SAMPLING AND ANALYSIS PLAN
PORT OF LONG BEACH PHASE I MAINTENANCE DREDGING

Prepared for

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degree Celsius
CDF	confined disposal facility
COC	chain-of-custody
COPC	chemical of potential concern
CSTF	Contaminated Sediments Task Force
CTR	California Toxic Rule
cy	cubic yard
DQO	data quality objective
EDD	electronic data deliverable
EET	effluent elutriate test
ERL	effects range low
ERM	effects range median
g	gram
L	liter
LCS	laboratory control sample
LDPE	low-density polyethylene
mL	milliliter
MLLW	mean low lower water
NAD 83	North American Datum 1983
oz	ounce
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
Port	Port of Long Beach
QA	quality assurance
QC	quality control
r/v	research vessel
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
SRM	standard reference material
TOC	total organic carbon

USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
UTM	*Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, and Upland Confined Disposal Facilities – Testing Manual*

1 INTRODUCTION

The Port of Long Beach (Port), located in Long Beach, California, plans to initiate Phase I of its Maintenance Dredging Program (Program). The Program involves maintenance dredging at seven separate project areas (Figure 1) within the Port beginning in late 2013. The Port estimates approximately 70,800 cubic yards (cy) of material will be managed as part of the Program. Maintenance operations will consist of either physical removal by mechanical methods (e.g., bucket dredge equipment) or knockdown (i.e., redistribution of sediment from high spots to depressions) using equipment and methodologies appropriate for site conditions. Proposed dredged material planned for removal will be placed inside a borrow pit being constructed within the footprint of the Middle Harbor Phase II Slip Fill.

This Sampling and Analysis Plan (SAP) documents procedures and methods to be used in sampling and testing of proposed dredged material from the Port's Program. Testing will be used to confirm chemicals of potential concern (COPCs) are not present at hazardous levels in dredged material and effluent generated during knockdown or placement activities will not result in any water quality impacts.

1.1 Project Summary

The Port's Program is planned to restore the permitted maintenance depth at seven sites located throughout the Port. Pier J Turning Basin will require mechanical dredging operations to remove proposed dredged material for placement at the Middle Harbor Phase II Slip Fill. Knockdown operations will be conducted at six sites (Pier B Berths 77-80, Pier G Berths 214-215, Pier J Berths 245-247, Pier T Berths 118-119, Pier T Berths 132-134, and West Basin Access Channel). Table 1 summarizes the proposed project depth, allowable overdepth, and estimated maintenance dredging volumes for Pier J Turning Basin, and Table 2 summarizes the proposed project depth and knockdown volume for the other six sites. Existing bathymetry for all seven project areas is shown on Figures 2 through 7. A description of each project area is provided below.

- **Pier J Turning Basin**—located in eastern San Pedro Bay, directly west of the jetties protecting the Pier J east-facing slip—has a permitted maintenance depth of -48 feet mean lower low water (MLLW), plus 2 feet of allowable overdepth (Figure 2). Approximately 65,900 cy of sediments will be removed from the project area via mechanical dredging methods.

- **Pier B Berths 77-80**—located on the eastern side of Pier B and facing the back reaches of Channel 2—has a permitted maintenance depth of -40 feet MLLW (Figure 3). Approximately 300 cy of sediments are proposed for knockdown.
- **Pier G Berths 214-215**—located on the southwest corner of Pier G and facing the western embayment of Southeast Basin—has a permitted maintenance depth of -40 feet MLLW (Figure 4). Approximately 100 cy of sediments are proposed for knockdown.
- **Pier J Berths 245-24**—located on the north side of Pier J and adjacent to the southern portion of Southeast Basin—has a permitted maintenance depth of -50 feet MLLW (Figure 5). Approximately 1,800 cy of sediments are proposed for knockdown.
- **Pier T Berths 118-119**—located on the eastern side of Pier T and adjacent to the southwestern portion of the Back Channel—has a permitted maintenance depth of -36 feet MLLW (Figure 6). Approximately 100 cy of sediments are proposed for knockdown.
- **Pier T Berths 132-134**—centrally located along the northern portion of West Basin—has a permitted maintenance depth of -51 feet MLLW (Figure 7). Approximately 700 cy of sediments are proposed for knockdown.
- **West Basin Access Channel**—diagonally trending from the southeast to northwest portions of West Basin—has a permitted maintenance depth of -51 feet MLLW (Figure 8). Approximately 1,900 cy of sediments are proposed for knockdown.

For the Pier J Turning Basin, dredge material characterization will be limited to physical and chemical analyses of bulk sediment and effluent elutriate on sediment collected to the project depth (permitted depth plus 2 feet of allowable overdredge). Material below project depth (i.e., z layer) will be archived and may be analyzed separately to estimate the condition of the post-dredge sediment surface. For planning purposes, the z layer is the 6 inches directly below the allowable overdepth (i.e., from +2 to +2.5 feet below the permitted depth).

Table 1
Proposed Maintenance Dredging Volumes

Project Area	Permitted Depth (feet MLLW)	Allowable Overdepth (feet MLLW)	Project Depth (Permitted plus 2 Feet of Allowable Overdepth) (feet MLLW)	Estimated Volume to Permitted Depth[1] (cy)	Estimated Volume for 2 Feet of Allowable Overdepth[1] (cy)	Total Estimated Project Volume (cy)
Mechanical Dredging/Dredged Material Removal						
Pier J Turning Basin	-48	2	-50	19,800	46,100	**65,900**

Notes:
NA = not applicable
1 Volume rounded to nearest 100 cy

For all other project areas, as defined in Table 2, dredge material characterization will be limited to chemical analysis of effluent elutriate on sediment collected to permitted depth. Z-layer samples will not be collected at these project areas. Because an effluent elutriate sample for the West Basin Access Channel was recently analyzed and showed no exceedance of water quality criteria (Anchor QEA 2012), additional samples will not be collected for this project area.

Table 2
Proposed Volumes for Knockdown Operations

Project Area	Permitted Depth (feet MLLW)	Estimated Volume to Permitted Depth[1] (cy)
Pier B Berths 77-80	-40	300
Pier G Berths 214-215	-40	100
Pier J Berths 245-247	-50	1,800
Pier T Berths 118-119	-36	100
Pier T Berths 132-134	-51	700
West Basin Access Channel	-51	1,900
Total Volume	**—**	**4,900**

Notes:
1 Volume rounded to nearest 100 cy

As recommended in the Port's *Sediment Management Handbook for Dredge and Fill Projects* (Anchor QEA and Thomas Johnson 2011), testing to determine suitability for placement at the Middle Harbor Phase II Slip Fill will include physical and chemical analyses on bulk sediment and elutriate testing using the effluent elutriate test (EET) in accordance with the *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, and Upland Confined Disposal Facilities – Testing Manual* (UTM; USACE 2003).

Testing to determine the suitability of knockdown operations will include chemical analyses on an elutriate sample using the effluent elutriate test (EET) in accordance with the UTM (USACE 2003). For the West Basin Access Channel, analytical data from the elutriate sample collected to support Piers T and J sediment characterization will be used (Anchor QEA 2012). These data showed no exceedance of water quality criteria. Additional sediment samples will not be collected in this project area.

In addition, z-layer samples for each core will be collected and archived from areas requiring mechanical dredging (i.e., removal of sediment). Z-layer samples will not be collected from areas requiring knockdown operations. Pending a review of project sediment chemistry results by the Contaminated Sediments Task Force (CSTF), the CSTF may request these z-layer samples be submitted for bulk sediment chemistry analysis to estimate the condition of the post-dredge sediment surface.

2 KNOCKDOWN OPERATIONS

Maintaining design depths within the Port has become a critical navigation and safety concern due to current draft requirements for Post-Panamax style container vessels. It is common for vessels to maintain very shallow clearances (sometimes inches) as they transit the Inner Harbor areas and along terminals. As such, areas where sediment accumulation exceeds 6- to 12 inches above the design depth presents significant concerns to vessel captains and port pilots. Occasionally, vessel scour during low tide events can create uneven surfaces resulting in sediment displacement and eventually accumulation that resembles small mounds. Because these mounds typically do not exceed 1 to 2 feet in elevation above the design depth and are usually spread around spatially rather than clumped together, the use of mechanical or hydraulic dredging equipment is not cost effective or feasible. Instead, a practice known as knockdown or drag beam (also known as beam leveling) is common practice for smoothing the uneven sediment surface. A presentation of knockdown methods and guidelines that were incorporated into the Port's Maintenance Dredging Regional General Permit 28 renewal is included in Appendix A. A review of potential water column and benthic community impacts associated with knockdown operations is included in Appendix B.

3 PROJECT MANAGEMENT AND RESPONSIBILITIES

Members of the project team and their responsibilities are summarized in the following sections.

3.1 Program and Field Activities

Matt Arms, Water Quality Specialist at the Port, will be Port's program manager. James Vernon, an Environmental Specialist at the Port, will be the Port's project manager for this Program and will assist Mr. Arms as needed.

Dr. Shelly Anghera, of Anchor QEA, L.P., will be the consultant's program manager. Dr. Anghera will serve as a technical expert and will coordinate with the CSTF. Andrew Martin, of Anchor QEA, will be project manager and assist Dr. Anghera as needed. Mr. Martin will be responsible for overall project coordination, including:

- Production of all project deliverables
- Collection and submittal of environmental samples to the laboratory for physical and chemical analyses
- Development of the Sampling and Analysis Report (SAR), interpretation of analytical results, and reporting
- Administrative coordination to ensure timely and successful completion of the project

Mr. Martin and/or Chris Osuch, the Field Manager, will be responsible for making all decisions concerning the coordination of field sampling activities and sample collection as well as ensuring that appropriate protocols for decontamination, sample preservation, and holding times are observed. Mr. Osuch will provide quality assurance (QA) oversight for the field sampling program and ensure samples are collected and documented accurately.

During sampling activities, the sampling vessel will be staffed by two Anchor QEA personnel to assist with collection, documentation, and processing of core samples. The vessel and vibracoring equipment is owned and will be operated by Leviathan Environmental Services, LLC.

3.2 Laboratory Project Management

Delaney Peterson will serve as Anchor QEA's QA managers. Ms. Peterson and/or her designee will provide QA oversight for the analytical laboratory program to ensure data quality and oversee data validation. QA responsibilities include ensuring that all laboratory analyses meet the Program's data quality objectives (DQOs) and other specification required by UTM guidelines (USACE 2003). Ms. Peterson will coordinate with and oversee the subcontractor listed in Table 3.

Table 3
Analytical Laboratory, Point of Contact, and Shipping/Delivery Information

Laboratory	Volume per Sample	Analyses Performed	Point of Contact	Shipping Information
Calscience Environmental Laboratories, Inc.	1L for all physical and chemical testing; 250mL of sediment per EET; 6.5L of site water per EET	Physical and chemical testing; EET	Bob Stearns (714) 895-5494, ext. 202	7440 Lincoln Way Garden Grove, CA 92841-1427

Notes:
L = liter
mL = milliliter

The contract laboratory is expected to meet the following minimum technical requirements:

- Adhere to methods outlined in this SAP.
- Deliver electronic data files as specified.
- Meet all reporting requirements.
- Implement QA/quality control (QC) procedures outlined in this SAP and required by UTM guidelines (USACE 2003).
- Allow Anchor QEA to perform laboratory and data audits, if necessary.
- Follow documentation, chain-of-custody (COC), and sample logbook procedures.
- Meet turnaround times for deliverables.

4 SAMPLING PROGRAM FOR SEDIMENT CORE COLLECTION AND HANDLING

4.1 Sampling Platform

Sediment cores and surface samples will be collected from the research vessel (R/V) *Leviathan*, an aluminum-hulled work boat modified for environmental sampling and owned and operated by Leviathan Environmental Services. The R/V *Leviathan* is 22 feet in length and has an open deck suitable for the staging, collecting, and processing sediment samples. The sampling device will be deployed from an 8-foot hydraulic A-frame on the stern of the deck. The *R/V Leviathan* is U.S. Coast Guard (USCG) inspected and is captained by a USCG Licensed Master.

4.2 Navigation and Vertical Control

On-vessel navigation and positioning will be accomplished using a DGPS. The navigation system will be used to guide the vessel to pre-determined sampling locations, with an accuracy of plus or minus 10 feet. Horizontal positions will be reported in latitude and longitude in degrees, decimal minutes (to three decimal places). Positions will be relative to North American Datum 1983 (NAD 83).

Upon locating the sampling station, depth will be measured using an onboard, calibrated fathometer or leadline. The mudline elevation relative to MLLW datum will be determined by adding the tidal elevation to the measured depth. All vertical elevations will be reported to the nearest 0.1 foot relative to MLLW.

4.3 Station and Sample Identification

Each sampling location and each individual and composite sediment sample will be assigned a unique alphanumeric identifier using the following format:

- For mechanical dredging operations, the first four characters identify the project area (i.e., PJTB for Pier J Turning Basin).
- For knockdown operations, the first two characters identify the project area (i.e., PB for Pier B, PG for Pier G, PJ for Pier J, and PT for Pier T). Sample identification codes for West Basin Access Channel are not included, because additional sediment samples will not be collected from this project area.

- The remaining characters will be used to identify:
  - The sampling location or individual sediment sample collected from a particular core or grab sample. These two characters will be 01, 02, 03, etc., and will be repeated for each respective sample.
  - The respective composite samples from the project area. The last four characters will be "COMP."
  - For the respective z-layer sample from each sample, the last character will be "z."

4.4 Sampling Locations

Sampling locations were chosen with the objective of representing, as accurately as possible, the physical and chemical characteristics of material proposed for dredging or knockdown. Target coordinates, estimated mudline elevations, and target core lengths for each station are presented in Table 4.

Five stations were identified for sediment sampling within Pier J Turning Basin (Figure 2). For all project areas where knockdown operations will occur (Pier B Berths 77-80, Pier G Berths 214-215, Pier T Berths 118-119 and Pier T Berths 132-134), multiple stations (one station per 500 linear feet of knockdown area along a wharf face and every 250 feet offshore) were identified for sediment sampling within each of the corresponding dredging footprints (Figures 3 through 7). Sediment sampling is not planned for West Basin Access Channel.

Table 4

Target Coordinates, Estimated Mudline Elevations, and Target Core Lengths

Project Area	Station ID	Latitude (Degrees Dec. Minutes)[1]	Longitude (Degrees Dec. Minutes)[1]	Estimated Mudline Elevation (feet MLLW)	Project Depth (Permitted plus 2 Feet of Allowable Overdepth)[2] (feet MLLW)	Length of Z Layer[3] (feet)	Z-Layer Depth[3] (feet MLLW)	Target Core Length (feet)[4]
Mechanical Dredging/Dredged Material Removal								
Pier J Turning Basin	PJTB-01	33° 44.362'	118° 10.739'	-47.6	-50	-0.5	-50.5	2.9
	PJTB-02	33° 44.322'	118° 10.829'	-46.4	-50	-0.5	-50.5	4.1
	PJTB-03	33° 44.411'	118° 10.676'	-46.7	-50	-0.5	-50.5	3.8
	PJTB-04	33° 44.343'	118° 10.662'	-47.3	-50	-0.5	-50.5	3.2
	PJTB-05	33° 44.376'	118° 10.691'	-46.9	-50	-0.5	-50.5	3.6
Knockdown Operations								
Pier B Berths 77-80	PB-01	33° 46.475'	118° 12.950'	-39.3	-40	NA	NA	surface
	PB-02	33° 46.511'	118° 12.857'	-39.5	-40	NA	NA	surface
	PB-03	33° 46.542'	118° 12.783'	-34.9	-40	NA	NA	surface
Pier G Berths 214-215	PG-01	33° 44.794'	118° 12.391'	-37.1	-40	NA	NA	surface
	PG-02	33° 44.721'	118° 12.391'	-39.4	-40	NA	NA	surface
Pier J Berths 245-247	PJ-01	33° 44.441'	118° 12.162'	-48.7	-50	NA	NA	surface
	PJ-02	33° 44.440'	118° 12.060'	-49.7	-50	NA	NA	surface
	PJ-03	33° 44.439'	118° 11.954'	-49.4	-50	NA	NA	surface
	PJ-04	33° 44.439'	118° 11.853'	-49.1	-50	NA	NA	surface
	PJ-05	33° 44.441'	118° 11.732'	-47.5	-50	NA	NA	surface
Pier T Berths 118-119	PT-01	33° 45.568'	118° 13.171'	-31.3	-36	NA	NA	surface
	PT-02	33° 45.676'	118° 13.228'	-35.1	-36	NA	NA	surface
Pier T Berths 132-134	PT-03	33° 45.218'	118° 14.058'	-49.7	-51	NA	NA	surface
	PT-04	33° 45.176'	118° 13.988'	-50.7	-51	NA	NA	surface
	PT-05	33° 45.240'	118° 13.981'	-50.2	-51	NA	NA	surface
	PT-06	33° 45.264'	118° 13.874'	-50.3	-51	NA	NA	surface
	PT-07	33° 45.250'	118° 13.845'	-50.7	-51	NA	NA	surface
	PT-08	33° 45.283'	118° 13.784'	-50.3	-51	NA	NA	surface
	PT-09	33° 45.262'	118° 13.750'	-50.6	-51	NA	NA	surface
West Basin Access Channel	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
NA = not applicable
1 NAD 83
2 Two feet of allowable overdepth applicable only to Pier J Turning Basin.
3 The z layer is only applicable to Pier J Turning Basin.
4 Target core lengths shown are to characterize to project depth plus z layer for the Pier J Turning Basin. Surface grabs (penetrating 10 inches) using a Van Veen sampler will be collected in all knockdown areas.

4.5 Field Sampling, Processing, and Shipping

4.5.1 Project Sediment and Site Water Collection

A total of 24 sediment samples will be collected from six of the seven project areas (Table 4). For mechanical dredging operations at Pier J Turning Basin, five core samples will be collected in the project area. Cores will be collected at each sampling location to project depth (permitted depth plus 2 feet of allowable overdredge) plus a 0.5-foot z layer or to refusal depth, whichever is encountered sooner.

For knockdown operations at Pier B Berths 77-80, Pier G Berths 214-215, Pier J Berths 245-247, Pier T Berths 118-119, and Pier T Berths 132-134, multiple surface sediment samples will be collected (one station per 500 linear feet of knockdown area along a wharf face and every 250 feet offshore):

- Three surface grab samples will be collected at Pier B Berths 77-80.
- Two surface grab samples will be collected at Pier G Berths 214-215.
- Five surface grab samples will be collected at Pier J Berths 245-247.
- Two surface grab samples will be collected at Piet T Berths 118-119.
- Seven surface grab samples will be collected at Pier T Berths 132-134.

Surface sediment will be collected using a Van Veen sediment grab sampler capable of penetrating a maximum of 10 inches. If the deposit thickness is less than 10 inches, surface sediment will be collected to the permitted depth only.

Sediment cores will be collected using an electrically powered vibracore. The core tube will consist of a polyethylene liner inside a 4-inch-outer-diameter aluminum casing and a stainless-steel catcher to retain the sediment. A new liner will be inserted into the core tube prior to sampling at each station to eliminate the possibility of cross contamination among stations. The vibracore will be deployed from the stern of the vessel using an A-frame and winch. It will be energized as it nears the bottom and will be supported upright with the winch line during penetration into the sediment. Upon completion of penetration at a station, the vibracore will be shut down, the position recorded, and the sampler recovered.

Refusal will be defined as less than 2 inches of penetration per minute. If refusal is encountered, the vessel will be moved and a second and third core attempted, if needed. If refusal is encountered after a third attempt, additional cores will not be attempted unless operational problems are suspected.

After the core is on deck, the liner containing sediment will be extracted onto a core tray and examined to determine compliance with acceptance criteria as follows:

- The core should penetrate and retain material to a maximum length of 10 feet, unless refusal was encountered.
- Cored material should not extend out the top of the core tube nor contact any part of the sampling apparatus at the top of the core tube.
- No obstructions should be present in the cored material that might have blocked the subsequent entry of sediment into the core tube and resulted in an incomplete core collection.

If core acceptance criteria are not achieved, the core will be rejected, the old liner will be cleaned or replaced, and the procedure will be repeated until acceptance criteria are met. If three repeated deployments within a 50-foot radius of the proposed sampling location do not yield a core that meets appropriate acceptance criteria, Anchor QEA's project manager may select an alternate location within the same project area.

Surface sediment will be collected using a modified 0.1-square meter Van Veen grab sampler. Prior to deployment, the sampler will be set with the jaws open. The sampler will be deployed from the stern of the vessel using an A-frame and winch. Once in contact with the bottom, the sampler's tripping mechanism will automatically release causing the jaws to close upon retrieval. The sampler will then be recovered and evaluated whether the sample is acceptable to be retained for processing (i.e., sediment penetration depth is adequate and there are no signs of washout or channeling of the sediment surface). If the grab sample is determined to be acceptable, the sediment will then be emptied into a stainless steel tray for processing.

In addition to sediment, site water will be collected for elutriate testing requirements. Site water will be collected from the dredge footprint using a peristaltic pump, or similar methods, and placed in low-density polyethylene (LDPE) cubitainers.

4.5.2 Sample Processing

Sediment core and grab samples will be processed onboard the sampling vessel. Physical characteristics of each core and grab sample will be noted on the individual sediment collection forms (Appendix C). A representative core or grab sample from each sampling location will be photographed. Sediment across the entire length of each core or grab sample will then be individually homogenized to a uniform consistency in a stainless-steel bowl. A 500-milliliter (mL) subsample of each individual homogenized core or grab sample will be archived to allow for additional chemical analysis if necessary. Archived samples will be stored frozen at -20 degrees plus or minus 10 degrees Celsius (°C) for up to 1 year after sample collection.

A proportionate volume, based on relative core lengths, of the homogenized sediment from each core or grab sample will be combined to form a single composite sample for each project area dredging footprint. A 500-mL subsample of each composite sample will be archived to allow for additional chemical analysis if necessary.

In addition, the z layer (i.e., 0.5 foot below project depth) from each individual core will be collected within Pier J Turning Basin. Z-layer material will be homogenized and archived for additional chemical analysis if necessary. The determination to analyze z-layer samples will be made by the CSTF following a review of project sediment chemistry results.

After compositing, sediment will be placed into jars appropriate for physical and chemical analyses, and all jars will be firmly sealed with Teflon-lined lids. Waterproof sampling labels will be filled out with an indelible-ink pen and affixed to sample containers. Each label will contain the project name, sample identification number, preservation technique, requested analyses, date and time of collection and preparation, and initials of the person preparing the sample. Samples will be temporarily stored in coolers supplied with crushed ice or frozen blue ice packs. Temperatures will be maintained at approximately 4° plus or minus 2°C and monitored throughout storage.

4.5.3 Sample Shipping

Sediment will be delivered to the analytical laboratory for analysis (see Table 3). Prior to delivery, samples will be securely packed inside a cooler with crushed ice or frozen blue ice packs. Proper COC procedures will be followed (Section 4.8.2). Original, signed COC forms will be placed into a sealed plastic bag and taped to the inside lid of the cooler. Packing tape will be wrapped completely around the cooler and a custody seal will be placed on the front lid seam. The laboratory sample custodian will measure and record the temperature of the temperature blank included in each cooler and will specifically note any coolers that do not contain ice packs or are not sufficiently cold upon receipt.

4.6 Field Equipment Decontamination Procedures

The deck of the vessel will be rinsed with site water between stations. Any sampling equipment that cannot be cleaned to the satisfaction of the project manager will not be used for any further sampling activity. All sampling equipment exposed to collected sediment will be decontaminated between stations using the following procedures:

- Rinse with site water and wash with scrub brush until free of sediment.
- Wash with phosphate-free biodegradable soap solution.
- Rinse with site water taken from below the water surface.

Acid or solvent washes will not be used in the field because of safety considerations and problems associated with rinsate disposal and sample integrity.

4.7 Waste Disposal

Prior to moving to the next sampling location, any incidental sediment remaining after sampling will be washed overboard at the collection site. Any sediment spilled on the deck of the sampling vessel will be washed into surface waters at the collection site after sampling.

All disposable sampling materials and personnel protective equipment used in sample processing (e.g., disposable coveralls, gloves, and paper towels) will be placed into heavy-duty garbage bags or other appropriate containers. Disposable supplies will be removed from the vessel by sampling personnel and placed into a normal refuse container for disposal as solid waste.

4.8 Documentation

All sampling activities will be documented in a field logbook, on sediment core collection forms, on COC forms, and in photographs.

4.8.1 Field Data Recording

A complete record of field activities will be maintained. Recordkeeping will include documentation of field activities and all samples collected for analysis. The project manager will maintain the field logbook. The field logbook will provide a description of all sampling activities, field personnel, and weather conditions as well as a record of all modifications to procedures and plans identified in this SAP. All entries will be made with an indelible-ink pen. The field logbook is intended to provide sufficient data and observations to enable readers to reconstruct events that occurred during the sampling period.

A sediment core collection form and a surface sediment collection form will be completed for each sediment core or surface sediment sample, respectively. Example forms are included in Appendix C. In addition to standard entries of personnel, date, and time, the form includes information regarding station coordinates, device penetration, and physical characteristics of the sediment (e.g., texture, color, odor, stratification, and sheen).

A representative core or grab sample from each location will be photographed. The project area, sample identification number, attempt number (if more than one attempt), and sample date and time will be labeled on a white board and included in each photograph.

4.8.2 Chain-of-Custody Procedures

COC procedures will be followed for all samples throughout the collection, handling, and analysis process. COC forms will be the principal documents used to detail the possession and transfer of samples.

The project manager or a designee will be responsible for all sample tracking and COC procedures. This person will be responsible for final sample inventory, maintenance of sample custody documentation, and completion of COC and sample tracking forms prior to transferring samples to the laboratory. A COC form will accompany each cooler of samples to the analytical laboratory. Each person who has custody of the samples will sign the COC form and ensure that the samples are not left unattended unless properly secured. Copies of all COC forms will be retained in the project files and will be attached to the final SAR.

The laboratory project manager will ensure that COC forms are properly signed upon receipt of the samples and will note questions or observations concerning sample integrity on the COC forms. The laboratory will contact the project manager or designee immediately if discrepancies between the COC forms and the sample shipment are discovered upon receipt.

5 PHYSICAL AND CHEMICAL ANALYSES

5.1 Sediment

Physical and chemical analyses of sediment from the Pier J Turning Basin were selected to characterize dredge material prior to its use as fill material. Physical analyses of the PJTB composite sediment sample will include grain size, total organic carbon (TOC), and total solids. Chemical analyses will include metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pyrethroids, and pesticides. If requested by the CSTF, physical and chemical analyses of all z-layer sediment samples will include TOC, total solids, metals, PAHs, PCBs, pyrethroids, and pesticides. All analytical methods used will follow U.S. Environmental Protection Agency (USEPA) or ASTM protocols. Table 5 presents proposed chemical and conventional parameters, recommended analytical methods, and reporting limits for the evaluation of sediment samples. Samples will be maintained according to the appropriate holding times and temperatures for each analysis, as presented in Table 6.

Table 5
Proposed Conventional and Chemical Parameters, Analytical Methods, and Reporting Limits for Sediment Samples

Parameter	Analytical Method	Units	Reporting Limits
Conventional Parameters			
Total solids	D2540B	% wet wt	0.1
TOC	9060A	% dry wt	0.05
Grain size	D4464	% dry wt	0.1
Metals			
Arsenic	6020	mg/kg dry wt	0.500
Cadmium	6020	mg/kg dry wt	0.100
Chromium	6020	mg/kg dry wt	0.100
Copper	6020	mg/kg dry wt	0.100
Lead	6020	mg/kg dry wt	0.100
Mercury	7471A	mg/kg dry wt	0.020
Nickel	6020	mg/kg dry wt	0.100
Selenium	6020	mg/kg dry wt	0.100

Parameter	Analytical Method	Units	Reporting Limits
Silver	6020	mg/kg dry wt	0.100
Zinc	6020	mg/kg dry wt	1.00
PAHs			
1,6,7-Trimethylnaphthalene	8270C SIM	µg/kg dry wt	20
1-Methylnaphthalene	8270C SIM	µg/kg dry wt	20
1-Methylphenanthrene	8270C SIM	µg/kg dry wt	20
2,6-Dimethylnaphthalene	8270C SIM	µg/kg dry wt	20
2-Methylnaphthalene	8270C SIM	µg/kg dry wt	20
Acenaphthene	8270C SIM	µg/kg dry wt	20
Acenaphthylene	8270C SIM	µg/kg dry wt	20
Anthracene	8270C SIM	µg/kg dry wt	20
Benzo (a) Anthracene	8270C SIM	µg/kg dry wt	20
Benzo (a) Pyrene	8270C SIM	µg/kg dry wt	20
Benzo (b) Fluoranthene	8270C SIM	µg/kg dry wt	20
Benzo (e) Pyrene	8270C SIM	µg/kg dry wt	20
Benzo (g,h,i) Perylene	8270C SIM	µg/kg dry wt	20
Benzo (k) Fluoranthene	8270C SIM	µg/kg dry wt	20
Biphenyl	8270C SIM	µg/kg dry wt	20
Chrysene	8270C SIM	µg/kg dry wt	20
Dibenz (a,h) Anthracene	8270C SIM	µg/kg dry wt	20
Fluoranthene	8270C SIM	µg/kg dry wt	20
Fluorene	8270C SIM	µg/kg dry wt	20
Indeno (1,2,3-c,d) Pyrene	8270C SIM	µg/kg dry wt	20
Naphthalene	8270C SIM	µg/kg dry wt	100
Perylene	8270C SIM	µg/kg dry wt	20
Phenanthrene	8270C SIM	µg/kg dry wt	20
Pyrene	8270C SIM	µg/kg dry wt	20
Organochlorine Pesticides			
2,4'-DDD	8081A	µg/kg dry wt	1.0
2,4'-DDE	8081A	µg/kg dry wt	1.0
2,4'-DDT	8081A	µg/kg dry wt	1.0
4,4'-DDD	8081A	µg/kg dry wt	1.0
4,4'-DDE	8081A	µg/kg dry wt	1.0
4,4'-DDT	8081A	µg/kg dry wt	1.0
Aldrin	8081A	µg/kg dry wt	1.0
Alpha Chlordane	8081A	µg/kg dry wt	1.0
Alpha-BHC	8081A	µg/kg dry wt	1.0
Beta-BHC	8081A	µg/kg dry wt	1.0

Parameter	Analytical Method	Units	Reporting Limits
Chlordane	8081A	µg/kg dry wt	10
Cis-nonachlor	8081A	µg/kg dry wt	1.0
Delta-BHC	8081A	µg/kg dry wt	1.0
Dieldrin	8081A	µg/kg dry wt	1.0
Endosulfan I	8081A	µg/kg dry wt	1.0
Endrin Aldehyde	8081A	µg/kg dry wt	1.0
Endrin Ketone	8081A	µg/kg dry wt	1.0
Gamma Chlordane	8081A	µg/kg dry wt	1.0
Gamma-BHC	8081A	µg/kg dry wt	1.0
Heptachlor	8081A	µg/kg dry wt	1.0
Heptachlor Epoxide	8081A	µg/kg dry wt	1.0
Methoxychlor	8081A	µg/kg dry wt	1.0
Oxychlordane	8081A	µg/kg dry wt	1.0
Toxaphene	8081A	µg/kg dry wt	20
Trans-nonachlor	8081A	µg/kg dry wt	1.0
Pyrethroids			
Bifenthrin	8270D modified (TQ/EI)	µg/kg	0.5
Cyfluthrin, total	8270D modified (TQ/EI)	µg/kg	0.5
Cypermethrin, total	8270D modified (TQ/EI)	µg/kg	0.5
Deltamethrin	8270D modified (TQ/EI)	µg/kg	0.5
Esfenvalerate/Fenvalerate, total	8270D modified (TQ/EI)	µg/kg	0.5
Fenpropathrin	8270D modified (TQ/EI)	µg/kg	0.5
Permethrin, cis+trans	8270D modified (TQ/EI)	µg/kg	1.0
Warrior (Lambda Cyhalothrin), total	8270D modified (TQ/EI)	µg/kg	0.5
PCB Congeners			
PCB003	8270C SIM	µg/kg dry wt	0.50
PCB008	8270C SIM	µg/kg dry wt	0.50
PCB018	8270C SIM	µg/kg dry wt	0.50
PCB028	8270C SIM	µg/kg dry wt	0.50
PCB031	8270C SIM	µg/kg dry wt	0.50
PCB033	8270C SIM	µg/kg dry wt	0.50
PCB037	8270C SIM	µg/kg dry wt	0.50
PCB044	8270C SIM	µg/kg dry wt	0.50
PCB049	8270C SIM	µg/kg dry wt	0.50
PCB052	8270C SIM	µg/kg dry wt	0.50
PCB056	8270C SIM	µg/kg dry wt	0.50
PCB060	8270C SIM	µg/kg dry wt	0.50
PCB066	8270C SIM	µg/kg dry wt	0.50
PCB070	8270C SIM	µg/kg dry wt	0.50

Parameter	Analytical Method	Units	Reporting Limits
PCB074	8270C SIM	µg/kg dry wt	0.50
PCB077	8270C SIM	µg/kg dry wt	0.50
PCB081	8270C SIM	µg/kg dry wt	0.50
PCB087	8270C SIM	µg/kg dry wt	0.50
PCB095	8270C SIM	µg/kg dry wt	0.50
PCB097	8270C SIM	µg/kg dry wt	0.50
PCB099	8270C SIM	µg/kg dry wt	0.50
PCB101	8270C SIM	µg/kg dry wt	0.50
PCB105	8270C SIM	µg/kg dry wt	0.50
PCB110	8270C SIM	µg/kg dry wt	0.50
PCB114	8270C SIM	µg/kg dry wt	0.50
PCB118	8270C SIM	µg/kg dry wt	0.50
PCB119	8270C SIM	µg/kg dry wt	0.50
PCB123	8270C SIM	µg/kg dry wt	0.50
PCB126	8270C SIM	µg/kg dry wt	0.50
PCB128	8270C SIM	µg/kg dry wt	0.50
PCB132	8270C SIM	µg/kg dry wt	0.50
PCB138/158	8270C SIM	µg/kg dry wt	1.00
PCB141	8270C SIM	µg/kg dry wt	0.50
PCB149	8270C SIM	µg/kg dry wt	0.50
PCB151	8270C SIM	µg/kg dry wt	0.50
PCB153	8270C SIM	µg/kg dry wt	0.50
PCB156	8270C SIM	µg/kg dry wt	0.50
PCB157	8270C SIM	µg/kg dry wt	0.50
PCB167	8270C SIM	µg/kg dry wt	0.50
PCB168	8270C SIM	µg/kg dry wt	0.50
PCB169	8270C SIM	µg/kg dry wt	0.50
PCB170	8270C SIM	µg/kg dry wt	0.50
PCB174	8270C SIM	µg/kg dry wt	0.50
PCB177	8270C SIM	µg/kg dry wt	0.50
PCB180	8270C SIM	µg/kg dry wt	0.50
PCB183	8270C SIM	µg/kg dry wt	0.50
PCB184	8270C SIM	µg/kg dry wt	0.50
PCB187	8270C SIM	µg/kg dry wt	0.50
PCB189	8270C SIM	µg/kg dry wt	0.50
PCB194	8270C SIM	µg/kg dry wt	0.50
PCB195	8270C SIM	µg/kg dry wt	0.50
PCB200	8270C SIM	µg/kg dry wt	0.50
PCB201	8270C SIM	µg/kg dry wt	0.50
PCB203	8270C SIM	µg/kg dry wt	0.50

Parameter	Analytical Method	Units	Reporting Limits
PCB206	8270C SIM	µg/kg dry wt	0.50
PCB209	8270C SIM	µg/kg dry wt	0.50

Notes:
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
SIM = selective ion monitoring
TQ/EI = triple quadrupole/electron ionization
wt = weight

Table 6
Container Requirements, Holding Times, and Preservation Methods

Parameter	Sample Size	Container Size and Type	Holding Time	Sample Preservation Technique
Elutriate Samples				
Metals	100mL	500-mL HDPE	6 months	Nitric acid to pH<2
PAHs	1L	2 x 1L amber	7 days to extraction	Cool/4°C
			40 days after extraction	
Pesticides	1L	2 x 1L amber	7 days to extraction	Cool/4°C
			40 days after extraction	
PCBs	1L	2 x 1L amber	7 days to extraction	Cool/4°C
			40 days after extraction	
Pyrethroids	1L	2 x 1L amber	7 days to extraction	Cool/4°C
			40 days after extraction	
Sediment Samples				
Grain size	100g	16-oz HDPE	6 months	Cool/4°C
Total solids	10g	8-oz glass	14 days	Cool/4°C
			6 months	Freeze/-18°C
TOC	50g		28 days	Cool/4°C
			6 months	Freeze/-18°C
Metals	50g		6 months; 28 days for mercury	Cool/4°C
			2 years (except mercury)	Freeze/-18°C

Parameter	Sample Size	Container Size and Type	Holding Time	Sample Preservation Technique
PAHs	30g	16-oz glass	14 days until extraction	Cool/4°C
			1 year until extraction	Freeze/-18°C
			40 days after extraction	Cool/4°C
Pesticides	30g		14 days until extraction	Cool/4°C
			1 year until extraction	Freeze/-18°C
			40 days after extraction	Cool/4°C
PCBs	30g		14 days until extraction	Cool/4°C
			2 years until extraction	Freeze/-18°C
			40 days after extraction	Cool/4°C
Pyrethroids	30g		14 days until extraction	Cool/4°C
			1 year until extraction	Freeze/-18°C
			40 days after extraction	Cool/4°C

Notes:
g = gram
L = liter
HDPE = high-density polyethylene
oz = ounce

5.2 Elutriate Effluent Test

The EET will be used to assess effluent discharge by evaluating the concentration of COPCs discharged from a nearshore confined disposal facility (CDF), such as the Middle Harbor Phase II Slip Fill, after placement. Sediment elutriates from the sediment samples collected from six project areas (Pier J Turning Basin, Pier B Berths 77-80, Pier G Berths 214-215, Pier T Berths 118-119 and Pier T Berths 132-134) and will be prepared for analysis in accordance procedures outlined in the UTM (USACE 2003) for elutriate evaluations of CDF effluent.

To prepare the effluent elutriate, sediment from the project areas and site water from the center of the Middle Harbor Phase II Slip Fill will be combined in a 4-liter (-L) cylinder at a concentration of 150 grams per liter (g/L; based on dry weight) then vigorously mixed at room temperature for 1 hour via aeration. After 1 hour, the mixture will be allowed to settle for 24 hours. After this settling period, the liquid and suspended material will be siphoned off with care as not to disturb the sediment. The resulting elutriate will be centrifuged to remove particulates prior to analysis. The dissolved fraction will be analyzed for metals, PAHs, PCBs, pyrethroids, and pesticides. All analytical methods used will follow USEPA protocols. Table 7 presents the proposed chemical parameters, recommended analytical methods, and reporting limits for the evaluation of elutriate samples. Samples will be maintained according to the appropriate holding times and temperatures for each analysis, as presented in Table 6.

Table 7
Proposed Chemical Parameters, Analytical Methods, and Reporting Limits for Elutriate Samples

Parameter	Analytical Method	Units	Reporting Limits
Metals			
Arsenic	1640/6020	µg/L	0.030
Cadmium	1640/6020	µg/L	0.030
Chromium	1640/6020	µg/L	0.200
Copper	1640/6020	µg/L	0.030
Lead	1640/6020	µg/L	0.030
Mercury	7470A	µg/L	0.050
Nickel	1640/6020	µg/L	0.20
Selenium	1640/6020	µg/L	0.050
Silver	1640/6020	µg/L	0.050
Zinc	1640/6020	µg/L	1.00
PAHs			
1,6,7-Trimethylnaphthalene	8270C SIM	µg/L	0.20
1-Methylnaphthalene	8270C SIM	µg/L	0.20
1-Methylphenanthrene	8270C SIM	µg/L	0.20
2,6-Dimethylnaphthalene	8270C SIM	µg/L	0.20
2-Methylnaphthalene	8270C SIM	µg/L	0.20
Acenaphthene	8270C SIM	µg/L	0.20
Acenaphthylene	8270C SIM	µg/L	0.20
Anthracene	8270C SIM	µg/L	0.20
Benzo (a) Anthracene	8270C SIM	µg/L	0.20
Benzo (a) Pyrene	8270C SIM	µg/L	0.20
Benzo (b) Fluoranthene	8270C SIM	µg/L	0.20
Benzo (e) Pyrene	8270C SIM	µg/L	0.20
Benzo (g,h,i) Perylene	8270C SIM	µg/L	0.20
Benzo (k) Fluoranthene	8270C SIM	µg/L	0.20
Biphenyl	8270C SIM	µg/L	0.20
Chrysene	8270C SIM	µg/L	0.20

Parameter	Analytical Method	Units	Reporting Limits
Dibenz (a,h) Anthracene	8270C SIM	µg/L	0.20
Fluoranthene	8270C SIM	µg/L	0.20
Fluorene	8270C SIM	µg/L	0.20
Indeno (1,2,3-c,d) Pyrene	8270C SIM	µg/L	0.20
Naphthalene	8270C SIM	µg/L	0.20
Perylene	8270C SIM	µg/L	0.20
Phenanthrene	8270C SIM	µg/L	0.20
Pyrene	8270C SIM	µg/L	0.20
Total HPAHs	8270C SIM	µg/L	0.20
Organochlorine Pesticides			
2,4'-DDD	8081A	µg/L	0.050
2,4'-DDE	8081A	µg/L	0.050
2,4'-DDT	8081A	µg/L	0.050
4,4'-DDD	8081A	µg/L	0.050
4,4'-DDE	8081A	µg/L	0.050
4,4'-DDT	8081A	µg/L	0.050
Aldrin	8081A	µg/L	0.050
Alpha Chlordane	8081A	µg/L	0.050
Alpha-BHC	8081A	µg/L	0.050
Beta-BHC	8081A	µg/L	0.050
Chlordane	8081A	µg/L	0.50
Cis-nonachlor	8081A	µg/L	0.050
Delta-BHC	8081A	µg/L	0.050
Dieldrin	8081A	µg/L	0.050
Endosulfan I	8081A	µg/L	0.050
Endosulfan II	8081A	µg/L	0.050
Endrin Ketone	8081A	µg/L	0.050
Gamma Chlordane	8081A	µg/L	0.050
Gamma-BHC	8081A	µg/L	0.050
Heptachlor	8081A	µg/L	0.050
Heptachlor Epoxide	8081A	µg/L	0.050
Methoxychlor	8081A	µg/L	0.050
Toxaphene	8081A	µg/L	2.0
Trans-nonachlor	8081A	µg/L	0.050
Total DDTs	8081A	µg/L	0.050
Pyrethroids			
Bifenthrin	8270D modified TQ/EI	µg/L	0.002
Cyfluthrin, total	8270D modified TQ/EI	µg/L	0.002

Parameter	Analytical Method	Units	Reporting Limits
Cypermethrin, total	8270D modified TQ/EI	µg/L	0.002
Deltamethrin	8270D modified TQ/EI	µg/L	0.002
Esfenvalerate/Fenvalerate, total	8270D modified TQ/EI	µg/L	0.002
Fenpropathrin	8270D modified TQ/EI	µg/L	0.002
Permethrin, cis+trans	8270D modified TQ/EI	µg/L	0.004
Warrior (Lambda Cyhalothrin), total	8270D modified TQ/EI	µg/L	0.002
PCB Congeners			
PCB003	8270C SIM	µg/L	0.020
PCB008	8270C SIM	µg/L	0.020
PCB018	8270C SIM	µg/L	0.020
PCB028	8270C SIM	µg/L	0.020
PCB031	8270C SIM	µg/L	0.020
PCB033	8270C SIM	µg/L	0.020
PCB037	8270C SIM	µg/L	0.020
PCB044	8270C SIM	µg/L	0.020
PCB049	8270C SIM	µg/L	0.020
PCB052	8270C SIM	µg/L	0.020
PCB056	8270C SIM	µg/L	0.020
PCB060	8270C SIM	µg/L	0.020
PCB066	8270C SIM	µg/L	0.020
PCB070	8270C SIM	µg/L	0.020
PCB074	8270C SIM	µg/L	0.020
PCB077	8270C SIM	µg/L	0.020
PCB081	8270C SIM	µg/L	0.020
PCB087	8270C SIM	µg/L	0.020
PCB095	8270C SIM	µg/L	0.020
PCB097	8270C SIM	µg/L	0.020
PCB099	8270C SIM	µg/L	0.020
PCB101	8270C SIM	µg/L	0.020
PCB105	8270C SIM	µg/L	0.020
PCB110	8270C SIM	µg/L	0.020
PCB114	8270C SIM	µg/L	0.020
PCB118	8270C SIM	µg/L	0.020
PCB119	8270C SIM	µg/L	0.020
PCB123	8270C SIM	µg/L	0.020
PCB126	8270C SIM	µg/L	0.020
PCB128	8270C SIM	µg/L	0.020
PCB132	8270C SIM	µg/L	0.020

Parameter	Analytical Method	Units	Reporting Limits
PCB138/158	8270C SIM	µg/L	0.040
PCB141	8270C SIM	µg/L	0.020
PCB149	8270C SIM	µg/L	0.020
PCB151	8270C SIM	µg/L	0.020
PCB153	8270C SIM	µg/L	0.020
PCB156	8270C SIM	µg/L	0.020
PCB157	8270C SIM	µg/L	0.020
PCB167	8270C SIM	µg/L	0.020
PCB168	8270C SIM	µg/L	0.020
PCB169	8270C SIM	µg/L	0.020
PCB170	8270C SIM	µg/L	0.020
PCB174	8270C SIM	µg/L	0.020
PCB177	8270C SIM	µg/L	0.020
PCB180	8270C SIM	µg/L	0.020
PCB183	8270C SIM	µg/L	0.020
PCB184	8270C SIM	µg/L	0.020
PCB187	8270C SIM	µg/L	0.020
PCB189	8270C SIM	µg/L	0.020
PCB194	8270C SIM	µg/L	0.020
PCB195	8270C SIM	µg/L	0.020
PCB200	8270C SIM	µg/L	0.020
PCB201	8270C SIM	µg/L	0.020
PCB203	8270C SIM	µg/L	0.020
PCB206	8270C SIM	µg/L	0.020
PCB209	8270C SIM	µg/L	0.020

Notes:
µg/L = micrograms per liter
SIM = selective ion monitoring
TQ/EI = triple quadrupole/electron ionization

6 QUALITY ASSURANCE AND QUALITY CONTROL

DQOs for the Program ensure that data collected are of known and acceptable quality in order to achieve project objectives. The quality of laboratory data is assessed by precision, accuracy, representativeness, comparability, and completeness.

6.1 Field and Laboratory Quality Assurance and Quality Control

Field and laboratory activities must be conducted in such a manner that results meet specified quality objectives and are fully defensible. Guidance for QA/QC is derived from protocols developed for USEPA test methods (1986), National Functional Guidelines (USEPA 1999, 2004, 2008), and other cited methods.

6.1.1 Field Quality Control

Samples will be identified and labeled in a consistent manner to ensure that field samples are traceable and that labels provide all information necessary for the laboratory to properly conduct required analyses. Samples will be placed in appropriate containers and preserved for shipment to the laboratory.

6.1.1.1 Sample Containers

Sample containers and preservatives will be provided by the laboratory. The laboratory will maintain documentation certifying cleanliness of bottles and purity of preservatives provided. Specific container requirements are included in Table 6.

6.1.1.2 Sample Identification Numbers and Labels

Each sample will have an adhesive plastic or waterproof paper label affixed to the container and will be labeled at the time of collection. The following information will be recorded on the container label at the time of collection:

- Project area
- Sample identification number
- Date and time of sample collection
- Preservative type (if applicable)

- Analysis to be performed

Samples will be uniquely identified with a sample identification number that, at a minimum, specifies sample matrix, sampling location, and type of sample.

6.1.1.3 Field Quality Assurance Sampling

Field QA procedures will consist of following acceptable practices for collecting and handling samples. Adherence to these procedures will be complemented by periodic and routine equipment inspection.

Additional sample volume will be collected at one project area to ensure that the laboratory has sufficient sample volume to run the program-required analytical QA/QC samples during analysis, as specified in Table 8. Additional sample volume to meet this requirement will be collected at a frequency of one in 20 samples processed.

6.1.2 Laboratory Quality Control

Laboratory QC procedures, where applicable and in accordance with California Environmental Laboratory Accreditation Program protocols, include initial and continuing instrument calibrations, standard reference materials (SRMs), laboratory control samples (LCSs), matrix replicates, matrix spikes, surrogate spikes (for organic analysis), and method blanks. Table 8 lists the frequency of analysis for laboratory QA/QC samples, and Table 9 summarizes DQOs for precision, accuracy, and completeness.

Table 8
Frequency of Analysis for Laboratory Quality Assurance/Quality Control Samples

Analysis Type	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes[5]	LCSs/SRMs	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Sediments								
Total solids	As needed[1]	NA	1 per batch[4]	NA	NA	NA	NA	NA
Grain size	As needed[2]	NA	1 per batch	NA	NA	NA	NA	NA
TOC	As needed	Prior to and at the end of each batch	1 per batch	1 per batch	1 per batch	NA	1 per batch	NA
Metals	Daily	Prior to each batch, after every 10 samples, and at the end of each batch	1 per batch	1 per batch	1 per batch	NA	1 per batch	NA
PAHs/Pyrethroids	As needed[3]	Prior to each batch and every 12 hours	NA	1 per batch	1 per batch	1 per batch	1 per batch	Every sample
Pesticides/PCBs	As needed[3]	Prior to and at the end of each batch	NA	1 per batch	1 per batch	1 per batch	1 per batch	Every sample
Elutriates								
Metals	Daily	Prior to each batch, after every 10 samples, and at the end of each batch	1 per batch	1 per batch	1 per batch	NA	1 per batch	NA
PAHs/Pyrethroids	As needed[3]	Prior to each batch and every 12 hours	NA	1 per batch	1 per batch	1 per batch	1 per batch	Every sample

Analysis Type	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes[5]	LCSs/SRMs	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Pesticides/PCBs	As needed[3]	Prior to and at the end of each batch	NA	1 per batch	1 per batch	1 per batch	1 per batch	Every sample

Notes:
NA = not applicable
1 Ovens are not calibrated or certified; the temperature is monitored daily prior to use to ensure the oven is maintaining the required temperature for the analysis. Oven thermometers are calibrated annually.
2 Balances are calibrated (and certified) annually by an outside vendor and monitored daily prior to use to ensure calibration is still appropriate.
3 Initial calibrations are considered valid until the ongoing, continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.
4 A batch is defined as 20 or fewer field samples.
5 Matrix QC will be performed only if sufficient volume is available.

Table 9
Data Quality Objectives

Parameter	Precision (duplicates)	Accuracy (LCS and Matrix Spike)	Completeness
Elutriate Samples			
Metals	± 20% RPD	80-120% R	95%
PAHs	± 30% RPD	60-140% R	95%
Pesticides	± 30% RPD	60-140% R	95%
PCBs	± 30% RPD	60-140% R	95%
Pyrethroids	± 30% RPD	60-140% R	95%
Sediment Samples			
Total solids	± 20% RPD	NA	95%
TOC	± 20% RPD	NA	95%
Grain size	± 20% RPD	NA	95%
Total metals	± 30% RPD	75-125% R	95%
PAHs	± 35% RPD	50-150% R	95%
Pesticides	± 35% RPD	50-150% R	95%
PCBs	± 35% RPD	50-150% R	95%
Pyrethroids	± 35% RPD	50-150% R	95%

Notes:
NA = not applicable
R = recovery
RPD = relative percent difference

Results from QA samples in each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. QC sample results will then be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, the QA manager will be contacted immediately and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

6.1.2.1 Laboratory Instrument Calibration and Frequency

An initial calibration will be performed on each laboratory instrument to be used at the start of the Program, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet method control criteria. A calibration verification will be analyzed following each initial calibration and will meet method criteria prior to analysis of samples. Continuing calibrations will be performed daily prior to any sample analysis to track instrument performance. The frequency of continuing calibration will be one for every 10 samples analyzed or daily, whichever is required by the analytical method. If the ongoing, continuing calibration is out of control, the analysis must come to a halt until the source of the control failure is eliminated or reduced to meet control specifications. All project samples analyzed while instrument calibration was out of control will be re-analyzed.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately prior to continuing calibration verification at the instrument for each type of applicable analysis.

6.1.2.2 Laboratory Duplicates/Replicates

Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates and replicates are subsamples of the original sample that are prepared and analyzed as a separate sample.

6.1.2.3 Matrix Spikes and Matrix Spike Duplicates

Analysis of matrix spike samples provides information on the extraction efficiency of the method on the sample matrix. By performing duplicate matrix spike analyses, information on the precision of the method is also provided.

6.1.2.4 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. The method blank for all analyses must contain less than the method reporting limit of any single target analyte or compound. If a laboratory method blank exceeds this criterion for any analyte or compound, analysis must stop, the source of contamination must be eliminated or reduced, and the affected samples must be re-prepared and re-analyzed.

6.1.2.5 Laboratory Control Samples

LCSs are analyzed to assess possible laboratory bias at all stages of sample preparation and analysis. The LCS is a matrix-dependent spiked sample prepared at the time of sample extraction along with the preparation of sample and matrix spikes. The LCS will provide information on the accuracy of the analytical process and, when analyzed in duplicate, will provide precision information as well.

6.1.2.6 Laboratory Deliverables

Data packages will be checked for completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested are present. Data quality will be assessed based on the DQOs described in this SAP and by considering the following:

- Holding times
- All compounds of interest reported
- Reporting limits
- Surrogate spike results
- Matrix spike and matrix spike duplicate results
- Blank spikes
- LCSs and LCS duplicates
- SRM results
- Method blanks
- Detection limits

6.2 Data Management

The laboratory will supply all analytical results in Adobe Acrobat (.pdf) format and electronic data deliverable (EDD) form. All data will be reviewed by the QA manager to ensure that DQOs for each analysis are met and that both the Adobe Acrobat and EDD forms of data are consistent with each other. Adobe Acrobat files will be stored in the project files on Anchor QEA's secure server, and the EDD form will be imported into Anchor QEA's database system.

7 DATA ANALYSIS AND INTERPRETATION

Data will be analyzed and presented clearly to determine characterization of dredge material for use as fill. All analytical data will be reviewed for accuracy prior to reporting.

7.1 Sediment Chemistry and Physical Analyses

For characterization purposes, results of sediment chemical analysis of Program sediment will be compared to effects range low (ERL) and effects range median (ERM) values developed by Long et al. (1995).

7.2 Elutriate Chemistry Data Analyses

EET results will be compared to applicable water quality standards for enclosed bays and estuaries. The USEPA developed numerical water standards for the protection of aquatic organisms. Numerical standards are defined under the California Toxic Rule (CTR), which applies to inland waters, bays, and estuaries within California, as presented in Table 10.

Table 10
California Toxic Rule Water Quality Criteria for Dissolved Contaminants for the Protection of Aquatic Life

Pollutant	Criteria for the Protection of Saltwater Aquatic Life	
	Acute CMC (µg/L)	Chronic CCC (µg/L)
Dissolved Metals		
Arsenic	69	36
Cadmium[1]	40	8.8
Chromium VI	1100	50
Copper	4.8	3.1
Lead	210	8.1
Mercury[1]	1.8	0.94
Nickel	74	8.2
Selenium	290	71
Silver	1.9	-
Zinc	90	81
Chlorinated Pesticides		

Pollutant	Criteria for the Protection of Saltwater Aquatic Life	
	Acute CMC (µg/L)	Chronic CCC (µg/L)
Aldrin	1.3	-
Alpha-BHC	-	-
Beta-BHC	-	-
Gamma-BHC	0.16	
Delta-BHC	-	-
Chlordane	0.09	0.004
4,4’-DDT	0.13	0.001
4,4’-DDE	-	-
4,4’-DDD	-	-
Dieldrin	0.71	0.0019
Alpha-Endosulfan	0.034	0.0087
Beta-Endosulfan	0.034	0.0087
Endosulfan Sulfate	-	-
Endrin	0.037	0.0023
Endrin Aldehyde	-	-
Heptachlor	0.053	0.0036
Heptachlor Epoxide	0.053	0.0036
Toxaphene	0.21	0.0002
PCBs		
Total PCBs[2]	-	0.03

Notes:
- = no criteria available
CMC = Criterion Maximum Concentration
CCC = Criterion Continuous Concentration
1 Cadmium and mercury criteria recommended by the USEPA.
2 Total PCBs are the sum of all congener, isomers, homologs, or Aroclors.

8 REPORTING AND DELIVERABLES

8.1 Sediment Characterization Sampling and Analysis Results

A SAR will be prepared to document all activities associated with collecting, processing, and analyzing sediment samples. Reports received from the laboratory will be included as appendices. The SAR will be submitted in both hard copy and electronic versions to the Port for presentation at a CSTF meeting. At a minimum, the following will be included in the SAR:

- Summary of all field activities including a description of any deviations from the approved SAP.
- Locations of sediment sampling stations in California State Plane coordinates (NAD 83) to the nearest foot and in latitude and longitude in degrees, decimal minutes (to three decimal places). All vertical elevations of mudline and water surface will be reported to the nearest 0.1 foot relative to MLLW.
- A project map depicting actual sampling locations.
- QA/QC summary for physical and chemical analyses.
- Data results. Electronic copies for all data will be stored on CD ROM. All electronic data will be provided in an EDD, and all documents will be provided in Adobe Acrobat format.
- Summary of comparison of chemical results with interpretive criteria.

8.2 Quality Assurance/Quality Control Report

The analytical laboratory will provide analytical results sheets and a QA/QC narrative describing results of the standard QA/QC protocols that the accompany analysis of field samples. All electronic copies will be digitally archived. At a minimum, laboratory reports will contain results of laboratory analysis, QA/QC results, all protocols, any deviations from the project SAP, and a narrative of COC details.

9 REFERENCES

Anchor QEA, L.P., and Thomas Johnson Consultant, LLC, 2011. *Sediment Management Handbook for Dredge and Fill Projects*. Prepared for the Port of Long Beach. December 2011.

Anchor QEA, 2012. *Piers T and J Sediment Characterization*. Prepared for the Port of Long Beach. June 2012.

Long et al. (Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder), 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. *Environmental Management* Vol. 19, pgs. 81-97.

USACE (U.S. Army Corps of Engineers), 2003. *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual*. ERDC/EL TR-03-1. Prepared by the USACE, Engineer Research and Development Center, Washington, D.C.

USEPA (U.S. Environmental Protection Agency), 1986. *Test Methods for the Evaluation of Solid Waste: Physical/Chemical Methods*. 3rd Edition. USEPA SW-846.

USEPA, 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*. USEPA540/R-99/008. October 1999.

USEPA, 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. USEPA540-R-04-004. October 2004.

USEPA, 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review. USEPA, Office of Superfund Remediation and Technology Innovation*. USEPA 540-R-08-01. June 2008.

FIGURES

AERIAL SOURCE: Aerial from ESRI basemaps. Dredge areas from City of Long Beach.
HORIZONTAL DATUM: California State Plane, Zone 5, NAD83.

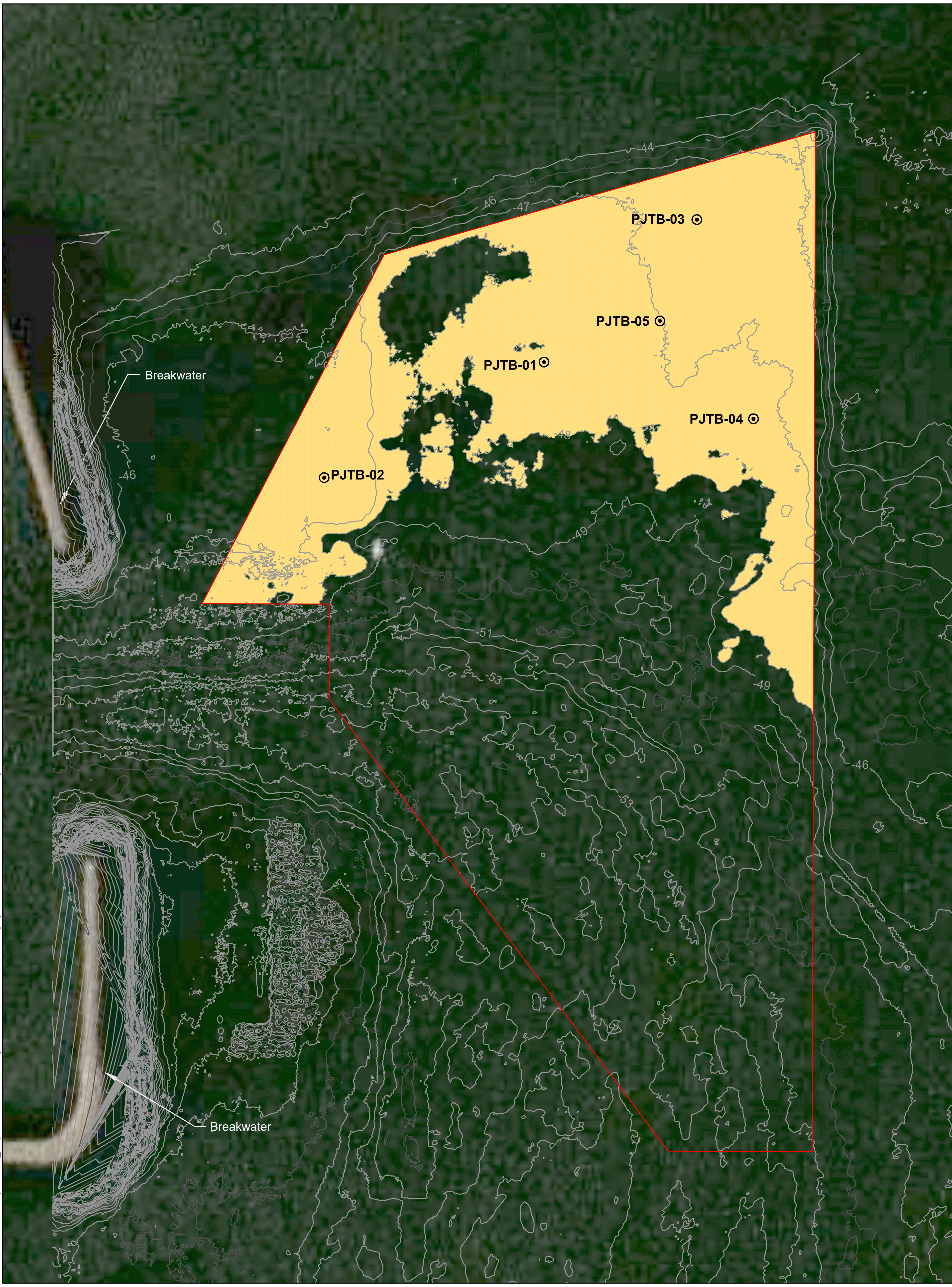
LEGEND:

Project Areas

0 3,000
Scale in Feet

ANCHOR QEA

Figure 1
Vicinity Map
Port of Long Beach Phase 1 Maintenance Dredging



L:\AutoCAD Project Files_Projects\0343-Port of Long Beach\Ph 1 Maintenance Dredging\0343 RP-005 PIER J TURNING.dwg FIG 2

Jun 27, 2013 3:24pm mpratschner

SOURCE: Aerial from Bing maps. Bathymetric contours from City of Long Beach. Surveys performed February 19, 2013.
HORIZONTAL DATUM: California State Plane, Zone 5, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

Areas Higher than -48 feet MLLW

Project Area

⊙ **TB-DU#** Sample Locations

0 200
Scale in Feet

ANCHOR QEA

Figure 2
Pier J Turning Basin
Port of Long Beach Phase 1 Maintenance Dredging

SOURCE: Aerial from Bing maps. Bathymetric contours from City of Long Beach. Surveys performed on February 19, 2013.
HORIZONTAL DATUM: California State Plane, Zone 5, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

Areas Higher than -40 feet MLLW

Project Area

PB-# Sampling Location

50' Between Minor Increments

0+00 1+00

100' Between Major Increments

0 120
Scale in Feet

ANCHOR QEA

Figure 3
Pier B Berths 77-80
Port of Long Beach Phase 1 Maintenance Dredging

SOURCE: Aerial from Bing maps. Bathymetric contours from City of Long Beach. Surveys performed February 19, 2013.
HORIZONTAL DATUM: California State Plane, Zone 5, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

- Areas Higher than -40 feet MLLW
- Project Area
- **PG-#** Sampling Location

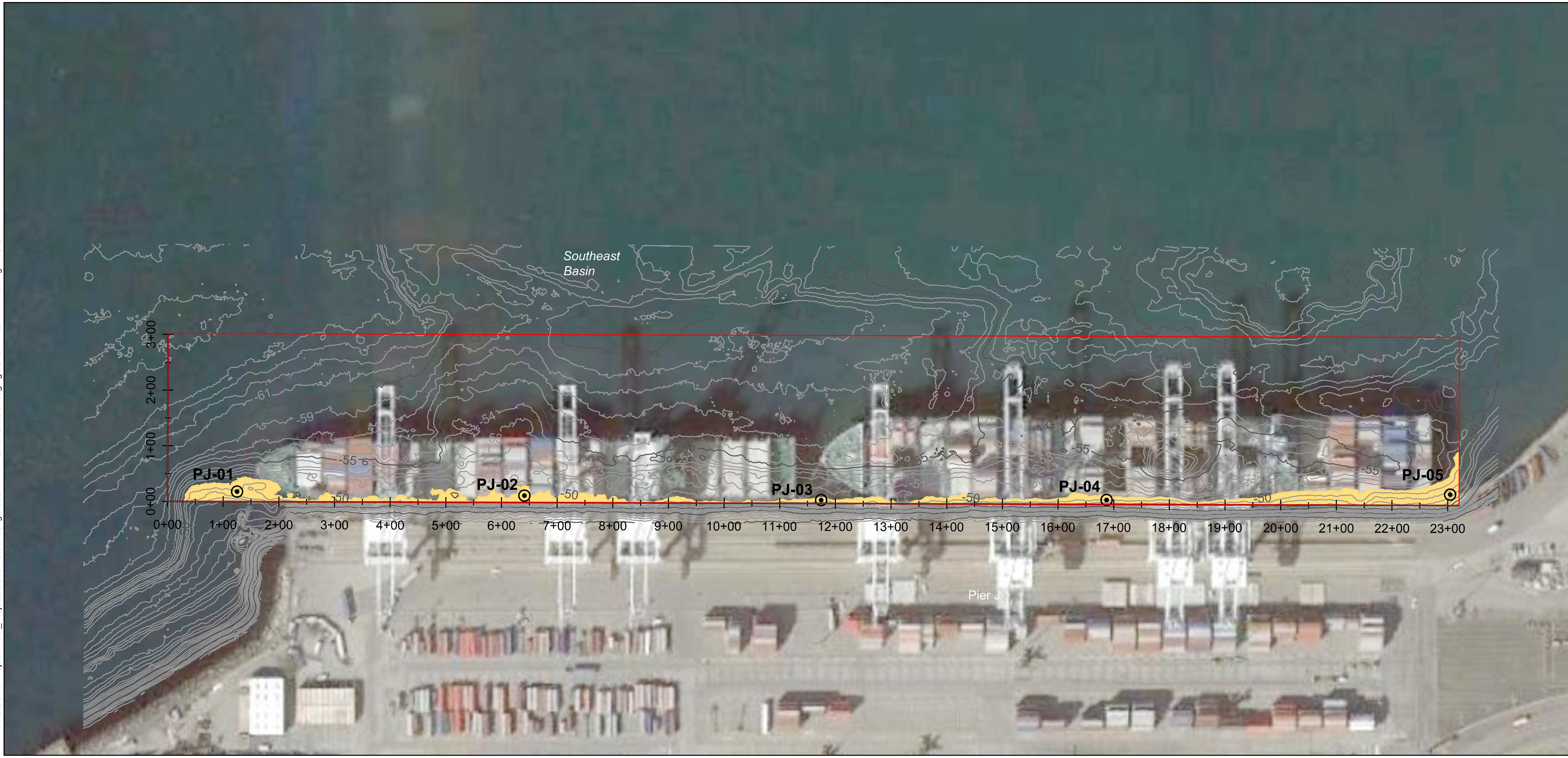
0+00 — 1+00
25' Between Minor Increments
100' Between Major Increments

0 — 60
Scale in Feet

L:\AutoCAD Project Files_Projects\0343-Port of Long Beach\Ph 1 Maintenance Dredging\0343 RP-003 PIER G.dwg FIG 4
Jun 27, 2013 3:28pm mpratschner

ANCHOR QEA

Figure 4
Pier G Berths 214-215
Port of Long Beach Phase 1 Maintenance Dredging



L:\AutoCAD Project Files_Projects\0343-Port of Long Beach\Ph 1 Maintenance Dredging\0343 RP-004 PIER J.dwg FIG 5

Jun 27, 2013 3:29pm mpratschner

SOURCE: Aerial from Bing maps. Bathymetric contours from City of Long Beach. Surveys performed on February 19, 2013.
HORIZONTAL DATUM: California State Plane, Zone 5, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

Areas Higher than -50 feet MLLW

Project Area

⊙ **PJ-#** Sampling Locations

0+00 1+00

50' Between Minor Increments

100' Between Major Increments

0 180
Scale in Feet

ANCHOR QEA

Figure 5
Pier J Berths 245-247
Port of Long Beach Phase 1 Maintenance Dredging

SOURCE: Aerial from Bing maps. Bathymetric contours from City of Long Beach. Surveys performed on February 19, 2013.
HORIZONTAL DATUM: California State Plane, Zone 5, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

Areas Higher than -36 feet MLLW

Project Area

⊙PT-# Sampling Location

25' Between Minor Increments

0+00 1+00

100' Between Major Increments

0 80

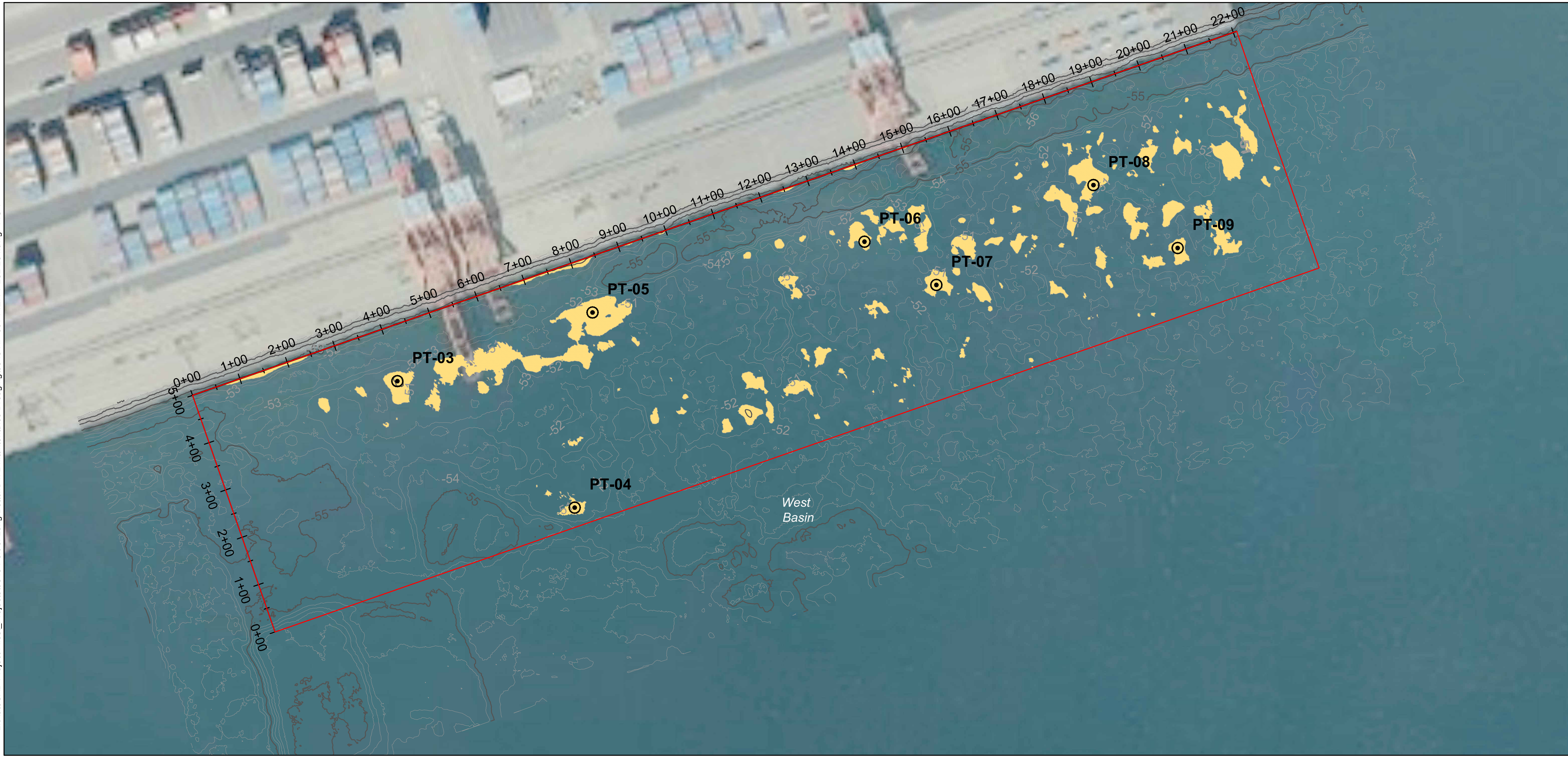
Scale in Feet

L:\AutoCAD Project Files_Projects\0343-Port of Long Beach\Ph 1 Maintenance Dredging\0343 RP-006 PIER T 118-119.dwg FIG 6

Jun 27, 2013 3:31pm mpratschner

ANCHOR QEA

Figure 6
Pier T Berths 118-119
Port of Long Beach Phase 1 Maintenance Dredging



SOURCE: Aerial from Bing maps. Bathymetric contours from City of Long Beach. Surveys performed on February 19, 2013.
HORIZONTAL DATUM: California State Plane, Zone 5, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

Areas Higher than -51 feet MLLW

Project Area

PT-# Sampling Locations

50' Between Minor Increments

100' Between Major Increments

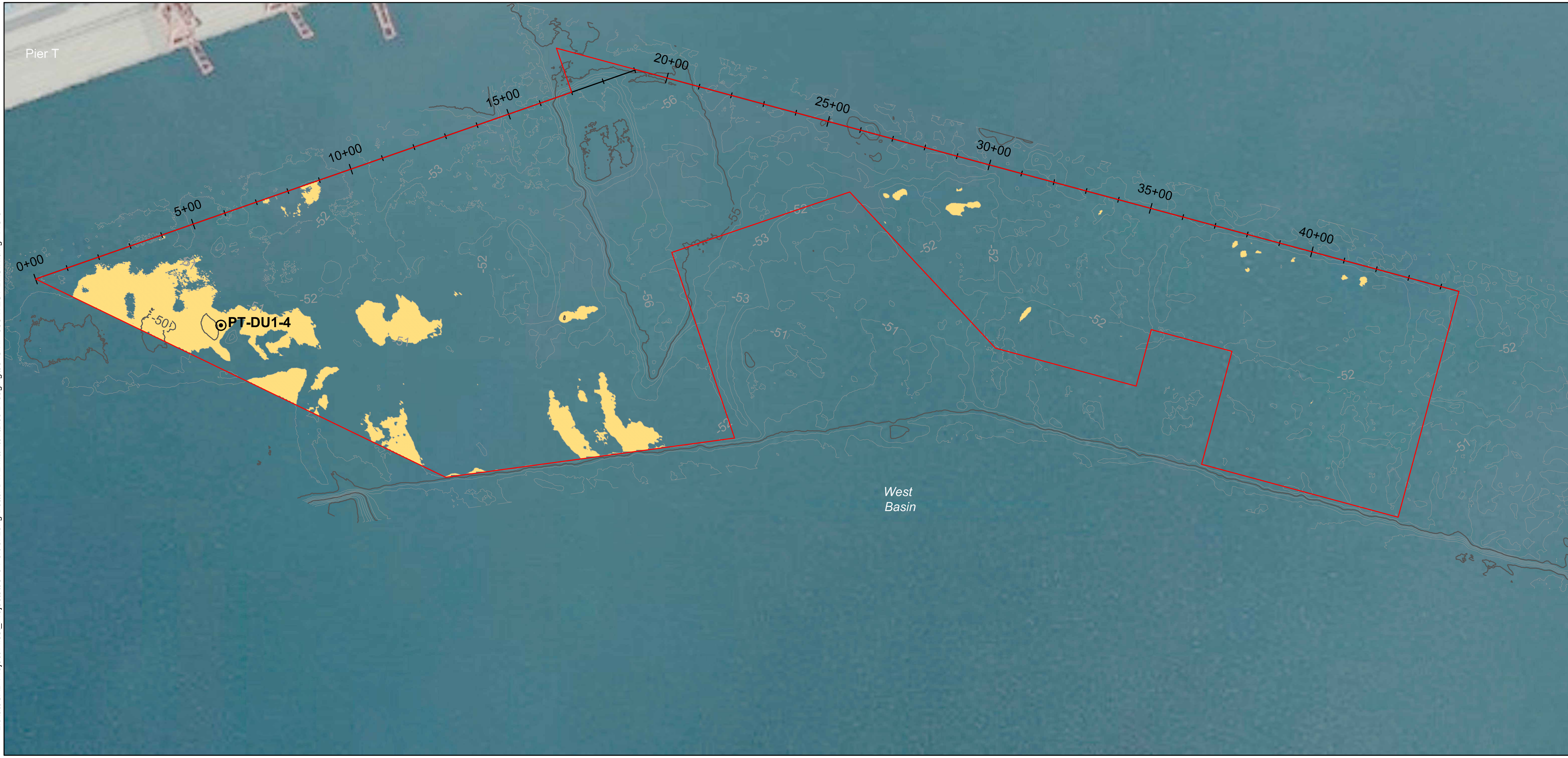
Scale in Feet

L:\AutoCAD Project Files_Projects\0343-Port of Long Beach\Ph 1 Maintenance Dredging\0343 RP-007 PIER T 132-134.dwg FIG 7

Jun 27, 2013 3:39pm mpratschner

ANCHOR QEA

Figure 7
Pier T Berths 132-134
Port of Long Beach Phase 1 Maintenance Dredging



SOURCE: Aerial from Bing maps. Bathymetric contours from City of Long Beach. Surveys performed on February 19, 2013.
HORIZONTAL DATUM: California State Plane, Zone 5, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

Areas Higher than -51 feet MLLW

Area to be Dredged

PT-DU# Sampling Locations (Historical Sampling Anchor QEA, 2012)

0+00 — 5+00: 100' Between Minor Increments; 500' Between Major Increments

0 — 300 Scale in Feet

L:\AutoCAD Project Files_Projects\0343-Port of Long Beach\Ph 1 Maintenance Dredging\0343 RP-008 WEST BASIN.dwg FIG 8

Jun 27, 2013 3:40pm mpratschner

ANCHOR QEA

Figure 8
West Basin Access Channel
Port of Long Beach Phase 1 Maintenance Dredging

APPENDIX A
KNOCKDOWN DREDGING METHODS AND GUIDELINES FOR MAINTENANCE DREDGING RGP 28 RENEWAL

Port of Long Beach
Knockdown Dredging Methods and Guidelines
For Maintenance Dredging RGP 28 and WDR Renewals

Knockdown Dredging Methods

The Port proposes to utilize the following methods when performing knockdown dredging for maintenance dredging. The specific method will be determined on a case-by-case basis for each knockdown dredging project depending on the type of material and location of the high spots in proximity to wharf structures (e.g. pilings, fenders, etc.).

1) **Drag Beam:** An I-beam, rake, cutting edge, or similar fixed object would be dragged by a vessel (e.g. boat, barge) across a shoal in order to redistribute the shoaled material from a high area to a low area within the approved project boundary.

2) **Clamshell Bucket or Excavator** - A clamshell bucket, excavator, or similar equipment would be used to "sweep" the bottom to knock down high spots. This method would be used to remove high spots near piles or other wharf structures where the use of a drag beam is not feasible. A clamshell bucket, excavator, or similar equipment could also be used to relocate (but not lift out of the water column) shoaled material and then place the material on the bottom of a nearby area within the project boundary. The material would either be placed in a lower area or would be placed on the bottom and then leveled out or pushed to a low area within the approved project boundary.

Proposed Knockdown Dredging Criteria & Guidelines

Proposed criteria for utilizing the drag beam or knockdown dredging include the following:

- Knockdown dredging where material is not removed but redistributed is limited to no more than 15,000 cubic yards of material per year.
- For each knockdown dredging project, the total volume to be knocked down cannot exceed 2,000 cy.
- Knockdown dredging shall not be performed in the same area more than once per year.
- Knockdown dredging will, at all times, be contained within an approved project boundary for the berth, channel, etc. The project boundary will be determined on a case-by-case basis in coordination with the Los Angeles Region Contaminated Sediments Task Force (CSTF). Material resulting from the knockdown dredging shall not be moved more than a 1,500 foot radius from where the high spot is located.
- The Port and its contractor shall be allowed a knock-down dredging tolerance of 1-foot below the design depth/permitted depth.
- Sediment sampling (i.e. elutriate testing) will be performed prior to each knockdown dredging project. The sampling approach will be presented in a Sampling and Analysis Plan and provided to the CSTF for approval.
- Water quality monitoring will not be performed during knockdown dredging projects due to the short duration of events.
- The Port would seek approval from the CSTF on the use of this method prior to receiving a notice to proceed (NTP) for each project. Detailed information on the type of knockdown dredging method and designated project boundary will be provided with the NTP request.

Proposed Sampling Guidelines for Characterizing Knockdown Dredging Sites

Proposed sampling guidelines for characterizing knockdown dredging sites include the following:

- Surface sediment samples using a Van Veen or similar sampling device shall be collected.
- Multiple stations per site may be sampled (one station per 500 linear feet of knockdown area [i.e., linear feet of shoals above project depth, not linear feet of wharf face] along a wharf face and every 250 feet offshore).
- Sediment from individual stations shall be composited for analysis and archived
- Site water shall be collected from within the area proposed for knockdown.
- Sediment samples and site water shall be submitted to an analytical chemistry lab for elutriate effluent test (EET). The effluent elutriate shall be tested for metals, polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides, polychlorinated biphenyl (PCB) congeners, and pyrethroids.

APPENDIX B
PRECEDENCE AND POTENTIAL ENVIRONMENTAL IMPACTS OF KNOCKDOWN DREDGING OPERATIONS

PRECEDENCE FOR KNOCKDOWN DREDGING IN REGIONAL GENERAL PERMITS

Knockdown dredging, also known as "beam leveling" or "underwater surface grading," is a common practice used at ports and harbors throughout the United States. The process involves leveling the surface of the sediment within a defined area such that all areas higher than an upper target elevation are graded into areas within a lower target elevation. For example, if a berth is designed to operate at an elevation of -20 feet mean lower low water (MLLW) and areas are present where the surface ranges from -18 feet MLLW to -22 feet MLLW, the port or harbor would hire a contractor to level out the high spots by pushing or dragging the material into the depressions. This technique can be accomplished using either a steel I-beam pulled behind or pushed in front a barge or by sweeping the sediment surface with a large clamshell bucket. Knockdown dredging is typically used instead of removing the material in areas prone to ship propeller scour and/or shoaling where the material only needs to be redistributed within the site as opposed to removed to allow safe vessel movements.

Regulatory permits for knockdown dredging operations have been issued to several West Coast ports in recent years. The Port of San Francisco's permit was combined with its normal maintenance dredging operations and allows maintenance of target elevations at several berths. The Port of Portland also managed a permit for knockdown dredging for the past 10 years that allows maintenance of target surface elevations at several berths. This permit has, in the past, been separate from normal maintenance dredging work, but it is currently being updated to combine the two operations into one permit. The Port of Seattle is currently working with the regulatory agencies in Region 10 to obtain a similar permit for its berths located in the Lower Duwamish Waterway. In all cases, permits typically allow maintenance at multiple berths over multiple years with per event and annual volume limits.

POTENTIAL IMPACTS TO WATER QUALITY

Both the quantity and the duration that particulates are suspended are considered when evaluating water quality impacts. Suspended particulates generated by the movement of equipment are greatest when equipment and sediments are moved through the water column and rise above the water surface; sediments become suspended in the water column by digging and removal activities. Water quality impacts from knockdown or drag beam dredging methods are expected to be minimal. Dredging equipment usually stays underwater, near the sediment's surface. In addition, knockdown dredging operations are usually a few hours to a few days.

Studies have been conducted to evaluate the potential water quality impacts of knockdown dredging operations by evaluation of the nature and extent of the suspended materials (i.e., total suspended solids [TSS]). The U.S. Army Corps of Engineers (USACE) led a study in the Port of Redwood City to characterize the spatial and temporal dynamics of suspended sediment plumes created during knockdown operations (Clarke et al., 2005). On a spatial scale, the following observations were made:

- Sediment disturbance was limited by the width of the bar.
- Lateral spread of the plume was slow, and only increased twice the width of the bar.
- Spatial characteristics of the plume were likely defined by the extent of bottom contact.
- Suspended sediment plumes were constrained to the lower water column.

Temporal characteristics of the plume included:

- Intermittent, or pulsed, increases in suspended sediment concentrations related to episodic passes of the drag beam across high spots
- Depending on the initial plume generated, suspended sediment concentrations may return to ambient levels prior to subsequent passes across the same high spot.

The study indicated that although fish and benthic organisms may be exposed to increased suspended sediment concentrations, these exposures were limited to the lower water column and plumes tended to diffuse laterally behind the barge and were not maintained for extended periods of time. The very nature of knockdown operations suggests elevated suspended sediment concentrations resulting from knockdown operations would not persist.

POTENTIAL FOR BENTHIC COMMUNITY RELATED IMPACTS

Impacts of dredging activities to benthic communities will vary by dredging equipment and methods used, the frequency of disturbance activities, the physical features of site (depth, rugosity, and water currents) and habitat type. Mechanical or hydraulic dredging removes the sediment and associated non-mobile organisms from the dredged area. Knockdown dredging relocates the material within the site by pushing or leveling in a sweeping motion.

Where sediment elevations are to be reduced, all dredging methods leave a new surface that is rapidly recolonized by opportunistic species. Mechanical or hydraulic dredging activities impact the sediment surface that is in excess of the project design. Knockdown dredging activities result in disturbance of sediment surface in the area in excess of project design as well as the surrounding area where material is being redistributed. Sediments are pushed or dragged into area adjacent to the knockdown area resulting in burial of current benthic habitat.

In the Port of Long Beach, the harbor bottom is dominated by soft unconsolidated substrate containing a mixture of sand, silts, and clays. Higher silts and clays are located in the inner harbor regions. The types of benthic organisms that dominate the harbor include small body invertebrates (e.g., polychaetes, oligochaetes, and crustaceans) that are defined ecologically as opportunistic species. Opportunistic organisms readily settle into new areas or have qualities that are resistant to physical disturbances (e.g., mobility and rebuilding habitat structure).

Navigation channels, wharf faces, and harbor bottoms support faunal characteristics of a physically disturbed community because of the nature of the port activities. It is expected that knockdown dredging and burial would not result in high mortality of the current benthic community in affected area. The area is also expected to rapidly colonize by the current species assemblages. Benthic recolonization times are expected to be less than a year (Wilber and Clark 2007; Carter et al. 2008; Løkkeborg 2004). Larger organisms that live in sand dominated areas may take up to a year to recolonize. Structurally complex habitats (e.g., eelgrass, hard bottom, and intertidal) and those that are relatively undisturbed by natural perturbations (e.g., deep-water mud substrata) are more adversely affected by dredging than unconsolidated sediment habitats that occur in shallow coastal waters , like those recommended for inclusion in the Regional General Permit.

REFERENCES

Carter et al. (Carter, A., E. Hague, and L. Floyd), 2008. Benthic Infauna Recovery Following Channel Dredging in the Vicinity of Bogue Inlet, North Carolina. Accessed June 12, 2013. Available from: http:www.fsbpa.com/08Proceedings/05CarterHague2008.pdf.

Clarke et al. (Clarke, D., A. Martin, C. Dickerson, and D. Moore), 2005. *Characterization of Suspended Sediment Plumes Associated with Knockdown Operations at Redwood City, California*. Prepared for U.S. Army Corps of Engineers, San Francisco District.

Løkkeborg, S., 2004. Impacts of Trawling and Scallop Dredging on Benthic Habitats and Communities. FAO Fisheries Technical Paper 472. Food and Agriculture Organization of the United Nations.

Wilber, D.H., and D.G. Clarke. 2007. Defining and Assessing Benthic Recovery Following Dredging and Dredged Material Disposal. 2007 World Organization of Dredging Associations (WODA) Conference, Lake Buena Vista, Florida. Session 3D.

APPENDIX C
SEDIMENT CORE AND SURFACE SEDIMENT COLLECTION FORMS

Sediment Core Collection Form

ANCHOR QEA

Project	Date Time
Station ID	Latitude Longitude
Type of Core	Water Depth (ft) Tide (ft)
Mudline Elevation (ft MLLW)	Target Core Length (ft)
Project Depth+Overdepth (ft MLLW)	Penetration Length (ft) Core Recovery (ft)

Depth In (ft.) Actual Core Sections	Sample Interval	Classification and Remarks (Color, Consistency, Moisture, Grain Size, Sheen, Odor)
1		
2		
3		
4		
5		
6		
7		
8		
9		

____ No. Photos Taken Recorded By: ______________________ Attempt No. ____ of ____

Surface Sediment Field Sample Record

Project Name: **Station ID:**

Field Personnel:	____________	Sample ID:	____________
Sample Date:	____________	Sampling Method:	____________
Sampling Vessel:	____________	Weather:	____________
Subcontractor(s):	____________	Water Depth (ft):	____________
Station Coordinates:	____________	Tide (ft):	____________
	____________	Depth MLLW:	____________
Datum:	NAD 83 / WGS 84	Zone:	
Analysis:	Metals / SVOCs / VOCs / PCBs / Pest	Other:	____________
	TS / Grain Size / TOC / Ammonia / Sulfides	Other:	____________

Grab Number: ________ Grab Recovery: __________cm Sample Interval: __________cm Time: ____________

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:	Comments:
cobble	D.O.	none	H2S	none	
gravel	gray	slight	petroleum	slight	
sand C M F	black	moderate	other:	moderate	
silt clay	brown	strong		heavy	
organic matter	brown surface	overwhelming			

Grab Number: ________ Grab Recovery: __________cm Sample Interval: __________cm Time: ____________

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:	Comments:
cobble	D.O.	none	H2S	none	
gravel	gray	slight	petroleum	slight	
sand C M F	black	moderate	other:	moderate	
silt clay	brown	strong		heavy	
organic matter	brown surface	overwhelming			

Grab Number: ________ Grab Recovery: __________cm Sample Interval: __________cm Time: ____________

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:	Comments:
cobble	D.O.	none	H2S	none	
gravel	gray	slight	petroleum	slight	
sand C M F	black	moderate	other:	moderate	
silt clay	brown	strong		heavy	
organic matter	brown surface	overwhelming			

Grab Number: ________ Grab Recovery: __________cm Sample Interval: __________cm Time: ____________

Sediment Type:	Sediment Color:	Sediment Odor:		Sheen:	Comments:
cobble	D.O.	none	H2S	none	
gravel	gray	slight	petroleum	slight	
sand C M F	black	moderate	other:	moderate	
silt clay	brown	strong		heavy	
organic matter	brown surface	overwhelming			

Notes:

_____ **No. Photos Taken** **Recorded By:**____________________________________