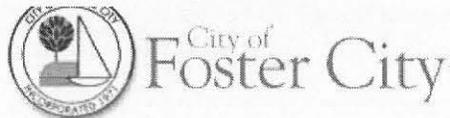


Sampling and Analysis Plan

**SAMPLING AND TESTING OF SEDIMENTS
DREDGING AT THE LAGOON INTAKE STRUCTURE (CIP 301-629)**



Prepared for:



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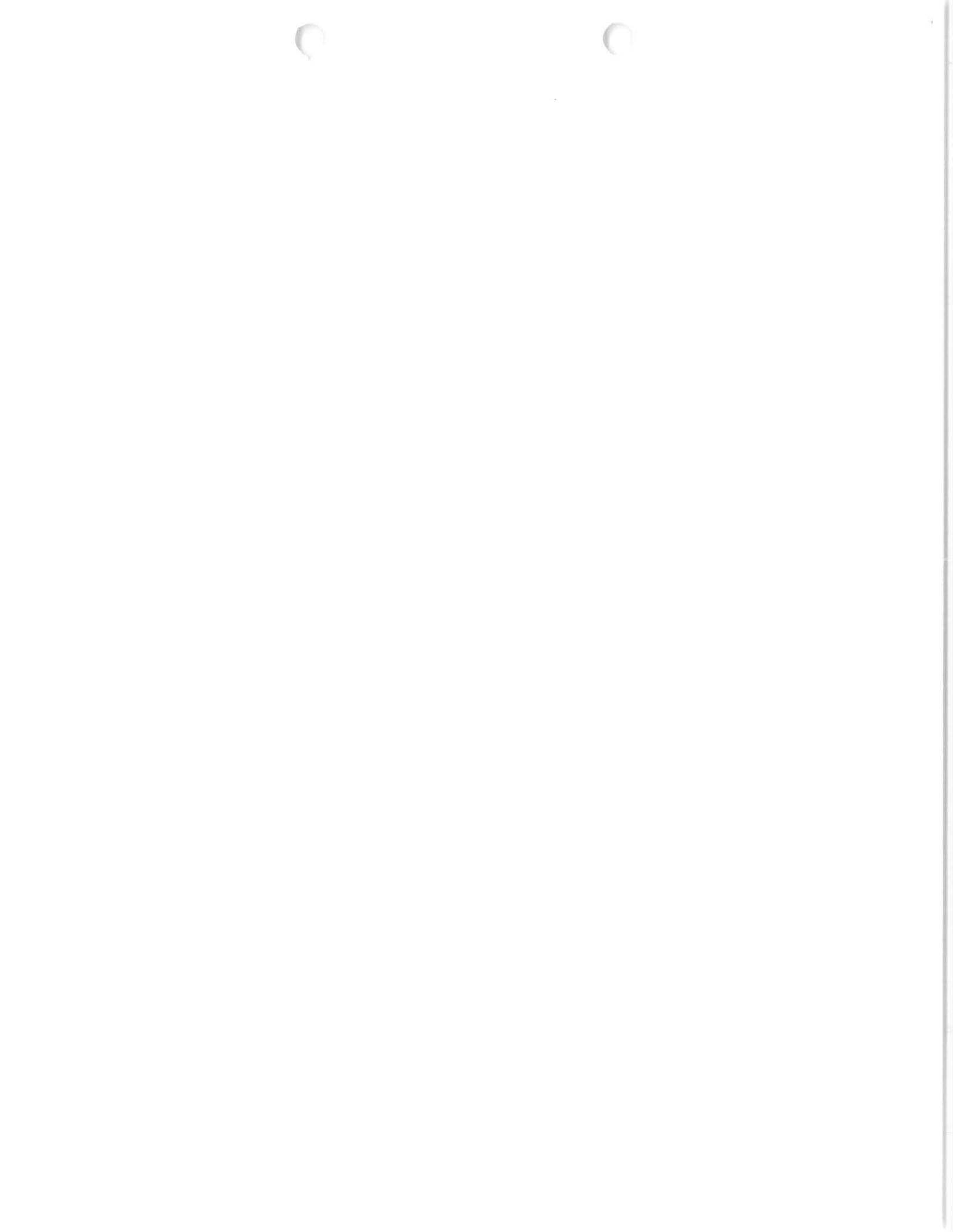
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**HUFFMAN-BROADWAY GROUP, INC.
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JANUARY 2016



Huffman-Broadway Group, Inc.
ENVIRONMENTAL REGULATORY CONSULTANTS





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Sampling and Analysis Plan

Sampling and Testing of Sediments
Dredging at the Lagoon Intake Structure (CIP 301-629)

January 2016

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LIST OF ACRONYMS

| | | | |
|------------------------|---|-----------------|---|
| ASTM | American Society for Testing and Materials | NAD | North American Datum |
| ANOVA | Analysis of Variance | NA | Not Applicable |
| BCDC | Bay Conservation and Development Commission | NAVD 88 | North American Vertical Datum of 1988 |
| CDFW | California Department of Fish and Wildlife | ND | Not Detected |
| COC | Chain of Custody | NOAA | National Oceanic and Atmospheric Administration |
| CRM | Certified Reference Material | PAH | Polycyclic Aromatic Hydrocarbon |
| CRWRP | Cullinan Ranch Wetland Restoration Project | PCB | Polychlorinated biphenyl |
| CSLC | California State Land Commission | PDS | Post Digestion Spike |
| CTR | California Toxics Rule | PDS | Post Digestion Spike Duplicate |
| CV | Coefficient of Variation | PVC | Polyvinyl Chloride |
| CWA | Clean Water Act | RMP | Regional Monitoring Program |
| CY | Cubic Yards | RPD | Relative Percent Difference |
| DDD | Dichlorodiphenyldichloroethane | SAP | Sampling and Analysis Plan |
| DDE | Dichlorodiphenyldichloroethylene | SAR | Sampling and Analysis Report |
| DDT | Dichlorodiphenyltrichloroethane | SET | Standard Elutriate Test |
| DGPS | Differential Global Positioning Satellite | SFBRWQCB | SF Bay Regional Water quality Control Board |
| DI-WET | Deionized Water Waste Extraction Test | SIM | Selected Ion Monitoring |
| DL | Detection Limit | SOP | Standard Operating Procedure |
| DMMO | Dredge Material Management Office | SM | Standard Methods |
| DO | Dissolved Oxygen | SP | Solid Phase |
| DUP | Duplicate | SPP | Suspended Particulate Phase |
| EC₅₀ | 50% of the Time Effects Concentration | SRM | Standard Reference Material |
| ERED | Environmental Residue-Effects Database | TEQ | Toxicity Equivalency Quotient |
| FDA | Food and Drug Administration | TMDL | Total Maximum Daily Load |
| HDPE | High Density Polyethylene | TOC | Total Organic Carbon |
| ITM | Inland Testing Manual | TPH | Total Petroleum Hydrocarbons |
| LC₅₀ | 50% of the Time Lethal Concentration | TRV | Toxicity Reference Value |
| LCS | Laboratory Control Spike | TSS | Total Suspended Solids |
| LCSD | Laboratory Control Spike Duplicate | USACE | U.S. Army Corps of Engineers |
| LDPE | Low Density Polyethylene | USCS | Unified Soil Classification System |
| MDL | Method Detection Limit | USEPA | U.S. Environmental Protection Agency |
| MET | Modified Elutriate Extract | USFWS | U.S. Fish and Wildlife Service |
| MLLW | Mean Lower Low Water | USNMFS | U.S. National Marine Fisheries Service |
| MS | Matrix Spike | UTM | Upland Testing Manual |
| MSD | Matrix Spike Duplicate | QA | Quality Assurance |
| MWRP | Montezuma Wetland Restoration Project | QC | Quality Control |

Sampling and Analysis Plan
Sampling and Testing of Sediments
Dredging at the Lagoon Intake Structure (CIP 301-629)

1.0 INTRODUCTION

The Foster City Lagoon (Figure 1) is a manmade waterway located within the City of Foster City (City) that was constructed as a stormwater retention system and to provide recreational uses. An intake structure by Sea Cloud Park (West Intake) is used to pump water from adjacent Belmont Slough located east of the Lagoon (Figure 2). The intake structure is used to provide proper water level and circulation within the lagoon system. A small channel, visible at low tide, connects the intake structure to Belmont slough. Over the years, this channel has experience substantial sedimentation that currently prevents water from reaching the intake structure except during high tides. At addition, the sediment also blocks the Bay Level Transducer at time, producing inaccurate water level readings. The City desires to perform maintenance dredging of the West Intake channel to restore the intake system to its maximum capacity.

This Sampling and Analysis Plan (SAP) has been prepared on behalf of the City to detail procedures and quality assurance/quality control (QA/QC) requirements for the sampling and testing of sediments from the Belmont Slough West Intake Channel in order to evaluate placement options for the dredged sediments.

1.1 Project Overview

The purpose of this project is to sample and test Belmont Slough sediments proposed for maintenance dredging to provide physical, chemical and biological data necessary to evaluate environmental effects of dredging and of reuse or placement options. Results will be transmitted in a complete technical report to support planning and permitting for this maintenance dredging project. This SAP is to fulfill requirements of the Inland Testing Manual (ITM) (USEPA/USACE, 1998), Section 404 of the Clean Water Act (CWA), and the San Francisco Bay Dredge Material Management Office (DMMO).

It is proposed to dredge the West Intake Channel to an elevation of -5.0 feet Mean Lower Low Water (MLLW) along the centerline of the channel. Design of the restored channel showing current and proposed sediment elevations as well as the limits of dredging is shown on Figures 3 and 4. The restored invert of the channel will be approximately 10 feet wide with 4:1 side slopes up to the adjacent mudflats. Based on this design and a December 2013 bathymetric survey, the estimated volume of sediments to be dredged is approximately 10,650 cubic yards (cy) of accumulated sediment below the high tide line and below the mean high water line within the West Intake Channel along Belmont Slough. With a one foot overdepth allowance, the total amount of material to be dredged could reach 12,500 cy.

Most of the dredging will occur from a barge-type dredge (Dredging Plant) with clamshell bucket and placed into a scow. Areas near the bank not accessible by the clamshell may require a backhoe. Dredge material will be placed into a scow and transported to the Cullinan Ranch Wetland Restoration Project (CRWRP) for beneficial reuse. The loaded scow will bring material up Dutchman Slough to any number of designated drop of locations. The dredge material will be lifted out of the scow using a clamshell bucket and placed over the perimeter levee inside the designated drop off location.

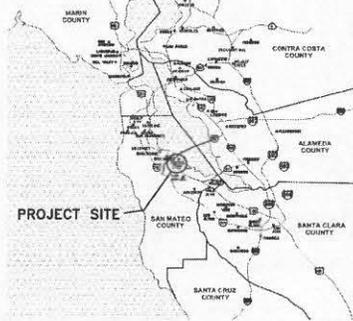
CITY OF FOSTER CITY
FOSTER CITY, CA 94404

**(CIP 301-629) DREDGING AT THE
LAGOON INTAKE STRUCTURE**

APPROVED BY:

JEFF MONEDA
DIRECTOR OF PUBLIC WORK/CITY ENGINEER

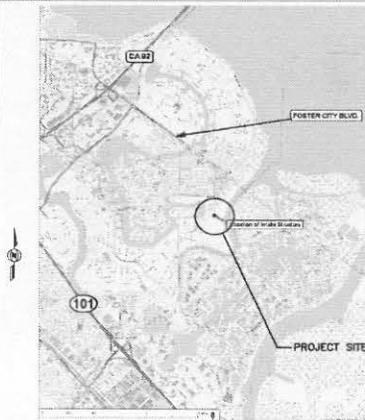
VICINITY MAP



ABBREVIATIONS

| | | | |
|-----------|------------------------------------|--------|-------------------------------|
| OP | at | LONG | longitudinal |
| B.G.S. | below grade surface | MFR | manufacturer |
| BLDG | building | MATL | material |
| B.O.P. | bottom of footing or foundation | MAX | maximum |
| BOT | bottom | MIN | minimum or minute |
| CBIC | California Building Code | MISC | miscellaneous |
| CDI | center | N.F. | near face |
| CDH | cast-in-drilled hole concrete pile | N.S. | near side |
| CD | center to center | N. | north |
| CLR | clear | NE | new |
| COL | column | NO | new |
| CONC | concrete | NAD | North American Datum |
| C.M.U. | concrete masonry unit | NAVG | North American Vertical Datum |
| CONN | connection | N.L.C. | not in contract |
| CONSTR | construction | N.T.S. | not to scale |
| CONSTR | construction | O.C. | on center |
| C.J. | construction joint | OPN | opening |
| CONT | continue, continued | OPD | outside diameter |
| DET | detail | O.G. | original grade |
| DIA | diameter | OS | original surface |
| DIR | dimension | PSI | pounds per square inch |
| D.F. | Double F | PSF | pounds per square foot |
| DN | down | REF | reference |
| DWG | drawing | REIN | reinforcing steel |
| EA | each | SECT | section |
| E.F. | each face | SF | square foot or square feet |
| E.W. | each way | SPEC | specification |
| EL | elevation | STC | structural |
| ENGR | engineer | STL | steel |
| EQ | equal | STRUCT | structural |
| EXST. (E) | existing | STA | station |
| EXT | exterior | SYMM | symmetrical |
| F.S. | finished grade | T.O.C. | top of concrete |
| F.F. | finished floor | T.O.S. | top of steel |
| FTG | footing | T.O.G. | top of grading |
| FDN | foundation | TRNSV | transverse |
| JT | joint | TYP | typical |
| | | UNL | unless otherwise noted |
| | | U.O.N. | unless otherwise noted |
| | | W | with |

LOCATION MAP



DRAWING INDEX

| SHEET | DWG. NO. | SHEET TITLE |
|-------|----------|------------------------|
| 1 | C-0.0 | TITLE SHEET |
| 2 | C-1.0 | GENERAL NOTES |
| 3 | C-2.0 | SITE PLAN |
| 4 | C-3.0 | DREDGING AREA PLAN |
| 5 | C-3.1 | DREDGING AREA SECTIONS |
| 6 | C-3.2 | DREDGING AREA SECTIONS |

SCOPE OF PROJECT

SCOPE OF WORK ON THESE PLANS INCLUDES DREDGING AT LAGOON INTAKE STRUCTURE TO RESTORE SITE CONDITIONS TO ORIGINAL CONSTRUCTION. DREDGED MATERIALS TO BE BARGED OFF-SITE.

DATE: 1/15/18
 DRAWN BY: JRM
 CHECKED BY: JRM
 DATE: 1/15/18
 SCALE: AS SHOWN
 SHEET NO. 1 OF 6
 PROJECT: (CIP 301-629) DREDGING AT THE LAGOON INTAKE STRUCTURE
 CITY OF FOSTER CITY
 FOSTER CITY, CA 94404
 C-0.0
 SHEET NO. 1 OF 6

Figure 1. Vicinity and Location of Project Area.

1.2 Site Location and Description

Foster City Lagoon is situated at the western end of the San Mateo-Hayward Bridge between San Francisco Bay and the Bayshore Freeway (US 101) in San Mateo County (Figure 1). Geographic coordinates (NAD 83) of the West Intake are 37° 32.75' N and 122° 15.25' W. The channel to be dredged is approximately 650 feet long by 100 feet wide. Total area to be dredged is approximately 1.6 acres.

1.3 Roles and Responsibilities

Key responsibilities for elements of this program are tabulated in Table 1. Key contacts for this sediment characterization program are listed as follows:

| | | |
|---|--|--|
| Terry Huffman Ph.D. Huffman-Broadway Group, Inc. 828 Mission Avenue San Rafael, CA 94901 thuffman@h-bgroup.com 415-925-2000 | Robert Perrera Huffman-Broadway Group, Inc. 828 Mission Avenue San Rafael, CA 94901 rperrera@h-bgroup.com 415-925-2000 | Mr. Allan Shu Senior Civil Engineer City of Foster City 610 Foster City Boulevard Foster City, 94404 CA |
| Ken Kronschnabl Kinnetic Laboratories, Inc. 307 Washington St. Santa Cruz, CA 95060 kkronsch@kinneticlabs.net 831- 457-3950 | Danielle Gonsman Eurofins Calscience 7440 Lincoln Way Garden Grove, CA 92841 DanielleGonsman@eurofinsUS.com 714- 895-5494 | Jeffrey Cotsifas Pacific EcoRisk 2250 Cordelia Road Fairfield, CA 94534 cotsifas@pacificecorisk.com, 707-207-7761 |

Principal users of data produced by this project are the following DMMO regulating agencies:

1. San Francisco District, U.S. Army Corps of Engineers (USACE)
2. San Francisco Bay Regional Water Quality Control Board (SFBRWQCB)
3. U.S. Environmental Protection Agency (USEPA) - Region IX;
4. San Francisco Bay Conservation and Development Commission (BCDC);
5. California State Lands Commission (CSLC).
6. California Department of Fish and Wildlife (CDFW);
7. U.S. Fish and Wildlife Service (USFWS); and
8. U.S. National Marine Fisheries Service (USNMFS).

Table 1. Project Team and Responsibilities.

| Responsibility | Name | Affiliation |
|--|------------------|---------------------|
| Project Planning, Coordination and Planning | Robert Perrera | HBG |
| | Terry Huffman | HBG |
| Sampling and Analysis Plan (SAP) Preparation | Ken Kronschnabl | KLI |
| | Amy Howk | KLI |
| | Robert Perrera | HBG |
| Field Sample Collection and Transport | Spencer Johnson | KLI |
| | Ken Kronschnabl | KLI |
| Health and Safety Officer and Site Safety Plan | Jon Toal | KLI |
| Laboratory Chemical Analyses | Danielle Gonsman | Eurofins Calscience |
| | Amy Howk | KLI |
| Laboratory Biological Testing | Jeffrey Cotsifas | Pacific EcoRisk |
| QA/QC Management | Marty Stevenson | KLI |
| | Danielle Gonsman | Eurofins Calscience |
| Technical Review | Marty Stevenson | KLI |
| | Robert Perrera | HBG |
| Final Sampling and Analysis Results Report | Ken Kronschnabl | KLI |
| | Patrick Kinney | KLI |
| Agency Coordination | Robert Perrera | HBG |
| | Terry Huffman | HBG |

KLI = Kinnetic Laboratories, Inc.

HBC = Huffman-Broadway Group, Inc.

2.0 SITE HISTORY AND HISTORICAL DATA REVIEW

The construction of the Foster City Lagoon, including excavation, shoreline protection, water control structures, and shore side development occurred in the 1960's. The West Intake and Belmont Slough channel was constructed afterwards in the late 1970's and has not been dredged since.

Most stormwater in Foster City enters the lagoon system before it is discharged directly into San Francisco Bay to the north of the lagoon system. There are no stormwater outfalls in the direct vicinity of the West Intake. However, Belmont Slough does receive stormwater runoff from a variety of other sources.

The Foster City Lagoon Disposal Site was constructed of fill material discharged under Corps Permit No. 9318-49 issued February 20, 1976. The collection basin acts as a seasonal pond since it last received dredged material from the lagoon in 2003. Approximately 110,000 cy of dredged material was discharged to the disposal site in 2003.

Other than dredging conducted in the late 1960s to supply material to the Redwood City General Improvement District, there are no dredging episodes on record for Belmont slough. Furthermore, there are no sediment quality data that could be located for the Belmont Slough sediments.

3.0 METHODS

This section describes dredging design, study design, and field and analytical methods for this testing program.

3.1 Dredge Design

Bathymetric data from a December 2013 condition survey are shown on Figures 5 and 6. Also shown are the West Intake Channel dredge limits. Total dredge volume for the intake channel is approximately 12,500 cy. This volume is based on dredging to the project elevation of -5.0 feet MLLW plus one foot for overdepth.

3.2 Study Design

The study design for this Sampling and Analysis Plan covers data collection tasks for the West Intake Channel. Evaluation guidelines are also discussed.

The main approach will be to sample dredge sediments to dredge depth plus allowable overdepth, composite sediments from individual locations into a single sample, and subject the composite sample to chemical biological testing to determine if the intake channel sediments are environmentally suitable for each of the placement options. All sampling and testing will follow requirements and procedures detailed in the ITM (USEPA/USACE, 1998) with further guidance from Public Notice 01-01 (USACE, 2001), and from draft guidelines for the beneficial reuse of dredged materials (SFBRWQCB, 2000). Acceptability guidelines published in these documents will be used to evaluate the suitability of the sediments to be dredged for reuse at the CRWRP.

3.2.1 Sediment Collection and Chemical Testing

Vibracore sampling, as described in Section 3.3.2 (Vibracore Sampling Methods), will be carried out to collect subsurface sediment data at five locations along the centerline of the West Intake Channel. The prefix for all locations shall be "FCLWICVC-15-##." Approximate sampling locations are shown on Figure 5. Core locations were chosen to represent the most shoaled sediments along the channel alignment but still cover the area spatially as shown in Figure 6. However, the locations may be adjusted in the field slightly if insufficient tidal depths prevent access to the preferred locations. If possible and site conditions allow, all cores will be advanced to the design elevation plus one foot for overdepth allowance and plus an additional 0.5 feet for potential testing of the material to be left in place after dredging (Z-layer) to a total elevation of -6.5 ft MLLW. Target coordinates, approximate seafloor elevations, and target elevations for the sample locations are listed in Table 2.

As mentioned, one composite sample will be created from the sediments collected from the five core locations for bulk sediment chemistry and toxicity testing. Continuous samples from the mudline to project depths plus one foot for overdepth (-6.0 ft MLLW) will be collected from all locations. These primary core intervals will be homogenized and then combined with like core intervals to form the composite sample. Sediments collected below the overdepth elevation will not be included in the sediment composite sample.

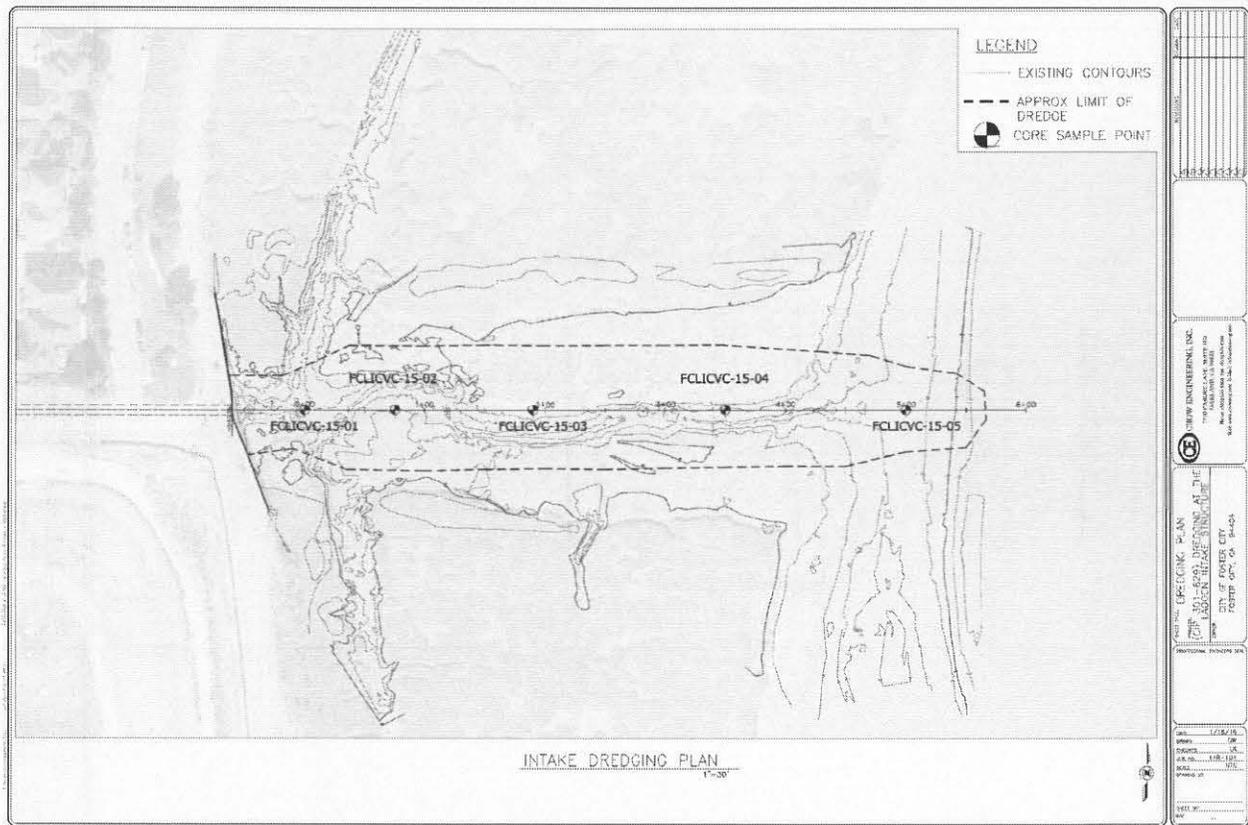


Figure 5. Bathymetric Data (December 2013), Dredge Boundaries and Sampling Locations for the Foster City Lagoon West Intake Channel.

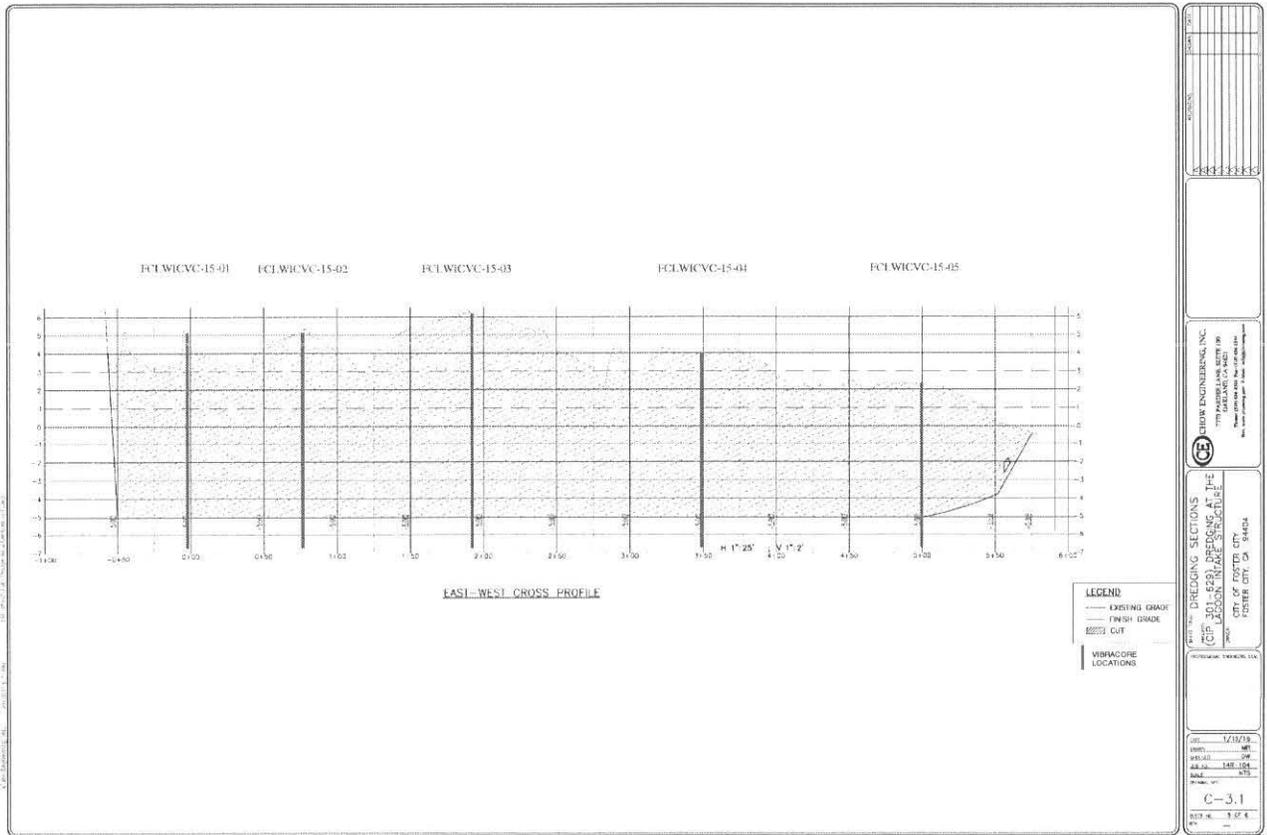


Figure 6. Longitudinal Cross Section of Bathymetry Data (December 2013) along the Centerline of the Foster City Lagoon West Intake Channel and Sampling Locations.

Table 2. Target Sampling Locations, Core Depths, Mudline Elevations, and Sampling Elevations, Foster City Lagoon West Intake Channel.

| Core Designation | California Lambert Zone 3 (NAD 83) | | Geographic Coordinates (NAD 83) | | Water Depths ¹ (ft., MLLW) | Design Depth + Overdepth + Z-Layer (ft., MLLW) | Expected Core Length ² (ft.) | Proposed Core Analyses | Proposed Composite Analyses |
|------------------|------------------------------------|----------------|---------------------------------|----------------|---------------------------------------|--|---|------------------------|-----------------------------|
| | Northing (feet) | Easting (feet) | Latitude North | Longitude West | | | | | |
| FCLWICVC15- 1 | 2025982 | 6053204 | 37 ° 32.751' | 122° 15.237' | +5.3 | -6.5 | 11.8 | Archive | Tier II and III |
| FCLWICVC15- 2 | 2025982 | 6053279 | 37 ° 32.751' | 122° 15.221' | +5.0 | -6.5 | 11.5 | Archive | |
| FCLWICVC15- 3 | 2025982 | 6053394 | 37 ° 32.751' | 122° 15.198' | +6.1 | -6.5 | 12.6 | Archive | |
| FCLWICVC15- 4 | 2025982 | 6053554 | 37 ° 32.752' | 122° 15.164' | +4.0 | -6.5 | 10.5 | Archive | |
| FCLWICVC15- 5 | 2025982 | 6053703 | 37 ° 32.752' | 122° 15.134' | +2.3 | -6.5 | 8.8 | Archive | |

1. Water depths are based on a December 2013 survey. Depths at the time of sampling may be different.
2. Target Sample Length is mudline to project elevation plus one foot for overdepth and an additional 0.5 feet for Z-layer material.

In addition to the composite sample, an archive bulk sediment chemistry sample will be collected from each core location. One archive sample from each location will represent the entire primary core interval (mudline to overdepth elevation). An additional bulk sediment chemistry sample of the Z-layer material (-6.0 to -6.5 ft MLLW) will be collected and archived from all locations. All archive samples will be stored frozen for at least six months unless directed otherwise.

Testing of the composite sample will be conducted to cover all dredged material placement options. Tier II bulk sediment physical and chemical constituents will include those specified for the CRWRP as follows:

- Grain size distribution
- Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag and Zn)
- Percent solids
- TOC
- Chlorinated pesticides
- PCB congeners
- PAHs
- Dioxins/Furans

Tier III testing for beneficial reuse as wetland cover requires benthic (solid phase or SP) toxicity using a polychaete worm and an amphipod.

A potential concern during placement at one of the wetland restoration sites is water quality impacts due to the return of decant water to the Bay. To address this, a modified (effluent) elutriate test (MET) extract will be formed from the composite sediments and site water. The MET extract and site water will be analyzed for total suspended solids (TSS), dissolved arsenic, cadmium, chromium, copper, nickel, selenium, silver and zinc, and total mercury and selenium. The MET extract and site water will also undergo an acute toxicity test using a mysid.

3.2.2 Data Evaluation

To aid in the evaluation of sediment chemical data, chemical concentrations of constituents found within the sediments will be compared to ambient threshold levels for San Francisco Bay and to dredge material screening criteria for CRWRP, which consists mostly of San Francisco Bay ambient threshold values. San Francisco Bay ambient threshold values were developed in draft form by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) as sediment screening guidelines for wetland surface material (Table 4, SFBRWQCB, 2000). Ambient threshold values are the 85th percentile of the given constituent concentration in the ambient sediment database for San Francisco Bay (SFBRWQCB, 1998).

Benthic bioassay results will be statistically compared with the bioassay control results. Guidelines for interpretation of benthic bioassay results are published in the ITM. If survival responses in test sediment are statistically lower than those in reference (control) sediment *and* if the difference in mean survival between groups is greater than 10% (20% for amphipods), then the test sediment is considered to have the potential to significantly degrade the marine environment.

Concentrations of inorganic constituents in the modified elutriate extracts will be compared to water quality standards (USEPA, 2000; SFBRWQCB, 2013) to determine whether such standards

are exceeded without expected dilutions. These standards are written in narrative form and in terms of numerical standards for mostly dissolved constituents. For effluent toxicity, the Basin Plan narrative objective for no toxicity is met when median survival in the 100% test elutriates is greater than 90%.

3.3 Field Sampling Protocols

Vibracore sampling, decontamination, sample processing and documentation procedures are discussed in this section.

3.3.1 Positioning and Depth Measurements

Positioning at sampling locations will be accomplished using a differential GPS (DGPS) navigation system with positioning accuracies of 1 to 3 meters. The locations will be recorded in both Geographic coordinates (NAD 83) and State Plane Coordinates (CA Zone III, NAD 83). Water depths will be measured with a graduated lead line and corrected to MLLW. Tidal stage will be determined using NOAA predicted tide tables adjusted to a local benchmark or tide gauge. This information will be used to calculate the seafloor elevation/mudline for each site.

All sampling sites will be located within dredge limits. Actual locations listed on Table 2 may change for a number of reasons. If the desired location cannot be reached (due to insufficient water depth, obstructions, etc.), a location as close as practical shall be sampled that is within the project limits. Locations may also be moved to another spot in the general area if the shoaling is minimal and more significant shoaling can be represented in the composite sample.

3.3.2 Vibracore Sampling Methods

All West Intake Channel sediment samples will be collected using an electric vibracore that can penetrate and obtain samples at the project sample elevation. The cores will be advanced to the target sampling elevation (project elevation plus one foot for overdepth allowance plus 0.5 feet for Z-layer) or to refusal. The depth of refusal is defined as the depth at which the average rate of penetration is less than 0.1 feet/minute for a two (2) minute period. At sites where the depth of refusal is reached prior to the sample depth, up to one additional attempt may be made to reach the sample depth if there is a reasonable chance of obtaining better results. If the sample depth cannot be reached after an additional attempt, the longer of the two cores will be retained for sampling. At the conclusion of a successful vibracore, the core liner will be removed and split open for inspection and sampling. Extrusion of the core will not be allowed. Processing will take place onshore.

Vibracore sampling at the West Intake Channel will be carried out from Dixon Marine Services vessel the R/V Walter Marie. This 32-foot work boat is equipped with an A-frame and winch suitable for handling coring equipment. The vessel will be secured for coring at each location using retractable spuds.

Kinnetic Laboratories' vibracore consists of a 4-inch diameter aluminum coring tube, a stainless steel cutting tip, and a stainless-steel core catcher. Inserted into the core tubes will be food-grade clean polyethylene liners. The vibrating unit has two counter-rotating motors encased in waterproof aluminum housing. A three-phase, 240-volt generator powers the motors. The

vibracore head and tube are lowered overboard via the boom or crane. The unit is then vibrated until it reaches target sampling elevation or until the depth of refusal is reached.

When penetration of the vibracore is complete, power is shut off to the vibra-head, and the vibracore is brought aboard the vessel. A check valve or piston located on top of the core tube reduces or prevents sediment loss during pull-out. The length of sediment recovered is noted by measuring down the interior of the core tube to the top of the sediment. The core tube is then detached from the vibra-head, and the core cutting tip and catcher are removed. Afterwards, the core liners are removed and sealed on both ends and transported to the onshore processing area.

3.3.3 Vibracore Decontamination

All sample contact surfaces will be stainless steel, polyethylene or Teflon[®] coated. Compositing tools will be stainless steel or Teflon[®] coated stainless steel. Except for the core liners, all contact surfaces of the sampling devices and the coring tubes are cleaned for each sampling area. The cleaning protocol consists of a site water rinse, a Micro-90[®] laboratory soap wash, and then finished with deionized water rinses. The polyethylene core liners will be new and of food grade quality. All rinseate will be collected in containers and disposed of properly.

3.3.4 Core Processing

Whole cores will be processed on top of tables. The tables will have a plastic covering that is freshly changed for every core. Cores will be placed in a PVC core rack that is cleaned between cores. After placement in the core rack, core liners will be split lengthwise to expose the recovered sediment. Once exposed, sediment that came in contact with the core liner will be removed by scraping with a pre-cleaned stainless steel utensil. Each core will be photographed, measured, and lithologically logged in accordance with the Unified Soil Classification System (USCS) as outlined in ASTM Standards D-2488 (2006) and D-2487 (2006). Additional sediment characteristics including likely sediment origin and other observations will also be recorded.

Photographs will be taken of each core (each photograph will cover a maximum two-foot interval), and of sampling equipment and procedures. These pictures will be provided in the Final Report with captions describing the subject and date. The pictures will be provided in electronic format (JPEG or other standard format). English units will be used for all measurements and calculations related to this SAP except where otherwise noted.

Following logging, vertical composite subsamples will be formed from each primary core interval by combining a representative sample from the mudline to overdepth elevation in a 500 ml pre-cleaned and certified glass jar with a Teflon[®]-lined lid for archived material. An additional sample of Z-layer material will be placed in another 500 ml glass jar. The remaining portion of each primary vertical composite subsample identified for composite sample formation will be placed in pre-cleaned 3.5 gallon buckets with new food grade LDPE liners. Horizontal compositing and homogenization of these samples for Tier II and III testing will take place at Kinnetic Laboratories' facility in Santa Cruz, CA.

The composite sample will be formed by combining the contents of all 3.5 gallon buckets from all five sample locations. The contents of all buckets will be combined in a large, 20 gallon stainless steel mixing bowl that by protocol will be cleaned prior to use. A commercial dough mixer with

a large aluminum paddle will be used to homogenize the sediments. The aluminum paddle will also be cleaned according to protocol prior to the formation of the composite sample.

Once the composite sample has been thoroughly homogenized to the greatest extent possible, a subsample will be placed in a new 1,000 ml glass jar with a Teflon lined lid for chemical analyses and a second subsample was placed in a Ziploc bag for grain size analysis. The remaining composted sediment will be placed back into 3.5 gallon buckets with new LDPE liners and re-chilled. At least three gallons of composited sediment will be delivered to the bioassay laboratory (Pacific EcoRisk) the next day. Chemistry and grain size samples will be shipped overnight to Eurofins Calscience in Garden Grove, California by Federal Express. A temperature blank will be placed in the cooler containing the chemistry sample.

Sample volumes, containers, and preservation required are summarized in Table 3. Except for archival material for chemical analyses, containers will be completely filled to minimize air bubbles being trapped in the sample container. A small amount of headspace will be allowed for samples archived for potential chemical analyses to prevent container breakage during freezing. For the preservation of samples, the filled containers will be placed on ice immediately following sampling and maintained at 2 to 4°C until analyzed. Archived samples for chemical analyses will be placed on ice initially and then frozen as soon as possible. The sample containers will be sealed to prevent any moisture loss and possible contamination. Samples showing external contamination due to handling or incorrect sampling procedures will be re-sampled.

3.3.5 Documentation and Sample Custody

All samples will have their containers physically marked as to sample location, date, time and analyses. All samples will be handled under Chain of Custody (COC) protocols beginning at the time of collection. Redundant sampling data will also be recorded on field data log sheets. A copy of the field data logs will be included in the Draft and Final Reports. An inventory will be included of all samples taken and delivered. Samples will be considered to be "in custody" if they are (1) in the custodian's possession or view, (2) in a secured place (locked) with restricted access, or (3) in a secure container. Standard COC procedures will be used for all samples collected, transferred, and analyzed as part of this project. COC forms will be used to identify the samples, custodians, and dates of transfer. Except for the shipping company, each person who has custody of the samples will sign the COC form and ensure samples are stored properly and not left unattended unless properly secured.

Standard information on COC forms include:

- Sample Identification
- Sample Collection Date and Time
- Sample Matrices (e.g., marine sediment)
- Analyses to be Performed
- Container Types
- Preservation Method
- Sampler Identification
- Dates of Transfer
- Names of Persons with Custody

Table 3. Sample Volumes and Storage Requirements.

| Parameter | Holding Time | Min. Sample Size ^a | Container ^b | Temperature ^c | Archive ^d |
|----------------------------|---|-------------------------------|-----------------------------------|--------------------------|------------------------------|
| Grain Size | NA | 2L | 1 gallon Ziploc | NA | Yes |
| Total Solids | 7 days | 50g | 1 L Glass ^b (Combined) | 2° – 4° C | Yes 500 mL Glass (Frozen) |
| Total Organic Carbon (TOC) | 28 days | 50g | | | |
| Mercury | | 50g | | | |
| Metals (except mercury) | 6 months | 200g | | | |
| Pesticides/ PCBs | 14 days pre-extraction 40 days post-extraction | 300g | | | |
| PAHs | | 200g | | | |
| Dioxins/Furans | | 200g | | | |
| MET Chemistry | 6 months preserved Filter within 48 hours | 150g | | | No |
| MET Toxicity | 8 weeks | 2L | 3.5 Gallon Bucket (LDPE Liner) | 2°- 4° C | Yes Composite Only |
| Benthic Toxicity (SP) | 8 weeks | 4L | | | |

^a Required sample sizes for one laboratory analysis. Actual volumes to be collected have been increased to provide a margin of error and allow for retests.

^b Containers will be completely filled with minimal head space.

^c During transport to the laboratory, samples will be stored on ice.

^d For each sampling station, two 500 mL glass containers will be filled and kept frozen and used as needed for any of the chemical analyses indicated.

The completed COC forms will be placed in a sealable plastic bag that will be placed in the cooler with the samples. COC forms will be immediately signed by a laboratory representative upon receipt. COC records will be included in the final report prepared by the analytical laboratories (Eurofins Calscience and Pacific EcoRisk).

Water will be collected from the middle of the Belmont Slough channel for use in preparing elutriates for chemical analyses and bioassays. A sample of background water will also be collected to assess ambient aquatic chemistry. Water will be collected directly into containers at a depth of one foot below the surface. Water for background chemistry will be placed in a one-liter plastic jar. Water for elutriate preparation will be placed in QC grade cubitainers. The water sample will be iced and shipped to the bioassay laboratory, where it will be held at 4°C until used.

3.4 Laboratory Testing Methods

Chemical analyses will be initiated as soon as practical after the collection of samples. Biological analyses will be initiated after initial review of the sediment physical characteristics. Analytical chemical and biological testing of sediments for this project will be carried out by Eurofins Calscience (Cal-ELAP No. 03220CA) and Pacific EcoRisk (NELAP No. 04225CA) using USEPA and USACE approved methodologies. Laboratory certifications and quality assurance manuals for the laboratories can be found in Appendix A.

3.4.1 Bulk Sediment Chemical Analyses

The single sediment composite sample collected from the West Intake Channel will be analyzed according to the parameters, methods and quantification limits specified in Table 4. Sediment samples will be analyzed in a manner consistent with guidelines for dredge material testing methods in the ITM. Samples will be extracted and analyzed within specified USEPA holding times, and will be accomplished with appropriate quality control measures.

3.4.2 Elutriate Preparation Method

MET samples will be prepared following the methods described in the UTM, (USACE, 2003; Appendix B-3.3). A slurry of sediment and dredge site water will be prepared at a concentration of 150 g/L (dry weight basis). The slurry will be mixed for five minutes to a uniform consistency with a laboratory mixer, and then vigorously aerated for one hour. The aerated slurry will then be allowed to settle for 24 hours, and the supernatant will be siphoned off and used for chemical and biological analyses.

3.4.3 Chemical Methods for Aqueous Extracts

Chemical analytes, test methods, and quantification limits for background water and MET chemical analyses are presented in Table 5.

3.4.5 Tier III Biological Testing

The composite sediment along with control sediment will be tested for toxicity. Bioassay protocols will follow ITM (USEPA/USACE, 1998) protocols for both SPP and SP bioassays. Testing for upland disposal requires only a single SPP bioassay conducted on a MET extract. MET bioassay protocols will follow USACE (2003). Species, methods and endpoints used for the bioassays are listed in Table 6. All species proposed for use in this testing program will comply with ITM recommendations and guidelines for bioassay tests.

Table 4. Analytical Methods and Quantitation Limits for Solid Matrices.

| Analyte | Method | Method Detection Limits | Laboratory Reporting Limits |
|---------------------------------------|--------------------|-------------------------|-----------------------------|
| Grain Size | ASTM D4464 | | |
| Percent Solids (%) | SM2540 B | 0.1 | 0.1 |
| Total Organic Carbon (%) | EPA 9060A | 0.012 | 0.05 |
| METALS (mg/kg) | | | |
| Arsenic | EPA 6020 | 0.087 | 0.1 |
| Cadmium | EPA 6020 | 0.057 | 0.1 |
| Chromium | EPA 6020 | 0.062 | 0.1 |
| Copper | EPA 6020 | 0.042 | 0.1 |
| Lead | EPA 6020 | 0.065 | 0.1 |
| Mercury | EPA 7471A | 0.0059 | 0.02 |
| Nickel | EPA 6020 | 0.051 | 0.1 |
| Selenium | EPA 6020 | 0.073 | 0.1 |
| Silver | EPA 6020 | 0.031 | 0.1 |
| Zinc | EPA 6020 | 0.795 | 1.0 |
| CHLORINATED PESTICIDES (µg/kg) | | | |
| 2,4' DDD | EPA 8081A | 0.076 | 0.2 |
| 2,4' DDE | EPA 8270C PEST-SIM | 0.035 | 0.2 |
| 2,4' DDT | EPA 8270C PEST-SIM | 0.062 | 0.2 |
| 4,4' DDD | EPA 8270C PEST-SIM | 0.040 | 0.2 |
| 4,4' DDE | EPA 8270C PEST-SIM | 0.040 | 0.2 |
| 4,4' DDT | EPA 8270C PEST-SIM | 0.053 | 0.2 |
| Total DDT | EPA 8270C PEST-SIM | -- | 0.2 |
| Aldrin | EPA 8270C PEST-SIM | 0.038 | 0.2 |
| BHC-alpha | EPA 8270C PEST-SIM | 0.058 | 0.2 |
| BHC-beta | EPA 8270C PEST-SIM | 0.067 | 0.2 |
| BHC-delta | EPA 8270C PEST-SIM | 0.093 | 0.2 |
| BHC-gamma (Lindane) | EPA 8270C PEST-SIM | 0.034 | 0.2 |
| Chlordane (Technical) | EPA 8270C-GCECD | 2.7 | 10 |
| Chlordane-alpha | EPA 8270C PEST-SIM | 0.067 | 0.2 |
| Chlordane-gamma | EPA 8270C PEST-SIM | 0.053 | 0.2 |
| Oxychlordane | EPA 8270C PEST-SIM | 0.073 | 0.2 |
| Total Chlordane | EPA 8270C PEST-SIM | -- | 0.2 |
| Dieldrin | EPA 8270C PEST-SIM | 0.11 | 0.2 |
| Endosulfan sulfate | EPA 8270C PEST-SIM | 0.10 | 0.2 |
| Endosulfan I | EPA 8270C PEST-SIM | 0.058 | 0.2 |
| Endosulfan II | EPA 8270C PEST-SIM | 0.091 | 0.2 |
| Endrin | EPA 8270C PEST-SIM | 0.057 | 0.2 |
| Endrin aldehyde | EPA 8270C PEST-SIM | 0.099 | 0.2 |
| Endrin ketone | EPA 8270C PEST-SIM | 0.055 | 0.2 |
| Heptachlor | EPA 8270C PEST-SIM | 0.051 | 0.2 |
| Heptachlor epoxide | EPA 8270C PEST-SIM | 0.044 | 0.2 |
| Methoxychlor | EPA 8270C PEST-SIM | 0.067 | 0.2 |
| Mirex | EPA 8270C PEST-SIM | 0.039 | 0.2 |
| Toxaphene | EPA 8270C-GCECD | 9.0 | 10 |
| trans-Nonachlor | EPA 8270C PEST-SIM | 0.43 | 0.2 |

Table 4. Analytical Methods and Quantitation Limits for Solid Matrices.

| Analyte | Method | Method Detection Limits | Laboratory Reporting Limits |
|---|-----------------|-------------------------|-----------------------------|
| PCBs (µg/kg) PCB congeners of: 008, 018, 028, 031, 033, 044, 049, 052, 056, 060, 066, 070, 074, 087, 095, 097, 099, 101, 105, 110, 118, 128, 132, 138/158, 141, 149, 151, 153, 156, 170, 174, 177, 180, 183, 187, 194, 195, 201, and 203. | EPA 8270C (SIM) | 0.053-0.53 | 0.5 |
| Total PCBs as sum of all individual PCB congeners. | EPA 8270C (SIM) | -- | 0.5 |
| PAHs (µg/kg) | | | |
| 1-Methylnaphthalene | EPA 8270C (SIM) | 1.2 | 10 |
| 1-Methylphenanthrene | EPA 8270C (SIM) | 4.0 | 10 |
| 1,6,7-Trimethylnaphthalene | EPA 8270C (SIM) | 1.6 | 10 |
| 2,6-Dimethylnaphthalene | EPA 8270C (SIM) | 1.7 | 10 |
| 2-Methylnaphthalene | EPA 8270C (SIM) | 4.6 | 10 |
| Acenaphthene | EPA 8270C (SIM) | 4.7 | 10 |
| Acenaphthylene | EPA 8270C (SIM) | 4.6 | 10 |
| Anthracene | EPA 8270C (SIM) | 5.0 | 10 |
| Benzo[a]anthracene | EPA 8270C (SIM) | 4.5 | 10 |
| Benzo[a]pyrene | EPA 8270C (SIM) | 4.8 | 10 |
| Benzo[b]fluoranthene | EPA 8270C (SIM) | 4.9 | 10 |
| Benzo[e]pyrene | EPA 8270C (SIM) | 2.0 | 10 |
| Benzo[g,h,i]perylene | EPA 8270C (SIM) | 4.9 | 10 |
| Benzo[k]fluoranthene | EPA 8270C (SIM) | 4.8 | 10 |
| Biphenyl | EPA 8270C (SIM) | 1.8 | 10 |
| Chrysene | EPA 8270C (SIM) | 4.2 | 10 |
| Dibenzo[a,h]anthracene | EPA 8270C (SIM) | 4.7 | 10 |
| Dibenzothiophene | EPA 8270C (SIM) | 1.5 | 10 |
| Fluoranthene | EPA 8270C (SIM) | 5.0 | 10 |
| Fluorene | EPA 8270C (SIM) | 5.0 | 10 |
| Indeno[1,2,3-c,d]pyrene | EPA 8270C (SIM) | 6.3 | 10 |
| Naphthalene | EPA 8270C (SIM) | 4.2 | 10 |
| Perylene | EPA 8270C (SIM) | 1.5 | 10 |
| Phenanthrene | EPA 8270C (SIM) | 5.0 | 10 |
| Pyrene | EPA 8270C (SIM) | 4.3 | 10 |
| Total Low Weight PAHs | EPA 8270C (SIM) | -- | 10 |
| Total High Weight PAHs | EPA 8270C (SIM) | -- | 10 |
| Total Detectable PAHs | EPA 8270C (SIM) | -- | 10 |
| DIOXINS/FURANS (ng/kg dry) | | | |
| 1234678-HpCDD | EPA 1613(B) | 0.5 | 5 |
| 1234678-HpCDF | EPA 1613(B) | 0.3 | 5 |
| 123478-HxCDD | EPA 1613(B) | 0.3 | 5 |
| 123478-HxCDF | EPA 1613(B) | 0.3 | 5 |
| 1234789-HpCDF | EPA 1613(B) | 0.4 | 5 |
| 123678-HxCDD | EPA 1613(B) | 0.4 | 5 |
| 123678-HxCDF | EPA 1613(B) | 0.2 | 5 |
| 12378-PeCDD | EPA 1613(B) | 0.4 | 5 |
| 12378-PeCDF | EPA 1613(B) | 0.4 | 5 |
| 123789-HxCDD | EPA 1613(B) | 0.3 | 5 |

Table 4. Analytical Methods and Quantitation Limits for Solid Matrices.

| Analyte | Method | Method Detection Limits | Laboratory Reporting Limits |
|--------------|-------------|-------------------------|-----------------------------|
| 123789-HxCDF | EPA 1613(B) | 0.5 | 5 |
| 234678-HxCDF | EPA 1613(B) | 0.3 | 5 |
| 23478-PeCDF | EPA 1613(B) | 0.3 | 5 |
| 2378-TCDD | EPA 1613(B) | 0.2 | 1 |
| 2378-TCDF | EPA 1613(B) | 0.2 | 1 |
| Total HpCDD | EPA 1613(B) | 3 | 10 |
| Total HpCDF | EPA 1613(B) | 0.5 | 10 |
| Total HxCDD | EPA 1613(B) | 0.2 | 5 |
| Total HxCDF | EPA 1613(B) | 0.4 | 5 |
| Total PeCDD | EPA 1613(B) | 0.4 | 5 |
| Total PeCDF | EPA 1613(B) | 0.5 | 5 |
| Total TCDD | EPA 1613(B) | 0.4 | 5 |
| Total TCDF | EPA 1613(B) | 0.4 | 5 |
| Total TEQ | Calculation | -- | -- |

Table 5. Analytical Methods and Quantitation Limits for Water Matrices

| Analyte | Method | Method Detection Limits | Target Reporting Limits |
|--|-----------|-------------------------|-------------------------|
| CONVENTIONALS | | | |
| Total Suspended Solids (%) | SM 2540 D | 0.95 | 1.0 |
| TOTAL AND DISSOLVED METALS (µg/L) | | | |
| Arsenic | EPA 1640 | 0.0133 | 0.03 |
| Cadmium | EPA 1640 | 0.0065 | 0.03 |
| Chromium | EPA 1640 | 0.0937 | 0.2 |
| Copper | EPA 1640 | 0.0088 | 0.03 |
| Lead | EPA 1640 | 0.0124 | 0.03 |
| Mercury | EPA 1631E | | 0.0005 |
| Nickel | EPA 1640 | 0.00736 | 0.05 |
| Selenium | EPA 1640 | 0.0112 | 0.05 |
| Silver | EPA 1640 | 0.0065 | 0.05 |
| Zinc | EPA 1640 | 0.0708 | 1.0 |

Table 6. Species, Methods, and End-Points for Biological Testing.

| Test Type | Species | Method | End Points |
|-----------------------|---------------------------------|--|------------------|
| MET Bioassays: | | | |
| Mysid | <i>Americamysis bahia</i> | USEPA/USACE 823-B-98-004 (1998) USEPA 821-R-02-012 (2002b) | 96 Hour Survival |
| SP Bioassays: | | | |
| Amphipod | <i>Ampelisca abdita</i> | ASTM E 1367-99 (1999) USEPA (1994) | 10 day survival |
| Polychaete worm | <i>Neanthes arenaceodentata</i> | ASTM E 1611-00 (2007) | 10 day survival |

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Kinnetic Laboratories conducts its activities in accordance with formal QA/QC procedures. The objectives of the QA/QC Program are to fully document the field and laboratory data collected, to maintain data integrity from the time of field collection through storage and archiving, and to produce the highest quality data possible. Quality assurance involves all of the planned and systematic actions necessary to provide confidence that work performed conforms to contract requirements, laboratory methodologies, state and federal regulation requirements, and corporate Standard Operating Procedures (SOPs). The program is designed to allow the data to be assessed by the following parameters: Precision, Accuracy, Comparability, Representativeness, and Completeness. These parameters are controlled by adhering to documented methods and procedures (SOPs), and by the analysis of quality control (QC) samples on a routine basis.

4.1 Field Sampling Quality Management

Field Quality Control procedures are summarized in Table 7 and includes adherence to SOPs and formal sample documentation and tracking. Standard Operating Procedures for vibracore sampling are provided in Appendix B.

Table 7. Quality Control Summary for Field Sediment Sampling

| <i>Sediment Sampling Field Activity</i> |
|--|
| <ul style="list-style-type: none">• Vibracore Sampling SOP• Grab Sampling SOP• Protocol Cleaning/Low Detection Limits• Certified Clean Laboratory Containers• Horizontal and Vertical Controls• Core Logging & Subsampling Protocols• Sample Control/ Chain of Custody Procedures• Field Logs and Core Logs• Sample Preservation & Shipping Procedures |

4.2 Chemical Analyses Quality Management

Please refer to the following tables for specific QC procedures to be employed for this sediment analytical chemistry testing program: Table 8 summarizes minimum laboratory QC requirements for the chemical analyses, which is to be performed at a rate of one per batch. Table 9 summarizes QA/QC objectives for sediment, and Table 10 summarizes QA/QC objectives for water. The Laboratory Quality Assurance Plan for Eurofins Calscience is included in Appendix A.

Analytical chemistry QC is formalized by USEPA and State certification agencies and involves internal quality control checks including QC checks such as method blanks, matrix spike/spike duplicates (MS/MSDs), laboratory control spike/laboratory control spike duplicates (LCS/LCSDs), laboratory replicates, and calibration standards. Post digestion spike/spike duplicates (PDS/PDSDs) are also run for the inorganic analyses.

Table 8. Minimum Quality Control Analyses for Sediment and Water Analyses.

| Analyte | Blanks | Duplicates | PDS/ SD ¹ | MS/ MSDs ² | LCS ^{3,4} | Surrogates |
|---------------------------------|--------|------------|-------------------------|--------------------------|--------------------|------------|
| <i>Sediment Matrices</i> | | | | | | |
| % Solids | — | ✓ | — | — | — | — |
| TOC | ✓ | — | — | ✓ | ✓ | — |
| Total Metals Inc. Mercury | ✓ | ✓ | ✓ | — | ✓ | — |
| Speciated butyltins | ✓ | ✓ | — | ✓ | ✓ | ✓ |
| PAHs | ✓ | ✓ | — | ✓ | ✓ | ✓ |
| Organochlorine Pesticides | ✓ | ✓ | — | ✓ | ✓ | ✓ |
| PCB Congeners | ✓ | ✓ | — | ✓ | ✓ | ✓ |
| Dioxins/Furans | ✓ | ✓ | — | ✓ | ✓ | ✓ |
| <i>Water Matrices</i> | | | | | | |
| Total Suspended Solids | — | ✓ | — | — | — | — |
| Total and Dissolved Metals | ✓ | ✓ | — | — | ✓ | — |

1. Post Digestion Spike/Spike Duplicate
2. Matrix Spike/Matrix Spike Duplicates
3. Laboratory Control Samples
4. For metals in seawater, both an LCS and LCS duplicate will be analyzed
5. Standard Reference Material

Table 9. Sediment Quality Assurance/Quality Control Objectives.

| Analyte | Accuracy | | Precision | |
|-------------------------------|--------------------|---|-------------------------------------|---|
| | Spike Recovery (%) | LCS/SRM ^a Recovery (mg/kg – dry) | Max. Blank or Matrix Spike RPDs (%) | Max. Laboratory Duplicate or LCS RPDs (%) |
| CONVENTIONALS | | | | |
| Percent Solids | - | - | - | 25 |
| Total Organic Carbon | 75-125 | 80-120 | 25 | 20 |
| METALS | | | | |
| Arsenic | 80 - 120 | 80 - 120 | 20 | 20 |
| Cadmium | 80 - 120 | 80 - 120 | 20 | 20 |
| Chromium | 80 - 120 | 80 - 120 | 20 | 20 |
| Copper | 80 - 120 | 80 - 120 | 20 | 20 |
| Lead | 80 - 120 | 80 - 120 | 20 | 20 |
| Mercury | 76-136 | 82-124 | 16 | 16 |
| Nickel | 80 - 120 | 80 - 120 | 20 | 20 |
| Selenium | 80 - 120 | 80 - 120 | 20 | 20 |
| Silver | 80 - 120 | 80 - 120 | 20 | 20 |
| Zinc | 80 - 120 | 80 - 120 | 20 | 20 |
| CHLORINATED PESTICIDES | | | | |
| 4,4'-DDD | 25 - 200 | 25 - 200 | 25 | 25 |
| 4,4'-DDE | 25 - 200 | 25 - 200 | 25 | 25 |
| 4,4'-DDT | 25 - 200 | 25 - 200 | 25 | 25 |
| Aldrin | 25 - 200 | 25 - 200 | 25 | 25 |
| BHC-alpha | 25 - 200 | 25 - 200 | 25 | 25 |
| BHC-beta | 25 - 200 | 25 - 200 | 25 | 25 |
| BHC-delta | 25 - 200 | 25 - 200 | 25 | 25 |
| BHC-gamma | 25 - 200 | 25 - 200 | 25 | 25 |
| Chlordane-alpha | 25 - 200 | 25 - 200 | 25 | 25 |
| Chlordane-gamma | 25 - 200 | 25 - 200 | 25 | 25 |
| Dieldrin | 25 - 200 | 25 - 200 | 25 | 25 |
| Endosulfan Sulfate | 25 - 200 | 25 - 200 | 25 | 25 |
| Endosulfan-I | 25 - 200 | 25 - 200 | 25 | 25 |
| Endosulfan-II | 25 - 200 | 25 - 200 | 25 | 25 |
| Endrin | 25 - 200 | 25 - 200 | 25 | 25 |
| Endrin Aldehyde | 25 - 200 | 25 - 200 | 25 | 25 |
| Endrin Ketone | 25 - 200 | 25 - 200 | 25 | 25 |
| Heptachlor | 25 - 200 | 25 - 200 | 25 | 25 |
| Heptachlor Epoxide | 25 - 200 | 25 - 200 | 25 | 25 |
| Methoxychlor | 25 - 200 | 25 - 200 | 25 | 25 |
| trans-Nonachlor | 25 - 200 | 25 - 200 | 25 | 25 |
| PCB CONGENERS | | | | |
| All Congeners | 50 - 125 | 50-125 | 30 | 30 |
| ORGANICS – PAHs | | | | |
| 1-Methylnaphthalene | 40 - 160 | 40-160 | 20 | 20 |
| 2-Methylnaphthalene | 40 - 160 | 40-160 | 20 | 20 |
| Acenaphthene | 40 - 106 | 48-108 | 20 | 20 |
| Acenaphthylene | 40 - 106 | 40-160 | 20 | 20 |
| Anthracene | 40 - 160 | 40-160 | 20 | 20 |
| Benz[a]anthracene | 40 - 160 | 40-160 | 20 | 20 |
| Benzo[a]pyrene | 17-163 | 17-163 | 20 | 20 |
| Benzo[b]fluoranthene | 40 - 160 | 40-160 | 20 | 20 |
| Benzo[e]pyrene | 40 - 160 | 40-160 | 20 | 20 |
| Benzo[g,h,i]perylene | 40 - 160 | 40-160 | 20 | 20 |
| Benzo[k]fluoranthene | 40 - 160 | 40-160 | 20 | 20 |
| Biphenyl | 40 - 160 | 40-160 | 20 | 20 |

Table 4. Analytical Methods and Quantitation Limits for Solid Matrices.

| Analyte | Method | Method Detection Limits | Laboratory Reporting Limits |
|--------------|-------------|-------------------------|-----------------------------|
| 123789-HxCDF | EPA 1613(B) | 0.5 | 5 |
| 234678-HxCDF | EPA 1613(B) | 0.3 | 5 |
| 23478-PeCDF | EPA 1613(B) | 0.3 | 5 |
| 2378-TCDD | EPA 1613(B) | 0.2 | 1 |
| 2378-TCDF | EPA 1613(B) | 0.2 | 1 |
| Total HpCDD | EPA 1613(B) | 3 | 10 |
| Total HpCDF | EPA 1613(B) | 0.5 | 10 |
| Total HxCDD | EPA 1613(B) | 0.2 | 5 |
| Total HxCDF | EPA 1613(B) | 0.4 | 5 |
| Total PeCDD | EPA 1613(B) | 0.4 | 5 |
| Total PeCDF | EPA 1613(B) | 0.5 | 5 |
| Total TCDD | EPA 1613(B) | 0.4 | 5 |
| Total TCDF | EPA 1613(B) | 0.4 | 5 |
| Total TEQ | Calculation | -- | -- |

Table 5. Analytical Methods and Quantitation Limits for Water Matrices

| Analyte | Method | Method Detection Limits | Target Reporting Limits |
|--|-----------|-------------------------|-------------------------|
| CONVENTIONALS | | | |
| Total Suspended Solids (%) | SM 2540 D | 0.95 | 1.0 |
| TOTAL AND DISSOLVED METALS (µg/L) | | | |
| Arsenic | EPA 1640 | 0.0133 | 0.03 |
| Cadmium | EPA 1640 | 0.0065 | 0.03 |
| Chromium | EPA 1640 | 0.0937 | 0.2 |
| Copper | EPA 1640 | 0.0088 | 0.03 |
| Lead | EPA 1640 | 0.0124 | 0.03 |
| Mercury | EPA 1631E | | 0.0005 |
| Nickel | EPA 1640 | 0.00736 | 0.05 |
| Selenium | EPA 1640 | 0.0112 | 0.05 |
| Silver | EPA 1640 | 0.0065 | 0.05 |
| Zinc | EPA 1640 | 0.0708 | 1.0 |

Table 6. Species, Methods, and End-Points for Biological Testing.

| Test Type | Species | Method | End Points |
|-----------------------|---------------------------------|--|------------------|
| MET Bioassays: | | | |
| Mysid | <i>Americamysis bahia</i> | USEPA/USACE 823-B-98-004 (1998) USEPA 821-R-02-012 (2002b) | 96 Hour Survival |
| SP Bioassays: | | | |
| Amphipod | <i>Ampelisca abdita</i> | ASTM E 1367-99 (1999) USEPA (1994) | 10 day survival |
| Polychaete worm | <i>Neanthes arenaceodentata</i> | ASTM E 1611-00 (2007) | 10 day survival |

Table 10. Quality Assurance/Quality Control Objectives for Water.

| Analyte | Accuracy | | Precision | |
|------------------------|-----------------|--------------------------|----------------------------------|--|
| | MS Recovery (%) | LCS Recovery (mg/kg dry) | Maximum MS and PD Spike RPDs (%) | Maximum Laboratory Duplicate or LCS RPDs (%) |
| Total Suspended Solids | | | | 10 |
| Arsenic | 50-150 | 70-130 | 20 | 20 |
| Cadmium | 50-150 | 70-130 | 20 | 20 |
| Chromium | 50-150 | 70-130 | 20 | 20 |
| Copper | 50-150 | 70-130 | 20 | 20 |
| Lead | 50-150 | 70-130 | 20 | 20 |
| Mercury | 71-125 | 50-130 | 24 | 30 |
| Nickel | 50-150 | 70-130 | 20 | 20 |
| Selenium | 50-150 | 70-130 | 20 | 20 |
| Silver | 50-150 | 70-130 | 20 | 20 |
| Zinc | 50-150 | 70-130 | 20 | 20 |

All data will be reviewed by laboratory team leaders and by the laboratory director. The project QA officer will be responsible for final data review and qualification. The laboratory will supply data in both electronic and hard copy formats, and results will be retained in the project files at Kinnetic Laboratories. Data analysis will consist of tabulation and comparison with reference and control data.

All analytical data collected for this sediment-testing program will undergo QA/QC evaluation according to USEPA National Functional Guidelines for organic and inorganic data review (USEPA, 2014a and 2014b). A summary of QA/QC findings will be included in the final report and all QA/QC data and a full QA/QC evaluation will be included.

All laboratories will supply testing results in both hard copy and electronic formats. All data in the summary tables will be coded as to quality. Each laboratory will be responsible that data reports are accurate. After completion of sediment data review, hard copies will be stored at Kinnetic Laboratories and be included as appendices to the final report. Data will also be entered into appropriate digital spreadsheets by the laboratories so appropriate summary tables and graphics can be constructed from the draft and final reports.

4.3 Biological Testing

Quality assurance measures applied to aquatic toxicity testing are explicitly stated in the referenced protocols. Each protocol provides a list of test acceptability criteria, including minimum control performance standards and required monitoring of environmental parameters. Test conditions must remain within the tolerance range of the test organisms throughout the test, and environmental factors are monitored and recorded daily. Any variation from specifications is documented and corrective action adjustments are reported with the test data. Protocols also provide guidance on test organisms procurement, care and acclimation. Pacific EcoRisk maintains laboratory logbooks documenting these factors.

Key monitoring factors for the bioassay tests are summarized in Table 11. Water quality parameters (pH, temperature, salinity and dissolved oxygen) will be monitored for all tests on a daily basis. Water samples from test chambers will also be collected at specified intervals to monitor ammonia concentrations. Water samples for ammonia analysis will be collected at test initiation and termination for the MET bioassays. For the 10-day solid-phase sediment tests, porewater samples will be collected through centrifugation and tested for ammonia and sulfides before test initiation and right after test termination. Overlying water will also be analyzed for ammonia at test initiation and termination. Should there be a high concentration of total ammonia in the porewater of a particular sample (>15 mg/L), ammonia purging of test chambers will be conducted for that sample prior to initiation of benthic exposures. This will be done by performing twice daily overlying water renewals coupled with aeration and measuring porewater ammonia concentrations from surrogate chambers once daily. Overlying water renewals will be performed until porewater total ammonia concentrations fall below 15 mg/L. All water quality monitoring data will be provided in the final report.

Two other important bioassay QA measures are the inclusion of an experimental control, where organisms are simultaneously exposed to laboratory test conditions in the absence of a toxicant stress, and the inclusion of reference toxicant bioassays, in which the organisms are exposed to standard toxicants (ammonia, copper, potassium and/or cadmium) to determine organism sensitivity relative to control charts from prior testing in the laboratory. Reference toxicant bioassays are run concurrently with and under the same conditions as the bioassays of the test material. The exception to this rule is that reference toxicant tests with solid phase species are performed as sediment-free 96-hour acute tests. Control charts are maintained in the laboratory for each species/toxicant combination. A minimum of five bioassays are required for a valid control chart, and upper and lower limits are developed which are two standard deviations on either side of the mean. Precision is quantified in the control charts by calculation of the coefficient of variation (CV). The application of a maximum acceptable value for the CV or the minimum significant difference (MSD) increases data reliability, and many newer protocols specify such maximum acceptable values.

Table 11. Sediment Interstitial and Overlying Water Analyses for Water Column and Benthic Exposures for Acute Toxicity Testing.

| Parameter | Water Column (All Species) | Benthic | |
|-------------|-------------------------------|----------|------|
| | | Amphipod | Worm |
| Ammonia | O | I, O | I, O |
| Sulfides | -- | I | I |
| DO | O | O | O |
| Temperature | O | O | O |
| Salinity | O | I, O | I, O |
| pH | O | I, O | I, O |

I = Interstitial Water O = Overlying Water

5.0 DATA REDUCTION ANALYSIS AND REPORTING

All data will be reviewed by laboratory team leaders and by the laboratory director. The project QA officer will be responsible for final data review and qualification. Laboratories will supply data in an electronic format and the results will be retained in a project file at Kinnetic Laboratories. Data analysis will consist of tabulation and comparison with sediment quality guidelines. Water quality data will be compared with water quality criteria, and applicable dilution models will be applied to determine if water quality goals will be met during in-bay dredge material placement.

Statistical analysis of experimental data will be performed for each of the bioassay. Tests of fundamental assumptions (e.g., normality, variance homogeneity) are followed by the appropriate parametric or non-parametric analyses.

Variance homogeneity is one of the underlying assumptions of most parametric statistics. Bartlett's or Cochran's test is therefore applied to the data from the bioassays. Significant results for this and all subsequent parametric tests are determined by the critical value ($\alpha = 0.05$) of the appropriate distributions.

Once homogeneity has been established, the parametric ANOVA and Dunnett's test will be employed to analyze differences between treatment responses (e.g., test sediment tanks). Survival responses in the control tanks serve primarily for procedural quality assurance.

When sample variances do not exhibit homogeneity, as determined by Cochran's test, the Testing Manual recommends a data transformation. Arcsine transformation is applied to proportional data of bioassays. When the data transformation is unsuccessful, non-parametric tests are employed.

Non-parametric procedures use ranked values for calculating test statistics and the corresponding hypotheses use rank sums for comparison. Kruskal-Wallis test and Dunn's procedure tests are used to identify differences between treatment responses.

Guidelines for interpretation of benthic bioassay results are published in the ITM. If survival responses in test sediment are statistically significantly lower than those in reference sediment *and* if the difference in mean survival between groups is greater than 10% (20% for amphipods), then the test sediment is considered to have the potential to significantly degrade the marine environment.

The findings from the testing program will be summarized in a sampling and analysis report (SAR) that will compare the results to sediment disposal guidelines for the placement/reuse options. The report will detail all sampling and testing methods and will present summarized results in concise tables. The report will include a Cover Sheet, Table of Contents, List of Tables, List of Figures, and narrative text.

The narrative text will include a project description, deviations from this SAP, a QA/QC discussion and a discussion of results and implications. Individual sampling locations will be tabulated by date and time of collection, precise position, mudline depth, and core length. Analytical chemistry values for all analytes will be presented in a summary table.

Detailed laboratory reports of analytical chemistry data will be presented as appendices. The appendices will also include detailed analytical chemistry QC elements. Copies of completed field logs and chain-of-custody documentation will be included in the appendices.

The project location and detailed sample locations will be presented in digitized maps.

The report and all supporting data will also be supplied in electronic format. Once the SAR is finalized, all data will be uploaded to the DMMO's San Francisco Bay Dredging and Disposal Database which can be accessed through the following link:

http://www.dmмосfbay.org/site/alias_dmмо/71024/meeting_area_document_and_data_submittal.aspx

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