**Southern California Dredged Materials Management Team**

# Sampling and Analysis Plan/Results Report Guidelines

**Revised: March 22, 2012**

These guidelines supplement the more detailed information in the Inland Testing Manual (ITM) and Ocean Testing Manual (OTM), and are not intended to be used on their own. These guidelines also do not provide technical details about laboratory testing protocols. The ITM and OTM, referenced literature, and any other agency guidance should be consulted for the most recent technical information. While following the full extent of these guidelines may not be necessary for each project, justification must be provided for any deviations. Applicants with projects covered by the Los Angeles Region Contaminated Sediments Task Force (CSTF) are reminded that the Long-Term Management Strategy may apply.

## Sampling and Analysis Plan and Sampling and Analysis Plan Results Report process:

Sampling and Analysis Plans (SAPs) help ensure that dredged material to be discharged at any given site (offshore, nearshore, beach) is suitable for that site and will not cause undesirable effects (human health-related, ecological, etc.). The purpose of a SAP is to ensure adequate sediment characterization through implementation of a project-specific sampling plan such that representative samples are collected in a timely and cost-effective manner.

**Regulatory Process.** Once an applicant submits a draft SAP to the agencies (for example, EPA, the Corps, the California Coastal Commission, and RWQCB) either through the SC-DMMT (or CSTF) or directly to agency staff, the agencies review the SAP and provide comments to the applicant either during a meeting (SC-DMMT/CSTF or otherwise) or through written correspondence. One or more agencies may require revisions to the SAP that require the applicant to resubmit the SAP prior to agencies' approval. The applicant proceeds with sediment testing once the agencies approve the SAP.

After testing is completed, the applicant submits the draft SAP Results report (SAPR) to the agencies. The agencies review the SAPR, provide comments to the applicant and may require additional testing and/or revisions before approval. As part of approving the SAPR, the agencies may make a preliminary suitability determination. The applicant then submits permit applications to the agencies that includes information on the characteristics and composition of the dredged material. The Corps reaches a permit decision that includes the final suitability determination.

## Electronic data submissions:

In order to aid the agencies in evaluating dredged material proposals, results data should be submitted electronically using the SC-DMMT Results Reporting Table version 1.0 for GIS purposes (available here: http://www.spl.usace.army.mil/regulatory/sc-dmmt_page.htm). The Results Reporting Table should be submitted "as-is" (i.e., in the required format shown in Table

4-1) and simultaneously with the draft SAPR. The final, agency-approved SAPR should be submitted with a final Results Reporting Table in electronic format. Electronic documents should be submitted on digital media (CD, DVD) and included with a paper copy of the final SAPR. Copies may also be sent via e-mail or FTP in advance of paper report submittal.

**SAP/SAPR Outline**

**Table of Contents**



**List of Tables**



**List of Figures**

## 1. INTRODUCTION

A. Project Summary: Summarize the purpose and scope of the proposed project. Each section should be as detailed as necessary for the reviewer to understand the project.

- Purpose and Objectives (maintenance, new work, or environmental remediation)
- Method of dredging (mechanical or hydraulic), where known
- Total area of dredge footprint (in acres)
- Authorized depth (in feet MLLW)
- Amount of overdepth (in feet) and overdepth limit (in feet MLLW) – sampling greater than 2 feet over dredged depth must be analyzed separately
- Total dredge volume (in cubic yards) , including with and without overdepth volumes, and volume of separate dredge areas (if applicable), including with and without overdepth volumes
- For Corps operation and maintenance projects with advanced maintenance dredging, explain need for advanced maintenance dredging and Corps Division (SPD) authorization
- Preferred and alternative placement options for dredged material (ocean, upland, confined disposal facility, contained aquatic disposal). Include a discussion of using materials for beneficial reuse (beach nourishment, port fill, etc.).
- Habitat considerations (e.g. presence of kelp beds, eelgrass beds, etc.) for the dredge site and potential disposal sites

➢ Figure 1-1: Vicinity Map (examples a and b)

B. Site Description: Describe the location of the project including latitude/longitude coordinates of the approximate geographic center of the dredge footprint (NAD 83) for use in Corps and EPA project databases.

C. Roles and Responsibilities: Identify person(s) responsible for each aspect of the project. Include contact information for the following:

1. Applicant and authorized representative responsible for field activities and project management
2. Consultant(s) responsible for sampling and sediment testing and dredging operations
3. Laboratory responsible for analysis (including any state or EPA national certification)

## 2. SITE HISTORY / HISTORICAL DATA REVIEW

A. Discuss the issues that affect existing or potential contaminants at dredging and disposal sites including:

- Historical uses of the site
- Surrounding land use (both immediate and adjacent areas)
- Historical contamination cleanup (e.g., nearby superfund sites, brownfields sites, cleanup orders from the Regional Boards)
- Sources of potential contamination at or within the vicinity of the site (e.g., storm drains, ship repair facilities, fuel docks, turning basins, etc.)

- Accidental spills or other unexpected discharges – reports or other documentation, including cleanup remedies
- 303(d) and TMDL status of water body
- Discharge/placement site history, where known, for sites other than Ocean Dredged Material Disposal Site

B. Previous sediment testing: If the proposed site has been previously dredged, or if sediment has been tested in the past, provide a narrative of the previous dredging and testing results accompanied with the following summary table. Summaries of sediment testing reports and results (data tables, map of core locations, and full report citation) from previous episodes should be provided as an appendix to the SAP with full reports provided separately in electronic format. If possible, overlay historic core locations on Figure 3-3 (Plan view of proposed dredge cut and core locations).

The narrative should describe all previous material management actions and disposal suitability determinations. If the area has been dredged multiple times, limit the summary to the last three dredging episodes. If the site has not been dredged, has been dredged but no records are available, or sediment testing has not been conducted, then state so.

➢ Table 2-1: Site History

| Dredging Year | Total Volume Dredged ($yd^3$) | Dredge Depth | Contaminants of Concern | Placement (ocean, upland, beach, etc.) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## 3. METHODS

A. Dredge Design: Describe the dredge footprint with use of figures, maps, plans, and tables. All maps, drawings, and figures should be to-scale, with north up and a scale bar provided. Be judicial in layering information in figures to ensure their readability. Most figures should fit within an 8.5" x 11" format. Figures should not exceed 11" x 17". As needed, divide large maps or figures into smaller units for presentation on 8.5"x11" format. Include the following figures:

➢ Figure 3-1: **Plan view of proposed dredging footprint(s)** (core locations optional).
➢ Figure 3-2: **Plan view of existing bathymetry** (examples a and b) (indicate year of bathymetric survey). EPA recommends that surveys should be no older than 1 year and new surveys may be required following any major changes in site conditions (e.g. following storms). Separate composite areas if necessary for readability.

- Figure 3-3: **Plan view of proposed dredge cut and core locations**. Map must show the difference between existing and proposed bathymetry (a.k.a., design depth). Color-coding of elevation differences is preferred. Separate composite areas into multiple maps if necessary for readability.
- Figure 3-4: **Representative cross-sections of proposed dredging footprint**.

- Table 3-1: Dredging Volumes

| | Area (acre) | Design Depth (ft. MLLW) | Overdepth (ft. MLLW) | Volume of Design Depth ($yd^3$) | Volume of Overdepth ($yd^3$) | Total Volume ($yd^3$) | Number of cores per unit |
|---|---|---|---|---|---|---|---|
| Composite Area | | | | | | | |
| Composite Area | | | | | | | |
| Total | | N/A | N/A | | | | |

B. <u>Sampling Design</u>

1. Sampling and Testing Objectives

2. Sample Identification: Core sample names should begin with a two-character site designator (e.g., NB for Newport Bay) followed by a two-digit year. Iindividual core locations within the dredge unit/composite area should be identified using numbers (1,2,3…), and each dredge unit and/or composite area should be labeled alphabetically (A, B, C…). Identifiable strata should be labeled using a numeric depth range where 0810 = core stratum from -8 ft to -10 ft MLLW. Examples of core sample names would then be: NB12-A for a composite sample collected from Newport Bay dredge unit A in 2012, NB12-2A for the second individual core which is located within dredge unit A in 2012, and NB12-2A0608 for the same second core sample taken from the -6 ft to -8 ft MLLW core stratum.

3. Composite Areas: Provide the rationale for creating composite areas (e.g., depth, homogeneity, previous sampling results) and for the number, location, areal extent, and estimated volume of composite areas.

   Horizontal Compositing (combining several sediment cores into a single sample) is often used for testing purposes. Careful consideration must be given to the compositing scheme for every project. Sediment samples should only be composited together when:

   - They are from contiguous portions of the project area,
   - There is reason to believe that sediment throughout that portion of the project area is similar (in terms of grain size, etc.) and is exposed to the same influences and pollutant sources, and

- Design depth and overdepth are the same; i.e. contiguous areas with differing design depths should be split into separate areas based on design depth.

Proposed compositing schemes should be identified in the SAP and the rationale used fully described. The amount of material from each core included in the composite sample shall be proportional to the length of the core (or cores if more than one core was necessary to secure adequate volume). Sediment composites should comprise a sufficient volume for conducting all of the physical, chemical, and biological testing, including any QC analysis.

Vertical Compositing: Normally, material is collected from the entire length of a sediment core and combined as one vertical composite sample. However, if it is suspected that contaminant levels vary with depth in the sediment or where multiple geologic strata are proposed to be dredged, cores can be divided into multiple, vertically stratified samples (upper, middle, lower) or in specific elevation internals (e.g., 1 ft "slices"). Such vertical stratification may be appropriate if/when there are:

- Distinct layers and/or contamination observed (note: sub-sampling and archiving may be appropriate prior to compositing)
- Contamination expected within particular strata
- Higher resolution desired to characterize contaminant distribution (e.g., for increased disposal options)
- If core lengths > 10 ft, consider splitting each core into upper and lower

When individual core samples are found to contain distinct layers that were not expected, the layers should be separated for individual testing (or at least sub-samples of each layer should be archived for possible later analysis).

4. Core Sample Locations and Depth: Propose an adequate number of sample locations to characterize the maximum volume of material to be dredged, including major shoals. Core locations should be distributed throughout the dredge area to obtain adequate spatial coverage. Core samples should be taken to the full project depth, plus the permitted overdepth allowance. The full permitted overdepth allowance should be sampled, even if it differs from the "pay depth" identified in a dredging contract. (i.e., one foot paid, one foot non-paid)

   Add core samples if/where there is:

   - History of contamination at site
   - Expected variation in sediment characteristics (grain size)
   - Outfalls, stream/river outlets, existing/past commercial/industrial activities, or other sources of pollution are present
   - Shoals and areas where dredging will remove greater volumes of material (shallower areas)
   - Downstream of major point sources of pollution and/or in quiescent areas, such as: turning basins and side channels

Fewer samples (or no testing) may be required for:

- Upland disposal (unless return water via NWP 16)
- Confined Disposal Facility (CDF)
- Exclusionary criteria (40 CFR 230.60(a))

Generally, a minimum of three to four samples is needed for a typical composite. However, because every dredging project is unique, additional or fewer samples may be needed based on dredge volume and area consideration, the results of past testing, or the presence of known or suspected pollution sources.

➢ Figure 3-5: Plan view of proposed core locations. Should include an overview map showing all composite areas (e.g., A, B, C) and core locations. These maps should also show storm drain locations and any other potential point sources of pollution. If possible, figure should also include historic core locations. Historic sample locations should be shown using distinctive symbols. Should also include most recent bathymetry.

➢ Table 3-2 (example): Core Information

| Sample ID | Water Depth (ft MLLW) | Latitude | Longitude | Target Sampling Depth (ft MLLW) | Target Core Length (ft) | No. of cores per location for required sample volume | Composite ID | Proposed individual core analyses | Proposed Composite Analyses |
|---|---|---|---|---|---|---|---|---|---|
| NB12-1A | 12 | 33.41436 | -118.27869 | -6 | 5.5 | 1 | A | None | Chemical, Physical, Biological |
| NB12-2A | 12 | 33.41273 | -118.27873 | -6 | 5.5 | 1 | | | |
| NB12-3B | 5 | 33.41252 | -118.27873 | -11 | 17.5 | 2 | B | Chemistry, & Physical | Biological |
| NB12-4B | 5 | 33.41389 | -118.27873 | -11 | 17.5 | 2 | | | |
| NB12-5B | 5 | 33.41224 | -118.27873 | -11 | 17.5 | 2 | | | |

7. Z-Layer testing (if appropriate): Z-layer testing is appropriate for projects with an explicitly-stated purpose of environmental remediation and/or contaminant (hot spot) removal in association with a dredging project. The purpose is to confirm the exposed sediment surface layer remaining after dredging is chemically similar to ambient sediment conditions in the vicinity of the project area and/or is below target SQGs, whichever evaluation is determined appropriate by the agencies. This is

typically accomplished by testing a 1-foot layer below the project depth or allowed overdepth.

8. Reference sample(s): should include latitude and longitude of reference sample location.

9. Proposed beach nourishment site sample(s): should include description of sampling design (e.g., transects), latitude and longitude of sample location(s), and sampling method.

10. Sampling Platform and Navigation and Vertical Control

11. Sample Collection, Processing, and Shipping
    - Separating layers
    - Field data documentation
    - Core photo-documentation
    - Archiving cores: Individual cores should be archived for potential future testing. Consult the ITM for specific holding times.
    - Transport/shipping
    - Chain of custody
    - Equipment decontamination procedures
    - Waste Disposal

C. <u>Physical and Chemical Testing</u>

Physical and chemical analyses should be conducted on each composite sediment sample. In some cases, evaluation of individual core samples may also assist in decision making. When a composite "fails" some aspect of the testing, and individual core data are available, the agencies can sometimes determine that sub-areas are suitable for unconfined aquatic disposal (SUAD) without further sampling and evaluation. Archiving individual cores for possible retesting is recommended. Routine sediment physical and chemical analyses should be performed for the list of physical characteristics and analytes listed in the following table. Specific analytes may be added or removed on a case-by-case basis; however, an explanation should be provided in the SAP for each analyte proposed for removal. Testing methods should follow the ITM/OTM; however alternative testing methods may be acceptable is the applicant provides sufficient justification.

1. Description of Physical Testing
2. Description of Chemical Testing
3. Quality Assurance/Quality Control: Describe how the project will meet data quality objectives and sample handling and storage requirements.

➢ Table 3-3 Analytes, Methods, and Detection Limits for Physical and Chemical Testing.

| GROUPINGS | Attributes | Analytical Method | MDL[1] | TRL[2] | Units |
|---|---|---|---|---|---|
| Conventionals | Grain Size | Plumb (1981) | NA | NA | % |
| | Ammonia | 350.1M | 0.04 | 0.5 | mg/kg |
| | TOC | USEPA 9060A | 0.07 | 0.2 | % |
| | Moisture | 160.3 | NA | NA | % |
| | TSS | SM 2540 D | 5 | 5 | mg/L |
| | TVS | SM 2540E | NA | NA | % |
| | TPH | SW-846 | NA | NA | Mg/kg |
| | TRPH | 1664M | 1.6 | 25 | mg/kg |
| Metals | Arsenic | USEPA 6020 | 0.051 | 0.2 | mg/kg |
| | Cadmium | USEPA 6020 | 0.005 | 0.2 | mg/kg |
| | Chromium | USEPA 6020 | 0.017 | 0.2 | mg/kg |
| | Copper | USEPA 6020 | 0.018 | 0.2 | mg/kg |
| | Lead | USEPA 6020 | 0.009 | 0.2 | mg/kg |
| | Mercury | USEPA 7471A | 0.001 | 0.04 | mg/kg |
| | Nickel | USEPA 6020 | 0.016 | 0.2 | mg/kg |
| | Selenium | USEPA 6020 | 0.035 | 0.2 | mg/kg |
| | Silver | USEPA 6020 | 0.004 | 0.2 | mg/kg |
| | Zinc | USEPA 6020 | 0.26 | 2 | mg/kg |
| Organotins | Dibutyltin | Krone 1989 | 0.6 | 6 | microg/kg |
| | Monobutyltin | Krone 1989 | 0.97 | 6 | microg/kg |
| | Tetrabutyltin | Krone 1989 | 0.36 | 6 | microg/kg |
| | Tributyltin | Krone 1989 | 0.33 | 6 | microg/kg |
| PAHs | 1-Methylnapthalene | EPA 8270C SIM | 1.04 | 20 | microg/kg |
| | 2-Methylnapthalene | EPA 8270C SIM | 1.04 | 20 | microg/kg |
| | 2,4,5-Trichlorophenol | EPA 8270C SIM | 1.5 | 10 | microg/kg |
| | 2,4,6-Trichlorophenol | EPA 8270C SIM | 3.6 | 20 | microg/kg |
| | 2,4-Dichlorophenol | EPA 8270C SIM | 2.7 | 20 | microg/kg |
| | 2,4-Dimethylphenol | EPA 8270C SIM | 3.1 | 20 | microg/kg |
| | 2,4-Dinitrophenol | EPA 8270C SIM | 63 | 1000 | microg/kg |
| | 2-Chlorphenol | EPA 8270C SIM | 3.4 | 20 | microg/kg |
| | 2-Methylnapthalene | EPA 8270C SIM | 0.92 | 20 | microg/kg |
| | Acenaphthene | EPA 8270C SIM | 0.76 | 20 | microg/kg |
| | Acenaphthylene | EPA 8270C SIM | 0.73 | 20 | microg/kg |
| | Anthracene | EPA 8270C SIM | 0.66 | 20 | microg/kg |
| | Benzo(a)anthracene | EPA 8270C SIM | 1.01 | 20 | microg/kg |
| | Benzo(a)pyrene | EPA 8270C SIM | 0.64 | 20 | microg/kg |
| | Benzo (b) Fluoranthene | EPA 8270C SIM | 0.77 | 20 | microg/kg |
| | Benzo (g,h,i) Perylene | EPA 8270C SIM | 1.14 | 20 | microg/kg |
| | Benzo (k) Fluoranthene | EPA 8270C SIM | 0.96 | 20 | microg/kg |
| | Chrysene | EPA 8270C SIM | 0.76 | 20 | microg/kg |
| | Dibenz (a,h) Anthracene | EPA 8270C SIM | 0.53 | 20 | microg/kg |
| | Fluoranthene | EPA 8270C SIM | 0.78 | 20 | microg/kg |
| | Fluorene | EPA 8270C SIM | 0.7 | 20 | microg/kg |
| | Indeno (1,2,3-c,d) Pyrene | EPA 8270C SIM | 0.66 | 20 | microg/kg |

[1] Method Detection Limit (dry weight)
[2] Target Reporting Limit (dry weight)

| | | | | | |
|---|---|---|---|---|---|
| | Naphthalene | EPA 8270C SIM | 0.83 | 20 | microg/kg |
| | Pentachlorophenol | EPA 8270C SIM | 88 | 1000 | microg/kg |
| | Phenanthrene | EPA 8270C SIM | 1.08 | 20 | microg/kg |
| | Pyrene | EPA 8270C SIM | 0.82 | 20 | microg/kg |
| | Total PAHs | EPA 8270C SIM | | | microg/kg |
| PCBs | PCB 018 | USEPA 8082A ECD | 0.086 | 0.5 | microg/kg |
| | PCB 028 | USEPA 8082A ECD | 0.53 | 0.5 | microg/kg |
| | PCB 037 | USEPA 8082A ECD | 0.12 | 0.5 | microg/kg |
| | PCB 044 | USEPA 8082A ECD | 0.25 | 0.50 | microg/kg |
| | PCB 049 | USEPA 8082A ECD | 0.095 | 0.50 | microg/kg |
| | PCB 052 | USEPA 8082A ECD | 0.15 | 0.50 | microg/kg |
| | PCB 066 | USEPA 8082A ECD | 0.1 | 0.50 | microg/kg |
| | PCB 070 | USEPA 8082A ECD | 0.15 | 0.50 | microg/kg |
| | PCB 074 | USEPA 8082A ECD | 0.1 | 0.50 | microg/kg |
| | PCB 077 | USEPA 8082A ECD | 0.082 | 0.50 | microg/kg |
| | PCB 081 | USEPA 8082A ECD | 0.07 | 0.50 | microg/kg |
| | PCB 087 | USEPA 8082A ECD | 0.15 | 0.50 | microg/kg |
| | PCB 099 | USEPA 8082A ECD | 0.079 | 0.50 | microg/kg |
| | PCB 101 | USEPA 8082A ECD | 0.078 | 0.50 | microg/kg |
| | PCB 105 | USEPA 8082A ECD | 0.053 | 0.50 | microg/kg |
| | PCB 110 | USEPA 8082A ECD | 0.082 | 0.50 | microg/kg |
| | PCB 114 | USEPA 8082A ECD | 0.068 | 0.50 | microg/kg |
| | PCB 118 | USEPA 8082A ECD | 0.078 | 0.50 | microg/kg |
| | PCB 119 | USEPA 8082A ECD | 0.072 | 0.50 | microg/kg |
| | PCB 123 | USEPA 8082A ECD | 0.092 | 0.50 | microg/kg |
| | PCB 126 | USEPA 8082A ECD | 0.072 | 0.50 | microg/kg |
| | PCB 128 | USEPA 8082A ECD | 0.08 | 0.50 | microg/kg |
| | PCB 138 | USEPA 8082A ECD | 0.075 | 0.50 | microg/kg |
| | PCB 149 | USEPA 8082A ECD | 0.07 | 0.50 | microg/kg |
| | PCB 151 | USEPA 8082A ECD | 0.069 | 0.50 | microg/kg |
| | PCB 153 | USEPA 8082A ECD | 0.097 | 0.50 | microg/kg |
| | PCB 156 | USEPA 8082A ECD | 0.073 | 0.50 | microg/kg |
| | PCB 157 | USEPA 8082A ECD | 0.076 | 0.50 | microg/kg |
| | PCB 158 | USEPA 8082A ECD | 0.07 | 0.50 | microg/kg |
| | PCB 167 | USEPA 8082A ECD | 0.088 | 0.50 | microg/kg |
| | PCB 168 | USEPA 8082A ECD | 0.069 | 0.50 | microg/kg |
| | PCB 169 | USEPA 8082A ECD | 0.093 | 0.50 | microg/kg |
| | PCB 170 | USEPA 8082A ECD | 0.066 | 0.50 | microg/kg |
| | PCB 177 | USEPA 8082A ECD | 0.089 | 0.50 | microg/kg |
| | PCB 180 | USEPA 8082A ECD | 0.083 | 0.50 | microg/kg |
| | PCB 183 | USEPA 8082A ECD | 0.064 | 0.50 | microg/kg |
| | PCB 187 | USEPA 8082A ECD | 0.087 | 0.50 | microg/kg |
| | PCB 189 | USEPA 8082A ECD | 0.068 | 0.50 | microg/kg |
| | PCB 194 | USEPA 8082A ECD | 0.082 | 0.50 | microg/kg |
| | PCB 201 | USEPA 8082A ECD | 0.13 | 0.50 | microg/kg |
| | PCB 206 | USEPA 8082A ECD | 0.078 | 0.50 | microg/kg |
| | PCBs | USEPA 8082A ECD | | | microg/kg |

| | | | | | |
|---|---|---|---|---|---|
| Pesticides | 2,4'-DDD | US EPA 8081A | 0.2 | 2 | microg/kg |
| | 2,4'-DDE | US EPA 8081A | 0.18 | 2 | microg/kg |
| | 2,4'-DDT | US EPA 8081A | 0.14 | 2 | microg/kg |
| | 4,4'-DDD | US EPA 8081A | 0.26 | 2 | microg/kg |
| | 4,4'-DDE | US EPA 8081A | 0.3 | 2 | microg/kg |
| | 4,4-DDT | US EPA 8081A | 0.33 | 2 | microg/kg |
| | DDTs | US EPA 8081A | | | microg/kg |
| | Aldrin | US EPA 8081A | 0.31 | 2 | microg/kg |
| | Alpha-BHC | US EPA 8081A | 0.29 | 2 | microg/kg |
| | Beta-BHC | US EPA 8081A | 0.26 | 2 | microg/kg |
| | Chlordane | US EPA 8081A | 1.9 | 10 | microg/kg |
| | Delta-BHC | US EPA 8081A | 0.32 | 2 | microg/kg |
| | Dieldrin | US EPA 8081A | 0.23 | 2 | microg/kg |
| | Endosulfan I | US EPA 8081A | 0.36 | 2 | microg/kg |
| | Endosulfan II | US EPA 8081A | 0.18 | 2 | microg/kg |
| | Endosulfan Sulfate | US EPA 8081A | 0.26 | 2 | microg/kg |
| | Endrin | US EPA 8081A | 0.2 | 2 | microg/kg |
| | Endrin Aldehyde | US EPA 8081A | 0.2 | 2 | microg/kg |
| | Endrin Ketone | US EPA 8081A | 0.3 | 2 | microg/kg |
| | Gamma-BHC | US EPA 8081A | 0.23 | 2 | microg/kg |
| | Heptachlor | US EPA 8081A | 0.22 | 2 | microg/kg |
| | Heptachlor Epoxide | US EPA 8081A | 0.18 | 2 | microg/kg |
| | Methoxychlor | US EPA 8081A | 0.17 | 2 | microg/kg |
| | Toxaphene | US EPA 8081A | 8.5 | 40 | microg/kg |
| Phtalates | Bis(2-Ethylhexyl) Phthalate | EPA 8270C SIM | 4.1 | 20 | microg/kg |
| | Butylbenzyl Phthalate | EPA 8270C SIM | 4.4 | 20 | microg/kg |
| | Diethyl Phthalate | EPA 8270C SIM | 5 | 20 | microg/kg |
| | Dimethyl Phthalate | EPA 8270C SIM | 5.4 | 20 | microg/kg |
| | Di-n-butyl Phthalate | EPA 8270C SIM | 5.1 | 20 | microg/kg |
| | Di-n-octyl Phthalate | EPA 8270C SIM | 4.7 | 20 | microg/kg |
| Phenols | 2-Methylphenol | EPA 8270C SIM | 5.3 | 20 | microg/kg |
| | 2-Nitrophenol | EPA 8270C SIM | 2.4 | 20 | microg/kg |
| | 3,4-Methylphenol | EPA 8270C SIM | | | microg/kg |
| | 4,6-Dinitro-2-Methylphenol | EPA 8270C SIM | | | microg/kg |
| | 4-Chloro-3-Methylphenol | EPA 8270C SIM | 3.5 | 20 | microg/kg |
| | Bisphenol A | EPA 8270C SIM | ? | ? | microg/kg |
| | Total phenols | EPA 8270C SIM | 3.7 | 30 | microg/kg |
| Pyrethroids | Allethrin (Bioallethrin) | GC/MS/MS | 0.09 | 1 | microg/kg |
| | Bifenthrin | GC/MS/MS | 0.085 | 1 | microg/kg |
| | Cyfluthrin-beta (Baythroid) | GC/MS/MS | 0.1 | 1 | microg/kg |
| | Cyhalothrin-Lamba | GC/MS/MS | 0.078 | 1 | microg/kg |
| | Cypermethrin | GC/MS/MS | 0.15 | 1 | microg/kg |
| | Deltamethrin (Decamethrin) | GC/MS/MS | 0.093 | 1 | microg/kg |
| | Esfenvalerate | GC/MS/MS | 0.087 | 1 | microg/kg |
| | Fenpropathrin (Danitol) | GC/MS/MS | 0.091 | 1 | microg/kg |
| | Fenvalerate (sanmarton) | GC/MS/MS | 0.094 | 1 | microg/kg |
| | Fluvalinate | GC/MS/MS | 0.12 | 1 | microg/kg |

| | | | | | |
|---|---|---|---|---|---|
| | Permethrin (cis and trans) | GC/MS/MS | 0.088 | 1 | microg/kg |
| | Resmethrin (Bioresmethrin) | GC/MS/MS | 0.079 | 1 | microg/kg |
| | Resmethrin | GC/MS/MS | 0.013 | 1 | microg/kg |
| | Sumithrin (Phenothrin) | GC/MS/MS | 0.09 | 1 | microg/kg |
| | Tetramethrin | GC/MS/MS | 0.085 | 1 | microg/kg |
| | Tralomethrin | GC/MS/MS | 0.1 | 1 | microg/kg |

D. Biological Testing (if required)

1. Suspended-particulate phase testing
2. Solid phase testing
3. Bioaccumulation potential testing
4. Bioaccumulation tissue chemistry
5. Quality Assurance/ Quality Control

➢ Table 3-4 (example): Test Conditions for Biological Testing

| Test Type | Species | Method | End Points |
|---|---|---|---|
| **BIOASSAYS:** | | | |
| **Suspended Particulate Phase:** | | | |
| Bivalve Larvae | *Mytilus galloprovincialis* | ASTM, 1998 E 724 98 | 48 hr. survival and normal development |
| Fish Larvae | *Menidia beryllina* | USACE/USEPA 1998 | 4 day survival |
| Mysid Shrimp | *Mysidopsis bahia* | USACE/USEPA 1998 | 4 day survival |
| **Solid Phase:** | | | |
| Amphipod | *Ampelisca abdita* | ASTM, 1999a E 1367 92; USEPA 1994 | 10 day survival |
| Polychaete worm | *Nephtys caecoides* | ASTM, 1999b E 1611 94 | 10 day survival |
| **BIOACCUMULATION EXPOSURES:** | | | |
| Clam | *Macoma nasuta* | USACE/USEPA 1998 | 28 day benthic exposure |
| Worm | *Nephtys caecoides or Nereis virens* | USACE/USEPA 1998 | 28 day benthic exposure |

## 4. **RESULTS** (SAPR only)

A. Summary of sample collection and processing, noting any deviations from the approved SAP

B. Physical testing results
1. Dredge unit(s) results
2. Reference results
3. Proposed placement site results (if applicable). For proposed beach nourishment sites, include grain size envelopes/plots.

C. Chemical testing results
1. Dredge unit(s) results – compare results with appropriate sediment quality guidelines (SQG), including at a minimum the Effects Range Low (ERLs), Effects Range Median (ERMs), and Regional Screening Levels (RSLs, formerly PRGs).
2. Reference results
3. Proposed placement site results (if applicable). For proposed beach nourishment sites, compare results with appropriate SQG, including at a minimum ERLs, ERMs, and Regional Screening Levels (RSLs).

➢ Table 4-1 Summary Results of Physical and Chemical Testing – In cases of large and/or complex projects, provide a summary of results in the SAPR text (see example table below). Exceedences of SQGs should be bolded. All projects should submit full physical and chemical results electronically using the SC-DMMT results reporting table, version 1.0, available here: http://www.spl.usace.army.mil/regulatory/sc-dmmt_page.htm).

| GROUPING | Attribute | Units | ERL[1] | ERM[2] | RSL[3] | COMP X | COMP Y |
|---|---|---|---|---|---|---|---|
| Conventionals | Ammonia | mg/kg | | | | | |
| | TOC | % | | | | | |
| | Moisture | % | | | | | |
| | TSS | % | | | | | |
| | TVS | % | | | | | |
| | TDS | mg/kg | | | | | |
| | TRPH | ? | | | | | |
| | TPH-oil-&-grease | microg/kg | | | | | |
| Metals | Arsenic | mg/kg | 8.2 | 70 | 4.5 | | |
| | Cadmium | mg/kg | 1.2 | 9.6 | | | |
| | Chromium | mg/kg | 81 | 370 | | | |
| | Copper | mg/kg | 34 | 270 | | | |
| | Lead | mg/kg | 46.7 | 218 | | | |
| | Mercury | mg/kg | 0.15 | 0.71 | | | |
| | Nickel | mg/kg | 20.9 | 51.6 | | | |

[1] NOAA Effects Range Low
[2] NOAA Effects Range Medium
[3] EPA Regional Screening Level for dermal exposure cancer risk

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Selenium | mg/kg | | | | | |
| | Silver | mg/kg | 1 | 3.7 | | | |
| | Zinc | mg/kg | 150 | 410 | | | |
| Organotins | Dibutyltin | microg/kg | | | | | |
| | Monobutyltin | microg/kg | | | | | |
| | Tetrabutyltin | microg/kg | | | | | |
| | Tributyltin | microg/kg | | | | | |
| PAHs | 1-Methylnapthalene | microg/kg | | | | | |
| | 2-Methylnapthalene | microg/kg | 70 | 670 | | | |
| | 2,4,5-Trichlorophenol | microg/kg | | | | | |
| | 2,4,6-Trichlorophenol | microg/kg | | | 180000 | | |
| | 2,4-Dichlorophenol | microg/kg | | | | | |
| | 2,4-Dimethylphenol | microg/kg | | | | | |
| | 2,4-Dinitrophenol | microg/kg | | | | | |
| | 2-Chlorphenol | microg/kg | | | | | |
| | 2-Methylnapthalene | microg/kg | | | | | |
| | Acenaphthene | microg/kg | 16 | 500 | | | |
| | Acenaphthylene | microg/kg | 44 | 640 | | | |
| | Anthracene | microg/kg | 85.8 | 1100 | | | |
| | Benzo(a)anthracene | microg/kg | 261 | 1600 | 530 | | |
| | Benzo(a)pyrene | microg/kg | 430 | 1600 | 53 | | |
| | Benzo (b) Fluoranthene | microg/kg | | | 530 | | |
| | Benzo (g,h,i) Perylene | microg/kg | | | | | |
| | Benzo (k) Fluoranthene | microg/kg | | | 5300 | | |
| | Chrysene | microg/kg | 384 | 2800 | 53000 | | |
| | Dibenz (a,h) Anthracene | microg/kg | 63.4 | 260 | 53 | | |
| | Fluoranthene | microg/kg | 600 | 5100 | | | |
| | Fluorene | microg/kg | 19 | 540 | | | |
| | Indeno (1,2,3-c,d) Pyrene | microg/kg | | | 530 | | |
| | Naphthalene | microg/kg | 160 | 2100 | | | |
| | N-Nitrosodimethylamine | microg/kg | | | | | |
| | Pentachlorophenol | microg/kg | | | | | |
| | Phenanthrene | microg/kg | 240 | 1500 | | | |
| | Pyrene | microg/kg | 665 | 2600 | | | |
| | Total PAHs | microg/kg | 4022 | 44792 | | | |
| PCBs | PCB 018 | microg/kg | | | | | |
| | PCB 028 | microg/kg | | | | | |
| | PCB 037 | microg/kg | | | | | |
| | PCB 044 | microg/kg | | | | | |
| | PCB 049 | microg/kg | | | | | |
| | PCB 052 | microg/kg | | | | | |
| | PCB 066 | microg/kg | | | | | |
| | PCB 070 | microg/kg | | | | | |
| | PCB 074 | microg/kg | | | | | |
| | PCB 077 | microg/kg | | | 110 | | |
| | PCB 081 | microg/kg | | | 110 | | |
| | PCB 087 | microg/kg | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PCB 099 | microg/kg | | | | | | |
| | PCB 101 | microg/kg | | | | | | |
| | PCB 105 | microg/kg | | | 110 | | | |
| | PCB 110 | microg/kg | | | | | | |
| | PCB 114 | microg/kg | | | 2.2 | | | |
| | PCB 118 | microg/kg | | | 110 | | | |
| | PCB 119 | microg/kg | | | | | | |
| | PCB 123 | microg/kg | | | 110 | | | |
| | PCB 126 | microg/kg | | | 0.11 | | | |
| | PCB 128 | microg/kg | | | | | | |
| | PCB 138 | microg/kg | | | | | | |
| | PCB 149 | microg/kg | | | | | | |
| | PCB 151 | microg/kg | | | | | | |
| | PCB 153 | microg/kg | | | | | | |
| | PCB 156 | microg/kg | | | 22 | | | |
| | PCB 157 | microg/kg | | | 22 | | | |
| | PCB 158 | microg/kg | | | | | | |
| | PCB 167 | microg/kg | | | 1100 | | | |
| | PCB 168 | microg/kg | | | | | | |
| | PCB 169 | microg/kg | | | 1.1 | | | |
| | PCB 170 | microg/kg | | | | | | |
| | PCB 177 | microg/kg | | | | | | |
| | PCB 180 | microg/kg | | | | | | |
| | PCB 183 | microg/kg | | | | | | |
| | PCB 187 | microg/kg | | | | | | |
| | PCB 189 | microg/kg | | | 110 | | | |
| | PCB 194 | microg/kg | | | | | | |
| | PCB 201 | microg/kg | | | | | | |
| | PCB 206 | microg/kg | | | | | | |
| | PCBs | microg/kg | 22.7 | 180 | | | | |
| Pesticides | 2,4'-DDD | microg/kg | | | | | | |
| | 2,4'-DDE | microg/kg | | | | | | |
| | 2,4'-DDT | microg/kg | | | | | | |
| | 4,4'-DDD | microg/kg | 2 | 20 | 8400 | | | |
| | 4,4'-DDE | microg/kg | 2.2 | 27 | 6000 | | | |
| | 4,4-DDT | microg/kg | 1 | 7 | 20000 | | | |
| | DDTs | microg/kg | 1.58 | 46.1 | | | | |
| | Aldrin | microg/kg | | | | | | |
| | Alpha-BHC | microg/kg | | | | | | |
| | Beta-BHC | microg/kg | | | | | | |
| | Chlordane | microg/kg | 0.5 | 6 | 14000 | | | |
| | Delta-BHC | microg/kg | | | | | | |
| | Dieldrin | microg/kg | 0.02 | 8 | 130 | | | |
| | Endosulfan I | microg/kg | | | | | | |
| | Endosulfan II | microg/kg | | | | | | |
| | Endosulfan Sulfate | microg/kg | | | | | | |
| | Endrin | microg/kg | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Endrin Aldehyde | microg/kg | | | | | |
| | Endrin Ketone | microg/kg | | | | | |
| | Gamma-BHC | microg/kg | | | | | |
| | Heptachlor | microg/kg | | | | | |
| | Heptachlor Epoxide | microg/kg | | | 220 | | |
| | Methoxychlor | microg/kg | | | | | |
| | Toxaphene | microg/kg | | | 1800 | | |
| Phtalates | Bis(2-Ethylhexyl) Phthalate | microg/kg | | | | | |
| | Butylbenzyl Phthalate | microg/kg | | | | | |
| | Diethyl Phthalate | microg/kg | | | | | |
| | Dimethyl Phthalate | microg/kg | | | | | |
| | Di-n-butyl Phthalate | microg/kg | | | | | |
| | Di-n-octyl Phthalate | microg/kg | | | | | |
| Phenols | 2-Methylphenol | microg/kg | | | | | |
| | 2-Nitrophenol | microg/kg | | | | | |
| | 3,4-Methylphenol | microg/kg | | | | | |
| | 4,6-Dinitro-2-Methylphenol | microg/kg | | | | | |
| | 4-Chloro-3-Methylphenol | microg/kg | | | | | |
| | Bisphenol A | microg/kg | | | | | |
| | Total phenols | microg/kg | | | | | |
| Pyrethroids | Allethrin (Bioallethrin) | microg/kg | | | | | |
| | Bifenthrin | microg/kg | | | | | |
| | Cyfluthrin-beta (Baythroid) | microg/kg | | | | | |
| | Cyhalothrin-Lamba | microg/kg | | | | | |
| | Cypermethrin | microg/kg | | | | | |
| | Deltamethrin (Decamethrin) | microg/kg | | | | | |
| | Esfenvalerate | microg/kg | | | | | |
| | Fenpropathrin (Danitol) | microg/kg | | | | | |
| | Fenvalerate (sanmarton) | microg/kg | | | | | |
| | Fluvalinate | microg/kg | | | | | |
| | Permethrin (cis and trans) | microg/kg | | | | | |
| | Resmethrin (Bioresmethrin) | microg/kg | | | | | |
| | Resmethrin | microg/kg | | | | | |
| | Sumithrin (Phenothrin) | microg/kg | | | | | |
| | Tetramethrin | microg/kg | | | | | |
| | Tralomethrin | microg/kg | | | | | |

D. Biological testing results

1. Suspended-particulate phase testing - calculation of LC50
2. Solid phase testing - comparison to reference
3. Bioaccumulation potential testing

4. Bioaccumulation tissue chemistry: In addition to comparison to the reference site (reflecting site conditions of the EPA-designated ocean dredged material disposal sites) per OTM, tissue concentrations should be compared to relevant end point concentrations listed in the USACE's Environmental Residue Effects Database (ERED). This database can be found at: http://el.erdc.usace.army.mil/ered/. Additional evaluations may be required and discussed with the SC-DMMT.

- Table 4-2: Results of Biological Testing (bold results that are significantly different from reference results)

**Summary of Mussel Suspended Particulate-Phase Toxicity Test Results**

| Add species name here | Percent Normal Development | | |
|---|---|---|---|
| % Sample or Endpoint | COMP X | COMP Y | COMP Z |
| Lab Control | | | |
| Receiving Water | | | |
| Salt Control | | | |
| 1 | | | |
| 10 | | | |
| 50 | | | |
| 100 | | | |
| NOEC | | | |
| $LC_{50}$ | | | |

**Summary of Mysid Suspended Particulate-Phase Toxicity Test Results**

| Add species name here | Percent Mean Survival | | |
|---|---|---|---|
| % Sample or Endpoint | COMP X | COMP Y | COMP Z |
| Lab Control | | | |
| Receiving Water | | | |
| Salt Control | | | |
| 1 | | | |
| 10 | | | |
| 50 | | | |
| 100 | | | |
| NOEC | | | |
| $LC_{50}$ | | | |

**Summary of Menidia Suspended Particulate-Phase Toxicity Test Results**

| Add species name here | Percent Mean Survival | | |
|---|---|---|---|
| % Sample or Endpoint | COMP X | COMP Y | COMP Z |
| Lab Control | | | |
| Receiving Water | | | |
| Salt Control | | | |
| 1 | | | |
| 10 | | | |
| 50 | | | |
| 100 | | | |
| NOEC | | | |
| $LC_{50}$ | | | |

## Summary of Solid-Phase Toxicity Test Survival

| ***Sample ID*** | ***Amphipod*** Add species name here | ***Polychaete*** Add species name here |
|---|---|---|
| | ***% Survival*** | ***% Survival*** |
| Lab Control 1 | | |
| Lab Control 2 | | |
| Grain Size Control | | |
| Reference Sediment | | |
| COMP X | | |
| COMP Y | | |
| COMP Z | | |

## Summary of Bioaccumulation Survival Results

| ***Sample ID*** | ***Clam*** Add species name here | ***Worm*** Add species name here |
|---|---|---|
| | ***% Survival*** | ***% Survival*** |
| Lab Control 1 | | |
| Lab Control 2 | | |
| Fine Grain Size Control | | |
| Reference Sediment | | |
| COMP X | | |
| COMP Y | | |
| COMP Z | | |

## Summary of Tissue Analysis for Bioaccumulation Tests

**Clam** Add species name here

| ***Analyte*** | ***Day 0*** | ***Reference Replicates*** | | | | | ***COMP X Replicates*** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Worm** Add species
name here

| ***Analyte*** | ***Day 0*** | ***Reference Replicates*** | | | | | ***COMP XReplicates*** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

E. Quality assurance and quality control (QA/QC) – Provide a summary of any QA/QC issues. Include the full QA/QC report as an appendix per the ITM/OTM, as applicable.

1. Physical and chemical testing
2. Biological testing (if required)

F. Results of habitat surveys (if conducted): Provide a brief description of the habitat surveys. Full surveys should be attached as appendices.

## 5. CONCLUSIONS AND RECOMMENDATIONS (SAPR only)

A. Summarize major findings from physical, chemical, and biological testing

B. Suitability and placement options:

1. List the available and preferred placement options (sites), and any alternatives.
2. Ensure the sampling design covers requirements for the placement options (e.g. some placement options require tests in addition to basic chemistry such as elutriate, solid phase toxicity, bioaccumulation, and identification of reference sites).
3. Describe proposed placement sites and option(s) for transportation of dredged material (including map(s) showing routes from dredging site(s) to placement site(s)). Southern California offshore disposal site locations and extents (radius) are as follows:

   LA-2: site centered at latitude 33°37’6”N and longitude 118°17’24”W with a bottom radius of 3,000 feet and a surface disposal radius of 1,000 feet.

   LA-3: site centered at latitude 33°31’00”N and longitude 117°53’30”W with a bottom radius of 3,000 feet and a surface disposal radius of 1,000 feet.

   LA-5: site centered at latitude 32°36'50"N and longitude: 117°20'40"W with a bottom radius of 3,000 feet and a surface disposal radius of 1,000 feet.

4. Describe measures proposed to avoid impacts to sensitive aquatic resources (eelgrass, kelp beds, etc.).

C. Operation summary: Describe the equipment proposed for use for each phase of the project, if known, including dredging, transport, and disposal. Summarize treatment of dredge material and elutriate (e.g., dewatering, flocculation of elutriate) as well.

- Dredge platform (e.g., clamshell, hydraulic, etc.)
- Transport and disposal equipment (e.g., barge, scow, etc.)

- Figure 5-1: Proposed dredging and disposal site(s) map. Should be single map showing all proposed sites.

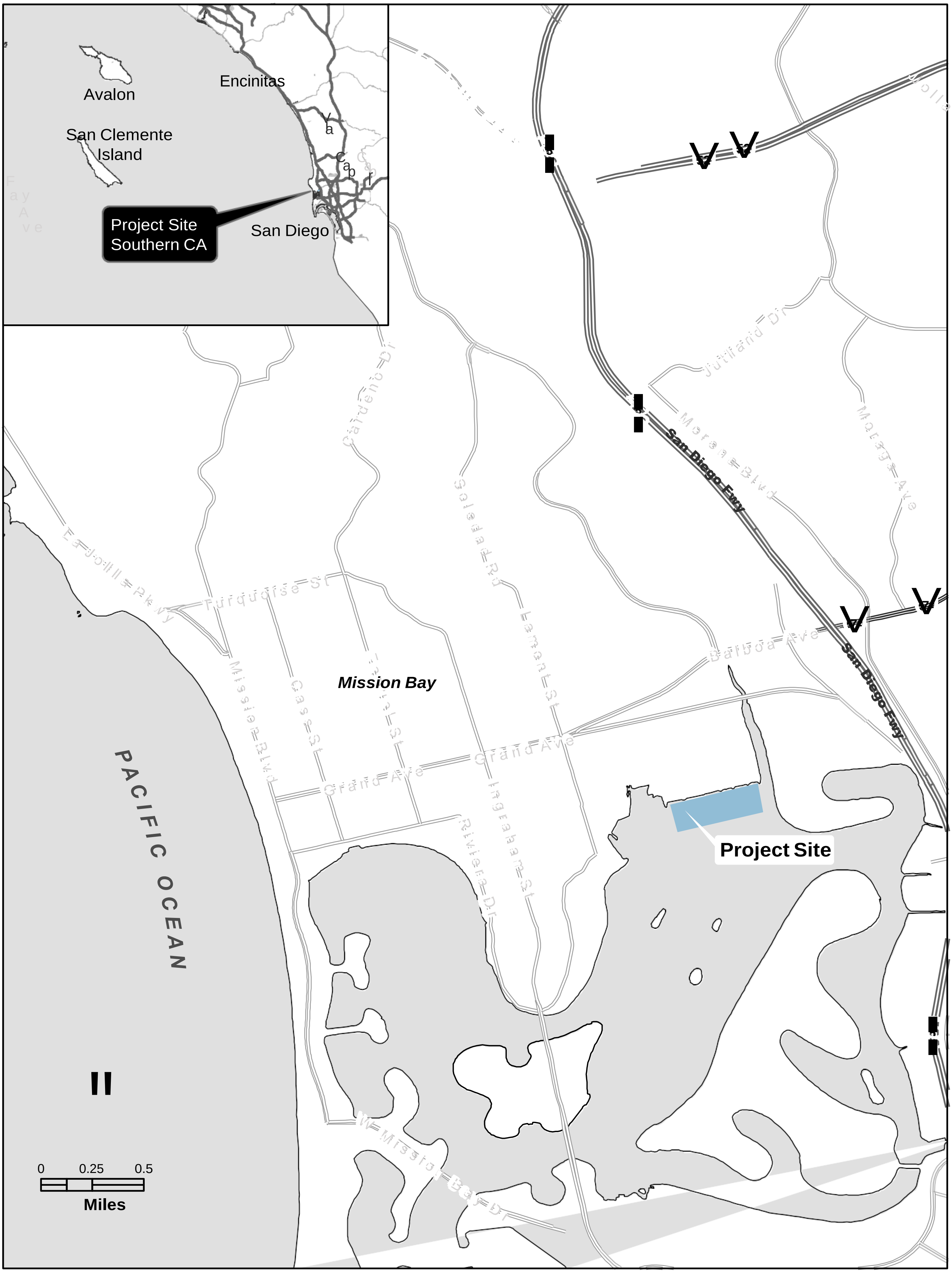
## 6. REFERENCES

## 7. ACRONYMS AND ABBREVIATIONS

## 8. UNITS OF MEASURE

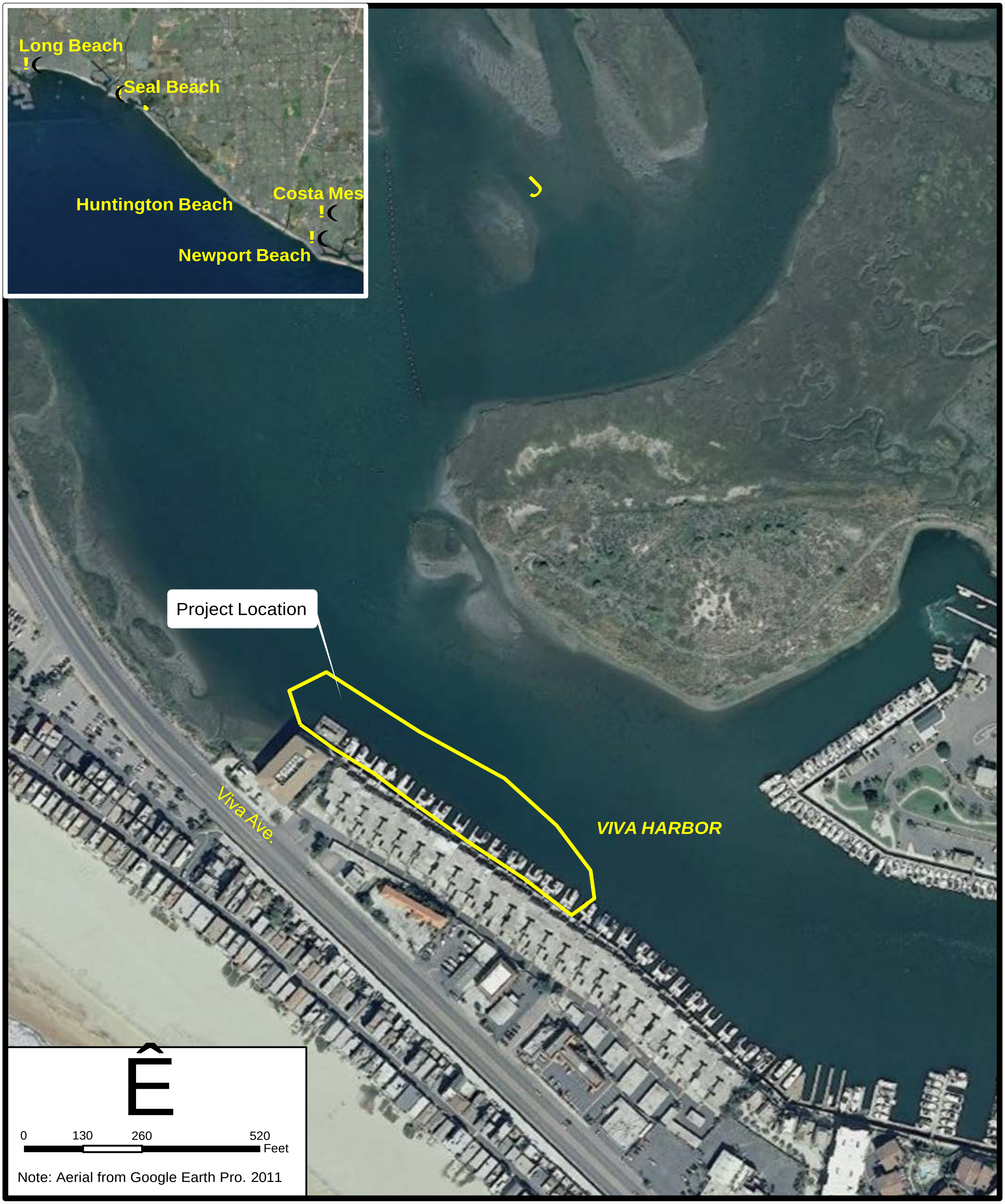
## 9. APPENDICES

A. Previous sampling results
B. Core logs
C. Laboratory Reports for Physical, Chemical, and Biological Testing
D. Habitat Surveys for initial dredge project and disposal site location, if applicable
E. QA/QC Reports




**Vicinity Map**
**Mission Bay Docks**
**Viva Harbor, California**

**Figure 1-1a**




Region 9 GIS Center

**Figure 1-1b**

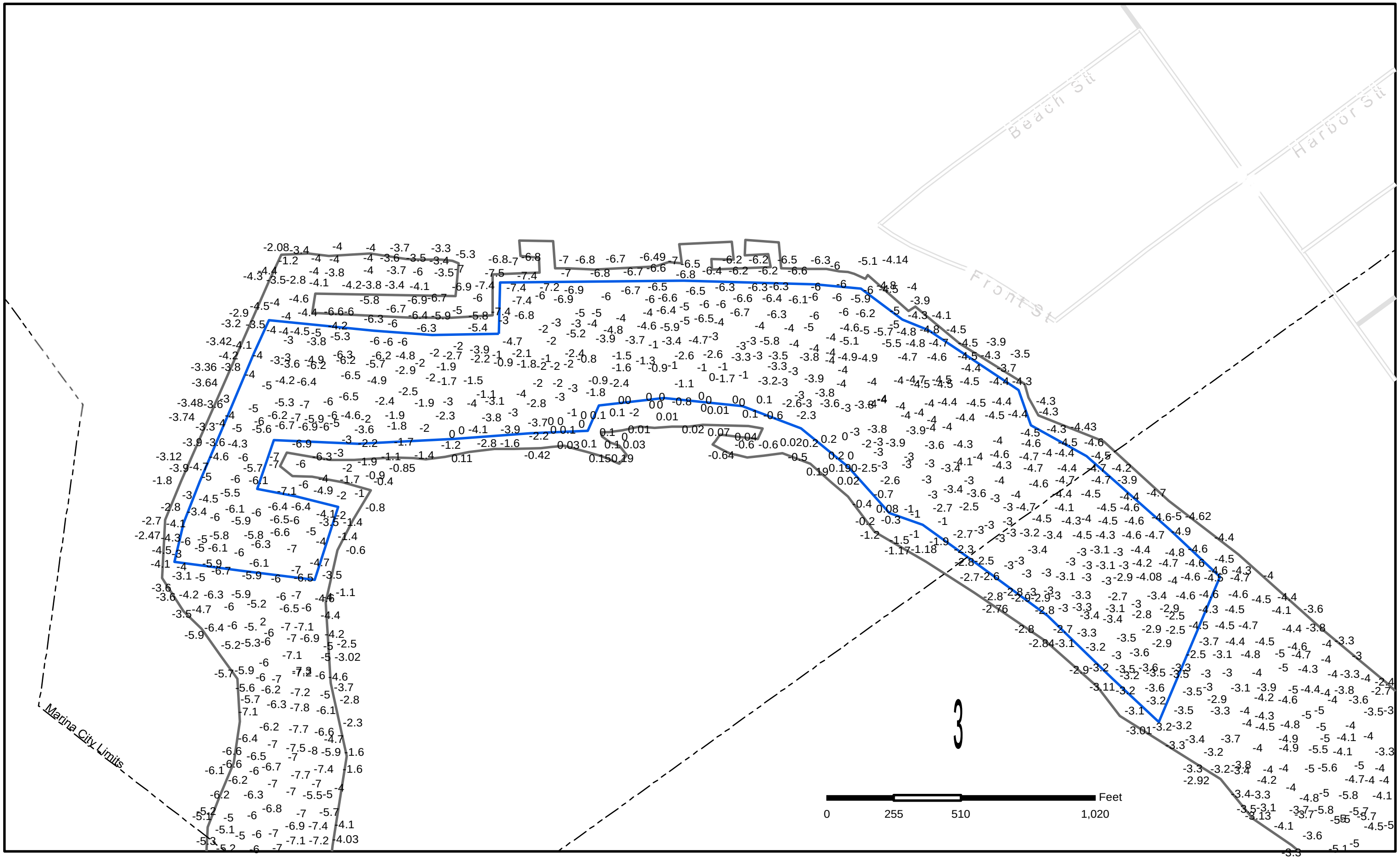
Vicinity Map
Viva Avenue Marina
Huntington Beach, California


# Plan View of the Proposed Dredging Area

**Figure 3-1**

Source: Basemap and bathymetry digitized using
data provided by Reese Water and Land Surveying (January 2010)
HORIZONTAL DATUM: California State Plane, Zone V, NAD83
VERTICAL DATUM: mean lower low water (MLLW)

Extent of Dredge Areas




# Plan View of Existing Bathymetry within the Proposed Dredging Boundaries

**Figure 3-2a**

Source: Basemap and bathymetry digitized using
data provided by Reese Water and Land Surveying (January 2010)
HORIZONTAL DATUM: California State Plane, Zone V, NAD83
VERTICAL DATUM: mean lower low water (MLLW)

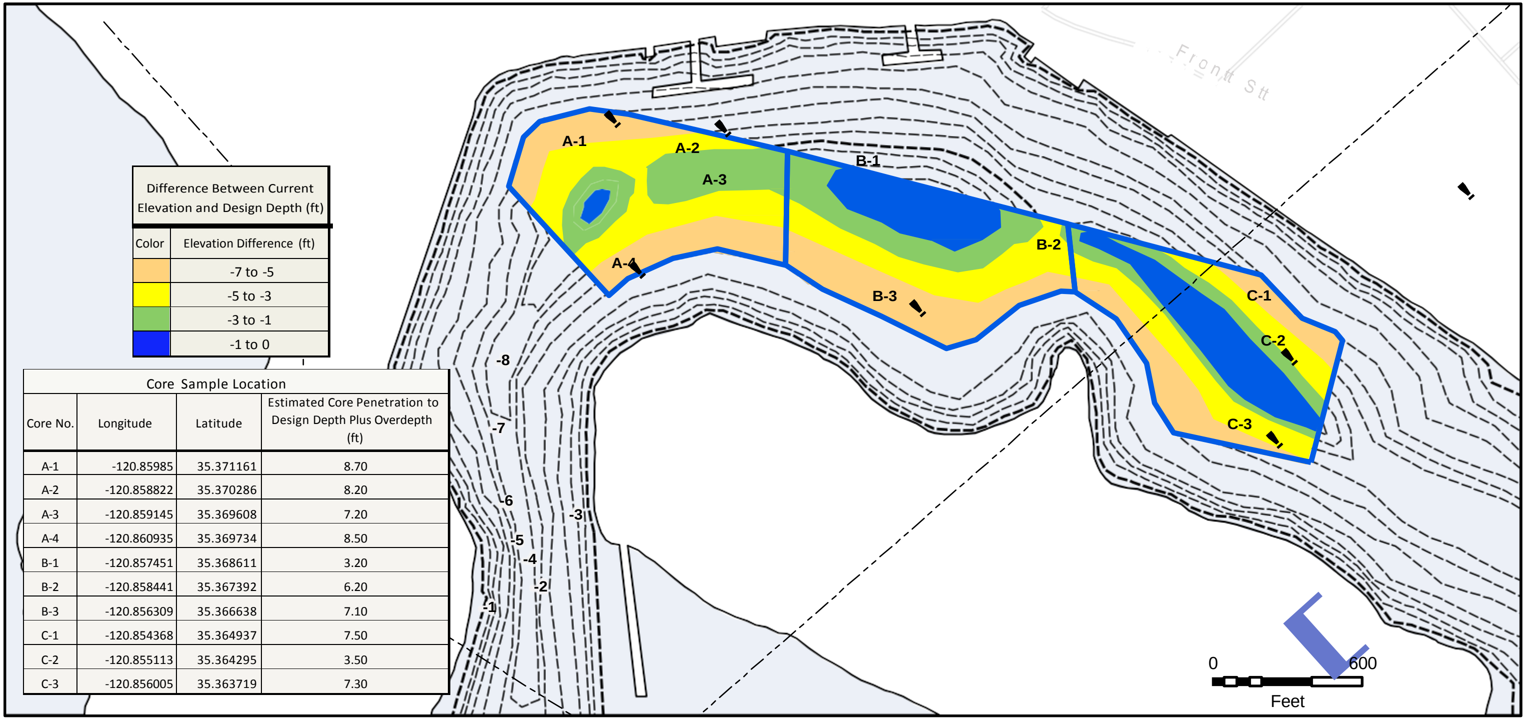
Extent of Dredge Areas


# Plan View of Existing Bathymetry within the Proposed Dredging Boundaries

**Figure 3-2b**

Source: Basemap and bathymetry digitized using
data provided by Reese Water and Land Surveying (January 2010)
HORIZONTAL DATUM: California State Plane Zone V, NAD83
VERTICAL DATUM: mean lower low water (MLLW)

Extent of Dredge Areas




| Difference Between Current Elevation and Design Depth (ft) | |
|---|---|
| Color | Elevation Difference (ft) |
| | -7 to -5 |
| | -5 to -3 |
| | -3 to -1 |
| | -1 to 0 |

Core Sample Location

| Core No. | Longitude | Latitude | Estimated Core Penetration to Design Depth Plus Overdepth (ft) |
|---|---|---|---|
| A-1 | -120.85985 | 35.371161 | 8.70 |
| A-2 | -120.858822 | 35.370286 | 8.20 |
| A-3 | -120.859145 | 35.369608 | 7.20 |
| A-4 | -120.860935 | 35.369734 | 8.50 |
| B-1 | -120.857451 | 35.368611 | 3.20 |
| B-2 | -120.858441 | 35.367392 | 6.20 |
| B-3 | -120.856309 | 35.366638 | 7.10 |
| C-1 | -120.854368 | 35.364937 | 7.50 |
| C-2 | -120.855113 | 35.364295 | 3.50 |
| C-3 | -120.856005 | 35.363719 | 7.30 |

Source: Basemap and bathymetry digitized using data provided by Reese Water and Land Surveying (January 2010)
HORIZONTAL DATUM: California State Plane, Zone V, NAD83
VERTICAL DATUM: mean lower low water (MLLW)

**LEGEND:**

| | |
|---|---|
| -11' | Conceptual Design Dredge Elevation |
| -12 | Feet Below Mean Lower Low Water (- MLLW) |
| (heavy dashed line) | Exisiting Contour (Major) |
| (thin line) | Exisiting Contour (Minor) |
| (blue line) | Extent of Dredging Areas |
| (dashed line) | City Limit Line |

**Figure 3-3**

Proposed Sampling Core Locations for Viva Harbor
Viva Harbor Channel Dredging

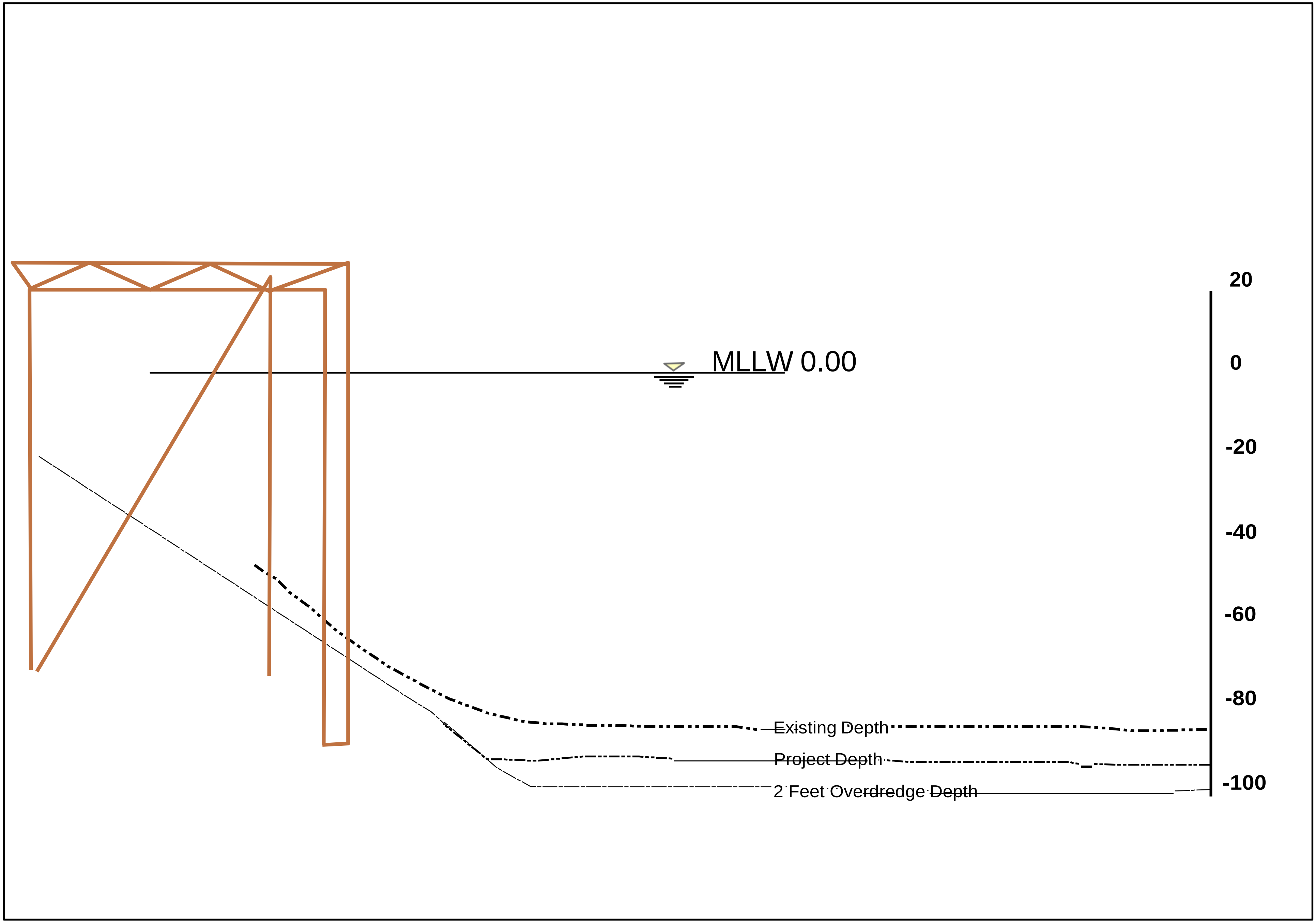
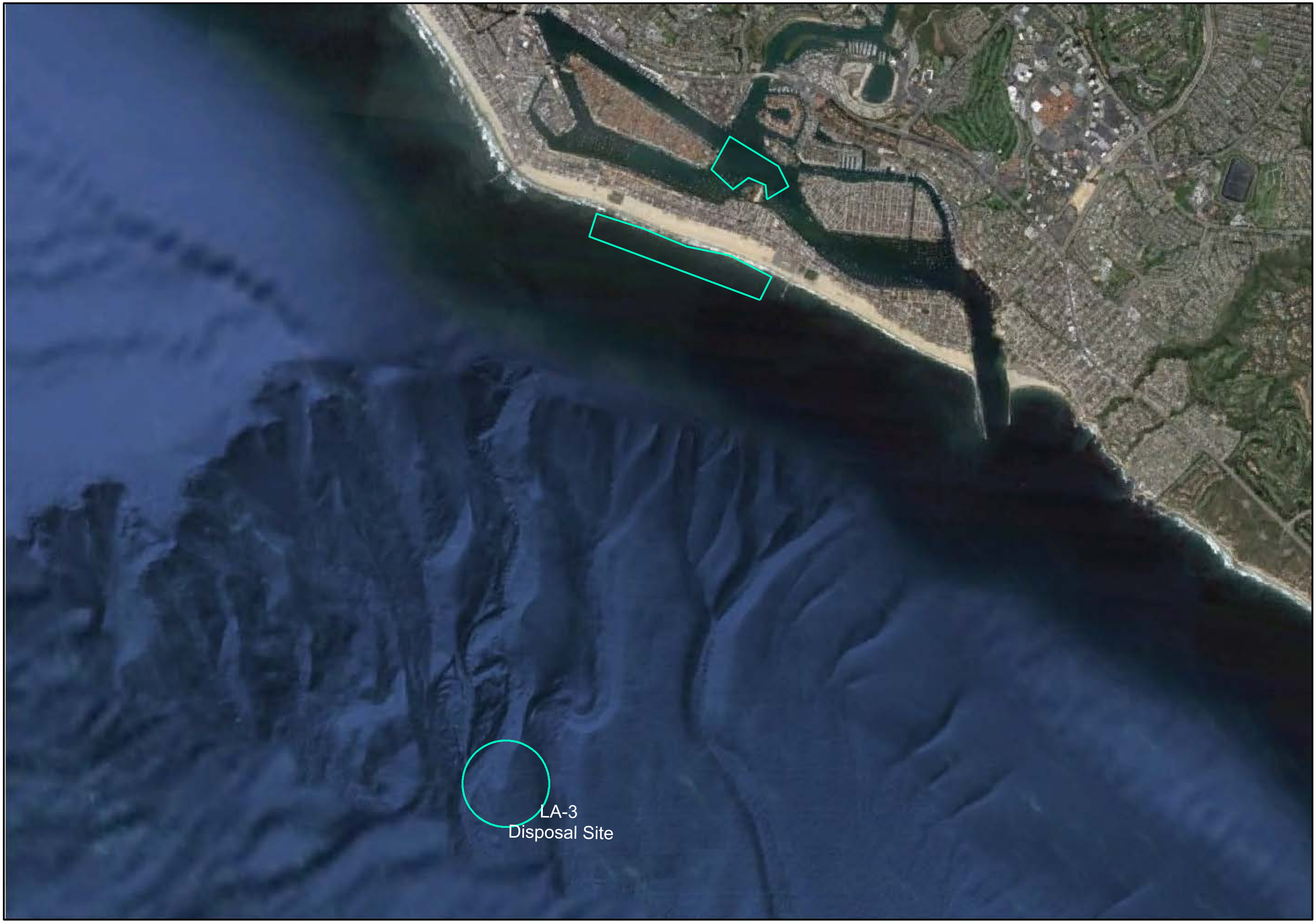



Figure 3-4

# Typical Cross Section of Berth Dredge Footprint




Offshore Ocean Dredged Material Disposal Site;
and Other Alternative Placement Sites

Figure 5-1