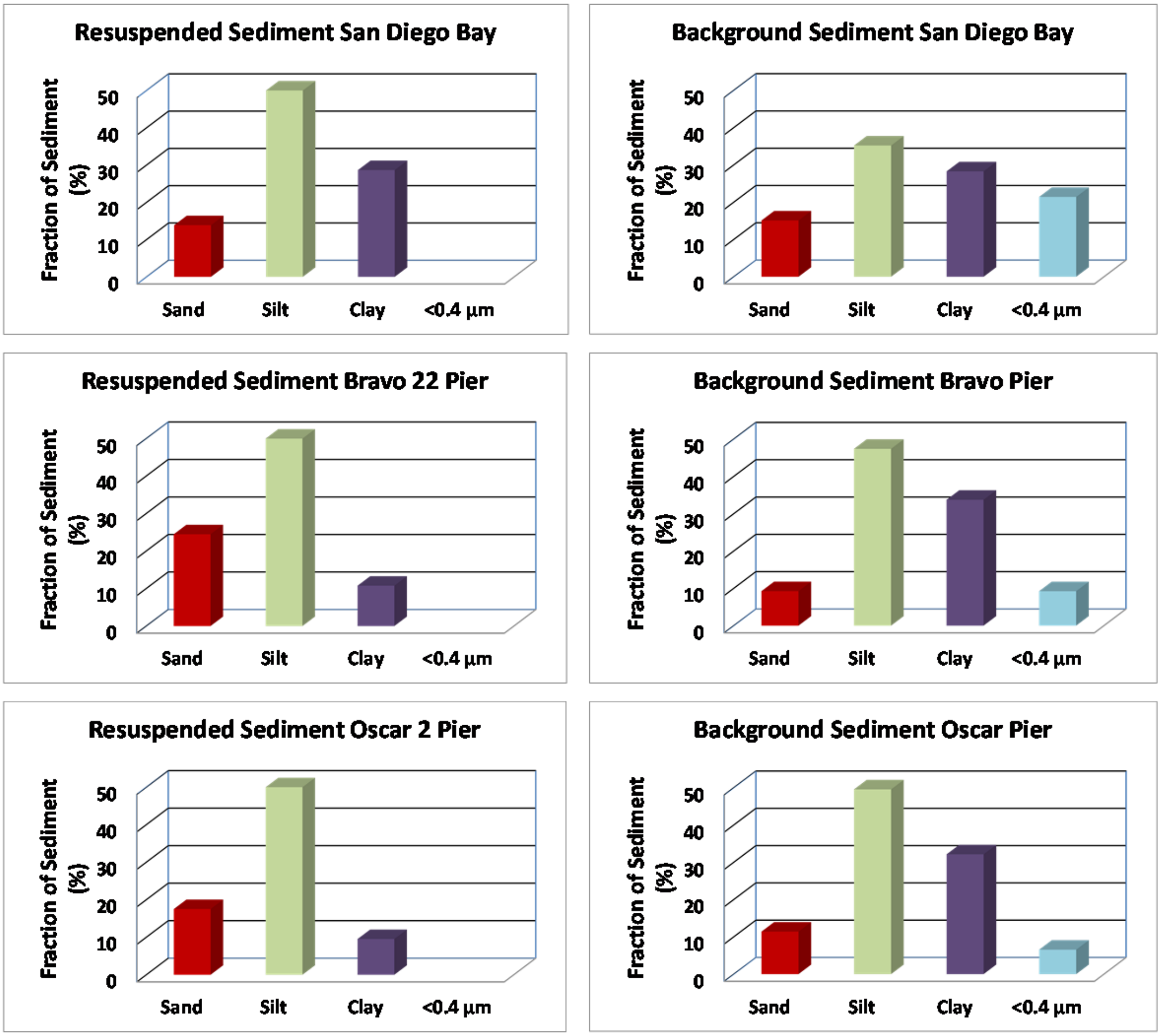


Figure 7. Average mass fraction (%) of the sand, silt and clay fractions sampled in the three resuspension events on the left, and from background sediments sampled before the resuspension events on the right.

Table 6. Particle size fractionation and total organic carbon (TOC) measured prior to resuspension from the three sites selected for this study. Data for Oscar Pier is from one sample, and was not analyzed for TOC.

	San Diego Bay, CA		Bravo Pier, HI		Oscar Pier, HI	
	Average (%)	Std. Dev. (%)	Average (%)	Std. Dev. (%)	Average (%)	Std. Dev. (%)
Sand (>60µm)	15.10	4.88	9.3	3.77	11.4	N/A
Silt (5 to 60 µm)	35.2	3.43	47.4	0.22	49.6	N/A
Clay (0.4 to 5 µm)	28.3	2.32	33.7	2.40	32.1	N/A
<0.4 µm	21.4	5.92	9.2	1.26	6.6	N/A
TOC	1.8	0.15	1.5	0.32	N/A	N/A

Table 7. Nationally recommended water quality criteria by the U.S. Environmental Protection Agency (USEPA). CMC = Criterion Maximum Concentration, CCC = Criterion Continuous Concentration (or Chronic Criterion).

Metal	Chemical Symbol	Priority Pollutant	CMC Acute (µg/L)	CCC Chronic (µg/L)	Notes	Publication year
Chromium (VI)	Cr	Yes	1100	50	D	1995
Nickel	Ni	Yes	74	8.2	D	1995
Copper	Cu	Yes	4.8	3.1	D, cc	2007
Zinc	Zn	Yes	90	81	D	1995
Arsenic	As	Yes	69	36	A,D	1995
Silver	Ag	Yes	1.9		D	1980
Cadmium	Cd	Yes	40	8.8	D	2001
Lead	Pb	Yes	210	8.1	D	1980

Notes:

A This recommended water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic, which might imply that arsenic (III) and arsenic (V) are equally toxic to aquatic life and that their toxicities are additive. No data are known to be available concerning whether the toxicities of the forms of arsenic to aquatic organisms are additive. Please consult the criteria document for details.

D Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria (PDF)," (49 pp, 3MB) October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available on NSCEP's web site and 40CFR§131.36(b)(1). **cc** When the concentration of dissolved or organic carbon is elevated, copper is substantially less toxic and use of water effect ratios might be appropriate.

Table 8. Metal concentrations measured in aqua regia digestates on background sediments from San Diego Bay. All data is provided in µg/g but for recoveries that are given as %. Certified are certified concentrations. Silver (Ag) is not certified in the SRMs.

		Cr (µg/g)	Ni (µg/g)	Cu (µg/g)	Zn (µg/g)	As (µg/g)	Ag (µg/g)	Cd (µg/g)
Total (n=6)	Average	32.0	10.2	90. 8	72.8	4.57	0.67	0.54
	Std. Dev.	5.7	1.7	24.8	17.4	1.00	0.21	0.07
63 µm (n=5)	Average	39.6	12.7	100.7	73.7	5.30	0.70	0.59
	Std. Dev.	2.4	0.63	17.2	8.6	0.48	0.07	0.07
5 µm (n=5)	Average	644.7	217.1	107.3	332.1	40.00	3.77	11.77
	Std. Dev.	445.6	147.8	69.5	234.4	27.92	2.39	8.10
Blank (n=3)	Average	0.11	-0.0020	0.05	1.79	0.74	0.0035	0.000014
	Std. Dev.	0.0048	0.0015	0.040	0.55	0.046	0.00090	0.00022
SRM PACS-1 (n=3)	Certified	113	44.1	452	824	211		2.38
	Average	39.6	19.7	135.6	226.6	69.6	0.69	1.26
	Std. Dev.	4.5	1.8	1.8	6.6	3.0	0.10	0.03
	Recovery (%)	35	45	30	27	33		53
SRM BCSS-1 (n=3)	Certified	14	55.3	18.5	119	11.1		0.25
	Average	30.6	22.4	5.6	26.8	4.6	0.13	0.27
	Std. Dev.	5.8	2.2	0.3	1.3	0.4	0.04	0.08
	Recovery (%)	219	40	30	23	41		106

Table 9. Metal concentrations measured in aqua regia digestates from background sediments from Bravo Pier and Oscar Pier in Pearl Harbor. All data is provided in μg/g but for recoveries that are given as %. Certified are certified concentrations. Silver is not certified in SRMs BCSS-1 and PACS-1.

		Cr (μg/g)	Ni (μg/g)	Cu (μg/g)	Zn (μg/g)	As (μg/g)	Ag (μg/g)	Cd (μg/g)	Pb (μg/g)
Bravo Pier Total	**Average**	**86.4**	**54.0**	**97.8**	**290**	**13.0**	**0.67**	**0.82**	**53.0**
	Std. Dev.	**5.5**	**3.8**	**62.2**	**100**	**1.1**	**0.43**	**0.20**	**35.1**
Bravo Pier <60μm	**Average**	**89.9**	**56.2**	**93.3**	**344**	**13.8**	**0.84**	**1.10**	**52.8**
	Std. Dev.	**1.4**	**2.4**	**40.3**	**82**	**0.5**	**0.56**	**0.25**	**32.2**
Bravo Pier <0.4μm	**Average**	**27.9**	**14.1**	**29.3**	**1165**	**33.7**	**1.70**	**5.31**	**25.3**
	Std. Dev.	**7.5**	**3.3**	**4.7**	**220**	**3.4**	**0.23**	**0.62**	**15.2**
Oscar Pier Total	**Average**	**51.8**	**33.2**	**49.0**	**225**	**10.5**	**0.32**	**0.41**	**41.8**
	Std. Dev.	**9.2**	**6.2**	**8.6**	**34**	**2.7**	**0.06**	**0.09**	**4.7**
Oscar Pier <60μm	**Average**	**44.2**	**28.6**	**41.4**	**207**	**9.5**	**0.32**	**0.47**	**31.5**
	Std. Dev.	2.9	0.7	10.8	19	0.4	0.02	0.05	3.9
Oscar Pier <0.4μm	Average	22.9	11.1	24.3	1406	32.9	1.32	4.90	10.4
	Std. Dev.	5.2	2.2	6.5	263	5.9	0.09	0.79	2.9
Blanks (n=5)	Average	0.062	0.080	0.60	16.3	0.58	0.0052	0.081	0.050
	Std. Dev.	0.039	0.0031	0.21	9.2	0.039	0.0029	0.0025	0.0077
BCSS-1 (n=3)	Certified	123	55.3	18.5	119	11.1		0.25	22.7
	Average	27.6	32.0	12.3	175	10.0	0.09	0.5	14.2
	Std. Dev.	1.8	1.7	0.7	2	0.6	0.02	0.0	1.1
	Recovery (%)	22	58	67	147	90		208	63
MESS-2 (n=3)	Certified	106	49.3	39.3	172	20.7	0.18	0.24	21.9
	Average	15.1	29.6	29.0	219	17.3	0.10	0.5	13.0
	Std. Dev.	1.0	3.5	1.9	29	1.2	0.02	0.1	0.7
	Recovery (%)	14	60	74	127	83	56	217	59
PACS-1 (n=3)	Certified	113	44.1	452	824	211		2.38	404
	Average	34.2	22.9	291.8	835	140	1.19	2.95	268
	Std. Dev.	2.3	1.7	21.1	9	5	0.04	0.13	19
	Recovery (%)	30	52	65	101	66		124	66

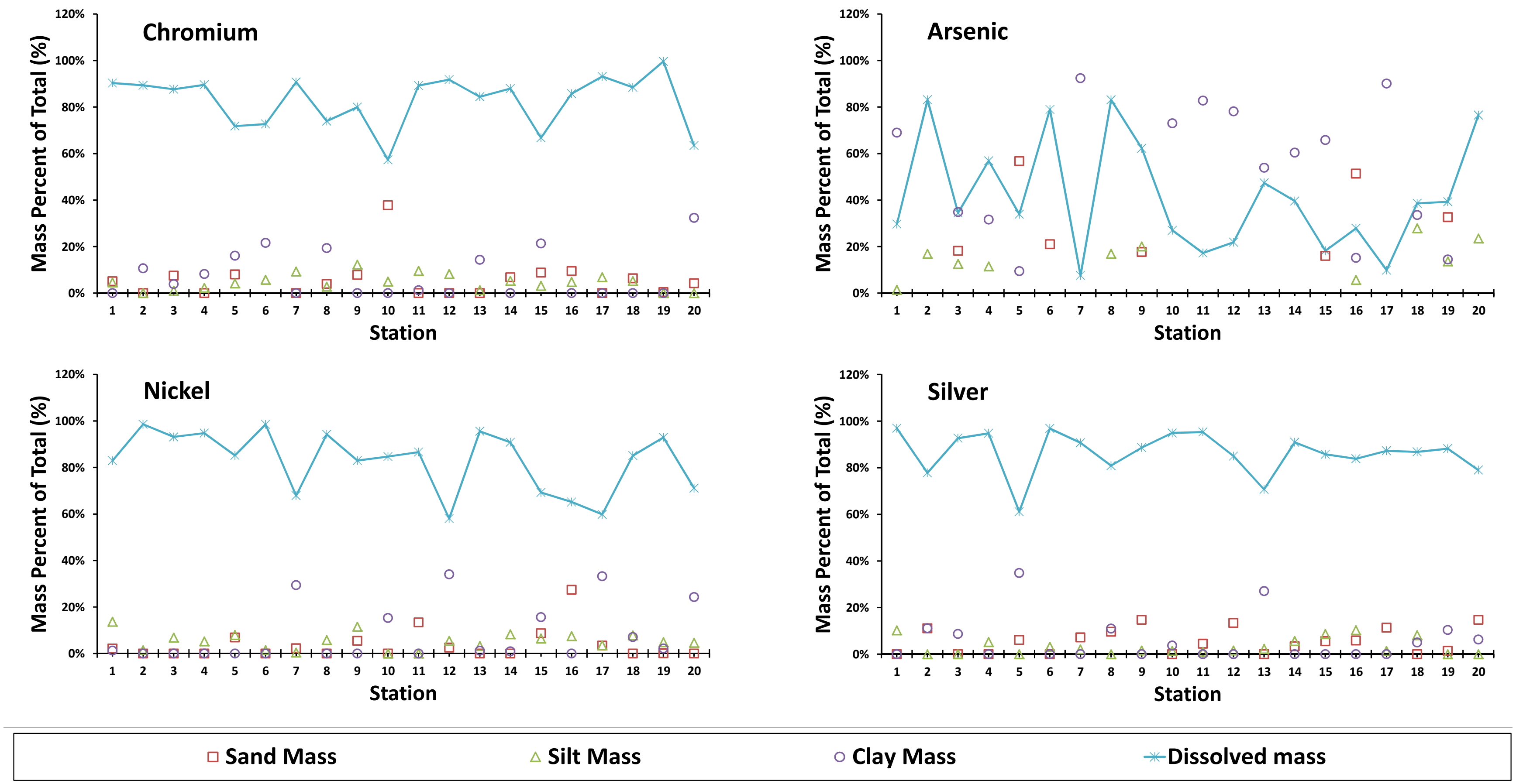


Figure 8. Chromium, arsenic, nickel and silver distributions in the different particle size-fractions collected from the resuspension event of 28 August 2012 at Bravo 2 Pier in Pearl Harbor. The metal content in each fraction is calculated with the total fraction as the sum of all fractions.

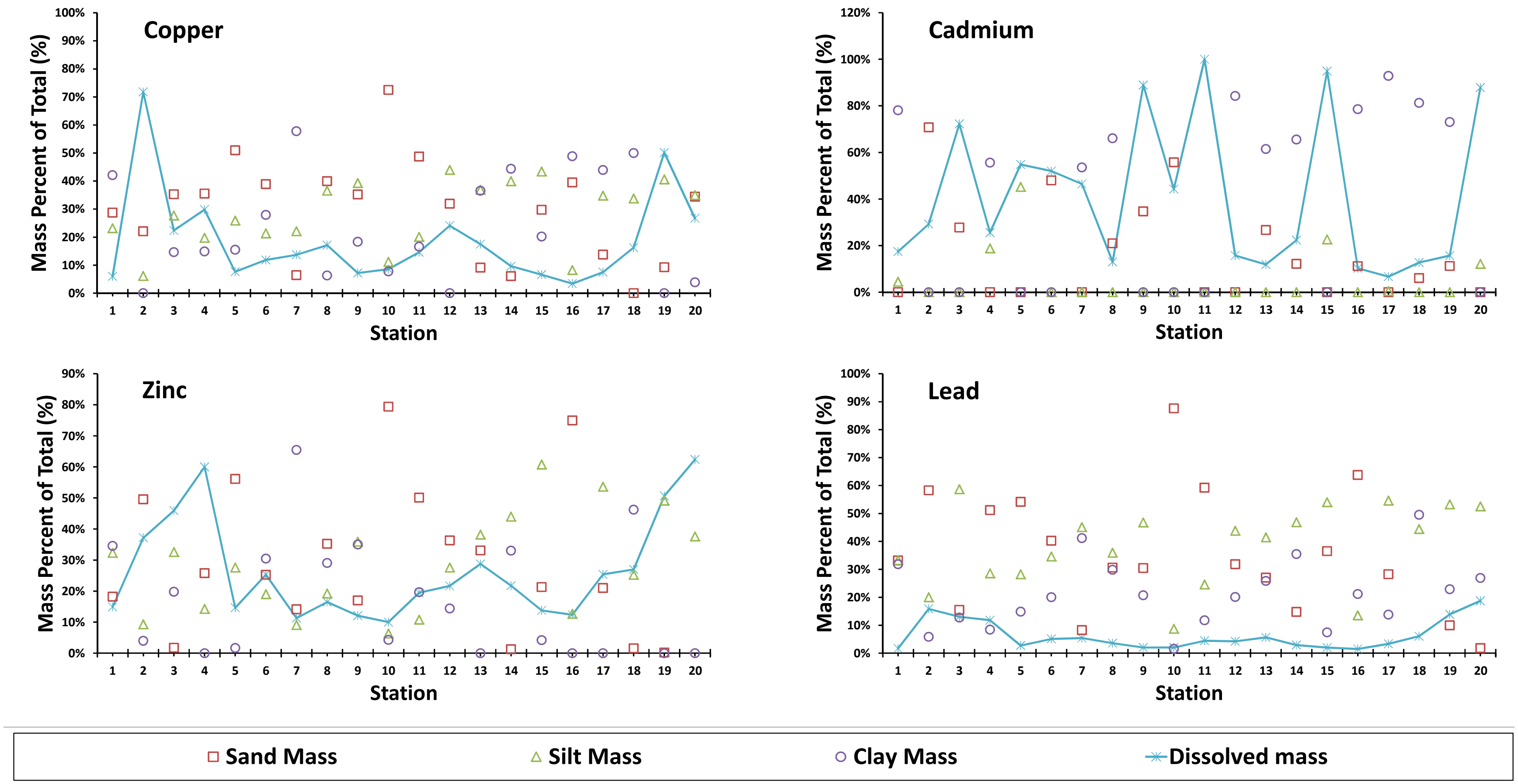


Figure 9. Copper, cadmium, zinc and lead distributions in the different particle size-fractions collected from the resuspension event of 28 August 2012 at Bravo 2 Pier in Pearl Harbor. The metal content in each fraction is calculated with the total fraction as the sum of all fractions.

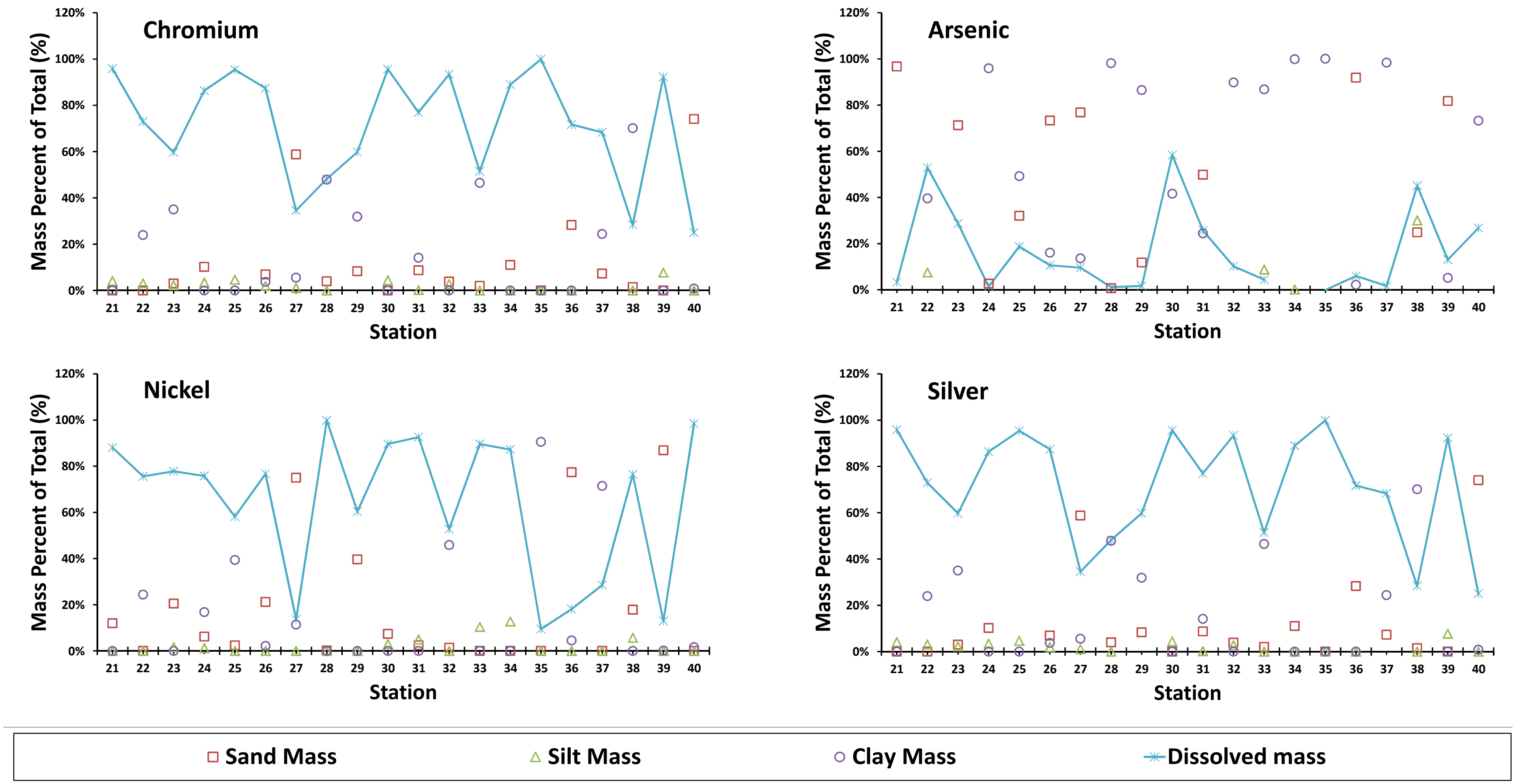


Figure 10. Chromium, arsenic, nickel and silver distributions in the different particle size-fractions collected from the resuspension event of 29 August 2012 at Oscar 22 Pier in Pearl Harbor. The metal content in each fraction is calculated with the total fraction as the sum of all fractions.

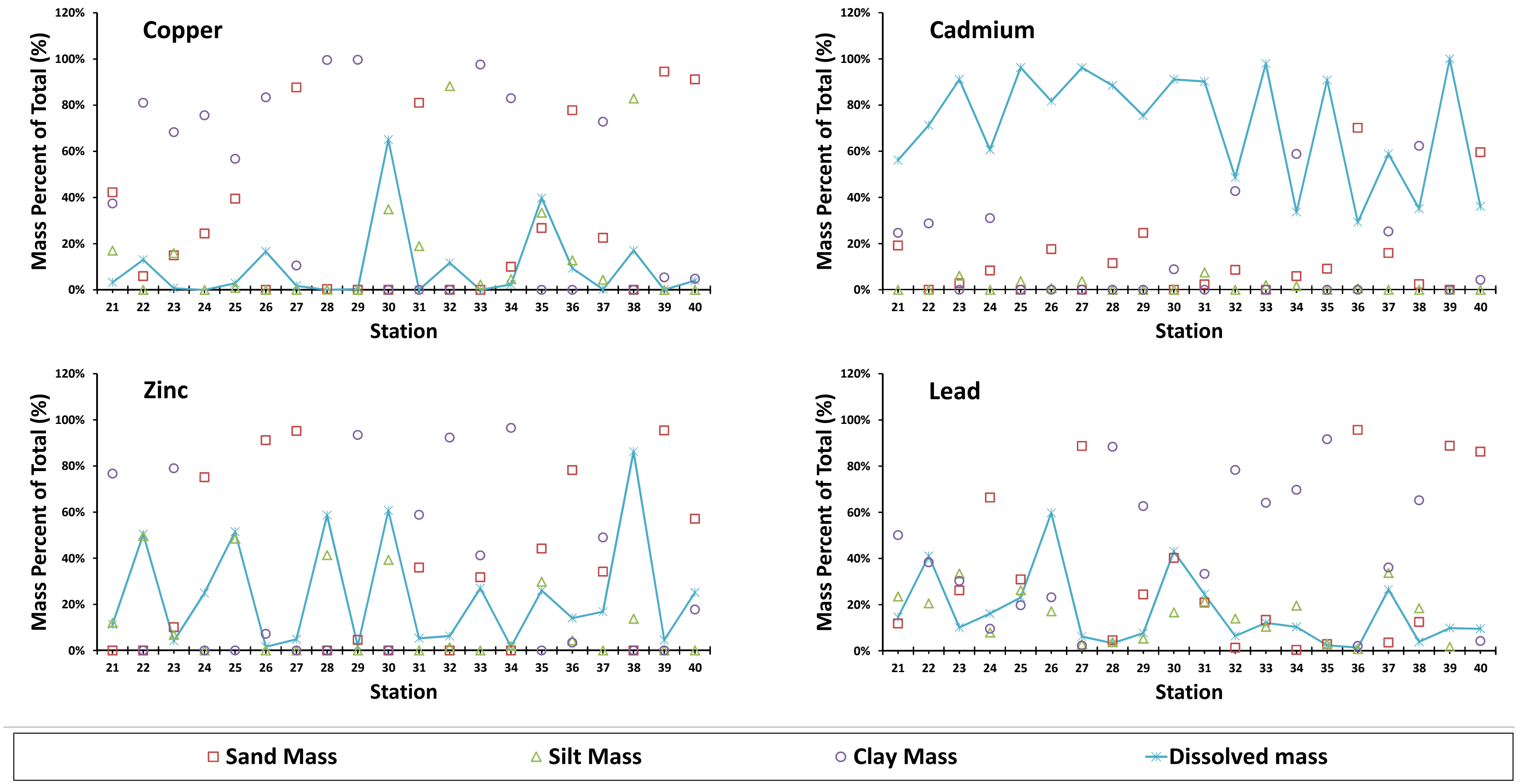


Figure 11. Copper, cadmium, zinc and lead distributions in the different particle size-fractions collected from the resuspension event of 29 August 2012 at Oscar 22 Pier in Pearl Harbor. The metal content in each fraction is calculated with the total fraction as the sum of all fractions.

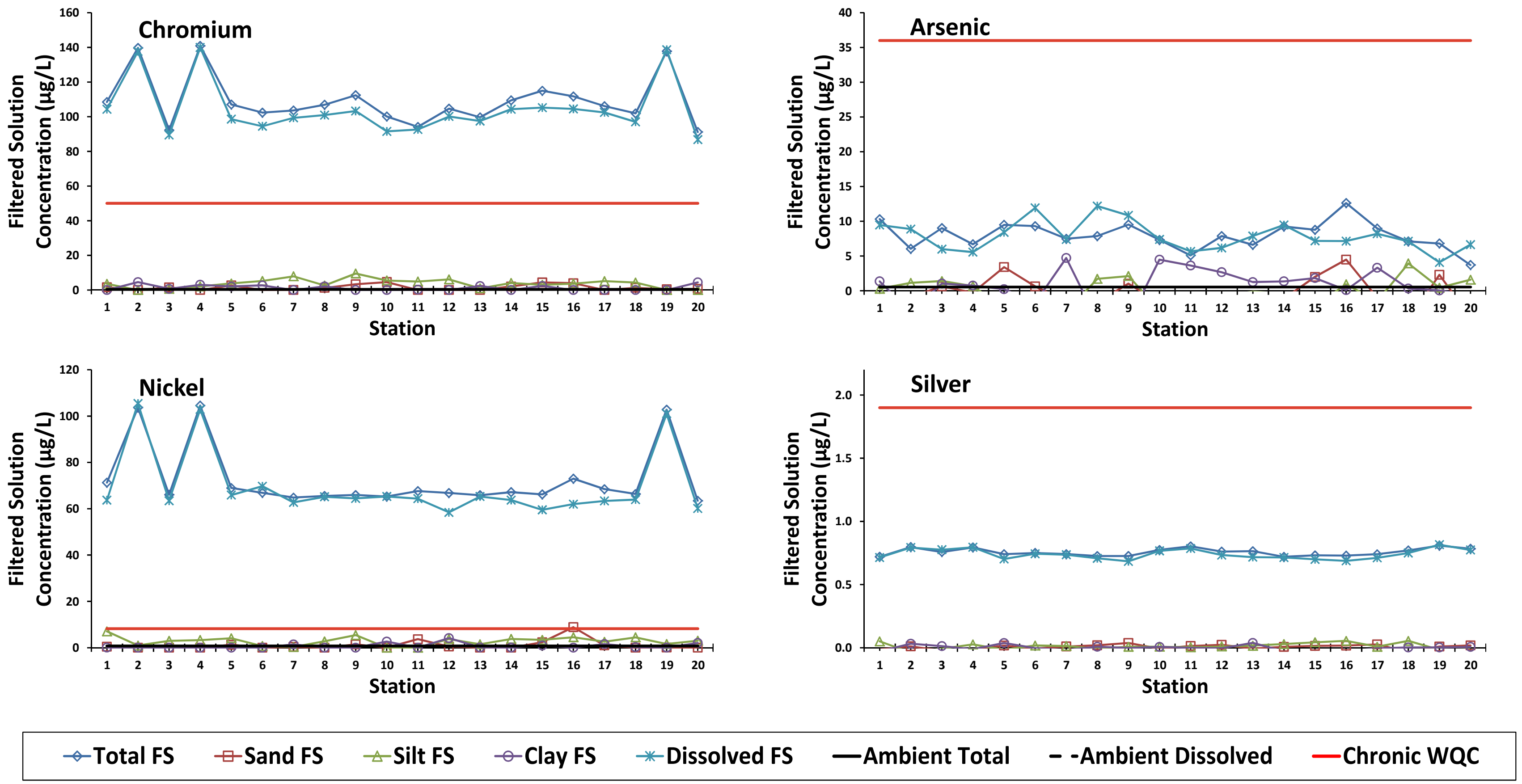


Figure 12. Chromium, arsenic, nickel and silver concentrations in the filtered solution (FS) for each different particle size-fractions collected from the resuspension event of 28 August 2012 at Bravo 2 Pier in Pearl Harbor. Ambient Total and Ambient Dissolved are from samples collected prior to the resuspension event. The USEPA Chronic Water Quality Criterion is provided as a measure of the potential concern derived from these quantifications.

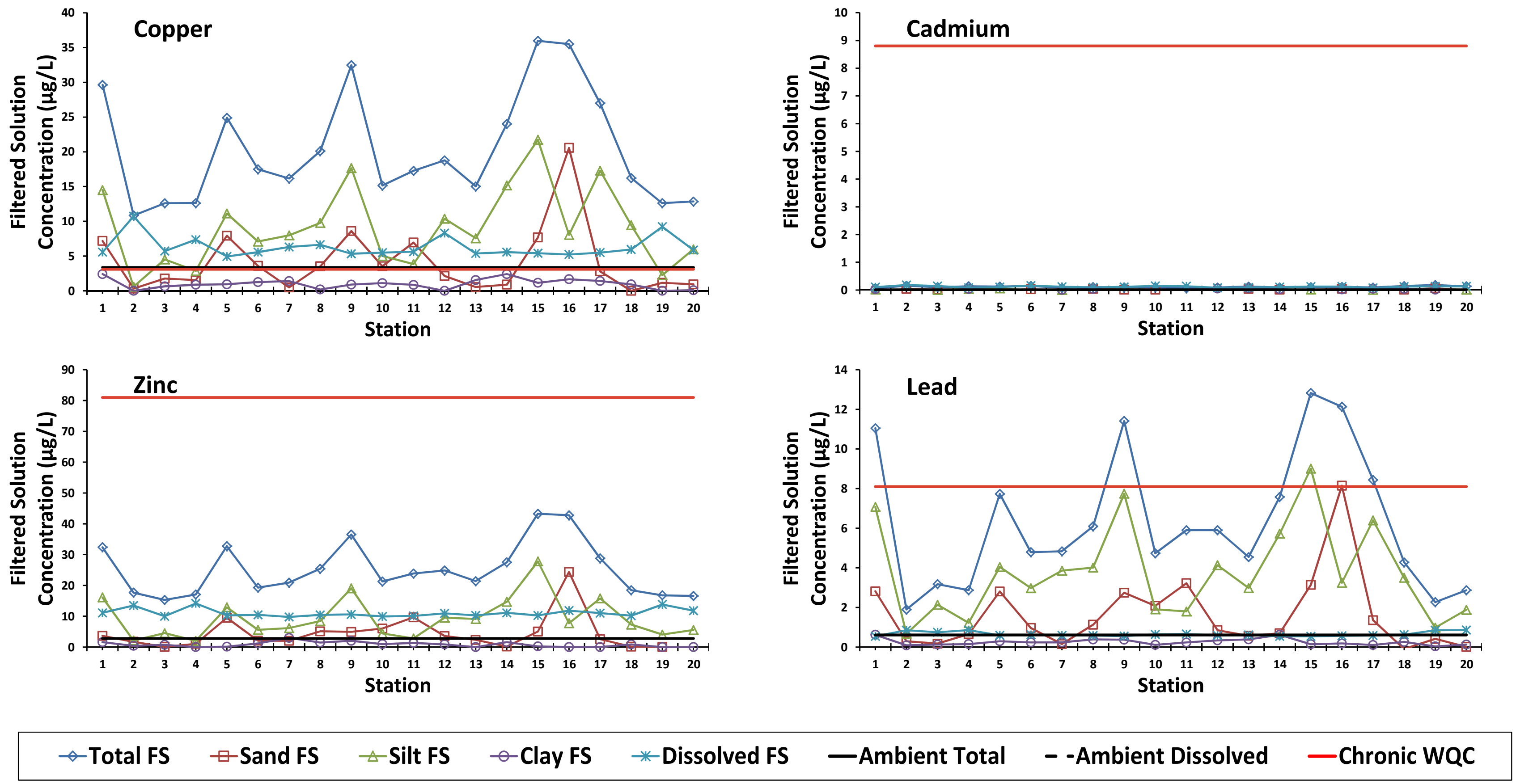


Figure 13. Copper, cadmium, zinc, and lead concentrations in the filtered solution (FS) for each different particle size-fractions collected from the resuspension event of 28 August 2012 at Bravo 2 Pier in Pearl Harbor. Ambient Total and Ambient Dissolved are from samples collected prior to the resuspension event. The USEPA Chronic Water Quality Criterion is provided as a measure of the potential concern derived from these quantifications.

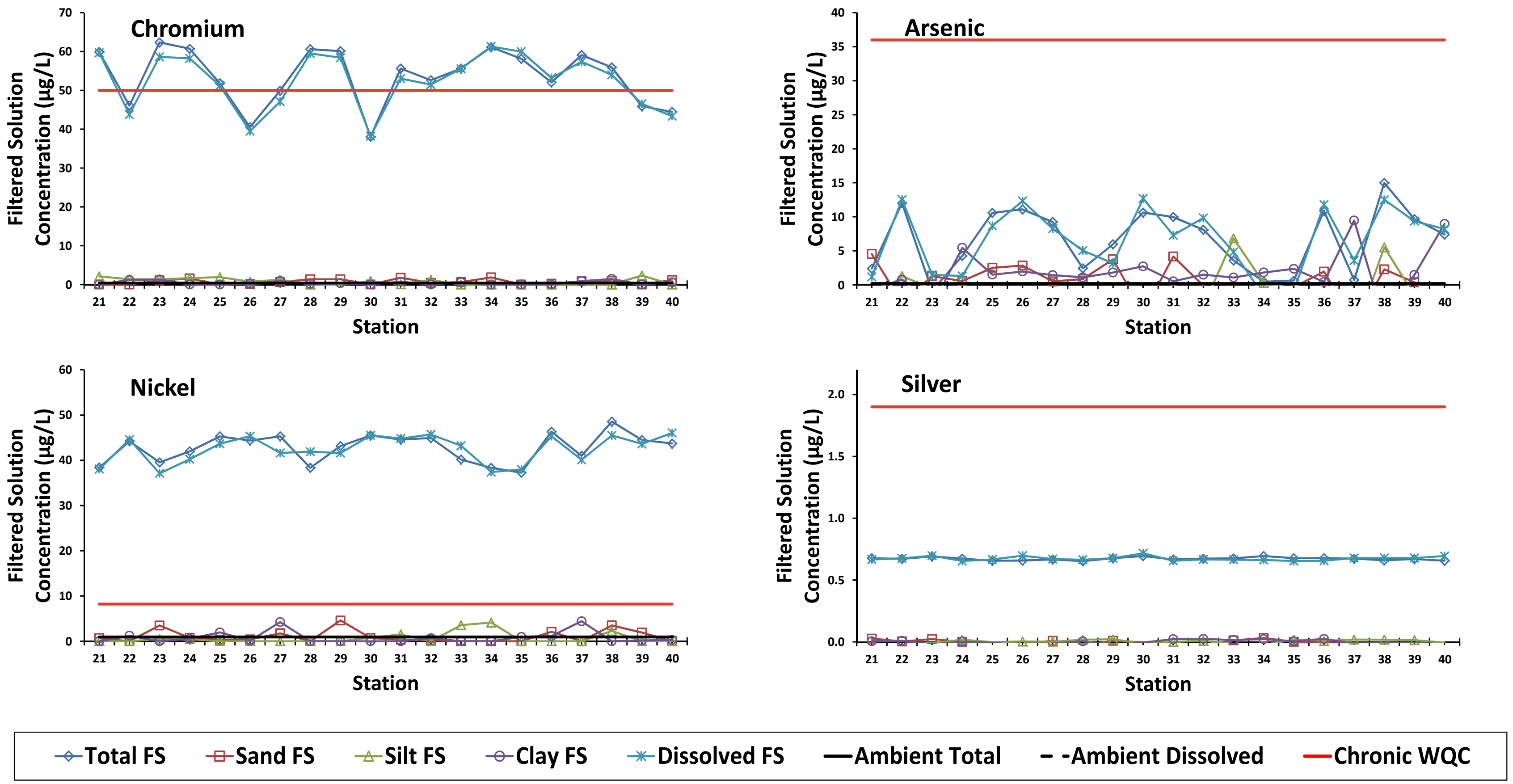


Figure 14. Chromium, arsenic, nickel and silver concentrations in the filtered solution (FS) for each different particle size-fractions collected from the resuspension event of 28 August 2012 at Oscar 22 Pier in Pearl Harbor. Ambient Total and Ambient Dissolved are from samples collected prior to the resuspension event. The USEPA Chronic Water Quality Criterion is provided as a measure of the potential concern derived from these quantifications.

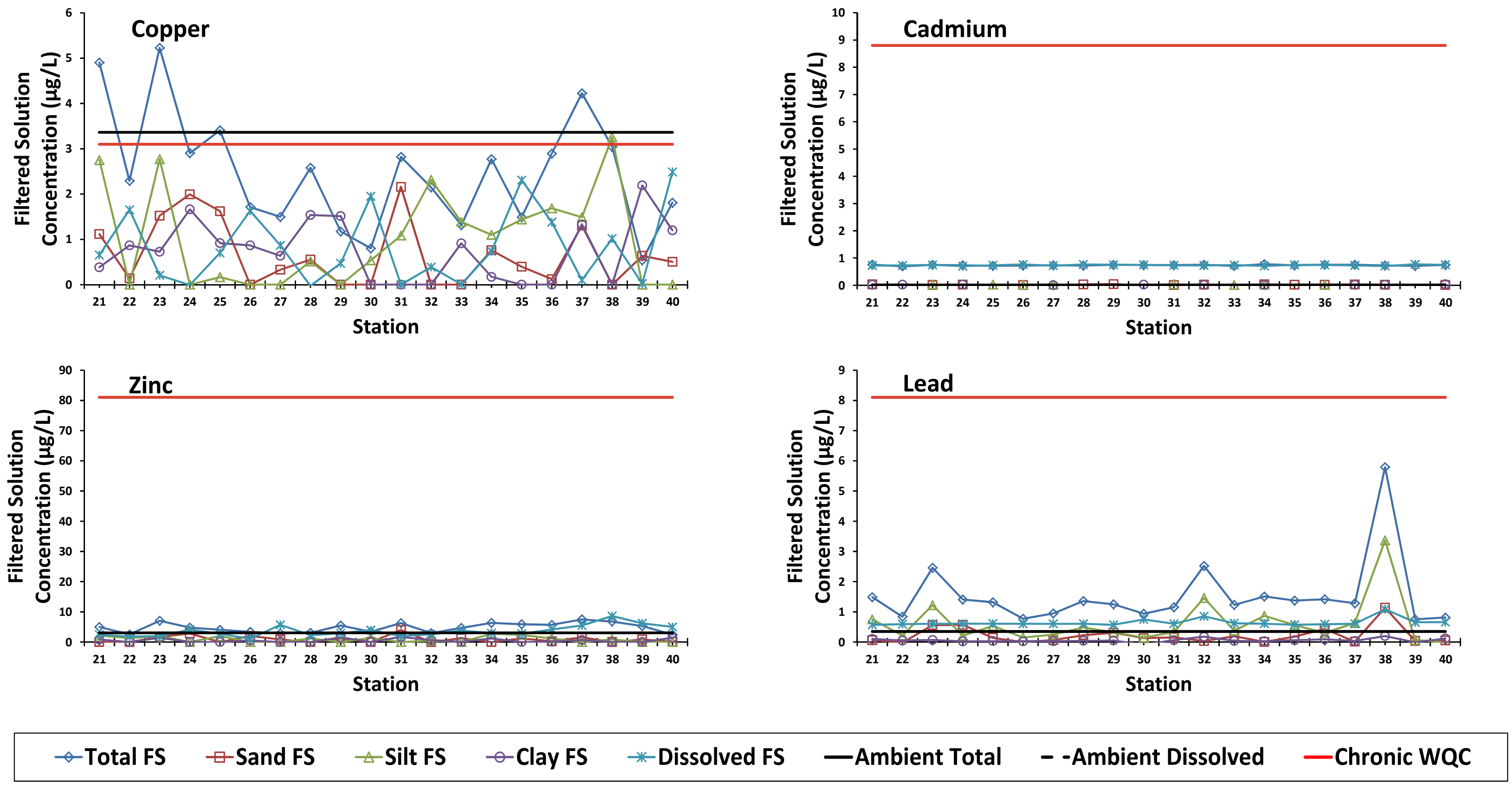


Figure 15. Copper, cadmium, zinc and lead concentrations in the filtered solution (FS) for each different particle size-fractions collected from the resuspension event of 28 August 2012 at Oscar 22 Pier in Pearl Harbor. Ambient Total and Ambient Dissolved are from samples collected prior to the resuspension event. The USEPA Chronic Water Quality Criterion is provided as a measure of the potential concern derived from these quantifications.

Table 10. Method detection limits (MDL, µg/L) for the samples analyzed for the National Oceanic and Atmospheric Administration (NOAA) - 18 polychlorinated biphenyls (PCB) and pesticides from the Bravo Pier event of 28 August 2012. All the samples were qualified as undetected. B is background, 2 mm in the size fraction column indicates that only the 2-mm fraction was analyzed, All is all the fractions analyzed, × means analyzed, - means not-analyzed.

ample ID	Sampling Event	Sample Depth (ft)	Size Fraction (2 mm or All)	TOTAL PCB NOAA-18	PCB-101	PCB-105	PCB-118	PCB-128	PCB-138	PCB-153	PCB-170	PCB-18	PCB-180	PCB-187	PCB-195	PCB-206	PCB-206	PCB-28	PCB-44	PCB-52	PCB-66	PCB-8	DIELDRIN	ENDOSULFAN I	ENDOSULFAN II	ENDOSULFAN SULFATE	TOTAL ENDOSULFAN
MDL				0.36	0.39	0.39	0.52	0.4	0.5	0.36	0.5	0.46	0.39	0.39	0.49	0.53	0.38	0.42	0.53	0.46	0.43	0.46	0.01	0.01	0.004	0.01	0.004
B		3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
1	1	3	All	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
2	1	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
3	1	3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
4	1	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
5	1	3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
6	1	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
7	2	3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
8	2	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
9	2	3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
10	2	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
11	2	3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
12	2	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
13	3	15	All	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
14	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
15	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
16	3	15	All	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
17	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
18	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
19	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
20	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-

Table 11. Method detection limits (MDL, µg/L) for the samples analyzed for the National Oceanic and Atmospheric Administration (NOAA) - 18 PCB and pesticides from the Oscar Pier event of 29 August 2012. All the samples were qualified as undetected. B is background, 2 in the size-fraction column indicates that only the 2-mm fraction was analyzed, All is all the fractions analyzed, × means analyzed, - means not-analyzed.

Sample ID	Sampling Event	Sample Depth (ft)	Size Fraction (2 mm or All)	TOTAL PCB NOAA-18	PCB-101	PCB-105	PCB-118	PCB-128	PCB-138	PCB-153	PCB-170	PCB-18	PCB-180	PCB-187	PCB-195	PCB-206	PCB-206	PCB-28	PCB-44	PCB-52	PCB-66	PCB-8	DIELDRIN	ENDOSULFAN I	ENDOSULFAN II	ENDOSULFAN SULFATE	TOTAL ENDOSULFAN
MDL				**0.36**	**0.39**	**0.39**	**0.52**	**0.4**	**0.5**	**0.36**	**0.5**	**0.46**	**0.39**	**0.39**	**0.49**	**0.53**	**0.38**	**0.42**	**0.53**	**0.46**	**0.43**	**0.46**	**0.01**	**0.01**	**0.004**	**0.01**	**0.004**
B		3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
21	1	3	All	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
22	1	15	All	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
23	1	3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
24	1	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
25	1	3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
26	1	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
27	2	3	All	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
28	2	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
29	2	3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
30	2	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
31	2	3	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
32	2	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
33	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
34	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
35	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
36	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
37	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
38	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
39	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-
40	3	15	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	-	-	-

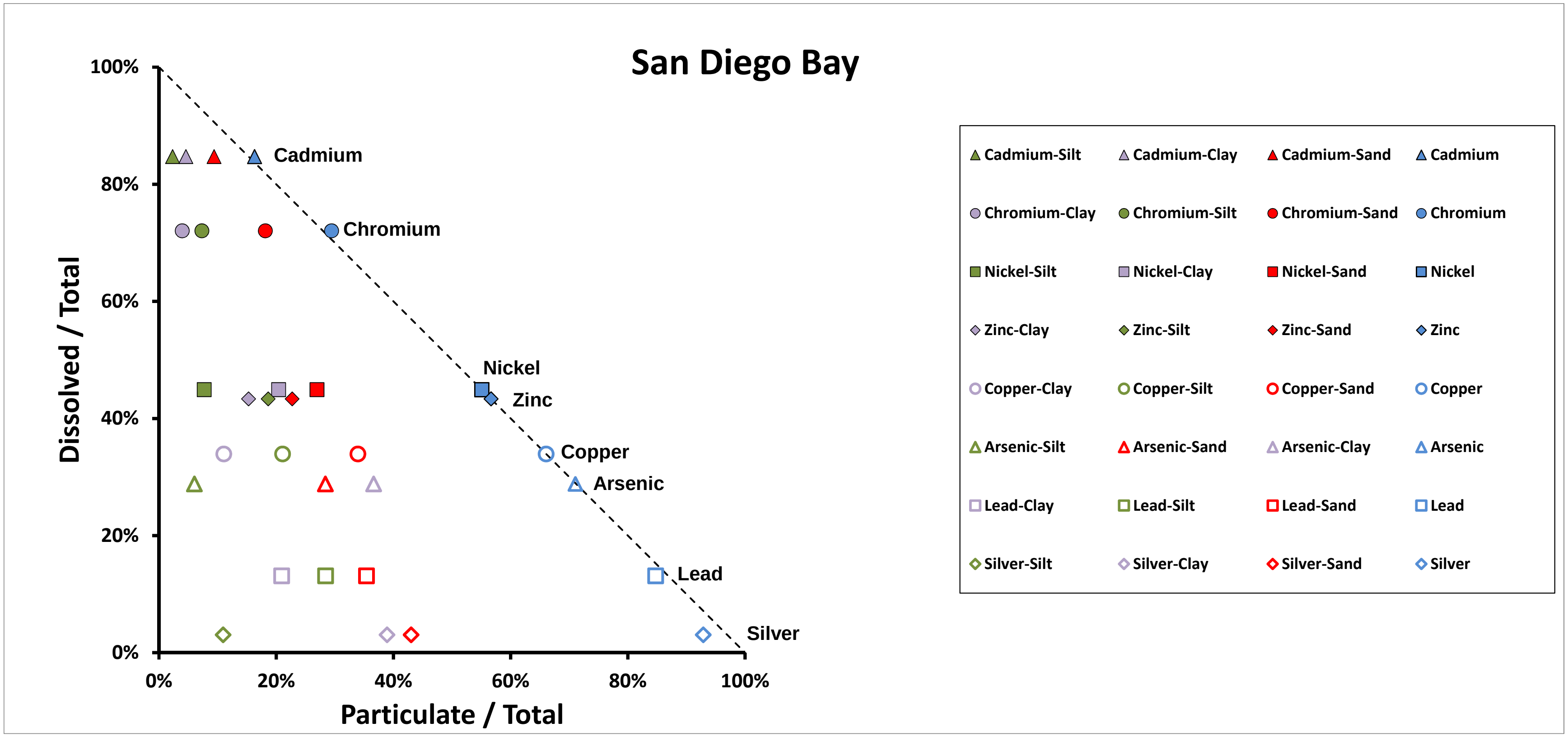


Figure 16. Size-fraction distribution of metals for the resuspension event of 4 April 2012 in San Diego Bay.

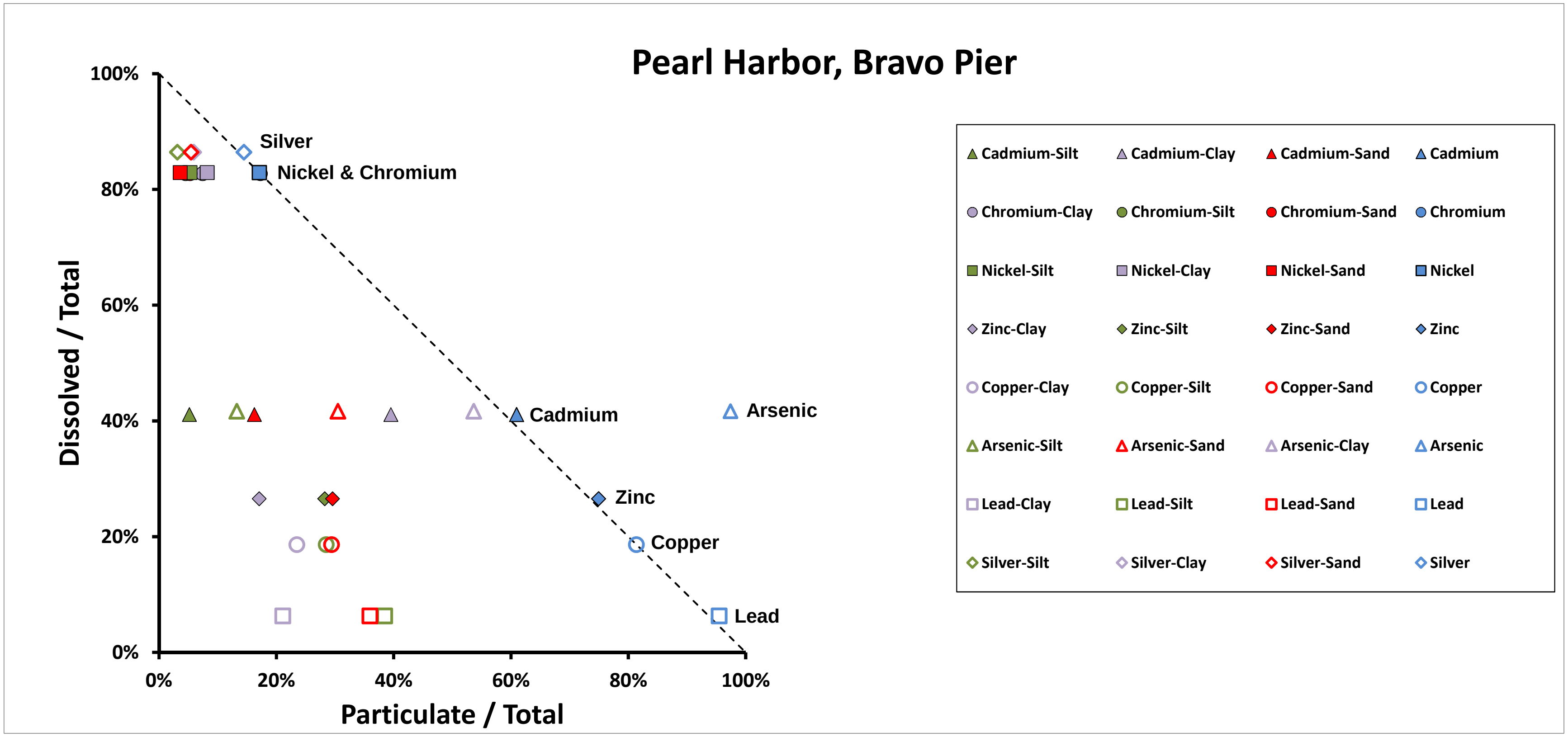


Figure 17. Size-fraction distribution of metals for the resuspension event of 28 August 2012 at Bravo 2 Pier in Pearl Harbor.

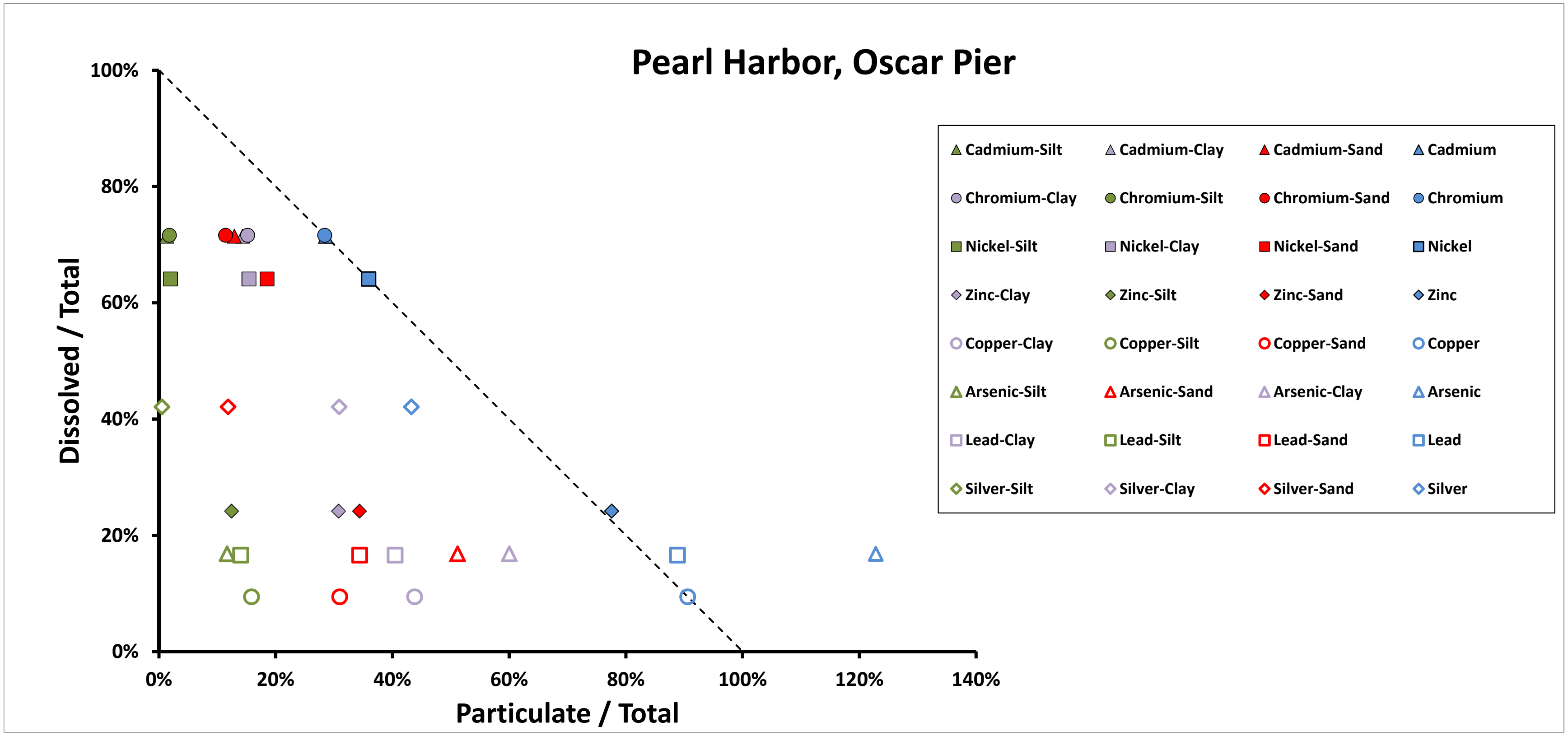


Figure 18. Size-fraction distribution of metals for the resuspension event of 28 August 2012 at Oscar 22 Pier in Pearl Harbor.

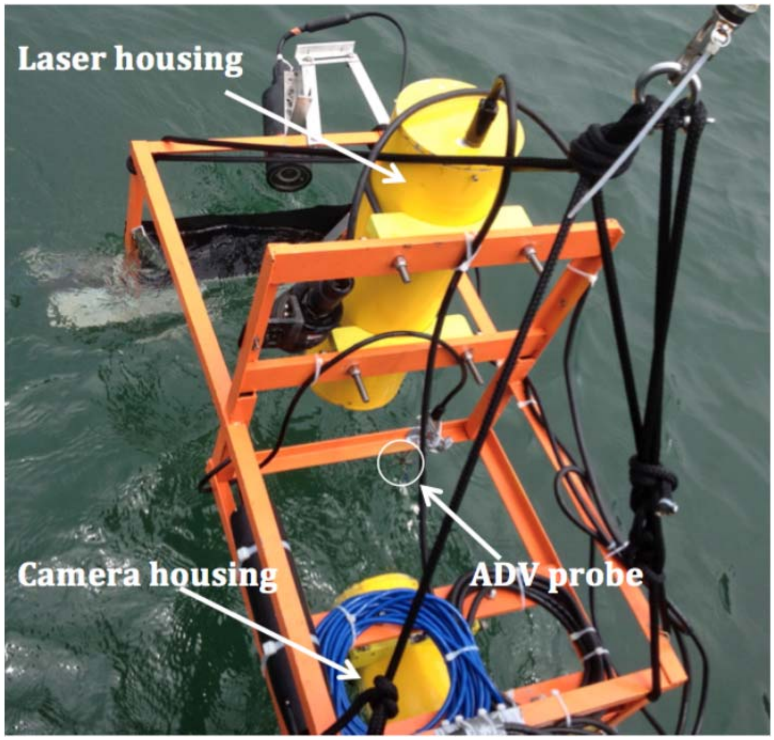


Figure 19. Deployment of the UWMPIV frame in Pearl Harbor.

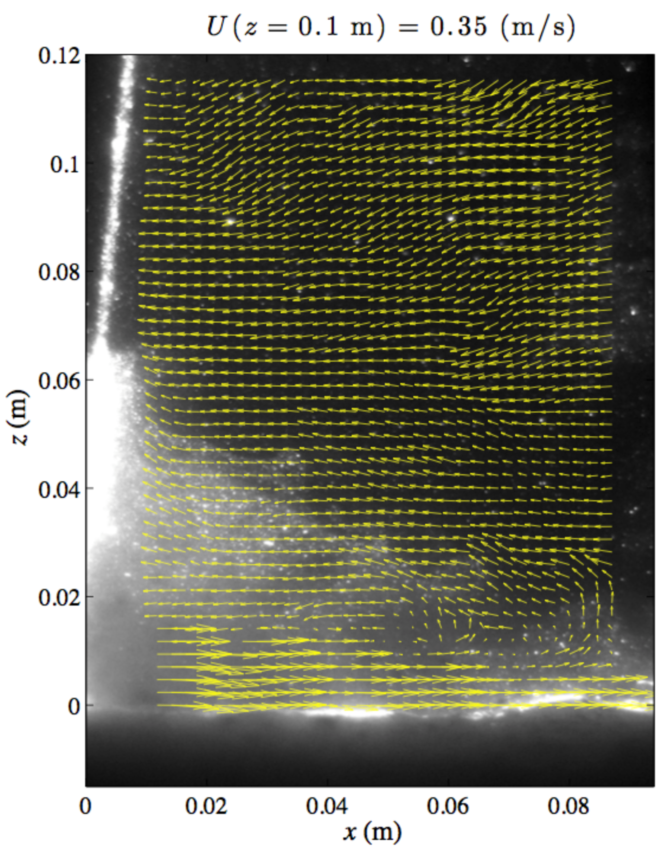


Figure 20. Sample PIV image: initiation of sediment resuspension.

The instrument platform was deployed at two sites behind the propeller of the tug-boat: 80 and 110 m, respectively. At the 80-m site, we noticed that the mean flow direction near the sediment bed was reversed for most of the time, suggesting that the propeller jet had been unable to touch the ground. The near-bottom flow was largely due to the secondary entraining flow caused by the propeller jet. Although the magnitude of the entraining flow was high enough to suspend sediment from time to time, we do not present the details in this report. We have focused on the 110-m site, where the propeller jet flow had completely touched the ground and reached a fully developed state.

For the 110-m site, the propeller started with a rotation speed of 20 rpm at 13:40 on 19 July 2012. Then the speed ramped up to 50, 100, and 150 rpm, respectively, and it stopped at 14:24. For each rpm, the propeller speed was held steady for about 10 min. 2 to ~ 3 sets of PIV images were acquired for each rpm, while the ADV was kept recording throughout the all experiments.

3.5.2 Current and Turbulence Measured by ADV

Using the bottom check function of the Nortek ADV, we were able to determine the height of the ADV sample volume above the sediment bed, which varied from 12 to 13 cm at the 110-m site. The variation might be partly from the measurement error, or it might reflect the variation of the sediment bed due to resuspension and deposition.

Figure 21 shows the entire time series of velocities measured at the 110-m site. The abscissa represents the time in hours since midnight on 19 July 2012. Dashed blacked lines represent the starting time of each rpm. Since the probe was about 110 m away from the propeller, it would take several minutes for the ADV to detect the change of propeller speed after the change of rpm. We have estimated this time lag, and marked the effective starting time for each propeller speed, and they are shown as pink dashed lines in Figure 21.

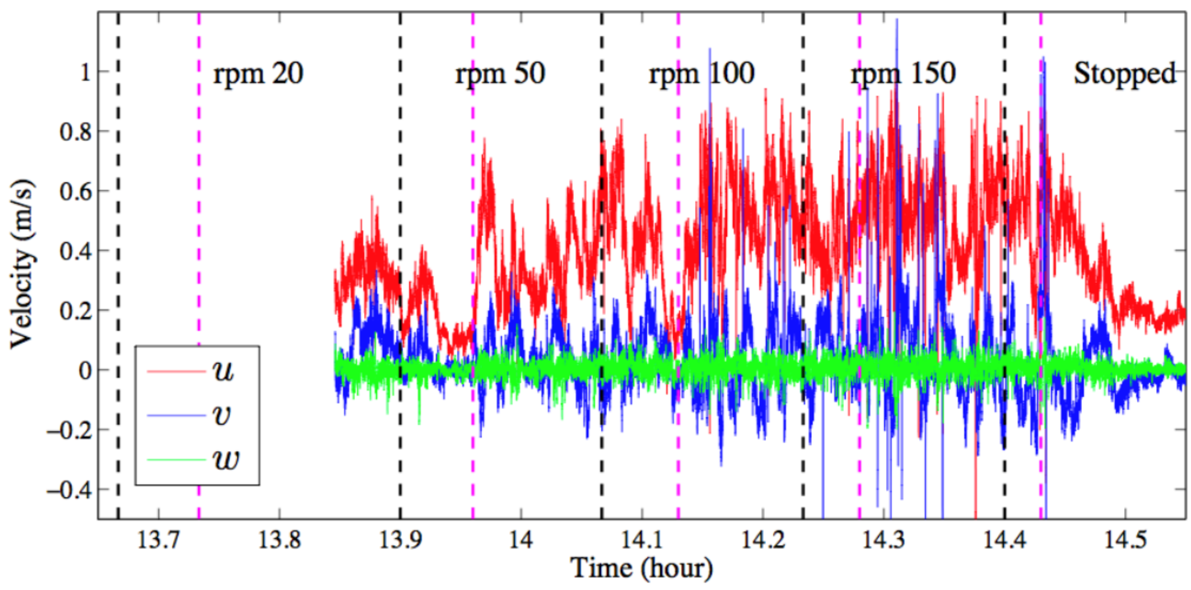


Figure 21. Time series of velocities measured by the ADV, which was 110 m away from the propeller. The sample volume was about 12 cm above the sediment bed. Black dashed lines are the starting time of each rpm run. Pink dashed lines are estimated starting time for the change of propeller speed to affect the 110-m measurement site.

The near-bottom flow at the 110-m site was unsteady. Undulating patterns can be observed from the recorded time series of the two horizontal velocity components. This agreed with the meandering flow pattern we observed on the surface behind the propeller. Figure 22 shows the probability distribution of the direction of the horizontal flow as measured by the ADV over the entire measurement period. The meandering of the flow was, however, confined to a range of ±30° with respect to *x*. The root-mean-square (RMS) of the fluctuating velocities are calculated for each rpm run. The delineations of different rpm runs are the same as those pink dashed lines shown in Figure 21. Figure 23 shows the mean velocity components vs. the propeller speed. Error bars are drawn based on the standard deviation of the signal. The mean stream-wise velocity did increase with propeller rpm, while the increase was not linear. As the propeller speed increased from 100 pm to 150 rpm, the mean velocity only increased by 5 cm/s. The mean span-wise velocity was positive, indicating that the instrument frame was not perfectly aligned with the mean flow direction, although the deviation is rather small. This can also be shown by the probability distribution of the flow direction, i.e., Figure 22. The mean vertical direction is negative for rpm = 50, suggesting a mean trend of sediment deposition. Sediment might be entrained at an upstream site, transported, and deposited to the 110-m site under this propeller speed. As the mean speed increased with rpm, the mean vertical velocity changed to positive and showed an increasing trend with rpm (Figure 23). This indicates a mean effect of resuspension.

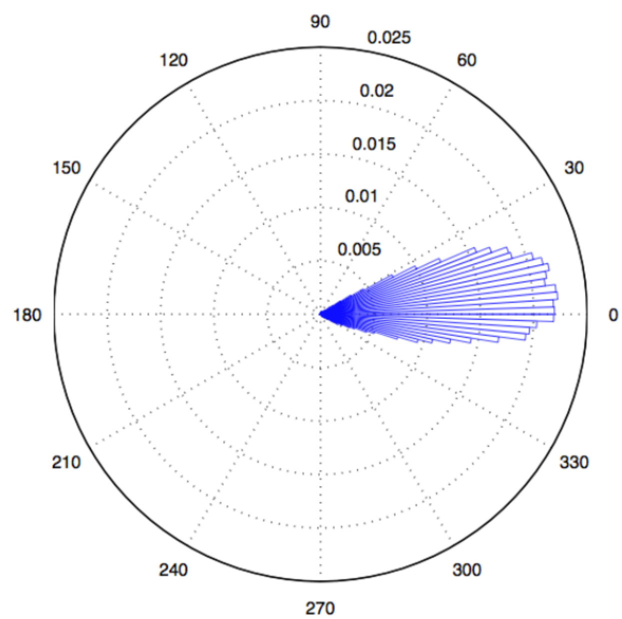


Figure 22. Probability of the direction of the horizontal velocity recorded by the ADV probe.

The RMS of velocity fluctuations for each propeller rpm is shown in Figure 24. The velocity variations of all the three components increase with rpm in general. However, due to the meandering of the propeller jet at the measurement site, it is difficult to isolate turbulent fluctuations from the total velocity variations, which also include the change of the velocities due to the shift of jet centerline.

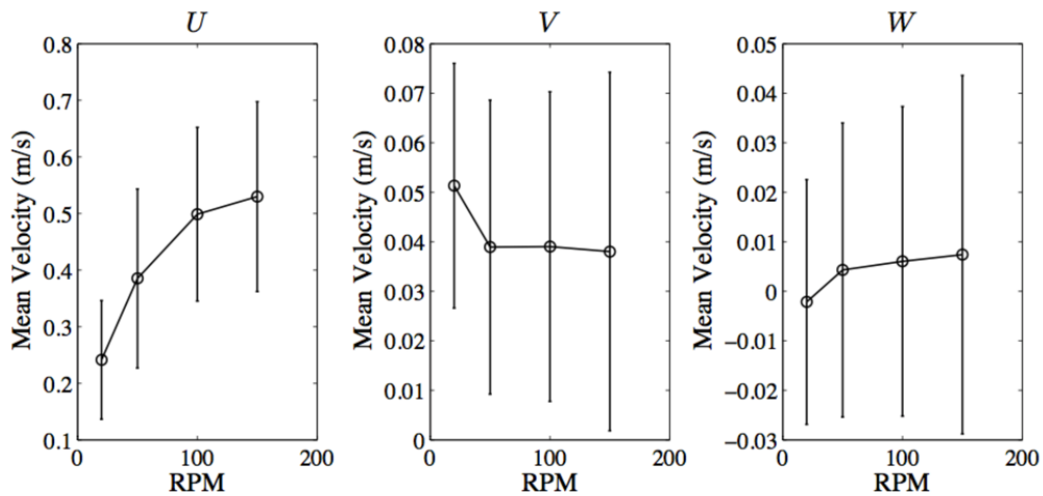


Figure 23. Change of mean velocities with the propeller rpm.

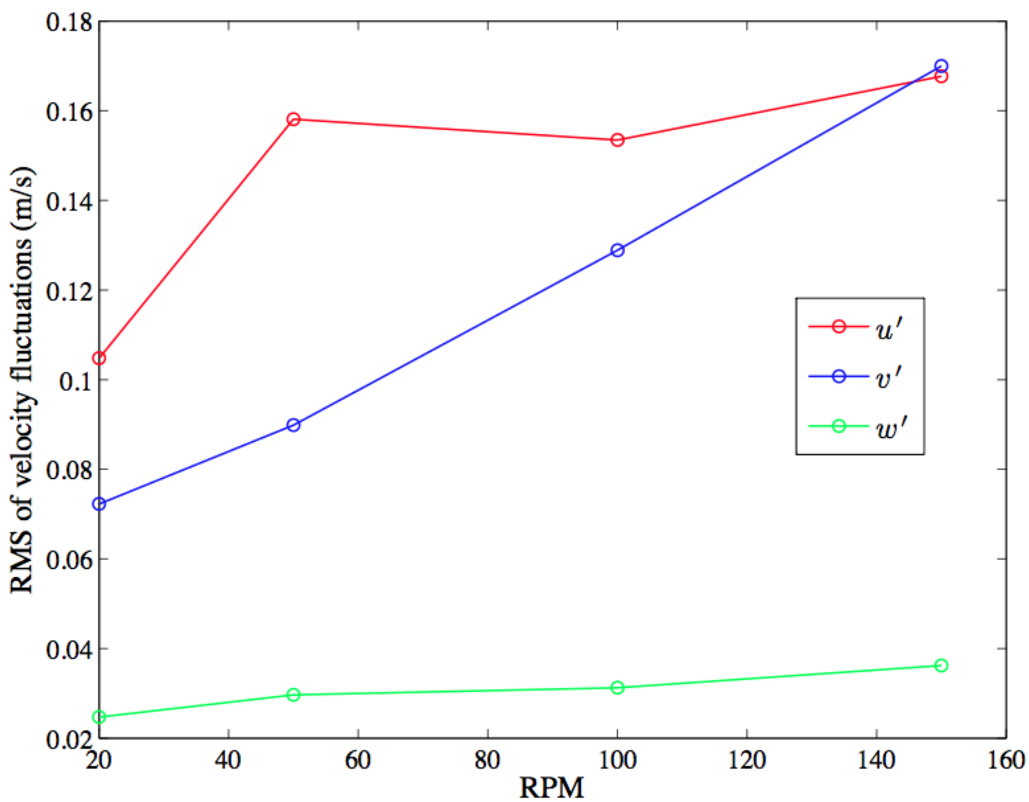


Figure 24. Change of RMS of velocity variations with the propeller rpm.

3.5.3 Structure of Turbulence above the Sediment Bed Measured by PIV

Significant sediment resuspension occurred as the propeller speed ramped up to 50 rpm. High sediment concentration during resuspension made optical access to the laser “sheet” impossible. Most PIV measurements were not available during the experiment with high flows, while we could capture the initiation of sediment entrainment through PIV images and make measurement on flow structures around that moment. PIV in this research is applied to validate the ADV in estimating the bottom shear stress and to determine the critical shear stress for sediment resuspension.

Figure 25 shows the time series of the velocities *u* and *w* measured by ADV and PIV at around 14:00. Signals from PIV were obtained at z = 11.5 cm, the highest position of PIV measurement, while the ADV's sample volume was approximately at z = 12.5 cm, and it was about 10 cm away from the PIV laser "sheet" in both the *x* and *y* direction. Despite that, the comparison is not from the same spatial location, they agreed well in terms of large temporal variations. Note that PIV data is unavailable at around 14:01 when a strong sediment resuspension blocked the optical access. During that time, we can observe a sudden increase of stream-wise velocity from about 0.3 to 0.5 m/s.

From the PIV time series shown in Figure 25, we can see two distinct sections, here denoted as section A (from 14.005 to 14.021 hour) and section B (from 14.026 to 14.037 hour). Section A is characterized by a relatively steady flow, while section B shows a deceleration trend of *u*.

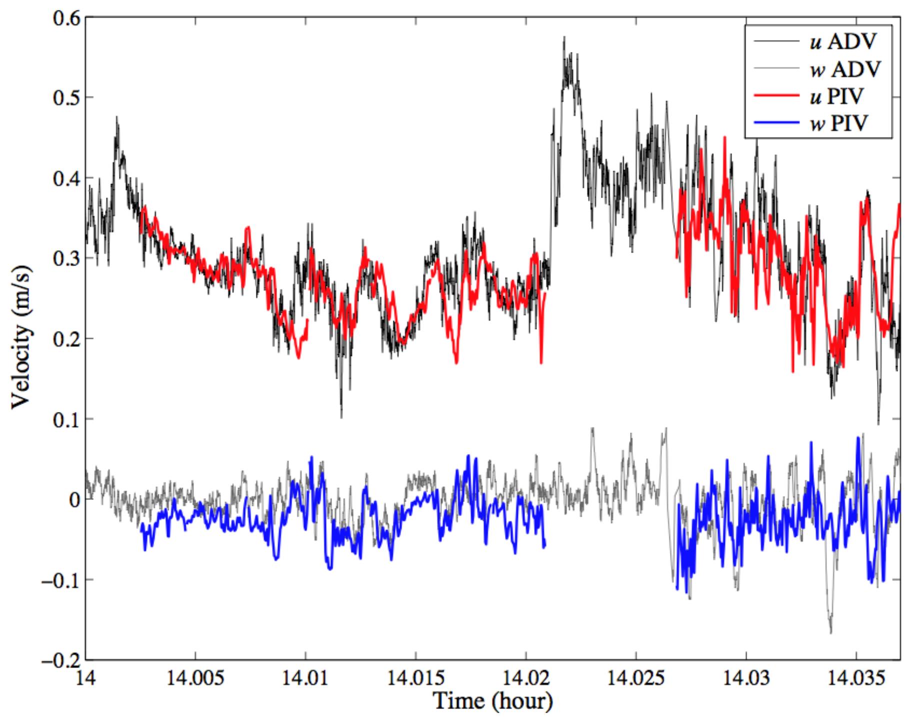


Figure 25. Time series of velocities measured concurrently by PIV and ADV. PIV signals were measured at z = 11.5 cm, while ADV data was at z = 12.5 cm.

Statistics of the turbulent flow were calculated for section A. The vertical profile of the mean stream-wise velocity is presented in Figure 26 in a semi-log plot. There is clearly a log-law region from which we can estimate the shear velocity by fitting with the equation: $\frac{U}{u_*} = \frac{1}{\kappa} \ln \frac{z}{z_0}$

$$\frac{U}{u_*} = \frac{1}{\kappa} \ln \frac{z}{z_0} \tag{1}$$

The best fit gives $u_* = 0.015$ (m/s). The vertical profiles of Reynolds stresses $\overline{u'^2}$, $\overline{w'^2}$ and $-\overline{u'w'}$ are shown in Figure 27. The horizontal velocity fluctuation u' peaked at z = 4 cm and decreased with height, while the vertical fluctuation w' increased monotonically with z. This observation suggested that the vertical structure of turbulent fluctuations was different from that of a canonical turbulent boundary layer of a uniform horizontal flow, where both vertical and horizontal fluctuations reach a peak value close to the wall. This difference might be caused by the unsteadiness of the propeller current flow, or by the transport of turbulence in the "free stream," which was produced by the propeller itself.

The Reynolds shear stress had a peak value near the bottom. Taking a square root of the peak value as an estimate of the shear velocity, we have $u_* \approx \sqrt{-\overline{u'w'}_{peak}} = 0.0143$ (m/s), very close to the estimate from the log-law fitting.

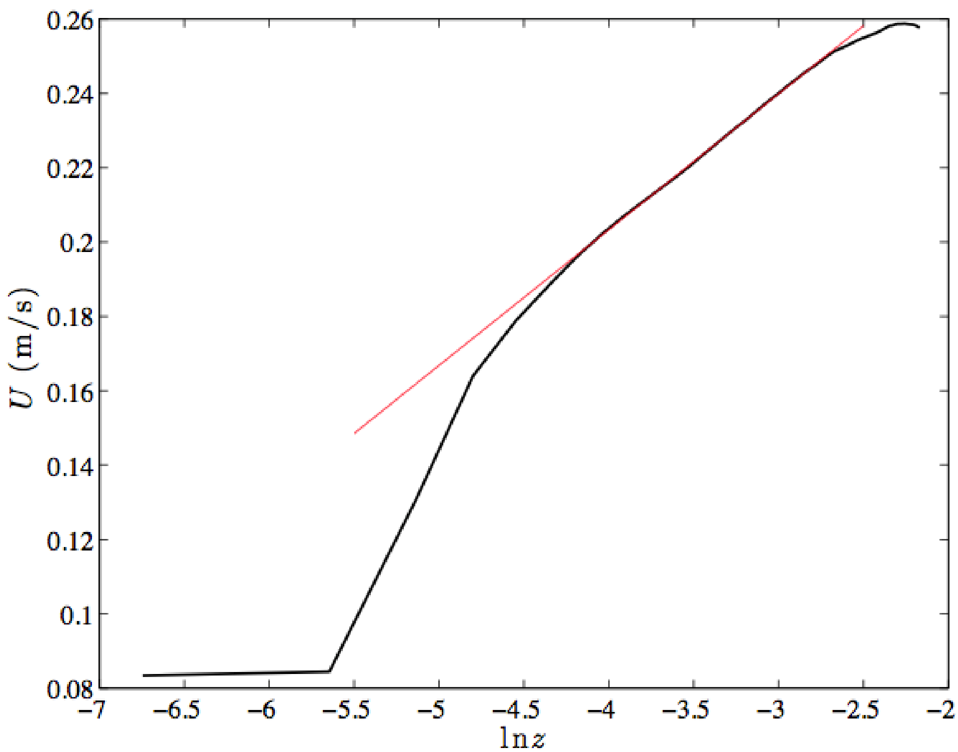


Figure 26. Vertical profile of the mean velocity measured by PIV between 14:00 and 14:01 (Section A). The red line is the fitted log-law with a shear velocity u* = 1.5 cm/s.

For flow during section B, the mean current profile can still be well described by a log-law despite the deceleration trend (Figure 28). The shear velocity was estimated to be $u_* = 0.016$ (m/s). The variances of turbulent fluctuations, $\overline{u'^2}$, $\overline{w'^2}$, were about two times higher, which can be attributed to the transient feature of the mean flow (see Figure 29a). The Reynolds shear stress showed a negative value near the bottom, and it increases with height. No peak value was found within the entire height of PIV measurement, making it difficult to estimate the bottom shear stress (or the shear velocity) based on the measurement of Reynolds shear stress. This, again, can be attributed to the unsteadiness of the mean flow.

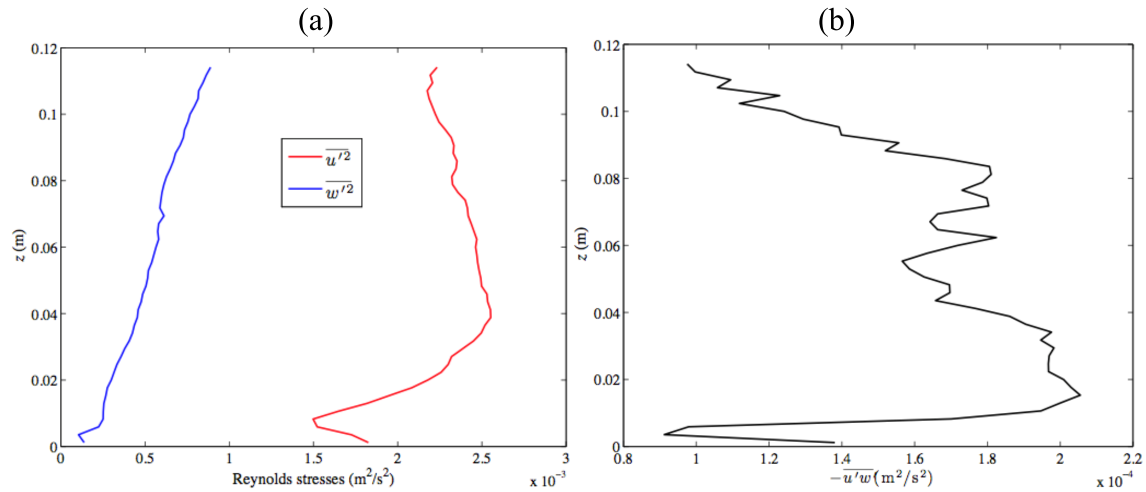


Figure 27. Vertical profiles of Reynolds stresses (a) normal stresses (b) shear stresses measured between 14:00 and 14:01 (Section A).

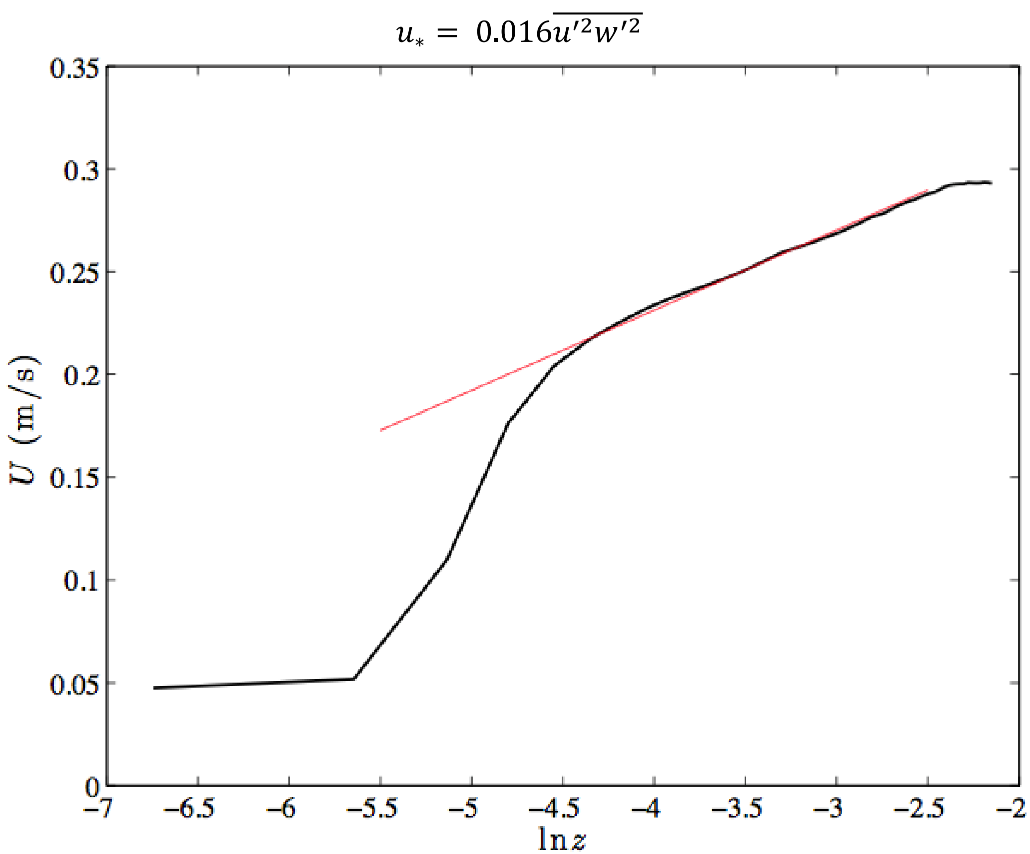


Figure 28. Vertical profile of the mean velocity measured by PIV between 14:01 and 14:02 (Section B). The red line is the fitted log-law with a shear velocity u* = 1.6 cm/s.

(a) (b)

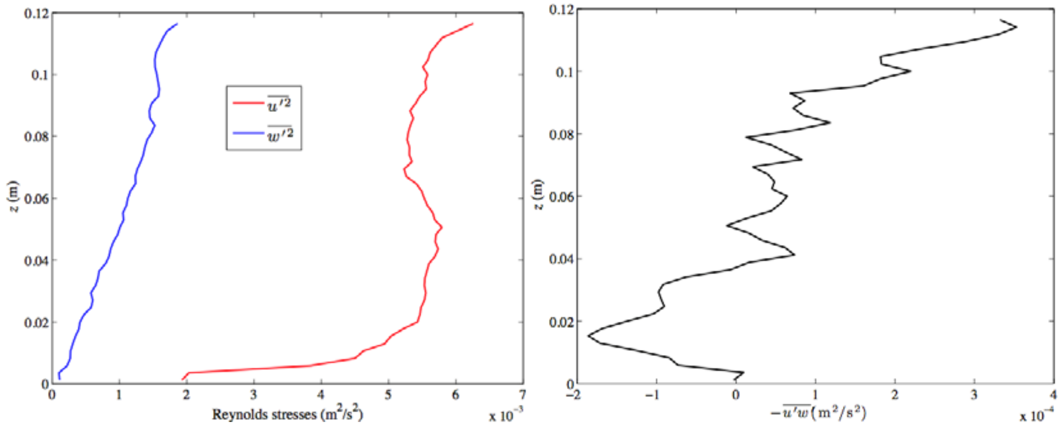


Figure 29. Vertical profiles of Reynolds stresses: (a) normal stresses, and (b) shear stresses measured between 14:01 and 14:02 (Section B).

The vertical profiles of the dissipation rate of TKE for the two sections are shown in Figure 30. Dissipation rate in section B was significantly higher than that in section A. For both sections, we did not see a decrease of dissipation rate with height z, while for canonical wall turbulence, we'd expect to see $\epsilon \sim z^{-1}$. The dissipation rate is rather uniform except a sharp increase very close to the sediment surface. This again suggested that the turbulence near the bottom could still be affected by the turbulence generated by the propeller and transported in the "free stream."

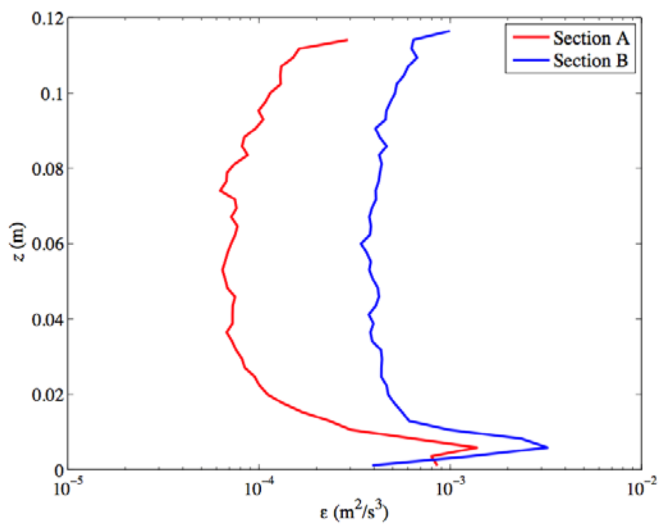


Figure 30. Vertical profiles of the TKE dissipation rate measured during section A and B.

3.5.4 Bottom Shear Stress Estimation

The bed shear stress is the most important parameter that links the flow condition to sediment transport. Estimated shear stress was used to determine both the inception of resuspension (the critical shear stress) and the subsequent entrainment rate. Existing models for propeller wash, i.e., Maynord's model (1984, 1998), predicts the near-bed velocity, which is then converted to a bed shear stress. Such a conversion is based on the theory of turbulent boundary layer in channel flows, usually under a uniform and steady flow condition. Almost all existing sediment entrainment models are obtained through laboratory flume studies with well-defined flow conditions. The flow field behind a propeller is extremely turbulent and unsteady as we have shown in Section 3.5.2, which differs significantly from that in a channel or river, or flows induced by tidal current, flood flow, wind wave, etc.

Despite the importance, the bottom shear stress and its relation to sediment transport is hard to quantify, particularly in a complex flow field where flow is highly three dimensional and transient, such as that in a propeller wash flow. Although methods exist to directly measure bottom shear stress with appropriate sensors, such as a shear plate (Rankin and Hires, 2000; Barnes, O'Donoghue, Alsina, and Baldock, 2009), these methods are rarely applied in field experiments due to technical difficulties. In situ measurement of bottom shear stress usually relies on indirect estimation based on flow velocity measurements. These methods have been documented by Biron et al. (2004) and summarized in Table 12. Bottom shear stress is denoted as τ_0, and the shearing velocity is defined as $u_* \equiv \sqrt{\frac{\tau_0}{\rho}}$, where ρ is the density of fluid.

Note that all of these methods are indirect. The instantaneous bottom shear stress is itself a random variable. It is related to the near-bottom turbulence in a statistical sense, which depends on the temporal and spatial scales. We suppose that statistical values obtained over a longer period produces a mean shear stress with a lower uncertainty, but also misses peak values that are significant for the prediction of sediment entrainment and erosion rate. For unsteady flows, such as the propeller jet-induced current, longer sampling time may include the transient processes into the calculation of Reynolds stresses. We also suppose that statistics measured at a higher position above the bed represents an average of bed stress over a larger area upstream, i.e., the 'footprint' concept used to estimated water-sediment mass exchange using an "eddy correlation" approach (Berg et al., 2003).

In this study, we tried to estimate the bed shear stress with both the ADV and PIV measurements. Taking the advantage of the high sampling rate of the ADV and high spatial resolution of the PIV, we explored to calculate the statistics of turbulence over a rather short period (a few seconds) to reduce the effects of unsteady flows on the estimation of the bed shear stress.

With available PIV data, we applied average on every 5 sec with a 50% overlap, which are 40 instantaneous 2D flow fields. Spatial average was also applied over the horizontal direction to obtain the vertical profiles. Bed shear stress was estimated with both the log-law approach on the mean velocity, and the covariance method, i.e., the shear velocity was assumed to be the maximum of $\sqrt{-\overline{u'w'}}$ over 5 cm of water column above the sediment bed. Despite the short time averaging window, mean velocity profiles had always agreed well with a log-law. Figure 31 shows 60 mean velocity profiles measured during 2.5 min, starting from 14:00. After normalized with the estimated shear velocity, all profiles showed a log-linear trend with z for $z < 5$ cm.

With ADV measurements, bed shear stress was estimated with the direct covariance method, the TKE method, and the modified TKE method (see Table 12). Statistics were calculated over an averaging window of 10 sec, which corresponded to 300 data points with a sample rate of 30 Hz. Since all the three methods need a coefficient to account for the uncertainty about the optimal height of the sample volume, we calibrated the shear stress with that from PIV when it is available. Figure 32 shows the comparison among various methods for bottom shear stress estimation between 14:00 and 14:02, when both ADV and PIV results are available. In general, good agreements are found among all methods. Results from PIV were not available in a period when the bed stress was high than 0.8 (Pa), approximately due to sediment resuspension.

Model coefficients for ADV data were determined based on the best fit with PIV estimations. As a result, we have the following calibrated estimations from the ADV data series that were measured at z = 12.5 cm:

Direct covariance method (COV):

$$\tau_0 = -0.67\rho\overline{u'w'} \quad (2)$$

TKE method:

$$\tau_0 = 0.13\rho\left[\frac{1}{2}\left(\overline{u'^2} + \overline{v'^2} + \overline{w'^2}\right)\right] \quad (3)$$

Modified TKE method:

$$\tau_0 = -0.67\rho\overline{u'w'} \quad (4)$$

Time series of the estimated bed shear stresses with Equations (2) through (4) over the entire period of measurement are plotted in Figure 33. Generally good agreements were found over the three different methods. Shear stress from COV and TKE methods produced several larger peaks at higher propeller rpm, while the estimate from the modified TKE method was much less "spiky" compared with the other two.

Figure 34 shows the cumulative of the shear stress over the entire period of ADV measurements, about 35 min. As a result, the cumulative effects of the bottom shear were not significantly different until the rpm went up to 150. The major difference was found at the end of rpm 150. The highest cumulative is from the TKE method, which is about 81% higher than the modified TKE method. The result from the covariance method is about 40% higher than that of the modified TKE method.

3.5.5 Erosion Rate

Although most PIV images were blurred or became completely dark with high sediment suspension at higher rpms, there were moments when the sediment bottom became visible. We have selected some images throughout the period of experiment to evaluate the sediment erosion rate. Figure 35 shows combined images acquired at different times when the sediment bed was visible. From these images, we did observe a continuous erosion of the bed before the propeller stopped at 14.41 hour. After that, the sediment bed actually rose up slightly, probably due to sediment deposition. Assuming that the instrument frame did not sink, as it stands on four large "feet" with steaks inserting deeply into the sediment bed, we could estimate the change of sea bottom as a function of time, as shown in Figure 36.

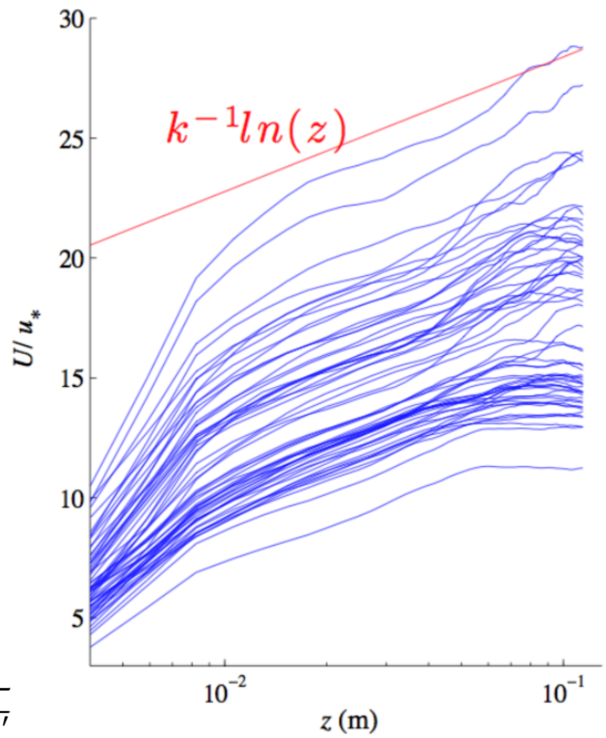
Generally, sediment erosion rate can be modeled by (Krone, 1999)

$$E = \epsilon_M(\tau_0 - \tau_c)^\alpha, \quad (5)$$

where E is the mass erosion rate with a dimension of [g m^{-2} s^{-1}], ε_M is the erosion rate constant, τ_c is the critical shear stress, and α = 1 or 2. Kandiah (1974) proposed a linear relation (α = 1) for cohesive sediment, while Lee, Wu, and Hoopes (2004) found α = 2 according to their laboratory erosion experiments with undisturbed sediment cores from the Sheboygan River in Wisconsin.

Table 12. Methods for estimation of bottom shear stress (Biron et al., 2004).

Model	Description	Advantages	Disadvantages
"Law of the Wall" (LOG law)	Fit measured mean velocity with $u = \frac{u_*}{\kappa} \ln\left(\frac{z}{z_0}\right)$, where z_0 is the roughness height.	Can be used to map spatial patterns of shear stress as well as bottom roughness Standard error of regression can be provided as an estimate of error in u_*. Can be measured with an ADCP	Flow must conform with log velocity profile Result is sensitive to the measurement of height (z). Requires measurement of velocity profile, thus can't be applied with point-wise instrument (e.g., an ADV)
Quadratic stress law	$\tau_0 = \rho C_d U^2$, where C_d is the drag coefficient	Simple, only requires measurement of mean velocity at one point	Hard to accurately estimate the drag coefficient, generally a function of Reynolds number and geometry of the bottom
Direct estimate of the near-bed shear stress with the covariance method (COV)	$\tau_0 = -\rho \overline{u'w'}$, where u' and w' are the fluctuations of velocities in the stream wise and the vertical directions.	Direct measurement with least assumptions No need to estimate roughness height Can be obtained by point-wise instrument (e.g., an ADV)	No general rule for "How close to the bottom to measure" Sensitive to sensor tilt.
Turbulent Kinetic Energy (TKE) method	TKE: $k = \frac{1}{2}\left(\overline{u'^2} + \overline{v'^2} + \overline{w'^2}\right)$ and $\tau_0 = C_1 \rho k$, where $C_1 = 0.19$	No need to estimate roughness height Can be obtained by point-wise instrument (e.g., an ADV)	No general rule for "How close to the bottom to measure" Coefficient C_1 might be different for various environment (i.e., oceanic vs. riverine)
Modified TKE method	$\tau_0 = C_2 \rho \overline{w'^2}$, where $C_2 = 0.9$	No need to estimate roughness height Can be obtained by point-wise instrument (e.g., an ADV) For an ADV probe, the vertical velocity component *w* can be measured with higher accuracy and less noise level.	No general rule for "How close to the bottom to measure" Coefficient C_2 might be different for various environment (i.e., oceanic vs. riverine)



$\sqrt{-\overline{u'w'}}$

Figure 31. Mean velocity profiles averaged every 5 sec starting from 14:00.

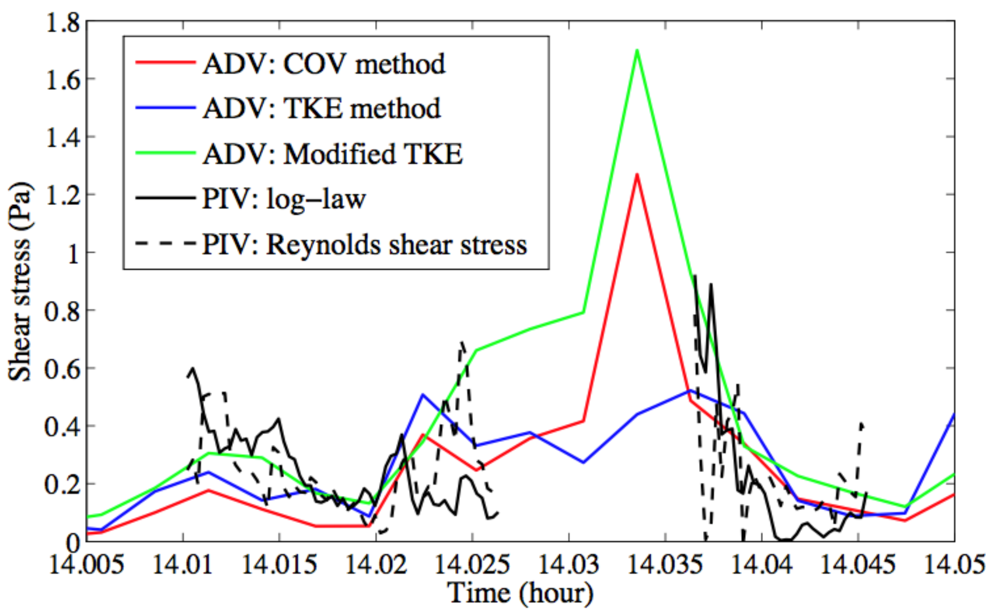


Figure 32. Time series of estimated bottom shear stress with different methods.

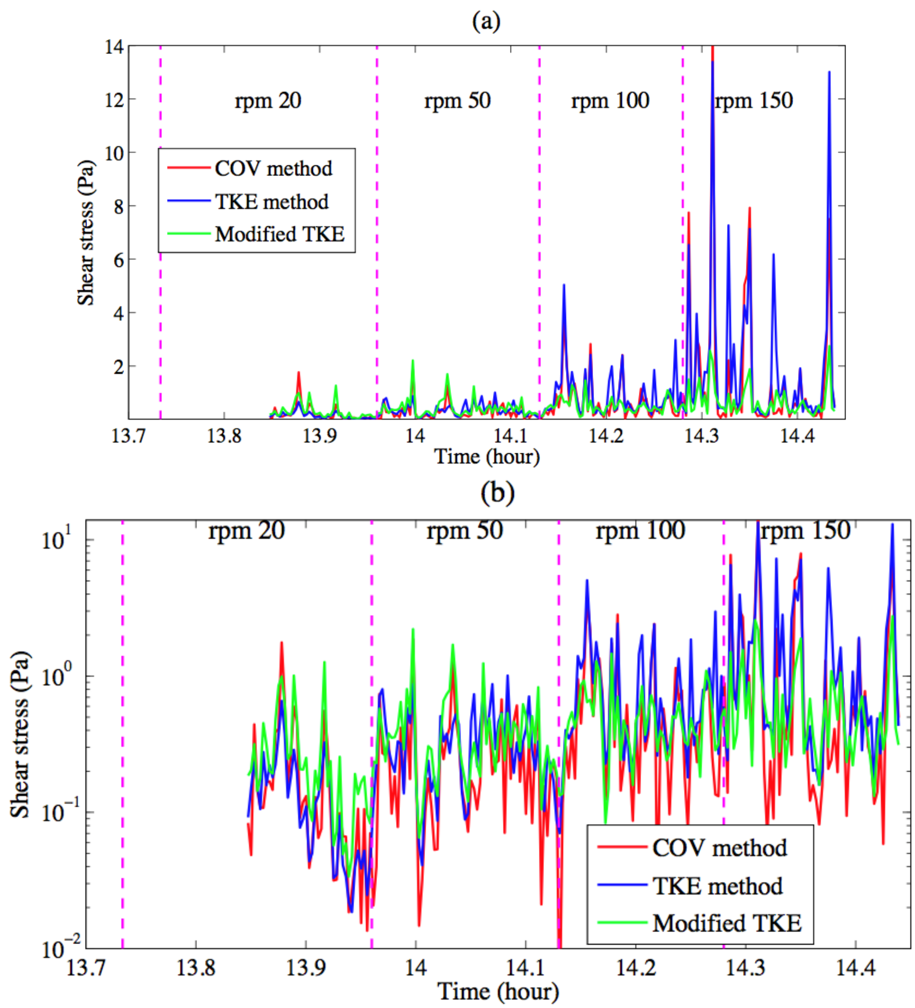


Figure 33. Time series of estimated bottom shear stress from ADV measurement: (a) stress in linear scale, and (b) stress in log scale.

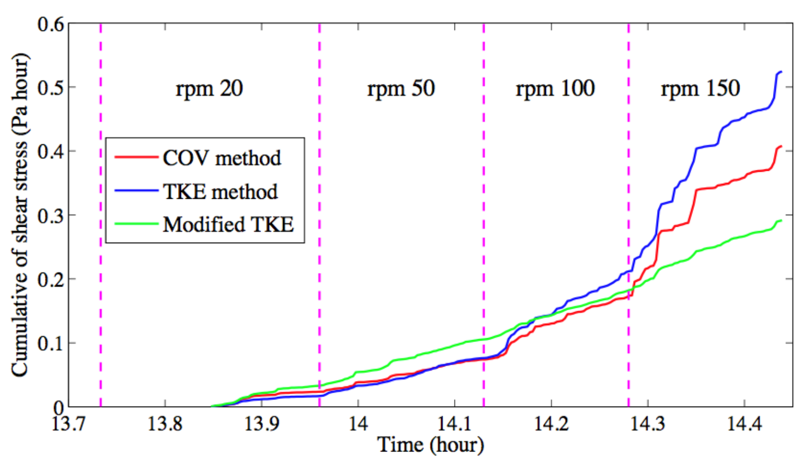


Figure 34. Cumulative of the estimated bottom shear stress from ADV measurements.

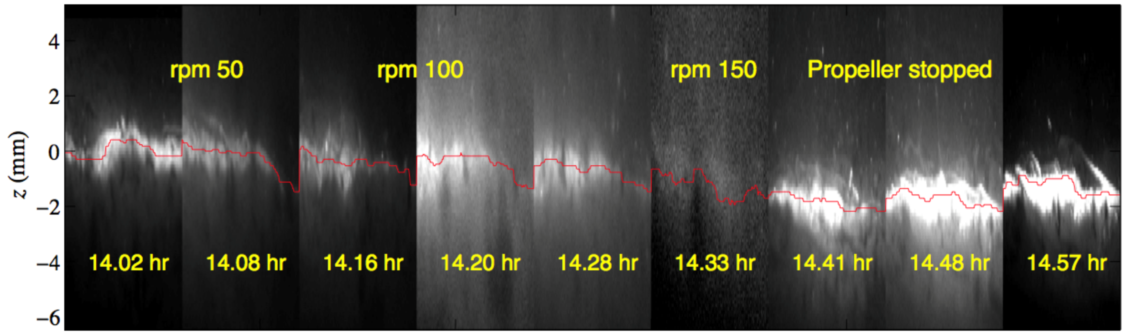


Figure 35. PIV images with visible sediment bed. The red line is the reconstructed bottom line from the bottom image.

Mass erosion rate can be converted to the depth erosion rate (E_D [m/s]) with the following relation:

$$E = \rho_b E_D, \tag{6}$$

where ρ_b is the dry bulk density of the sediment. Therefore, the cumulative of the erosion depth can be modeled as$D(t) = \frac{\epsilon_M}{\rho_b}\int_0^t (\tau_0 - \tau_c)^\alpha dt'$

$$D(t) = \frac{\epsilon_M}{\rho_b}\int_0^t (\tau_0 - \tau_c)^\alpha dt'. \tag{7}$$

We have applied Equation (7) to fit the observed cumulative erosion depth to obtain the erosion rate constant ε_M. Bottom shear stress estimated with the three different methods, i.e., the covariance, TKE and modified TKE methods, were all applied. The parameter $\frac{\epsilon_M}{\rho}$ was obtained through least square fitting. The best results are found when we select $\alpha = 1$. The correlation efficient (R^2) for the three methods are 51, 56 and 93%, respectively. This again suggests that bottom shear stress estimated from the modified TKE is more reasonable. The cumulative erosion depth and the model results from Equation (7) are shown in Figure 36.

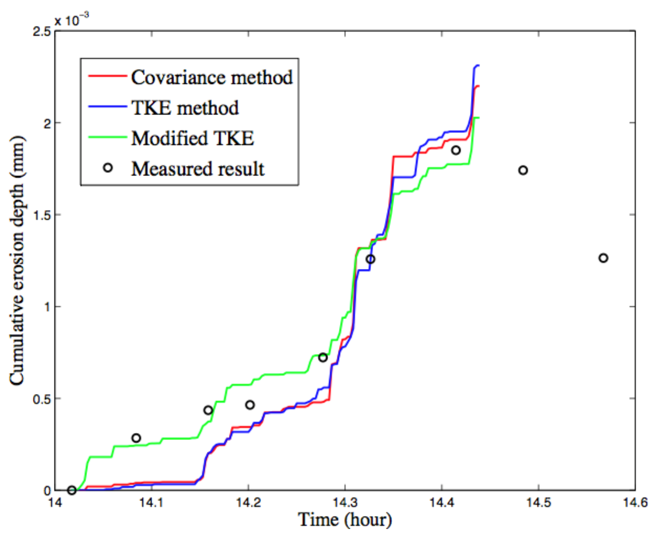


Figure 36. Cumulative erosion depth measured form PIV image analysis and modeling results with bottom shear stress obtained from ADV data.

Using the shear stress based on the modified TKE method, we have the rate of erosion depth E_D [mm s^{-1}]= 0.0079[mm s^{-1} pa^{-1})]$\times$ $(\tau_0 - \tau_b)$ [pa]. Taking a typical value for the dry bulk density of cohesive sediments, $\rho_b = 200$ (kg m^{-3}), we have the erosion rate constant $\epsilon_b = 15.7$ (g m^{-2} s^{-1} pa^{-1}).

3.6 SEDIMENT PROFILING IMAGERY (SPI)

On 28 August 2012, G&A personnel participated in the Navy's prop wash erosion experiment conducted at both the B-22 (Bravo) and O-2 (Oscar) piers in Pearl Harbor, HI. SPI was used to collect 1500 sediment profile images at each of two stations. A lightweight aluminum, modified Ocean Imaging Systems Model 3731 sediment profile camera was used for the survey; the internal printed circuit card on the camera was re-designed so that the firing rate could be programmed at user-specified intervals for use in a time-lapse deployment.

SPI was developed almost four decades ago as a rapid reconnaissance tool for characterizing physical, chemical, and biological seafloor processes and has been used in numerous seafloor surveys throughout North America, Asia, Europe, and Africa (Rhoads and Germano, 1982, 1986, 1990; Revelas, Germano, and Rhoads, 1987; Diaz and Schaffner, 1988; Valente, Rhoads, Germano, and Cabelli, 1992; Germano et al. 2011). The sediment profile camera works like an inverted periscope. A Nikon D7000 16.2-megapixel SLR camera with two 16-gigabyte SD cards was mounted horizontally inside a watertight housing on top of a wedge-shaped prism.

The prism has a Plexiglas® faceplate at the front with a mirror placed at a 45° angle at the back. The camera lens looks down at the mirror, which is reflecting the image from the faceplate. The prism has an internal strobe mounted inside at the back of the wedge to provide illumination for the image; this chamber is filled with distilled water, so the camera always has an optically clear path. This wedge assembly was fitted with 2 side- handles & an underwater trigger so that it could be inserted in the sediment at a specified location by a diver (Figure 37).

Figure 37. The hand-held, diver-deployed sediment profile camera used in Pearl Harbor.

The diver initially deployed the camera and took a test image so that the proper ISO and f-stop could be adjusted on the DSLR for the particular sediment bed. After the proper camera adjustments were made, the diver then inserted two pieces of perforated angle-iron into the sediment to keep the profile camera in place during the experiment; each piece was approximately 2 m in length and was inserted far enough so that only 50 cm of angle iron was projecting above the sediment-water interface. The camera prism was inserted in the seafloor and plastic tie-wraps were used to secure the camera prism to the angle iron. At the beginning of the survey, the time on the sediment profile camera's internal data logger was synchronized with Brad Davidson's timepiece (used for officially recording the progress and milestones of the experiment). Details of the camera settings for each digital image are available in the associated parameters file embedded in the electronic image file; for this survey, the ISO-equivalent was set at 640. The additional camera settings used were as follows: shutter speed was 1/250, f8, white balance set to flash, color mode to Adobe RGB, sharpening to none, noise reduction off, and storage in Joint Photographic Expert Group (jpeg) files (approximately 3 MB each).

The camera was programed to take an image every 3 sec for 75 min after an initial 10-min delay after the diver depressed the trigger (20 images per minute, 1500 images for each experimental run).

A spare camera and charged battery were carried in the field at all times to ensure uninterrupted sample acquisition. After deployment of the camera at each of the two stations, the frame counter was checked to make sure that the requisite number of replicates (1500) had been taken.

Back in the lab, the intensity histogram (RGB channel) for each image was adjusted in Adobe Photoshop® to maximize contrast without distortion. The jpeg images were then calibrated by measuring 1-cm gradations from the Kodak® Color Separation Guide that was photographed at the start of the experiment. This calibration information was applied to the SPI images analyzed from each deployment: 885 images from the Bravo site and 552 from the Oscar site. Linear and area measurements were recorded as number of pixels and converted to scientific units using the calibration information.

Measured parameters were recorded on a Microsoft® Excel© spreadsheet. G&A's senior scientist (Dr. J. Germano) subsequently checked all these data as an independent quality assurance/quality control review of the measurements before final interpretation was performed.

3.6.1 Measuring, Interpreting, and Mapping SPI Parameters

3.6.1.1 Prism Penetration Depth

The SPI prism penetration depth was measured from the bottom of the image to the sediment-water interface. The area of the entire cross-sectional sedimentary portion of the image was digitized, and this number was divided by the calibrated linear width of the image to determine the average penetration depth. Linear maximum and minimum depths of penetration were also measured. All three measurements (maximum, minimum, and average penetration depths) were recorded in the data file.

3.6.1.2 Suspended Sediment Area

The particles of suspended sediment were digitized to get a relative estimation of the amount of suspended load in the water column as a function of time. Both the total number of pixels and the area of suspended sediment were recorded for each image.

3.6.2 Results

A complete set of all the summary data measured from each image is presented in Appendix A. Animated time-lapse movies were made of all 1500 images from each site and delivered to the client under separate cover.

The Bravo site, which was the first experiment performed that day, had the instrument array closer to the stern of the tug-boat than at the Bravo site. The sediments at the Bravo site were primarily silt-clay particles (< 62 microns) with a layer of fine to medium sand on the surface. At the start of the experiment, the camera prism was inserted to the full depth of the faceplate window, with the average height of the imaged sediment cross section at 21.15 cm (Figure 38; see Appendix A). At the conclusion of the experiment, the cross-sectional height of the sediment was 4.93 (Figure 38), meaning a surface layer slightly exceeding 16 cm had eroded away from this particular location as a result of the prop wash at the Bravo site.

The instrument deployment at the Oscar site was at a greater distance from the tug stern, and the sediments at this location site consisted of silty, very fine to fine sands (Figure 39); at the start of the experiment, the average height of the sediment column was 16.73 cm (Appendix A). The last image of the sediment cross-section recorded by the SPI camera had an average height of 14.28 cm, so an average of 2.45 cm of sediment was eroded from the surface during the course of the experiment. There were two different occasions where a long-eyed swimming crab (*Podophthalnus vigil*) was recorded walking across the sediment in front of the faceplate (at 14:38 and 15:02—see Figure 40 and the comment field in Appendix A, as well as the time-lapse movie).

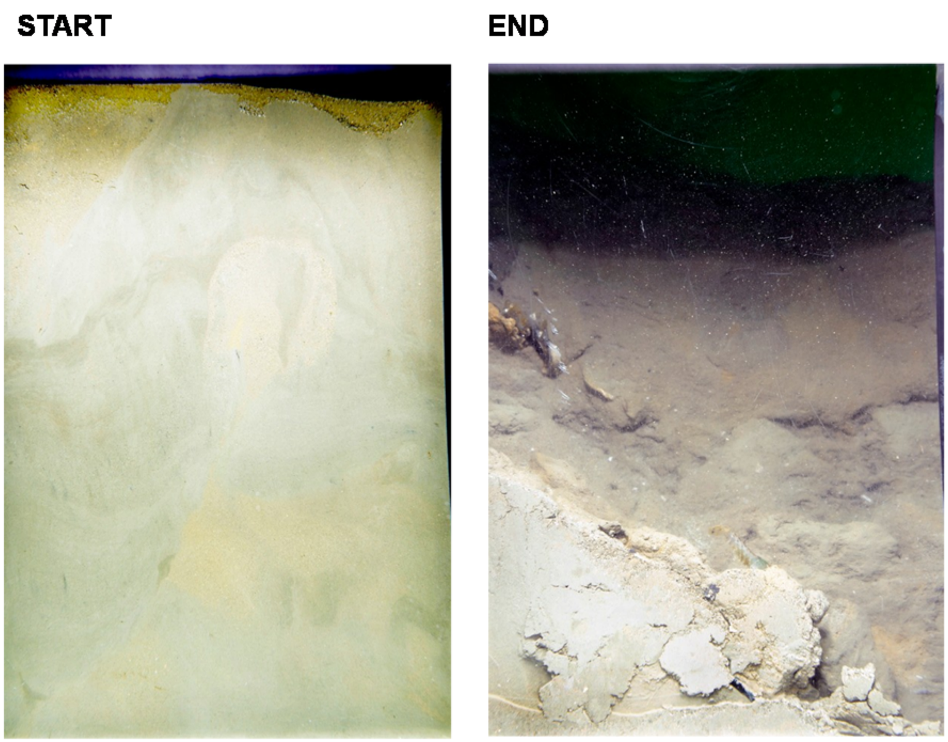


Figure 38. Sediment profile image at the Bravo site at the start (left) and end (right) of the experiment. Scale: width of each image = 14.5 cm.

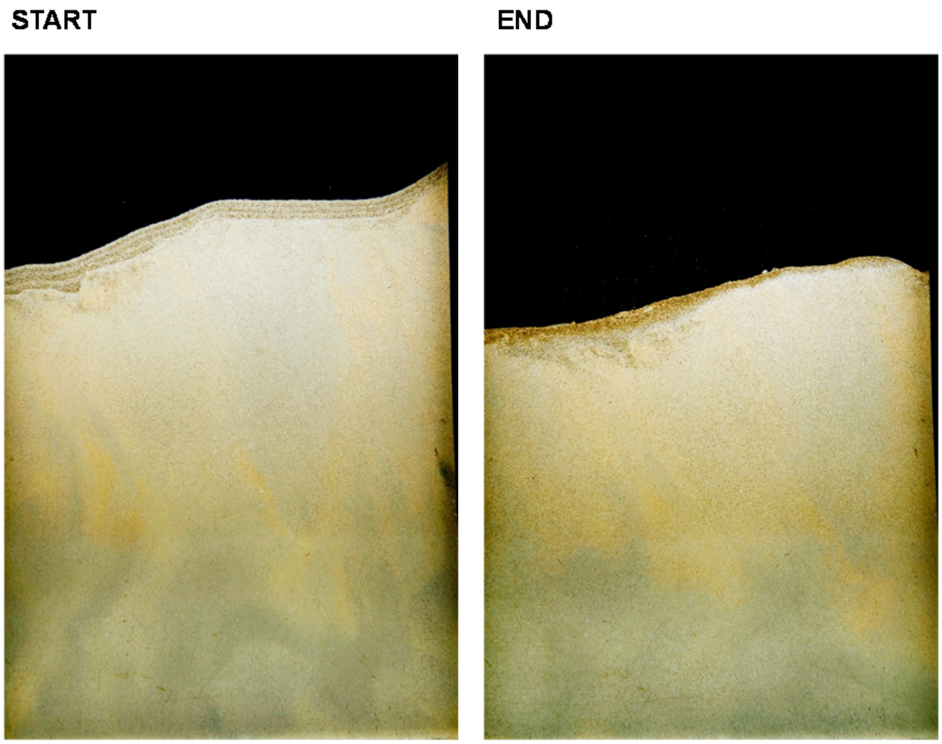


Figure 39. Sediment profile image from the Oscar site at the start (left) and end (right) of the experiment. Scale: width of each image = 14.5 cm.

There appeared to be two different types of erosion occurring: a steady, gradual loss of sediment particles from the sediment-water interface (the characteristic dynamic at the Oscar site), or occasional saltational erosion "events," when a large amount of sediment would erode or be lifted up into the water column and a "new" sediment–water interface would be established from that point onward (both of these types of dynamics happened at the Bravo site). Fracturing events in the muds at the Bravo site could be visualized periodically, and it is unclear whether or not this was an artifact from the sediment being pressed up against the camera faceplate or was an accurate reflection of what was happening at other locations in the bed. Sometimes sediment that had been resuspended would resettle on the surface and be incorporated back into the sediment column; this resulted in occasional increases in the sediment height at times, followed over time by steady decreases (see Appendix A and Figures 41–42).

There were varying amounts of suspended sediments measured in the water column as a function of time, corresponding to planned adjustments in the propeller speed; the peaks in suspended sediment reflected the initial reaction of the sediment bed to the changes in speed until the final decline in suspended sediment load at the end of the experiment (Figures 41–42). At the Bravo site, large sediment chunks were on the surface or in the background that were excluded from the measurement of the suspended sediment particles. The amount of particles in the water column immediately over the sediment bed appeared to be much greater at the Bravo site (Figure 41) than at the Oscar site (Figure 42); this was to be expected, given the closer position of the instrument array to the tug stern at the Bravo site as compared with the Oscar site (stronger currents and more erosion measured at the Bravo deployment as compared with the Oscar experiment).

There were varying amounts of suspended sediments measured in the water column as a function of time, corresponding to planned adjustments in the propeller speed; the peaks in suspended sediment reflected the initial reaction of the sediment bed to the changes in speed until the final decline in suspended sediment load at the end of the experiment (Figures 41–42). At the Bravo site, large sediment chunks were on the surface or in the background that were excluded from the measurement of the suspended sediment particles. The amount of particles in the water column immediately over the sediment bed appeared to be much greater at the Bravo site (Figure 41) than at the Oscar site (Figure 42); this was to be expected, given the closer position of the instrument array to the tug stern at the Bravo site as compared with the Oscar site (stronger currents and more erosion measured at the Bravo deployment as compared with the Oscar experiment).

The data in Appendix A will no doubt be useful for correlation with the measurements from the other instrument arrays and the water column samples taken during the course of each experimental run, and should help provide a more comprehensive understanding of the sediment dynamics at each location.

3.7 MAYNORD'S MODEL

Maynord's model is based on the empirical model developed by Blaauw and van de Kaa (1978), which follows the law of conservation of momentum. The power of the rotating propeller is equal to the momentum of the flow field in the wake of the propeller. The propeller-induced velocity can be expressed explicitly as

$$U(x,z) = AU_0\left(\frac{D_0}{x}\right)e^{-B\left(\frac{z}{x}\right)^2}, \tag{8}$$

where x is the distance along the axial direction and z is the radial distance of the propeller (Figure 43). D_0 is the equivalent propeller diameter, and U_0 is the exit velocity of the propeller, which can be approximated by the power and diameter of the propeller (Blaauw and van de Kaa, 1978):

$$U_0 = C\left(\frac{P}{D_P}\right)^{1/3}, \tag{9}$$

where C is an empirical constant, P the engine power of the propeller in [horse power], and D_p is the propeller diameter.

In Equation (8), A and B are two coefficients (constants) obtained empirically. Maynord's model is for single-screw propellers in infinite flow domain. The velocities at the bottom are calculated by assigning the position (x, z) of the bottom to the equation, which means that the bottom is treated as a virtual bottom (transparent) in the model and the bottom effect to the hydrodynamics of the propeller wash is ignored. To reduce the effects of ignoring the bottom effect, it is advised to apply Maynord's model for propellers with the ratio of diameter/shaft-to-bottom distance D_p/H_p at low values (Figure 43), which were suggested as less than 1.2 by Maynord (1998) (no theoretical reasons or proof was given). However, most vessels in DoD harbors operate in very shallow water conditions with D_p/H_p far exceeding 1.2 (e.g., air craft carriers, distillers dried grains with solubles [DDG], etc.). Furthermore, Maynord's model does not consider the interaction of twin-screw propellers such as those on DDG ships. For the DDG test case considered in the preliminary investigation, the ship draft is 31 ft and the water depth is 35 ft. The diameter of the twin-screw propeller is D_p = 17 ft, and the distance from propeller shaft to harbor bottom is $H_p = 15.3$ ft. This gives $D_p/H_p = 1.11$, which is near the threshold applicable range of Maynord's model. However, there is a strong interaction between the two counter-rotating propellers. Consequently, the bottom shear-stress distribution is drastically different from that induced by a single-screw propeller. We conducted a literature search and we could not find many published manuscripts/data for validation of Maynord's model, in particular, for the scenarios, $D_p/H_p > 1.2$, for which most naval vessels in DoD harbors operate. In the application of Maynord's model (Maynord, 1998), two examples were discussed in the study of sand particle sizes for protecting the sediment caps for a commercial vessel traffic and a recreational vessel traffic. Table 13 lists the parameter values for the two applications.

For both applications, the ratios of D_p/H_p are less than 1.2, which are within the applicable range for Maynord's model. The range of applicability for Maynord's model is also emphasized by Jay (2002) , in which it was suggested that Maynord's model should be applied only for deep water scenarios with the D_p/H_p ratio the smaller the better. By limiting to deep water application, the bottom effect would be reduced, which is presumably more conformal to the model. However, for deep water, the propeller is closer to the free surface than to the bottom and the propeller jet should hit the free surface earlier than it hits the bottom. Therefore, the free surface effect would attenuate the propeller wash flow, and interfere with the conservation of momentum principal, on which Maynord's model is based (Blaauw and van de Kaa, 1978; Maynord, 1984).

3.7.1 Results of Maynord's Model

A user-friendly version of Maynord's model has been developed (Figure 44 and Figure 45) for twin-engine tug-boat. Input parameters for the model include propeller type (Kort nozzle or traditional), propeller diameter, thrust, shaft to bottom distance and water depth (Figure 29). The model calculates velocity profiles and shear stress at the bottom sediment bed. Both visual output and ASCII data files are produced (Figure 44).

3.8 FATE AND TRANSPORT MODEL (CH3D)

The numerical hydrodynamic fate and transport model applied for this study is the CH3D. This model is a boundary-fitted finite difference, Z-coordinate model developed at the U.S. Army Corps of Engineers Waterways Experiment Station (Johnson et. al., 1991) to simulate physical processes in bays, rivers, lakes and estuaries (Wang and Martin, 1991; Wang, 1992; Wang and McCutcheon, 1993; Wang et al., 1997, 1998; Johnson et al., 1995). The model simulates hydrodynamic currents in four dimensions (x, y, z, and time) and allows for the prediction of the fate and/or transport of metals, sediment, and other contaminants in estuarine s and coastal environments under the forcing of tides, wind and freshwater inflows (Sheng et al., 1990; Wang and Richter, 1999). The CH3D model was implemented and applied to support the following relevant studies: (1) Copper and other antifouling biocide concentrations from hull paint in San Diego Bay (Wang et al., 2006), and concentrations of copper and its species in support of ESTCP's project for San Diego Bay and Pearl Harbor (Chadwick et al., 2008); and (2) Sediment transport and deposition of sediment loads from the surrounding watersheds for Pearl Harbor (Wang et al., 2009). Further details about the model and results can be found in the cited references.

For this study, CH3D has been set up for simulating the fate and transport of plumes from the propeller wash for Pearl Harbor (Figure 46–Figure 48) and San Diego Bay. Both models have been modified with increased resolutions, with the cell sizes decreased from 100–150 meters to 20–50 meters, at the study sites: Bravo Pier (Figure 47) and Oscar Pier (Figure 48) for Pearl Harbor, and Pier 4–5 of San Diego Bay.

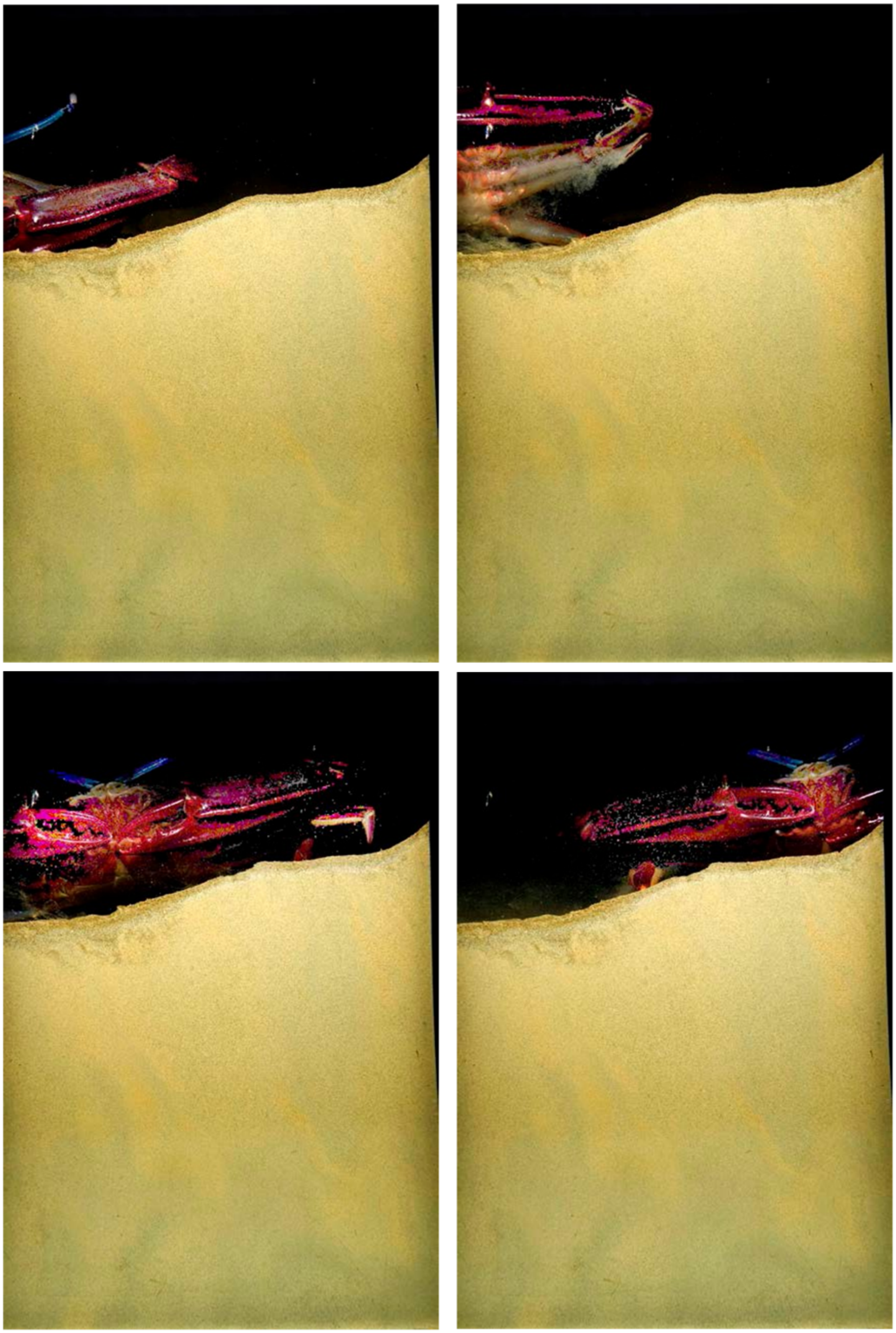


Figure 40. One of the appearances of the crab over a 9-sec interval during the Oscar site deployment; each image taken 3 seconds apart, starting at 15:02:49 (see Appendix A).

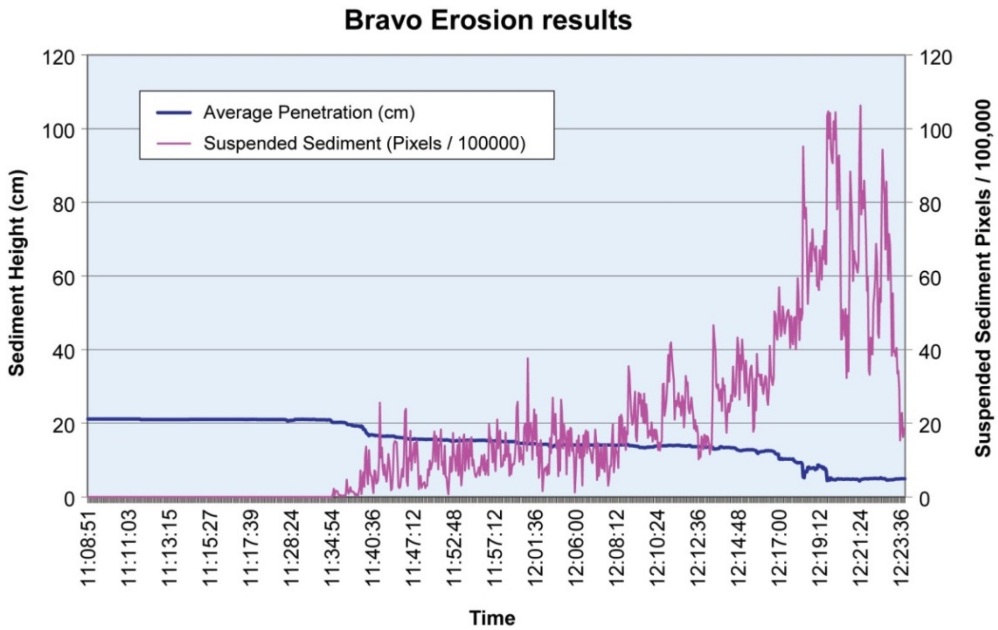


Figure 41. Height of sediment and amount of suspended sediment in water column as a function of time during Bravo experiment.

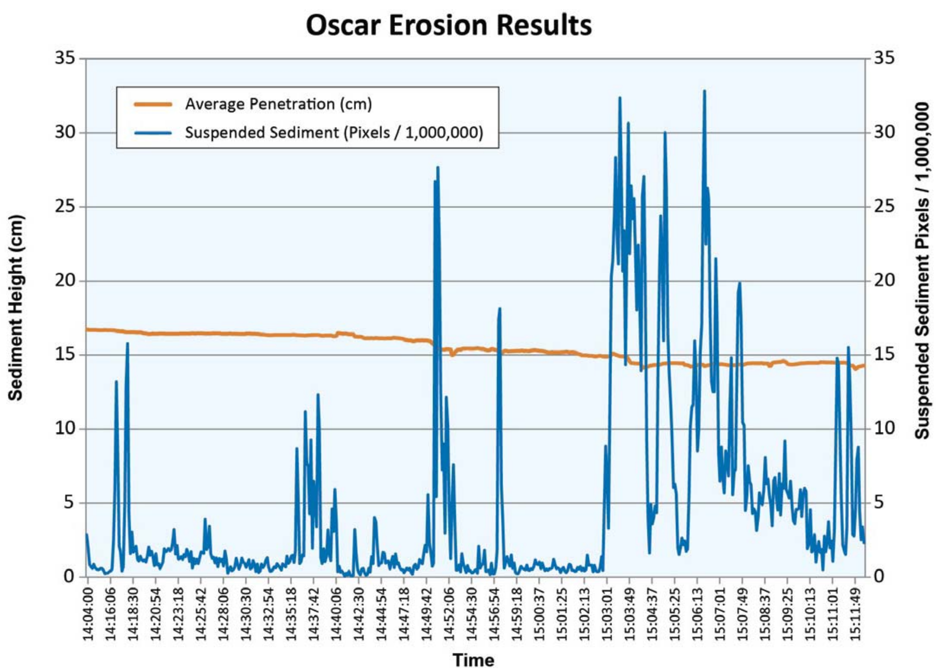


Figure 42. Height of sediment and amount of suspended sediment in water column as a function of time during Oscar experiment.

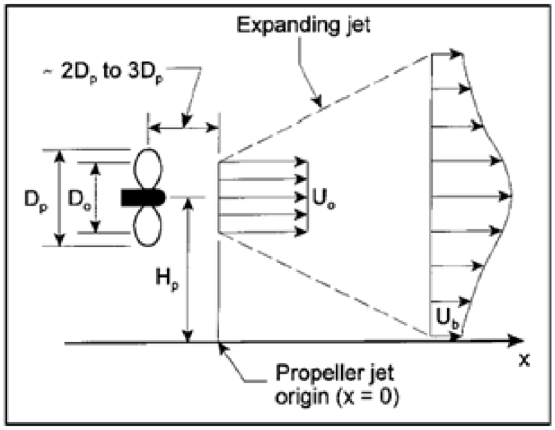


Figure 43. Configuration and parameters for the Maynord's model, which is for single-screw propeller in infinite flow domain.

Table 13. Key parameters for Maynord's model application examples (Maynord, 1998).

	Water Depth (ft)	Propeller Diameter (D_p, ft)	Shaft to Bottom Distance (H_p, ft)	D_p/H_p
Commercial Traffic	16	5	9.5	0.53
Recreational Traffic	5	1.44	3	0.48

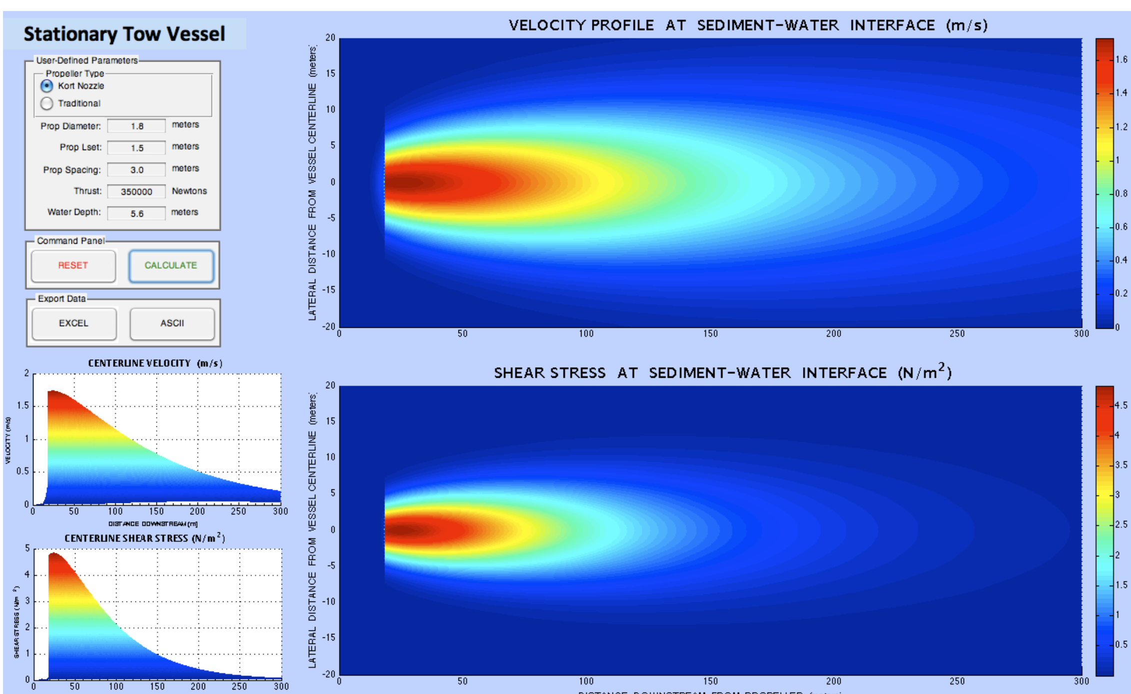


Figure 44. Tug-boat model screen shot for bottom velocity and shear stress (new user-friendly model based on Maynord's theory).

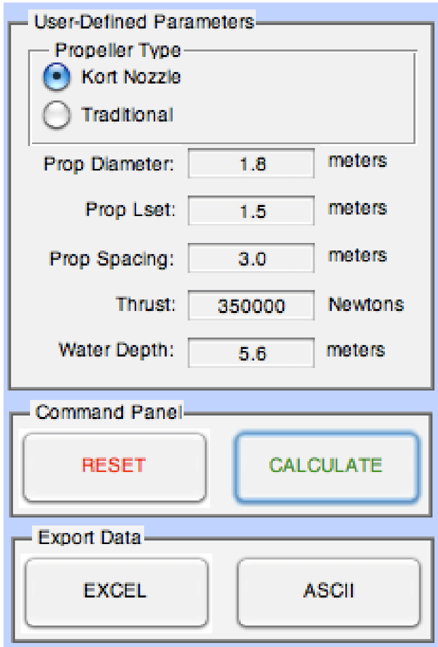


Figure 45. User's input panel for tugboat model (versatile for any twin-engine tugboat).

Figure 49 and Figure 50 show how the field data were assigned to the model cells as loads to drive the fate and transport simulations. Water sample data and optical backscatter sensor (OBS)-based TSS loads are interpolated to the pier sites with model grid overlaid. Interpolated TSS and metal loads were assigned to the nearest model cell and model simulation then starts.

Based on the water column data analyzed, the metals to be simulated by the fate and transport model are chromium, copper, nickel and lead for Pearl Harbor and nickel and copper for San Diego Bay. These metals have values either above or close to the US EPA's chronic water quality criteria.

The following aspects of the model are briefly described.

3.8.1 Model Validation

CH3D has been set up and can simulate the sampling conditions for the three pier sites, including San Diego Bay and Pearl Harbor. Both measured and extrapolated metal and TSS concentrations, discussed previously, have been compared with model results. The OBS and ADCP-derived TSS concentrations were uniquely used for model validation, in particular, during the later portion of the sampling effort for Oscar Pier, since ADCP data shows persistent submerged "plumes" which exhibited elevated concentrations in the lower portions of the water column.

3.8.2 Transport by Tide and Freshwater Inflows

CH3D simulated the fate and transport of the plume for different tidal forcing scenarios, including flood and ebb tides. Effects of freshwater inflows, although expected to be small, were included in the simulation. Model results provided information how and where these sediment plumes would be transported by tidal currents.

3.8.3 Particle Bound and Settling (Depositions)

CH3D was implemented to include settling associated with particles with three different sizes, clay, silt, and sand. Metals bound on each of the three particle sizes are assumed to settle with the particles and hence to be lost from the water column as they settle to the bottom. Settling velocities were assigned for each of the particle sizes, based on the Stoke's theory.

Deposition (footprint) of particulate metals were simulated. It is expected that sand-bound metals settle faster than silt and clay bound metals. The model quantified these relative deposition patterns under various tidal conditions for the various metals. Re-contamination potential by the contaminated sediment plumes can be simulated and quantified.

3.8.4 Transport of Dissolved Phase and Dilution

Dissolved phase of metals pose re-contamination potential to marine organisms due to elevated concentrations from plume transport. Dissolved phase was assigned a settling velocity of zero or/and slightly higher than zero for simulating the fluff organic-like substances. As these dissolved metals are transported, they are subject to continuous dilutions. Therefore, the migration-dilution patterns of dissolved metals were simulated and quantified during the periods when they are significant and pose a risk.

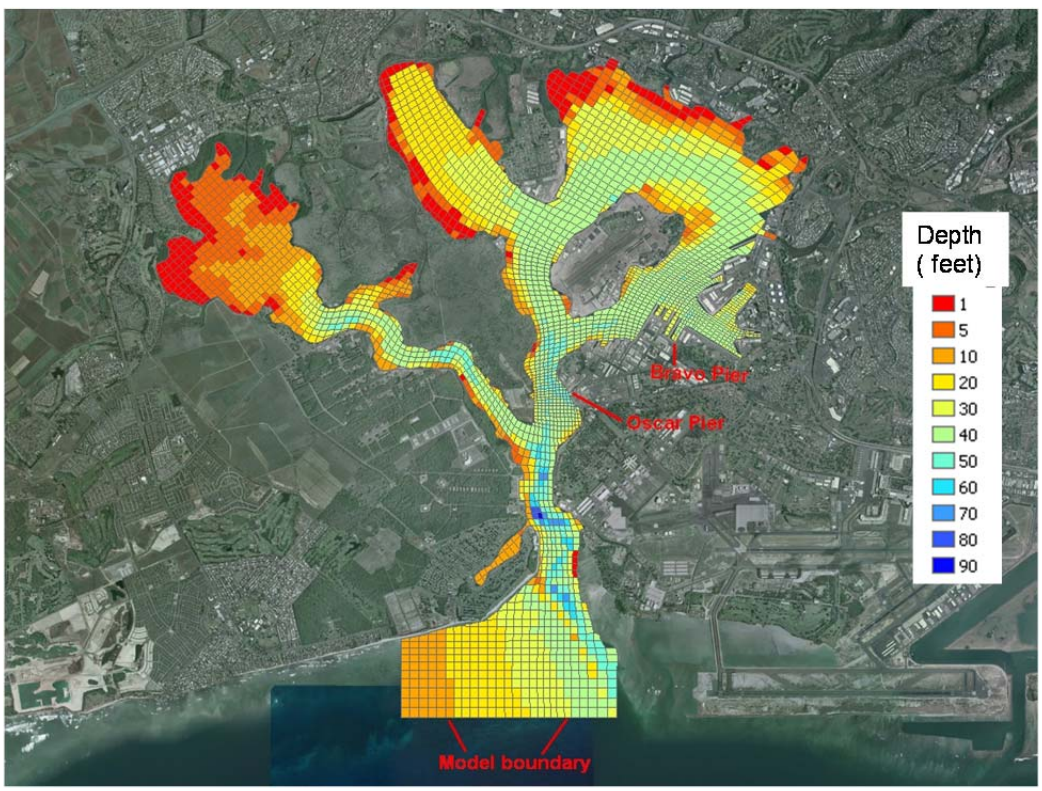


Figure 46. Refined fate and transport model, CH3D, for Pearl Harbor.

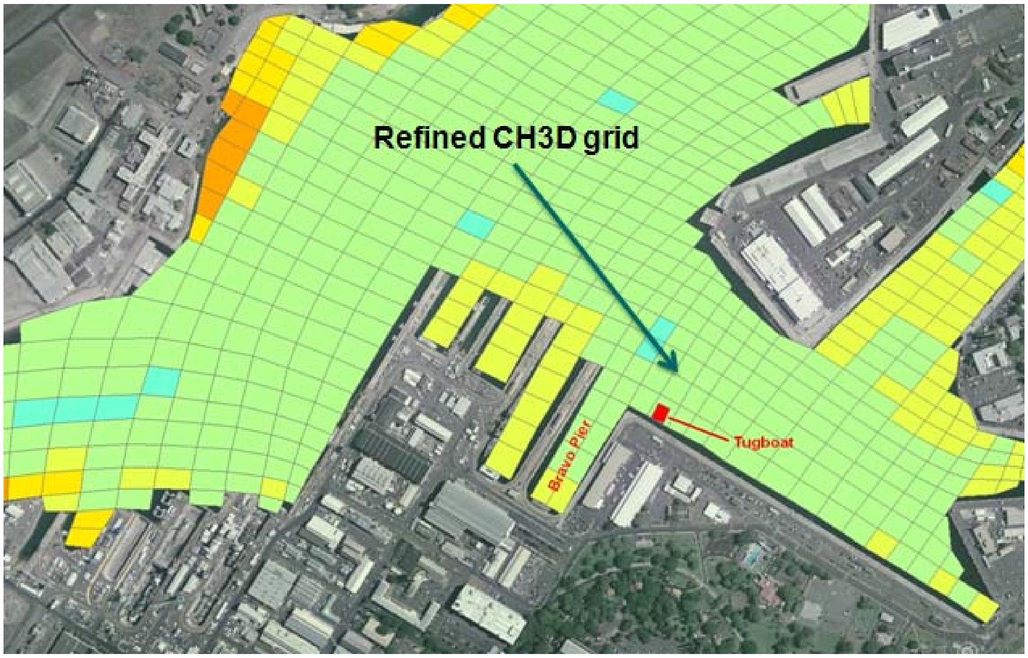


Figure 47. Fate and transport model grid near Bravo Pier, Pearl Harbor.

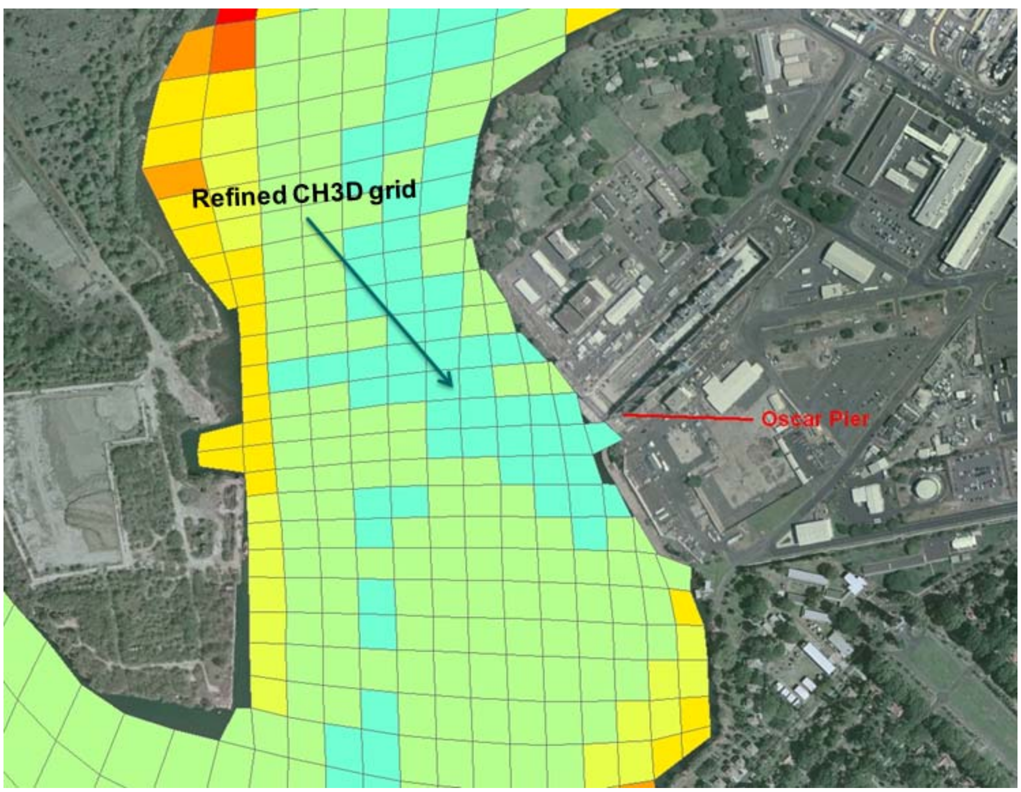


Figure 48. Fate and transport model grid near Oscar Pier, Pearl Harbor.

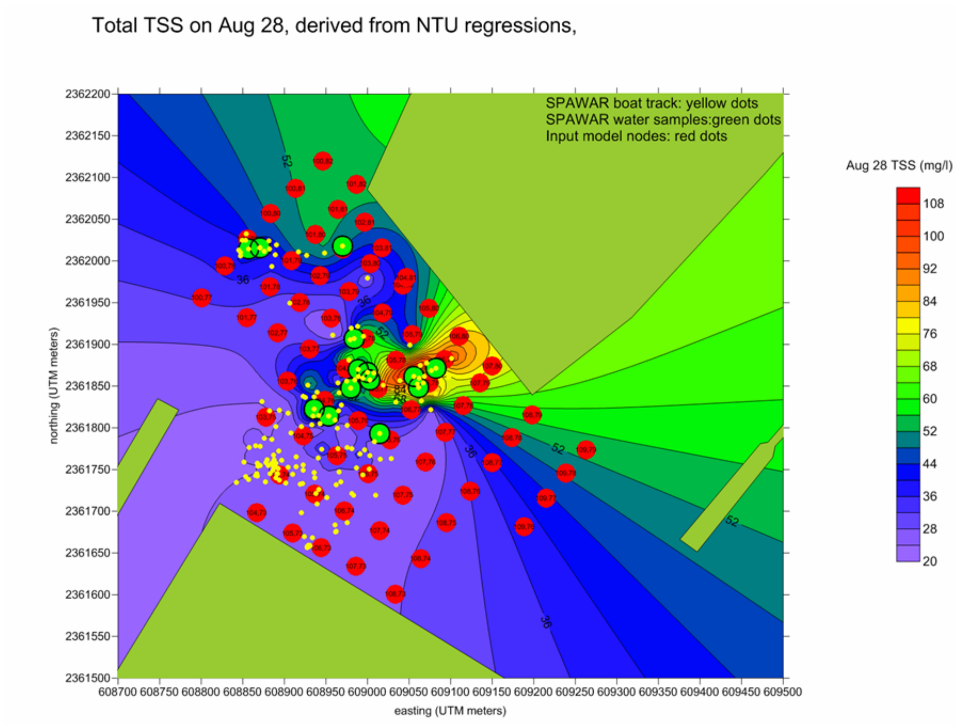


Figure 49. Model cells with the initial plume loads (red circles) estimated and extrapolated (e.g., color contours for TSS) from the measured water samples (green circles) and OBS data (yellow circles) for Bravo Pier.

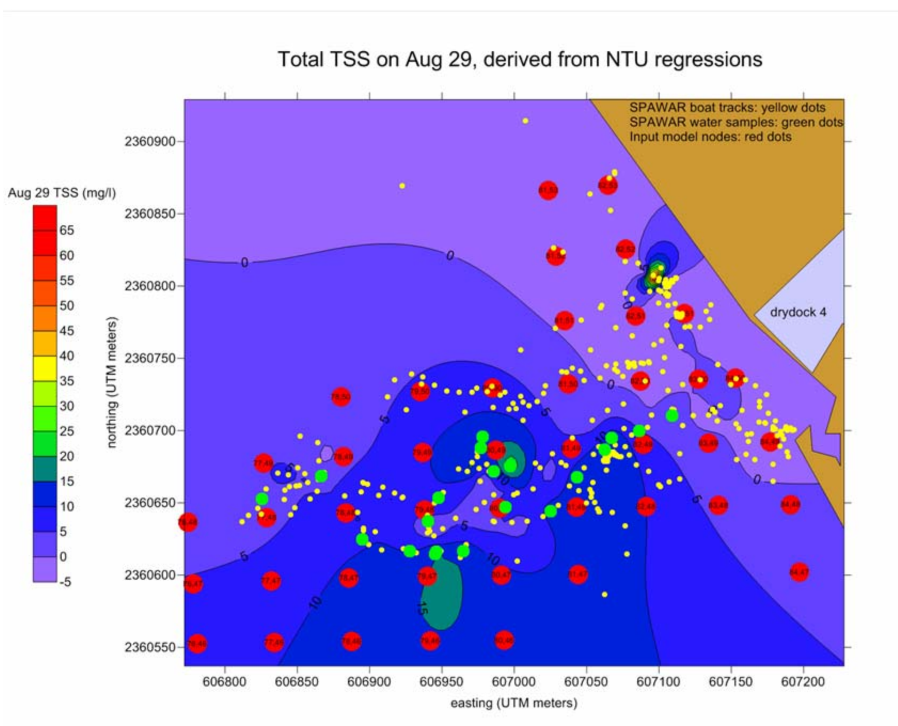


Figure 50. Model cells with the initial plume loads (red circles) estimated and extrapolated (e.g., color contours for TSS) from the measured water samples (green circles) and OBS data (yellow circles) for Oscar Pier.

3.8.5 Relevant Data Collected for Fate and Transport Study

The following data were used for fate and transport study:

1) 20 water sample data for TSS fractions, and dissolved and particle-bound metals (8 metals) at each of the three piers
2) About 200 OBS turbidity data for TSS projection at each pier
3) ~ 10k ADCP backscattering data for TSS projection at each pier

Field sampling has been completed for San Diego Bay and Pearl Harbor. By tracking turbidity and chemical (metals) plumes, water samples were collected at approximately 15 locations for each of the Bravo Pier and Oscar Pier and 17 locations for San Diego Bay. concentrations of TSS, particle size distributions (clay, silt, and sand fractions), and eight priority pollutant metals associated with each particle size were measured.

Figure 51 shows trajectories of water samples from the plumes in Bravo Pier (28 August 2012) and Oscar Pier (29 August 2012), Pearl Harbor, and Figure 52 for San Diego Bay. After the tug-boat gave the first full-throttle for 90 seconds, the sampling boat took the surface and mid-depth samples at three stations in 5 minutes (a total of six samples). Ten minutes after the last sampling, the tug-boat gave its second 90-second full throttle and another six samples were taken at three locations. These locations were selected at the scene based on an observations from someone standing at the upper deck of the parking vessel at the pier. We, on the sampling boat, could also see where the plumes were and steered the boat to the “center” of the plume for sampling. About 40 minutes after the sampling following the second burst, the tug-boat ran its full-throttle for 5 minutes before another 12 water samples were taken at mid-depth. In summary, at each pier, water samples were taken at the surface layer (3-feet deep) and mid-depth (15-feet deep) for the first three stations and at the mid-depth layer for the other 12 stations, resulting in 20 water samples. Another boat with an ADCP backscattering device onboard was moving though the study area, taking backscattering data for TSS projection.

For San Diego Bay (Figure 52), 34 water samples were collected at 17 stations at both surface and mid-depth of the water column. OBS onboard the sampling boat recorded turbidity data in nephelometric turbidity unit, NTU, which was calibrated using the water samples collected during the field study.

3.8.6 Metal Data and Data for Particle Sizes and Total Suspended Solid (TSS)

For each water sample, eight metals, including copper, zinc, chromium, cadmium, arsenic, silver, nickel, and lead were analyzed in the SSC Pacific laboratory. The metal data includes dissolved, and three particle-bound phases for clay, silt, and sand, respectively, and total metal concentrations.

At the San Diego Bay, 34 water samples were collected, which included both surface and mid-depth samples. The complete dataset are stored as an Excel file for each of the three studies. For illustration, Figure 53 and Figure 54 show only copper data for the Bravo Pier and Oscar Pier, respectively, and Figure 55 shows the copper data for San Diego Bay.

Figure 56 and Figure 57 show statistical mean ratios of dissolved metal concentrations versus particle-bound concentrations for Bravo Pier and San Diego Bay, respectively.

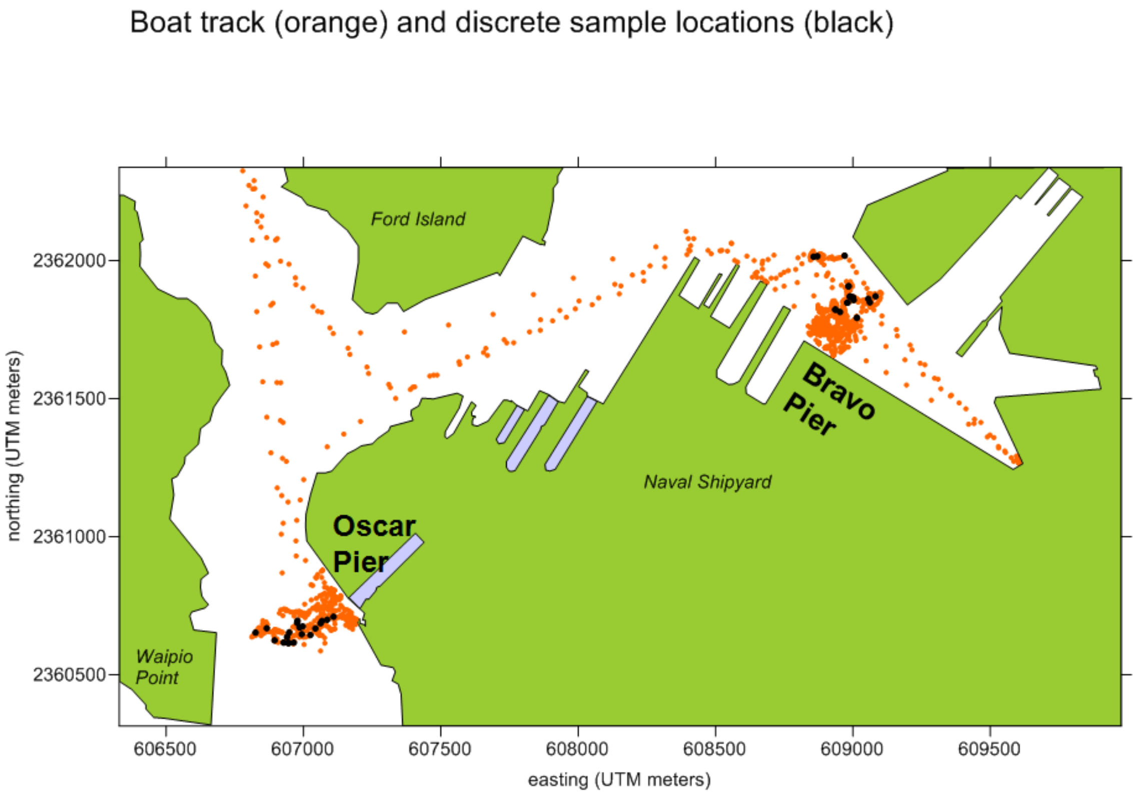


Figure 51. Water sampling locations and boat track with OBS for Pearl Harbor.

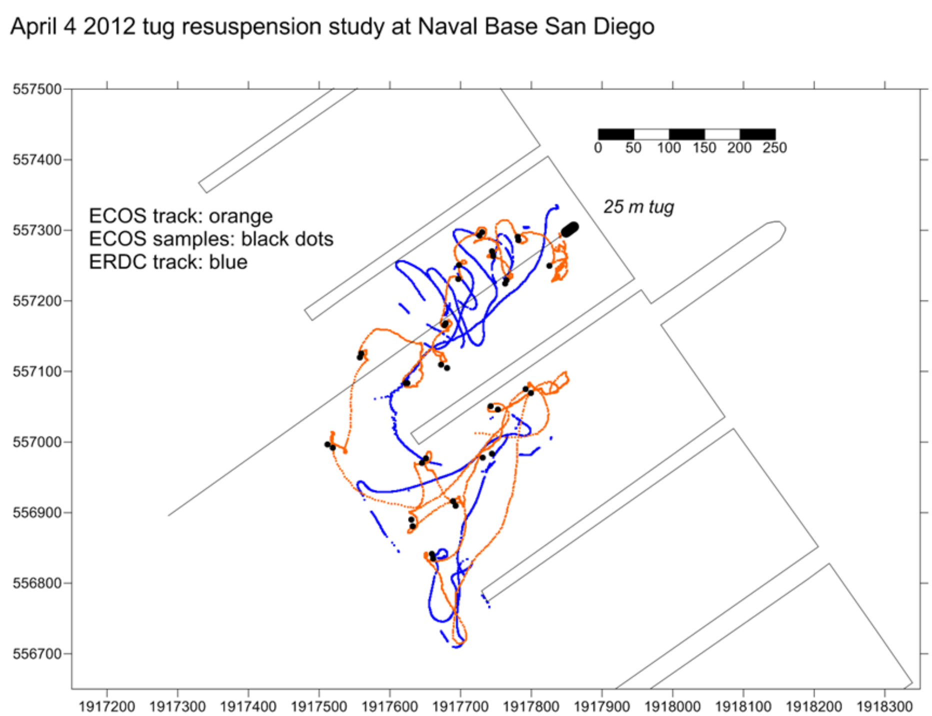


Figure 52. Water sampling locations (black dots) and boat track with OBS (orange) for San Diego Bay.

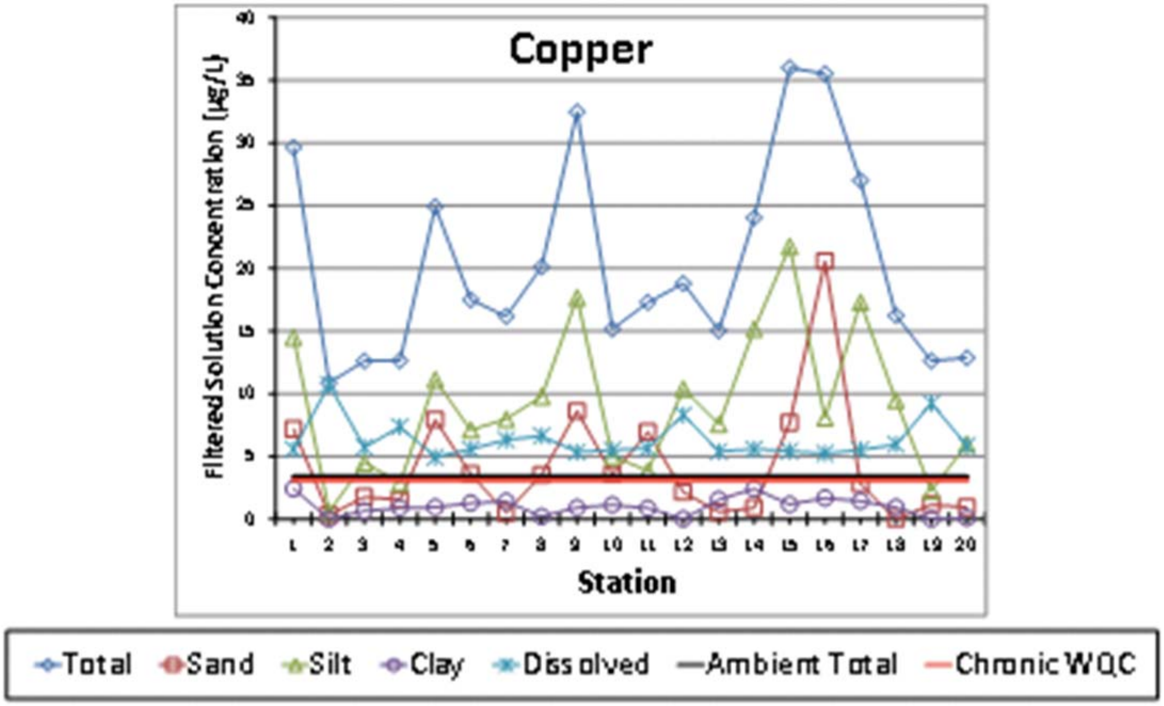


Figure 53. Total, dissolved and three particle-bound copper concentrations for Bravo Pier (first 20 water samples) in Pearl Harbor.

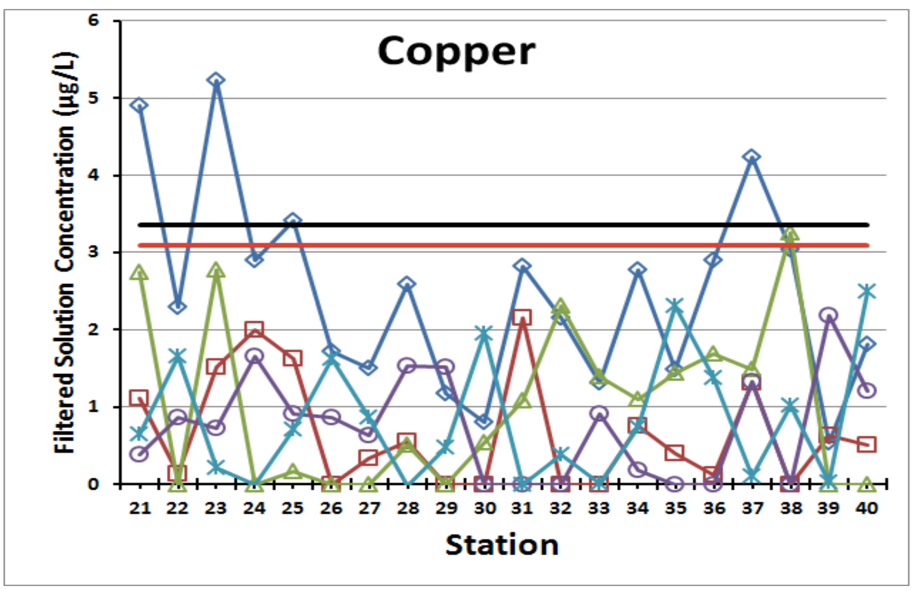


Figure 54. Total, dissolved, and three particle-bound copper concentrations for Oscar Pier (21 to 40 water samples) in Pearl Harbor.

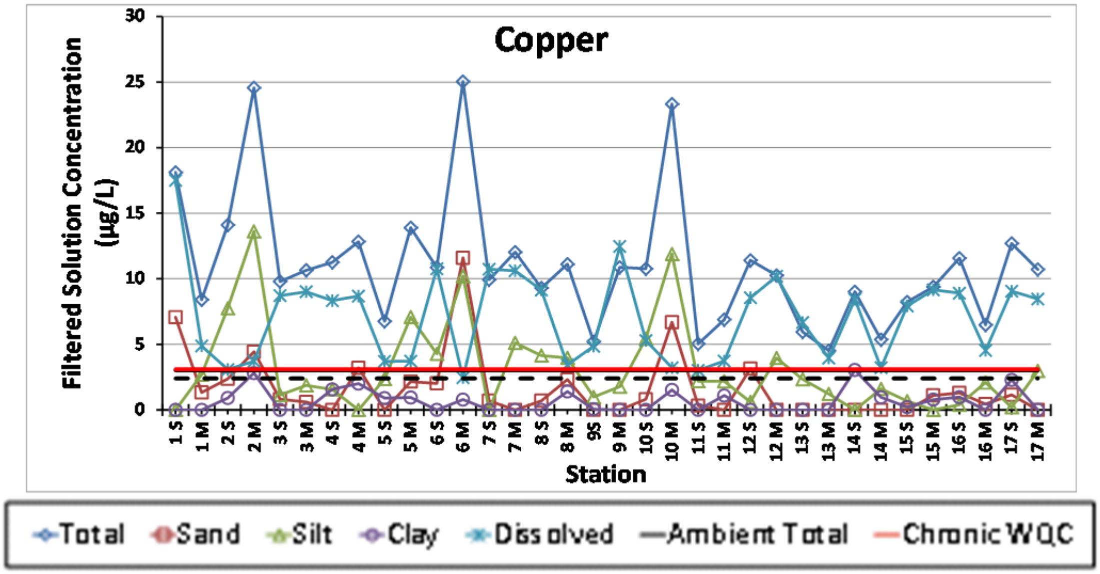


Figure 55. Total, dissolved, and three particle-bound copper concentrations for Bravo Pier (34 water samples) in San Diego Bay.

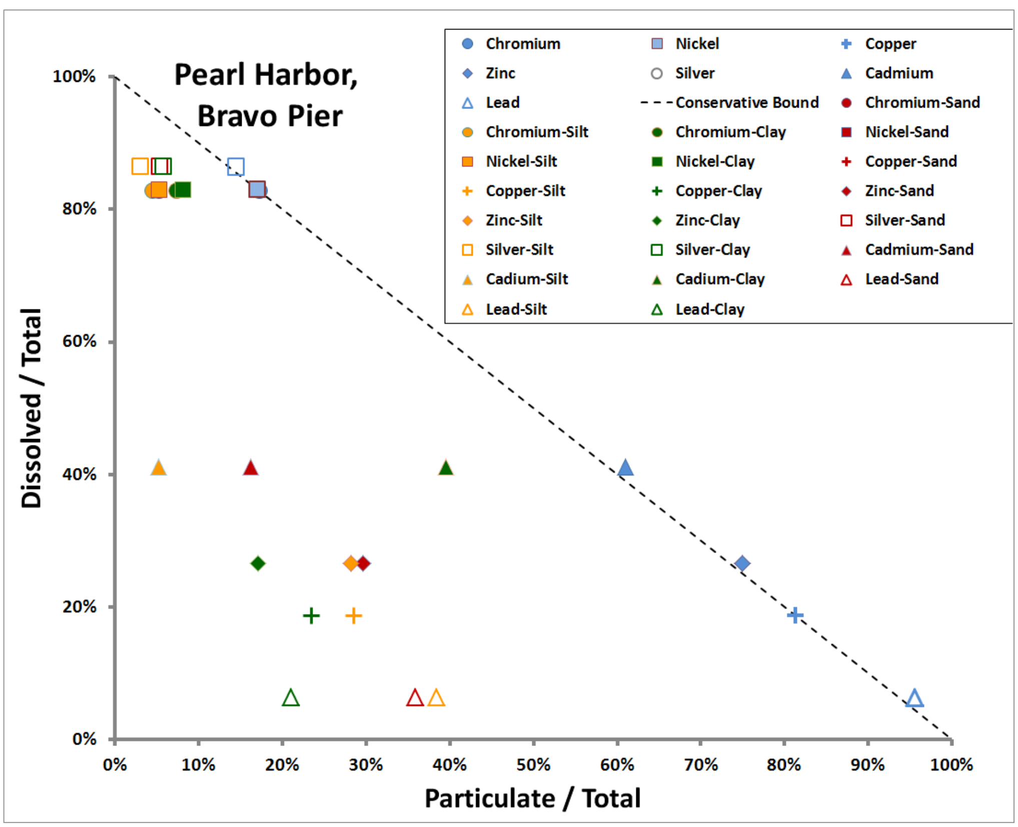


Figure 56. Statistical mean ratios for dissolved, three particle-bound and total metal concentrations for Bravo Pier, Pearl Harbor.

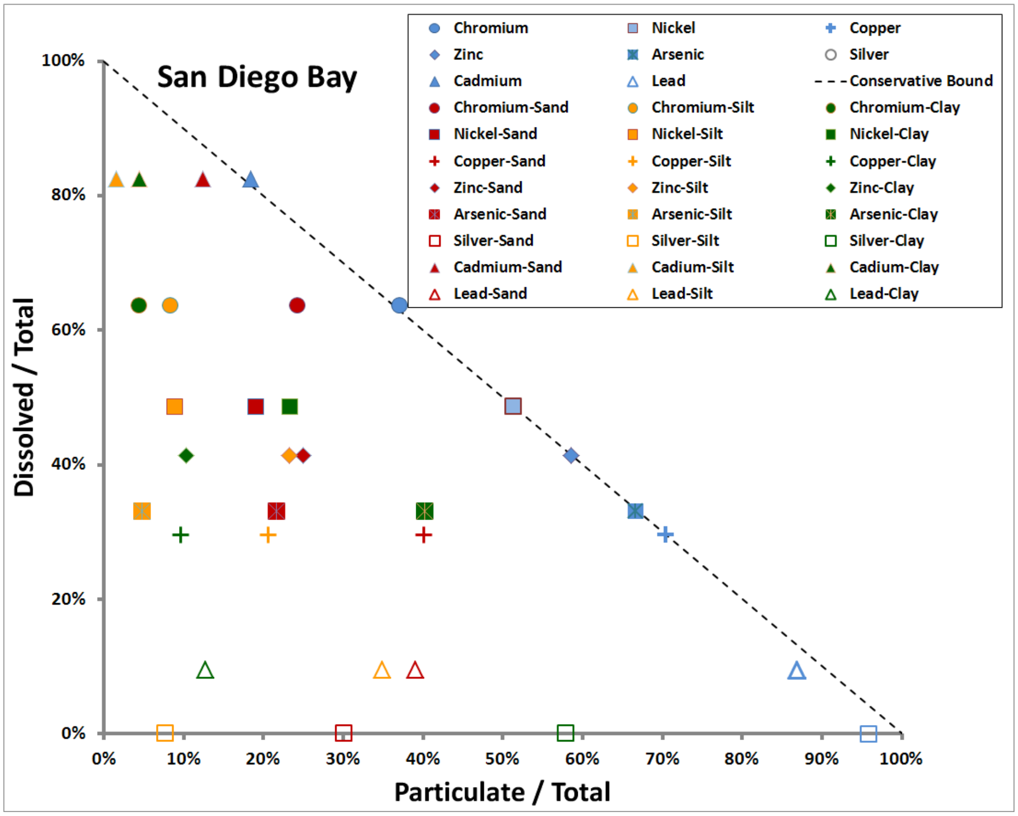


Figure 57. Statistical mean ratios for dissolved, three particle-bound and total metal concentrations for San Diego Bay.

3.8.7 TSS Fraction Data in Water Column

TSS fractions were estimated from the water samples collected during the plume surveys.

Figure 58 and Figure 59 show fractions of TSS in clay, silt, and sand for the combined water sample data of Bravo Pier and Oscar Pier. The water column TSS fraction data is similar to the background sediment data collected at the study sites before the surveys. In general, TSS is composed of, primarily, silt, followed by sand and clay. The silt-dominance composition stayed unchanged for nearly all the 40 samples for Pearl Harbor, except at sample #19 where sand fraction is higher than silt. Compared to silt, clay and sand compositions are both small and switch their relative composition throughout the sample locations.

Figure 60 shows the corresponding TSS fraction data for San Diego Bay, which shows similar dominance by silt, but with larger variability among the samples. Similar compositions are followed by clay and sand, in the corresponding order, except for six stations (out of 34 stations).

Geometric means of each of the particles were estimated to distribute OBS-projected TSS concentrations into the three particle groups.

3.8.8 OBS Data

Discrete water samples were used to calibrate the OBS data into TSS size fractions. Once the OBS data is calibrated, OBS data were used to extrapolate for particle concentrations and metal loads to those TSS size fractions. The metal concentrations and TSS size fraction concentrations were interpolated/extrapolated throughout the vicinity of the piers and averaged values were assigned to the closest (< 25m) model nodes.

As shown in Figure 51 with the water sample locations and the OBS dataset locations, it is our goal to use the OBS data to extrapolate and populate datasets from 20 water samples to ~ 200 TSS and TSS fraction-bound metal datasets. Therefore, the OBS data in NTU needs to be calibrated to TSS data.

3.8.9 TSS Calibration

Figure 61, Figure 62 and Figure 63 show the maps of 20 water sampling locations, the OBS locations and interpolated TSS concentrations are based on the formulae developed from these two datasets for Bravo Pier, Oscar Pier, and San Diego Bay, respectively. For calibration, the locations were identified where both OBS data and water samples were at the same locations or were closest both in time and in space. OBS NTU and TSS concentrations from the sampled water were used for calibration.

Figure 64 shows TSS calibration results from the OBS data for Bravo Pier and Oscar Pier. These two regression curves are similar, and were used to estimate TSS and particle fractions for these two studies.

3.8.10 ADCP Backscattering Data (for TSS)

During the plume tracking/sampling studies, a separate boat (Boston Whaler) equipped with an ADCP backscattering instrument cruised continuously in the study area during the entire study period. Figure 65 shows the ADCP data trajectories for the Oscar Pier study. During the last half study period, the boat intentionally conducted straight-line transect surveys, aiming to track and record the plumes, which, as the data shows, stayed submerged and could not be seen visually from the boat.

Figure 66 shows three transect TSS datasets from the ADCP backscattering data during the Oscar Pier study. As shown in the figure, plumes were visible from these three snapshots (out of the entire trajectories shown in Figure 66) with varying degree of dispersion. In particular, the plume is observed from a concentrated surface source (the first figure), which progressed toward to middle and lower layer of the water column, knowing that these snapshots were in the right order in time, but at different locations. This ADCP data was compared with model results for model validation.

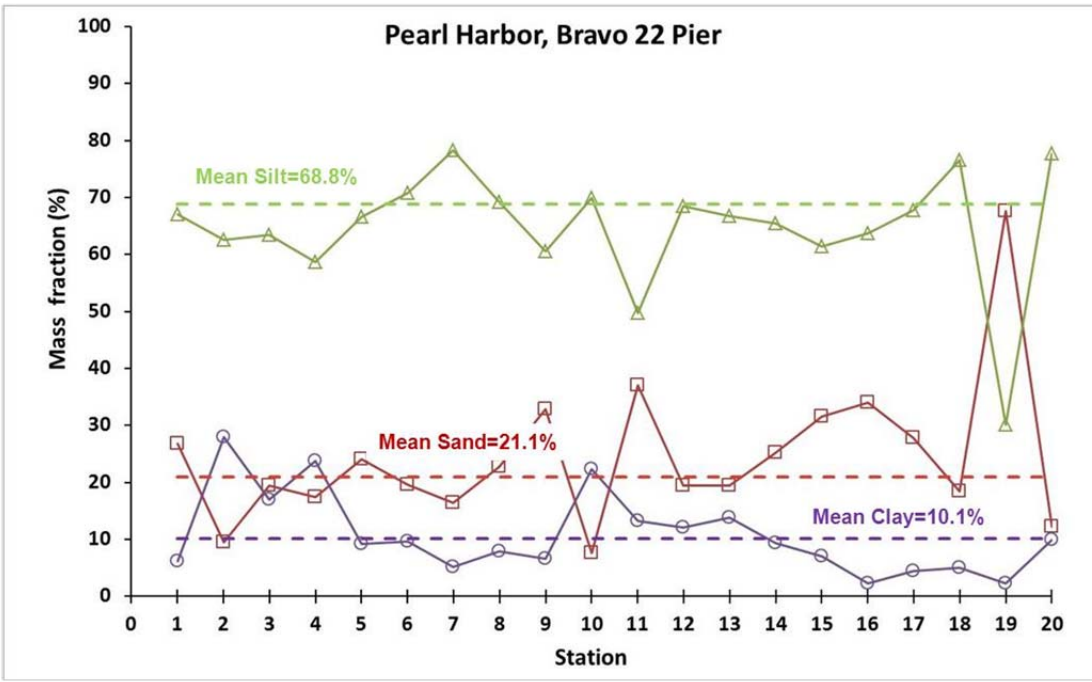
ADCP data for Bravo Pier is still under analysis by the Environmental Research and Development Center (ERDC) scientists and is unavailable. The dataset for San Diego Bay is partially erroneous due to malfunction of the antenna post.

3.9 MODEL RESULTS

The hydrodynamic model, CH3D,was implemented with fate and transport of dissolved and particulate metals. Eight metals were measured and simulated fate and transport of dissolved and silt-bound copper concentrations are demonstrated for Bravo Pier and Oscar Pier.

The measured TSS and copper concentrations at Bravo Pier (Figure 67) and Oscar Pier (Figure 68) were interpolated and assigned to the model grid (red circles) as the initial conditions for the model. The model started the hydrodynamic simulation from a state of zero motion (zero forcing) from 00:00 26 August 2012 with tidal forcing from the mouth of the harbor. Model simulation continues for 60 hours before the initial copper concentrations were assigned for the Bravo Pier at

12:00 28 August, and for 84 hours before the initial copper concentrations were assigned for the Oscar Pier at 12:00 29 August. Simulation continues until 23:00 2 September 2012. Model output of dissolved and silt-bound concentrations in the water column and silt-bound deposits to the sediment bed are analyzed.



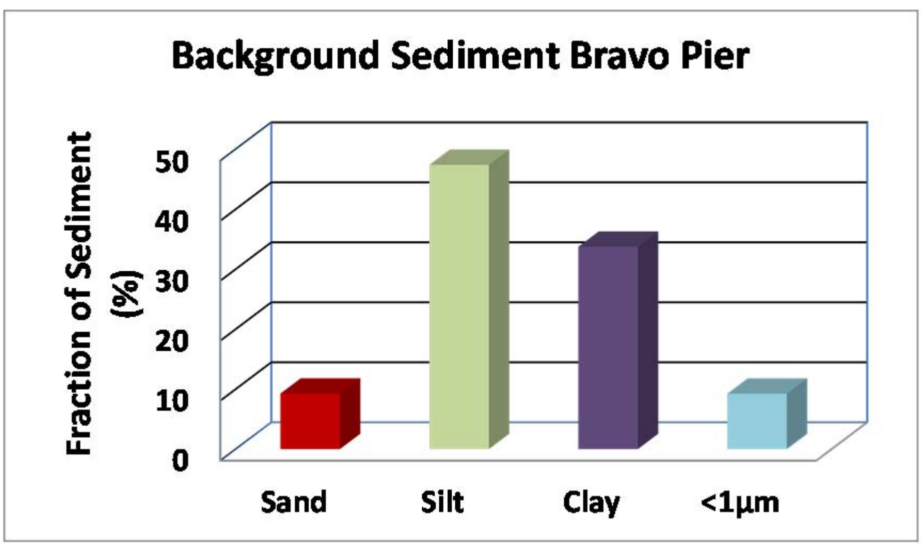
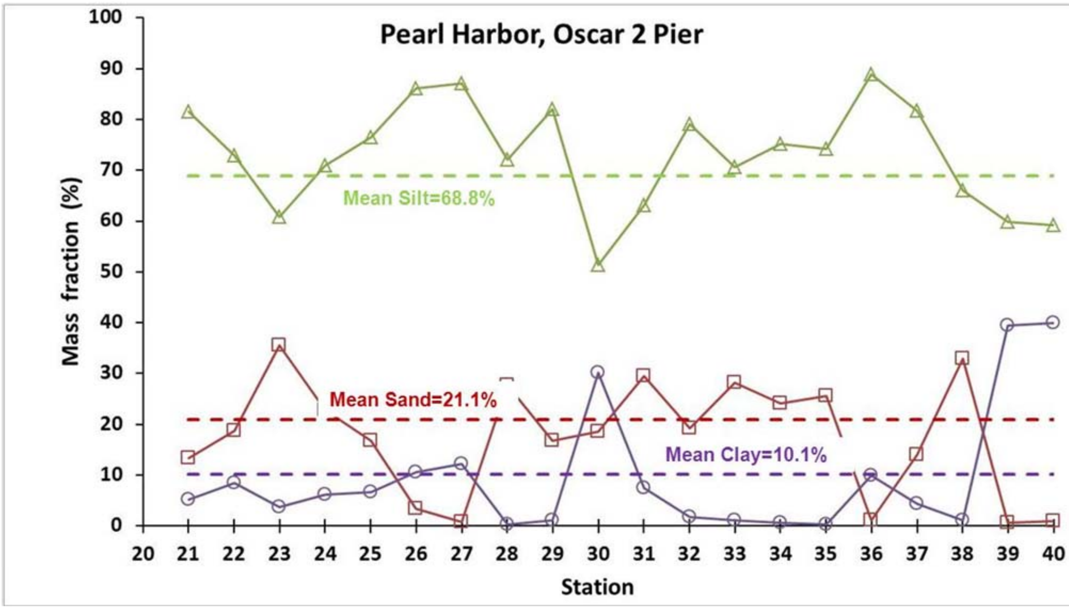


Figure 58. Water column particle size fractions and background sediment for clay (.4 to 5 µm), silt (5 to 60 µm) and sand (> 60 µm) for Bravo Pier in Pearl Harbor.



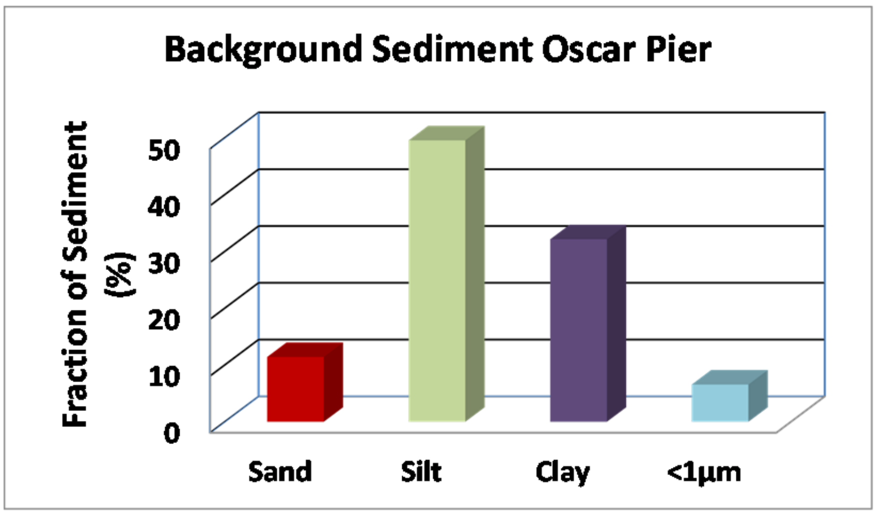
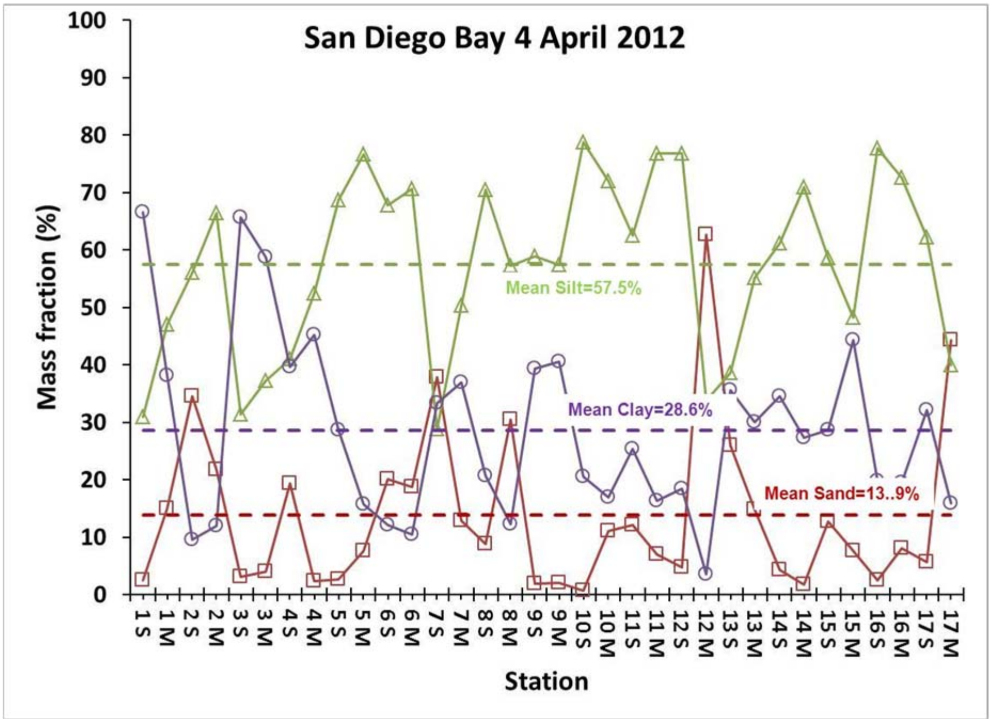


Figure 59. Water column particle size fractions and background sediment for clay (0.4 to 5.0 µm), silt (5 to 60 µm) and sand (> 60 µm) for Oscar Pier in Pearl Harbor.



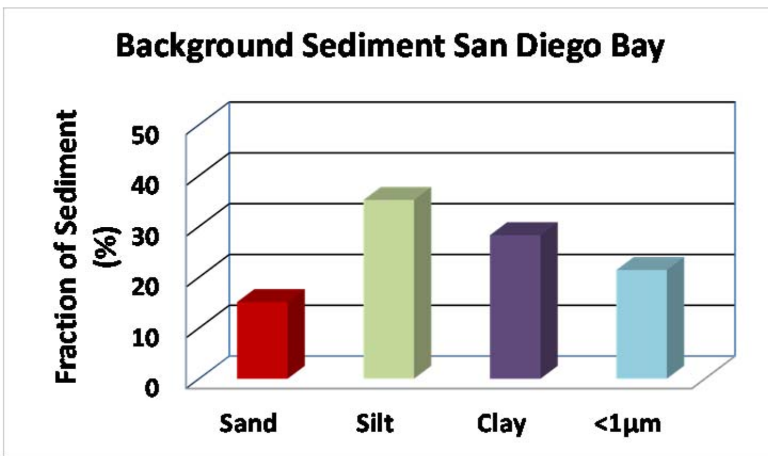


Figure 60. Water column particle size fractions and background sediment for clay (.4 to 5 µm), silt (5 to 60 µm) and sand (> 60 µm) for San Diego Bay.

3.9.1 Bravo Pier

The propellers of the tug-boat were turned on at the Bravo Pier between 10:36 and 11:00, 28 August. Between 11:02-12:20, water samples were collected by chasing after the plumes. Metal concentrations measured during the period were used and interpolated as the initial conditions for the subsequent fate and transport of the plume by the tidal currents.

Figure 69–Figure 74, inclusive, show the simulated transport patterns of dissolved copper in the surface layer at six selected times, t = 0 (initial condition), 3, 9, 18, 30, and 120 hours after the propeller wash, respectively. The propeller wash took place at the end of a flooding tide, and fate and transport was initiated during the ebbing tide. Figure 69 and Figure 70 show during the first 3 hours, ebbing tides transport the plume out of the naval station channel going first westward and then northward. As time progresses, the plume starts to go through tidal dispersion processes,

oscillating during tidal cycles with the plume expanding to other regions. Dilution and expansion of the plume can be visualized from these figures. At the end of 5th day (Figure 74), the dissolved copper concentrations are diluted from an initial concentration of ~ 12 to ~ 0 to 0.2 µg/L values, a reduction of 98.5% in concentrations, whereas the domain of the plume expanding to almost entire harbor.

In addition to the advection transport for dissolved copper, silt-particle-bound copper is subject to settling of the silt particles, which remove silt-bound copper from the water column to the bottom sediment bed. Figure 75–Figure 78 show simulated silt-particle-bound copper concentrations at the surface layer at the times of t=0 (initial condition), 3, 9, and 18 hours, respectively. The transport patterns are similar to those for dissolved copper, except that silt-bound concentrations decay fast during the transport. At 9 hours, simulated silt-bound copper concentrations reduce to a 0.0- to 0.2-µg/L level (Figure 77), whereas dissolved copper retains a highest concentration ~ 10 µg/L (Figure 70). At 18 hours, silt-bound copper concentrations reduce to zero in the surface layer (Figure 78).

Silt-bound concentrations in the bottom layer behave in a way similar to that in the surface layer, except that they decay with a much slower rate. This is because, due to settling, silt-bound copper concentrations in the bottom layer lose mass to the bottom, they also receive copper mass from the upper layers. Therefore, the loss rate at the bottom layer is much slower than that for the surface layer. As such, silt-bound copper concentrations still retain a level of 0 to 0.3 µg/L at 30 hours (Figure 82). The submerged plume loses its total mass at 120 hour (Figure 83).

Figure 84–88, inclusive, show simulated silt-bound copper deposits (footprint) from the propeller wash plume during the first 5 days. Figure 84 and Figure 85 show that the initial plume deposits a major portion of the mass during the first 3 to 9 hours toward the inner channel (sub-base). As time progresses with the plume migrating, the deposit increases both in magnitude and in domain. The general deposition pattern starts from the resuspension site extending toward the Southeast Loch from the channel east of Ford Island and then toward the central channel, between Naval Reservation and Ford Island. At 120 hours, the deposition domain has extended to the water surrounding Ford Island and further toward the mouth. Simulated deposition patterns reveal that prop wash may be a local activity (in the pier for this study), the fate and transport of the sediment plume may result in re-migration and deposition patterns that extend beyond the local site.

3.9.2 Oscar Pier

The propellers of the tug-boat were turned on at the Oscar Pier between 10:25 and 11:30, 20 August 29. Between 11:30-13:08, water samples were collected by chasing after the plumes. Metal concentrations measured during the period were used and interpolated as the initial conditions for the subsequent fate and transport of the plume by the tidal currents.

Figure 89–Figure 94, inclusive, show the simulated transport patterns of dissolved copper in the surface layer at six selected times, t = 0 (initial condition), 3, 9, 18, 30, and 120 hours after the propeller wash, respectively. The propeller wash took place during the flooding tide, and fate and transport was initiated during the flooding tide. Figure 89 and Figure 90 show that, during the first 3 hours, flooding tides push the plume northward, toward Ford Island along the west channel. As time progresses, the plume starts to going through tidal dispersion processes, oscillating during tidal cycles with the plume expanding to other regions. Dilution and expansion of the plume can be seen from these figures. At the end of the 5th day (Figure 94), the dissolved copper concentrations are diluted from an initial concentration of ~ 1 µg/L to ~ 0 to 0.2 µg/L values, a reduction of 90% in concentrations, whereas the domain of the plume expanding to a larger

domain including a major portion of East Loch and Middle Loch, and the channels west of Ford Island.

Compared to the resuspension sediment plume for Bravo Pier, the Oscar Pier plume is much smaller in magnitude. The color spectrum shows that approximately the highest concentration of the plume is 1 µg/L for the Oscar Pier test, compared to ~ 15 µg/L for the Bravo Pier plume.

Therefore, Figure 95–99 inclusive, show that silt-bound copper concentrations are low throughout the first few hours of the plume. The surface silt-bound plume loses its major mass before 9 hours and bottom layer loses its mass before 18 hours.

The Oscar Pier plume deposits its majority of mass of the silt particles and the associated copper mass during the first 18 hours (Figure 100–102, inclusive). However, deposition of the low-concentration plume of the water column continues during the first 30 hours (Figure 103 and 104). Between 30 and 120 hours, the deposition patterns only increase slightly in the East Loch.

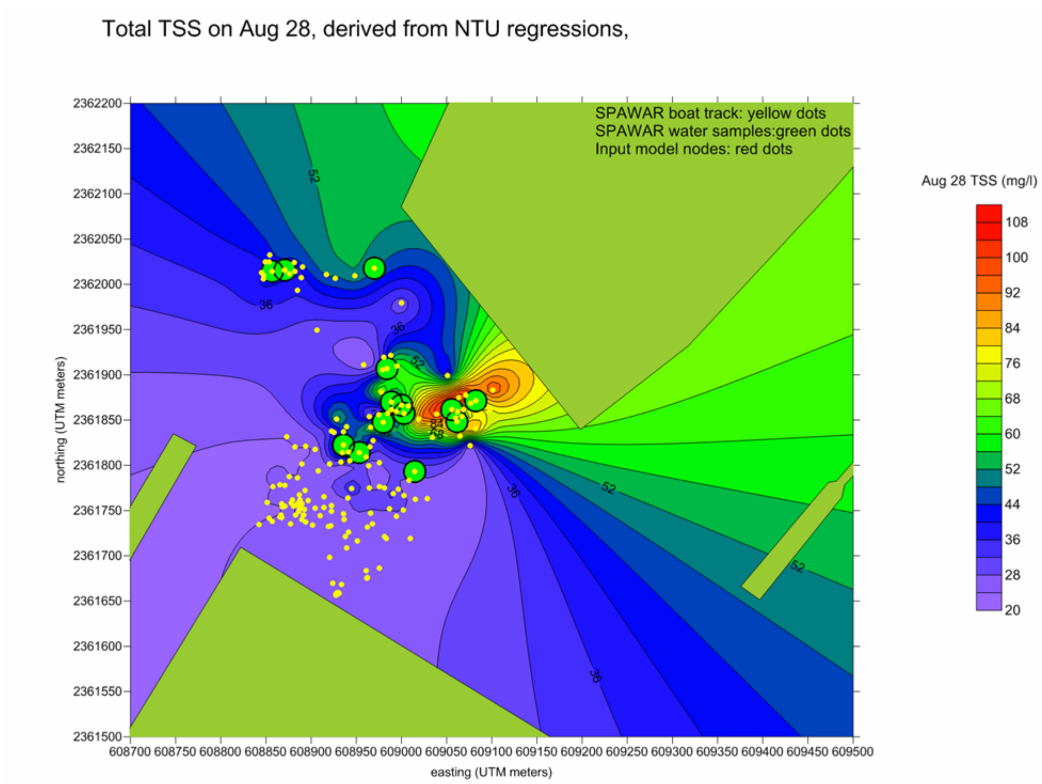


Figure 61. Locations for water samples, OBS data, and ADCP backscattering data for Bravo Pier, Pearl Harbor.

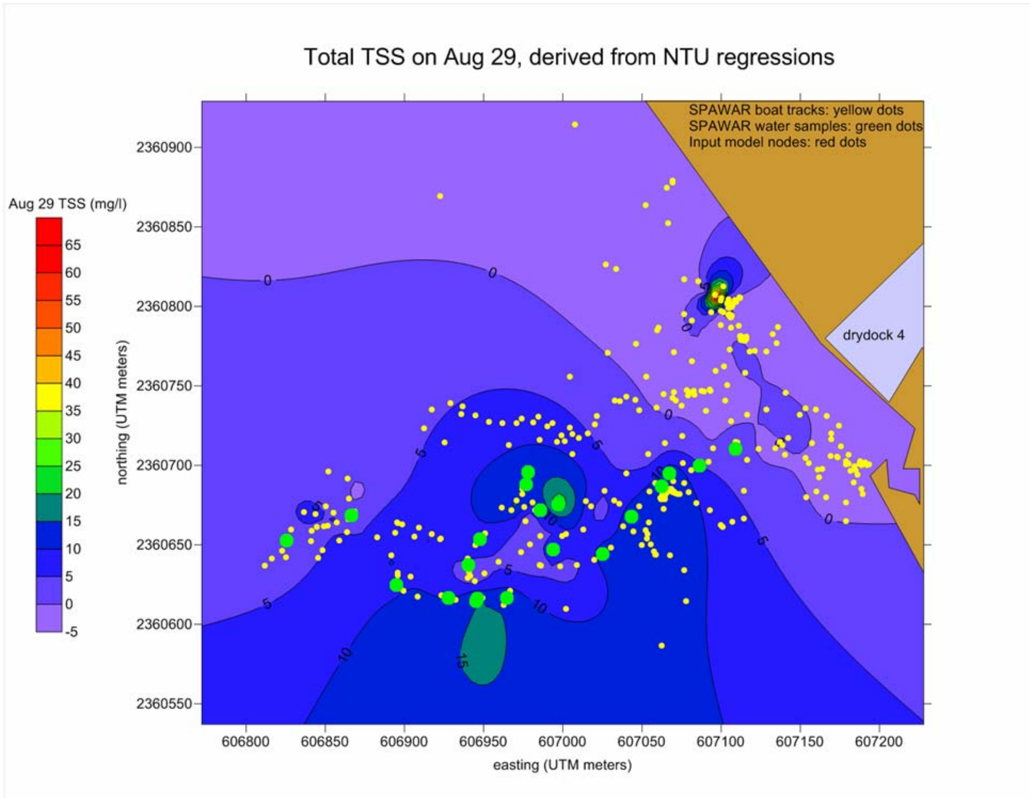


Figure 62. Locations for water samples, OBS data and ADCP backscattering data for Oscar Pier, Pearl Harbor.

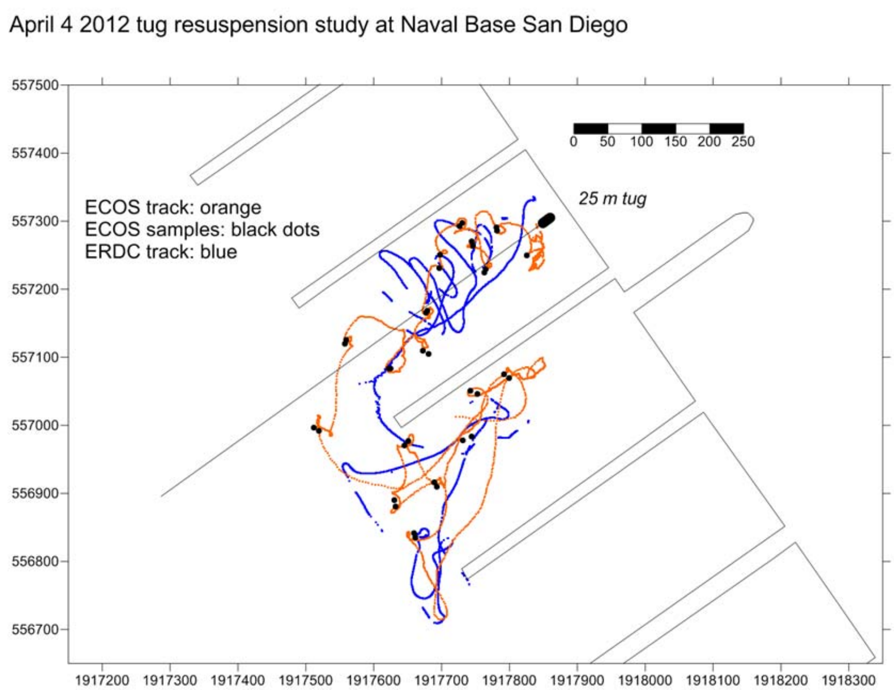


Figure 63. Locations for water samples, OBS data, and ADCP backscattering data for San Diego Bay.

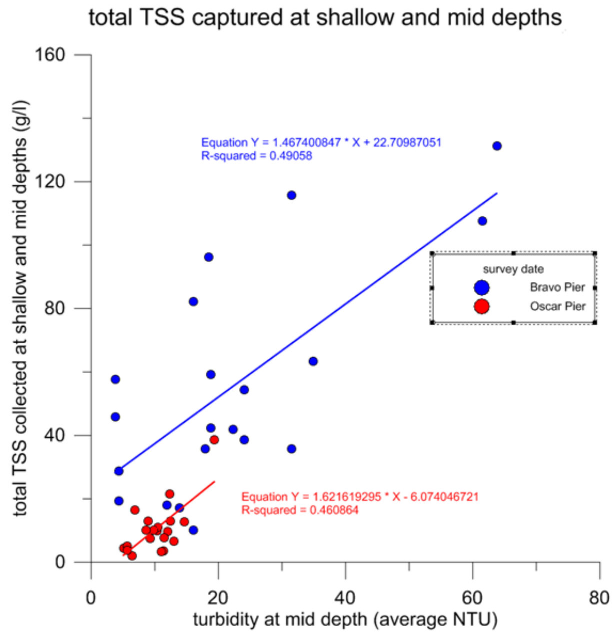


Figure 64. TSS calibration using OBS data independently against (1) field water samples at the nearest OBS data locations (in blue), and (2) dilution.

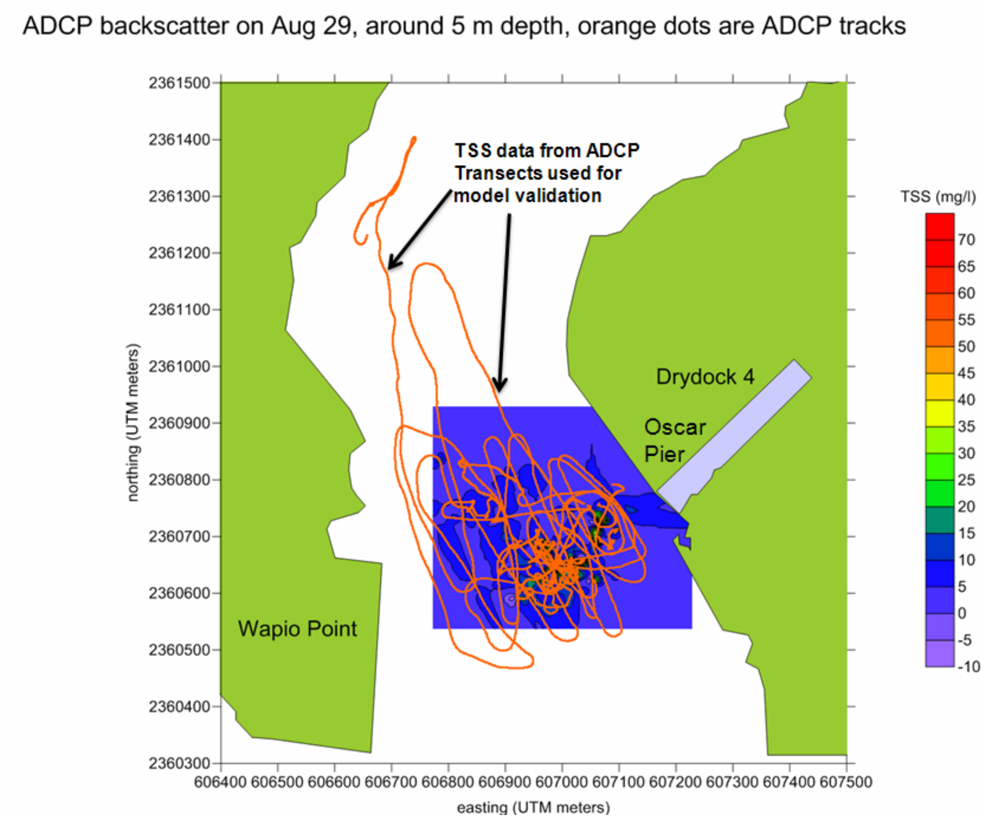


Figure 65. Trajectories of ADCP backscattering data for the Oscar Pier study in Pearl Harbor.

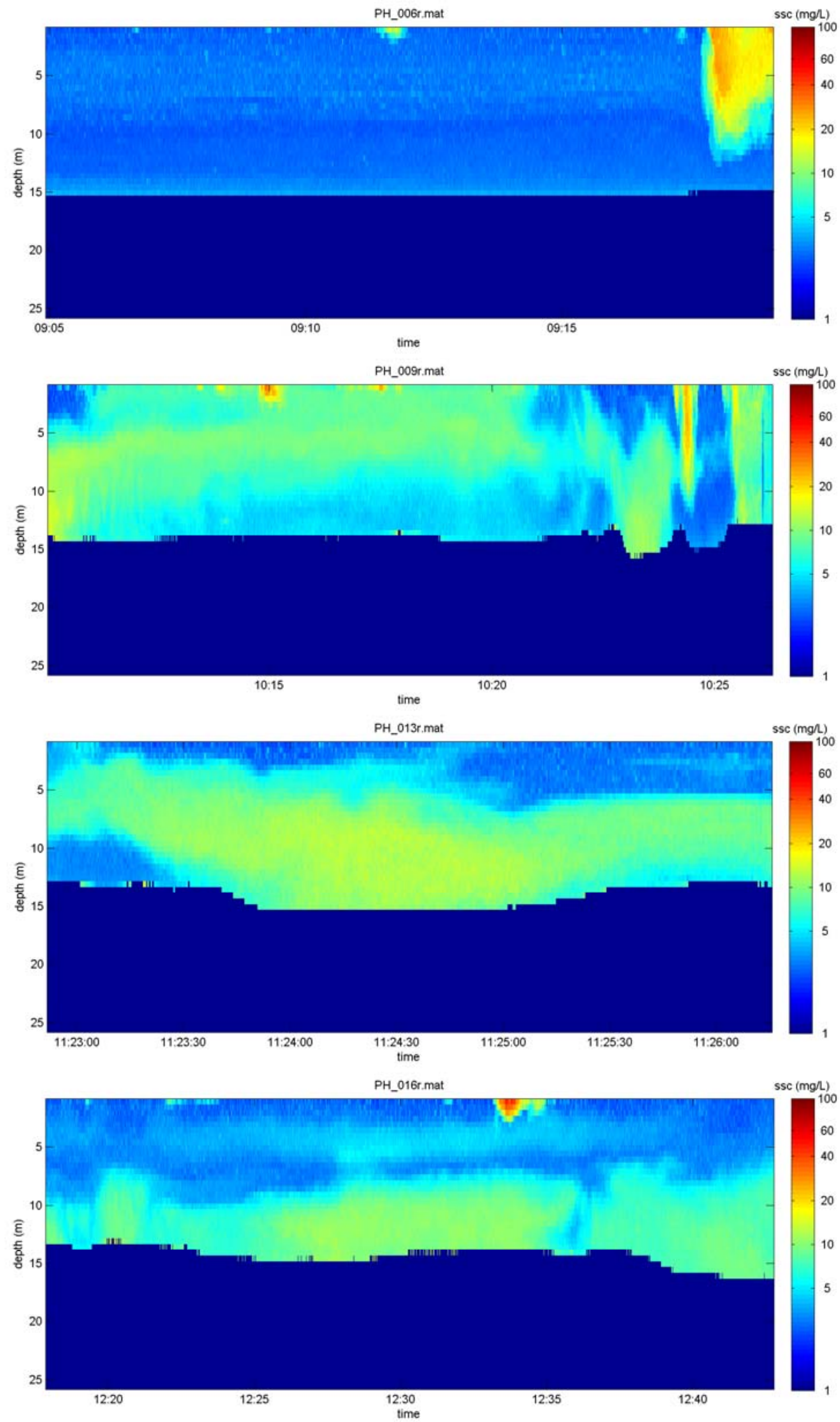


Figure 66. Three transect TSS datasets estimated from ADCP backscattering data during the Oscar Pier study on 29 August 2012. Time windows are (from top to bottom): 9:05 to 9:18, 10:10 to 10:26, 11:23 to 11:26, and 12:18 to 12:42.

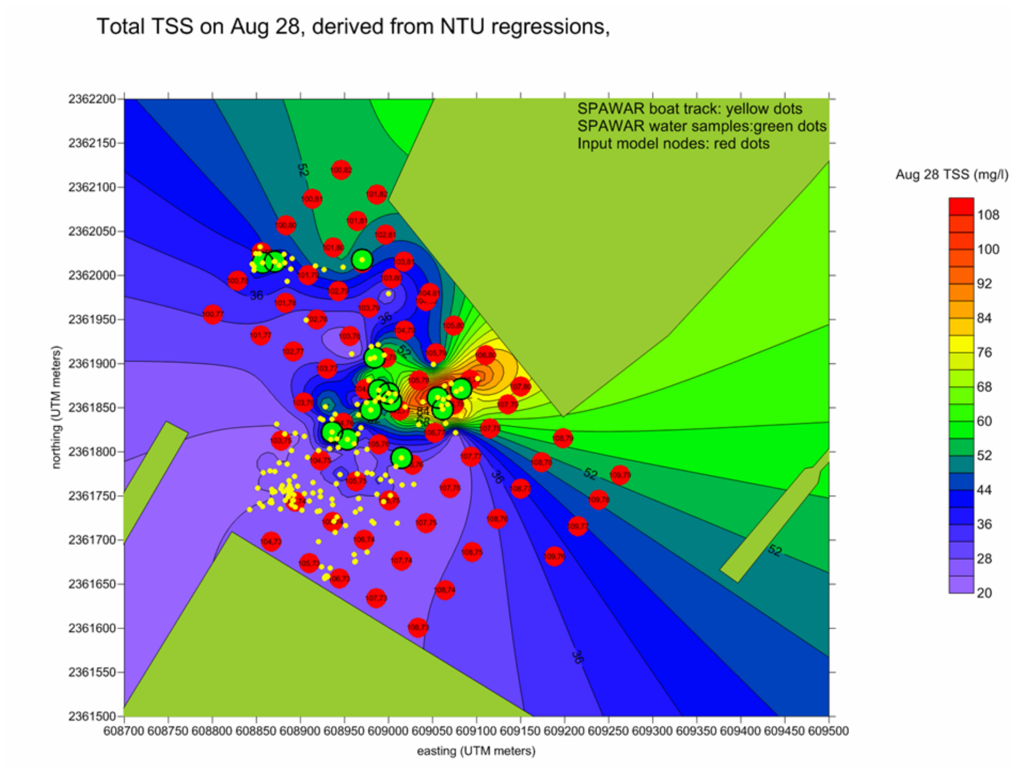


Figure 67. Model grid points and interpolated TSS concentrations for Bravo Pier.

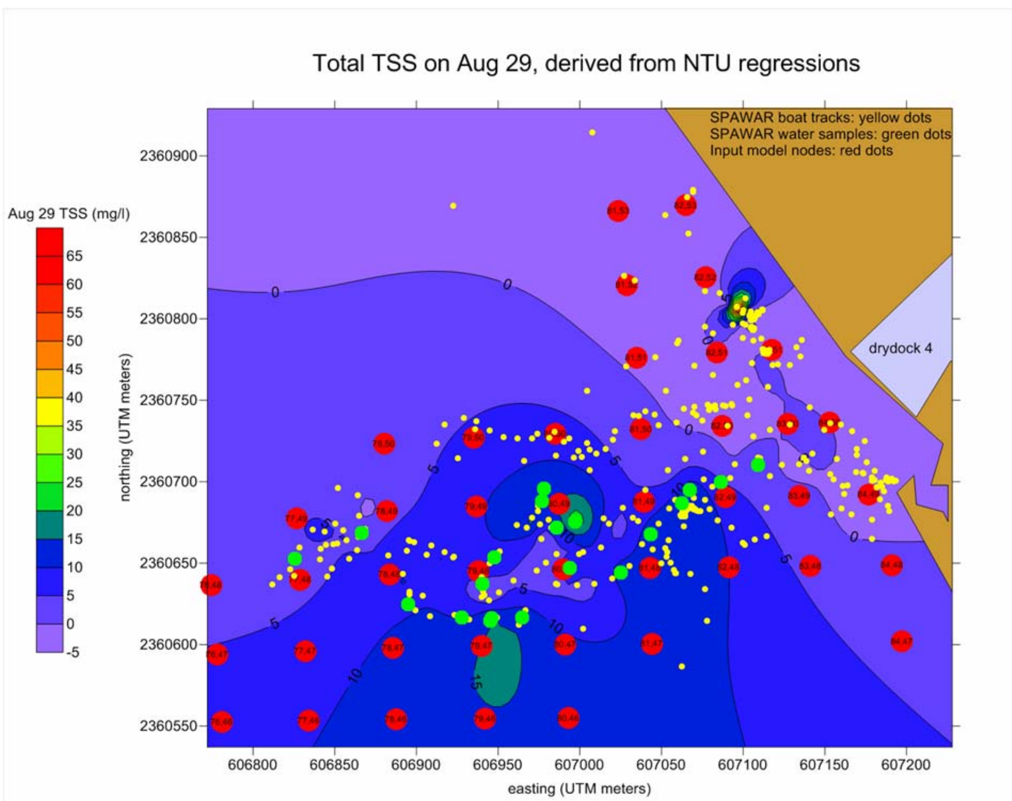


Figure 68. Model grid points and interpolated TSS concentrations for Oscar Pier deposition patterns that extend beyond the local site.

Figure 69. Initial dissolved copper concentrations at surface layer for CH3D fate and transport simulation at t = 0 after resuspension from prop wash (color key applies to Figure 69 through Figure 74, inclusive).

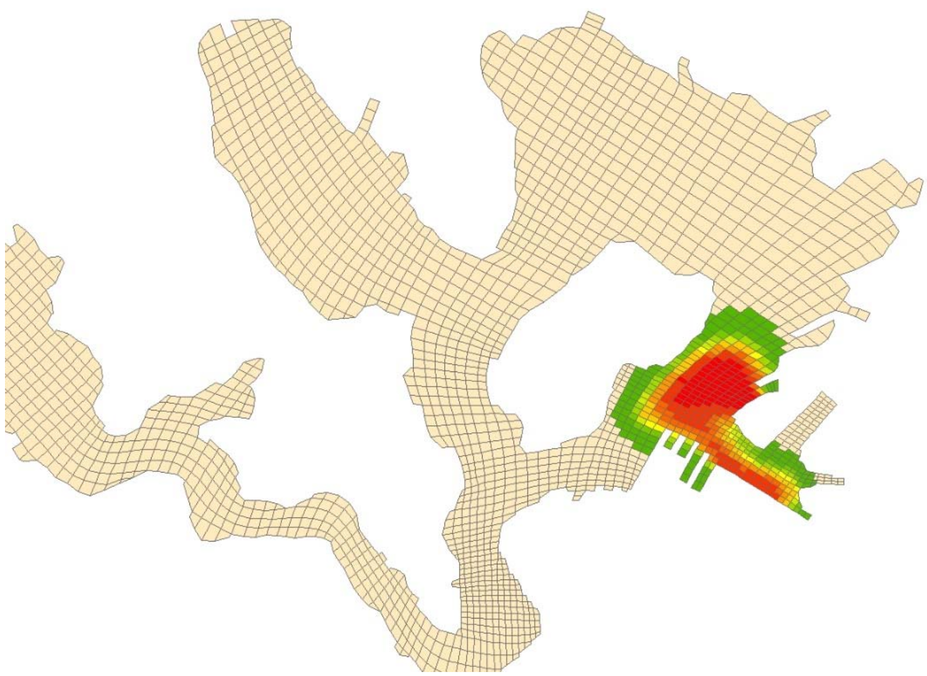


Figure 70. Simulated dissolved copper concentrations at surface layer at t = 3 hours after prop-wash resuspension.

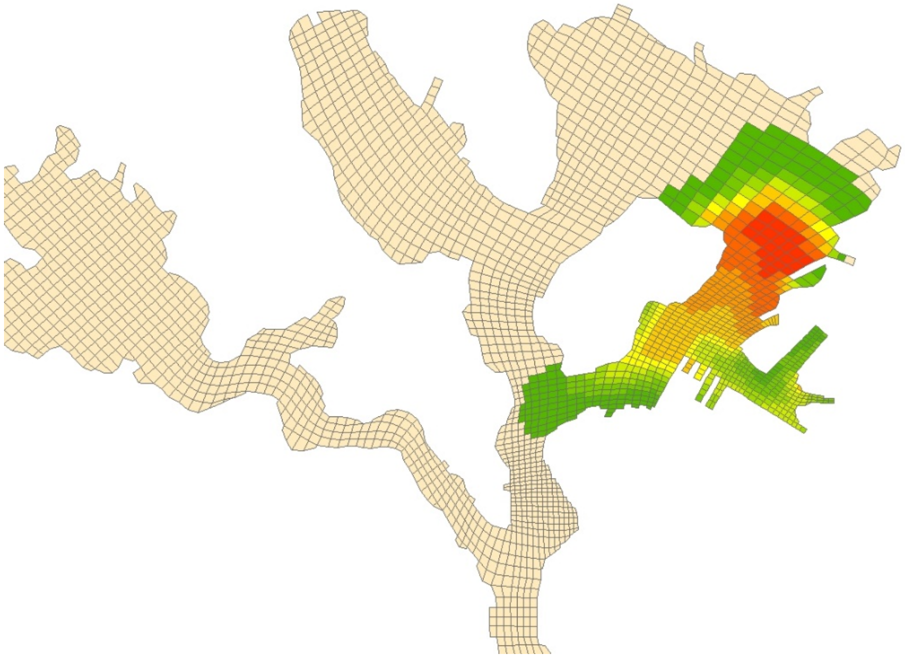


Figure 71. Simulated dissolved copper concentrations at surface layer at t = 9 hours after prop-wash resuspension.

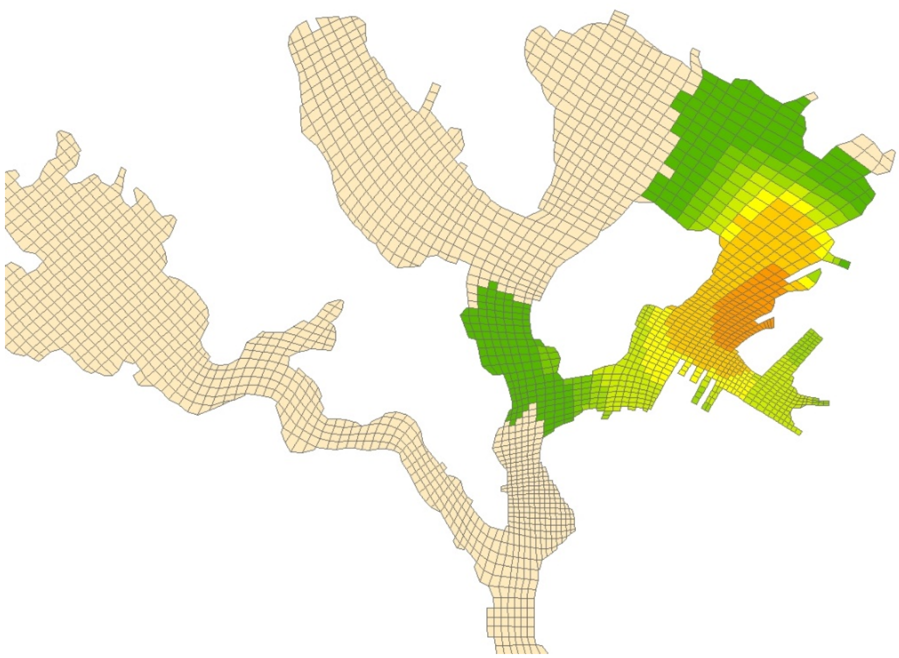


Figure 72. Simulated dissolved copper concentrations at surface layer at t = 18 hours after prop-wash resuspension.

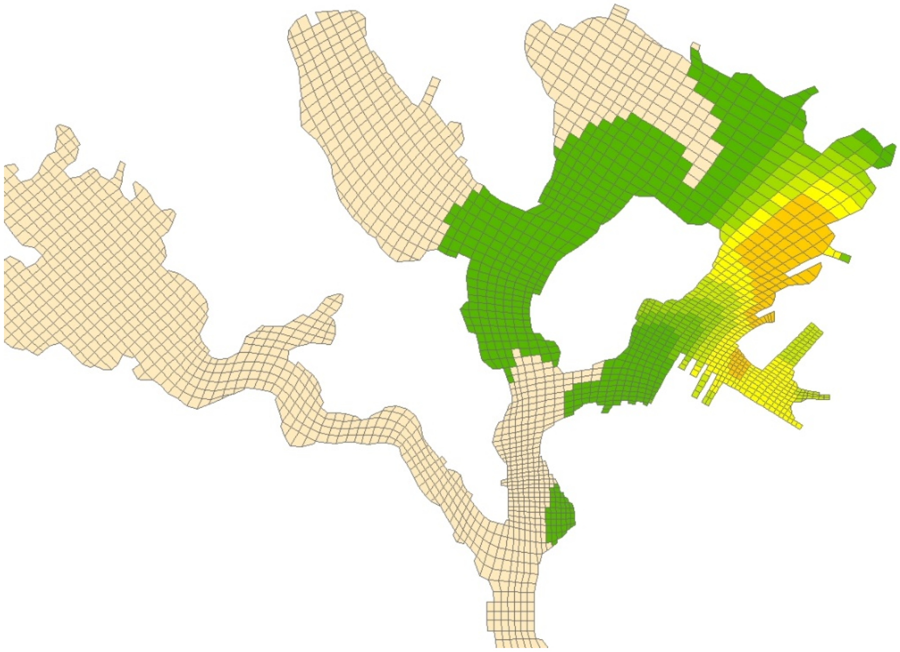


Figure 73. Simulated dissolved copper concentrations at surface layer at t = 30 hours after prop-wash resuspension.

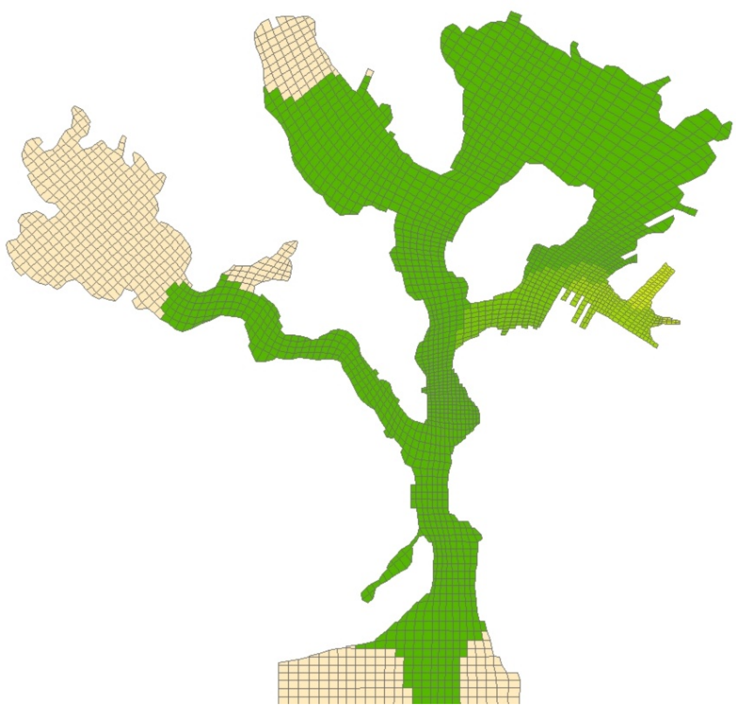


Figure 74. Simulated dissolved copper concentrations at surface layer at t = 120 hours after prop-wash resuspension.

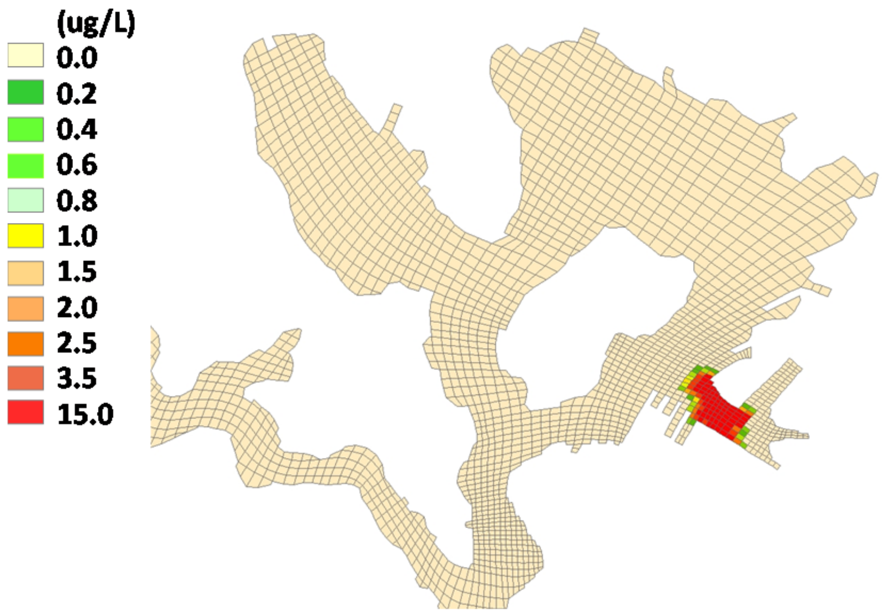


Figure 75. Initial silt-particle-bound copper concentrations at surface layer for CH3D fate and transport simulation at t = 0 after resuspension from prop wash (color key applies to Figure 75–59, respectively).

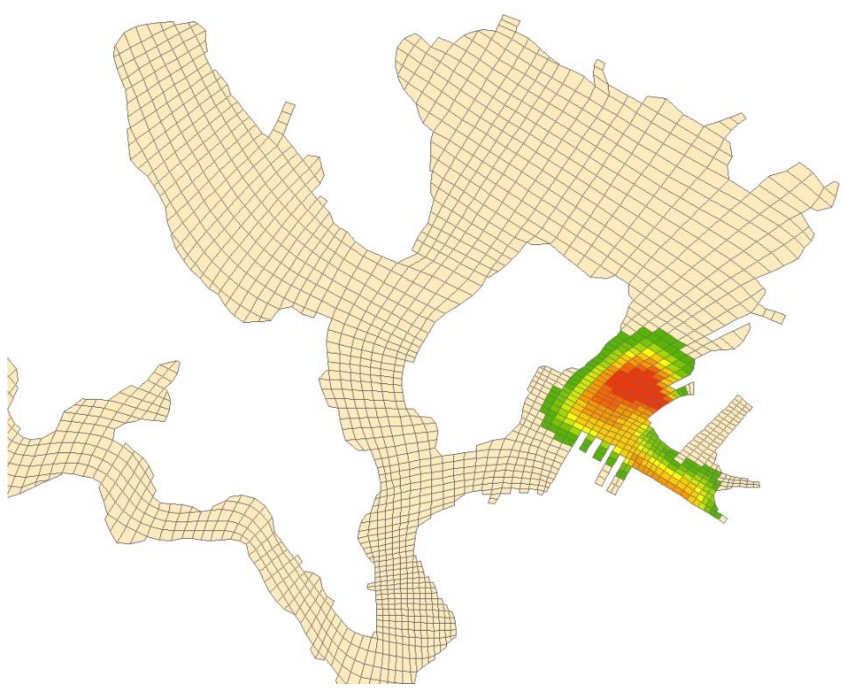


Figure 76. Simulated silt-particle-bound copper concentrations at surface layer at t = 3 hours after prop-wash resuspension.

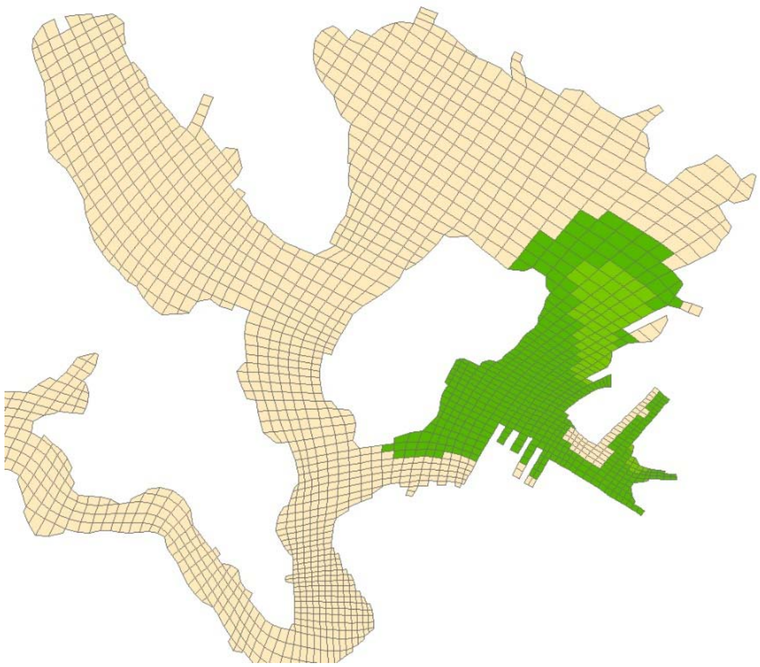


Figure 77. Simulated silt-particle-bound copper concentrations at surface layer at t = 9 hours after prop-wash resuspension.

Figure 78. Simulated silt-particle-bound copper concentrations at surface layer at t = 18 hours after prop-wash resuspension.

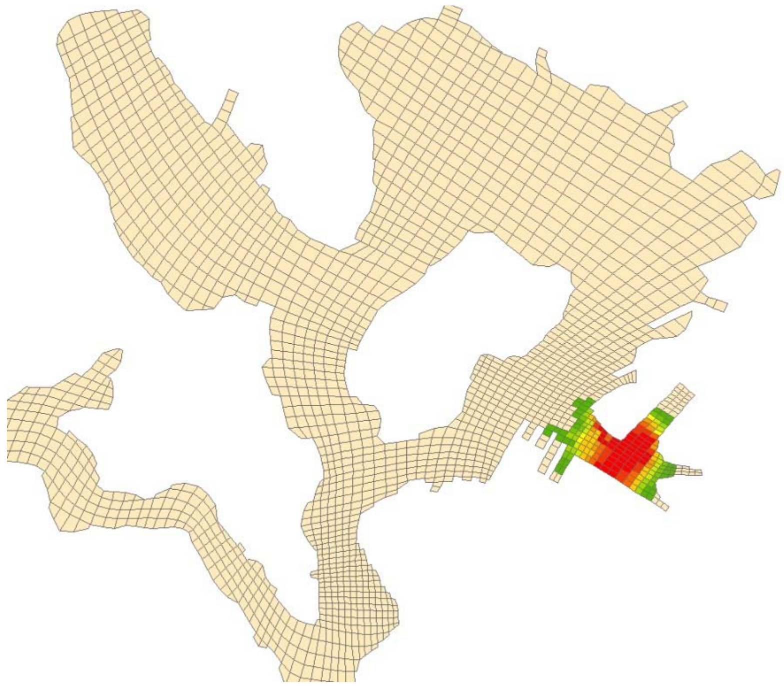


Figure 79. Simulated silt-particle-bound copper concentrations at bottom layer at t = 3 hours after prop-wash resuspension.

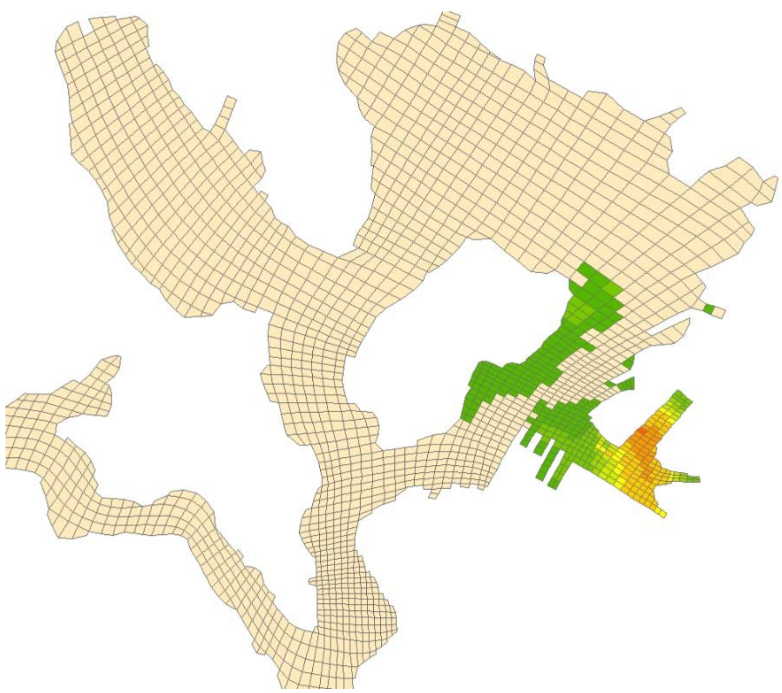


Figure 80. Simulated silt-particle-bound copper concentrations at bottom layer at t = 9 hours after prop-wash resuspension.

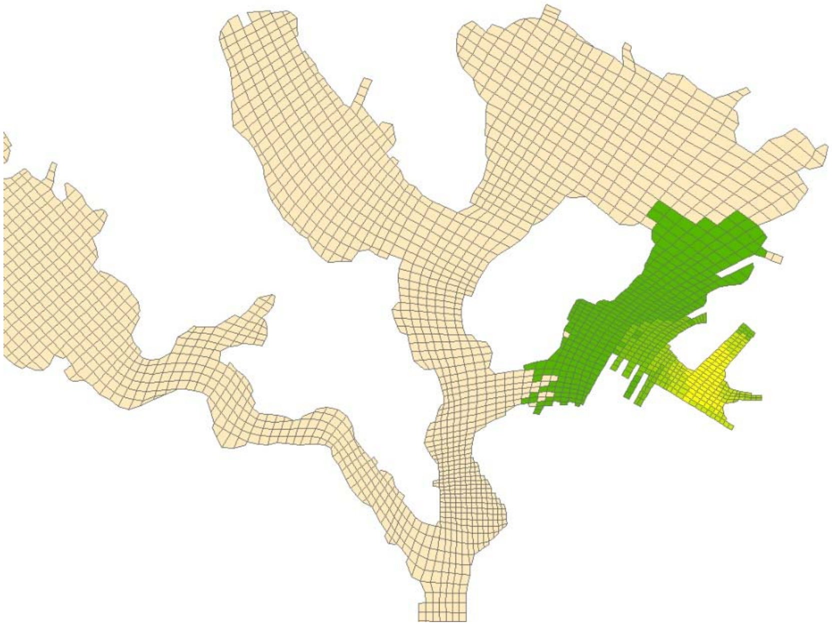


Figure 81. Simulated silt-particle-bound copper concentrations at bottom layer at t = 18 hours after prop-wash resuspension.

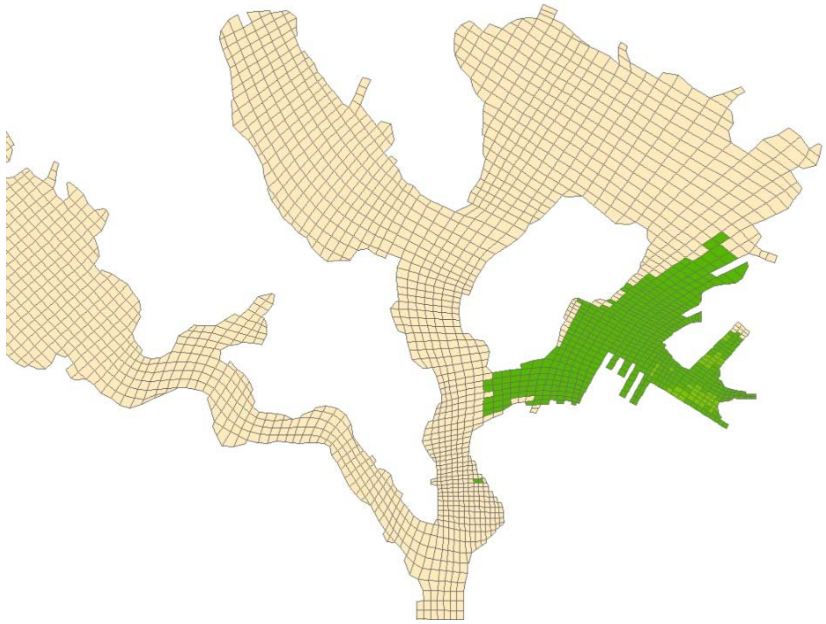


Figure 82. Simulated silt-particle-bound copper concentrations at bottom layer at t = 30 hours after prop-wash resuspension.

Figure 83. Simulated silt-particle-bound copper concentrations at bottom layer at t = 120 hours after prop-wash resuspension.

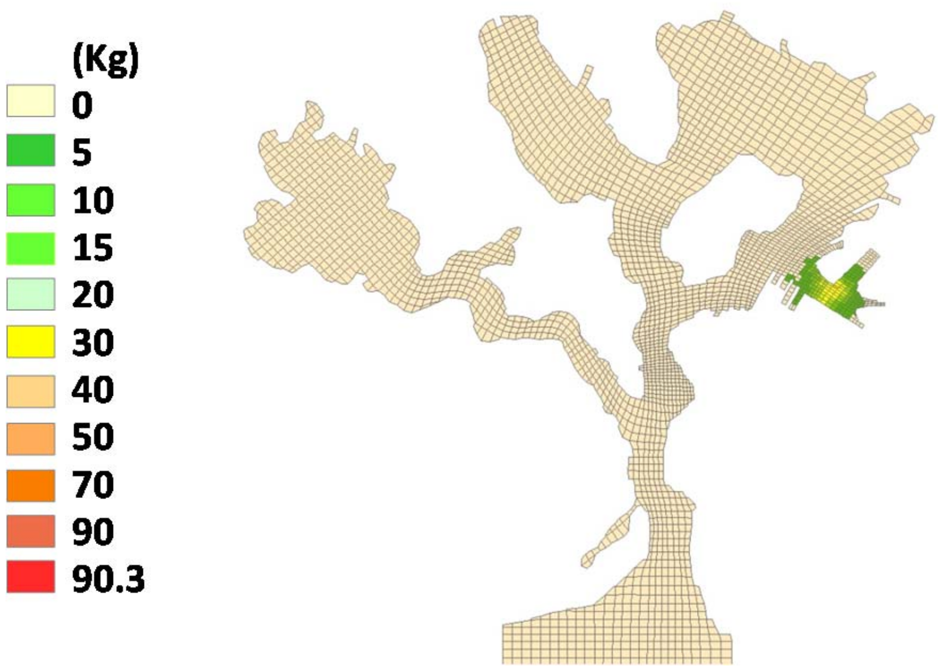


Figure 84. Simulated silt-particle-bound deposits to the bottom bed at t = 3 hours after prop-wash resuspension (color key applies to Figure 84–Figure 88, inclusive).

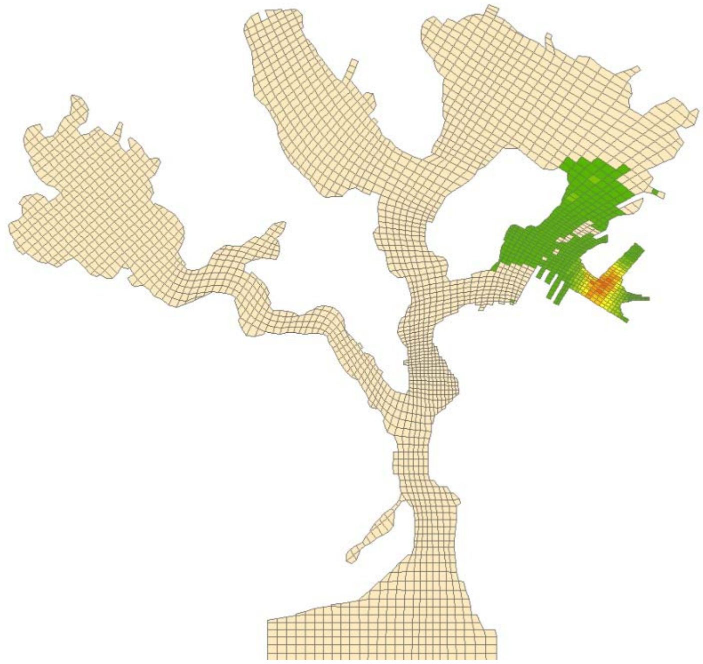


Figure 85. Simulated silt-particle-bound deposits to the bottom bed at t = 9 hours after prop-wash resuspension.

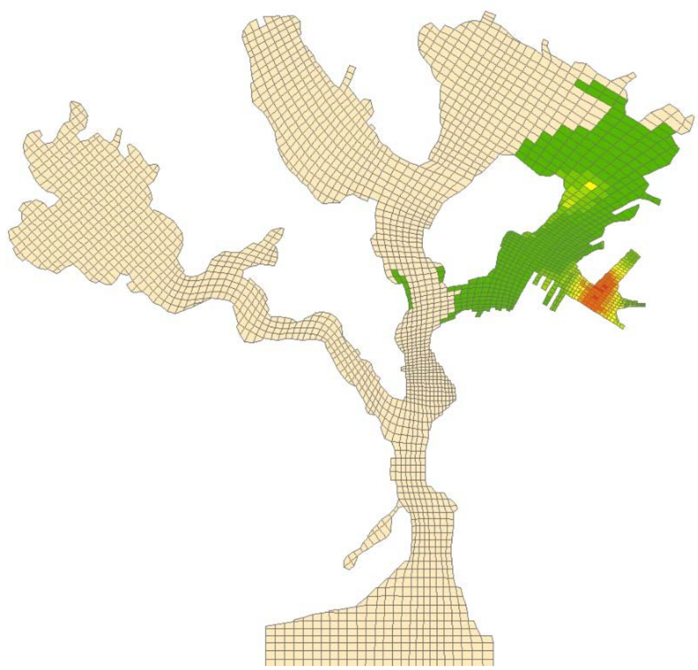


Figure 86. Simulated silt-particle-bound deposits to the bottom bed at t = 18 hours after prop-wash resuspension.

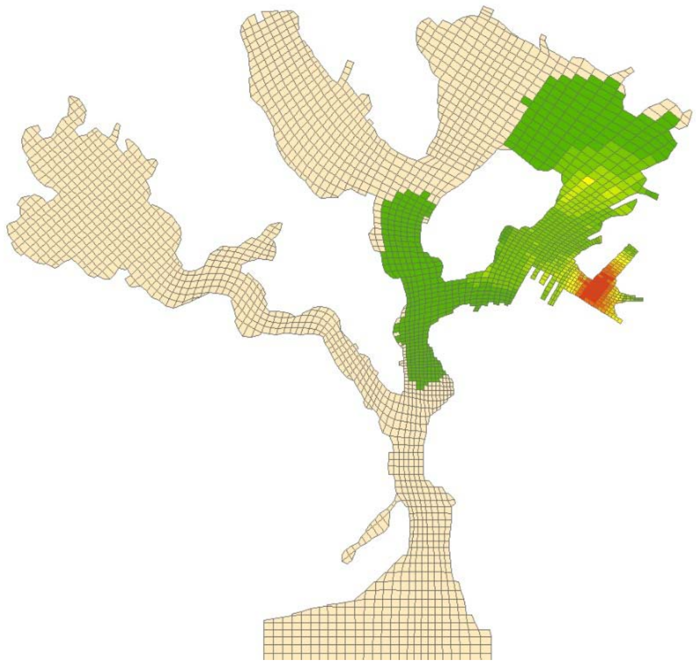


Figure 87. Simulated silt-particle-bound deposits to the bottom bed at t = 30 hours after prop-wash resuspension.

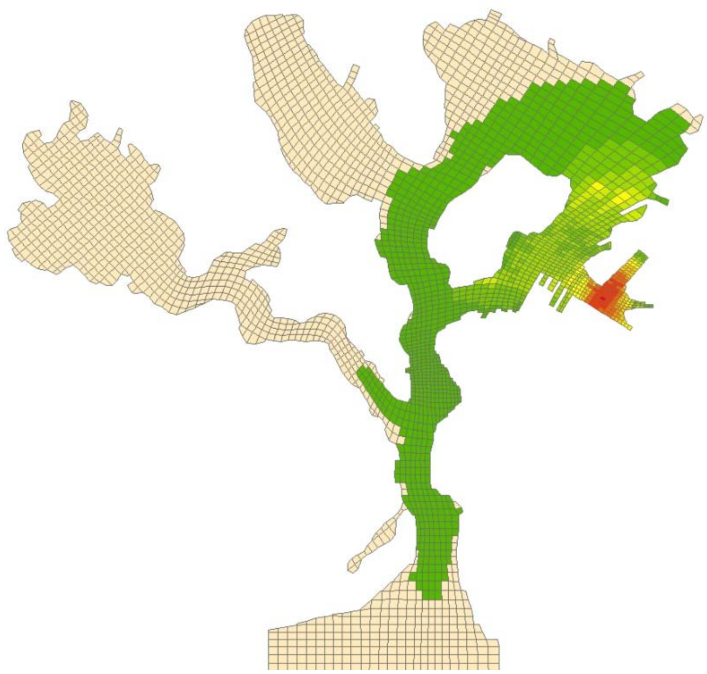


Figure 88. Simulated silt-particle-bound deposits to the bottom bed at t = 120 hours after prop-wash resuspension.

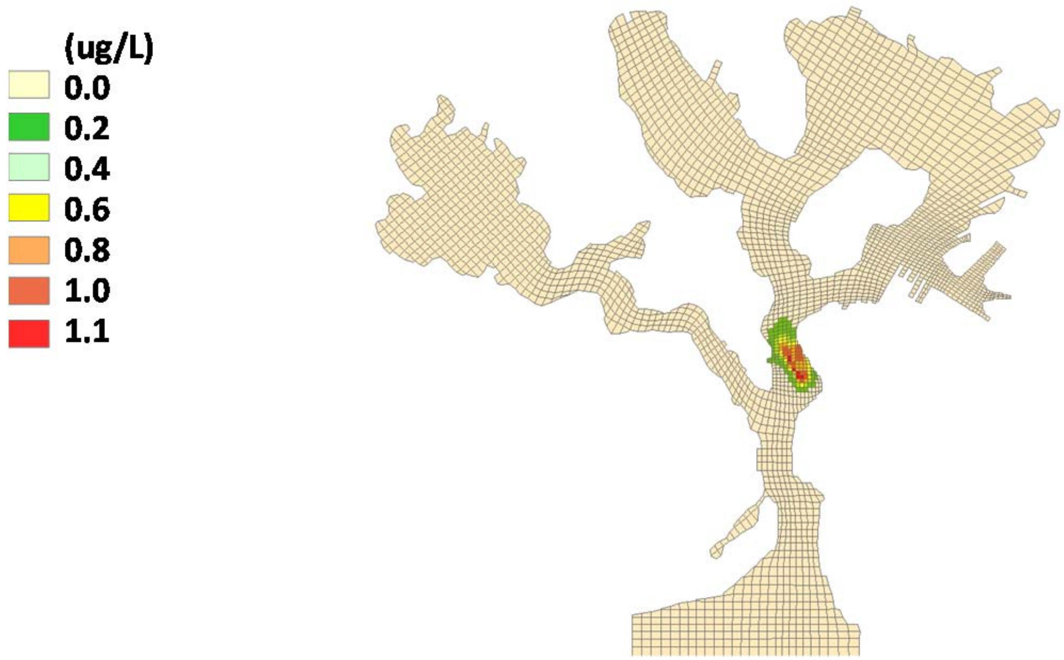


Figure 89. Initial dissolved copper concentrations at Oscar Pier surface layer for CH3D simulation at t = 0 after resuspension from prop wash (color key applies to Figure 89–Figure 99, inclusive).

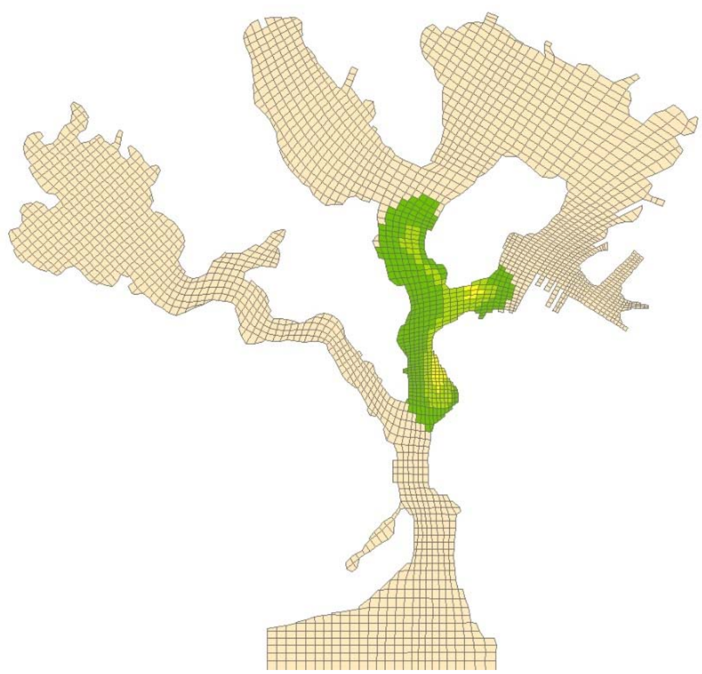


Figure 90. Simulated dissolved copper concentrations at Oscar Pier surface layer for CH3D simulation at t = 3 hours after prop-wash resuspension.

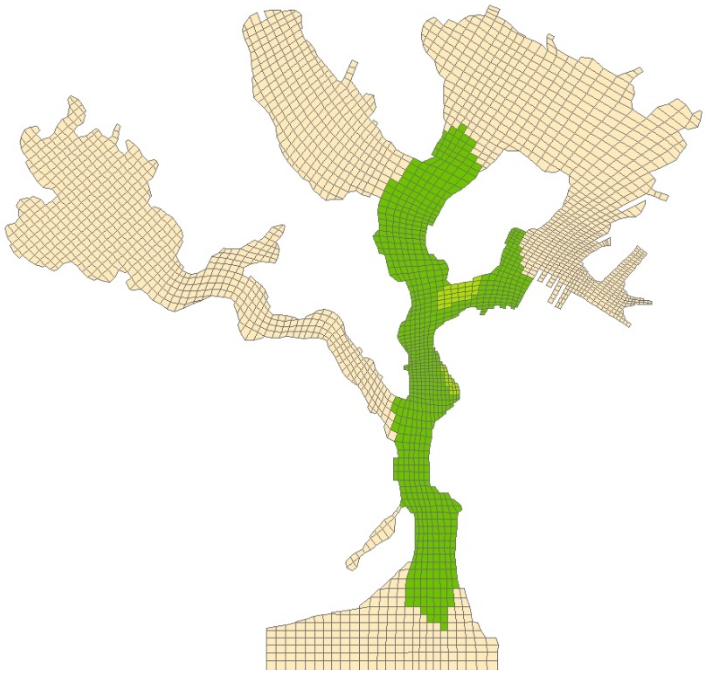


Figure 91. Simulated dissolved copper concentrations at Oscar Pier surface layer for CH3D simulation at t = 9 hours after prop-wash resuspension.

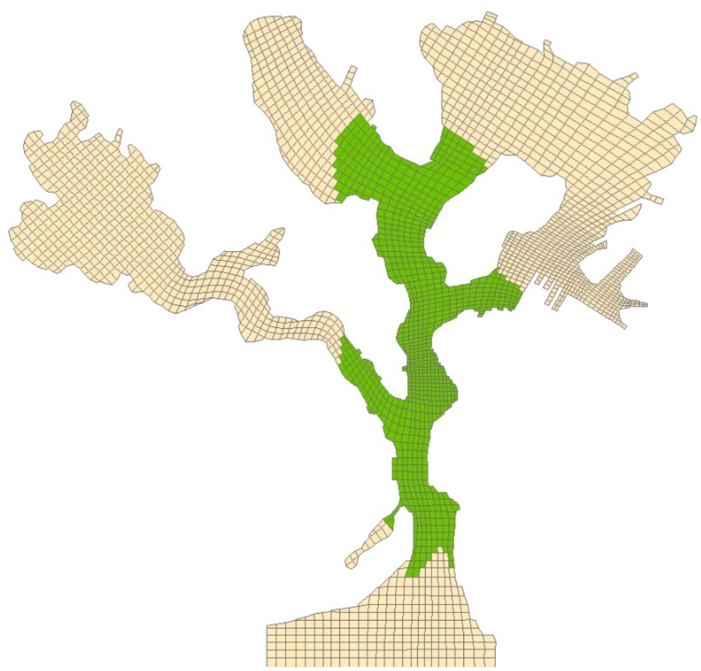


Figure 92. Simulated dissolved copper concentrations at Oscar Pier surface layer for CH3D simulation at t = 18 hours after prop-wash resuspension.

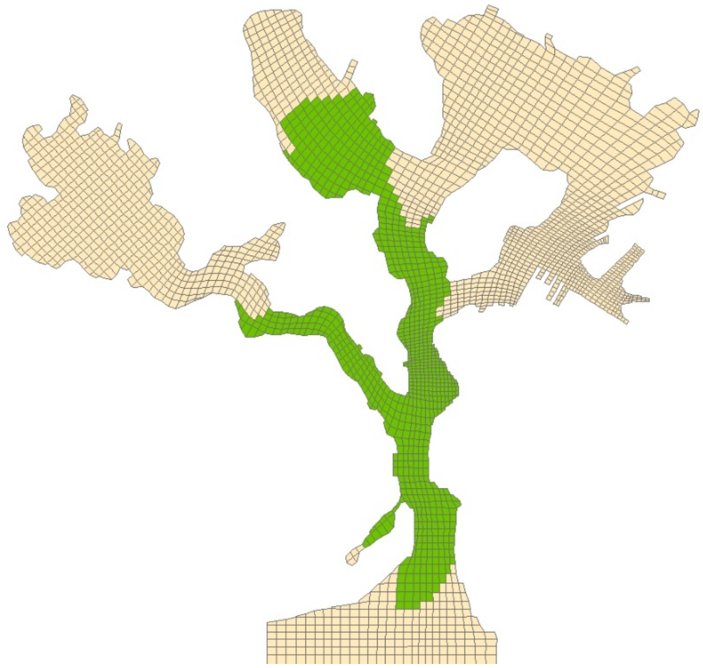


Figure 93. Simulated dissolved copper concentrations at Oscar Pier surface layer for CH3D simulation at t = 30 hours after prop-wash resuspension.

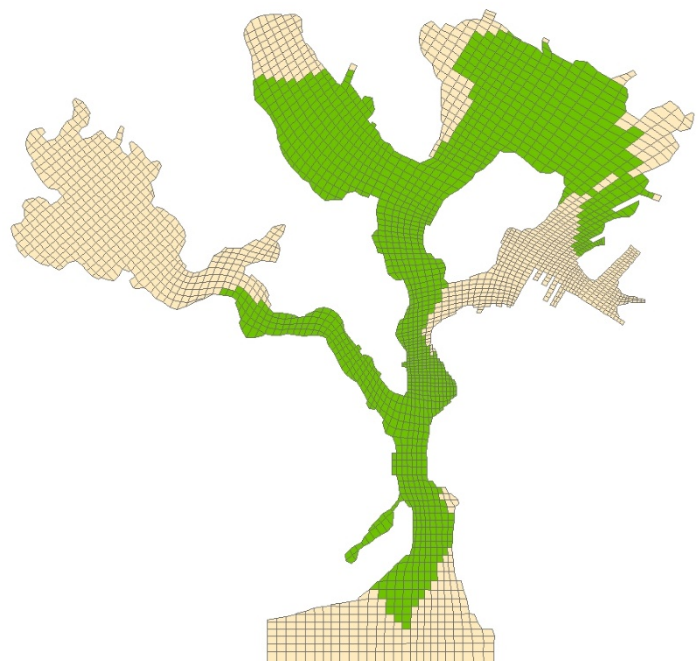


Figure 94. Simulated dissolved copper concentrations at Oscar Pier surface layer for CH3D simulation at t = 120 hours after prop-wash resuspension.

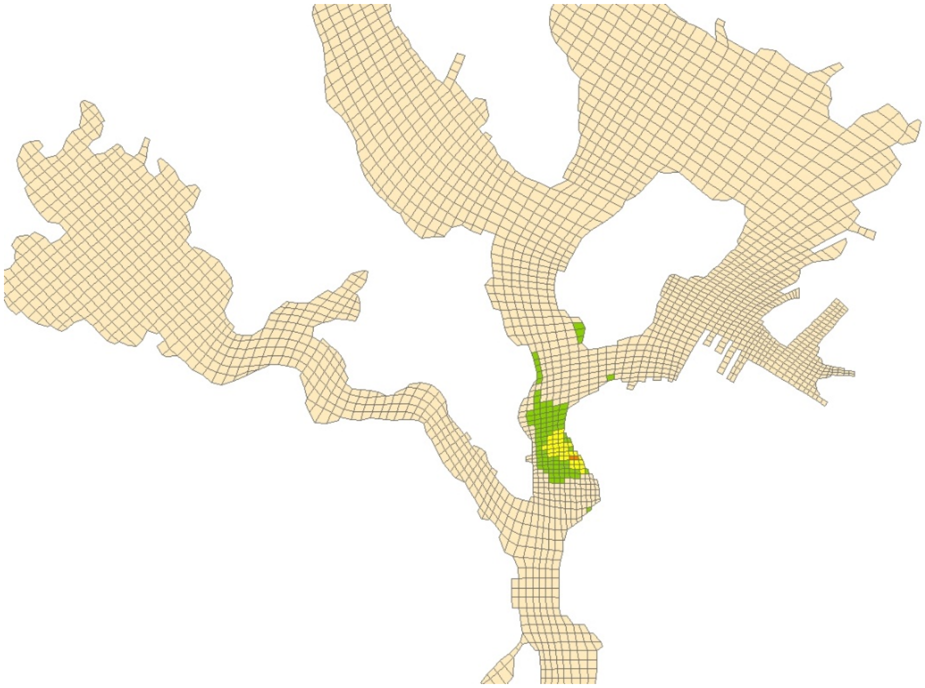


Figure 95. Simulated silt-particle-bound copper concentrations at Oscar Pier surface layer for CH3D simulation at t = 3 hours after prop-wash resuspension.

Figure 96. Simulated silt-particle-bound copper concentrations at Oscar Pier surface layer for CH3D simulation at t = 9 hours after prop-wash resuspension.

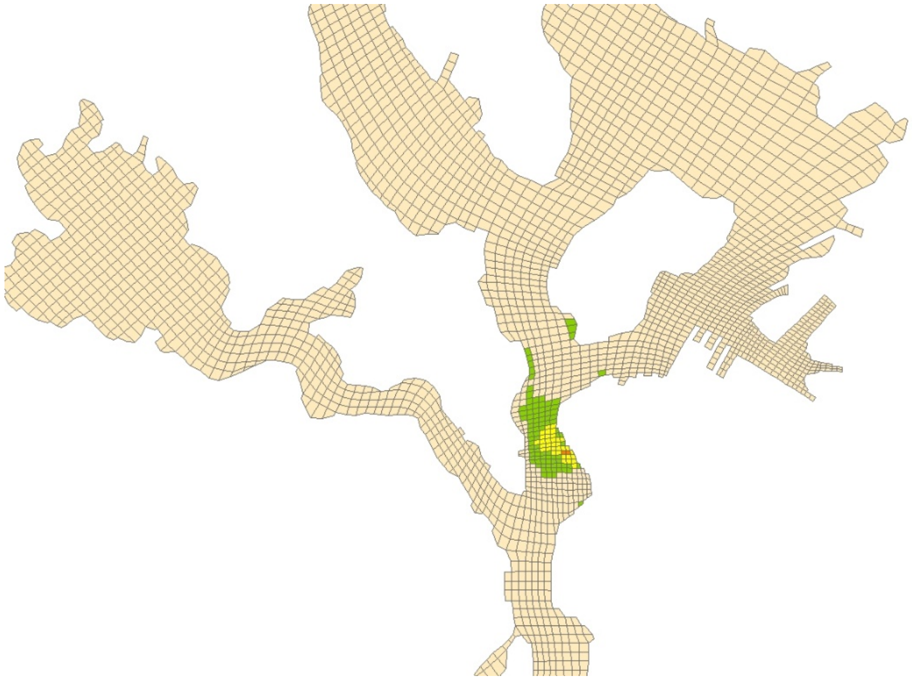


Figure 97. Simulated silt-particle-bound copper concentrations at Oscar Pier bottom layer for CH3D simulation at t = 3 hours after prop-wash resuspension

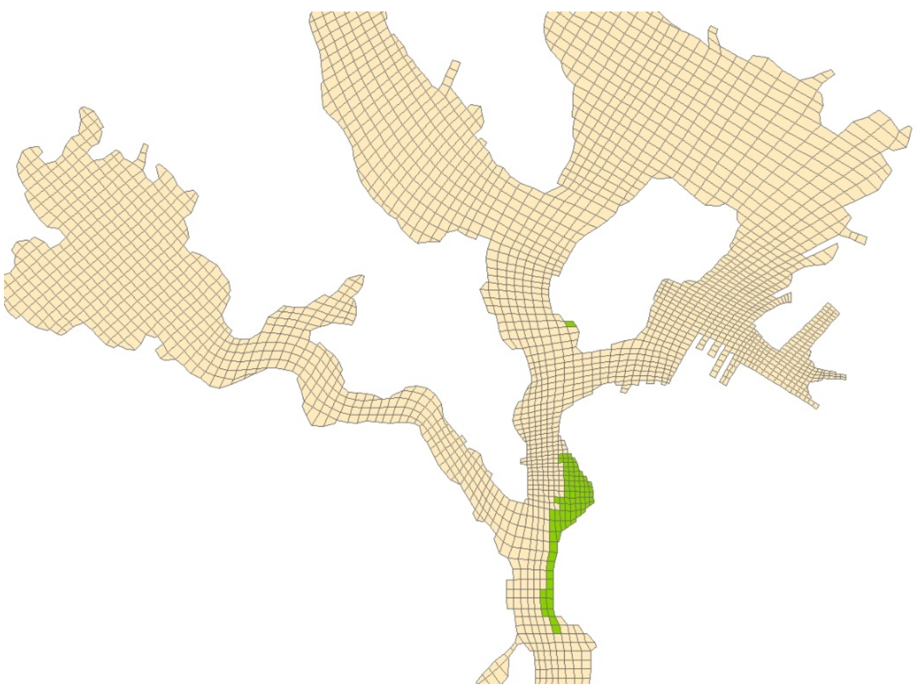


Figure 98. Simulated silt-particle-bound copper concentrations at Oscar Pier bottom layer for CH3D simulation at t = 9 hours after prop-wash resuspension.

Figure 99. Simulated silt-particle-bound copper concentrations at Oscar Pier bottom layer for CH3D simulation at t = 18 hours after prop-wash resuspension.

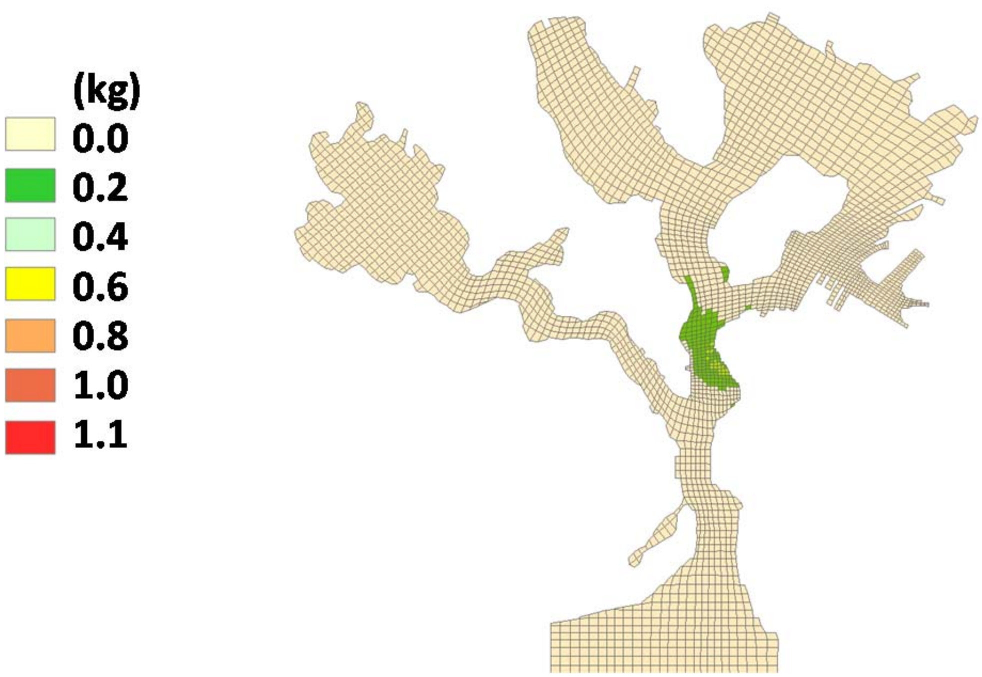


Figure 100. Simulated silt-particle-bound deposits to the bottom bed at t = 3 hours after prop-wash resuspension at Oscar Pier (color key applies to Figure 100–Figure 104, inclusive)

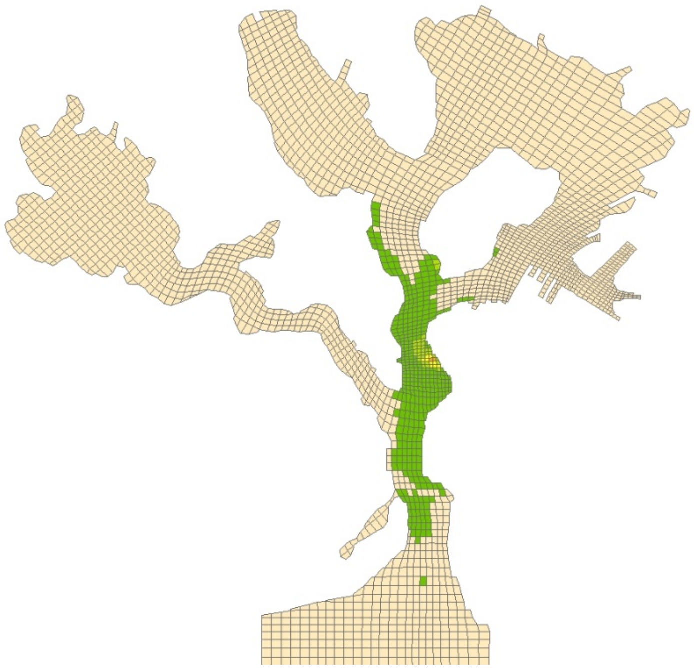


Figure 101. Simulated silt-particle-bound deposits to the bottom bed at t = 9 hours after prop-wash resuspension at Oscar Pier.

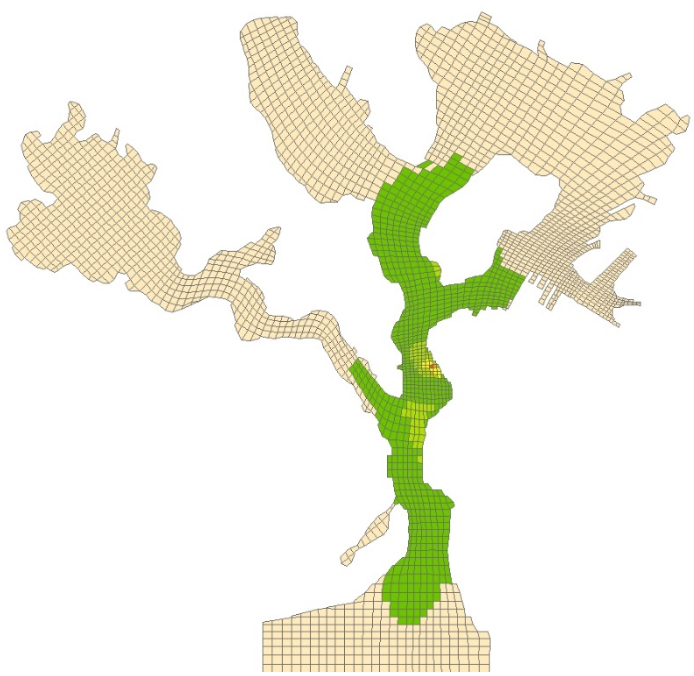


Figure 102. Simulated silt-particle-bound deposits to the bottom bed at t = 18 hours after prop-wash resuspension at Oscar Pier.

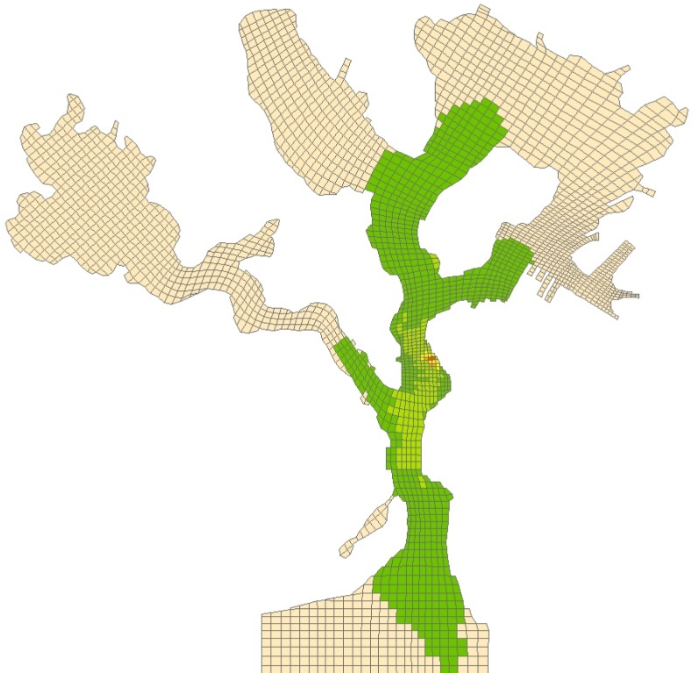


Figure 103. Simulated silt-particle-bound deposits to the bottom bed at t = 30 hours after prop-wash resuspension at Oscar Pier.

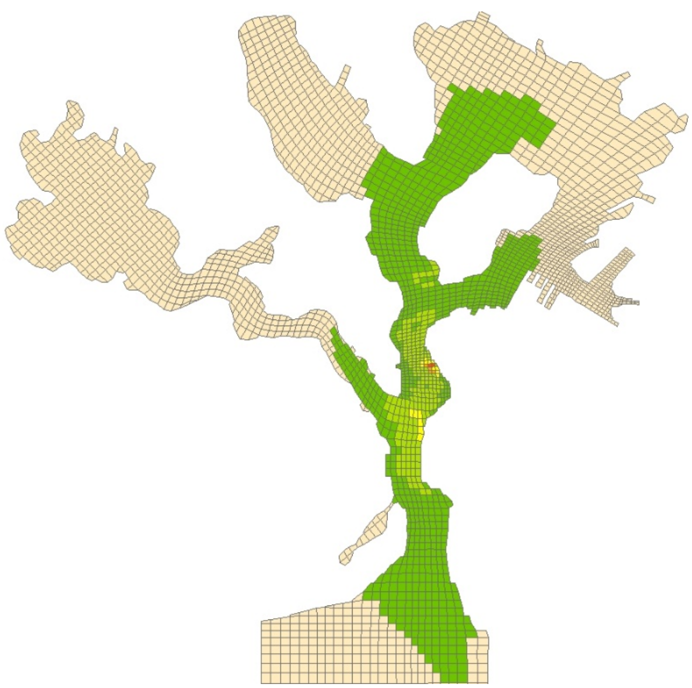


Figure 104. Simulated silt-particle-bound deposits to the bottom bed at t = 120 hours after prop-wash resuspension at Oscar Pier.

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APPENDIX A

SEDIMENT PROFILE IMAGE ANALYSIS RESULTS

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	1	8/30/2012	11:08:51	14.455	305.69	21.15	21.03	-	-	-	4.35	0.30	
Pearl Harb_B22	2	8/30/2012	11:08:54	14.455	305.79	21.15	21.03	-	-	-	4.26	0.29	
Pearl Harb_B22	3	8/30/2012	11:08:57	14.455	305.72	21.15	21.03	-	-	-	4.33	0.30	
Pearl Harb_B22	4	8/30/2012	11:09:00	14.455	305.93	21.16	21.03	-	-	-	4.11	0.28	
Pearl Harb_B22	5	8/30/2012	11:09:03	14.455	305.69	21.15	21.03	-	-	-	4.35	0.30	
Pearl Harb_B22	6	8/30/2012	11:09:06	14.455	305.70	21.15	21.03	-	-	-	4.34	0.30	
Pearl Harb_B22	7	8/30/2012	11:09:09	14.455	305.77	21.15	21.03	-	-	-	4.27	0.30	
Pearl Harb_B22	8	8/30/2012	11:09:12	14.455	305.70	21.15	21.03	-	-	-	4.34	0.30	
Pearl Harb_B22	9	8/30/2012	11:09:15	14.455	305.75	21.15	21.03	-	-	-	4.29	0.30	
Pearl Harb_B22	10	8/30/2012	11:09:18	14.455	305.56	21.14	21.03	-	-	-	4.48	0.31	
Pearl Harb_B22	11	8/30/2012	11:09:21	14.455	305.77	21.15	21.03	-	-	-	4.27	0.30	
Pearl Harb_B22	12	8/30/2012	11:09:24	14.455	305.76	21.15	21.03	-	-	-	4.28	0.30	
Pearl Harb_B22	13	8/30/2012	11:09:27	14.455	305.66	21.15	21.03	-	-	-	4.38	0.30	
Pearl Harb_B22	14	8/30/2012	11:09:30	14.455	305.84	21.16	21.03	-	-	-	4.20	0.29	
Pearl Harb_B22	15	8/30/2012	11:09:33	14.455	305.68	21.15	21.03	-	-	-	4.36	0.30	
Pearl Harb_B22	16	8/30/2012	11:09:36	14.455	305.84	21.16	21.03	-	-	-	4.20	0.29	
Pearl Harb_B22	17	8/30/2012	11:09:39	14.455	305.84	21.16	21.03	-	-	-	4.21	0.29	
Pearl Harb_B22	18	8/30/2012	11:09:42	14.455	305.81	21.16	21.03	-	-	-	4.23	0.29	
Pearl Harb_B22	19	8/30/2012	11:09:45	14.455	305.81	21.16	21.03	-	-	-	4.23	0.29	
Pearl Harb_B22	20	8/30/2012	11:09:48	14.455	305.75	21.15	21.03	-	-	-	4.30	0.30	
Pearl Harb_B22	21	8/30/2012	11:09:51	14.455	305.81	21.16	21.03	-	-	-	4.24	0.29	
Pearl Harb_B22	22	8/30/2012	11:09:54	14.455	305.80	21.16	21.03	-	-	-	4.24	0.29	
Pearl Harb_B22	23	8/30/2012	11:09:57	14.455	305.72	21.15	21.03	-	-	-	4.32	0.30	
Pearl Harb_B22	24	8/30/2012	11:10:00	14.455	305.76	21.15	21.03	-	-	-	4.28	0.30	
Pearl Harb_B22	25	8/30/2012	11:10:03	14.455	305.83	21.16	21.03	-	-	-	4.21	0.29	
Pearl Harb_B22	26	8/30/2012	11:10:06	14.455	305.83	21.16	21.03	-	-	-	4.21	0.29	
Pearl Harb_B22	27	8/30/2012	11:10:09	14.455	305.83	21.16	21.03	-	-	-	4.21	0.29	
Pearl Harb_B22	28	8/30/2012	11:10:12	14.455	305.80	21.16	21.03	-	-	-	4.24	0.29	
Pearl Harb_B22	29	8/30/2012	11:10:15	14.455	305.90	21.16	21.03	-	-	-	4.14	0.29	
Pearl Harb_B22	30	8/30/2012	11:10:18	14.455	305.94	21.16	21.03	-	-	-	4.10	0.28	
Pearl Harb_B22	31	8/30/2012	11:10:21	14.455	305.93	21.16	21.03	-	-	-	4.11	0.28	
Pearl Harb_B22	32	8/30/2012	11:10:24	14.455	305.93	21.16	21.03	-	-	-	4.11	0.28	
Pearl Harb_B22	33	8/30/2012	11:10:27	14.455	305.83	21.16	21.03	-	-	-	4.21	0.29	
Pearl Harb_B22	34	8/30/2012	11:10:30	14.455	305.90	21.16	21.03	-	-	-	4.14	0.29	
Pearl Harb_B22	35	8/30/2012	11:10:33	14.455	305.91	21.16	21.03	-	-	-	4.13	0.29	
Pearl Harb_B22	36	8/30/2012	11:10:36	14.455	305.93	21.16	21.03	-	-	-	4.12	0.28	
Pearl Harb_B22	37	8/30/2012	11:10:39	14.455	305.83	21.16	21.05	-	-	-	4.21	0.29	
Pearl Harb_B22	38	8/30/2012	11:10:42	14.455	305.94	21.17	21.05	-	-	-	4.10	0.28	
Pearl Harb_B22	39	8/30/2012	11:10:45	14.455	305.91	21.16	21.04	-	-	-	4.13	0.29	
Pearl Harb_B22	40	8/30/2012	11:10:48	14.455	306.03	21.17	21.06	-	-	-	4.02	0.28	
Pearl Harb_B22	41	8/30/2012	11:10:51	14.455	306.02	21.17	21.06	-	-	-	4.02	0.28	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	42	8/30/2012	11:10:54	14.455	305.90	21.16	21.05	-	-	-	4.14	0.29	
Pearl Harb_B22	43	8/30/2012	11:10:57	14.455	305.94	21.16	21.04	-	-	-	4.11	0.28	
Pearl Harb_B22	44	8/30/2012	11:11:00	14.455	305.90	21.16	21.05	-	-	-	4.14	0.29	
Pearl Harb_B22	45	8/30/2012	11:11:03	14.455	306.01	21.17	21.05	-	-	-	4.03	0.28	
Pearl Harb_B22	46	8/30/2012	11:11:06	14.455	305.92	21.16	21.03	-	-	-	4.13	0.29	
Pearl Harb_B22	47	8/30/2012	11:11:09	14.455	305.93	21.16	21.05	-	-	-	4.11	0.28	
Pearl Harb_B22	48	8/30/2012	11:11:12	14.455	305.91	21.16	21.05	-	-	-	4.13	0.29	
Pearl Harb_B22	49	8/30/2012	11:11:15	14.455	305.84	21.16	21.02	-	-	-	4.20	0.29	
Pearl Harb_B22	50	8/30/2012	11:11:18	14.455	305.84	21.16	21.03	-	-	-	4.20	0.29	
Pearl Harb_B22	51	8/30/2012	11:11:21	14.455	305.93	21.16	21.04	-	-	-	4.11	0.28	
Pearl Harb_B22	52	8/30/2012	11:11:24	14.455	305.91	21.16	21.03	-	-	-	4.13	0.29	
Pearl Harb_B22	53	8/30/2012	11:11:27	14.455	305.94	21.16	21.04	-	-	-	4.10	0.28	
Pearl Harb_B22	54	8/30/2012	11:11:30	14.455	305.87	21.16	21.03	-	-	-	4.17	0.29	
Pearl Harb_B22	55	8/30/2012	11:11:33	14.455	305.94	21.16	21.05	-	-	-	4.10	0.28	
Pearl Harb_B22	56	8/30/2012	11:11:36	14.455	305.91	21.16	21.03	-	-	-	4.13	0.29	
Pearl Harb_B22	57	8/30/2012	11:11:39	14.455	306.03	21.17	21.01	-	-	-	4.01	0.28	
Pearl Harb_B22	58	8/30/2012	11:11:42	14.455	303.21	20.98	20.53	-	-	-	6.83	0.47	chunk of sed at right side, eroded; lower avg and min penetration
Pearl Harb_B22	59	8/30/2012	11:11:45	14.455	303.27	20.98	20.53	-	-	-	6.77	0.47	
Pearl Harb_B22	60	8/30/2012	11:11:48	14.455	303.34	20.99	20.53	-	-	-	6.70	0.46	
Pearl Harb_B22	61	8/30/2012	11:11:51	14.455	303.35	20.99	20.53	-	-	-	6.70	0.46	
Pearl Harb_B22	62	8/30/2012	11:11:54	14.455	303.31	20.98	20.54	-	-	-	6.73	0.47	
Pearl Harb_B22	63	8/30/2012	11:11:57	14.455	303.29	20.98	20.55	-	-	-	6.75	0.47	
Pearl Harb_B22	64	8/30/2012	11:12:00	14.455	303.53	21.00	20.54	-	-	-	6.52	0.45	
Pearl Harb_B22	65	8/30/2012	11:12:03	14.455	303.52	21.00	20.54	-	-	-	6.52	0.45	
Pearl Harb_B22	66	8/30/2012	11:12:06	14.455	303.34	20.98	20.54	-	-	-	6.70	0.46	
Pearl Harb_B22	67	8/30/2012	11:12:09	14.455	303.46	20.99	20.55	-	-	-	6.58	0.46	
Pearl Harb_B22	68	8/30/2012	11:12:12	14.455	303.48	20.99	20.54	-	-	-	6.56	0.45	
Pearl Harb_B22	69	8/30/2012	11:12:15	14.455	303.48	21.00	20.54	-	-	-	6.56	0.45	
Pearl Harb_B22	70	8/30/2012	11:12:18	14.455	303.49	21.00	20.55	-	-	-	6.55	0.45	
Pearl Harb_B22	71	8/30/2012	11:12:21	14.455	303.34	20.99	20.54	-	-	-	6.70	0.46	
Pearl Harb_B22	72	8/30/2012	11:12:24	14.455	303.48	20.99	20.55	-	-	-	6.56	0.45	
Pearl Harb_B22	73	8/30/2012	11:12:27	14.455	303.45	20.99	20.54	-	-	-	6.59	0.46	
Pearl Harb_B22	74	8/30/2012	11:12:30	14.455	303.47	20.99	20.54	-	-	-	6.57	0.45	
Pearl Harb_B22	75	8/30/2012	11:12:33	14.455	303.28	20.98	20.54	-	-	-	6.76	0.47	
Pearl Harb_B22	76	8/30/2012	11:12:36	14.455	303.22	20.98	20.55	-	-	-	6.82	0.47	
Pearl Harb_B22	77	8/30/2012	11:12:39	14.455	303.26	20.98	20.54	-	-	-	6.78	0.47	
Pearl Harb_B22	78	8/30/2012	11:12:42	14.455	303.39	20.99	20.54	-	-	-	6.65	0.46	
Pearl Harb_B22	79	8/30/2012	11:12:45	14.455	303.36	20.99	20.54	-	-	-	6.69	0.46	
Pearl Harb_B22	80	8/30/2012	11:12:48	14.455	303.42	20.99	20.54	-	-	-	6.62	0.46	
Pearl Harb_B22	81	8/30/2012	11:12:51	14.455	303.30	20.98	20.54	-	-	-	6.74	0.47	
Pearl Harb_B22	82	8/30/2012	11:12:54	14.455	303.30	20.98	20.54	-	-	-	6.74	0.47	
Pearl Harb_B22	83	8/30/2012	11:12:57	14.455	303.41	20.99	20.55	-	-	-	6.63	0.46	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	84	8/30/2012	11:13:00	14.455	303.32	20.98	20.54	-	-	-	6.72	0.46	
Pearl Harb_B22	85	8/30/2012	11:13:03	14.455	303.25	20.98	20.54	-	-	-	6.80	0.47	
Pearl Harb_B22	86	8/30/2012	11:13:06	14.455	303.26	20.98	20.54	-	-	-	6.78	0.47	
Pearl Harb_B22	87	8/30/2012	11:13:09	14.455	303.24	20.98	20.54	-	-	-	6.80	0.47	
Pearl Harb_B22	88	8/30/2012	11:13:12	14.455	303.33	20.98	20.54	-	-	-	6.71	0.46	
Pearl Harb_B22	89	8/30/2012	11:13:15	14.455	303.30	20.98	20.55	-	-	-	6.74	0.47	
Pearl Harb_B22	90	8/30/2012	11:13:18	14.455	303.32	20.98	20.55	-	-	-	6.72	0.47	
Pearl Harb_B22	91	8/30/2012	11:13:21	14.455	303.24	20.98	20.55	-	-	-	6.80	0.47	
Pearl Harb_B22	92	8/30/2012	11:13:24	14.455	303.29	20.98	20.54	-	-	-	6.75	0.47	
Pearl Harb_B22	93	8/30/2012	11:13:27	14.455	303.31	20.98	20.55	-	-	-	6.73	0.47	
Pearl Harb_B22	94	8/30/2012	11:13:30	14.455	303.31	20.98	20.54	-	-	-	6.73	0.47	
Pearl Harb_B22	95	8/30/2012	11:13:33	14.455	303.25	20.98	20.55	-	-	-	6.79	0.47	
Pearl Harb_B22	96	8/30/2012	11:13:36	14.455	303.35	20.99	20.55	-	-	-	6.70	0.46	
Pearl Harb_B22	97	8/30/2012	11:13:39	14.455	303.34	20.99	20.56	-	-	-	6.70	0.46	
Pearl Harb_B22	98	8/30/2012	11:13:42	14.455	303.34	20.98	20.55	-	-	-	6.71	0.46	
Pearl Harb_B22	99	8/30/2012	11:13:45	14.455	303.33	20.98	20.55	-	-	-	6.71	0.46	
Pearl Harb_B22	100	8/30/2012	11:13:48	14.455	303.31	20.98	20.55	-	-	-	6.73	0.47	
Pearl Harb_B22	101	8/30/2012	11:13:51	14.455	303.39	20.99	20.56	-	-	-	6.66	0.46	
Pearl Harb_B22	102	8/30/2012	11:13:54	14.455	303.40	20.99	20.55	-	-	-	6.64	0.46	
Pearl Harb_B22	103	8/30/2012	11:13:57	14.455	303.49	21.00	20.55	-	-	-	6.55	0.45	
Pearl Harb_B22	104	8/30/2012	11:14:00	14.455	303.44	20.99	20.55	-	-	-	6.60	0.46	
Pearl Harb_B22	105	8/30/2012	11:14:03	14.455	303.47	20.99	20.56	-	-	-	6.58	0.45	
Pearl Harb_B22	106	8/30/2012	11:14:06	14.455	303.48	20.99	20.59	-	-	-	6.56	0.45	
Pearl Harb_B22	107	8/30/2012	11:14:09	14.455	303.47	20.99	20.58	-	-	-	6.57	0.45	
Pearl Harb_B22	108	8/30/2012	11:14:12	14.455	303.58	21.00	20.59	-	-	-	6.46	0.45	
Pearl Harb_B22	109	8/30/2012	11:14:15	14.455	303.60	21.00	20.59	-	-	-	6.44	0.45	
Pearl Harb_B22	110	8/30/2012	11:14:18	14.455	303.62	21.00	20.59	-	-	-	6.42	0.44	
Pearl Harb_B22	111	8/30/2012	11:14:21	14.455	303.98	21.03	20.68	-	-	-	6.06	0.42	
Pearl Harb_B22	112	8/30/2012	11:14:24	14.455	303.97	21.03	20.65	-	-	-	6.08	0.42	
Pearl Harb_B22	113	8/30/2012	11:14:27	14.455	303.77	21.01	20.62	-	-	-	6.28	0.43	
Pearl Harb_B22	114	8/30/2012	11:14:30	14.455	303.83	21.02	20.63	-	-	-	6.21	0.43	
Pearl Harb_B22	115	8/30/2012	11:14:33	14.455	303.79	21.02	20.63	-	-	-	6.26	0.43	
Pearl Harb_B22	116	8/30/2012	11:14:36	14.455	303.88	21.02	20.62	-	-	-	6.16	0.43	
Pearl Harb_B22	117	8/30/2012	11:14:39	14.455	303.96	21.03	20.63	-	-	-	6.08	0.42	
Pearl Harb_B22	118	8/30/2012	11:14:42	14.455	303.94	21.03	20.64	-	-	-	6.10	0.42	
Pearl Harb_B22	119	8/30/2012	11:14:45	14.455	303.98	21.03	20.63	-	-	-	6.06	0.42	
Pearl Harb_B22	120	8/30/2012	11:14:48	14.455	303.96	21.03	20.64	-	-	-	6.08	0.42	
Pearl Harb_B22	121	8/30/2012	11:14:51	14.455	304.03	21.03	20.65	-	-	-	6.01	0.42	
Pearl Harb_B22	122	8/30/2012	11:14:54	14.455	303.93	21.03	20.65	-	-	-	6.11	0.42	
Pearl Harb_B22	123	8/30/2012	11:14:57	14.455	303.99	21.03	20.64	-	-	-	6.05	0.42	
Pearl Harb_B22	124	8/30/2012	11:15:00	14.455	303.96	21.03	20.64	-	-	-	6.08	0.42	
Pearl Harb_B22	125	8/30/2012	11:15:03	14.455	303.96	21.03	20.64	-	-	-	6.08	0.42	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	126	8/30/2012	11:15:06	14.455	303.90	21.02	20.63	-	-	-	6.15	0.43	
Pearl Harb_B22	127	8/30/2012	11:15:09	14.455	304.07	21.04	20.62	-	-	-	5.97	0.41	
Pearl Harb_B22	128	8/30/2012	11:15:12	14.455	303.88	21.02	20.63	-	-	-	6.16	0.43	
Pearl Harb_B22	129	8/30/2012	11:15:15	14.455	303.96	21.03	20.63	-	-	-	6.08	0.42	
Pearl Harb_B22	130	8/30/2012	11:15:18	14.455	303.98	21.03	20.64	-	-	-	6.07	0.42	
Pearl Harb_B22	131	8/30/2012	11:15:21	14.455	303.86	21.02	20.62	-	-	-	6.18	0.43	
Pearl Harb_B22	132	8/30/2012	11:15:24	14.455	304.00	21.03	20.64	-	-	-	6.04	0.42	
Pearl Harb_B22	133	8/30/2012	11:15:27	14.455	303.96	21.03	20.63	-	-	-	6.08	0.42	
Pearl Harb_B22	134	8/30/2012	11:15:30	14.455	303.96	21.03	20.64	-	-	-	6.08	0.42	
Pearl Harb_B22	135	8/30/2012	11:15:33	14.455	303.92	21.02	20.63	-	-	-	6.13	0.42	
Pearl Harb_B22	136	8/30/2012	11:15:36	14.455	303.86	21.02	20.63	-	-	-	6.18	0.43	
Pearl Harb_B22	137	8/30/2012	11:15:39	14.455	303.88	21.02	20.63	-	-	-	6.16	0.43	
Pearl Harb_B22	138	8/30/2012	11:15:42	14.455	303.90	21.02	20.63	-	-	-	6.14	0.42	
Pearl Harb_B22	139	8/30/2012	11:15:45	14.455	303.94	21.03	20.63	-	-	-	6.10	0.42	
Pearl Harb_B22	140	8/30/2012	11:15:48	14.455	303.99	21.03	20.63	-	-	-	6.05	0.42	
Pearl Harb_B22	141	8/30/2012	11:15:51	14.455	303.97	21.03	20.63	-	-	-	6.07	0.42	
Pearl Harb_B22	142	8/30/2012	11:15:54	14.455	303.96	21.03	20.63	-	-	-	6.08	0.42	
Pearl Harb_B22	143	8/30/2012	11:15:57	14.455	303.94	21.03	20.62	-	-	-	6.10	0.42	
Pearl Harb_B22	144	8/30/2012	11:16:00	14.455	304.01	21.03	20.63	-	-	-	6.03	0.42	
Pearl Harb_B22	145	8/30/2012	11:16:03	14.455	303.99	21.03	20.62	-	-	-	6.06	0.42	
Pearl Harb_B22	146	8/30/2012	11:16:06	14.455	303.90	21.02	20.63	-	-	-	6.15	0.43	
Pearl Harb_B22	147	8/30/2012	11:16:09	14.455	304.04	21.03	20.62	-	-	-	6.00	0.42	
Pearl Harb_B22	148	8/30/2012	11:16:12	14.455	303.94	21.03	20.62	-	-	-	6.10	0.42	
Pearl Harb_B22	149	8/30/2012	11:16:15	14.455	303.86	21.02	20.62	-	-	-	6.19	0.43	
Pearl Harb_B22	150	8/30/2012	11:16:18	14.455	303.97	21.03	20.62	-	-	-	6.07	0.42	
Pearl Harb_B22	151	8/30/2012	11:16:21	14.455	304.05	21.03	20.62	-	-	-	5.99	0.41	
Pearl Harb_B22	152	8/30/2012	11:16:24	14.455	303.88	21.02	20.62	-	-	-	6.16	0.43	
Pearl Harb_B22	153	8/30/2012	11:16:27	14.455	303.99	21.03	20.62	-	-	-	6.05	0.42	
Pearl Harb_B22	154	8/30/2012	11:16:30	14.455	303.92	21.03	20.62	-	-	-	6.13	0.42	
Pearl Harb_B22	155	8/30/2012	11:16:33	14.455	303.86	21.02	20.62	-	-	-	6.19	0.43	
Pearl Harb_B22	156	8/30/2012	11:16:36	14.455	303.90	21.02	20.62	-	-	-	6.14	0.43	
Pearl Harb_B22	157	8/30/2012	11:16:39	14.455	303.93	21.03	20.62	-	-	-	6.11	0.42	
Pearl Harb_B22	158	8/30/2012	11:16:42	14.455	303.92	21.03	20.62	-	-	-	6.12	0.42	
Pearl Harb_B22	159	8/30/2012	11:16:45	14.455	303.84	21.02	20.62	-	-	-	6.20	0.43	
Pearl Harb_B22	160	8/30/2012	11:16:48	14.455	303.76	21.01	20.62	-	-	-	6.28	0.43	
Pearl Harb_B22	161	8/30/2012	11:16:51	14.455	303.90	21.02	20.62	-	-	-	6.14	0.43	
Pearl Harb_B22	162	8/30/2012	11:16:54	14.455	303.83	21.02	20.61	-	-	-	6.22	0.43	
Pearl Harb_B22	163	8/30/2012	11:16:57	14.455	303.77	21.01	20.59	-	-	-	6.27	0.43	
Pearl Harb_B22	164	8/30/2012	11:17:00	14.455	303.90	21.02	20.61	-	-	-	6.15	0.43	
Pearl Harb_B22	165	8/30/2012	11:17:03	14.455	303.85	21.02	20.60	-	-	-	6.19	0.43	
Pearl Harb_B22	166	8/30/2012	11:17:06	14.455	303.82	21.02	20.59	-	-	-	6.22	0.43	
Pearl Harb_B22	167	8/30/2012	11:17:09	14.455	303.87	21.02	20.60	-	-	-	6.17	0.43	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	168	8/30/2012	11:17:12	14.455	303.81	21.02	20.60	-	-	-	6.23	0.43	
Pearl Harb_B22	169	8/30/2012	11:17:15	14.455	303.82	21.02	20.60	-	-	-	6.22	0.43	
Pearl Harb_B22	170	8/30/2012	11:17:18	14.455	303.80	21.02	20.60	-	-	-	6.24	0.43	
Pearl Harb_B22	171	8/30/2012	11:17:21	14.455	303.63	21.01	20.60	-	-	-	6.41	0.44	
Pearl Harb_B22	172	8/30/2012	11:17:24	14.455	303.65	21.01	20.59	-	-	-	6.39	0.44	
Pearl Harb_B22	173	8/30/2012	11:17:27	14.455	303.81	21.02	20.59	-	-	-	6.23	0.43	
Pearl Harb_B22	174	8/30/2012	11:17:30	14.455	303.66	21.01	20.60	-	-	-	6.38	0.44	
Pearl Harb_B22	175	8/30/2012	11:17:33	14.455	303.86	21.02	20.60	-	-	-	6.19	0.43	
Pearl Harb_B22	176	8/30/2012	11:17:36	14.455	303.76	21.01	20.60	-	-	-	6.28	0.43	
Pearl Harb_B22	177	8/30/2012	11:17:39	14.455	303.72	21.01	20.60	-	-	-	6.32	0.44	
Pearl Harb_B22	178	8/30/2012	11:17:42	14.455	303.76	21.01	20.60	-	-	-	6.28	0.43	
Pearl Harb_B22	179	8/30/2012	11:17:45	14.455	303.71	21.01	20.60	-	-	-	6.33	0.44	
Pearl Harb_B22	180	8/30/2012	11:17:48	14.455	303.78	21.02	20.59	-	-	-	6.26	0.43	
Pearl Harb_B22	181	8/30/2012	11:17:51	14.455	303.75	21.01	20.59	-	-	-	6.29	0.44	
Pearl Harb_B22	184	8/30/2012	11:18:00	14.455	303.78	21.02	20.59	-	-	-	6.26	0.43	
Pearl Harb_B22	234	8/30/2012	11:20:30	14.455	303.57	21.00	20.57	-	-	-	6.47	0.45	
Pearl Harb_B22	284	8/30/2012	11:23:00	14.455	303.45	20.99	20.54	-	-	-	6.59	0.46	
Pearl Harb_B22	287	8/30/2012	11:23:09	14.455	303.28	20.98	20.54	-	-	-	6.76	0.47	
Pearl Harb_B22	290	8/30/2012	11:23:18	14.455	303.35	20.99	20.54	-	-	-	6.69	0.46	
Pearl Harb_B22	293	8/30/2012	11:23:27	14.455	303.36	20.99	20.54	-	-	-	6.68	0.46	
Pearl Harb_B22	296	8/30/2012	11:23:36	14.455	303.29	20.98	20.54	-	-	-	6.75	0.47	
Pearl Harb_B22	299	8/30/2012	11:23:45	14.455	303.33	20.98	20.53	-	-	-	6.71	0.46	
Pearl Harb_B22	302	8/30/2012	11:23:54	14.455	303.17	20.97	20.53	-	-	-	6.87	0.48	
Pearl Harb_B22	305	8/30/2012	11:24:03	14.455	303.24	20.98	20.53	-	-	-	6.80	0.47	
Pearl Harb_B22	308	8/30/2012	11:24:12	14.455	303.25	20.98	20.53	-	-	-	6.80	0.47	
Pearl Harb_B22	311	8/30/2012	11:24:21	14.455	303.23	20.98	20.53	-	-	-	6.81	0.47	
Pearl Harb_B22	314	8/30/2012	11:24:30	14.455	303.29	20.98	20.53	-	-	-	6.75	0.47	
Pearl Harb_B22	317	8/30/2012	11:24:39	14.455	303.13	20.97	20.53	-	-	-	6.91	0.48	
Pearl Harb_B22	320	8/30/2012	11:24:48	14.455	303.31	20.98	20.53	-	-	-	6.73	0.47	
Pearl Harb_B22	323	8/30/2012	11:24:57	14.455	303.17	20.97	20.53	-	-	-	6.87	0.48	
Pearl Harb_B22	326	8/30/2012	11:25:06	14.455	303.12	20.97	20.52	-	-	-	6.92	0.48	
Pearl Harb_B22	329	8/30/2012	11:25:15	14.455	303.19	20.97	20.52	-	-	-	6.85	0.47	
Pearl Harb_B22	332	8/30/2012	11:25:24	14.455	303.18	20.97	20.52	-	-	-	6.86	0.47	
Pearl Harb_B22	335	8/30/2012	11:25:33	14.455	303.22	20.98	20.52	-	-	-	6.82	0.47	
Pearl Harb_B22	338	8/30/2012	11:25:42	14.455	303.20	20.98	20.52	-	-	-	6.85	0.47	
Pearl Harb_B22	341	8/30/2012	11:25:51	14.455	303.21	20.98	20.52	-	-	-	6.84	0.47	
Pearl Harb_B22	344	8/30/2012	11:26:00	14.455	303.18	20.97	20.52	-	-	-	6.86	0.47	
Pearl Harb_B22	347	8/30/2012	11:26:09	14.455	303.21	20.98	20.52	-	-	-	6.84	0.47	
Pearl Harb_B22	350	8/30/2012	11:26:18	14.455	303.16	20.97	20.52	-	-	-	6.88	0.48	
Pearl Harb_B22	353	8/30/2012	11:26:27	14.455	303.14	20.97	20.52	-	-	-	6.90	0.48	
Pearl Harb_B22	356	8/30/2012	11:26:36	14.455	303.17	20.97	20.52	-	-	-	6.88	0.48	
Pearl Harb_B22	359	8/30/2012	11:26:45	14.455	303.25	20.98	20.52	-	-	-	6.79	0.47	

BRAVO SPI RESULTS

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Pearl Harb_B22	362	8/30/2012	11:26:54	14.455	303.09	20.97	20.52	-	-	-	6.95	0.48	
Pearl Harb_B22	365	8/30/2012	11:27:03	14.455	303.01	20.96	20.51	-	-	-	7.03	0.49	
Pearl Harb_B22	368	8/30/2012	11:27:12	14.455	303.13	20.97	20.61	-	-	-	6.91	0.48	
Pearl Harb_B22	371	8/30/2012	11:27:21	14.455	303.13	20.97	20.59	-	-	-	6.91	0.48	
Pearl Harb_B22	374	8/30/2012	11:27:30	14.455	302.49	20.93	20.52	-	-	-	7.55	0.52	a little more of SWI visible on left
Pearl Harb_B22	377	8/30/2012	11:27:39	14.455	300.87	20.81	20.42	-	-	-	9.17	0.63	even more of SWI visible on left
Pearl Harb_B22	380	8/30/2012	11:27:48	14.455	297.63	20.59	20.27	-	-	-	12.41	0.86	even more of SWI visible on left; almost all visible
Pearl Harb_B22	383	8/30/2012	11:27:57	14.455	298.83	20.67	20.31	-	-	-	11.22	0.78	
Pearl Harb_B22	386	8/30/2012	11:28:06	14.455	299.25	20.70	20.34	-	-	-	10.80	0.75	
Pearl Harb_B22	389	8/30/2012	11:28:15	14.455	299.75	20.74	20.39	-	-	-	10.29	0.71	
Pearl Harb_B22	392	8/30/2012	11:28:24	14.455	300.04	20.76	20.39	-	-	-	10.01	0.69	
Pearl Harb_B22	395	8/30/2012	11:28:33	14.455	300.07	20.76	20.38	-	-	-	9.97	0.69	
Pearl Harb_B22	398	8/30/2012	11:28:42	14.455	301.12	20.83	20.50	-	-	-	8.93	0.62	a little more of SWI visible on left
Pearl Harb_B22	401	8/30/2012	11:28:51	14.455	301.32	20.85	20.47	-	-	-	8.72	0.60	
Pearl Harb_B22	404	8/30/2012	11:29:00	14.455	304.24	21.05	20.84	-	-	-	5.81	0.40	a clump of sediment that was re-suspended at 401, has settled back onto the surface (on right); looking ahead (434), this clump persists and is erodes, so I have measured it as part of the penetration depth
Pearl Harb_B22	407	8/30/2012	11:29:09	14.455	303.99	21.03	20.84	-	-	-	6.05	0.42	
Pearl Harb_B22	410	8/30/2012	11:29:18	14.455	304.11	21.04	20.84	-	-	-	5.93	0.41	a little less of SWI visible on left
Pearl Harb_B22	413	8/30/2012	11:29:27	14.455	304.00	21.03	20.85	-	-	-	6.05	0.42	
Pearl Harb_B22	416	8/30/2012	11:29:36	14.455	303.97	21.03	20.85	-	-	-	6.08	0.42	
Pearl Harb_B22	419	8/30/2012	11:29:45	14.455	304.14	21.04	20.85	-	-	-	5.91	0.41	
Pearl Harb_B22	422	8/30/2012	11:29:54	14.455	304.33	21.05	20.87	-	-	-	5.72	0.40	
Pearl Harb_B22	425	8/30/2012	11:30:03	14.455	304.23	21.05	20.84	-	-	-	5.81	0.40	
Pearl Harb_B22	428	8/30/2012	11:30:12	14.455	304.51	21.07	20.85	-	-	-	5.53	0.38	
Pearl Harb_B22	431	8/30/2012	11:30:21	14.455	304.16	21.04	20.77	-	-	-	5.88	0.41	min penetration is from different point now
Pearl Harb_B22	434	8/30/2012	11:30:30	14.455	304.38	21.06	20.80	-	-	-	5.67	0.39	
Pearl Harb_B22	437	8/30/2012	11:30:39	14.455	304.32	21.05	20.78	-	-	-	5.72	0.40	
Pearl Harb_B22	440	8/30/2012	11:30:48	14.455	303.94	21.03	20.76	-	-	-	6.10	0.42	
Pearl Harb_B22	443	8/30/2012	11:30:57	14.455	303.85	21.02	20.74	-	-	-	6.19	0.43	
Pearl Harb_B22	446	8/30/2012	11:31:06	14.455	303.88	21.02	20.75	-	-	-	6.16	0.43	
Pearl Harb_B22	449	8/30/2012	11:31:15	14.455	303.52	21.00	20.74	-	-	-	6.52	0.45	orangish clump in center (no sign of it before), gone by 461; not measured in penetration depth
Pearl Harb_B22	452	8/30/2012	11:31:24	14.455	303.56	21.00	20.69	-	-	-	6.48	0.45	
Pearl Harb_B22	455	8/30/2012	11:31:33	14.455	303.36	20.99	20.70	-	-	-	6.68	0.46	a little more of SWI visible on left
Pearl Harb_B22	458	8/30/2012	11:31:42	14.455	303.60	21.00	20.73	-	-	-	6.44	0.45	
Pearl Harb_B22	461	8/30/2012	11:31:51	14.455	304.01	21.03	20.76	-	-	-	6.03	0.42	a little less of SWI visible on left
Pearl Harb_B22	464	8/30/2012	11:32:00	14.455	303.71	21.01	20.69	-	-	-	6.34	0.44	
Pearl Harb_B22	467	8/30/2012	11:32:09	14.455	303.97	21.03	20.61	-	-	-	6.07	0.42	
Pearl Harb_B22	470	8/30/2012	11:32:18	14.455	303.25	20.98	20.49	-	-	-	6.79	0.47	
Pearl Harb_B22	473	8/30/2012	11:32:27	14.455	302.84	20.95	20.46	-	-	-	7.20	0.50	
Pearl Harb_B22	476	8/30/2012	11:32:36	14.455	302.65	20.94	20.44	-	-	-	7.39	0.51	
Pearl Harb_B22	479	8/30/2012	11:32:45	14.455	302.65	20.94	20.46	-	-	-	7.40	0.51	
Pearl Harb_B22	482	8/30/2012	11:32:54	14.455	302.82	20.95	20.47	-	-	-	7.22	0.50	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	485	8/30/2012	11:33:03	14.455	302.65	20.94	20.42	-	-	-	7.39	0.51	
Pearl Harb_B22	486	8/30/2012	11:33:06	14.455	302.85	20.95	20.45	-	-	-	7.19	0.50	
Pearl Harb_B22	489	8/30/2012	11:33:15	14.455	302.78	20.95	20.44	-	-	-	7.27	0.50	
Pearl Harb_B22	492	8/30/2012	11:33:24	14.455	302.83	20.95	20.44	-	-	-	7.22	0.50	
Pearl Harb_B22	495	8/30/2012	11:33:33	14.455	302.83	20.95	20.44	-	-	-	7.21	0.50	a little less of SWI visible on left
Pearl Harb_B22	498	8/30/2012	11:33:42	14.455	302.86	20.95	20.47	-	-	-	7.19	0.50	
Pearl Harb_B22	501	8/30/2012	11:33:51	14.455	302.81	20.95	20.46	-	-	-	7.23	0.50	
Pearl Harb_B22	504	8/30/2012	11:34:00	14.455	301.72	20.87	20.33	-	-	-	8.32	0.58	a little more of SWI visible on left
Pearl Harb_B22	507	8/30/2012	11:34:09	14.455	301.99	20.89	20.34	-	-	-	8.06	0.56	a little more of SWI visible on left
Pearl Harb_B22	510	8/30/2012	11:34:18	14.455	302.83	20.95	20.35	-	-	-	7.21	0.50	clump of sed blew from right over skipped images, settled to right of center, measured in pen
Pearl Harb_B22	513	8/30/2012	11:34:27	14.455	302.13	20.90	20.31	-	-	-	7.91	0.55	
Pearl Harb_B22	516	8/30/2012	11:34:36	14.455	301.73	20.87	20.24	-	-	-	8.31	0.57	
Pearl Harb_B22	519	8/30/2012	11:34:45	14.455	299.66	20.73	20.19	-	-	-	10.38	0.72	more of SWI visible on left; previous clump of sed blown out
Pearl Harb_B22	522	8/30/2012	11:34:54	14.455	293.17	20.28	19.88	21.21	-	-	16.88	1.17	first image with full SWI visible
Pearl Harb_B22	523	8/30/2012	11:34:57	14.455	292.31	20.22	19.73	21.16	1.26	0.09	17.74	1.23	
Pearl Harb_B22	524	8/30/2012	11:35:00	14.455	292.03	20.20	19.78	21.13	4.22	0.29	18.02	1.25	
Pearl Harb_B22	525	8/30/2012	11:35:03	14.455	292.08	20.21	19.73	21.24	0.92	0.06	17.96	1.24	
Pearl Harb_B22	526	8/30/2012	11:35:06	14.455	292.39	20.23	19.80	21.19	3.17	0.22	17.65	1.22	
Pearl Harb_B22	527	8/30/2012	11:35:09	14.455	292.51	20.24	19.78	21.27	3.04	0.21	17.54	1.21	
Pearl Harb_B22	528	8/30/2012	11:35:12	14.455	292.24	20.22	19.80	21.32	2.99	0.21	17.80	1.23	
Pearl Harb_B22	529	8/30/2012	11:35:15	14.455	292.24	20.22	19.78	21.29	1.27	0.09	17.80	1.23	
Pearl Harb_B22	530	8/30/2012	11:35:18	14.455	292.24	20.22	19.78	21.29	0.17	0.01	17.80	1.23	
Pearl Harb_B22	531	8/30/2012	11:35:21	14.455	292.69	20.25	19.78	21.27	0.91	0.06	17.35	1.20	
Pearl Harb_B22	534	8/30/2012	11:35:30	14.455	292.08	20.21	19.74	21.23	0.86	0.06	17.96	1.24	
Pearl Harb_B22	537	8/30/2012	11:35:39	14.455	292.19	20.21	19.74	21.21	0.25	0.02	17.85	1.23	
Pearl Harb_B22	540	8/30/2012	11:35:48	14.455	292.30	20.22	19.73	21.21	0.52	0.04	17.74	1.23	
Pearl Harb_B22	543	8/30/2012	11:35:57	14.455	291.64	20.18	19.69	21.21	0.84	0.06	18.41	1.27	
Pearl Harb_B22	546	8/30/2012	11:36:06	14.455	291.20	20.15	19.59	21.21	0.32	0.02	18.84	1.30	
Pearl Harb_B22	549	8/30/2012	11:36:15	14.455	289.77	20.05	19.62	21.12	1.03	0.07	20.27	1.40	
Pearl Harb_B22	552	8/30/2012	11:36:24	14.455	287.14	19.86	19.61	20.92	9.07	0.63	22.90	1.58	lots of suspended sed- almost entire SWI
Pearl Harb_B22	555	8/30/2012	11:36:33	14.455	283.73	19.63	19.27	20.77	3.79	0.26	26.31	1.82	
Pearl Harb_B22	558	8/30/2012	11:36:42	14.455	283.41	19.61	19.29	20.68	1.63	0.11	26.63	1.84	
Pearl Harb_B22	561	8/30/2012	11:36:51	14.455	283.12	19.59	19.17	20.67	3.46	0.24	26.92	1.86	
Pearl Harb_B22	564	8/30/2012	11:37:00	14.455	283.32	19.60	19.22	20.67	5.11	0.35	26.72	1.85	
Pearl Harb_B22	567	8/30/2012	11:37:09	14.455	281.65	19.48	19.16	20.55	2.62	0.18	28.39	1.96	
Pearl Harb_B22	570	8/30/2012	11:37:18	14.455	279.15	19.31	18.54	20.48	2.78	0.19	30.89	2.14	
Pearl Harb_B22	573	8/30/2012	11:37:27	14.455	280.06	19.37	18.56	20.59	2.71	0.19	29.99	2.07	
Pearl Harb_B22	576	8/30/2012	11:37:36	14.455	278.62	19.27	18.36	20.54	2.12	0.15	31.42	2.17	
Pearl Harb_B22	579	8/30/2012	11:37:45	14.455	277.81	19.22	18.25	20.50	0.97	0.07	32.23	2.23	
Pearl Harb_B22	582	8/30/2012	11:37:54	14.455	279.43	19.33	18.46	20.60	1.55	0.11	30.62	2.12	
Pearl Harb_B22	585	8/30/2012	11:38:03	14.455	279.08	19.31	18.42	20.60	0.85	0.06	30.96	2.14	
Pearl Harb_B22	588	8/30/2012	11:38:12	14.455	278.17	19.24	18.32	20.48	0.50	0.03	31.88	2.21	
Pearl Harb_B22	591	8/30/2012	11:38:21	14.455	277.86	19.22	18.33	20.50	2.35	0.16	32.18	2.23	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	594	8/30/2012	11:38:30	14.455	277.94	19.23	18.52	20.34	5.27	0.36	32.11	2.22	lots of suspended sed- esp on right
Pearl Harb_B22	597	8/30/2012	11:38:39	14.455	274.97	19.02	18.64	20.37	14.07	0.97	35.07	2.43	
Pearl Harb_B22	600	8/30/2012	11:38:48	14.455	277.61	19.21	18.44	20.37	1.40	0.10	32.43	2.24	
Pearl Harb_B22	603	8/30/2012	11:38:57	14.455	274.68	19.00	18.56	20.30	8.43	0.58	35.37	2.45	lots of suspended sed- including larger clumps
Pearl Harb_B22	606	8/30/2012	11:39:06	14.455	265.28	18.35	18.00	18.60	13.09	0.91	44.76	3.10	top of left side blown up, maximum pen point now in middle
Pearl Harb_B22	609	8/30/2012	11:39:15	14.455	265.35	18.36	17.94	18.52	5.30	0.37	44.69	3.09	
Pearl Harb_B22	612	8/30/2012	11:39:24	14.455	261.10	18.06	17.94	18.45	21.20	1.47	48.94	3.39	lots of suspended sed
Pearl Harb_B22	615	8/30/2012	11:39:33	14.455	252.45	17.46	17.15	18.07	26.71	1.85	57.60	3.98	lots of suspended sed
Pearl Harb_B22	618	8/30/2012	11:39:42	14.455	248.60	17.20	16.42	17.75	12.48	0.86	61.44	4.25	
Pearl Harb_B22	621	8/30/2012	11:39:51	14.455	245.98	17.02	16.35	17.71	6.80	0.47	64.06	4.43	
Pearl Harb_B22	624	8/30/2012	11:40:00	14.455	240.13	16.61	15.86	17.57	24.75	1.71	69.91	4.84	min penetration is from different point now
Pearl Harb_B22	627	8/30/2012	11:40:09	14.455	243.02	16.81	16.23	17.59	13.88	0.96	67.03	4.64	
Pearl Harb_B22	630	8/30/2012	11:40:18	14.455	242.75	16.79	16.23	17.53	11.29	0.78	67.29	4.66	
Pearl Harb_B22	633	8/30/2012	11:40:27	14.455	243.89	16.87	16.43	17.61	11.06	0.76	66.15	4.58	
Pearl Harb_B22	636	8/30/2012	11:40:36	14.455	243.21	16.83	16.27	17.56	5.33	0.37	66.83	4.62	
Pearl Harb_B22	639	8/30/2012	11:40:45	14.455	242.34	16.77	15.95	17.51	1.95	0.14	67.70	4.68	
Pearl Harb_B22	642	8/30/2012	11:40:54	14.455	242.63	16.79	15.96	17.66	14.01	0.97	67.41	4.66	
Pearl Harb_B22	645	8/30/2012	11:41:03	14.455	239.66	16.58	15.85	17.54	13.45	0.93	70.38	4.87	
Pearl Harb_B22	648	8/30/2012	11:41:12	14.455	240.63	16.65	15.94	17.56	7.04	0.49	69.42	4.80	
Pearl Harb_B22	651	8/30/2012	11:41:21	14.455	240.74	16.65	15.90	17.56	7.65	0.53	69.30	4.79	
Pearl Harb_B22	654	8/30/2012	11:41:30	14.455	239.92	16.60	15.97	17.51	9.01	0.62	70.12	4.85	
Pearl Harb_B22	657	8/30/2012	11:41:39	14.455	239.53	16.57	15.85	17.50	19.66	1.36	70.52	4.88	
Pearl Harb_B22	660	8/30/2012	11:41:48	14.455	238.21	16.48	15.61	17.63	50.24	3.48	71.83	4.97	lots of suspended sed- almost entire SWI
Pearl Harb_B22	663	8/30/2012	11:41:57	14.455	238.10	16.47	15.70	17.38	20.94	1.45	71.95	4.98	
Pearl Harb_B22	666	8/30/2012	11:42:06	14.455	237.54	16.43	15.59	17.61	26.25	1.82	72.50	5.02	min pen is now back at the right edge
Pearl Harb_B22	669	8/30/2012	11:42:15	14.455	238.28	16.48	15.74	17.61	15.86	1.10	71.76	4.96	
Pearl Harb_B22	672	8/30/2012	11:42:24	14.455	237.80	16.45	15.57	17.59	11.66	0.81	72.25	5.00	
Pearl Harb_B22	675	8/30/2012	11:42:33	14.455	237.62	16.44	15.55	17.63	17.17	1.19	72.42	5.01	
Pearl Harb_B22	678	8/30/2012	11:42:42	14.455	238.43	16.49	15.58	17.65	11.37	0.79	71.61	4.95	
Pearl Harb_B22	681	8/30/2012	11:42:51	14.455	237.73	16.45	15.55	17.59	8.13	0.56	72.31	5.00	
Pearl Harb_B22	684	8/30/2012	11:43:00	14.455	238.82	16.52	15.51	17.52	13.44	0.93	71.22	4.93	
Pearl Harb_B22	687	8/30/2012	11:43:09	14.455	238.23	16.48	15.48	17.52	22.73	1.57	71.81	4.97	
Pearl Harb_B22	690	8/30/2012	11:43:18	14.455	237.14	16.41	15.46	17.49	18.89	1.31	72.90	5.04	
Pearl Harb_B22	693	8/30/2012	11:43:27	14.455	238.17	16.48	15.56	17.60	12.29	0.85	71.87	4.97	
Pearl Harb_B22	696	8/30/2012	11:43:36	14.455	238.30	16.49	15.52	17.56	3.46	0.24	71.74	4.96	
Pearl Harb_B22	699	8/30/2012	11:43:45	14.455	238.37	16.49	15.52	17.56	4.34	0.30	71.67	4.96	
Pearl Harb_B22	702	8/30/2012	11:43:54	14.455	238.44	16.50	15.51	17.56	13.15	0.91	71.61	4.95	
Pearl Harb_B22	705	8/30/2012	11:44:03	14.455	238.14	16.47	15.49	17.54	27.90	1.93	71.90	4.97	
Pearl Harb_B22	708	8/30/2012	11:44:12	14.455	236.64	16.37	15.43	17.39	29.67	2.05	73.40	5.08	
Pearl Harb_B22	711	8/30/2012	11:44:21	14.455	233.62	16.16	14.16	17.35	29.33	2.03	76.42	5.29	
Pearl Harb_B22	714	8/30/2012	11:44:30	14.455	234.01	16.19	14.16	17.35	29.01	2.01	76.03	5.26	
Pearl Harb_B22	717	8/30/2012	11:44:39	14.455	233.92	16.18	14.53	17.34	19.43	1.34	76.13	5.27	
Pearl Harb_B22	720	8/30/2012	11:44:48	14.455	233.86	16.18	14.51	17.34	5.46	0.38	76.18	5.27	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	723	8/30/2012	11:44:57	14.455	232.91	16.11	14.34	17.30	4.65	0.32	77.13	5.34	
Pearl Harb_B22	726	8/30/2012	11:45:06	14.455	232.75	16.10	14.16	17.31	5.43	0.38	77.29	5.35	
Pearl Harb_B22	729	8/30/2012	11:45:15	14.455	231.95	16.05	14.10	17.24	11.16	0.77	78.10	5.40	
Pearl Harb_B22	732	8/30/2012	11:45:24	14.455	232.03	16.05	14.07	17.22	14.78	1.02	78.02	5.40	
Pearl Harb_B22	735	8/30/2012	11:45:33	14.455	231.83	16.04	14.09	17.28	10.67	0.74	78.21	5.41	
Pearl Harb_B22	738	8/30/2012	11:45:42	14.455	230.66	15.96	14.07	17.21	20.95	1.45	79.38	5.49	
Pearl Harb_B22	741	8/30/2012	11:45:51	14.455	228.84	15.83	13.58	17.31	45.34	3.14	81.20	5.62	lots of suspended sed- including larger clumps
Pearl Harb_B22	744	8/30/2012	11:46:00	14.455	228.78	15.83	13.60	17.29	46.86	3.24	81.26	5.62	lots of suspended sed- including larger clumps
Pearl Harb_B22	747	8/30/2012	11:46:09	14.455	229.45	15.87	13.61	17.29	8.50	0.59	80.59	5.58	
Pearl Harb_B22	750	8/30/2012	11:46:18	14.455	228.09	15.78	13.53	17.29	5.91	0.41	81.95	5.67	
Pearl Harb_B22	753	8/30/2012	11:46:27	14.455	227.39	15.73	13.51	17.22	20.67	1.43	82.65	5.72	
Pearl Harb_B22	756	8/30/2012	11:46:36	14.455	226.66	15.68	13.48	17.22	19.36	1.34	83.38	5.77	
Pearl Harb_B22	759	8/30/2012	11:46:45	14.455	224.93	15.56	13.47	17.26	35.15	2.43	85.11	5.89	
Pearl Harb_B22	762	8/30/2012	11:46:54	14.455	225.39	15.59	13.39	17.06	14.10	0.98	84.65	5.86	
Pearl Harb_B22	765	8/30/2012	11:47:03	14.455	225.49	15.60	13.49	17.06	21.60	1.49	84.56	5.85	
Pearl Harb_B22	768	8/30/2012	11:47:12	14.455	226.51	15.67	13.58	17.17	23.41	1.62	83.53	5.78	
Pearl Harb_B22	771	8/30/2012	11:47:21	14.455	227.61	15.75	13.57	17.17	28.65	1.98	82.43	5.70	
Pearl Harb_B22	774	8/30/2012	11:47:30	14.455	227.01	15.70	13.54	17.12	18.36	1.27	83.03	5.74	
Pearl Harb_B22	777	8/30/2012	11:47:39	14.455	226.57	15.67	13.53	17.16	28.66	1.98	83.48	5.77	
Pearl Harb_B22	780	8/30/2012	11:47:48	14.455	226.68	15.68	13.50	17.11	29.92	2.07	83.36	5.77	
Pearl Harb_B22	783	8/30/2012	11:47:57	14.455	226.20	15.65	13.50	17.11	19.25	1.33	83.84	5.80	
Pearl Harb_B22	786	8/30/2012	11:48:06	14.455	226.67	15.68	13.53	17.14	4.18	0.29	83.37	5.77	
Pearl Harb_B22	789	8/30/2012	11:48:15	14.455	226.61	15.68	13.53	17.14	8.34	0.58	83.44	5.77	
Pearl Harb_B22	792	8/30/2012	11:48:24	14.455	226.58	15.67	13.52	17.14	11.19	0.77	83.46	5.77	
Pearl Harb_B22	795	8/30/2012	11:48:33	14.455	226.34	15.66	13.50	17.14	4.80	0.33	83.70	5.79	
Pearl Harb_B22	798	8/30/2012	11:48:42	14.455	226.24	15.65	13.50	17.12	6.40	0.44	83.80	5.80	
Pearl Harb_B22	801	8/30/2012	11:48:51	14.455	225.85	15.62	13.47	17.11	6.97	0.48	84.19	5.82	
Pearl Harb_B22	804	8/30/2012	11:49:00	14.455	225.25	15.58	13.45	17.08	7.77	0.54	84.79	5.87	
Pearl Harb_B22	807	8/30/2012	11:49:09	14.455	225.21	15.58	13.44	17.02	4.68	0.32	84.83	5.87	
Pearl Harb_B22	810	8/30/2012	11:49:18	14.455	224.83	15.55	13.44	16.84	6.01	0.42	85.21	5.89	
Pearl Harb_B22	813	8/30/2012	11:49:27	14.455	225.70	15.61	13.49	16.90	5.98	0.41	84.34	5.83	
Pearl Harb_B22	816	8/30/2012	11:49:36	14.455	225.67	15.61	13.50	16.89	14.67	1.01	84.37	5.84	
Pearl Harb_B22	819	8/30/2012	11:49:45	14.455	225.92	15.63	13.49	16.89	11.36	0.79	84.12	5.82	
Pearl Harb_B22	822	8/30/2012	11:49:54	14.455	225.85	15.62	13.49	16.89	19.30	1.33	84.19	5.82	
Pearl Harb_B22	825	8/30/2012	11:50:03	14.455	225.74	15.62	13.49	16.89	14.69	1.02	84.30	5.83	
Pearl Harb_B22	828	8/30/2012	11:50:12	14.455	225.94	15.63	13.49	16.90	17.14	1.19	84.11	5.82	
Pearl Harb_B22	831	8/30/2012	11:50:21	14.455	225.85	15.62	13.51	16.90	19.10	1.32	84.19	5.82	
Pearl Harb_B22	834	8/30/2012	11:50:30	14.455	226.14	15.64	13.56	16.89	30.26	2.09	83.90	5.80	
Pearl Harb_B22	837	8/30/2012	11:50:39	14.455	225.80	15.62	13.50	16.89	34.85	2.41	84.24	5.83	
Pearl Harb_B22	840	8/30/2012	11:50:48	14.455	223.97	15.49	13.43	16.86	18.73	1.30	86.08	5.95	
Pearl Harb_B22	843	8/30/2012	11:50:57	14.455	225.13	15.57	13.55	16.90	32.48	2.25	84.91	5.87	
Pearl Harb_B22	844	8/30/2012	11:51:00	14.455	224.41	15.52	13.55	16.92	27.90	1.93	85.64	5.92	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	846	8/30/2012	11:51:06	14.455	223.88	15.49	13.55	16.87	14.66	1.01	86.16	5.96	
Pearl Harb_B22	848	8/30/2012	11:51:12	14.455	224.10	15.50	13.52	16.83	27.23	1.88	85.94	5.95	
Pearl Harb_B22	850	8/30/2012	11:51:18	14.455	223.79	15.48	13.52	16.86	28.26	1.96	86.26	5.97	
Pearl Harb_B22	852	8/30/2012	11:51:24	14.455	223.34	15.45	13.48	16.82	35.93	2.49	86.70	6.00	
Pearl Harb_B22	854	8/30/2012	11:51:30	14.455	223.48	15.46	13.50	16.85	16.93	1.17	86.56	5.99	
Pearl Harb_B22	856	8/30/2012	11:51:36	14.455	223.46	15.46	13.50	16.86	18.60	1.29	86.58	5.99	
Pearl Harb_B22	858	8/30/2012	11:51:42	14.455	223.49	15.46	13.48	16.84	12.10	0.84	86.55	5.99	
Pearl Harb_B22	860	8/30/2012	11:51:48	14.455	222.76	15.41	13.44	16.84	27.19	1.88	87.28	6.04	several chunks of sed in sus sed
Pearl Harb_B22	862	8/30/2012	11:51:54	14.455	223.51	15.46	13.45	16.85	10.68	0.74	86.53	5.99	
Pearl Harb_B22	864	8/30/2012	11:52:00	14.455	223.65	15.47	13.45	16.85	10.34	0.72	86.40	5.98	
Pearl Harb_B22	866	8/30/2012	11:52:06	14.455	223.08	15.43	13.44	16.82	5.06	0.35	86.96	6.02	
Pearl Harb_B22	868	8/30/2012	11:52:12	14.455	222.70	15.41	13.43	16.82	1.30	0.09	87.34	6.04	
Pearl Harb_B22	870	8/30/2012	11:52:18	14.455	221.69	15.34	13.42	16.76	9.41	0.65	88.35	6.11	
Pearl Harb_B22	872	8/30/2012	11:52:24	14.455	221.33	15.31	13.40	16.73	21.20	1.47	88.71	6.14	
Pearl Harb_B22	874	8/30/2012	11:52:30	14.455	218.79	15.14	13.21	16.66	13.26	0.92	91.26	6.31	
Pearl Harb_B22	876	8/30/2012	11:52:36	14.455	217.30	15.03	13.21	16.25	13.94	0.96	92.74	6.42	
Pearl Harb_B22	878	8/30/2012	11:52:42	14.455	218.25	15.10	13.25	16.25	33.90	2.35	91.79	6.35	
Pearl Harb_B22	880	8/30/2012	11:52:48	14.455	219.59	15.19	13.27	16.34	22.90	1.58	90.45	6.26	
Pearl Harb_B22	882	8/30/2012	11:52:54	14.455	219.52	15.19	13.28	16.34	20.94	1.45	90.52	6.26	
Pearl Harb_B22	884	8/30/2012	11:53:00	14.455	220.28	15.24	13.35	16.40	13.81	0.96	89.76	6.21	
Pearl Harb_B22	886	8/30/2012	11:53:06	14.455	220.52	15.26	13.39	16.42	21.23	1.47	89.52	6.19	
Pearl Harb_B22	888	8/30/2012	11:53:12	14.455	220.02	15.22	13.31	16.42	27.75	1.92	90.02	6.23	
Pearl Harb_B22	890	8/30/2012	11:53:18	14.455	219.19	15.16	13.33	16.38	11.45	0.79	90.85	6.29	
Pearl Harb_B22	892	8/30/2012	11:53:24	14.455	221.13	15.30	13.53	16.47	31.65	2.19	88.91	6.15	
Pearl Harb_B22	894	8/30/2012	11:53:30	14.455	221.27	15.31	13.52	16.47	17.82	1.23	88.77	6.14	
Pearl Harb_B22	896	8/30/2012	11:53:36	14.455	221.22	15.30	13.51	16.46	6.04	0.42	88.82	6.14	
Pearl Harb_B22	898	8/30/2012	11:53:42	14.455	220.88	15.28	13.40	16.45	12.52	0.87	89.16	6.17	
Pearl Harb_B22	900	8/30/2012	11:53:48	14.455	221.35	15.31	13.39	16.50	30.09	2.08	88.69	6.14	
Pearl Harb_B22	902	8/30/2012	11:53:54	14.455	221.46	15.32	13.41	16.49	33.22	2.30	88.58	6.13	
Pearl Harb_B22	904	8/30/2012	11:54:00	14.455	221.45	15.32	13.42	16.48	13.93	0.96	88.60	6.13	
Pearl Harb_B22	906	8/30/2012	11:54:06	14.455	221.31	15.31	13.42	16.48	22.20	1.54	88.73	6.14	
Pearl Harb_B22	908	8/30/2012	11:54:12	14.455	221.60	15.33	13.27	16.52	29.69	2.05	88.44	6.12	
Pearl Harb_B22	910	8/30/2012	11:54:18	14.455	222.19	15.37	13.28	16.55	20.17	1.40	87.85	6.08	
Pearl Harb_B22	912	8/30/2012	11:54:24	14.455	222.22	15.37	13.32	16.59	14.88	1.03	87.83	6.08	
Pearl Harb_B22	914	8/30/2012	11:54:30	14.455	222.34	15.38	13.48	16.58	30.11	2.08	87.71	6.07	
Pearl Harb_B22	916	8/30/2012	11:54:36	14.455	221.90	15.35	13.43	16.55	21.82	1.51	88.14	6.10	
Pearl Harb_B22	918	8/30/2012	11:54:42	14.455	221.79	15.34	13.29	16.55	31.72	2.19	88.25	6.10	
Pearl Harb_B22	920	8/30/2012	11:54:48	14.455	221.59	15.33	13.29	16.53	16.75	1.16	88.45	6.12	
Pearl Harb_B22	922	8/30/2012	11:54:54	14.455	221.33	15.31	13.27	16.51	19.74	1.37	88.71	6.14	
Pearl Harb_B22	924	8/30/2012	11:55:00	14.455	221.09	15.30	13.27	16.51	14.66	1.01	88.95	6.15	
Pearl Harb_B22	926	8/30/2012	11:55:06	14.455	221.03	15.29	13.27	16.51	11.24	0.78	89.01	6.16	
Pearl Harb_B22	928	8/30/2012	11:55:12	14.455	221.67	15.34	13.40	16.54	10.50	0.73	88.37	6.11	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	930	8/30/2012	11:55:18	14.455	221.70	15.34	13.44	16.54	12.27	0.85	88.34	6.11	
Pearl Harb_B22	932	8/30/2012	11:55:24	14.455	221.90	15.35	13.49	16.54	13.21	0.91	88.14	6.10	
Pearl Harb_B22	934	8/30/2012	11:55:30	14.455	221.89	15.35	13.46	16.54	15.77	1.09	88.16	6.10	
Pearl Harb_B22	936	8/30/2012	11:55:36	14.455	222.13	15.37	13.49	16.51	11.47	0.79	87.92	6.08	
Pearl Harb_B22	938	8/30/2012	11:55:42	14.455	221.47	15.32	13.45	16.51	15.56	1.08	88.57	6.13	
Pearl Harb_B22	940	8/30/2012	11:55:48	14.455	221.83	15.35	13.32	16.55	22.05	1.53	88.21	6.10	
Pearl Harb_B22	942	8/30/2012	11:55:54	14.455	222.62	15.40	13.32	16.58	18.73	1.30	87.42	6.05	
Pearl Harb_B22	944	8/30/2012	11:56:00	14.455	222.52	15.39	13.33	16.59	14.01	0.97	87.52	6.05	
Pearl Harb_B22	946	8/30/2012	11:56:06	14.455	222.56	15.40	13.29	16.59	22.43	1.55	87.48	6.05	
Pearl Harb_B22	948	8/30/2012	11:56:12	14.455	221.66	15.33	13.32	16.55	11.90	0.82	88.38	6.11	
Pearl Harb_B22	950	8/30/2012	11:56:18	14.455	221.13	15.30	13.28	16.52	15.35	1.06	88.92	6.15	
Pearl Harb_B22	952	8/30/2012	11:56:24	14.455	220.84	15.28	13.27	16.51	19.48	1.35	89.20	6.17	
Pearl Harb_B22	954	8/30/2012	11:56:30	14.455	220.16	15.23	13.21	16.46	11.53	0.80	89.88	6.22	
Pearl Harb_B22	956	8/30/2012	11:56:36	14.455	217.14	15.02	13.07	16.32	38.58	2.67	92.90	6.43	
Pearl Harb_B22	958	8/30/2012	11:56:42	14.455	219.18	15.16	13.33	16.43	31.11	2.15	90.86	6.29	
Pearl Harb_B22	960	8/30/2012	11:56:48	14.455	218.87	15.14	13.33	16.41	31.59	2.19	91.17	6.31	
Pearl Harb_B22	962	8/30/2012	11:56:54	14.455	218.88	15.14	13.14	16.41	26.72	1.85	91.16	6.31	
Pearl Harb_B22	964	8/30/2012	11:57:00	14.455	219.21	15.17	13.19	16.44	18.49	1.28	90.83	6.28	
Pearl Harb_B22	966	8/30/2012	11:57:06	14.455	219.29	15.17	13.19	16.44	29.34	2.03	90.75	6.28	
Pearl Harb_B22	968	8/30/2012	11:57:12	14.455	219.46	15.18	13.20	16.45	19.36	1.34	90.58	6.27	
Pearl Harb_B22	970	8/30/2012	11:57:18	14.455	219.94	15.22	13.22	16.47	13.75	0.95	90.10	6.23	
Pearl Harb_B22	972	8/30/2012	11:57:24	14.455	219.67	15.20	13.39	16.46	26.86	1.86	90.37	6.25	
Pearl Harb_B22	974	8/30/2012	11:57:30	14.455	218.28	15.10	13.15	16.51	41.10	2.84	91.76	6.35	lots of sus sed- also chunk blown out at right
Pearl Harb_B22	976	8/30/2012	11:57:36	14.455	216.99	15.01	13.07	16.45	25.90	1.79	93.05	6.44	
Pearl Harb_B22	978	8/30/2012	11:57:42	14.455	216.35	14.97	13.09	16.45	32.76	2.27	93.69	6.48	
Pearl Harb_B22	980	8/30/2012	11:57:48	14.455	217.26	15.03	13.14	16.47	35.35	2.45	92.78	6.42	
Pearl Harb_B22	982	8/30/2012	11:57:54	14.455	217.57	15.05	13.15	16.49	15.93	1.10	92.48	6.40	
Pearl Harb_B22	984	8/30/2012	11:58:00	14.455	217.29	15.03	13.15	16.47	16.36	1.13	92.75	6.42	
Pearl Harb_B22	986	8/30/2012	11:58:06	14.455	216.89	15.00	13.14	16.46	16.83	1.16	93.15	6.44	
Pearl Harb_B22	988	8/30/2012	11:58:12	14.455	216.98	15.01	13.17	16.44	22.20	1.54	93.07	6.44	
Pearl Harb_B22	990	8/30/2012	11:58:18	14.455	216.98	15.01	13.14	16.47	19.50	1.35	93.06	6.44	
Pearl Harb_B22	992	8/30/2012	11:58:24	14.455	217.14	15.02	13.12	16.47	34.21	2.37	92.90	6.43	
Pearl Harb_B22	994	8/30/2012	11:58:30	14.455	216.55	14.98	13.13	16.48	21.36	1.48	93.50	6.47	
Pearl Harb_B22	996	8/30/2012	11:58:36	14.455	216.96	15.01	13.14	16.51	24.12	1.67	93.08	6.44	
Pearl Harb_B22	998	8/30/2012	11:58:42	14.455	216.86	15.00	13.10	16.48	27.88	1.93	93.18	6.45	
Pearl Harb_B22	1000	8/30/2012	11:58:48	14.455	217.10	15.02	13.17	16.50	11.27	0.78	92.94	6.43	
Pearl Harb_B22	1002	8/30/2012	11:58:54	14.455	217.03	15.01	13.13	16.47	22.65	1.57	93.02	6.43	
Pearl Harb_B22	1004	8/30/2012	11:59:00	14.455	217.11	15.02	13.13	16.50	12.13	0.84	92.94	6.43	
Pearl Harb_B22	1006	8/30/2012	11:59:06	14.455	216.96	15.01	13.13	16.50	16.06	1.11	93.08	6.44	
Pearl Harb_B22	1008	8/30/2012	11:59:12	14.455	217.00	15.01	13.13	16.48	17.46	1.21	93.05	6.44	
Pearl Harb_B22	1010	8/30/2012	11:59:18	14.455	216.99	15.01	13.13	16.48	17.40	1.20	93.05	6.44	
Pearl Harb_B22	1012	8/30/2012	11:59:24	14.455	216.52	14.98	13.13	16.48	20.95	1.45	93.53	6.47	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	1014	8/30/2012	11:59:30	14.455	216.38	14.97	13.13	16.45	30.03	2.08	93.67	6.48	
Pearl Harb_B22	1016	8/30/2012	11:59:36	14.455	214.32	14.83	13.08	16.43	47.24	3.27	95.72	6.62	lots of suspended sed- almost entire SWI
Pearl Harb_B22	1018	8/30/2012	11:59:42	14.455	211.59	14.64	13.06	16.49	50.58	3.50	98.45	6.81	
Pearl Harb_B22	1020	8/30/2012	11:59:48	14.455	208.89	14.45	12.97	16.04	26.11	1.81	101.16	7.00	
Pearl Harb_B22	1022	8/30/2012	11:59:54	14.455	210.40	14.56	13.07	16.13	18.72	1.30	99.64	6.89	
Pearl Harb_B22	1024	8/30/2012	12:00:00	14.455	209.79	14.51	13.01	16.12	26.41	1.83	100.25	6.94	
Pearl Harb_B22	1026	8/30/2012	12:00:06	14.455	209.48	14.49	13.00	16.10	20.22	1.40	100.56	6.96	
Pearl Harb_B22	1028	8/30/2012	12:00:12	14.455	210.27	14.55	13.05	16.15	22.14	1.53	99.77	6.90	
Pearl Harb_B22	1030	8/30/2012	12:00:18	14.455	210.59	14.57	13.10	16.17	17.17	1.19	99.45	6.88	
Pearl Harb_B22	1032	8/30/2012	12:00:24	14.455	210.69	14.58	13.12	16.19	36.64	2.53	99.36	6.87	
Pearl Harb_B22	1034	8/30/2012	12:00:30	14.455	210.68	14.58	13.10	16.18	39.11	2.71	99.36	6.87	
Pearl Harb_B22	1036	8/30/2012	12:00:36	14.455	209.48	14.49	13.05	16.13	35.05	2.43	100.56	6.96	
Pearl Harb_B22	1038	8/30/2012	12:00:42	14.455	207.24	14.34	12.98	16.10	24.58	1.70	102.80	7.11	small chunk on less blown up
Pearl Harb_B22	1040	8/30/2012	12:00:48	14.455	208.41	14.42	13.06	16.20	73.70	5.10	101.63	7.03	lots of suspended sed- almost entire SWI
Pearl Harb_B22	1042	8/30/2012	12:00:54	14.455	208.21	14.40	12.84	16.09	28.79	1.99	101.83	7.04	large chunks on left side of SWI
Pearl Harb_B22	1044	8/30/2012	12:01:00	14.455	210.39	14.55	12.89	16.22	34.08	2.36	99.66	6.89	large chunks on left side of SWI
Pearl Harb_B22	1046	8/30/2012	12:01:06	14.455	207.78	14.37	12.64	15.98	39.47	2.73	102.26	7.07	cont'd
Pearl Harb_B22	1048	8/30/2012	12:01:12	14.455	208.44	14.42	12.68	15.89	34.04	2.35	101.60	7.03	cont'd
Pearl Harb_B22	1050	8/30/2012	12:01:18	14.455	208.58	14.43	12.71	16.01	19.87	1.37	101.46	7.02	cont'd
Pearl Harb_B22	1052	8/30/2012	12:01:24	14.455	208.72	14.44	12.73	15.89	35.69	2.47	101.32	7.01	cont'd
Pearl Harb_B22	1054	8/30/2012	12:01:30	14.455	208.62	14.43	12.75	15.90	46.50	3.22	101.42	7.02	cont'd
Pearl Harb_B22	1056	8/30/2012	12:01:36	14.455	208.94	14.45	12.70	15.88	30.36	2.10	101.10	6.99	cont'd
Pearl Harb_B22	1058	8/30/2012	12:01:42	14.455	207.35	14.34	11.65	15.85	43.66	3.02	102.70	7.10	lots of sus sed- several med-lrg chunks in suspension
Pearl Harb_B22	1060	8/30/2012	12:01:48	14.455	205.10	14.19	11.55	15.80	22.05	1.53	104.94	7.26	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1062	8/30/2012	12:01:54	14.455	204.65	14.16	11.03	15.80	28.37	1.96	105.39	7.29	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1064	8/30/2012	12:02:00	14.455	204.49	14.15	11.06	16.23	10.14	0.70	105.55	7.30	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1066	8/30/2012	12:02:06	14.455	204.72	14.16	11.06	15.81	18.70	1.29	105.32	7.29	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1068	8/30/2012	12:02:12	14.455	204.88	14.17	11.06	15.81	30.19	2.09	105.17	7.28	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1070	8/30/2012	12:02:18	14.455	204.50	14.15	11.06	15.58	24.90	1.72	105.54	7.30	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1072	8/30/2012	12:02:24	14.455	206.16	14.26	11.23	15.67	3.09	0.21	103.88	7.19	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1074	8/30/2012	12:02:30	14.455	206.55	14.29	11.24	15.69	11.06	0.76	103.49	7.16	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1076	8/30/2012	12:02:36	14.455	206.57	14.29	11.27	15.70	15.11	1.05	103.47	7.16	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1078	8/30/2012	12:02:42	14.455	206.33	14.27	11.26	15.69	14.04	0.97	103.71	7.18	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1080	8/30/2012	12:02:48	14.455	206.29	14.27	11.25	15.69	15.95	1.10	103.75	7.18	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1082	8/30/2012	12:02:54	14.455	206.38	14.28	11.25	15.70	11.60	0.80	103.66	7.17	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1084	8/30/2012	12:03:00	14.455	205.30	14.20	11.54	15.64	17.23	1.19	104.74	7.25	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1086	8/30/2012	12:03:06	14.455	203.29	14.06	11.25	15.46	12.16	0.84	106.76	7.39	cont'd-large chunks on left side of SWI
Pearl Harb_B22	1088	8/30/2012	12:03:12	14.455	194.76	13.47	10.41	14.73	31.29	2.16	115.28	7.97	large chunks on left gone
Pearl Harb_B22	1090	8/30/2012	12:03:18	14.455	196.02	13.56	10.52	14.89	23.27	1.61	114.03	7.89	
Pearl Harb_B22	1092	8/30/2012	12:03:24	14.455	196.96	13.63	10.45	15.04	34.19	2.37	113.09	7.82	
Pearl Harb_B22	1094	8/30/2012	12:03:30	14.455	196.16	13.57	10.46	14.96	52.74	3.65	113.88	7.88	
Pearl Harb_B22	1096	8/30/2012	12:03:36	14.455	200.20	13.85	10.97	15.22	34.65	2.40	109.85	7.60	
Pearl Harb_B22	1098	8/30/2012	12:03:42	14.455	201.35	13.93	11.01	15.30	33.08	2.29	108.70	7.52	
Pearl Harb_B22	1100	8/30/2012	12:03:48	14.455	203.21	14.06	11.07	15.44	44.11	3.05	106.84	7.39	
Pearl Harb_B22	1102	8/30/2012	12:03:54	14.455	203.39	14.07	11.08	15.46	25.96	1.80	106.65	7.38	
Pearl Harb_B22	1104	8/30/2012	12:04:00	14.455	202.70	14.02	11.04	15.30	29.85	2.06	107.34	7.43	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	1106	8/30/2012	12:04:06	14.455	201.45	13.94	10.98	15.21	11.04	0.76	108.59	7.51	
Pearl Harb_B22	1108	8/30/2012	12:04:12	14.455	201.14	13.91	11.01	15.19	30.35	2.10	108.90	7.53	
Pearl Harb_B22	1110	8/30/2012	12:04:18	14.455	202.40	14.00	11.04	15.23	13.92	0.96	107.64	7.45	
Pearl Harb_B22	1112	8/30/2012	12:04:24	14.455	201.05	13.91	10.77	15.20	51.68	3.58	108.99	7.54	
Pearl Harb_B22	1114	8/30/2012	12:04:30	14.455	201.82	13.96	10.85	15.21	44.91	3.11	108.22	7.49	
Pearl Harb_B22	1116	8/30/2012	12:04:36	14.455	203.88	14.10	10.95	15.35	25.85	1.79	106.16	7.34	
Pearl Harb_B22	1118	8/30/2012	12:04:42	14.455	204.05	14.12	10.97	15.35	38.46	2.66	105.99	7.33	
Pearl Harb_B22	1120	8/30/2012	12:04:48	14.455	205.01	14.18	11.14	15.37	33.78	2.34	105.03	7.27	
Pearl Harb_B22	1122	8/30/2012	12:04:54	14.455	205.17	14.19	11.26	15.39	29.56	2.04	104.87	7.26	
Pearl Harb_B22	1124	8/30/2012	12:05:00	14.455	203.80	14.10	10.92	15.31	11.97	0.83	106.24	7.35	
Pearl Harb_B22	1126	8/30/2012	12:05:06	14.455	203.12	14.05	11.05	15.30	34.72	2.40	106.92	7.40	
Pearl Harb_B22	1128	8/30/2012	12:05:12	14.455	202.89	14.04	11.38	15.27	35.23	2.44	107.16	7.41	
Pearl Harb_B22	1130	8/30/2012	12:05:18	14.455	201.85	13.96	11.04	15.22	21.85	1.51	108.19	7.48	
Pearl Harb_B22	1132	8/30/2012	12:05:24	14.455	202.85	14.03	11.38	15.25	36.73	2.54	107.19	7.42	
Pearl Harb_B22	1134	8/30/2012	12:05:30	14.455	202.59	14.02	11.32	15.25	36.25	2.51	107.45	7.43	large chunk of sed rolling down slope on right
Pearl Harb_B22	1136	8/30/2012	12:05:36	14.455	203.02	14.04	11.66	15.25	24.45	1.69	107.02	7.40	
Pearl Harb_B22	1138	8/30/2012	12:05:42	14.455	202.79	14.03	11.65	15.25	27.47	1.90	107.26	7.42	
Pearl Harb_B22	1140	8/30/2012	12:05:48	14.455	203.21	14.06	11.53	15.29	20.92	1.45	106.83	7.39	
Pearl Harb_B22	1142	8/30/2012	12:05:54	14.455	203.56	14.08	11.16	15.31	2.28	0.16	106.48	7.37	
Pearl Harb_B22	1144	8/30/2012	12:06:00	14.455	203.63	14.09	11.13	15.32	14.19	0.98	106.41	7.36	
Pearl Harb_B22	1145	8/30/2012	12:06:03	14.455	204.14	14.12	11.49	15.34	29.94	2.07	105.91	7.33	
Pearl Harb_B22	1146	8/30/2012	12:06:06	14.455	203.60	14.09	11.16	15.31	23.76	1.64	106.44	7.36	
Pearl Harb_B22	1147	8/30/2012	12:06:09	14.455	203.61	14.09	11.49	15.33	32.71	2.26	106.43	7.36	
Pearl Harb_B22	1148	8/30/2012	12:06:12	14.455	203.54	14.08	11.47	15.30	20.76	1.44	106.51	7.37	one sed chunk in suspension on right
Pearl Harb_B22	1149	8/30/2012	12:06:15	14.455	203.72	14.09	11.52	15.33	25.95	1.80	106.32	7.36	
Pearl Harb_B22	1150	8/30/2012	12:06:18	14.455	203.88	14.10	11.54	15.33	26.52	1.83	106.16	7.34	
Pearl Harb_B22	1151	8/30/2012	12:06:21	14.455	204.00	14.11	11.50	15.34	6.06	0.42	106.04	7.34	
Pearl Harb_B22	1152	8/30/2012	12:06:24	14.455	203.97	14.11	11.50	15.34	32.67	2.26	106.07	7.34	
Pearl Harb_B22	1153	8/30/2012	12:06:27	14.455	204.52	14.15	11.53	15.36	21.63	1.50	105.52	7.30	
Pearl Harb_B22	1154	8/30/2012	12:06:30	14.455	204.49	14.15	11.59	15.35	33.72	2.33	105.55	7.30	
Pearl Harb_B22	1155	8/30/2012	12:06:33	14.455	204.68	14.16	11.58	15.35	35.38	2.45	105.36	7.29	
Pearl Harb_B22	1156	8/30/2012	12:06:36	14.455	204.25	14.13	11.59	15.35	23.26	1.61	105.79	7.32	
Pearl Harb_B22	1157	8/30/2012	12:06:39	14.455	204.17	14.12	11.66	15.34	34.58	2.39	105.87	7.32	
Pearl Harb_B22	1158	8/30/2012	12:06:42	14.455	203.64	14.09	11.66	15.31	26.91	1.86	106.40	7.36	
Pearl Harb_B22	1159	8/30/2012	12:06:45	14.455	203.64	14.09	11.59	15.30	25.35	1.75	106.40	7.36	
Pearl Harb_B22	1160	8/30/2012	12:06:48	14.455	203.42	14.07	11.52	15.31	23.81	1.65	106.63	7.38	
Pearl Harb_B22	1161	8/30/2012	12:06:51	14.455	203.51	14.08	11.57	15.31	19.78	1.37	106.53	7.37	
Pearl Harb_B22	1162	8/30/2012	12:06:54	14.455	203.38	14.07	11.47	15.31	18.02	1.25	106.66	7.38	
Pearl Harb_B22	1163	8/30/2012	12:06:57	14.455	203.71	14.09	11.48	15.33	26.19	1.81	106.34	7.36	
Pearl Harb_B22	1164	8/30/2012	12:07:00	14.455	203.77	14.10	11.47	15.32	26.05	1.80	106.28	7.35	
Pearl Harb_B22	1165	8/30/2012	12:07:03	14.455	203.50	14.08	11.46	15.32	35.72	2.47	106.54	7.37	
Pearl Harb_B22	1166	8/30/2012	12:07:06	14.455	203.67	14.09	11.48	15.31	28.52	1.97	106.37	7.36	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	1167	8/30/2012	12:07:09	14.455	203.49	14.08	11.48	15.31	8.98	0.62	106.56	7.37	
Pearl Harb_B22	1168	8/30/2012	12:07:12	14.455	203.41	14.07	11.45	15.31	28.60	1.98	106.63	7.38	
Pearl Harb_B22	1169	8/30/2012	12:07:15	14.455	203.33	14.07	11.51	15.31	11.11	0.77	106.71	7.38	
Pearl Harb_B22	1170	8/30/2012	12:07:18	14.455	203.52	14.08	11.50	15.31	19.95	1.38	106.52	7.37	
Pearl Harb_B22	1171	8/30/2012	12:07:21	14.455	203.62	14.09	11.51	15.31	26.22	1.81	106.42	7.36	
Pearl Harb_B22	1172	8/30/2012	12:07:24	14.455	203.52	14.08	11.53	15.32	15.39	1.06	106.53	7.37	
Pearl Harb_B22	1173	8/30/2012	12:07:27	14.455	203.54	14.08	11.66	15.32	15.12	1.05	106.50	7.37	
Pearl Harb_B22	1174	8/30/2012	12:07:30	14.455	203.39	14.07	11.59	15.31	27.67	1.91	106.66	7.38	
Pearl Harb_B22	1175	8/30/2012	12:07:33	14.455	203.29	14.06	11.50	15.30	13.34	0.92	106.76	7.39	
Pearl Harb_B22	1176	8/30/2012	12:07:36	14.455	203.25	14.06	11.47	15.31	25.31	1.75	106.80	7.39	
Pearl Harb_B22	1177	8/30/2012	12:07:39	14.455	203.03	14.05	11.20	15.31	27.66	1.91	107.01	7.40	
Pearl Harb_B22	1178	8/30/2012	12:07:42	14.455	203.28	14.06	11.22	15.31	13.66	0.94	106.76	7.39	
Pearl Harb_B22	1179	8/30/2012	12:07:45	14.455	203.42	14.07	11.16	15.32	5.99	0.41	106.62	7.38	
Pearl Harb_B22	1180	8/30/2012	12:07:48	14.455	203.44	14.07	11.16	15.31	9.60	0.66	106.60	7.37	
Pearl Harb_B22	1181	8/30/2012	12:07:51	14.455	203.21	14.06	11.14	15.32	16.46	1.14	106.84	7.39	
Pearl Harb_B22	1182	8/30/2012	12:07:54	14.455	203.29	14.06	11.18	15.31	16.31	1.13	106.76	7.39	
Pearl Harb_B22	1183	8/30/2012	12:07:57	14.455	203.16	14.05	11.09	15.31	28.75	1.99	106.88	7.39	some chunks in suspension
Pearl Harb_B22	1184	8/30/2012	12:08:00	14.455	203.07	14.05	11.09	15.30	38.80	2.68	106.98	7.40	
Pearl Harb_B22	1185	8/30/2012	12:08:03	14.455	202.66	14.02	11.47	15.28	13.11	0.91	107.38	7.43	
Pearl Harb_B22	1186	8/30/2012	12:08:06	14.455	202.40	14.00	11.46	15.23	18.28	1.26	107.64	7.45	
Pearl Harb_B22	1187	8/30/2012	12:08:09	14.455	202.57	14.01	11.47	15.26	26.15	1.81	107.47	7.44	
Pearl Harb_B22	1188	8/30/2012	12:08:12	14.455	202.16	13.99	11.47	15.23	23.53	1.63	107.88	7.46	
Pearl Harb_B22	1189	8/30/2012	12:08:15	14.455	202.57	14.01	11.48	15.25	23.94	1.66	107.47	7.43	
Pearl Harb_B22	1190	8/30/2012	12:08:18	14.455	203.51	14.08	11.60	15.31	15.44	1.07	106.53	7.37	
Pearl Harb_B22	1191	8/30/2012	12:08:21	14.455	203.82	14.10	11.57	15.32	42.52	2.94	106.22	7.35	
Pearl Harb_B22	1192	8/30/2012	12:08:24	14.455	203.70	14.09	11.55	15.33	28.74	1.99	106.34	7.36	
Pearl Harb_B22	1193	8/30/2012	12:08:27	14.455	204.34	14.14	11.59	15.36	43.73	3.03	105.70	7.31	
Pearl Harb_B22	1194	8/30/2012	12:08:30	14.455	204.29	14.13	11.63	15.33	41.50	2.87	105.75	7.32	
Pearl Harb_B22	1195	8/30/2012	12:08:33	14.455	203.95	14.11	11.56	15.33	27.91	1.93	106.09	7.34	
Pearl Harb_B22	1196	8/30/2012	12:08:36	14.455	203.86	14.10	11.59	15.39	33.83	2.34	106.19	7.35	
Pearl Harb_B22	1197	8/30/2012	12:08:39	14.455	204.09	14.12	11.61	15.39	37.07	2.56	105.95	7.33	
Pearl Harb_B22	1198	8/30/2012	12:08:42	14.455	204.19	14.13	11.53	15.39	25.05	1.73	105.85	7.32	
Pearl Harb_B22	1199	8/30/2012	12:08:45	14.455	204.25	14.13	11.45	15.39	34.82	2.41	105.79	7.32	
Pearl Harb_B22	1200	8/30/2012	12:08:48	14.455	205.43	14.21	11.83	15.43	33.43	2.31	104.61	7.24	
Pearl Harb_B22	1201	8/30/2012	12:08:51	14.455	203.17	14.06	11.67	15.25	69.58	4.81	106.88	7.39	thick cloud of sus sed, few large chunks in suspension as well
Pearl Harb_B22	1202	8/30/2012	12:08:54	14.455	200.65	13.88	11.29	15.16	65.64	4.54	109.40	7.57	lots of sus sed; few chunks in suspension as well
Pearl Harb_B22	1203	8/30/2012	12:08:57	14.455	200.83	13.89	11.21	15.19	53.97	3.73	109.21	7.56	
Pearl Harb_B22	1204	8/30/2012	12:09:00	14.455	201.17	13.92	11.44	15.19	44.23	3.06	108.87	7.53	
Pearl Harb_B22	1205	8/30/2012	12:09:03	14.455	200.65	13.88	11.43	15.16	38.47	2.66	109.39	7.57	
Pearl Harb_B22	1206	8/30/2012	12:09:06	14.455	199.87	13.83	11.43	15.15	40.24	2.78	110.17	7.62	
Pearl Harb_B22	1207	8/30/2012	12:09:09	14.455	199.79	13.82	11.43	15.16	47.94	3.32	110.25	7.63	
Pearl Harb_B22	1208	8/30/2012	12:09:12	14.455	199.28	13.79	11.19	15.13	55.99	3.87	110.76	7.66	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	1209	8/30/2012	12:09:15	14.455	198.53	13.73	11.15	15.05	32.35	2.24	111.51	7.71	
Pearl Harb_B22	1210	8/30/2012	12:09:18	14.455	199.00	13.77	11.22	15.07	29.62	2.05	111.04	7.68	left edge seems to have been shifted over to right; indent of chunk is reference point
Pearl Harb_B22	1211	8/30/2012	12:09:21	14.455	199.02	13.77	11.28	15.06	43.25	2.99	111.02	7.68	
Pearl Harb_B22	1212	8/30/2012	12:09:24	14.455	195.91	13.55	10.90	14.90	55.33	3.83	114.13	7.90	
Pearl Harb_B22	1213	8/30/2012	12:09:27	14.455	193.83	13.41	10.90	14.85	49.76	3.44	116.21	8.04	
Pearl Harb_B22	1214	8/30/2012	12:09:30	14.455	193.57	13.39	10.90	14.84	54.59	3.78	116.47	8.06	mound on left is now almost entirely out of view on the left side- just top of it
Pearl Harb_B22	1215	8/30/2012	12:09:33	14.455	194.27	13.44	10.88	14.91	43.00	2.97	115.77	8.01	
Pearl Harb_B22	1216	8/30/2012	12:09:36	14.455	193.49	13.39	10.91	14.88	51.21	3.54	116.55	8.06	mound on left is now completely out of view and thick sus sed on left
Pearl Harb_B22	1217	8/30/2012	12:09:39	14.455	193.69	13.40	10.94	14.87	39.90	2.76	116.35	8.05	
Pearl Harb_B22	1218	8/30/2012	12:09:42	14.455	192.41	13.31	10.58	14.79	54.97	3.80	117.63	8.14	
Pearl Harb_B22	1219	8/30/2012	12:09:45	14.455	192.61	13.32	10.90	14.79	39.11	2.71	117.43	8.12	
Pearl Harb_B22	1220	8/30/2012	12:09:48	14.455	193.83	13.41	10.64	14.88	49.37	3.42	116.22	8.04	
Pearl Harb_B22	1221	8/30/2012	12:09:51	14.455	194.74	13.47	10.77	14.95	45.15	3.12	115.30	7.98	
Pearl Harb_B22	1222	8/30/2012	12:09:54	14.455	195.43	13.52	11.08	15.00	31.51	2.18	114.62	7.93	
Pearl Harb_B22	1223	8/30/2012	12:09:57	14.455	195.05	13.49	11.08	14.99	34.81	2.41	115.00	7.96	
Pearl Harb_B22	1224	8/30/2012	12:10:00	14.455	195.09	13.50	11.08	14.97	35.26	2.44	114.95	7.95	
Pearl Harb_B22	1225	8/30/2012	12:10:03	14.455	195.28	13.51	11.11	14.98	32.68	2.26	114.76	7.94	
Pearl Harb_B22	1226	8/30/2012	12:10:06	14.455	195.38	13.52	10.73	14.98	39.70	2.75	114.66	7.93	
Pearl Harb_B22	1227	8/30/2012	12:10:09	14.455	195.33	13.51	10.55	14.98	29.50	2.04	114.71	7.94	
Pearl Harb_B22	1228	8/30/2012	12:10:12	14.455	195.60	13.53	10.58	14.99	34.81	2.41	114.44	7.92	
Pearl Harb_B22	1229	8/30/2012	12:10:15	14.455	198.32	13.72	10.99	15.18	35.89	2.48	111.72	7.73	
Pearl Harb_B22	1230	8/30/2012	12:10:18	14.455	198.78	13.75	11.08	15.21	30.59	2.12	111.26	7.70	
Pearl Harb_B22	1231	8/30/2012	12:10:21	14.455	199.21	13.78	11.40	15.22	35.55	2.46	110.83	7.67	
Pearl Harb_B22	1232	8/30/2012	12:10:24	14.455	199.10	13.77	11.01	15.23	31.60	2.19	110.94	7.68	
Pearl Harb_B22	1233	8/30/2012	12:10:27	14.455	198.89	13.76	10.79	15.22	25.06	1.73	111.15	7.69	
Pearl Harb_B22	1234	8/30/2012	12:10:30	14.455	198.93	13.76	11.03	15.22	28.76	1.99	111.12	7.69	
Pearl Harb_B22	1235	8/30/2012	12:10:33	14.455	199.25	13.78	11.02	15.23	24.71	1.71	110.79	7.66	
Pearl Harb_B22	1236	8/30/2012	12:10:36	14.455	199.32	13.79	11.16	15.23	29.18	2.02	110.72	7.66	
Pearl Harb_B22	1237	8/30/2012	12:10:39	14.455	200.07	13.84	11.53	15.28	29.54	2.04	109.98	7.61	
Pearl Harb_B22	1238	8/30/2012	12:10:42	14.455	200.13	13.85	11.46	15.27	59.97	4.15	109.91	7.60	
Pearl Harb_B22	1239	8/30/2012	12:10:45	14.455	200.27	13.85	11.47	15.27	60.31	4.17	109.77	7.59	
Pearl Harb_B22	1240	8/30/2012	12:10:48	14.455	200.14	13.85	11.43	15.27	43.25	2.99	109.90	7.60	
Pearl Harb_B22	1241	8/30/2012	12:10:51	14.455	200.20	13.85	11.43	15.27	47.44	3.28	109.85	7.60	
Pearl Harb_B22	1242	8/30/2012	12:10:54	14.455	200.47	13.87	11.47	15.27	51.45	3.56	109.57	7.58	
Pearl Harb_B22	1243	8/30/2012	12:10:57	14.455	200.86	13.90	11.39	15.30	60.87	4.21	109.18	7.55	
Pearl Harb_B22	1244	8/30/2012	12:11:00	14.455	201.69	13.95	11.64	15.33	75.63	5.23	108.36	7.50	lots of sus sed; few small chunks in suspension as well
Pearl Harb_B22	1245	8/30/2012	12:11:03	14.455	202.51	14.01	11.85	15.40	61.33	4.24	107.54	7.44	image seems to have shifted up in last 10-15 images
Pearl Harb_B22	1246	8/30/2012	12:11:06	14.455	201.49	13.94	12.14	15.35	80.80	5.59	108.55	7.51	thick cloud of sus sed
Pearl Harb_B22	1247	8/30/2012	12:11:09	14.455	202.16	13.99	12.15	15.38	82.21	5.69	107.89	7.46	thick cloud of sus sed; lots of small chunks of sed on surface, esp to left
Pearl Harb_B22	1248	8/30/2012	12:11:12	14.455	201.63	13.95	12.08	15.34	73.49	5.08	108.41	7.50	lots of small chunks of sed on surface, esp to left
Pearl Harb_B22	1249	8/30/2012	12:11:15	14.455	200.92	13.90	12.05	15.32	67.66	4.68	109.12	7.55	
Pearl Harb_B22	1250	8/30/2012	12:11:18	14.455	201.25	13.92	12.10	15.29	61.80	4.28	108.80	7.53	
Pearl Harb_B22	1251	8/30/2012	12:11:21	14.455	201.52	13.94	12.03	15.28	41.17	2.85	108.53	7.51	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	1252	8/30/2012	12:11:24	14.455	201.54	13.94	12.03	15.30	51.02	3.53	108.50	7.51	
Pearl Harb_B22	1253	8/30/2012	12:11:27	14.455	201.87	13.97	12.04	15.31	48.41	3.35	108.18	7.48	
Pearl Harb_B22	1254	8/30/2012	12:11:30	14.455	202.41	14.00	12.25	15.33	51.09	3.53	107.64	7.45	
Pearl Harb_B22	1255	8/30/2012	12:11:33	14.455	202.61	14.02	11.90	15.33	55.25	3.82	107.43	7.43	
Pearl Harb_B22	1256	8/30/2012	12:11:36	14.455	202.32	14.00	11.89	15.33	47.91	3.31	107.73	7.45	
Pearl Harb_B22	1257	8/30/2012	12:11:39	14.455	201.20	13.92	11.72	15.26	50.35	3.48	108.84	7.53	
Pearl Harb_B22	1258	8/30/2012	12:11:42	14.455	200.43	13.87	11.67	15.20	43.26	2.99	109.61	7.58	
Pearl Harb_B22	1259	8/30/2012	12:11:45	14.455	200.03	13.84	11.67	15.19	53.76	3.72	110.01	7.61	
Pearl Harb_B22	1260	8/30/2012	12:11:48	14.455	200.28	13.86	11.67	15.21	51.02	3.53	109.77	7.59	
Pearl Harb_B22	1261	8/30/2012	12:11:51	14.455	200.59	13.88	11.70	15.20	37.03	2.56	109.45	7.57	split appears in sediment on right, appearing like a crack, gap seen farther down on right side too several cm below SWI at prism edge
Pearl Harb_B22	1262	8/30/2012	12:11:54	14.455	199.79	13.82	11.74	15.21	45.13	3.12	110.26	7.63	"slump"on right
Pearl Harb_B22	1263	8/30/2012	12:11:57	14.455	199.44	13.80	11.78	15.21	64.34	4.45	110.60	7.65	
Pearl Harb_B22	1264	8/30/2012	12:12:00	14.455	199.70	13.82	11.74	15.21	59.51	4.12	110.34	7.63	
Pearl Harb_B22	1265	8/30/2012	12:12:03	14.455	200.13	13.84	11.77	15.22	60.92	4.21	109.92	7.60	
Pearl Harb_B22	1266	8/30/2012	12:12:06	14.455	201.15	13.92	11.79	15.23	46.90	3.24	108.90	7.53	pieces of sed that had been on surface at left are now incorporated into the SWI- begin measuring as part of penetration depth
Pearl Harb_B22	1267	8/30/2012	12:12:09	14.455	201.58	13.95	11.81	15.24	44.50	3.08	108.46	7.50	
Pearl Harb_B22	1268	8/30/2012	12:12:12	14.455	201.34	13.93	12.17	15.22	47.78	3.31	108.70	7.52	small bit of sediment has settled on top of shelf at right created by slump, now part of penetration depth
Pearl Harb_B22	1269	8/30/2012	12:12:15	14.455	197.26	13.65	11.82	14.93	52.93	3.66	112.79	7.80	
Pearl Harb_B22	1270	8/30/2012	12:12:18	14.455	196.99	13.63	11.80	14.91	47.99	3.32	113.06	7.82	
Pearl Harb_B22	1271	8/30/2012	12:12:21	14.455	197.18	13.64	11.80	14.91	43.52	3.01	112.86	7.81	
Pearl Harb_B22	1272	8/30/2012	12:12:24	14.455	197.29	13.65	11.80	14.91	36.30	2.51	112.76	7.80	
Pearl Harb_B22	1273	8/30/2012	12:12:27	14.455	197.06	13.63	11.80	14.91	40.92	2.83	112.99	7.82	
Pearl Harb_B22	1274	8/30/2012	12:12:30	14.455	196.95	13.62	11.82	14.91	35.07	2.43	113.10	7.82	
Pearl Harb_B22	1275	8/30/2012	12:12:33	14.455	197.19	13.64	11.84	14.92	37.69	2.61	112.85	7.81	
Pearl Harb_B22	1276	8/30/2012	12:12:36	14.455	197.12	13.64	11.84	14.92	33.11	2.29	112.93	7.81	large chunk on left
Pearl Harb_B22	1277	8/30/2012	12:12:39	14.455	196.90	13.62	11.47	14.93	19.93	1.38	113.14	7.83	
Pearl Harb_B22	1278	8/30/2012	12:12:42	14.455	196.80	13.61	11.48	14.93	23.69	1.64	113.25	7.83	
Pearl Harb_B22	1279	8/30/2012	12:12:45	14.455	196.68	13.61	11.47	14.93	21.09	1.46	113.37	7.84	
Pearl Harb_B22	1280	8/30/2012	12:12:48	14.455	196.73	13.61	11.47	14.93	32.07	2.22	113.31	7.84	pieces of sed that had been on surface at left are loosening- begin measuring as part of penetration depth
Pearl Harb_B22	1281	8/30/2012	12:12:51	14.455	196.31	13.58	11.49	14.93	29.38	2.03	113.73	7.87	
Pearl Harb_B22	1282	8/30/2012	12:12:54	14.455	196.15	13.57	11.46	14.92	25.31	1.75	113.90	7.88	
Pearl Harb_B22	1283	8/30/2012	12:12:57	14.455	196.01	13.56	11.47	14.92	33.06	2.29	114.03	7.89	
Pearl Harb_B22	1284	8/30/2012	12:13:00	14.455	195.79	13.54	11.46	14.90	32.59	2.25	114.25	7.90	
Pearl Harb_B22	1285	8/30/2012	12:13:03	14.455	195.01	13.49	11.78	14.88	26.69	1.85	115.03	7.96	
Pearl Harb_B22	1286	8/30/2012	12:13:06	14.455	195.29	13.51	11.79	14.86	32.32	2.24	114.75	7.94	
Pearl Harb_B22	1287	8/30/2012	12:13:09	14.455	195.29	13.51	11.43	14.87	31.65	2.19	114.75	7.94	
Pearl Harb_B22	1288	8/30/2012	12:13:12	14.455	195.32	13.51	11.45	14.88	28.07	1.94	114.72	7.94	
Pearl Harb_B22	1289	8/30/2012	12:13:15	14.455	195.66	13.54	11.81	14.88	22.78	1.58	114.38	7.91	
Pearl Harb_B22	1290	8/30/2012	12:13:18	14.455	194.93	13.49	11.71	14.84	27.66	1.91	115.11	7.96	
Pearl Harb_B22	1291	8/30/2012	12:13:21	14.455	195.02	13.49	11.75	14.83	25.61	1.77	115.02	7.96	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	1292	8/30/2012	12:13:24	14.455	194.60	13.46	11.33	14.81	54.12	3.74	115.45	7.99	
Pearl Harb_B22	1293	8/30/2012	12:13:27	14.455	187.92	13.00	10.28	14.52	91.45	6.33	122.12	8.45	lots of sus sed, thick, large chunk in suspension, looks like some of surface blown into suspension
Pearl Harb_B22	1294	8/30/2012	12:13:30	14.455	188.69	13.05	10.52	14.46	83.79	5.80	121.35	8.40	small and med chunks in suspension
Pearl Harb_B22	1295	8/30/2012	12:13:33	14.455	187.27	12.96	10.60	14.27	77.21	5.34	122.77	8.49	
Pearl Harb_B22	1296	8/30/2012	12:13:36	14.455	188.60	13.05	10.77	14.34	59.03	4.08	121.45	8.40	
Pearl Harb_B22	1297	8/30/2012	12:13:39	14.455	189.11	13.08	10.74	14.35	57.77	4.00	120.93	8.37	
Pearl Harb_B22	1298	8/30/2012	12:13:42	14.455	189.13	13.08	10.44	14.38	59.86	4.14	120.91	8.36	
Pearl Harb_B22	1299	8/30/2012	12:13:45	14.455	190.22	13.16	10.41	14.46	51.12	3.54	119.82	8.29	gap in sed on right clearly visible few cm below SWI
Pearl Harb_B22	1300	8/30/2012	12:13:48	14.455	195.50	13.52	10.77	14.80	54.44	3.77	114.54	7.92	
Pearl Harb_B22	1301	8/30/2012	12:13:51	14.455	196.74	13.61	11.01	14.88	57.29	3.96	113.30	7.84	
Pearl Harb_B22	1302	8/30/2012	12:13:54	14.455	195.66	13.54	11.03	14.81	45.75	3.16	114.39	7.91	small chunk resting on SWI at right edge
Pearl Harb_B22	1303	8/30/2012	12:13:57	14.455	194.07	13.43	10.88	14.73	63.14	4.37	115.98	8.02	
Pearl Harb_B22	1304	8/30/2012	12:14:00	14.455	193.24	13.37	10.74	14.69	56.88	3.93	116.80	8.08	
Pearl Harb_B22	1305	8/30/2012	12:14:03	14.455	193.22	13.37	10.74	14.67	59.31	4.10	116.83	8.08	
Pearl Harb_B22	1306	8/30/2012	12:14:06	14.455	193.79	13.41	10.74	14.69	44.23	3.06	116.26	8.04	
Pearl Harb_B22	1307	8/30/2012	12:14:09	14.455	193.86	13.41	10.73	14.70	34.15	2.36	116.18	8.04	
Pearl Harb_B22	1308	8/30/2012	12:14:12	14.455	194.00	13.42	10.74	14.71	44.96	3.11	116.04	8.03	
Pearl Harb_B22	1309	8/30/2012	12:14:15	14.455	194.03	13.42	10.70	14.70	49.67	3.44	116.01	8.03	
Pearl Harb_B22	1310	8/30/2012	12:14:18	14.455	193.54	13.39	10.68	14.70	45.26	3.13	116.50	8.06	
Pearl Harb_B22	1311	8/30/2012	12:14:21	14.455	193.40	13.38	10.66	14.70	48.75	3.37	116.64	8.07	
Pearl Harb_B22	1312	8/30/2012	12:14:24	14.455	192.19	13.30	10.61	14.65	54.14	3.75	117.85	8.15	
Pearl Harb_B22	1313	8/30/2012	12:14:27	14.455	192.27	13.30	10.55	14.65	51.03	3.53	117.77	8.15	
Pearl Harb_B22	1314	8/30/2012	12:14:30	14.455	192.59	13.32	10.59	14.66	69.30	4.79	117.45	8.13	
Pearl Harb_B22	1315	8/30/2012	12:14:33	14.455	192.53	13.32	10.53	14.65	58.88	4.07	117.51	8.13	
Pearl Harb_B22	1316	8/30/2012	12:14:36	14.455	191.13	13.22	10.39	14.59	53.44	3.70	118.91	8.23	several chunks in suspension
Pearl Harb_B22	1317	8/30/2012	12:14:39	14.455	189.61	13.12	10.23	14.50	54.79	3.79	120.43	8.33	
Pearl Harb_B22	1318	8/30/2012	12:14:42	14.455	186.07	12.87	10.10	14.34	71.16	4.92	123.98	8.58	
Pearl Harb_B22	1319	8/30/2012	12:14:45	14.455	184.56	12.77	10.13	14.33	84.86	5.87	125.49	8.68	area on left surface blown out, top "peeling back" a bit; crack more fully opening from top mound from the right down and to the left- several cm long
Pearl Harb_B22	1320	8/30/2012	12:14:48	14.455	182.47	12.62	10.11	14.14	79.60	5.51	127.58	8.83	left side gap now closed
Pearl Harb_B22	1321	8/30/2012	12:14:51	14.455	182.36	12.62	10.11	14.23	51.85	3.59	127.69	8.83	long crack is narrower now, three vertical cracks opening up on right, in area that was a "slump" that has widened
Pearl Harb_B22	1322	8/30/2012	12:14:54	14.455	181.00	12.52	10.09	13.98	75.49	5.22	129.04	8.93	
Pearl Harb_B22	1323	8/30/2012	12:14:57	14.455	181.41	12.55	10.07	14.02	67.68	4.68	128.63	8.90	
Pearl Harb_B22	1324	8/30/2012	12:15:00	14.455	182.21	12.61	9.27	14.10	83.79	5.80	127.84	8.84	
Pearl Harb_B22	1325	8/30/2012	12:15:03	14.455	183.29	12.68	9.41	14.16	73.84	5.11	126.76	8.77	
Pearl Harb_B22	1326	8/30/2012	12:15:06	14.455	183.68	12.71	9.23	14.18	69.54	4.81	126.36	8.74	
Pearl Harb_B22	1327	8/30/2012	12:15:09	14.455	183.40	12.69	9.26	14.18	55.41	3.83	126.64	8.76	
Pearl Harb_B22	1328	8/30/2012	12:15:12	14.455	184.53	12.77	9.33	14.27	72.42	5.01	125.51	8.68	
Pearl Harb_B22	1329	8/30/2012	12:15:15	14.455	184.84	12.79	9.40	14.27	61.34	4.24	125.20	8.66	
Pearl Harb_B22	1330	8/30/2012	12:15:18	14.455	184.37	12.75	9.44	14.27	57.25	3.96	125.67	8.69	area on left of center mound has fallen off toward the back, no longer measured as part of SWI
Pearl Harb_B22	1331	8/30/2012	12:15:21	14.455	184.77	12.78	9.44	14.27	48.49	3.35	125.28	8.67	
Pearl Harb_B22	1332	8/30/2012	12:15:24	14.455	184.07	12.73	9.07	14.35	62.64	4.33	125.97	8.71	right edge- connection from surface to gap below almost completely visible

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	1333	8/30/2012	12:15:27	14.455	184.72	12.78	9.20	14.30	68.20	4.72	125.32	8.67	
Pearl Harb_B22	1334	8/30/2012	12:15:30	14.455	184.98	12.80	9.47	14.32	69.86	4.83	125.06	8.65	
Pearl Harb_B22	1335	8/30/2012	12:15:33	14.455	184.89	12.79	9.45	14.32	60.44	4.18	125.15	8.66	
Pearl Harb_B22	1336	8/30/2012	12:15:36	14.455	184.73	12.78	9.39	14.32	34.67	2.40	125.32	8.67	
Pearl Harb_B22	1337	8/30/2012	12:15:39	14.455	183.81	12.72	9.31	14.28	36.85	2.55	126.23	8.73	
Pearl Harb_B22	1338	8/30/2012	12:15:42	14.455	182.33	12.61	9.12	14.18	62.78	4.34	127.71	8.84	
Pearl Harb_B22	1339	8/30/2012	12:15:45	14.455	181.53	12.56	9.37	14.10	46.11	3.19	128.51	8.89	
Pearl Harb_B22	1340	8/30/2012	12:15:48	14.455	173.77	12.02	9.23	13.52	76.11	5.26	136.27	9.43	
Pearl Harb_B22	1341	8/30/2012	12:15:51	14.455	169.72	11.74	9.26	13.31	64.25	4.44	140.32	9.71	small "cave-in" on middle of mound at the center of right
Pearl Harb_B22	1342	8/30/2012	12:15:54	14.455	175.62	12.15	9.30	13.68	65.22	4.51	134.42	9.30	
Pearl Harb_B22	1343	8/30/2012	12:15:57	14.455	176.17	12.19	8.95	13.69	64.82	4.48	133.87	9.26	
Pearl Harb_B22	1344	8/30/2012	12:16:00	14.455	176.22	12.19	8.91	13.70	59.56	4.12	133.82	9.26	
Pearl Harb_B22	1345	8/30/2012	12:16:03	14.455	177.66	12.29	8.92	13.83	65.14	4.51	132.38	9.16	
Pearl Harb_B22	1346	8/30/2012	12:16:06	14.455	178.03	12.32	9.03	13.87	57.28	3.96	132.01	9.13	
Pearl Harb_B22	1347	8/30/2012	12:16:09	14.455	178.39	12.34	8.97	13.87	54.77	3.79	131.65	9.11	
Pearl Harb_B22	1348	8/30/2012	12:16:12	14.455	178.71	12.36	9.13	13.90	59.83	4.14	131.34	9.09	
Pearl Harb_B22	1349	8/30/2012	12:16:15	14.455	181.13	12.53	9.35	14.04	64.36	4.45	128.92	8.92	
Pearl Harb_B22	1350	8/30/2012	12:16:18	14.455	180.92	12.52	9.25	14.09	63.19	4.37	129.12	8.93	
Pearl Harb_B22	1351	8/30/2012	12:16:21	14.455	180.74	12.50	9.25	14.07	51.83	3.59	129.30	8.95	
Pearl Harb_B22	1352	8/30/2012	12:16:24	14.455	181.71	12.57	9.59	14.11	49.03	3.39	128.34	8.88	center of main mound starting to "crack" apart
Pearl Harb_B22	1353	8/30/2012	12:16:27	14.455	181.58	12.56	9.34	14.11	57.95	4.01	128.46	8.89	
Pearl Harb_B22	1354	8/30/2012	12:16:30	14.455	180.69	12.50	9.25	14.14	80.44	5.57	129.36	8.95	think sus sed on right; likely obscuring part of sediment on right near min pen
Pearl Harb_B22	1355	8/30/2012	12:16:33	14.455	180.82	12.51	9.35	14.11	65.65	4.54	129.22	8.94	
Pearl Harb_B22	1356	8/30/2012	12:16:36	14.455	180.30	12.47	9.35	14.04	61.99	4.29	129.75	8.98	
Pearl Harb_B22	1357	8/30/2012	12:16:39	14.455	178.56	12.35	9.39	14.06	59.53	4.12	131.49	9.10	center of main mound has collapsed
Pearl Harb_B22	1358	8/30/2012	12:16:42	14.455	178.08	12.32	9.31	14.10	63.17	4.37	131.96	9.13	
Pearl Harb_B22	1359	8/30/2012	12:16:45	14.455	175.28	12.13	8.94	14.15	98.75	6.83	134.76	9.32	lots of sus sed, more sed dislodged- one chunk on left; more of right cut away, can almost see the connection to gap below SWI
Pearl Harb_B22	1360	8/30/2012	12:16:48	14.455	168.93	11.69	4.92	13.21	97.11	6.72	141.11	9.76	much sus sed, more sed dislodged; right cut away area connected from SWI to lower down now
Pearl Harb_B22	1361	8/30/2012	12:16:51	14.455	168.15	11.63	4.94	13.15	86.98	6.02	141.89	9.82	less sus sed, less chunks in suspension; one chunk resting on left edge
Pearl Harb_B22	1362	8/30/2012	12:16:54	14.455	166.91	11.55	4.72	13.33	83.73	5.79	143.13	9.90	
Pearl Harb_B22	1363	8/30/2012	12:16:57	14.455	167.47	11.59	4.34	13.45	96.58	6.68	142.57	9.86	lots of sus sed, medium chunks in sus; horizonal cracks throughout the upper couple cm
Pearl Harb_B22	1364	8/30/2012	12:17:00	14.455	148.65	10.28	4.38	12.07	111.59	7.72	161.39	11.17	thick sus sed on left; large chunk in sus on right; entire center/right mound blown off; high point is now to left
Pearl Harb_B22	1365	8/30/2012	12:17:03	14.455	146.99	10.17	4.38	12.03	94.83	6.56	163.05	11.28	
Pearl Harb_B22	1366	8/30/2012	12:17:06	14.455	147.61	10.21	4.51	12.01	85.63	5.92	162.44	11.24	more of middle section eroded
Pearl Harb_B22	1367	8/30/2012	12:17:09	14.455	150.35	10.40	4.44	11.97	89.94	6.22	159.70	11.05	
Pearl Harb_B22	1368	8/30/2012	12:17:12	14.455	147.12	10.18	4.54	12.04	101.46	7.02	162.93	11.27	more of middle eroded
Pearl Harb_B22	1369	8/30/2012	12:17:15	14.455	147.95	10.24	4.53	12.04	96.41	6.67	162.09	11.21	
Pearl Harb_B22	1370	8/30/2012	12:17:18	14.455	148.86	10.30	4.50	12.09	87.00	6.02	161.19	11.15	
Pearl Harb_B22	1371	8/30/2012	12:17:21	14.455	148.79	10.29	4.52	12.16	91.56	6.33	161.25	11.16	
Pearl Harb_B22	1372	8/30/2012	12:17:24	14.455	147.76	10.22	4.52	12.18	95.69	6.62	162.29	11.23	
Pearl Harb_B22	1373	8/30/2012	12:17:27	14.455	148.20	10.25	4.57	12.20	98.59	6.82	161.84	11.20	

BRAVO SPI RESULTS

STATION	REP	DATE	TIME	Calibration Constant	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_B22	1374	8/30/2012	12:17:30	14.455	148.06	10.24	4.57	12.19	99.59	6.89	161.99	11.21	
Pearl Harb_B22	1375	8/30/2012	12:17:33	14.455	148.41	10.27	4.57	12.19	94.22	6.52	161.63	11.18	
Pearl Harb_B22	1376	8/30/2012	12:17:36	14.455	148.24	10.26	4.57	12.17	79.38	5.49	161.80	11.19	
Pearl Harb_B22	1377	8/30/2012	12:17:39	14.455	147.83	10.23	4.54	12.15	96.19	6.65	162.21	11.22	
Pearl Harb_B22	1378	8/30/2012	12:17:42	14.455	147.77	10.22	4.54	12.15	84.14	5.82	162.27	11.23	
Pearl Harb_B22	1379	8/30/2012	12:17:45	14.455	148.33	10.26	4.58	12.20	81.28	5.62	161.71	11.19	
Pearl Harb_B22	1380	8/30/2012	12:17:48	14.455	141.97	9.82	4.56	12.32	95.18	6.58	168.07	11.63	more sed dislodged, esp from left side
Pearl Harb_B22	1381	8/30/2012	12:17:51	14.455	138.82	9.60	4.54	10.80	95.82	6.63	171.22	11.85	more sed dislodged, esp from left side
Pearl Harb_B22	1382	8/30/2012	12:17:54	14.455	136.38	9.43	4.49	10.62	78.62	5.44	173.66	12.01	chunk of sed rolling 'downhill' on right
Pearl Harb_B22	1383	8/30/2012	12:17:57	14.455	135.37	9.36	4.46	10.57	92.52	6.40	174.68	12.08	very large chunk on surface at center
Pearl Harb_B22	1384	8/30/2012	12:18:00	14.455	132.68	9.18	4.48	10.54	116.42	8.05	177.36	12.27	chunk on right near bottom partly gone and obscured too
Pearl Harb_B22	1385	8/30/2012	12:18:03	14.455	133.51	9.24	4.56	10.51	108.11	7.48	176.54	12.21	
Pearl Harb_B22	1386	8/30/2012	12:18:06	14.455	134.31	9.29	4.62	10.66	83.57	5.78	175.73	12.16	more erosion on right edge
Pearl Harb_B22	1387	8/30/2012	12:18:09	14.455	134.65	9.32	4.54	10.70	100.15	6.93	175.39	12.13	
Pearl Harb_B22	1388	8/30/2012	12:18:12	14.455	134.27	9.29	4.54	10.66	94.23	6.52	175.77	12.16	
Pearl Harb_B22	1389	8/30/2012	12:18:15	14.455	127.39	8.81	4.39	10.11	97.79	6.76	182.65	12.64	part of right lower area "bucking" in toward faceplate
Pearl Harb_B22	1390	8/30/2012	12:18:18	14.455	78.06	5.40	1.31	9.54	186.66	12.91	231.99	16.05	**estimate at best; whole area is blown out, SWI mostly obscured
Pearl Harb_B22	1391	8/30/2012	12:18:21	14.455	74.94	5.18	1.31	9.36	157.42	10.89	235.10	16.26	**SWI still obscured in middle
Pearl Harb_B22	1392	8/30/2012	12:18:24	14.455	99.56	6.89	1.42	9.41	148.36	10.26	210.48	14.56	SWI is more visible, still lots of sus sed and chunks of sed in suspension
Pearl Harb_B22	1393	8/30/2012	12:18:27	14.455	97.91	6.77	0.76	9.46	154.05	10.66	212.13	14.68	
Pearl Harb_B22	1394	8/30/2012	12:18:30	14.455	97.57	6.75	1.00	9.71	135.76	9.39	212.48	14.70	part of faceplate side is somewhat sloughing toward the faceplate; very messy
Pearl Harb_B22	1395	8/30/2012	12:18:33	14.455	115.03	7.96	2.05	9.66	102.85	7.12	195.02	13.49	all of SWI now visible, some against faceplate, some more in background; measure forward part as much as possible
Pearl Harb_B22	1396	8/30/2012	12:18:36	14.455	116.90	8.09	2.05	9.66	118.42	8.19	193.15	13.36	
Pearl Harb_B22	1397	8/30/2012	12:18:39	14.455	111.04	7.68	2.04	9.60	129.00	8.92	199.00	13.77	
Pearl Harb_B22	1398	8/30/2012	12:18:42	14.455	111.42	7.71	2.02	9.63	135.28	9.36	198.62	13.74	
Pearl Harb_B22	1399	8/30/2012	12:18:45	14.455	112.54	7.79	2.06	9.69	119.99	8.30	197.50	13.66	
Pearl Harb_B22	1400	8/30/2012	12:18:48	14.455	113.01	7.82	2.06	9.72	142.46	9.86	197.03	13.63	
Pearl Harb_B22	1401	8/30/2012	12:18:51	14.455	114.60	7.93	2.14	9.76	132.55	9.17	195.44	13.52	
Pearl Harb_B22	1402	8/30/2012	12:18:54	14.455	112.68	7.80	1.99	9.74	131.61	9.10	197.36	13.65	crack opening up to right of center near base
Pearl Harb_B22	1403	8/30/2012	12:18:57	14.455	106.84	7.39	2.13	9.69	125.75	8.70	203.20	14.06	many pieces dislodged, some against faceplate, right SWI obscured
Pearl Harb_B22	1404	8/30/2012	12:19:00	14.455	109.60	7.58	1.98	9.95	133.52	9.24	200.45	13.87	
Pearl Harb_B22	1405	8/30/2012	12:19:03	14.455	111.00	7.68	2.30	10.08	112.41	7.78	199.04	13.77	still very messy; some sed slumping a bit on left few cm down; dislodged chunks pressed against faceplate on right
Pearl Harb_B22	1406	8/30/2012	12:19:06	14.455	124.63	8.62	3.62	10.22	113.50	7.85	185.41	12.83	areas that were eroded previously are getting filled in with resettled sed
Pearl Harb_B22	1407	8/30/2012	12:19:09	14.455	124.14	8.59	3.69	10.17	110.12	7.62	185.90	12.86	
Pearl Harb_B22	1408	8/30/2012	12:19:12	14.455	119.47	8.27	3.27	9.94	131.46	9.09	190.57	13.18	more sed chunks accumulated at center
Pearl Harb_B22	1409	8/30/2012	12:19:15	14.455	118.35	8.19	2.72	9.91	122.92	8.50	191.69	13.26	
Pearl Harb_B22	1410	8/30/2012	12:19:18	14.455	118.24	8.18	3.10	9.88	115.72	8.01	191.80	13.27	
Pearl Harb_B22	1411	8/30/2012	12:19:21	14.455	112.52	7.78	2.39	9.93	133.60	9.24	197.52	13.66	some sed at center now eroded or in suspension; SWI obscured on right
Pearl Harb_B22	1412	8/30/2012	12:19:24	14.455	116.46	8.06	2.44	9.96	126.67	8.76	193.58	13.39	center right blowing up a bit- part at surface lifting and separating some; chunks in suspension
Pearl Harb_B22	1413	8/30/2012	12:19:27	14.455	108.55	7.51	2.40	9.87	141.75	9.81	201.50	13.94	much of right side blown up, lots of chunks in suspension
Pearl Harb_B22	1414	8/30/2012	12:19:30	14.455	110.59	7.65	2.34	9.84	124.08	8.58	199.45	13.80	
Pearl Harb_B22	1415	8/30/2012	12:19:33	14.455	102.82	7.11	1.47	9.37	123.99	8.58	207.23	14.34	
Pearl Harb_B22	1416	8/30/2012	12:19:36	14.455	63.47	4.39	0.12	9.63	202.96	14.04	246.57	17.06	thick cloud of sus sed, chunks in sus; SWI on left visible, but not to right of center

BRAVO SPI RESULTS

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Pearl Harb_B22	1417	8/30/2012	12:19:39	14.455	74.31	5.14	0.12	9.33	205.32	14.20	235.73	16.31	thick cloud of sus sed; left SWI blown up, steep slope visible on right side
Pearl Harb_B22	1418	8/30/2012	12:19:42	14.455	65.70	4.55	0.04	7.69	190.96	13.21	244.34	16.90	thick cloud of sus sed; SWI mostly visible
Pearl Harb_B22	1419	8/30/2012	12:19:45	14.455	66.31	4.59	0.03	7.67	204.45	14.14	243.73	16.86	thick cloud of sus sed
Pearl Harb_B22	1420	8/30/2012	12:19:48	14.455	73.75	5.10	0.03	7.71	185.83	12.86	236.29	16.35	
Pearl Harb_B22	1421	8/30/2012	12:19:51	14.455	70.48	4.88	0.03	7.68	179.46	12.41	239.56	16.57	parts of center blown up; chunk on right dislodged, poised to 'roll'
Pearl Harb_B22	1422	8/30/2012	12:19:54	14.455	67.79	4.69	0.03	7.72	177.75	12.30	242.25	16.76	
Pearl Harb_B22	1423	8/30/2012	12:19:57	14.455	67.64	4.68	0.03	7.76	200.04	13.84	242.40	16.77	
Pearl Harb_B22	1424	8/30/2012	12:20:00	14.455	67.21	4.65	0.03	7.71	190.52	13.18	242.83	16.80	
Pearl Harb_B22	1425	8/30/2012	12:20:03	14.455	66.01	4.57	0.03	7.66	204.95	14.18	244.04	16.88	
Pearl Harb_B22	1426	8/30/2012	12:20:06	14.455	69.69	4.82	0.03	7.84	184.51	12.76	240.35	16.63	
Pearl Harb_B22	1427	8/30/2012	12:20:09	14.455	69.95	4.84	0.03	7.80	153.16	10.60	240.09	16.61	
Pearl Harb_B22	1428	8/30/2012	12:20:12	14.455	70.75	4.89	0.03	7.87	179.87	12.44	239.29	16.55	
Pearl Harb_B22	1429	8/30/2012	12:20:15	14.455	69.25	4.79	0.03	7.83	181.92	12.59	240.79	16.66	
Pearl Harb_B22	1430	8/30/2012	12:20:18	14.455	69.71	4.82	0.03	7.85	152.62	10.56	240.34	16.63	
Pearl Harb_B22	1431	8/30/2012	12:20:21	14.455	70.14	4.85	0.03	7.85	83.82	5.80	239.90	16.60	
Pearl Harb_B22	1432	8/30/2012	12:20:24	14.455	70.09	4.85	0.03	7.82	83.99	5.81	239.95	16.60	
Pearl Harb_B22	1433	8/30/2012	12:20:27	14.455	68.51	4.74	0.03	7.92	99.67	6.90	241.53	16.71	
Pearl Harb_B22	1434	8/30/2012	12:20:30	14.455	68.58	4.74	0.03	7.85	94.48	6.54	241.46	16.70	
Pearl Harb_B22	1435	8/30/2012	12:20:33	14.455	69.36	4.80	0.03	7.83	85.77	5.93	240.68	16.65	
Pearl Harb_B22	1436	8/30/2012	12:20:36	14.455	69.20	4.79	0.03	7.85	100.12	6.93	240.84	16.66	
Pearl Harb_B22	1437	8/30/2012	12:20:39	14.455	69.08	4.78	0.03	7.82	63.30	4.38	240.96	16.67	
Pearl Harb_B22	1438	8/30/2012	12:20:42	14.455	69.14	4.78	0.03	7.81	96.60	6.68	240.91	16.67	
Pearl Harb_B22	1439	8/30/2012	12:20:45	14.455	69.11	4.78	0.03	7.80	66.84	4.62	240.94	16.67	
Pearl Harb_B22	1440	8/30/2012	12:20:48	14.455	69.18	4.79	0.03	7.82	115.37	7.98	240.86	16.66	
Pearl Harb_B22	1441	8/30/2012	12:20:51	14.455	68.60	4.75	0.03	7.85	173.28	11.99	241.44	16.70	thick sus sed
Pearl Harb_B22	1442	8/30/2012	12:20:54	14.455	68.77	4.76	0.03	7.79	158.61	10.97	241.27	16.69	thick sus sed; more sed sloughing toward faceplate to left of center
Pearl Harb_B22	1443	8/30/2012	12:20:57	14.455	69.07	4.78	0.03	7.79	148.01	10.24	240.97	16.67	
Pearl Harb_B22	1444	8/30/2012	12:21:00	14.455	69.20	4.79	0.03	7.81	115.00	7.96	240.84	16.66	
Pearl Harb_B22	1445	8/30/2012	12:21:03	14.455	69.18	4.79	0.03	7.81	130.87	9.05	240.86	16.66	
Pearl Harb_B22	1446	8/30/2012	12:21:06	14.455	68.74	4.76	0.03	7.77	125.49	8.68	241.31	16.69	
Pearl Harb_B22	1447	8/30/2012	12:21:09	14.455	68.98	4.77	0.03	7.82	124.29	8.60	241.06	16.68	
Pearl Harb_B22	1448	8/30/2012	12:21:12	14.455	69.02	4.77	0.03	7.79	121.63	8.41	241.02	16.67	
Pearl Harb_B22	1449	8/30/2012	12:21:15	14.455	68.59	4.75	0.03	7.75	119.46	8.26	241.45	16.70	
Pearl Harb_B22	1450	8/30/2012	12:21:18	14.455	66.48	4.60	0.03	7.61	125.13	8.66	243.56	16.85	
Pearl Harb_B22	1451	8/30/2012	12:21:21	14.455	62.13	4.30	0.03	7.59	184.21	12.74	247.92	17.15	thick cloud of sus sed; eroded section middle left
Pearl Harb_B22	1452	8/30/2012	12:21:24	14.455	66.34	4.59	0.03	7.67	208.46	14.42	243.71	16.86	thick cloud of sus sed
Pearl Harb_B22	1453	8/30/2012	12:21:27	14.455	68.58	4.74	0.03	7.77	150.46	10.41	241.46	16.70	two very large chunks on surface on left
Pearl Harb_B22	1454	8/30/2012	12:21:30	14.455	69.17	4.78	0.03	7.80	162.92	11.27	240.88	16.66	small chunk on left surface; sed still sloughing toward faceplate
Pearl Harb_B22	1455	8/30/2012	12:21:33	14.455	69.67	4.82	0.03	7.93	153.74	10.64	240.37	16.63	
Pearl Harb_B22	1456	8/30/2012	12:21:36	14.455	70.89	4.90	0.03	7.92	168.46	11.65	239.16	16.54	
Pearl Harb_B22	1457	8/30/2012	12:21:39	14.455	71.11	4.92	0.03	7.91	152.74	10.57	238.93	16.53	
Pearl Harb_B22	1458	8/30/2012	12:21:42	14.455	70.68	4.89	0.03	7.92	137.62	9.52	239.36	16.56	
Pearl Harb_B22	1459	8/30/2012	12:21:45	14.455	70.62	4.89	0.03	7.91	109.76	7.59	239.42	16.56	

BRAVO SPI RESULTS

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Pearl Harb_B22	1460	8/30/2012	12:21:48	14.455	70.48	4.88	0.03	7.94	116.90	8.09	239.56	16.57	
Pearl Harb_B22	1461	8/30/2012	12:21:51	14.455	70.81	4.90	0.03	7.98	67.48	4.67	239.24	16.55	
Pearl Harb_B22	1462	8/30/2012	12:21:54	14.455	71.41	4.94	0.03	7.96	64.99	4.50	238.64	16.51	
Pearl Harb_B22	1463	8/30/2012	12:21:57	14.455	71.48	4.95	0.03	7.96	84.84	5.87	238.56	16.50	little bit of sed has resettled on surface, so pen depth has gone up a little bit
Pearl Harb_B22	1464	8/30/2012	12:22:00	14.455	71.45	4.94	0.03	7.89	76.25	5.27	238.60	16.51	
Pearl Harb_B22	1465	8/30/2012	12:22:03	14.455	71.45	4.94	0.03	7.94	75.87	5.25	238.60	16.51	
Pearl Harb_B22	1466	8/30/2012	12:22:06	14.455	71.49	4.95	0.03	7.96	103.14	7.14	238.55	16.50	
Pearl Harb_B22	1467	8/30/2012	12:22:09	14.455	72.20	4.99	0.03	7.96	107.59	7.44	237.84	16.45	
Pearl Harb_B22	1468	8/30/2012	12:22:12	14.455	71.99	4.98	0.03	7.95	117.42	8.12	238.05	16.47	
Pearl Harb_B22	1469	8/30/2012	12:22:15	14.455	72.26	5.00	0.03	8.00	134.77	9.32	237.78	16.45	
Pearl Harb_B22	1470	8/30/2012	12:22:18	14.455	71.94	4.98	0.03	7.97	124.81	8.63	238.11	16.47	
Pearl Harb_B22	1471	8/30/2012	12:22:21	14.455	71.93	4.98	0.03	7.99	86.85	6.01	238.11	16.47	
Pearl Harb_B22	1472	8/30/2012	12:22:24	14.455	71.47	4.94	0.03	7.93	84.71	5.86	238.57	16.50	
Pearl Harb_B22	1473	8/30/2012	12:22:27	14.455	71.38	4.94	0.03	8.00	111.07	7.68	238.66	16.51	
Pearl Harb_B22	1474	8/30/2012	12:22:30	14.455	74.63	5.16	0.03	8.08	103.74	7.18	235.41	16.29	
Pearl Harb_B22	1475	8/30/2012	12:22:33	14.455	72.89	5.04	0.03	8.02	156.59	10.83	237.15	16.41	part of middle blown up- chunks on surface and large ones in suspension
Pearl Harb_B22	1476	8/30/2012	12:22:36	14.455	70.95	4.91	0.03	7.80	184.94	12.79	239.09	16.54	thick cloud of sus sed; chunks in suspension
Pearl Harb_B22	1477	8/30/2012	12:22:39	14.455	70.60	4.88	0.03	7.84	169.33	11.71	239.44	16.56	
Pearl Harb_B22	1478	8/30/2012	12:22:42	14.455	71.77	4.97	0.03	7.97	160.18	11.08	238.27	16.48	
Pearl Harb_B22	1479	8/30/2012	12:22:45	14.455	70.22	4.86	0.03	7.96	131.86	9.12	239.82	16.59	
Pearl Harb_B22	1480	8/30/2012	12:22:48	14.455	66.31	4.59	0.03	8.02	167.87	11.61	243.73	16.86	
Pearl Harb_B22	1481	8/30/2012	12:22:51	14.455	65.53	4.53	0.03	8.00	145.81	10.09	244.51	16.92	
Pearl Harb_B22	1482	8/30/2012	12:22:54	14.455	66.58	4.61	0.03	8.06	115.51	7.99	243.46	16.84	
Pearl Harb_B22	1483	8/30/2012	12:22:57	14.455	66.56	4.60	0.03	8.08	140.00	9.69	243.49	16.84	
Pearl Harb_B22	1484	8/30/2012	12:23:00	14.455	66.80	4.62	0.03	8.08	134.00	9.27	243.24	16.83	
Pearl Harb_B22	1485	8/30/2012	12:23:03	14.455	66.64	4.61	0.03	8.11	108.28	7.49	243.41	16.84	
Pearl Harb_B22	1486	8/30/2012	12:23:06	14.455	67.00	4.63	0.03	8.13	75.19	5.20	243.05	16.81	
Pearl Harb_B22	1487	8/30/2012	12:23:09	14.455	67.07	4.64	0.03	8.10	108.35	7.50	242.97	16.81	
Pearl Harb_B22	1488	8/30/2012	12:23:12	14.455	67.46	4.67	0.03	8.11	77.32	5.35	242.59	16.78	
Pearl Harb_B22	1489	8/30/2012	12:23:15	14.455	68.89	4.77	0.03	8.20	77.47	5.36	241.16	16.68	
Pearl Harb_B22	1490	8/30/2012	12:23:18	14.455	70.31	4.86	0.03	8.24	74.89	5.18	239.73	16.58	
Pearl Harb_B22	1491	8/30/2012	12:23:21	14.455	70.26	4.86	0.03	8.29	79.37	5.49	239.78	16.59	
Pearl Harb_B22	1492	8/30/2012	12:23:24	14.455	70.38	4.87	0.03	8.24	65.71	4.55	239.66	16.58	
Pearl Harb_B22	1493	8/30/2012	12:23:27	14.455	70.35	4.87	0.03	8.24	67.12	4.64	239.69	16.58	
Pearl Harb_B22	1494	8/30/2012	12:23:30	14.455	70.40	4.87	0.03	8.24	57.00	3.94	239.64	16.58	
Pearl Harb_B22	1495	8/30/2012	12:23:33	14.455	70.67	4.89	0.03	8.25	30.07	2.08	239.37	16.56	
Pearl Harb_B22	1496	8/30/2012	12:23:36	14.455	70.59	4.88	0.03	8.25	39.57	2.74	239.45	16.57	
Pearl Harb_B22	1497	8/30/2012	12:23:39	14.455	70.58	4.88	0.03	8.28	44.75	3.10	239.46	16.57	
Pearl Harb_B22	1498	8/30/2012	12:23:42	14.455	70.76	4.90	0.03	8.30	31.92	2.21	239.28	16.55	crustacean- some kind of shrimp- on surface at far left
Pearl Harb_B22	1499	8/30/2012	12:23:45	14.455	70.73	4.89	0.03	8.26	36.52	2.53	239.32	16.56	shrimp walking on surface twd center
Pearl Harb_B22	1500	8/30/2012	12:23:48	14.455	71.29	4.93	0.03	8.33	35.18	2.43	238.76	16.52	shrimp now at center

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STATION	REP	DATE	TIME	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Sus Sed Area (sq.cm)	Sus Sed (cm)	Area of Water Visible (sq cm)	Water Visible (cm)	COMMENT
Pearl Harb_O2	137	8/30/2012	14:04:00	241.81	16.73	14.96	18.48	5.65	0.39	68.23	4.72	
Pearl Harb_O2	237	8/30/2012	14:09:00	241.49	16.71	14.93	18.44	3.95	0.27	68.55	4.74	rope in view on left
Pearl Harb_O2	337	8/30/2012	14:14:00	241.3	16.69	14.96	18.44	1.69	0.12	68.74	4.76	
Pearl Harb_O2	340	8/30/2012	14:14:09	241.36	16.70	14.93	18.45	1.43	0.10	68.68	4.75	
Pearl Harb_O2	343	8/30/2012	14:14:18	241.32	16.69	14.96	18.41	1.18	0.08	68.72	4.75	
Pearl Harb_O2	346	8/30/2012	14:14:27	241.31	16.69	14.95	18.45	1.75	0.12	68.73	4.75	
Pearl Harb_O2	349	8/30/2012	14:14:36	241.28	16.69	14.96	18.45	1.26	0.09	68.76	4.76	
Pearl Harb_O2	352	8/30/2012	14:14:45	241.25	16.69	14.96	18.45	1.08	0.08	68.79	4.76	
Pearl Harb_O2	355	8/30/2012	14:14:54	241.19	16.69	14.96	18.43	1.01	0.07	68.85	4.76	
Pearl Harb_O2	358	8/30/2012	14:15:03	241.17	16.68	14.95	18.43	1.06	0.07	68.87	4.76	
Pearl Harb_O2	361	8/30/2012	14:15:12	241.2	16.69	14.96	18.43	1.20	0.08	68.85	4.76	rope is now out of view; progressively moved out of view over last images
Pearl Harb_O2	364	8/30/2012	14:15:21	241.15	16.68	14.95	18.43	1.17	0.08	68.89	4.77	
Pearl Harb_O2	367	8/30/2012	14:15:30	241.22	16.69	14.96	18.43	0.88	0.06	68.83	4.76	
Pearl Harb_O2	370	8/30/2012	14:15:39	241.22	16.69	14.96	18.43	0.49	0.03	68.82	4.76	
Pearl Harb_O2	373	8/30/2012	14:15:48	241.14	16.68	14.95	18.43	0.54	0.04	68.90	4.77	
Pearl Harb_O2	376	8/30/2012	14:15:57	241.2	16.69	14.95	18.43	0.55	0.04	68.84	4.76	
Pearl Harb_O2	379	8/30/2012	14:16:06	241.21	16.69	14.94	18.43	0.77	0.05	68.83	4.76	
Pearl Harb_O2	382	8/30/2012	14:16:15	241.19	16.69	14.93	18.43	0.82	0.06	68.85	4.76	
Pearl Harb_O2	385	8/30/2012	14:16:24	241.15	16.68	14.93	18.43	1.08	0.07	68.89	4.77	
Pearl Harb_O2	388	8/30/2012	14:16:33	240.96	16.67	14.89	18.43	4.96	0.34	69.08	4.78	
Pearl Harb_O2	391	8/30/2012	14:16:42	240.82	16.66	14.88	18.42	11.56	0.80	69.22	4.79	
Pearl Harb_O2	394	8/30/2012	14:16:51	240.5	16.64	14.85	18.39	25.90	1.79	69.54	4.81	
Pearl Harb_O2	397	8/30/2012	14:17:00	240.28	16.62	14.84	18.38	17.41	1.20	69.76	4.83	
Pearl Harb_O2	400	8/30/2012	14:17:09	240.19	16.62	14.82	18.37	4.11	0.28	69.85	4.83	
Pearl Harb_O2	403	8/30/2012	14:17:18	240.15	16.61	14.81	18.37	3.37	0.23	69.89	4.84	
Pearl Harb_O2	406	8/30/2012	14:17:27	240.12	16.61	14.83	18.37	0.82	0.06	69.92	4.84	
Pearl Harb_O2	409	8/30/2012	14:17:36	240.06	16.61	14.82	18.37	1.37	0.09	69.98	4.84	
Pearl Harb_O2	412	8/30/2012	14:17:45	239.48	16.57	14.71	18.33	9.79	0.68	70.56	4.88	
Pearl Harb_O2	415	8/30/2012	14:17:54	239.17	16.55	14.75	18.29	25.26	1.75	70.87	4.90	
Pearl Harb_O2	418	8/30/2012	14:18:03	239.28	16.55	14.76	18.29	30.98	2.14	70.77	4.90	
Pearl Harb_O2	421	8/30/2012	14:18:12	239.27	16.55	14.76	18.27	8.52	0.59	70.77	4.90	
Pearl Harb_O2	424	8/30/2012	14:18:21	239.26	16.55	14.80	18.27	3.16	0.22	70.79	4.90	
Pearl Harb_O2	427	8/30/2012	14:18:30	239.19	16.55	14.80	18.26	5.97	0.41	70.85	4.90	
Pearl Harb_O2	430	8/30/2012	14:18:39	239.17	16.55	14.80	18.27	3.34	0.23	70.87	4.90	
Pearl Harb_O2	433	8/30/2012	14:18:48	239.14	16.54	14.76	18.28	3.62	0.25	70.90	4.90	
Pearl Harb_O2	436	8/30/2012	14:18:57	239.04	16.54	14.76	18.25	4.12	0.29	71.01	4.91	
Pearl Harb_O2	439	8/30/2012	14:19:06	239.07	16.54	14.76	18.25	2.36	0.16	70.97	4.91	
Pearl Harb_O2	442	8/30/2012	14:19:15	239.04	16.54	14.76	18.25	2.17	0.15	71.01	4.91	
Pearl Harb_O2	445	8/30/2012	14:19:24	239.01	16.54	14.76	18.24	2.81	0.19	71.03	4.91	
Pearl Harb_O2	448	8/30/2012	14:19:33	238.83	16.52	14.73	18.22	2.34	0.16	71.21	4.93	
Pearl Harb_O2	451	8/30/2012	14:19:42	238.25	16.48	14.70	18.18	2.16	0.15	71.79	4.97	
Pearl Harb_O2	454	8/30/2012	14:19:51	238.04	16.47	14.71	18.19	2.32	0.16	72.00	4.98	

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Pearl Harb_O2	457	8/30/2012	14:20:00	237.85	16.45	14.69	18.16	2.03	0.14	72.20	4.99	
Pearl Harb_O2	460	8/30/2012	14:20:09	237.54	16.43	14.65	18.15	2.75	0.19	72.51	5.02	
Pearl Harb_O2	463	8/30/2012	14:20:18	237.33	16.42	14.63	18.14	4.00	0.28	72.71	5.03	
Pearl Harb_O2	466	8/30/2012	14:20:27	237.36	16.42	14.65	18.14	2.91	0.20	72.68	5.03	
Pearl Harb_O2	469	8/30/2012	14:20:36	237.48	16.43	14.67	18.14	3.44	0.24	72.56	5.02	
Pearl Harb_O2	472	8/30/2012	14:20:45	237.67	16.44	14.69	18.16	2.78	0.19	72.38	5.01	
Pearl Harb_O2	475	8/30/2012	14:20:54	237.56	16.43	14.67	18.16	1.56	0.11	72.48	5.01	
Pearl Harb_O2	478	8/30/2012	14:21:03	237.52	16.43	14.67	18.15	3.16	0.22	72.52	5.02	
Pearl Harb_O2	481	8/30/2012	14:21:12	237.56	16.43	14.67	18.17	1.67	0.12	72.48	5.01	
Pearl Harb_O2	484	8/30/2012	14:21:21	237.68	16.44	14.67	18.17	1.82	0.13	72.36	5.01	
Pearl Harb_O2	487	8/30/2012	14:21:30	237.7	16.44	14.67	18.16	1.14	0.08	72.34	5.00	
Pearl Harb_O2	490	8/30/2012	14:21:39	237.76	16.45	14.68	18.16	1.59	0.11	72.28	5.00	
Pearl Harb_O2	493	8/30/2012	14:21:48	237.71	16.44	14.69	18.17	2.01	0.14	72.33	5.00	
Pearl Harb_O2	496	8/30/2012	14:21:57	237.65	16.44	14.67	18.17	3.79	0.26	72.39	5.01	
Pearl Harb_O2	499	8/30/2012	14:22:06	237.58	16.44	14.67	18.16	3.39	0.23	72.46	5.01	
Pearl Harb_O2	502	8/30/2012	14:22:15	237.54	16.43	14.68	18.17	3.51	0.24	72.50	5.02	
Pearl Harb_O2	505	8/30/2012	14:22:24	237.62	16.44	14.68	18.17	3.80	0.26	72.43	5.01	
Pearl Harb_O2	508	8/30/2012	14:22:33	237.49	16.43	14.68	18.16	3.52	0.24	72.56	5.02	
Pearl Harb_O2	511	8/30/2012	14:22:42	237.45	16.43	14.66	18.16	3.61	0.25	72.59	5.02	
Pearl Harb_O2	514	8/30/2012	14:22:51	237.48	16.43	14.65	18.16	4.70	0.32	72.56	5.02	
Pearl Harb_O2	517	8/30/2012	14:23:00	237.55	16.43	14.65	18.16	6.32	0.44	72.49	5.01	
Pearl Harb_O2	520	8/30/2012	14:23:09	237.53	16.43	14.66	18.16	3.08	0.21	72.51	5.02	
Pearl Harb_O2	523	8/30/2012	14:23:18	237.57	16.43	14.66	18.17	4.25	0.29	72.48	5.01	
Pearl Harb_O2	526	8/30/2012	14:23:27	237.63	16.44	14.65	18.18	2.41	0.17	72.41	5.01	
Pearl Harb_O2	529	8/30/2012	14:23:36	237.67	16.44	14.68	18.17	2.47	0.17	72.37	5.01	
Pearl Harb_O2	532	8/30/2012	14:23:45	237.65	16.44	14.66	18.16	2.76	0.19	72.39	5.01	
Pearl Harb_O2	535	8/30/2012	14:23:54	237.68	16.44	14.66	18.16	2.37	0.16	72.36	5.01	
Pearl Harb_O2	538	8/30/2012	14:24:03	237.73	16.45	14.67	18.17	3.05	0.21	72.31	5.00	
Pearl Harb_O2	541	8/30/2012	14:24:12	237.69	16.44	14.66	18.17	2.72	0.19	72.35	5.01	
Pearl Harb_O2	544	8/30/2012	14:24:21	237.69	16.44	14.67	18.17	3.68	0.25	72.35	5.01	
Pearl Harb_O2	547	8/30/2012	14:24:30	237.74	16.45	14.66	18.17	3.09	0.21	72.30	5.00	
Pearl Harb_O2	550	8/30/2012	14:24:39	237.76	16.45	14.67	18.17	2.12	0.15	72.28	5.00	
Pearl Harb_O2	553	8/30/2012	14:24:48	237.86	16.46	14.68	18.17	3.39	0.23	72.18	4.99	
Pearl Harb_O2	556	8/30/2012	14:24:57	237.9	16.46	14.67	18.17	1.20	0.08	72.14	4.99	
Pearl Harb_O2	559	8/30/2012	14:25:06	237.89	16.46	14.67	18.17	2.50	0.17	72.15	4.99	
Pearl Harb_O2	562	8/30/2012	14:25:15	237.84	16.45	14.66	18.16	1.81	0.12	72.20	5.00	
Pearl Harb_O2	565	8/30/2012	14:25:24	237.85	16.45	14.67	18.17	2.41	0.17	72.19	4.99	
Pearl Harb_O2	568	8/30/2012	14:25:33	237.96	16.46	14.67	18.17	1.84	0.13	72.08	4.99	
Pearl Harb_O2	571	8/30/2012	14:25:42	237.89	16.46	14.66	18.17	2.48	0.17	72.16	4.99	
Pearl Harb_O2	574	8/30/2012	14:25:51	237.92	16.46	14.65	18.17	3.34	0.23	72.12	4.99	
Pearl Harb_O2	577	8/30/2012	14:26:00	237.88	16.46	14.65	18.17	3.30	0.23	72.16	4.99	
Pearl Harb_O2	580	8/30/2012	14:26:09	237.86	16.46	14.65	18.18	3.16	0.22	72.18	4.99	
Pearl Harb_O2	583	8/30/2012	14:26:18	237.77	16.45	14.65	18.17	7.71	0.53	72.28	5.00	
Pearl Harb_O2	586	8/30/2012	14:26:27	237.78	16.45	14.65	18.16	3.66	0.25	72.26	5.00	
Pearl Harb_O2	589	8/30/2012	14:26:36	237.78	16.45	14.66	18.17	4.03	0.28	72.26	5.00	
Pearl Harb_O2	592	8/30/2012	14:26:45	237.79	16.45	14.67	18.17	6.78	0.47	72.26	5.00	

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Pearl Harb_O2	595	8/30/2012	14:26:54	237.8	16.45	14.67	18.16	3.14	0.22	72.24	5.00	
Pearl Harb_O2	598	8/30/2012	14:27:03	237.88	16.46	14.69	18.17	2.49	0.17	72.16	4.99	
Pearl Harb_O2	601	8/30/2012	14:27:12	237.93	16.46	14.69	18.18	2.66	0.18	72.11	4.99	
Pearl Harb_O2	604	8/30/2012	14:27:21	237.92	16.46	14.68	18.17	1.92	0.13	72.13	4.99	
Pearl Harb_O2	607	8/30/2012	14:27:30	237.89	16.46	14.67	18.17	2.56	0.18	72.15	4.99	
Pearl Harb_O2	610	8/30/2012	14:27:39	237.86	16.46	14.68	18.18	1.39	0.10	72.18	4.99	
Pearl Harb_O2	613	8/30/2012	14:27:48	237.88	16.46	14.67	18.18	2.49	0.17	72.17	4.99	
Pearl Harb_O2	616	8/30/2012	14:27:57	237.74	16.45	14.68	18.18	2.13	0.15	72.31	5.00	
Pearl Harb_O2	619	8/30/2012	14:28:06	237.56	16.43	14.69	18.18	2.41	0.17	72.48	5.01	
Pearl Harb_O2	622	8/30/2012	14:28:15	237.57	16.43	14.67	18.16	1.48	0.10	72.48	5.01	
Pearl Harb_O2	625	8/30/2012	14:28:24	237.53	16.43	14.67	18.17	3.48	0.24	72.52	5.02	
Pearl Harb_O2	628	8/30/2012	14:28:33	237.57	16.44	14.68	18.17	2.50	0.17	72.47	5.01	
Pearl Harb_O2	631	8/30/2012	14:28:42	237.53	16.43	14.67	18.17	0.56	0.04	72.51	5.02	
Pearl Harb_O2	634	8/30/2012	14:28:51	237.68	16.44	14.68	18.17	0.97	0.07	72.36	5.01	
Pearl Harb_O2	637	8/30/2012	14:29:00	237.66	16.44	14.68	18.18	1.41	0.10	72.38	5.01	
Pearl Harb_O2	640	8/30/2012	14:29:09	237.44	16.43	14.67	18.16	0.85	0.06	72.61	5.02	
Pearl Harb_O2	643	8/30/2012	14:29:18	237.51	16.43	14.67	18.17	1.03	0.07	72.53	5.02	
Pearl Harb_O2	646	8/30/2012	14:29:27	237.47	16.43	14.67	18.16	1.32	0.09	72.58	5.02	
Pearl Harb_O2	649	8/30/2012	14:29:36	237.43	16.43	14.67	18.16	2.51	0.17	72.61	5.02	
Pearl Harb_O2	652	8/30/2012	14:29:45	237.47	16.43	14.67	18.17	1.84	0.13	72.57	5.02	
Pearl Harb_O2	655	8/30/2012	14:29:54	237.41	16.42	14.67	18.18	1.10	0.08	72.63	5.02	
Pearl Harb_O2	658	8/30/2012	14:30:03	237.38	16.42	14.67	18.18	1.67	0.12	72.67	5.03	
Pearl Harb_O2	661	8/30/2012	14:30:12	237.34	16.42	14.65	18.18	2.55	0.18	72.70	5.03	
Pearl Harb_O2	664	8/30/2012	14:30:21	237.4	16.42	14.66	18.18	2.00	0.14	72.64	5.03	
Pearl Harb_O2	667	8/30/2012	14:30:30	237.4	16.42	14.67	18.18	1.89	0.13	72.64	5.03	
Pearl Harb_O2	670	8/30/2012	14:30:39	237.75	16.45	14.67	18.18	1.32	0.09	72.29	5.00	
Pearl Harb_O2	673	8/30/2012	14:30:48	237.79	16.45	14.68	18.20	1.81	0.13	72.25	5.00	
Pearl Harb_O2	676	8/30/2012	14:30:57	237.76	16.45	14.69	18.20	2.32	0.16	72.28	5.00	
Pearl Harb_O2	679	8/30/2012	14:31:06	237.65	16.44	14.68	18.18	1.12	0.08	72.39	5.01	
Pearl Harb_O2	682	8/30/2012	14:31:15	237.56	16.43	14.68	18.18	1.19	0.08	72.48	5.01	
Pearl Harb_O2	685	8/30/2012	14:31:24	237.56	16.43	14.67	18.19	2.21	0.15	72.48	5.01	
Pearl Harb_O2	688	8/30/2012	14:31:33	237.45	16.43	14.67	18.17	1.73	0.12	72.59	5.02	
Pearl Harb_O2	691	8/30/2012	14:31:42	237.46	16.43	14.66	18.17	0.76	0.05	72.59	5.02	
Pearl Harb_O2	694	8/30/2012	14:31:51	237.29	16.42	14.65	18.15	1.79	0.12	72.75	5.03	
Pearl Harb_O2	697	8/30/2012	14:32:00	237.24	16.41	14.64	18.16	0.62	0.04	72.81	5.04	
Pearl Harb_O2	700	8/30/2012	14:32:09	236.98	16.39	14.63	18.14	0.85	0.06	73.06	5.05	
Pearl Harb_O2	703	8/30/2012	14:32:18	236.8	16.38	14.63	18.13	1.76	0.12	73.24	5.07	
Pearl Harb_O2	706	8/30/2012	14:32:27	236.9	16.39	14.64	18.14	1.28	0.09	73.14	5.06	
Pearl Harb_O2	709	8/30/2012	14:32:36	236.63	16.37	14.62	18.12	1.64	0.11	73.41	5.08	
Pearl Harb_O2	712	8/30/2012	14:32:45	236.5	16.36	14.62	18.12	2.23	0.15	73.54	5.09	
Pearl Harb_O2	715	8/30/2012	14:32:54	236.38	16.35	14.61	18.11	2.61	0.18	73.66	5.10	
Pearl Harb_O2	718	8/30/2012	14:33:03	236.35	16.35	14.60	18.10	1.34	0.09	73.69	5.10	
Pearl Harb_O2	721	8/30/2012	14:33:12	236.25	16.34	14.59	18.10	0.80	0.06	73.80	5.11	
Pearl Harb_O2	724	8/30/2012	14:33:21	236.23	16.34	14.58	18.10	0.81	0.06	73.81	5.11	
Pearl Harb_O2	727	8/30/2012	14:33:30	236.36	16.35	14.61	18.12	1.05	0.07	73.68	5.10	
Pearl Harb_O2	730	8/30/2012	14:33:39	236.58	16.37	14.62	18.12	1.41	0.10	73.46	5.08	

Pearl Harb_O2	733	8/30/2012	14:33:48	236.57	16.37	14.61	18.11	1.23	0.09	73.47	5.08	
Pearl Harb_O2	736	8/30/2012	14:33:57	236.47	16.36	14.61	18.10	1.83	0.13	73.57	5.09	
Pearl Harb_O2	739	8/30/2012	14:34:06	236.53	16.36	14.62	18.11	1.54	0.11	73.51	5.09	
Pearl Harb_O2	742	8/30/2012	14:34:15	236.5	16.36	14.60	18.11	1.30	0.09	73.54	5.09	
Pearl Harb_O2	745	8/30/2012	14:34:24	236.48	16.36	14.61	18.11	0.97	0.07	73.56	5.09	
Pearl Harb_O2	748	8/30/2012	14:34:33	236.48	16.36	14.61	18.10	1.81	0.13	73.56	5.09	
Pearl Harb_O2	751	8/30/2012	14:34:42	236.4	16.35	14.60	18.10	1.56	0.11	73.65	5.09	
Pearl Harb_O2	754	8/30/2012	14:34:51	236.46	16.36	14.60	18.11	1.38	0.10	73.59	5.09	
Pearl Harb_O2	757	8/30/2012	14:35:00	236.46	16.36	14.61	18.11	2.80	0.19	73.58	5.09	
Pearl Harb_O2	760	8/30/2012	14:35:09	236.43	16.36	14.60	18.12	1.87	0.13	73.61	5.09	
Pearl Harb_O2	763	8/30/2012	14:35:18	236.44	16.36	14.61	18.12	2.08	0.14	73.60	5.09	
Pearl Harb_O2	766	8/30/2012	14:35:27	236.44	16.36	14.61	18.12	2.81	0.19	73.60	5.09	
Pearl Harb_O2	769	8/30/2012	14:35:36	236.64	16.37	14.64	18.10	2.95	0.20	73.40	5.08	
Pearl Harb_O2	772	8/30/2012	14:35:45	236.65	16.37	14.62	18.11	1.98	0.14	73.39	5.08	
Pearl Harb_O2	775	8/30/2012	14:35:54	236.42	16.36	14.61	18.11	3.53	0.24	73.62	5.09	
Pearl Harb_O2	778	8/30/2012	14:36:03	236.29	16.35	14.61	18.09	17.02	1.18	73.76	5.10	
Pearl Harb_O2	781	8/30/2012	14:36:12	236.22	16.34	14.59	18.12	10.69	0.74	73.82	5.11	
Pearl Harb_O2	784	8/30/2012	14:36:21	236.15	16.34	14.58	18.12	1.84	0.13	73.89	5.11	
Pearl Harb_O2	787	8/30/2012	14:36:30	236.12	16.33	14.58	18.10	2.10	0.15	73.92	5.11	
Pearl Harb_O2	790	8/30/2012	14:36:39	236.11	16.33	14.58	18.10	2.99	0.21	73.93	5.11	
Pearl Harb_O2	793	8/30/2012	14:36:48	235.77	16.31	14.61	18.06	2.84	0.20	74.27	5.14	
Pearl Harb_O2	796	8/30/2012	14:36:57	235.79	16.31	14.61	18.03	21.94	1.52	74.25	5.14	
Pearl Harb_O2	799	8/30/2012	14:37:06	236.12	16.33	14.64	18.09	15.12	1.05	73.92	5.11	
Pearl Harb_O2	802	8/30/2012	14:37:15	236.34	16.35	14.62	18.12	14.70	1.02	73.70	5.10	
Pearl Harb_O2	805	8/30/2012	14:37:24	236.29	16.35	14.62	18.12	8.40	0.58	73.75	5.10	
Pearl Harb_O2	808	8/30/2012	14:37:33	236.27	16.34	14.65	18.11	18.17	1.26	73.78	5.10	
Pearl Harb_O2	811	8/30/2012	14:37:42	236.45	16.36	14.65	18.12	3.83	0.27	73.59	5.09	
Pearl Harb_O2	814	8/30/2012	14:37:51	236.29	16.35	14.68	18.06	12.74	0.88	73.76	5.10	
Pearl Harb_O2	817	8/30/2012	14:38:00	236.45	16.36	14.69	18.11	10.41	0.72	73.59	5.09	
Pearl Harb_O2	820	8/30/2012	14:38:09	236.46	16.36	14.70	18.13	6.69	0.46	73.58	5.09	hint of red on the left (later proves to be large crab)
Pearl Harb_O2	823	8/30/2012	14:38:18	236.42	16.36	14.69	18.13	24.16	1.67	73.62	5.09	
Pearl Harb_O2	826	8/30/2012	14:38:27	236.21	16.34	14.69	18.13	19.61	1.36	73.83	5.11	
Pearl Harb_O2	829	8/30/2012	14:38:36	235.94	16.32	14.67	18.10	2.62	0.18	74.10	5.13	
Pearl Harb_O2	832	8/30/2012	14:38:45	235.64	16.30	14.66	17.99	1.84	0.13	74.40	5.15	
Pearl Harb_O2	835	8/30/2012	14:38:54	235.68	16.30	14.67	18.03	3.76	0.26	74.37	5.14	
Pearl Harb_O2	838	8/30/2012	14:39:03	236.09	16.33	14.67	18.05	2.08	0.14	73.95	5.12	opening claw on left facing SPI faceplate, other part of crab visible in background
Pearl Harb_O2	841	8/30/2012	14:39:12	235.85	16.32	14.69	18.02	2.74	0.19	74.20	5.13	left side of a crab visible on the left
Pearl Harb_O2	844	8/30/2012	14:39:21	235.9	16.32	14.89	18.00	6.28	0.43	74.14	5.13	most of crab claw on left
Pearl Harb_O2	847	8/30/2012	14:39:30	236.14	16.34	14.90	18.00	3.08	0.21	73.91	5.11	most of crab claw on left
Pearl Harb_O2	850	8/30/2012	14:39:39	236.11	16.33	14.89	18.00	2.23	0.15	73.93	5.11	most of crab claw on left
Pearl Harb_O2	853	8/30/2012	14:39:48	235.72	16.31	14.81	17.99	9.06	0.63	74.32	5.14	
Pearl Harb_O2	856	8/30/2012	14:39:57	235.27	16.28	14.74	17.98	6.03	0.42	74.77	5.17	
Pearl Harb_O2	859	8/30/2012	14:40:06	235.23	16.27	14.81	17.97	11.65	0.81	74.82	5.18	crab on surface, taking up all but far right of SWI
Pearl Harb_O2	862	8/30/2012	14:40:15	235.57	16.30	14.87	17.99	7.17	0.50	74.48	5.15	crab on surface, covering the whole SWI, disturbing sed
Pearl Harb_O2	865	8/30/2012	14:40:24	238.11	16.47	14.91	17.99	0.76	0.05	71.93	4.98	crab at rest on surface, covering whole SWI
Pearl Harb_O2	868	8/30/2012	14:40:33	238.1	16.47	14.88	17.99	1.47	0.10	71.94	4.98	crab at rest on surface, covering whole SWI
Pearl Harb_O2	871	8/30/2012	14:40:42	237.97	16.46	14.92	17.98	0.67	0.05	72.07	4.99	crab at rest on surface, covering whole SWI

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Pearl Harb_O2	874	8/30/2012	14:40:51	237.79	16.45	14.92	17.97	0.83	0.06	72.25	5.00	crab at rest on surface, covering whole SWI
Pearl Harb_O2	877	8/30/2012	14:41:00	237.62	16.44	14.89	17.96	0.52	0.04	72.42	5.01	crab at rest on surface, covering whole SWI
Pearl Harb_O2	880	8/30/2012	14:41:09	237.8	16.45	14.94	17.97	0.12	0.01	72.25	5.00	crab at rest on surface, covering whole SWI
Pearl Harb_O2	883	8/30/2012	14:41:18	237.71	16.45	14.94	17.96	0.55	0.04	72.33	5.00	crab at rest on surface, covering whole SWI
Pearl Harb_O2	886	8/30/2012	14:41:27	237.34	16.42	14.90	17.93	0.25	0.02	72.70	5.03	crab at rest on surface, covering whole SWI
Pearl Harb_O2	889	8/30/2012	14:41:36	237.16	16.41	14.88	17.90	0.81	0.06	72.88	5.04	crab at rest on surface, covering whole SWI
Pearl Harb_O2	892	8/30/2012	14:41:45	237.08	16.40	14.91	17.91	0.23	0.02	72.96	5.05	crab at rest on surface, covering whole SWI
Pearl Harb_O2	895	8/30/2012	14:41:54	237.08	16.40	14.94	17.91	0.14	0.01	72.97	5.05	crab at rest on surface, covering whole SWI
Pearl Harb_O2	898	8/30/2012	14:42:03	237.09	16.40	14.93	17.91	0.24	0.02	72.95	5.05	crab at rest on surface, covering whole SWI
Pearl Harb_O2	901	8/30/2012	14:42:12	235.09	16.26	14.86	17.89	6.33	0.44	74.95	5.19	crab up on its hind legs, most of underside visible, sediment disturbed
Pearl Harb_O2	904	8/30/2012	14:42:21	234.81	16.24	14.83	17.90	3.28	0.23	75.23	5.20	
Pearl Harb_O2	907	8/30/2012	14:42:30	234.69	16.24	14.81	17.87	1.08	0.07	75.35	5.21	
Pearl Harb_O2	910	8/30/2012	14:42:39	234.62	16.23	14.83	17.89	0.58	0.04	75.42	5.22	
Pearl Harb_O2	913	8/30/2012	14:42:48	234.74	16.24	14.82	17.89	0.31	0.02	75.30	5.21	
Pearl Harb_O2	916	8/30/2012	14:42:57	234.6	16.23	14.82	17.85	1.09	0.08	75.45	5.22	
Pearl Harb_O2	919	8/30/2012	14:43:06	233.69	16.17	14.80	17.78	1.19	0.08	76.35	5.28	
Pearl Harb_O2	922	8/30/2012	14:43:15	233.09	16.13	14.76	17.77	0.64	0.04	76.95	5.32	
Pearl Harb_O2	925	8/30/2012	14:43:24	233.13	16.13	14.74	17.77	0.24	0.02	76.91	5.32	
Pearl Harb_O2	928	8/30/2012	14:43:33	233.22	16.13	14.76	17.79	0.36	0.02	76.82	5.31	
Pearl Harb_O2	931	8/30/2012	14:43:42	233.12	16.13	14.75	17.79	1.19	0.08	76.92	5.32	
Pearl Harb_O2	934	8/30/2012	14:43:51	233.22	16.13	14.76	17.79	0.69	0.05	76.82	5.31	
Pearl Harb_O2	937	8/30/2012	14:44:00	233.21	16.13	14.76	17.81	2.76	0.19	76.83	5.32	
Pearl Harb_O2	940	8/30/2012	14:44:09	233.05	16.12	14.74	17.79	1.83	0.13	76.99	5.33	
Pearl Harb_O2	943	8/30/2012	14:44:18	233.18	16.13	14.75	17.79	7.94	0.55	76.87	5.32	
Pearl Harb_O2	946	8/30/2012	14:44:27	233.44	16.15	14.78	17.80	7.30	0.51	76.60	5.30	
Pearl Harb_O2	949	8/30/2012	14:44:36	233.23	16.14	14.74	17.79	4.22	0.29	76.81	5.31	
Pearl Harb_O2	952	8/30/2012	14:44:45	233.11	16.13	14.74	17.80	1.54	0.11	76.93	5.32	
Pearl Harb_O2	955	8/30/2012	14:44:54	233.16	16.13	14.75	17.79	1.91	0.13	76.89	5.32	
Pearl Harb_O2	958	8/30/2012	14:45:03	233.05	16.12	14.73	17.76	1.93	0.13	76.99	5.33	
Pearl Harb_O2	961	8/30/2012	14:45:12	233.03	16.12	14.73	17.77	3.30	0.23	77.02	5.33	
Pearl Harb_O2	964	8/30/2012	14:45:21	232.96	16.12	14.72	17.80	3.21	0.22	77.08	5.33	
Pearl Harb_O2	967	8/30/2012	14:45:30	233.02	16.12	14.73	17.79	1.89	0.13	77.02	5.33	
Pearl Harb_O2	970	8/30/2012	14:45:39	233.05	16.12	14.73	17.79	2.09	0.14	77.00	5.33	
Pearl Harb_O2	973	8/30/2012	14:45:48	233.05	16.12	14.73	17.79	2.16	0.15	77.00	5.33	
Pearl Harb_O2	976	8/30/2012	14:45:57	233.17	16.13	14.73	17.79	1.12	0.08	76.87	5.32	
Pearl Harb_O2	979	8/30/2012	14:46:06	233.03	16.12	14.73	17.77	1.98	0.14	77.02	5.33	
Pearl Harb_O2	982	8/30/2012	14:46:15	233.46	16.15	14.77	17.76	2.79	0.19	76.59	5.30	
Pearl Harb_O2	985	8/30/2012	14:46:24	233.64	16.16	14.79	17.79	1.30	0.09	76.40	5.29	
Pearl Harb_O2	988	8/30/2012	14:46:33	233.52	16.15	14.79	17.76	3.12	0.22	76.53	5.29	
Pearl Harb_O2	991	8/30/2012	14:46:42	233.29	16.14	14.77	17.75	1.77	0.12	76.75	5.31	small egg sac or invert floating just about SWI on left
Pearl Harb_O2	994	8/30/2012	14:46:51	233.23	16.14	14.76	17.75	1.96	0.14	76.81	5.31	
Pearl Harb_O2	997	8/30/2012	14:47:00	233.03	16.12	14.76	17.76	1.23	0.09	77.01	5.33	
Pearl Harb_O2	###	8/30/2012	14:47:09	232.81	16.11	14.73	17.74	1.00	0.07	77.23	5.34	
Pearl Harb_O2	###	8/30/2012	14:47:18	232.77	16.10	14.73	17.74	1.03	0.07	77.28	5.35	
Pearl Harb_O2	###	8/30/2012	14:47:27	232.19	16.06	14.70	17.72	0.60	0.04	77.86	5.39	
Pearl Harb_O2	###	8/30/2012	14:47:36	231.65	16.03	14.66	17.72	0.95	0.07	78.39	5.42	
Pearl Harb_O2	###	8/30/2012	14:47:45	231.6	16.02	14.65	17.71	1.23	0.08	78.44	5.43	

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Pearl Harb_O2	###	8/30/2012	14:47:54	231.11	15.99	14.63	17.71	0.98	0.07	78.93	5.46	
Pearl Harb_O2	###	8/30/2012	14:48:03	231.22	16.00	14.63	17.69	1.20	0.08	78.82	5.45	
Pearl Harb_O2	###	8/30/2012	14:48:12	231.1	15.99	14.63	17.69	0.67	0.05	78.94	5.46	
Pearl Harb_O2	###	8/30/2012	14:48:21	230.61	15.95	14.59	17.69	0.39	0.03	79.44	5.50	
Pearl Harb_O2	###	8/30/2012	14:48:30	230.4	15.94	14.55	17.69	1.51	0.10	79.64	5.51	
Pearl Harb_O2	###	8/30/2012	14:48:39	230.96	15.98	14.59	17.73	1.76	0.12	79.08	5.47	
Pearl Harb_O2	###	8/30/2012	14:48:48	231.29	16.00	14.61	17.74	1.08	0.08	78.75	5.45	
Pearl Harb_O2	###	8/30/2012	14:48:57	231.28	16.00	14.60	17.71	1.26	0.09	78.76	5.45	
Pearl Harb_O2	###	8/30/2012	14:49:06	231.25	16.00	14.60	17.73	2.36	0.16	78.79	5.45	
Pearl Harb_O2	###	8/30/2012	14:49:15	231.23	16.00	14.60	17.74	1.96	0.14	78.81	5.45	
Pearl Harb_O2	###	8/30/2012	14:49:24	231.38	16.01	14.59	17.77	1.80	0.12	78.67	5.44	
Pearl Harb_O2	###	8/30/2012	14:49:33	231.24	16.00	14.58	17.74	3.25	0.22	78.80	5.45	
Pearl Harb_O2	###	8/30/2012	14:49:42	231.22	16.00	14.57	17.74	4.27	0.30	78.82	5.45	
Pearl Harb_O2	###	8/30/2012	14:49:51	231.11	15.99	14.57	17.73	3.40	0.24	78.94	5.46	
Pearl Harb_O2	###	8/30/2012	14:50:00	230.93	15.98	14.57	17.71	10.92	0.76	79.11	5.47	
Pearl Harb_O2	###	8/30/2012	14:50:09	230.48	15.94	14.55	17.69	4.51	0.31	79.56	5.50	
Pearl Harb_O2	###	8/30/2012	14:50:19	229.91	15.91	14.55	17.68	3.37	0.23	80.13	5.54	
Pearl Harb_O2	###	8/30/2012	14:50:28	228.18	15.79	14.40	17.59	1.46	0.10	81.86	5.66	
Pearl Harb_O2	###	8/30/2012	14:50:36	227.2	15.72	14.32	17.57	1.89	0.13	82.84	5.73	
Pearl Harb_O2	###	8/30/2012	14:50:45	226.29	15.66	14.32	17.48	52.40	3.63	83.75	5.79	lots of sus sed; filling most of SWI
Pearl Harb_O2	###	8/30/2012	14:50:55	224.15	15.51	14.22	17.32	10.70	0.74	85.90	5.94	
Pearl Harb_O2	###	8/30/2012	14:51:04	223.04	15.43	14.10	17.19	54.23	3.75	87.00	6.02	lots of sus sed; filling most of SWI
Pearl Harb_O2	###	8/30/2012	14:51:13	222.85	15.42	14.03	17.21	43.64	3.02	87.19	6.03	
Pearl Harb_O2	###	8/30/2012	14:51:21	222.65	15.40	14.07	17.23	24.62	1.70	87.39	6.05	
Pearl Harb_O2	###	8/30/2012	14:51:30	222.2	15.37	14.02	17.22	14.23	0.98	87.85	6.08	
Pearl Harb_O2	###	8/30/2012	14:51:40	222.18	15.37	13.99	17.21	17.68	1.22	87.86	6.08	
Pearl Harb_O2	###	8/30/2012	14:51:49	222.22	15.37	14.01	17.18	5.88	0.41	87.82	6.08	
Pearl Harb_O2	###	8/30/2012	14:51:57	222.73	15.41	14.00	17.19	23.81	1.65	87.32	6.04	
Pearl Harb_O2	###	8/30/2012	14:52:06	222.61	15.40	14.01	17.13	20.07	1.39	87.43	6.05	
Pearl Harb_O2	###	8/30/2012	14:52:16	222.54	15.40	14.01	17.17	9.43	0.65	87.50	6.05	
Pearl Harb_O2	###	8/30/2012	14:52:25	222.31	15.38	14.03	17.15	2.47	0.17	87.73	6.07	
Pearl Harb_O2	###	8/30/2012	14:52:33	216.61	14.99	13.61	17.04	9.37	0.65	93.43	6.46	
Pearl Harb_O2	###	8/30/2012	14:52:42	217.16	15.02	13.60	17.04	14.92	1.03	92.89	6.43	
Pearl Harb_O2	###	8/30/2012	14:52:52	219.43	15.18	13.65	17.11	7.57	0.52	90.61	6.27	
Pearl Harb_O2	###	8/30/2012	14:53:01	220.72	15.27	13.73	17.11	0.96	0.07	89.33	6.18	
Pearl Harb_O2	###	8/30/2012	14:53:09	222.07	15.36	13.80	17.17	0.98	0.07	87.97	6.09	
Pearl Harb_O2	###	8/30/2012	14:53:18	222.28	15.38	13.81	17.18	1.66	0.11	87.76	6.07	
Pearl Harb_O2	###	8/30/2012	14:53:28	221.88	15.35	13.80	17.15	0.72	0.05	88.16	6.10	
Pearl Harb_O2	###	8/30/2012	14:53:37	222.74	15.41	13.87	17.18	3.16	0.22	87.31	6.04	
Pearl Harb_O2	###	8/30/2012	14:53:45	223.23	15.44	13.90	17.19	1.77	0.12	86.81	6.01	
Pearl Harb_O2	###	8/30/2012	14:53:54	223.04	15.43	13.88	17.17	1.27	0.09	87.01	6.02	
Pearl Harb_O2	###	8/30/2012	14:54:04	223.15	15.44	13.89	17.19	0.62	0.04	86.90	6.01	
Pearl Harb_O2	###	8/30/2012	14:54:13	223.11	15.44	13.88	17.20	1.58	0.11	86.93	6.01	
Pearl Harb_O2	###	8/30/2012	14:54:21	223.11	15.43	13.88	17.19	0.84	0.06	86.93	6.01	
Pearl Harb_O2	###	8/30/2012	14:54:30	223.05	15.43	13.88	17.18	0.89	0.06	86.99	6.02	
Pearl Harb_O2	###	8/30/2012	14:54:40	223.12	15.44	13.89	17.20	0.57	0.04	86.92	6.01	

OSCAR SPI RESULTS

Pearl Harb_O2	###	8/30/2012	14:54:49	223.04	15.43	13.88	17.19	0.61	0.04	87.00	6.02	
Pearl Harb_O2	###	8/30/2012	14:54:57	223.13	15.44	13.88	17.18	0.88	0.06	86.91	6.01	
Pearl Harb_O2	###	8/30/2012	14:55:06	223.28	15.45	13.88	17.18	1.04	0.07	86.76	6.00	
Pearl Harb_O2	###	8/30/2012	14:55:16	223.53	15.46	13.93	17.17	0.54	0.04	86.51	5.98	
Pearl Harb_O2	###	8/30/2012	14:55:25	223.3	15.45	13.93	17.16	4.11	0.28	86.74	6.00	
Pearl Harb_O2	###	8/30/2012	14:55:34	223.03	15.43	13.93	17.13	1.20	0.08	87.02	6.02	
Pearl Harb_O2	###	8/30/2012	14:55:42	222.83	15.42	13.90	17.11	1.68	0.12	87.22	6.03	
Pearl Harb_O2	###	8/30/2012	14:55:52	223.02	15.43	13.91	17.16	1.78	0.12	87.02	6.02	
Pearl Harb_O2	###	8/30/2012	14:56:01	222.25	15.38	13.84	17.12	3.57	0.25	87.79	6.07	
Pearl Harb_O2	###	8/30/2012	14:56:10	221.94	15.35	13.81	17.11	0.78	0.05	88.10	6.09	
Pearl Harb_O2	###	8/30/2012	14:56:18	221.41	15.32	13.80	17.09	0.78	0.05	88.63	6.13	
Pearl Harb_O2	###	8/30/2012	14:56:28	221.34	15.31	13.78	17.10	0.95	0.07	88.70	6.14	
Pearl Harb_O2	###	8/30/2012	14:56:37	222.02	15.36	13.80	17.13	0.34	0.02	88.02	6.09	
Pearl Harb_O2	###	8/30/2012	14:56:46	222.71	15.41	13.94	17.10	1.90	0.13	87.34	6.04	
Pearl Harb_O2	###	8/30/2012	14:56:54	222.78	15.41	13.98	17.10	0.43	0.03	87.27	6.04	
Pearl Harb_O2	###	8/30/2012	14:57:04	222.21	15.37	13.93	17.08	0.45	0.03	87.84	6.08	
Pearl Harb_O2	###	8/30/2012	14:57:13	221.89	15.35	13.89	17.07	1.22	0.08	88.15	6.10	
Pearl Harb_O2	###	8/30/2012	14:57:22	221.73	15.34	13.87	17.08	3.50	0.24	88.31	6.11	
Pearl Harb_O2	###	8/30/2012	14:57:30	220.53	15.26	13.75	17.04	34.03	2.35	89.51	6.19	
Pearl Harb_O2	###	8/30/2012	14:57:40	219.07	15.16	13.71	17.02	35.58	2.46	90.97	6.29	
Pearl Harb_O2	###	8/30/2012	14:57:49	219.17	15.16	13.68	17.03	12.11	0.84	90.87	6.29	
Pearl Harb_O2	###	8/30/2012	14:57:58	219.44	15.18	13.67	17.04	7.07	0.49	90.60	6.27	
Pearl Harb_O2	###	8/30/2012	14:58:06	220.77	15.27	13.72	17.11	1.21	0.08	89.27	6.18	
Pearl Harb_O2	###	8/30/2012	14:58:16	220.98	15.29	13.74	17.11	2.01	0.14	89.06	6.16	
Pearl Harb_O2	###	8/30/2012	14:58:25	220.96	15.29	13.75	17.11	2.74	0.19	89.08	6.16	
Pearl Harb_O2	###	8/30/2012	14:58:34	220.2	15.23	13.68	17.08	2.10	0.15	89.84	6.21	
Pearl Harb_O2	###	8/30/2012	14:58:42	220.48	15.25	13.72	17.07	1.49	0.10	89.56	6.20	
Pearl Harb_O2	###	8/30/2012	14:58:52	220.67	15.27	13.71	17.07	2.99	0.21	89.38	6.18	
Pearl Harb_O2	###	8/30/2012	14:59:01	220.61	15.26	13.71	17.07	1.17	0.08	89.43	6.19	
Pearl Harb_O2	###	8/30/2012	14:59:10	220.7	15.27	13.71	17.07	1.93	0.13	89.34	6.18	
Pearl Harb_O2	###	8/30/2012	14:59:18	220.85	15.28	13.70	17.08	0.66	0.05	89.19	6.17	
Pearl Harb_O2	###	8/30/2012	14:59:28	220.88	15.28	13.71	17.08	0.45	0.03	89.16	6.17	
Pearl Harb_O2	###	8/30/2012	14:59:37	220.92	15.28	13.72	17.08	0.50	0.03	89.12	6.17	
Pearl Harb_O2	###	8/30/2012	14:59:46	220.93	15.28	13.74	17.07	0.97	0.07	89.11	6.16	
Pearl Harb_O2	###	8/30/2012	14:59:55	221.1	15.30	13.75	17.09	1.47	0.10	88.94	6.15	
Pearl Harb_O2	###	8/30/2012	15:00:04	221.22	15.30	13.76	17.09	1.17	0.08	88.82	6.14	
Pearl Harb_O2	###	8/30/2012	15:00:07	220.69	15.27	13.72	17.07	1.11	0.08	89.35	6.18	
Pearl Harb_O2	###	8/30/2012	15:00:10	220.77	15.27	13.74	17.06	0.99	0.07	89.28	6.18	
Pearl Harb_O2	###	8/30/2012	15:00:13	220.83	15.28	13.74	17.08	1.64	0.11	89.21	6.17	
Pearl Harb_O2	###	8/30/2012	15:00:16	220.7	15.27	13.74	17.05	0.98	0.07	89.34	6.18	
Pearl Harb_O2	###	8/30/2012	15:00:19	220.65	15.26	13.72	17.06	0.91	0.06	89.39	6.18	
Pearl Harb_O2	###	8/30/2012	15:00:22	221.24	15.31	13.74	17.09	1.17	0.08	88.80	6.14	
Pearl Harb_O2	###	8/30/2012	15:00:25	221.24	15.31	13.77	17.09	1.02	0.07	88.80	6.14	
Pearl Harb_O2	###	8/30/2012	15:00:28	221.77	15.34	13.81	17.08	1.39	0.10	88.27	6.11	
Pearl Harb_O2	###	8/30/2012	15:00:31	221.69	15.34	13.83	17.07	2.28	0.16	88.35	6.11	
Pearl Harb_O2	###	8/30/2012	15:00:34	221.39	15.32	13.83	17.03	1.78	0.12	88.66	6.13	

Pearl Harb_O2	###	8/30/2012	15:00:37	221.28	15.31	13.83	17.04	1.69	0.12	88.76	6.14	
Pearl Harb_O2	###	8/30/2012	15:00:40	220.89	15.28	13.80	17.04	2.04	0.14	89.15	6.17	
Pearl Harb_O2	###	8/30/2012	15:00:43	220.88	15.28	13.79	17.03	1.15	0.08	89.16	6.17	
Pearl Harb_O2	###	8/30/2012	15:00:46	220.91	15.28	13.81	17.05	1.93	0.13	89.13	6.17	
Pearl Harb_O2	###	8/30/2012	15:00:49	220.43	15.25	13.78	17.02	1.28	0.09	89.61	6.20	
Pearl Harb_O2	###	8/30/2012	15:00:52	220.21	15.23	13.74	17.02	0.88	0.06	89.83	6.21	
Pearl Harb_O2	###	8/30/2012	15:00:55	219.56	15.19	13.67	17.01	1.12	0.08	90.48	6.26	
Pearl Harb_O2	###	8/30/2012	15:00:58	219.38	15.18	13.64	17.01	0.92	0.06	90.66	6.27	
Pearl Harb_O2	###	8/30/2012	15:01:01	219.27	15.17	13.64	17.00	1.16	0.08	90.77	6.28	
Pearl Harb_O2	###	8/30/2012	15:01:04	219.46	15.18	13.64	17.01	1.16	0.08	90.58	6.27	
Pearl Harb_O2	###	8/30/2012	15:01:07	219.58	15.19	13.67	17.02	1.23	0.08	90.46	6.26	
Pearl Harb_O2	###	8/30/2012	15:01:10	219.49	15.18	13.65	17.01	2.36	0.16	90.55	6.26	
Pearl Harb_O2	###	8/30/2012	15:01:13	219.4	15.18	13.64	17.02	1.74	0.12	90.64	6.27	
Pearl Harb_O2	###	8/30/2012	15:01:16	219.4	15.18	13.64	17.01	1.11	0.08	90.64	6.27	
Pearl Harb_O2	###	8/30/2012	15:01:19	219.45	15.18	13.64	17.01	1.27	0.09	90.59	6.27	
Pearl Harb_O2	###	8/30/2012	15:01:22	219.38	15.18	13.64	17.01	1.10	0.08	90.66	6.27	
Pearl Harb_O2	###	8/30/2012	15:01:25	219.35	15.17	13.66	17.02	0.64	0.04	90.69	6.27	
Pearl Harb_O2	###	8/30/2012	15:01:28	219.55	15.19	13.68	17.02	1.10	0.08	90.49	6.26	
Pearl Harb_O2	###	8/30/2012	15:01:31	219.68	15.20	13.67	17.02	1.33	0.09	90.37	6.25	
Pearl Harb_O2	###	8/30/2012	15:01:34	219.84	15.21	13.68	17.02	0.83	0.06	90.21	6.24	
Pearl Harb_O2	###	8/30/2012	15:01:37	219.99	15.22	13.67	17.03	0.60	0.04	90.05	6.23	
Pearl Harb_O2	###	8/30/2012	15:01:40	219.82	15.21	13.67	17.03	0.93	0.06	90.22	6.24	
Pearl Harb_O2	###	8/30/2012	15:01:43	219.41	15.18	13.64	17.03	1.75	0.12	90.64	6.27	
Pearl Harb_O2	###	8/30/2012	15:01:46	219.41	15.18	13.64	17.01	1.69	0.12	90.63	6.27	
Pearl Harb_O2	###	8/30/2012	15:01:49	219.52	15.19	13.65	17.01	0.91	0.06	90.52	6.26	
Pearl Harb_O2	###	8/30/2012	15:01:52	219.55	15.19	13.65	17.01	0.94	0.07	90.49	6.26	
Pearl Harb_O2	###	8/30/2012	15:01:55	219.21	15.17	13.64	17.01	0.76	0.05	90.83	6.28	
Pearl Harb_O2	###	8/30/2012	15:01:58	219.14	15.16	13.63	17.01	0.81	0.06	90.91	6.29	
Pearl Harb_O2	###	8/30/2012	15:02:01	218.17	15.09	13.60	16.95	1.31	0.09	91.88	6.36	
Pearl Harb_O2	###	8/30/2012	15:02:04	217.75	15.06	13.59	16.94	1.08	0.07	92.29	6.38	
Pearl Harb_O2	###	8/30/2012	15:02:07	217.48	15.05	13.55	16.92	1.43	0.10	92.56	6.40	
Pearl Harb_O2	###	8/30/2012	15:02:10	216.35	14.97	13.45	16.91	0.88	0.06	93.70	6.48	
Pearl Harb_O2	###	8/30/2012	15:02:13	216.45	14.97	13.45	16.91	1.23	0.09	93.59	6.47	
Pearl Harb_O2	###	8/30/2012	15:02:16	216.5	14.98	13.45	16.93	0.84	0.06	93.54	6.47	
Pearl Harb_O2	###	8/30/2012	15:02:19	216.49	14.98	13.44	16.91	1.04	0.07	93.55	6.47	
Pearl Harb_O2	###	8/30/2012	15:02:22	216.5	14.98	13.45	16.91	2.94	0.20	93.55	6.47	
Pearl Harb_O2	###	8/30/2012	15:02:25	216.09	14.95	13.43	16.91	1.61	0.11	93.95	6.50	edge of crab claw on left side
Pearl Harb_O2	###	8/30/2012	15:02:28	216	14.94	13.37	16.91	1.63	0.11	94.04	6.51	two points of crab visible on left
Pearl Harb_O2	###	8/30/2012	15:02:31	216.04	14.95	13.34	16.91	1.63	0.11	94.01	6.50	partial view of two legs and one claw of crab on left
Pearl Harb_O2	###	8/30/2012	15:02:34	215.84	14.93	13.35	16.91	0.75	0.05	94.20	6.52	half of crab at rest on left
Pearl Harb_O2	###	8/30/2012	15:02:37	215.47	14.91	13.33	16.90	1.59	0.11	94.57	6.54	half of crab standing a bit on left
Pearl Harb_O2	###	8/30/2012	15:02:40	215.36	14.90	13.32	16.90	0.87	0.06	94.69	6.55	half of crab standing a bit on left
Pearl Harb_O2	###	8/30/2012	15:02:43	215.68	14.92	13.35	16.90	0.73	0.05	94.37	6.53	claw and one leg of crab visible on left
Pearl Harb_O2	###	8/30/2012	15:02:46	216.01	14.94	13.41	16.90	0.76	0.05	94.03	6.51	crab claw and three legs visible on left
Pearl Harb_O2	###	8/30/2012	15:02:49	216.14	14.95	13.61	16.92	1.27	0.09	93.90	6.50	half of crab at rest on left
Pearl Harb_O2	###	8/30/2012	15:02:52	215.84	14.93	13.53	16.90	2.74	0.19	94.20	6.52	slightly more than half of crab visible on left, standing, belly exposed; minimum pen depth affected by crab
Pearl Harb_O2	###	8/30/2012	15:02:55	215.48	14.91	13.49	16.90	0.92	0.06	94.56	6.54	almost whole crab visible in crouch, on left side of frame

Pearl Harb_O2	###	8/30/2012	15:02:58	215.21	14.89	13.45	16.90	9.94	0.69	94.83	6.56	almost whole crab visible in crouch, now on right side of frame
Pearl Harb_O2	###	8/30/2012	15:03:01	215.24	14.89	13.46	16.90	17.38	1.20	94.80	6.56	
Pearl Harb_O2	###	8/30/2012	15:03:04	215.26	14.89	13.46	16.90	12.65	0.88	94.78	6.56	
Pearl Harb_O2	###	8/30/2012	15:03:07	215.33	14.90	13.45	16.90	6.49	0.45	94.71	6.55	
Pearl Harb_O2	###	8/30/2012	15:03:10	215.74	14.92	13.51	16.90	23.67	1.64	94.30	6.52	
Pearl Harb_O2	###	8/30/2012	15:03:13	216.9	15.00	13.56	16.92	39.80	2.75	93.15	6.44	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:16	218.34	15.10	13.70	16.93	41.95	2.90	91.70	6.34	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:19	217.87	15.07	13.66	16.92	47.90	3.31	92.17	6.38	cloud of sus sed on left mostly
Pearl Harb_O2	###	8/30/2012	15:03:22	217.17	15.02	13.62	16.92	55.57	3.84	92.87	6.42	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:25	216.63	14.99	13.58	16.87	44.76	3.10	93.41	6.46	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:28	216.27	14.96	13.59	16.87	41.46	2.87	93.77	6.49	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:31	215.6	14.92	13.51	16.72	63.47	4.39	94.44	6.53	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:34	215.6	14.92	13.56	16.74	54.10	3.74	94.44	6.53	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:37	215.36	14.90	13.51	16.76	40.52	2.80	94.68	6.55	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:40	215.31	14.90	13.46	16.73	45.87	3.17	94.73	6.55	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:43	215.11	14.88	13.42	16.73	28.15	1.95	94.93	6.57	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:46	214.85	14.86	13.40	16.70	44.21	3.06	95.19	6.59	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:03:49	212.6	14.71	13.22	16.68	60.10	4.16	97.44	6.74	cloud of sus sed; med chunk of sed on surface at left
Pearl Harb_O2	###	8/30/2012	15:03:52	210.67	14.57	13.04	16.56	42.84	2.96	99.38	6.87	cloud of sus sed; med chunk of sed on surface at left
Pearl Harb_O2	###	8/30/2012	15:03:55	209.01	14.46	12.92	16.46	51.80	3.58	101.03	6.99	cloud of sus sed; med chunk of sed on surface at left
Pearl Harb_O2	###	8/30/2012	15:03:58	208.99	14.46	12.91	16.42	47.45	3.28	101.05	6.99	cloud of sus sed; med chunk of sed on surface at left
Pearl Harb_O2	###	8/30/2012	15:04:01	208.76	14.44	12.91	16.39	50.14	3.47	101.29	7.01	cloud of sus sed; med chunk of sed on surface at left
Pearl Harb_O2	###	8/30/2012	15:04:04	208.66	14.44	12.90	16.35	42.86	2.96	101.38	7.01	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:04:07	208.68	14.44	12.88	16.36	35.37	2.45	101.36	7.01	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:04:10	208.6	14.43	12.89	16.37	43.98	3.04	101.44	7.02	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:04:13	208.45	14.42	12.88	16.34	37.36	2.58	101.59	7.03	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:04:16	207.86	14.38	12.85	16.32	27.37	1.89	102.18	7.07	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:04:19	204.34	14.14	12.55	16.18	50.44	3.49	105.70	7.31	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:04:22	204.83	14.17	12.65	16.20	53.04	3.67	105.21	7.28	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:04:25	204.96	14.18	12.67	16.20	39.41	2.73	105.08	7.27	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:04:28	205.01	14.18	12.66	16.20	17.92	1.24	105.03	7.27	
Pearl Harb_O2	###	8/30/2012	15:04:31	205.48	14.21	12.72	16.23	8.05	0.56	104.56	7.23	
Pearl Harb_O2	###	8/30/2012	15:04:34	206.35	14.28	12.75	16.24	3.23	0.22	103.69	7.17	
Pearl Harb_O2	###	8/30/2012	15:04:37	206.55	14.29	12.73	16.24	9.65	0.67	103.50	7.16	
Pearl Harb_O2	###	8/30/2012	15:04:40	206.8	14.31	12.77	16.26	7.09	0.49	103.24	7.14	
Pearl Harb_O2	###	8/30/2012	15:04:43	207.13	14.33	12.79	16.25	7.81	0.54	102.91	7.12	
Pearl Harb_O2	###	8/30/2012	15:04:46	207.21	14.33	12.83	16.28	9.42	0.65	102.83	7.11	
Pearl Harb_O2	###	8/30/2012	15:04:49	207.24	14.34	12.75	16.26	8.52	0.59	102.80	7.11	
Pearl Harb_O2	###	8/30/2012	15:04:52	207.29	14.34	12.80	16.24	26.50	1.83	102.75	7.11	
Pearl Harb_O2	###	8/30/2012	15:04:55	207.39	14.35	12.85	16.25	40.25	2.78	102.65	7.10	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:04:58	207.71	14.37	12.87	16.30	47.86	3.31	102.33	7.08	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:05:01	208.22	14.40	12.87	16.26	41.15	2.85	101.83	7.04	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:05:04	208.52	14.43	12.91	16.25	31.34	2.17	101.52	7.02	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:05:07	208.71	14.44	12.90	16.28	58.85	4.07	101.33	7.01	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:05:10	208.93	14.45	12.96	16.28	51.65	3.57	101.11	7.00	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:05:13	209	14.46	12.94	16.26	32.31	2.24	101.04	6.99	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:05:16	209.17	14.47	12.97	16.26	27.10	1.87	100.87	6.98	
Pearl Harb_O2	###	8/30/2012	15:05:19	209.04	14.46	12.95	16.26	23.13	1.60	101.01	6.99	
Pearl Harb_O2	###	8/30/2012	15:05:22	209.06	14.46	12.94	16.26	18.72	1.29	100.98	6.99	
Pearl Harb_O2	###	8/30/2012	15:05:25	209.08	14.46	12.95	16.26	11.91	0.82	100.96	6.98	
Pearl Harb_O2	###	8/30/2012	15:05:28	209.02	14.46	12.96	16.26	12.33	0.85	101.03	6.99	

Pearl Harb_O2	###	8/30/2012	15:05:31	209.03	14.46	12.94	16.25	11.09	0.77	101.01	6.99	
Pearl Harb_O2	###	8/30/2012	15:05:34	208.95	14.46	12.92	16.26	3.86	0.27	101.09	6.99	
Pearl Harb_O2	###	8/30/2012	15:05:37	208.88	14.45	12.92	16.22	3.05	0.21	101.16	7.00	
Pearl Harb_O2	###	8/30/2012	15:05:40	208.9	14.45	12.90	16.25	3.97	0.27	101.14	7.00	
Pearl Harb_O2	###	8/30/2012	15:05:43	208.89	14.45	12.94	16.24	5.20	0.36	101.15	7.00	
Pearl Harb_O2	###	8/30/2012	15:05:46	208.82	14.45	12.96	16.24	4.32	0.30	101.23	7.00	
Pearl Harb_O2	###	8/30/2012	15:05:49	207.22	14.34	12.77	16.21	4.81	0.33	102.83	7.11	
Pearl Harb_O2	###	8/30/2012	15:05:52	207.23	14.34	12.78	16.22	3.48	0.24	102.82	7.11	
Pearl Harb_O2	###	8/30/2012	15:05:55	207.03	14.32	12.76	16.22	3.69	0.26	103.01	7.13	
Pearl Harb_O2	###	8/30/2012	15:05:58	206.52	14.29	12.71	16.19	10.96	0.76	103.52	7.16	
Pearl Harb_O2	###	8/30/2012	15:06:01	205.4	14.21	12.62	16.19	19.94	1.38	104.65	7.24	
Pearl Harb_O2	###	8/30/2012	15:06:04	205.47	14.21	12.64	16.20	22.58	1.56	104.57	7.23	
Pearl Harb_O2	###	8/30/2012	15:06:07	206.32	14.27	12.68	16.16	22.80	1.58	103.72	7.18	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:06:10	206.52	14.29	12.71	16.15	31.29	2.16	103.52	7.16	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:06:13	206.59	14.29	12.71	16.15	27.73	1.92	103.45	7.16	
Pearl Harb_O2	###	8/30/2012	15:06:16	206.85	14.31	12.75	16.15	16.75	1.16	103.19	7.14	
Pearl Harb_O2	###	8/30/2012	15:06:19	207.21	14.34	12.81	16.16	19.51	1.35	102.83	7.11	small cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:06:22	207.42	14.35	12.80	16.17	29.80	2.06	102.62	7.10	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:06:25	207.55	14.36	12.80	16.17	33.58	2.32	102.49	7.09	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:06:28	207.26	14.34	12.84	16.14	50.83	3.52	102.78	7.11	cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:06:31	205.9	14.24	12.94	15.67	64.37	4.45	104.14	7.20	cloud of sus sed; top of right side of SWI blown off; max point different now
Pearl Harb_O2	###	8/30/2012	15:06:34	206.32	14.27	12.86	15.54	44.10	3.05	103.72	7.18	cloud of sus sed; med/large sediment chunks on surface in back on right
Pearl Harb_O2	###	8/30/2012	15:06:37	206.71	14.30	12.90	15.81	51.53	3.57	103.34	7.15	cloud of sus sed; med/large sediment chunks on surface in back on right
Pearl Harb_O2	###	8/30/2012	15:06:40	207.02	14.32	12.92	15.78	50.16	3.47	103.02	7.13	cloud of sus sed; med/large sediment chunks on surface in back on right
Pearl Harb_O2	###	8/30/2012	15:06:43	207.42	14.35	12.98	15.75	34.19	2.37	102.62	7.10	small cloud of sus sed; med/large sediment chunks on surface in back on right
Pearl Harb_O2	###	8/30/2012	15:06:46	207.98	14.39	13.01	15.74	25.95	1.80	102.06	7.06	small cloud of sus sed; med/large sediment chunks on surface in back on right
Pearl Harb_O2	###	8/30/2012	15:06:49	208.18	14.40	13.06	15.77	24.57	1.70	101.86	7.05	small cloud of sus sed; med/large sediment chunks on surface in back on right
Pearl Harb_O2	###	8/30/2012	15:06:52	208.18	14.40	13.02	15.65	24.56	1.70	101.87	7.05	small cloud of sus sed; med/large sediment chunks on surface in back on right
Pearl Harb_O2	###	8/30/2012	15:06:55	207.83	14.38	12.98	15.71	42.16	2.92	102.21	7.07	cloud of sus sed; med/large sediment chunks on surface in back on right
Pearl Harb_O2	###	8/30/2012	15:06:58	207.49	14.35	13.04	15.64	33.84	2.34	102.55	7.09	cloud of sus sed; sml sediment chunk on surface and med rolling? out to right in back on right
Pearl Harb_O2	###	8/30/2012	15:07:01	207.73	14.37	12.99	15.54	16.45	1.14	102.31	7.08	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:04	207.83	14.38	13.07	15.53	12.74	0.88	102.21	7.07	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:07	207.94	14.39	13.06	15.54	17.27	1.19	102.11	7.06	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:10	207.7	14.37	13.08	15.51	13.06	0.90	102.34	7.08	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:13	207.59	14.36	13.06	15.50	11.15	0.77	102.45	7.09	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:16	207.44	14.35	13.04	15.50	16.72	1.16	102.61	7.10	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:19	207.21	14.33	13.02	15.49	15.71	1.09	102.83	7.11	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:22	207.04	14.32	12.99	15.47	13.38	0.93	103.00	7.13	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:25	206.93	14.32	12.99	15.47	22.46	1.55	103.12	7.13	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:28	206.95	14.32	12.99	15.45	29.06	2.01	103.10	7.13	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:31	206.89	14.31	13.01	15.45	10.92	0.76	103.15	7.14	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:34	206.92	14.31	13.01	15.45	14.00	0.97	103.13	7.13	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:37	207.24	14.34	13.01	15.49	14.25	0.99	102.80	7.11	sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:40	207.55	14.36	13.06	15.52	27.32	1.89	102.49	7.09	small cloud of sus sed; sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:43	207.63	14.36	13.07	15.52	37.68	2.61	102.41	7.08	cloud of sus sed; sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:46	207.51	14.36	13.05	15.51	38.93	2.69	102.53	7.09	cloud of sus sed; sml chunk of sed on right
Pearl Harb_O2	###	8/30/2012	15:07:49	207.27	14.34	13.05	15.47	34.29	2.37	102.77	7.11	small cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:07:52	207.35	14.34	13.09	15.45	20.49	1.42	102.69	7.10	
Pearl Harb_O2	###	8/30/2012	15:07:55	207.35	14.34	13.08	15.45	20.15	1.39	102.69	7.10	
Pearl Harb_O2	###	8/30/2012	15:07:58	208.15	14.40	13.14	15.48	8.84	0.61	101.89	7.05	

Pearl Harb_O2	###	8/30/2012	15:08:01	208.5	14.42	13.13	15.52	10.73	0.74	101.55	7.03	
Pearl Harb_O2	###	8/30/2012	15:08:04	208.81	14.45	13.19	15.53	14.77	1.02	101.23	7.00	
Pearl Harb_O2	###	8/30/2012	15:08:07	208.95	14.45	13.17	15.53	12.61	0.87	101.10	6.99	
Pearl Harb_O2	###	8/30/2012	15:08:10	208.92	14.45	13.18	15.55	12.27	0.85	101.12	7.00	
Pearl Harb_O2	###	8/30/2012	15:08:13	208.99	14.46	13.17	15.55	8.40	0.58	101.05	6.99	
Pearl Harb_O2	###	8/30/2012	15:08:16	209.03	14.46	13.18	15.55	9.08	0.63	101.01	6.99	
Pearl Harb_O2	###	8/30/2012	15:08:19	208.94	14.45	13.18	15.54	8.69	0.60	101.10	6.99	
Pearl Harb_O2	###	8/30/2012	15:08:22	208.96	14.46	13.16	15.55	6.17	0.43	101.08	6.99	
Pearl Harb_O2	###	8/30/2012	15:08:25	208.93	14.45	13.16	15.56	7.93	0.55	101.11	6.99	
Pearl Harb_O2	###	8/30/2012	15:08:28	208.93	14.45	13.16	15.54	11.18	0.77	101.11	6.99	
Pearl Harb_O2	###	8/30/2012	15:08:31	208.96	14.46	13.15	15.55	9.91	0.69	101.08	6.99	
Pearl Harb_O2	###	8/30/2012	15:08:34	208.97	14.46	13.15	15.55	9.61	0.66	101.07	6.99	
Pearl Harb_O2	###	8/30/2012	15:08:37	208.43	14.42	13.15	15.50	11.50	0.80	101.61	7.03	
Pearl Harb_O2	###	8/30/2012	15:08:40	208.53	14.43	13.11	15.51	15.86	1.10	101.51	7.02	
Pearl Harb_O2	###	8/30/2012	15:08:43	208.57	14.43	13.13	15.53	12.36	0.85	101.48	7.02	
Pearl Harb_O2	###	8/30/2012	15:08:46	208.56	14.43	13.13	15.51	13.00	0.90	101.48	7.02	
Pearl Harb_O2	###	8/30/2012	15:08:49	206.17	14.26	12.91	15.38	10.95	0.76	103.87	7.19	
Pearl Harb_O2	###	8/30/2012	15:08:52	206.33	14.27	12.97	15.39	9.53	0.66	103.71	7.17	
Pearl Harb_O2	###	8/30/2012	15:08:55	209.09	14.46	13.17	15.57	6.86	0.47	100.95	6.98	
Pearl Harb_O2	###	8/30/2012	15:08:58	209.75	14.51	13.19	15.62	12.81	0.89	100.30	6.94	
Pearl Harb_O2	###	8/30/2012	15:09:01	209.78	14.51	13.18	15.59	13.20	0.91	100.27	6.94	
Pearl Harb_O2	###	8/30/2012	15:09:04	209.87	14.52	13.21	15.60	10.49	0.73	100.17	6.93	
Pearl Harb_O2	###	8/30/2012	15:09:07	210.02	14.53	13.21	15.62	8.90	0.62	100.02	6.92	
Pearl Harb_O2	###	8/30/2012	15:09:10	210.03	14.53	13.21	15.61	13.73	0.95	100.01	6.92	
Pearl Harb_O2	###	8/30/2012	15:09:13	210.18	14.54	13.25	15.63	8.28	0.57	99.86	6.91	
Pearl Harb_O2	###	8/30/2012	15:09:16	210.78	14.58	13.30	15.64	12.37	0.86	99.26	6.87	
Pearl Harb_O2	###	8/30/2012	15:09:19	210.91	14.59	13.32	15.65	11.80	0.82	99.13	6.86	
Pearl Harb_O2	###	8/30/2012	15:09:22	210.5	14.56	13.29	15.61	18.03	1.25	99.55	6.89	small cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:09:25	209.87	14.52	13.23	15.61	11.67	0.81	100.17	6.93	
Pearl Harb_O2	###	8/30/2012	15:09:28	208.29	14.41	13.05	15.56	11.11	0.77	101.75	7.04	
Pearl Harb_O2	###	8/30/2012	15:09:31	207.81	14.38	13.03	15.52	10.50	0.73	102.24	7.07	
Pearl Harb_O2	###	8/30/2012	15:09:34	207.49	14.35	12.97	15.51	12.75	0.88	102.55	7.09	
Pearl Harb_O2	###	8/30/2012	15:09:37	207.51	14.36	12.98	15.53	9.48	0.66	102.54	7.09	
Pearl Harb_O2	###	8/30/2012	15:09:40	207.63	14.36	12.97	15.53	7.51	0.52	102.42	7.09	
Pearl Harb_O2	###	8/30/2012	15:09:43	207.78	14.37	13.00	15.56	7.14	0.49	102.26	7.07	
Pearl Harb_O2	###	8/30/2012	15:09:46	207.98	14.39	12.99	15.55	9.01	0.62	102.06	7.06	
Pearl Harb_O2	###	8/30/2012	15:09:49	208.16	14.40	13.02	15.57	9.00	0.62	101.88	7.05	
Pearl Harb_O2	###	8/30/2012	15:09:52	208.52	14.43	13.02	15.61	9.16	0.63	101.53	7.02	
Pearl Harb_O2	###	8/30/2012	15:09:55	208.74	14.44	13.06	15.62	11.62	0.80	101.31	7.01	
Pearl Harb_O2	###	8/30/2012	15:09:58	208.89	14.45	13.06	15.62	8.06	0.56	101.15	7.00	
Pearl Harb_O2	###	8/30/2012	15:10:01	208.94	14.45	13.07	15.64	10.99	0.76	101.10	6.99	
Pearl Harb_O2	###	8/30/2012	15:10:04	209.03	14.46	13.07	15.64	11.77	0.81	101.02	6.99	
Pearl Harb_O2	###	8/30/2012	15:10:07	209.08	14.46	13.08	15.64	11.40	0.79	100.96	6.98	
Pearl Harb_O2	###	8/30/2012	15:10:10	209.17	14.47	13.07	15.64	3.77	0.26	100.88	6.98	
Pearl Harb_O2	###	8/30/2012	15:10:13	209.21	14.47	13.10	15.64	4.50	0.31	100.83	6.98	
Pearl Harb_O2	###	8/30/2012	15:10:16	209.18	14.47	13.09	15.66	8.96	0.62	100.87	6.98	

Pearl Harb_O2	###	8/30/2012	15:10:19	209.18	14.47	13.07	15.66	3.37	0.23	100.86	6.98	
Pearl Harb_O2	###	8/30/2012	15:10:22	209.27	14.48	13.11	15.66	3.57	0.25	100.77	6.97	
Pearl Harb_O2	###	8/30/2012	15:10:25	209.28	14.48	13.11	15.66	5.64	0.39	100.76	6.97	
Pearl Harb_O2	###	8/30/2012	15:10:28	209.36	14.48	13.11	15.64	2.02	0.14	100.69	6.97	
Pearl Harb_O2	###	8/30/2012	15:10:31	209.3	14.48	13.11	15.66	3.72	0.26	100.74	6.97	
Pearl Harb_O2	###	8/30/2012	15:10:34	209.31	14.48	13.11	15.66	4.72	0.33	100.74	6.97	
Pearl Harb_O2	###	8/30/2012	15:10:37	209.85	14.52	13.18	15.66	3.33	0.23	100.19	6.93	
Pearl Harb_O2	###	8/30/2012	15:10:40	209.89	14.52	13.19	15.66	3.68	0.25	100.16	6.93	
Pearl Harb_O2	###	8/30/2012	15:10:43	209.88	14.52	13.18	15.66	1.01	0.07	100.16	6.93	
Pearl Harb_O2	###	8/30/2012	15:10:46	209.83	14.52	13.17	15.66	5.46	0.38	100.21	6.93	
Pearl Harb_O2	###	8/30/2012	15:10:49	209.75	14.51	13.16	15.65	3.41	0.24	100.29	6.94	
Pearl Harb_O2	###	8/30/2012	15:10:52	209.66	14.50	13.15	15.65	4.67	0.32	100.38	6.94	
Pearl Harb_O2	###	8/30/2012	15:10:55	209.72	14.51	13.14	15.66	7.36	0.51	100.33	6.94	
Pearl Harb_O2	###	8/30/2012	15:10:58	209.73	14.51	13.14	15.64	3.89	0.27	100.31	6.94	
Pearl Harb_O2	###	8/30/2012	15:11:01	209.78	14.51	13.16	15.64	4.81	0.33	100.26	6.94	
Pearl Harb_O2	###	8/30/2012	15:11:04	209.77	14.51	13.19	15.65	2.13	0.15	100.27	6.94	
Pearl Harb_O2	###	8/30/2012	15:11:07	209.52	14.49	13.18	15.62	6.17	0.43	100.52	6.95	
Pearl Harb_O2	###	8/30/2012	15:11:10	209.5	14.49	13.17	15.61	16.52	1.14	100.54	6.96	
Pearl Harb_O2	###	8/30/2012	15:11:13	209.47	14.49	13.18	15.59	28.99	2.01	100.57	6.96	small cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:11:16	209.5	14.49	13.18	15.60	28.26	1.96	100.54	6.96	
Pearl Harb_O2	###	8/30/2012	15:11:19	209.41	14.49	13.14	15.59	18.87	1.31	100.63	6.96	
Pearl Harb_O2	###	8/30/2012	15:11:22	209.49	14.49	13.17	15.58	10.46	0.72	100.56	6.96	
Pearl Harb_O2	###	8/30/2012	15:11:25	209.52	14.49	13.17	15.58	4.29	0.30	100.53	6.95	
Pearl Harb_O2	###	8/30/2012	15:11:28	209.5	14.49	13.21	15.60	3.61	0.25	100.54	6.96	
Pearl Harb_O2	###	8/30/2012	15:11:31	209.47	14.49	13.21	15.60	3.05	0.21	100.57	6.96	
Pearl Harb_O2	###	8/30/2012	15:11:34	209.09	14.46	13.20	15.56	6.54	0.45	100.95	6.98	
Pearl Harb_O2	###	8/30/2012	15:11:37	207.82	14.38	13.10	15.48	30.42	2.10	102.22	7.07	small cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:11:40	206.84	14.31	13.05	15.42	26.70	1.85	103.20	7.14	small cloud of sus sed
Pearl Harb_O2	###	8/30/2012	15:11:43	206.61	14.29	13.05	15.41	18.64	1.29	103.43	7.16	
Pearl Harb_O2	###	8/30/2012	15:11:46	206.54	14.29	13.02	15.40	5.70	0.39	103.50	7.16	
Pearl Harb_O2	###	8/30/2012	15:11:49	205.04	14.18	12.91	15.35	5.47	0.38	105.01	7.26	
Pearl Harb_O2	###	8/30/2012	15:11:52	203.46	14.08	12.82	15.27	8.95	0.62	106.58	7.37	
Pearl Harb_O2	###	8/30/2012	15:11:55	204.19	14.13	12.86	15.32	15.55	1.08	105.86	7.32	
Pearl Harb_O2	###	8/30/2012	15:11:58	205.26	14.20	12.94	15.36	17.22	1.19	104.78	7.25	
Pearl Harb_O2	###	8/30/2012	15:12:01	205.74	14.23	12.99	15.39	8.84	0.61	104.30	7.22	
Pearl Harb_O2	###	8/30/2012	15:12:04	205.91	14.24	13.01	15.38	4.97	0.34	104.13	7.20	
Pearl Harb_O2	###	8/30/2012	15:12:07	206.25	14.27	13.06	15.41	6.71	0.46	103.79	7.18	
Pearl Harb_O2	###	8/30/2012	15:12:10	206.44	14.28	13.08	15.42	4.62	0.32	103.60	7.17	

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14. ABSTRACT

Propeller wash induces disturbances to the bottom sediment in Department of Defense (DoD) harbors in multiple ways. Resuspension of bottom sediment, which is often contaminated, by propeller wash in DoD harbors is a phenomenon constantly observed and occasionally reported. While these resuspension events occur frequently, their effects on potential for erosion, transport, re-deposition, and re-contamination of bottom sediments have not been rigorously studied or quantified.

This study aims to demonstrate and validate an innovative quantitative method that integrates information from state-of-science measuring devices/tools with predictive methods, including models. These measuring devices have been used to measure and evaluate critical parameters that govern propeller wash resuspension and subsequent fate and transport of the eroded sediments in DoD harbors.

Accurate model results helped to reduce the uncertainty associated with propeller wash hydrodynamics and shear stress and resuspension potential of the sediment bed. Field data were used to support the fate and transport model, CH3D, which was successfully calibrated for San Diego Bay, CA; Pearl Harbor, HI; and Sinclair Inlet, WA. Once validated with the field data, CH3D was used to predict footprints (deposition) of the sediment plume and re-contamination potential from propeller wash. We have further extended the model's simulation and prediction capabilities on both the resuspension potential and fate and transport of the plume far and beyond the scenarios when the data were measured.

15. SUBJECT TERMS

propeller wash; CH3D model; fate and transport plume study; modeling study; erosion of sediment beds; resuspension; size-fraction distribution; field study; silt particles

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