U.S. Army Corps of Engineers

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Engineer Research and Development Center

Sampling, Chemical Analysis, and Bioassessment in Accordance with CWA Section 404

Houston Ship Channel Expansion Channel Improvement Project, North of Morgan's Point Houston Ship Channel, Texas

(Part 2 of 6: Appendix 1, USACE SAP)

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Appendices

Appendix 1: Sampling and Analysis Plan

SAMPLING AND ANALYSIS PLAN

Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Channel Segment 1 (North of Morgan's Point), Segment 4, Segment 5, and Segment 6
Houston Ship Channel, TX

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List of Acronyms

AOC	Area of Concern
BS	Blank Spike
BU	Beneficial Use
CMC	Criterion Maximum Concentration
COC	Contaminant of Concern
CY	cubic yards
DBF	Dibenzofuran
EDD	Electronic Data Deliverable
EIS	Environmental Impact Statement
E-M	Modified Elutriate
EL	Environmental Laboratory
ERDC	Engineer Research and Development Center
ER-L	Effects Range Low
ER-M	Effects Range Median
FB	Field Blank
FD	Field Duplicate
FDA	Food and Drug Administration
FEIS	Feasibility Environmental Impact Study
FR	Feasibility Report
ft.	feet
HPAH	High-molecular-weight Polycyclic Aromatic Hydrocarbons
ITM	Inland Testing Manual
LCS	Laboratory Control Sample
LC50	Lethal Concentration – 50%
LOE	Lines of Evidence
LPAH	Low-molecular-weight Polycyclic Aromatic Hydrocarbons
LPC	Limiting Permissible Concentration
MB	Mooring Basin
MCY	million cubic yards
MLT	Mean Low Tide
MLLW	Mean Lower Low Water
MPRSA	Marine Protection, Research, and Sanctuaries Act
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NOAA	National Oceanic and Atmospheric Administration
O&M	Operations and Maintenance
OTM	Ocean Testing Manual
PA	Placement Area

PCB	Polychlorinated biphenyl
POC	Point of Contact
POHA	Port of Houston Authority
QA	Quality Assurance
QC	Quality Control
R6	Region 6
RIA	Regional Implementation Agreement
RL	Reporting Limit
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SD	Sediment
snm	square nautical miles
SMMP	Site Management and Monitoring Plan
SQG	Sediment Quality Guidance
SVOC	Semivolatile Organic Compounds
SW	Surface Water
SWG	South West (Division) Galveston (District)
TAL	Target Analyte List
TB	Turning Basin
TDL	Target Detection Limit
TPH	Total Petroleum Hydrocarbon
TSWQS	Texas State Water Quality Standards
UCL	Upper Confidence Level
VOC	Volatile Organic Compounds
WQC	Water Quality Criteria
WQS	Water Quality Standards
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1.0 OBJECTIVES

This pre-dredging Sampling and Analysis Plan (SAP) was generated for the U.S. Army Corps of Engineers (USACE) Southwest Galveston (SWG) and the Port of Houston Authority (POHA), Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP). This SAP is focused on the Bayou Reach north of Morgan's Point, including: Segment 1 (Bay Reach north of Morgan's Point), Segment 4, Segment 5, and Segment 6 (Figure 1). The primary objectives of this SAP are to:

a) Provide the background for the proposed new construction
b) Specify environmental media to be collected, the locations of the sampling locations and other sampling parameters needed for the pre-dredging evaluation of dredged sediments within the dredging prism
c) Specify how and where to collect sediment cores representative of the dredged materials from the proposed dredging prisms for materials that are to be placed in an upland placement area (PA), or if suitable after testing to be used beneficially
d) Specify the chemical and physical analyses necessary to evaluate if the sediments are suitable for placement
e) Specify how and what to document for the field sampling and the results of physical and chemical analyses of site surface water and sediments, as well as quality control measures;
f) Specify the deliverables at the conclusion of the evaluation
g) Generate the information needed to determine whether unacceptable adverse impacts would result during either dredging within the proposed dredging prism or during placement at the selected upland PA or beneficial use

2.0 BACKGROUND AND APPROACH

2.1 Background

The Houston Ship Channel (HSC) system is located in southeast Texas and spans Harris, Chambers, and Galveston Counties, Texas and is 50 miles in length from Bolivar Island to the Main Turning Basin. The HSC for the Expansion Channel Improvement Project (ECIP) has been divided into the following six study segments (DIFR-EIS, 2017).

- Segment 1 – Bay Reach
- Segment 2 – Bayport Ship Channel (BSC)
- Segment 3 – Barbours Cut Channel (BCC)
- Segment 4 – Boggy Bayou to Sims Bayou
- Segment 5 – Sims Bayou to I-610 Bridge
- Segment 6 – I-610 Bridge to Main Turning Basin (TB)

The study area for this SAP includes: Bay Reach (Segment 1) north of Morgan's Point only (Stations 0+05 to 684+03), Boggy Bayou to Sims Bayou (Segment 4; Stations 684+03 to 833+05), Sims Bayou to I-610

Bridge (Segment 5; Stations 1110+77 to 1160+62), and I-610 Bridge to Main Turning Basin (Segment 6; Channel Stations 1160+60 to 1266+48, and Main TB Stations 0 to 30+95). The existing authorized depth of the Houston Ship Channel (HSC) for this study area ranges from -41.5 to -46.5 feet (ft.) mean lower low water (MLLW) and the existing width is 300 ft. The entire channel is not proposed for widening **and** deepening, but instead, individual target segments were identified for improvements and are specified below:

Segment 1: The existing width and depth of the main channel in Segment 1 north of Morgan's Point is 530-600 ft. and 46.5 ft. respectively, and will remain at this existing width and depth. The Mooring Basin (MB) at Station 500+00 (MM1_520+00) is approximately 57 acres and will be deepened to -41.5 ft.

Segment 4: Segment 4 has an existing width of 300 ft. with a new proposed width of 530 ft from Boggy Bayou to Greens Bayou only; the remainder of Segment 4 (Greens Bayou to Sims Bayou) will remain at its existing width. The existing depth of Segment 4 ranges from 38.5 to 41.5. Boggy Bayou to Washburn Tunnel has an existing depth of 41.5 ft. and a proposed depth of 46.5 ft. The remainder of Segment 4 will remain at its existing depth.

Segment 5: Segment 5 has an existing width of 300 ft. and will remain at its existing width. The depth of Segment 5 is 37.5 ft. with a proposed depth of 46.5 ft.

Segment 6: Segment 6 from I-610 Bridge to Main TB has an existing width of 300 ft. and the Main TB has an existing width of 400-932 ft. will remain at its existing width. The depth of Segment 6 is 37.5 ft. with a proposed depth is 41.5 ft.

2.2 Terminology

This new work construction will involve removal of predominantly new work material (virgin and non-virgin), however, some maintenance material may have shoaled in by the time dredging occurs. Each of these is defined below:

a) **Maintenance Material:** material that is removed from the navigational dredging prism in navigational channel that has shoaled in since previous maintenance dredging
b) **New Work Material:** material not within the navigational channel dredging prism defined in (a) above. New work material falls into two categories, virgin and non-virgin material:
   (i) **Virgin:** new work material that has not been dredged but is situated such that it is unlikely that exposure to contamination has occurred. An example of virgin material is an undisturbed, consolidated base geological layer from the preindustrialization era and outside of the influence of industrial releases
   (ii) **Non-Virgin:** refers to material that has not been dredged (i.e., outside of the current navigational channel dredging footprint) that has potential to have been exposed to contamination directly or indirectly from historical deposition since the industrial era, spills, transport, deposition and other mechanisms that will place such contamination within the new work dredging prism

2.3 Dredging Prism

Deepening and widening improvements will not occur in Segment 1 north of Morgan's Point. The remaining segments of the ship channel undergoing channel improvements are comprised of the following (Table 1, Figure 2):

1) **Mooring Basin (Station 500+00):** Dredged material from this area is expected to consist primarily of new work virgin material, consisting solely of undisturbed base layer geological formations free of impacts from industrial sources or transport mechanisms. There is a chance that influence from industrial sources may have occurred. As a result, these dredged materials will conservatively be considered new work non-virgin surficially, but new work virgin at depth
2) **Boggy Bayou to Washburn Tunnel (Stations 684+03 to 974+07):** Dredged material from this segment is expected to consist of some maintenance material in the existing channel, but primarily be new work virgin material, consisting solely of undisturbed base layer geological formations free of impacts from industrial sources or transport mechanisms. There is a chance that influence from industrial sources may have occurred. As a result, these dredged materials will conservatively be considered new work non-virgin surficially, but new work virgin at depth
3) **Sims Bayou to I-610 Bridge (Stations 1110+77 to 1160+62):** Dredged material from this segment is expected to consist of some maintenance material in the existing channel, but primarily be new work virgin material, consisting solely of undisturbed base layer geological formations free of impacts from industrial sources or transport mechanisms. There is a chance that influence from industrial sources may have occurred. As a result, these dredged materials will conservatively be considered new work non-virgin surficially, but new work virgin at depth
4) **I-610 Bridge to Main TB and Main TB (Stations 1160+60 to 1266+48; 0 to 30+95):** Dredged material from this segment is expected to consist of some maintenance material in the existing channel, but primarily be new work virgin material, consisting solely of undisturbed base layer geological formations free of impacts from industrial sources or transport mechanisms. There is a chance that influence from industrial sources may have occurred. As a result, these dredged materials will conservatively be considered new work non-virgin surficially, but new work virgin at depth

2.4 Placement

It is anticipated that at the time of new work dredging, there will be maintenance shoaling in the ship channels but that it will be negligible relative to the amount of new work material, since navigational maintenance dredging occurs at regular intervals. While not yet finalized, dredged material resulting from both new work or construction, operations and maintenance (O&M) will be utilized in a number of ways (e.g., upland confined, Beneficial Use (BU) such as marsh creation, bird island habitat, oyster reefs, dike reinforcement, etc.).

In this plan, approximately 5.9 MCY of new work material dredged from the study area as part of the construction phase is expected as described below:

- Segment 1 (Mooring Basin only) – 1,426,813 CY
- Segment 4 – 3,312,185 CY
- Segment 5 – 176,049 CY
- Segment 6 – 1,000,098 CY

Anticipated dredge volumes for Segments 1 (south of Morgan's Point), 2, and 3 are discussed separately in the "Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP) South of Morgan's Point SAP, 2018".

2.5 Tier I Evaluation – Potential Sources of Contamination and COC Reduction

New construction sediments are not expected to adversely impact human health or the environment, however, the evaluation supported by this SAP will include site surface water, sediment, and modified elutriates for new work sediments through direct sampling. Due this industrialized portion of the HSC, no contaminants of concern (COCs) were considered for exclusion. Instead, a full chemical analysis (i.e., VOCs, SVOCs, TPH, pesticides, total PCBs, TAL metals, dioxins/furans, and miscellaneous parameters) will be required for all media types.

Dioxins/furans are not routinely analyzed for in dredge material projects outside of the HSC, however, due to the presence of the San Jacinto Waste Pits and the Area of Concern (AOC) associated with the historical releases of dioxins/dibenzofurans from this area north of Morgan's Point (shown in Figure A-3), dioxins/furans have been added to the analyte list for this project.

3.0 SCOPE OF WORK and SCHEDULE

3.1 General

The FIELD CONTRACTOR will collect sediment and water samples from the HSC vicinity as outlined in this SAP and ensure delivery of all collected samples to the ANALYTICAL PROVIDER and Engineer Research and Development Center (ERDC), as appropriate, within the specified holding times. Some analyses will be sub-contracted by ERDC; however, all container distribution, sample processing, and communications will be facilitated directly through the ERDC Analytical POC. Procedures for sample collection, required volume, handling, preservation and storage, and shipment are outlined in subsequent sections.

Close coordination by the CONTRACTORS with POHA, SWG, and ERDC personnel is an essential component of this SAP. The project coordination Points of Contact (POC) are:

Technical Team

ERDC Project Manager/Project Technical POC:
Dr. Cheryl R. Montgomery (ERDC, Environmental Laboratory, CEERD-EP-R)
W: 978-318-8644 (EST)
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ERDC Sample Coordinator POC:
Mr. J. Daniel Farrar (ERDC, Environmental Laboratory, CEERD-EP-R)
W: 601-634-2118 (CST)
Mr. Al Kennedy (ERDC, Environmental Laboratory, CEERD-EP-R)
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ERDC Analytical POC:
Dr. Anthony Bednar (ERDC, Environmental Laboratory, CEERD-EP-C)
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Project Delivery Team (PDT)

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The FIELD CONTRACTOR will collect sediment and water samples from the HSC vicinity as outlined in this SAP and ensure delivery of all collected samples to the ANALYTICAL PROVIDER and Engineer Research and Development Center (ERDC), as appropriate, within the specified holding times. Procedures for sample collection, required volume, handling, preservation and storage, and shipment are outlined in subsequent sections and attachments.

If, at the time of sampling and analyzing, conditions require major deviation from the approach outlined in this SAP, the CONTRACTORS must discuss the deviation with the ERDC Project Manager/Technical POC prior to application/implementation.

Figure 5 presents an organization chart of the project managers and technical leads.

3.2 Project Area

The CONTRACTOR will collect samples from 9-channel locations within the HSC from Boggy Bayou (Station 684+03) to Main Turning Basin (Station 1266+48) along with one (1) sample from the Mooring Basin and one (1) sample the Main Turning Basin.

3.3 Sample Location and Type

Sample locations and types are specified in Table 1. Sample locations have been selected from available geotechnical borings surveys from 1963 and 1964. Where geotechnical borings surveys were not available (Segments 5 and 6), samples were distributed evenly across the length of the remaining channel to be spatially representative of the dredging prism materials. Exact sample coordinates for the channel locations will be determined in the field at the time of sampling. Each sediment sample will be a composite of two subsamples from within the area proximate to the channel location. **If a sample cannot be acquired at a designated location, the location will be moved the least distance possible, while remaining within the dredge prism.**

One field duplicate must be collected for chemical analyses. For sediment, a total of 11 channel samples plus one field duplicate will be new work material samples for chemical analyses and 11 channel locations will be collected as bulk samples for modified elutriate. For surface water, 11 channel stations and one field duplicate will be collected for chemical analyses and 11 bulk water channel samples will be collected for modified elutriate. Water samples will be collected from approximately mid-column depth.

If scouring to below the authorized depth (+ 4 ft.) occurs at the preselected locations, the FIELD CONTRACTOR MANAGER and the ERDC Technical POC will jointly decide how to shift the sample locations. All details of the steps taken to arrive at a decision as to when/how to shift a sampling point will be noted in the field logs and documented in the final report.

For the new work channel improvement area, 11 samples (+ 1 QC) in total will be sampled to dredge prism depth plus 2 feet for over dredge and 2 feet for advanced maintenance for sediment. Any material collected outside the dredge prism is not relevant to this sampling event and will be discarded. Each channel sample is a composite of material representative of a geological component of the new work dredge prism in the ship channel, since the location of these sampling points is based upon geotechnical boring information (with the reservations expressed in the preceding three paragraphs, and are listed below).

Justification for choosing these sample locations is included in Attachment A.

HSCNew-NMP-01 (Segment 1, Station 500+00): Three samples (i.e., '**-A**', '**-B**', '**-C**') are to be taken within the existing Mooring Basin and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-02 (Segment 4, Station 720+00): Two samples (i.e., '**-A**', '**-B**'), one on each side of the HSC near the assigned station, are to be taken and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-03(Segment 4, Station 800+00): Two samples (i.e., '**-A**', '**-B**'), one on each side of the HSC near the assigned station, are to be taken and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-04 (Segment 4, Station 912+00): Three samples (i.e., '**-A**', '**-B**', '**-C**'), one point in the turning basin expansion area and one on each side of the HSC near the assigned station, are to be taken and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-05 (Segment 4, Station 970+00):
Two samples (i.e., '**-A**', '**-B**'), one on each side of the HSC near the assigned station, are to be taken and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-06 (Segment 5, Station 1115+00):
Two samples (i.e., '**-A**', '**-B**'), one on each side of the HSC near the assigned station, are to be taken and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-07 (Segment 5, Station 1160+00):
Two samples (i.e., '**-A**', '**-B**'), one on each side of the HSC near the assigned station, are to be taken and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-08 (Segment 6, Station 1200+00): Three samples (i.e., '**-A**', '**-B**', '**-C**'), one point in the turning basin expansion area and one on each side of the HSC near the assigned station, are to be taken and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-09 (Segment 6, Station 1230+00):
Two samples (i.e., '**-A**', '**-B**'), one on each side of the HSC near the assigned station, are to be taken and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-10 (Segment 6, Station 1260+00):
Two samples (i.e., '**-A**', '**-B**'), one on each side of the HSC near the assigned station, are to be taken and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

HSCNew-NMP-11 (Segment 6, Main TB, Station 24+00): Three samples (i.e., '**-A**', '**-B**', '**-C**') are to be taken along a transect and composited to one sediment sample as proposed for this reach of virgin new work material; surface water and bulk water samples will be collected mid-column where the bulk of the sediment is collected.

3.4 Schedule, Deliverables & Required Coordination

(1) The FIELD CONTRACTOR shall provide POHA and SWG with a draft Field Sampling and Safety Plan for review ***within 30-days of the notice to proceed***. Initiation of sample collection may not begin prior to POHA and SWG approval of the Field Sampling and Safety Plan. The draft plan should provide sufficient detail on how the FIELD CONTRACTOR intends to meet sampling requirements outlined in this Scope of Work. After POHA and SWG review, any recommended changes will be incorporated and a finalized plan will be provided to POHA and SWG prior to initiation of sample collection. Two hard copies and electronic files (e.g., Microsoft Office Word, Excel, and PDF formats) of the draft and final plans will be submitted to POHA, SWG, and electronic copy only to ERDC.

(2) The FIELD CONTRACTOR is responsible for organizing and hosting a pre-construction conference call with SWG project manager, ERDC PM/technical POCs and POHA project POCs identified in Section 3.1 above. This conference call must be scheduled ***at least 3 weeks prior*** to sample collection. Additional communications should occur as needed to ensure complete clarity in project preparation, execution and deliverables.

Additionally, ***two weeks in advance*** of this call, the FIELD CONTRACTOR should provide an overview of the Field Sampling Plan and specifically acknowledge sampling techniques, required sample types and volumes, sample preservation and storage, and sample shipment strategies.

(3) The FIELD CONTRACTOR is responsible for coordination with the ERDC technical POCs, and as needed, the TOX and ANALYTICAL POCs at ERDC regarding exact sampling dates and exact sample shipment and receiving dates.

(4) Sample collection as outlined in this scope of work should be completed ***no later than date to be specified when contract is awarded***. Exact day(s) of collection should be coordinated with all SWG, ERDC, and POHA POCs identified in Section 3.1 above to ensure that sample shipment date is compatible with laboratory schedules and that the ERDC personnel are prepared for exact sample shipping and receiving dates.

(5) The FIELD CONTRACTOR shall provide POHA and SWG with a draft Post-Sampling Field Report ***within 20-days of completion of field sampling activities*** that describes sampling methods and materials, exact sample locations (latitude and longitude, NAD83) and water depth, surface water quality parameters (temperature, salinity, pH, dissolved oxygen), core descriptions, daily observations (sea-state, air temperature, wind direction and speed, etc.), pictures of sampling activities, and soil cores as well as any deviations from the Field Sampling and Safety Plan for each sample location. After POHA, ERDC, and SWG review, any recommended changes will be incorporated and a finalized report will be provided to the

POHA POC, SWG PM, and ERDC PM. Two hard copies and electronic files (Microsoft Office Word, Excel, and PDF formats) of the draft and final report (including tables, attachments, photos, etc.) should be submitted to SWG, and electronic copies to others as specified in Section 6.

4.0 SAMPLING (APPROACH and COLLECTION)

4.1 Overview

This SAP is widely based upon the four resource documents listed below but contains specifications appropriate for the HSC ECIP project:

a) USACE (1995). QA/QC Guidance for Sampling and Analysis of Sediments, Water and Tissues for Dredged Material Evaluations (Chemical Evaluations). USEPA-823-B-95-001;
b) USEPA and USACE (1998). Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual. Inland Testing Manual (ITM);
c) USACE (2003). Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual;
d) USEPA and USACE (2003). Regional Implementation Agreement (RIA) for the Ocean Dredged Material Disposal Program. USEPA Region 6 and US Army Corps of Engineers, Galveston District. July 2003;

The following outlines the approach for sample collection, distribution and evaluation. Any deviations, including corrective actions taken, if any, will be noted and recorded (Section 4.2). Dredged material sampling locations have been selected to be spatially representative of the dredge prism materials (Section 3.3); sampling to dredging depth addresses the vertical component of the dredging prism (Section 4.3.1, Figure 2, Table 1). Surface water (Section 4.3.2), sediment (Section 4.3.3), and modified elutriate (Section 4.3.4) samples are to be collected from the dredge prism at each channel location for the purpose of conducting testing to characterize the material that will be excavated. Field quality control (Section 4.3.5), sample preservation and storage (Table 2, Section 4.3.6), and Chain-of-Custody/Shipping procedures (Section 4.3.7) will be observed in the field. The field notebook and the final report will include this information. Sufficient volumes of materials for chemical and physical analyses (Sections 5.2) plus any required field QC samples will be collected.

Laboratory quality control (Section 5.1) will be consistent with procedures and methods in the references cited above and in the Attachments.
All chemical analyses for environmental media (Sections 5.2.1 and 5.2.2) and miscellaneous parameters (Section 5.2.3) will be tabulated and evaluated according to appropriate existing standard procedures. The evaluation shall consist of comparing analytical results to screening benchmarks for the chemical analyses of water and modified elutriate samples (Table 3) and bulk sediment (Table 4) as well as for appropriate miscellaneous parameters (Tables 3 and 4).

Since the dredge materials from this SAP are expected to be placed primarily in upland confined PAs, bioassays such as toxicity, survival and bioaccumulation are not required unless end uses of the dredged materials change from upland confined PAs to another end use (e.g. BU), in which case, the sampling event may need to be repeated to acquire sufficient materials to complete these studies.

Collection of field parameters, field sample collection and preservation, and chain of custody procedures are outlined in general below. Additional details for the FIELD CONTRACTOR are listed in Attachment B.

4.2 Deviations from SAP Procedures

All deviations from the procedures outlined in the main body of this SAP or its attachments and the effect, if any, the deviation is expected to have on the data must be documented photographically and in writing. Such deviations and the evaluation of them must be included in both the field data sheets and in the final report for the field work as well as in the final project report.

4.3 Collection/Preparation/Compositing

Samples will be collected so as to proceed from locations expected to be virgin new work to non-virgin new work. The portion of the ship channel from the open bay in the Houston Ship Channel at Bolivar Road (Station 125+000) and proceed to the Morgan's Point (Station 0+000) has already been addressed under a separate MPRSA 103 SAP. This SAP's sample collection begins at Morgan's Point and proceeds to the Main TB in Houston.

Sample quantities will be confirmed with the analytical and testing providers prior to executing sample collection. In preparation for field sampling, sufficient precleaned and laboratory approved sampling containers/equipment provided by the ANALYTICAL PROVIDER, per Attachment B, will be assembled along with preprinted labels. Sample compositing and subsample distribution for chemical testing will be performed at ERDC; only bulk samples need be collected under the conditions of Attachment B.

4.3.1 Channel Sample Locations

Based upon a review of a geotechnical borings for the HSC (Attachment A) and the proposed dredge prism, samples will be taken so as to be representative of the portions of the channel undergoing widening and/or deepening only, since these are the only potions to be dredged. These portions include Stations 520+00, 684+03 to 974+07, Stations 1110+77.54 to 1266+48 and Main TB, from which 11-samples are to be collected to obtain a representative samples of the Beaumont Clay Formation and/or channel conditions in these sections. For each channel sampling location, one water sample will collected and two or three sediment samples (see Table 1) are to be taken so that the volume from each subsample is approximately equivalent. All samples will be shipped to ERDC for compositing, subsampling, and distribution. Some individual sample locations may require multiple cores to obtain sufficient volume. Composite samples are acceptable only at an individual sampling location at each channel location; compositing between locations is not permitted. If the volume of the core exceeds the volume required for analysis, subsampling of the core shall be conducted (Attachment B).

To ensure that representative dredged materials are sampled, sample locations where depths are already at or below project depth will not be sampled. Recent bathymetry will be reviewed prior to sampling to ensure the presence of sufficient material within the proposed dredge prism and at the boring location. These conditions will be confirmed in the field prior to sampling; **however, if sufficient material is not present at the proposed boring location when in the field sampling, material for testing will be gathered in equal volumes from a location where material is present and proximate to the selected channel location.** All field conditions and coring locations will be recorded in the field notes and included in the final report.

Table 1 summarizes the planned sampling for this dredging prism, including the dredging segment, sample ID, station, distance from the existing channel center line, coordinates, media to be collected, compositing and analyses/testing required. Figures 2, 3, and 4 provide a mapping of sampling locations for the channel.

Sample collection will be carried out by the FIELD CONTRACTOR with the ERDC PM/Technical POC present. The ERDC PM/Technical POC will be on-board at the time of sampling and all sampling-related locations, deviations, etc., will be the result of concurrence between the FIELD CONTRACTOR and the ERDC PM/Technical POC.

Additional sample location determination details are provided in Attachment A.

4.3.2 Water Sample Collection

Surface water samples (mid-column) will be collected from the sampling point replicate where the bulk of the sediment is collected for each sampling location. Prior to sample collection, site conditions and water quality parameters will be collected (Attachment B). At each sample location, the water depth to the top of sediment will be determined prior to sample collection to ensure water samples are collected at the midpoint of the water column. Depths recorded must be corrected to mean lower low water (MLLW) or applicable local datum either through the use of a tide gauge or tide table.

Water samples from separate channel locations will not be composited to create a single channel sample. Each location will be sampled, analyzed, and reported as a distinct data point collocated with the sediment sample(s) for that point. All water samples bound for chemical analyses are to be filtered **WITH THE FOLLOWING EXCEPTIONS**: (1) TOC, TSS, VOCs, and metals for mercury and selenium **ONLY** and (2) water intended for modified elutriate testing. A determination as to whether water samples, along with field blanks, are field filtered or filtered in the laboratory will be made prior to sample collection.

Additional water collection details are provided in Attachment B.

4.3.3 Sediment Sample Collection

Sediment samples will be collected at the 11 channel locations (plus 1 QA), as indicated in Figure 2 and Table 1. Since the channel locations are selected to be representative of the dredge prism, shifts in position will be allowed if sufficient sediment is not present to allow a sample to be collected. Should this circumstance occur, the sampling location will be shifted as minimally as possible while remaining within

the dredge prism and within the general formation traits indicated by the geotechnical borings to facilitate acquisition of sufficient sample volume. Any deviations will be noted in the field notes and documented in the final report.

Sediment cores will be taken to the depth of dredge using a sampling method capable of accomplishing such a task (Attachment B). The X- and Y-coordinates will be recorded for each of the sampling point replicates (replicates '**-A**', '**-B**', '**-C**') for HSCNew-NMP-01 through -11. Cores between or from more than one sampling location will not be composited.

Additional sediment collection details are provided in Attachment B.

4.3.4 Modified Elutriate Preparation

Sufficient sample volume of surface water (unfiltered) and sediment will be collected so that the ERDC laboratory is able to complete modified elutriate testing for each location. Approximate sample volumes are noted in Table 2; however, sample volumes will be confirmed with the ERDC laboratory prior to field collection commencing.

A modified elutriate test (MET) will be prepared at ERDC by the analytical team according to guidance (USACE Tech Note EEDP 04-2) by mixing a calculated volume of sediment and dredging site water that should be approximately equal to 150 g/L. The well-mixed slurry will be aerated for 1 hour and allowed to settle for 24 hours (maximum) before extracting the supernatant. The supernatant will be centrifuged or filtered before following the proper preservation techniques required for all analyses. TSS, TOC, and mercury will be excluded from centrifugation or filtration.

4.3.5 Field Quality Control

Field duplicate samples (not split samples) will be collected with a frequency of one per 20 samples per environmental matrix or one per 20 samples per day, whichever is less (USEPA, 1995). Field blanks will be collected with a frequency of one per 20 samples per environmental matrix or one per 20 samples per day, whichever is less.

4.3.6 Sample Preservation and Storage

4.3.6.1 Chemical and Physical Analysis

USEPA SW-846 provides guidance, as do the references cited in Section 4.1 of this SAP, regarding preservation and storage for physical and chemical analyses of environmental media. Immediately after collection, the samples will be stored on ice in insulated coolers at 2ºC to 4ºC and shipped to the laboratory. Alternate arrangements, such as shipment in a refrigerated truck/van can also be used, provided the temperature requirements of the study are met. The laboratory must document the temperature of the cooler upon arrival and must store samples at 4°C. All studies/analyses will be performed such that the recommended holding times, as described in the referenced guidance documents and in Table 2, are met.

All sample volumes, handling, storage, and preservation requirements will be confirmed with the testing laboratories prior to sampling beginning.

4.3.7 Chain-of-Custody and Shipping

Appropriate Chain of Custody protocols will be followed. Guidance can be found in the references cited in Section 4.1. Chain of custody will be discussed and confirmed with the FIELD CONTRACTOR and ERDC prior to field collection beginning. Shipment means and receiving facility log-in/processing will ensure that holding times are met. EPA and USACE have agreed on previous projects that provided sediment storage temperatures are maintained at <4°C and that this is documented, that hold times for sediment would start at the time the composite sample is created at ERDC. Hold times for surface water begin at the time of collection, consequently, all surface water samples are collected as rapidly as possible at the end of the study. To meet this schedule, the ERDC laboratory requires that all samples (water, sediment, bulk samples etc.) be shipped at one time. These activities will be coordinated prior to field work commencing.

Media samples for chemical and physical characterization and bulk samples will be sent to ERDC-Vicksburg, MS.

The primary POC is:

Mr. J. Daniel Farrar
US Army ERDC
Environmental Laboratory, CEERD-EP-R
3909 Halls Ferry Road, Building 6009
Vicksburg, MAS 39180-6199
W: 601-634-2118 (CST)

The alternate POC is:

Mr. Al Kennedy
US Army ERDC
Environmental Laboratory, CEERD-EP-R
3909 Halls Ferry Road, Building 6009
Vicksburg, MS 39180-6199
W: 601-634-3344 (CST)

Once modified elutriate samples for chemical analyses are generated, they will be sent to the ERDC Analytical POC where analyses will be initiated/coordinated.

5.0 CHEMICAL ANALYSES AND DATA EVALUATION

All chemical analytical analyses will be performed and/or coordinated by ERDC. Additional details pertaining to chemical laboratory methods, analyses and reporting can be found in Attachment C.

5.1 Laboratory Quality Control

All chemical and physical analyses must include laboratory Quality Control (QC) samples; details of the numbers and types of laboratory QC samples can be found in Attachment C. A Level II validation package must be furnished including documentation of all QC activities performed specifically in conjunction with this project, along with sample results. The laboratory will provide a case narrative of the analyses and any deviations or out of specification events that took place during the analyses with each laboratory deliverable. The laboratories will also provide completed USEPA Region 6 (Draft) Data Review and Validation Requirements worksheets for dredged material disposal evaluation (Attachment C, Supplemental Attachment C-1). Copies of all raw data, lab notes, chromatograms, standard curves, etc., will be furnished upon request.

5.2 Chemical Analyses

All analyses shall be performed within the holding period described in the referenced guidance documents and outlined in Table 2. Chemical parameters to be analyzed in each medium are listed in Tables 3, and 4, along with required Target Detection Limits (TDLs). Sediment sample data will be reported as dry weight. If TDLs cannot be met and this is known either prior to field work commencing or while analyses are occurring, the analytical contractor will immediately contact the ERDC PM/Technical POC to resolve the potential implications this situation may have on the data usability.

Full analyte suites will be reported for all multi-analyte methods and all data will be compared to Agency screening criteria for water and guidance values for sediment. When analytes do not have screening criteria, patterns of detection limits and detected compounds will be evaluated. If analytes are all non-detected within a category with no analytical deviations or raised reporting limits, that analytical category will not require further evaluation, provided a brief summary of data quality is provided in the text (e.g., no elevated RLs, QC within parameters, etc.).

5.2.1 Surface Water and Modified Elutriate

As a preliminary screen, surface water and modified elutriate results will be screened against TSWQS (Table 3). The prioritization of the benchmark criteria from Table 3 is as follows: (1) TSWQS (marine – acute); (2) USEPA WQC (marine – CMC); (3) NOAA (marine – acute); (4) Region 6 (marine). One exception to this prioritization is copper will first be screened against the Region 6 marine chronic criteria for copper (3.6 ug/L) which is protective of oyster waters. If this criteria is exceeded, the sample will then be screened against the TSWQS value. These findings will need to be considered, as appropriate, when the placement options for these dredged materials are evaluation to ensure that protection of oyster waters/reefs is maintained.

5.2.2 Sediment

With the exception of dioxins/furans, sediment results will be screened against sediment guidance values (Table 4). The prioritization of the guidance values from Table 4 is as follows: (1) NOAA (marine ER-L); (2) NOAA ER-M (marine); and (3) USEPA R6 (marine).

Screening criteria has not been established for dioxins/furans in sediment; therefore, sediment results for dioxins/furans will be compared for consistency with previous sampling events in the area where the USEPA gave open water ocean placement concurrence.

5.2.3 Miscellaneous Parameter Analyses

Each of the miscellaneous analyses noted in Tables 3 and 4 shall be analyzed for and reported in tabular format and discussed in the report.

6.0 DELIVERABLES

Deliverables shall include both hard copy and electronic versions of the final report and data as outlined below.

6.1 Report

A report compliant with this SAP will be submitted by ERDC to SWG and POHA at completion of the dredge material characterization and evaluation. The report will synoptically summarize the key points as appropriate from the SAP, cross reference to study documents and at a minimum include:

a) Sample collection: sampling sites and locations (water and sediment); tabulated and plotted on figure showing locations and the dredging prism; summarized and cross referenced to study documents as needed
b) Field procedures: synoptic summaries and cross referenced to provided project documents; including compositing, physical observations (e.g., odor, stratification, etc.) and other field procedures, observations, deviations as appropriate
c) Quality Control (field): described and cross referenced to project documents as needed
d) Analyses: description of what was analyzed for, methodologies, etc.
e) Results and discussion: discuss data and proceed by environmental medium and within each medium, by analyte category. Each section below must have the following discussion components:
    i. Tabular Data Summaries Tables: Include appropriate statistics (e.g. N=number, minimum, mean, standard deviation from the mean, median and maximum etc.) for both analytical and miscellaneous parameters) for all media and tests
    ii. Discussion of results as per criteria outlined in Attachments and the RIA
    iii. Data review and validation (See Attachment C, Supplemental Attachment C-1)
    iv. Incorporate field and laboratory qualifiers when they impact the evaluation
    v. Incorporate site-specific aspects (e.g. matrix effects, dilution required etc.) that might impact the data discussions

vi. Summarize deviations and discuss impact, if any
vii. Cross-reference text discussion with data summary tables
viii. Incorporate USEPA R6 policy for treatment of non-detect chemical data (memo appended to Attachment C, Supplemental Attachment C-2)

6.2 Submittal

The report will be submitted to the SWG-PM:

Andrea Catanzaro (CESWG-PM-J)
W: 409-766-6346 (CST)
M: 409-502-0984 (CST)

6.2.1 Hard Copy

- One (1) hard copy of the final report and all accompanying figures and tables
- Attachments will be included; if attachments are extensive, attachments such as field/raw data sheets, photographic logs, laboratory reports as PDFs, etc. ONLY will be submitted as PDF on disc

6.2.2 Electronic Copy

- One PDF electronic copy of the final report and all accompanying figures, tables, field data sheets, raw data sheets
- PDF files of all laboratory reports for chemical and physical analyses/characterization
- Laboratory Electronic Data Deliverables (EDDs) (Equis type) (Access or sortable Excel format) consistent with attached EDD memo at the end of Attachment C as Supplemental Attachment C-2
- Additional PDF copies upon request

7.0 REFERENCES

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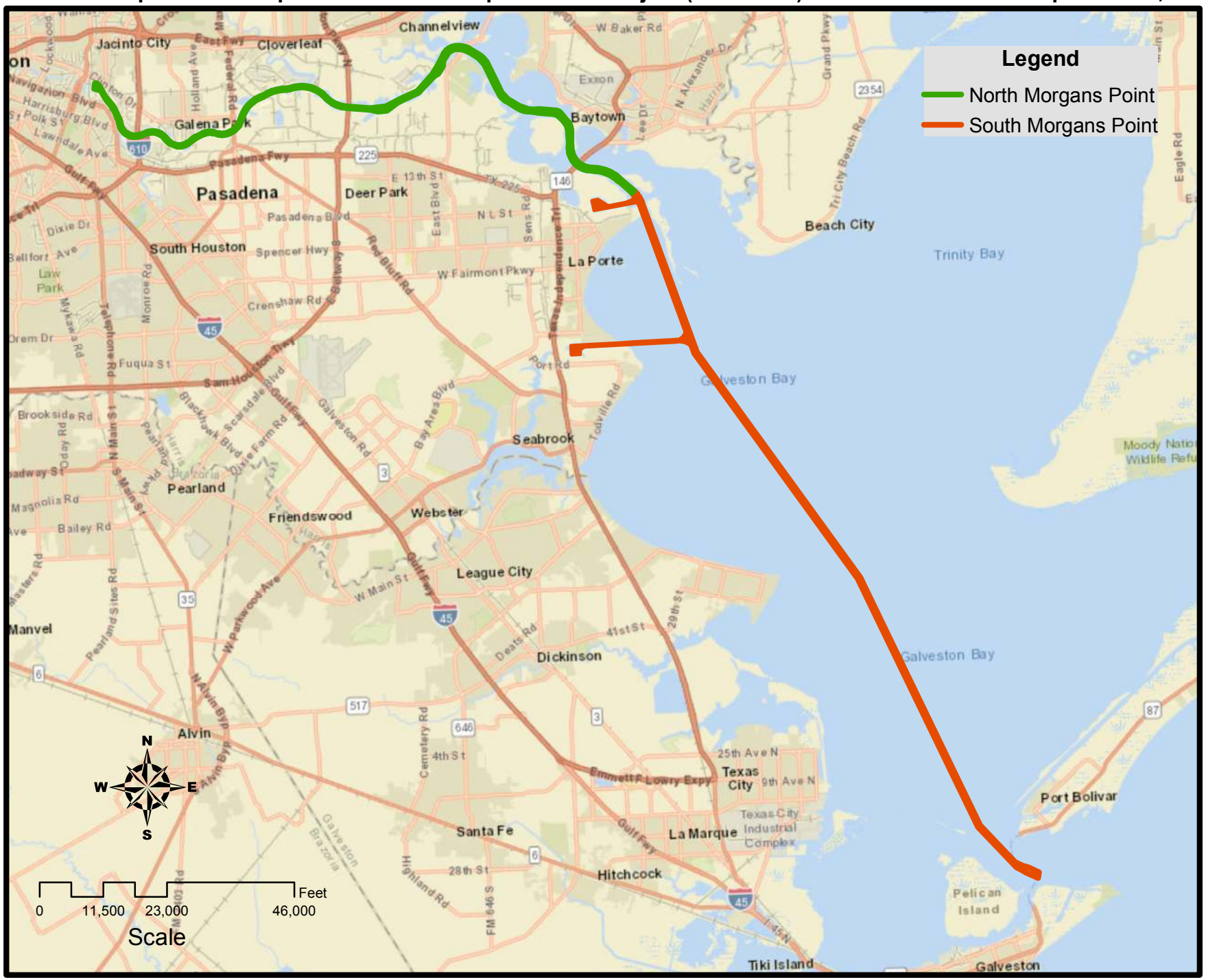
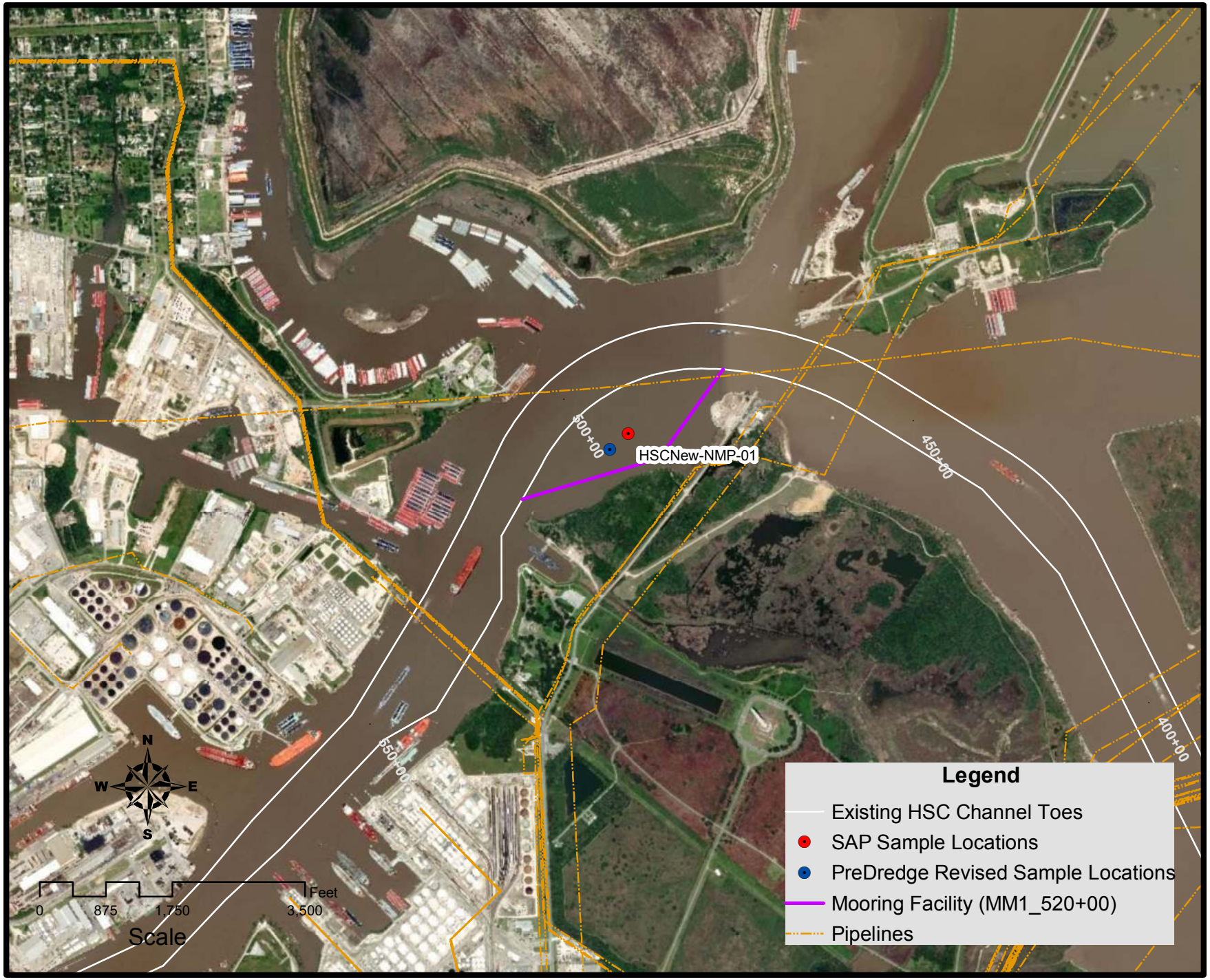
Figures

Figure 1: Study Area - Bayou Reach North of Morgans Point
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP) New Work Houston Ship Channel, TX



Imagery: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC,
© OpenStreetMap contributors, and the GIS User Community

Figure 2: SAP Revised Sampling Locations - Segment 1 Bayou
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP) New Work Houston Ship Channel, TX

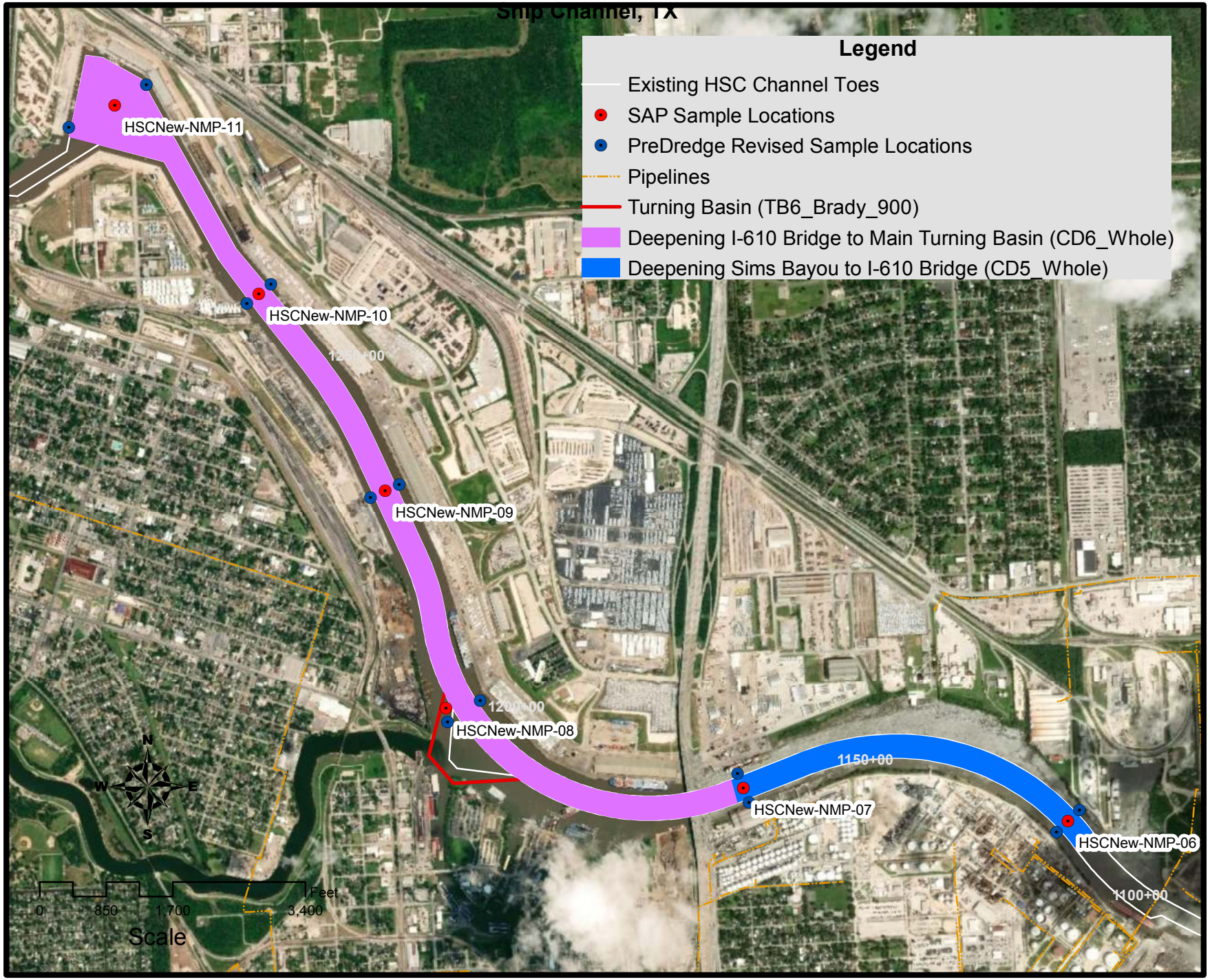


Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 3: SAP Revised Sampling Locations -
Houston Ship Channel Segment 4 Expansion Channel Improvement Project Work Houston Ship Channel, TX (HSC-ECIP) New

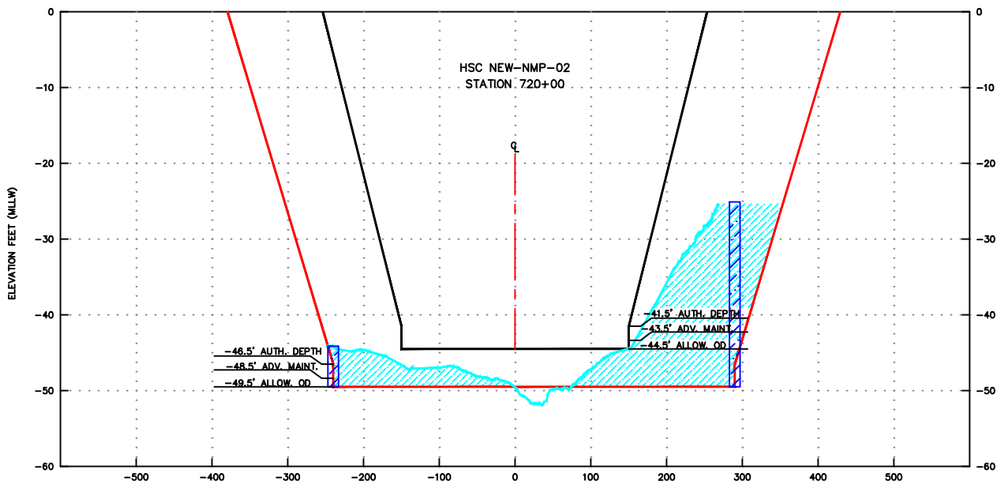
Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

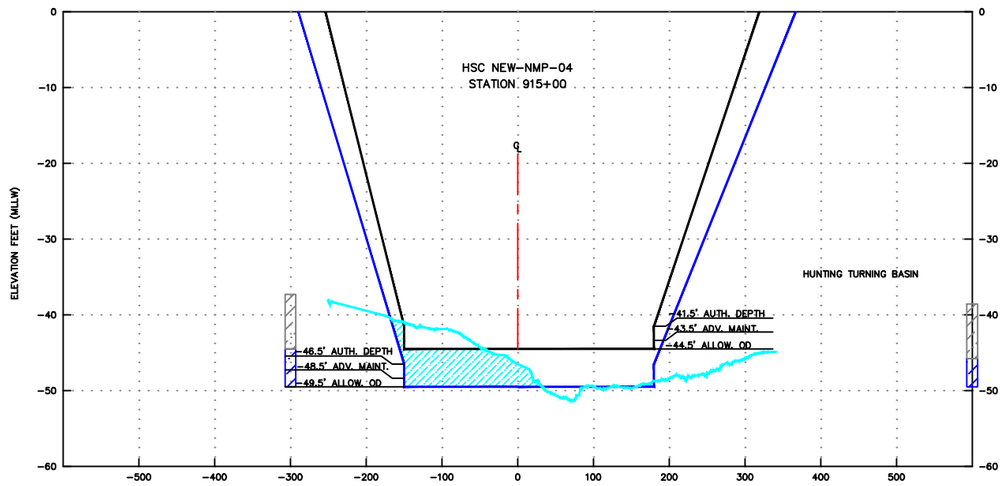
Figure 4: SAP Revised Sampling Locations - Segment 5 & 6
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP) New Work Houston Ship Channel, TX

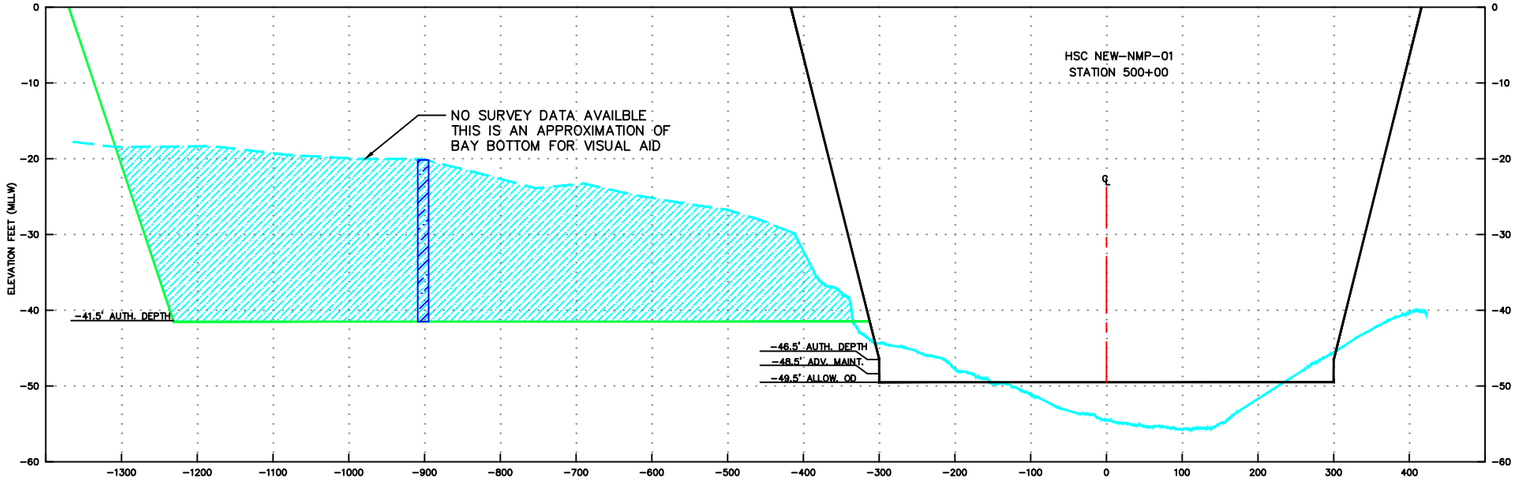


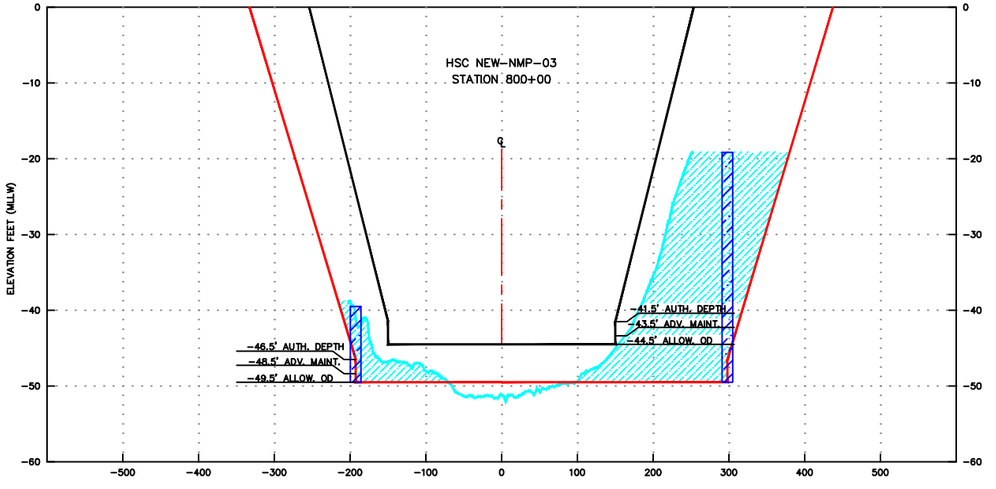
Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 5: Cross Sections for Selected Sampling Locations Including Dredge Prisms and Sampling Depth to be Retained
Houston Ship Channel Expsansion Channel Improvement Project (HSC-ECIP), Houston, TX





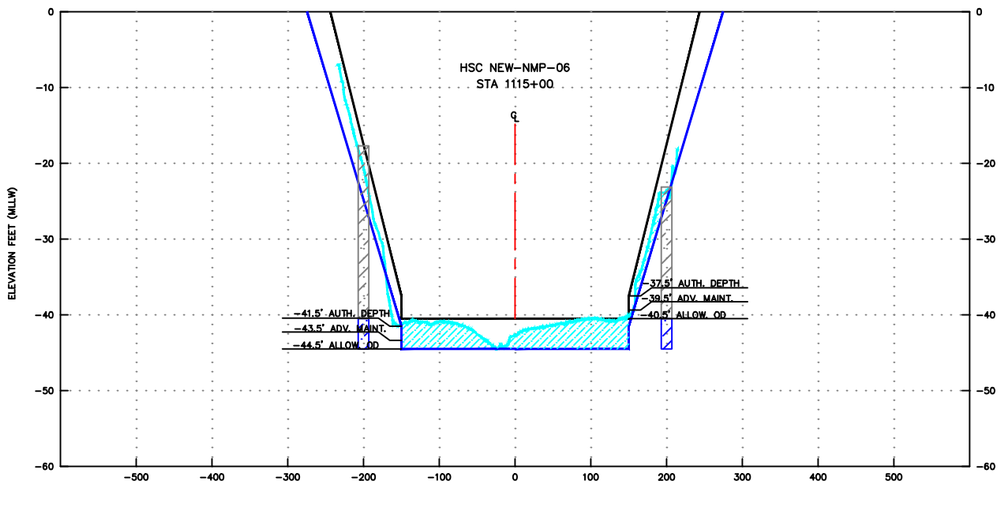


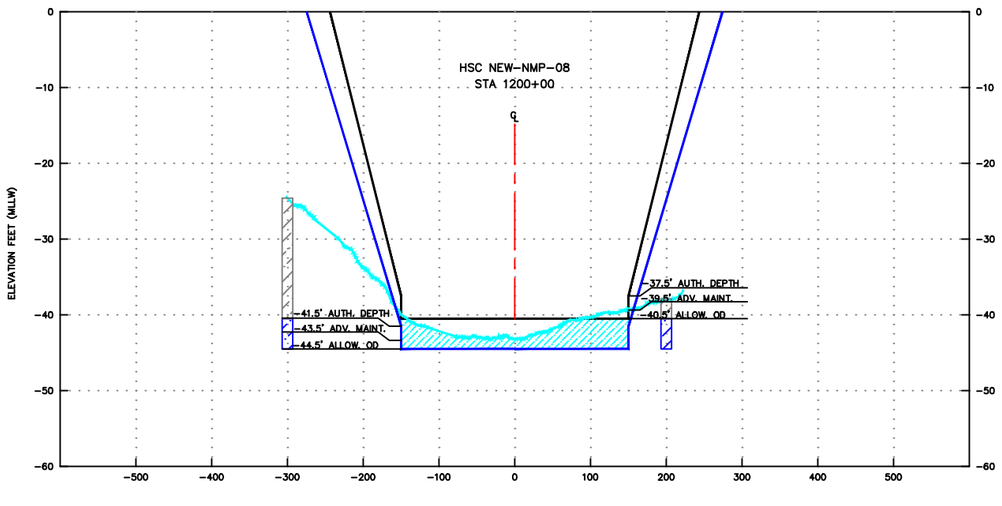


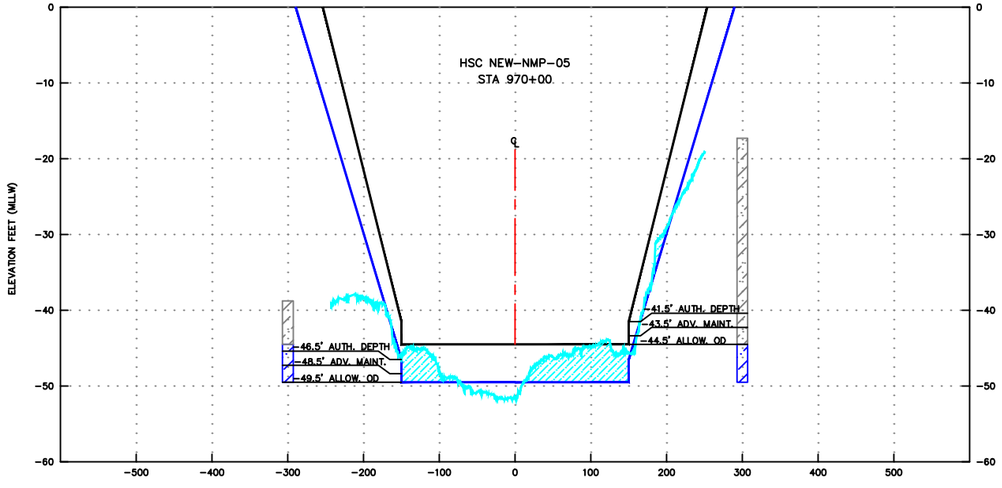
LEGEND
EXISTING CHANNEL TEMPLATE
DEEPENED CHANNEL TEMPLATE
530-FT WIDENED/DEEPENED CHANNEL TEMPLATE
MOORING BASIN (MM1_520+00)
2018 USACE SURVEY-NOAA SURVEY COMBO
NEW WORK DREDGE PRISM
SAMPLE COLLECTED
SAMPLE COLLECTED BUT DISCARDED – DOES NOT REPRESENT DREDGING PRISM
*NOTE ALL SECTIONS LOOKING TOWARDS INCREASING STATION

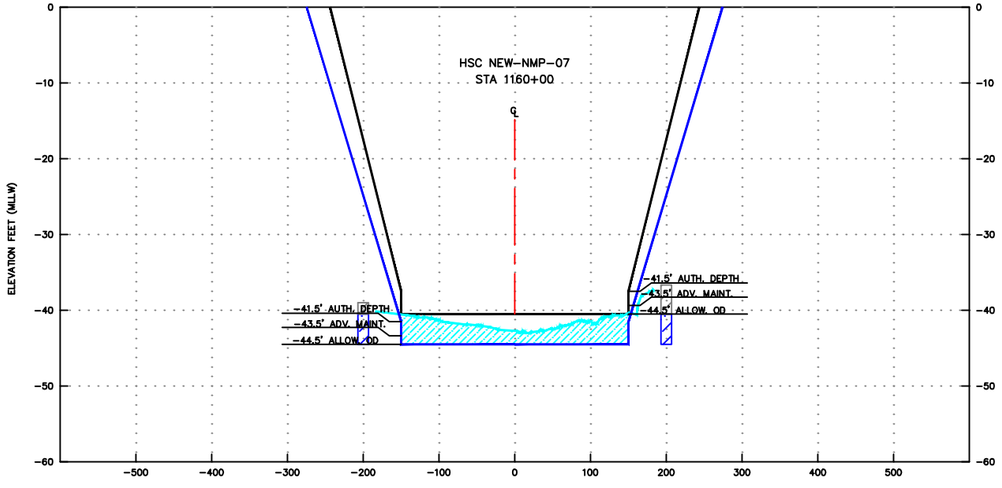
NORTH OF MORGANS POINT SAMPLING LOCATIONS REVISED 08/16/2018
SHEET 1 OF 3

Figure 5 (continued): Cross Sections for Selected Sampling Locations Including Dredge Prisms and Sampling Depth to be Retained
Houston Ship Channel Expsansion Channel Improvement Project (HSC-ECIP), Houston, TX



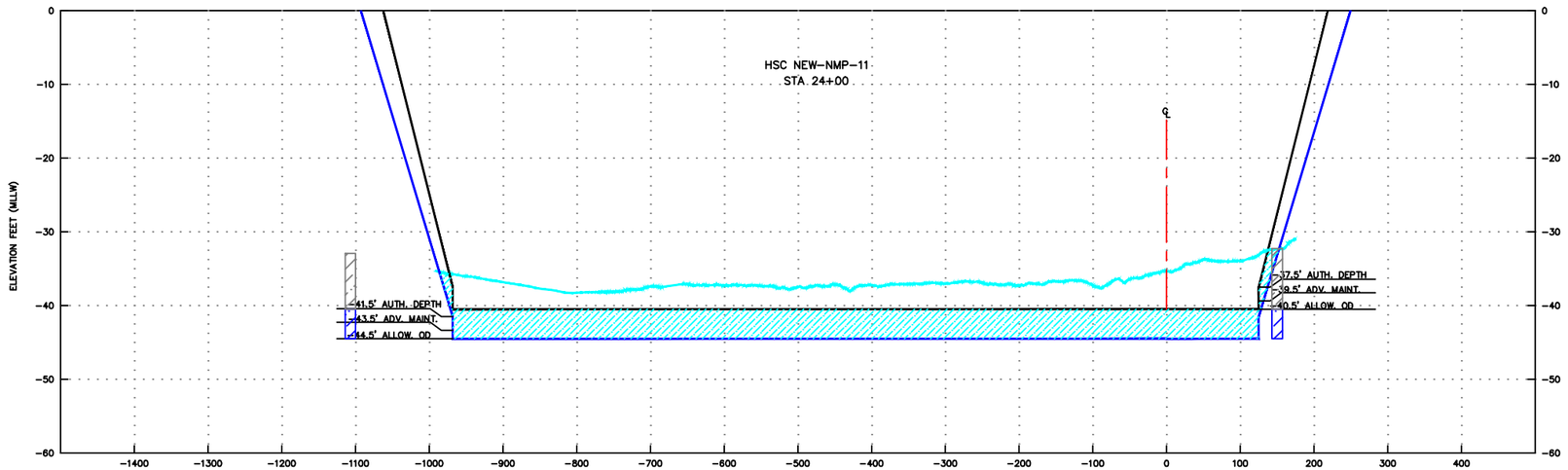


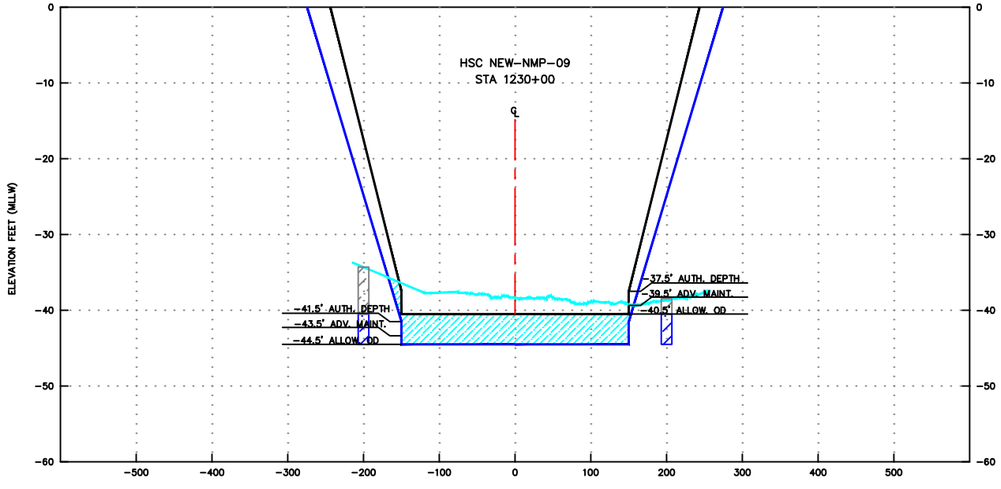


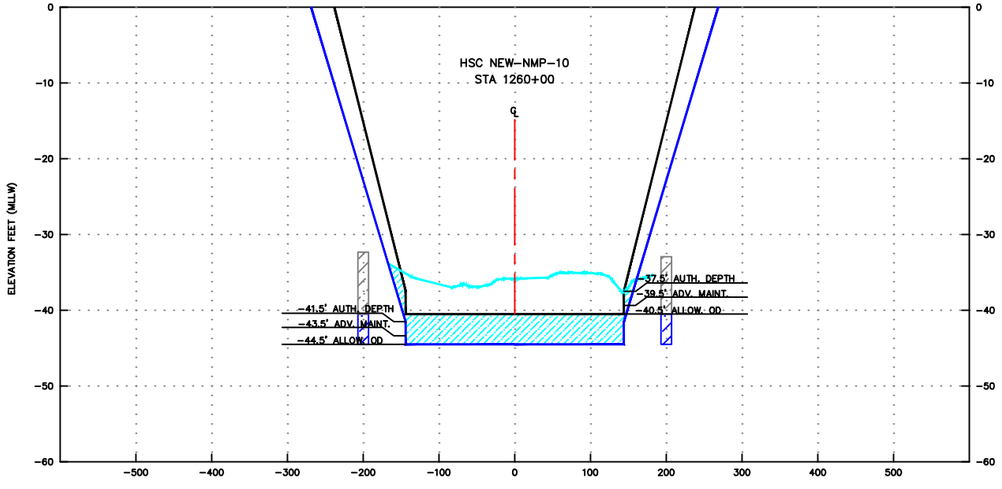


LEGEND
EXISTING CHANNEL TEMPLATE
DEEPENED CHANNEL TEMPLATE
2018 USACE SURVEY-NOAA SURVEY COMBO
NEW WORK DREDGE PRISM
SAMPLE COLLECTED
SAMPLE COLLECTED BUT DISCARDED – DOES NOT REPRESENT DREDGING PRISM
*NOTE ALL SECTIONS LOOKING TOWARDS INCREASING STATION

Figure 5 (continued): Cross Sections for Selected Sampling Locations Including Dredge Prisms and Sampling Depth to be Retained
Houston Ship Channel Expsansion Channel Improvement Project (HSC-ECIP), Houston, TX







LEGEND
EXISTING CHANNEL TEMPLATE
DEEPENED CHANNEL TEMPLATE
2018 USACE SURVEY-NOAA SURVEY COMBO
NEW WORK DREDGE PRISM
SAMPLE COLLECTED
SAMPLE COLLECTED BUT DISCARDED – DOES NOT REPRESENT DREDGING PRISM
*NOTE ALL SECTIONS LOOKING TOWARDS INCREASING STATION

NORTH OF MORGANS POINT SAMPLING LOCATIONS REVISED 08/16/2018
SHEET 3 OF 3

Tables

Table 1: Summary of Sample Collection and Testing
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP) - North of Morgan's Point
Houston Ship Channel, TX

Segment	Sample Locations (1)	Station	Distance from Existing Channel Center Line (2)	Proposed Depth and Width (ft) (3)	Coordinates (NAD83)		Sample Matrix (4)	Categories of Analyses by Media (4, 5)	Chemical Analyses (6)
					N	E			
1 Mooring Basin	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	01-A	500+00	700	D = -45.5 (-41.5+2+2)	13,844,904	3,210,094	SD, SW (7)		
	01-B		1000	W = 1,075			SD		
	01-C		700				SD		
4 Boggy Bayou to Greens Bayou	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	02-A	720+00	-265	D = -50.5 (-46.5+2+2)	13,835,216	3,191,689	SD, SW		
	02-B		265	W = 530			SD		
4 Boggy Bayou to Greens Bayou	HSCNew-NMP-							SW - dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	03-A	800+00	-193	D = -50.5 (-46.5+2+2)	13,838,494	3,184,648	SD, SW		
	03-B		298	W = 530			SD		
4 Greens Bayou to Washburn Tunnel	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	04-A	912+00	In TB	D = -50.5 (-46.5+2+2)	13,836,595	3,173,878	SD, SW		
	04-B		-150	W = NA			SD		
	04-C		150				SD		
4 Greens Bayou to Washburn Tunnel	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	05-A	970+00	-150	D = -50.5 (-46.5+2+2)	13,831,491	3,170,996	SD, SW		
	05-B		150	W = NA			SD		
5 Sims Bayou to I-610 Bridge	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	06-A	1115+00	-150	D = -45.5 (-41.5+2+2)	13,829,832	3,158,049	SD, SW		
	06-B		150	W = NA			SD		
6 I-610 Bridge to Main Turning Basin	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	07-A	1160+00	-150	D = -45.5 (-41.5+2+2)	13,830,260	3,153,903	SD, SW		
	07-B		150	W = NA			SD		
6 I-610 Bridge to Main Turning Basin	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	08-A	1200+00	In TB	D = -45.5 (-41.5+2+2)	13,831,271	3,150,100	SD, SW		
	08-B		-150	W = NA			SD		
	08-C		150				SD		
6 I-610 Bridge to Main Turning Basin	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	09-A	1230+00	-150	D = -45.5 (-41.5+2+2)	13,834,052	3,149,321	SD, SW		
	09-B		150	W = NA			SD		
6 I-610 Bridge to Main Turning Basin	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	10-A	1260+00	-150	D = -45.5 (-41.5+2+2)	13,836,566	3,147,710	SD, SW		
	10-B		150	W = NA			SD		
Main Turning Basin	HSCNew-NMP-							SW - total dissolved (filtered) except VOC and Hg and Se (unfiltered); E-M - total and dissolved; SD - total (bulk)	VOCs, SVOCs, Pest, PCBs, Dioxins/DBF, TPH, TAL metals, Misc Parm.
	11-A	24+00	400	D = -45.5 (-41.5+2+2)	13,838,984	3,145,867	SD, SW		
	11-B		0	W = 1,300			SD		
	11-C		400				SD		

FOOTNOTES:

1) Three subsamples planned for collection within each sampling point as a transect as presented in the SAP, to be composited into one sample.
2) Station 800+00 is at a channel center line realignment, consequently the distances from the center line are asymmetrical
3) Reported as MLLW. The total proposed depth includes 2 feet of advanced maintenance and 2 feet of allowable over depth
4) SW = Water sample, SD = Sediment sample, E-M= Modified Elutriate, Misc - Miscellaneous. Refer to Sampling and Analysis plan for further details
5) Samples should not be filtered for VOCs, mercury and selenium analyses. Sample compositing will ONLY be permitted as designated in the SAP at each location for sediment samples. Refer to Tables 2, 3 and 4 for further detail.
6) Chemical Analyses: VOCs = Volatile Organic Compounds, SVOCs = SemiVolatile Organic Compounds, Pest = Pesticides, PCBs = PolyChlorinated Biphenyls, Dioxins/DBF = Dioxins/Dibenzofurans, TPH = Total Petroleum Hydrocarbons, Metals = Target Analyte
7) SW should be collected from the location where the bulk of the sediment is located wihtin the sample area

Table 2: Summary of Recommended Procedures for Sample Collection, Preservation and Storage [(a)]
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Analyses	Collection Method[b]	Amount Required[c]	Container[d]	Preservation Technique	Storage Conditions	Holding Times[e]
SEDIMENT						
Chemical/Physical Analyses						
Volatile Organic Compounds	Grab/corer	100 g	Glass jar with Teflon lid	Refrigerate; no preservation	$4^{o}C$[f]/dark[g]	2 days if no chemical preservation at 4 ± 2°C; 14 days for sample analysis if preserved within 2 days[m]
SVOCs	Grab/corer	250 g	Solvent-rinsed amber glass jar with Teflon lid[f]	Dry ice[f] or freezer storage for extended storages; otherwise refrigerate	$4^{o}C$[f]/dark[g]	14 days (extraction)[h]
Pesticides	Grab/corer	250 g	Solvent-rinsed amber glass jar with Teflon lid[f]	Dry ice[f] or freezer storage for extended storages; otherwise refrigerate	$4^{o}C$[f]/dark[g]	14 days (extraction)[h]
Polychlorinated Biphenyls (PCBs)	Grab/corer	250 g	Solvent-rinsed amber glass jar with Teflon lid[f]	Dry ice[f] or freezer storage for extended storages; otherwise refrigerate	$4^{o}C$[f]/dark[g]	14 days (extraction)[h]
Polyaromatic Hydrocarbons (PAHs) if more lower RLs required than provided by Method 8270	Grab/corer	250 g	Solvent-rinsed amber glass jar with Teflon lid[f]	Dry ice[f] or freezer storage for extended storages; otherwise refrigerate	$4^{o}C$[f]/dark[g]	14 days (extraction)[h]
Dioxins/Furans	Grab/corer	150g	Glass jar	Refrigerate or freeze -10 ^{o}C	$<4^{o}C$	1 year to extraction; 1 year after extraction
TPH	Grab/corer	150g	Glass jar with Teflon lid	Refrigerate; no preservation	$4^{o}C$[f]/dark[g]	2 days if no chemical preservation at 4 ± 2°C; 14 days for sample analysis if preserved within 2 days[m]
Metals	Grab/corer	100 g	Amber glass jar	Dry ice[f] or freezer storage for extended storages; otherwise refrigerate	$4^{o}C$	Hg - 28 days Others – 180 days

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Chromium III and VI	Grab/corer	100 g	4 oz amber glass jar	Refrigerate; no preservation	$4^{o}C$/dark	30 days
Grain Size	Grab/corer	1000g	Whirl-pac bag[f]	Refrigerate	$<4^{o}C$	Undetermined
Total Organic Carbon (TOC)	Grab/corer	50 g	Heat treated amber glass jar	Dry ice[f] or freezer storage for extended storages; otherwise refrigerate	$4^{o}C$[f]	14 days
Ammonia	Grab/corer	40g	Glass jar	Refrigerate	$<4^{o}C$	7 days
Total solids/specific gravity	Grab/corer	50 g	Whirl-pac bag	Refrigerate	$<4^{o}C$	Undetermined
Miscellaneous	Grab/corer	50g	Whirl-pac bag	Refrigerate	$<4^{o}C$	Undetermined
Sediment from which elutriate is prepared	Grab/corer	Depends on tests being performed	Amber glass with Teflon-lined lid	Completely fill and refrigerate	$4^{o}C$/dark/airtight	8 weeks
Volume of Sediment Required per Sample Location		2 gallons sediment for chemical analyses (media) + 4 gallons sediment for modified elutriate Total = 6 gallons of sediment per location PLUS QC/Field Duplicate: 2 gallons sediment for chemical analyses				
Total Volume Sediment Required for 11-Channel Locations + 1-Field QA/Field Duplicate		66 gallons total of sediment for channel locations chemical analyses and modified elutriate PLUS 2 gallons sediment for the QC/Field Duplicate Sample for chemical analysis				

Table 2: Summary of Recommended Procedures for Sample Collection, Preservation and Storage [(a)]
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

WATER AND ELUTRIATE						
Chemical/Physical Analyses						
Volatile Organic Compounds	Discrete sampler or pump	80 mL	Amber glass VOA vials with Teflon-lined lid[k]	pH <2 with 1:1 HCL; refrigerate in airtight, completely filled container[k]	$4^{o}C$[k]	14 days for sample analysis if preserved[m]
Semivolatile Organic Compounds	Discrete sampler or pump	2 L	Amber glass bottle with Teflon-lined lid[k]	Airtight seal; refrigerate	$4^{o}C$[k]	7 days for extraction; 40 days for extract analysis[k]
Pesticides	Discrete sampler or pump	1 L	Amber glass bottle with Teflon-lined lid[k]	Airtight seal; refrigerate	$4^{o}C$[k]	7 days for extraction; 40 days for extract analysis[k]
Polychlorinatd Biphenyls (PCBs)	Discrete sampler or pump	1 L	Amber glass bottle with Teflon-lined lid[k]	Airtight seal; refrigerate	$4^{o}C$[k]	7 days for extraction; 40 days for extract analysis[k]
Polyaromatic Hydrocarbons (PAHs) if more lower RLs required than provided by Method 8270	Discrete sampler or pump	1 L	Amber glass bottle with Teflon-lined lid[k]	Airtight seal; refrigerate	$4^{o}C$[k]	7 days for extraction; 40 days for extract analysis[k]
Phenolic compounds	Discrete sampler or pump	1 L	Amber glass[l]	0.1 - 1.0 g $CuSO_4$; H_2SO_4 to pH <2; refrigerate	$4^{o}C$[l]	24 h[l]
Dioxins/Furans	Discrete sampler or pump	1000 mL	Amber glass	Refrigerate	$4^{o}C$	1 year to extraction; 1 year after extraction
TPH	Graba/corer		Preweighed VOA vials with PTFE lined caps (fi); Encore Sampler or Solvent-rinsed amber glass VOA vials with Teflon lid[f]	Low level VOCs (Encores): NaHSO4 preservation at the lab within 24 hrs of collection; On-Site MeOH preservation for non-Encore “low” and "high" samples. Dry ice[f] or freezer storage for extended storages; otherwise refrigerate	$4^{o}C$[f]/dark[g]	2 days if no chemical preservation at 4 ± 2°C; 14 days for sample analysis if preserved within 2 days[m]
Sulfides	Discrete sampler or pump	500 mL	Plastic or glass[l]	pH >9 NaOH (ZnOAc); refrigerate	$4^{o}C$[l]	24 h[l]

Table 2: Summary of Recommended Procedures for Sample Collection, Preservation and Storage [(a)]
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Metals	Discrete sampler or pump	100 mL	Acid-rinsed polyethylene or glass jar[k]	pH <2 with HNO_3[k]; refrigerate	4^oC 2^oC[k]	Hg - 14 days Others – 180 days
Chromium III and VI	Discrete sampler or pump	125 mL	Plastic	Refrigerate; no preservation	4^oC/dark	24 h
Dissolved Organic Carbon (DOC)	Discrete sampler or pump	100 mL	Amber glass VOA vials	H_2SO_4 to pH <2; refrigerate	4^oC[l]	28 days[l]
Total cyanide	Discrete sampler or pump	500 mL	Plastic	pH >12 NaOH; refrigerate	4^oC	14 days
Ammonia	Discrete sampler or pump	500 mL	Plastic	H_2SO_4 to pH <2; refrigerate	4^oC	7 days
Particulate analysis	Discrete sampler or pump	500-2000 mL	Plastic or glass	Lugols solution and refrigerate	4^oC	Undetermined
Volume of Site Water per Channel Location		3 gallons water for chemical analyses (media) + 25 gallons water for modified elutriate Total = 28 gallons of water per location PLUS QC/Field Duplicate: 3 gallons water for chemical analyses				
Total Volume Surface Water Required for 11-Channel Locations + 1-QC/Field Duplicate		308 gallons total of water for channel location chemical analyses and modified elutriate PLUS 3 gallons water for the QC/Field Duplicate Sample for chemical analysis				

Table 2: Summary of Recommended Procedures for Sample Collection, Preservation and Storage [(a)]
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Footnotes

a (i) primary reference USEPA/USACE, Regional Implementation Agreement, July 2003;

(ii) **CONSULT WITH YOUR ANALYTICAL PROVIDER**. This table contains only a summary of collection, preservation, and storage procedures for samples. Consult with your analytical provider to confirm or modify for site-specific sampling and analyses. The cited references should be consulted for a more detailed description of these procedures (Inland Testing Manual, EPA-823-B-98-004);

b Collection method should include appropriate liners;

c Amount of sample required by the laboratory to perform the analysis (wet weight or volume provided, as appropriate). CONFIRM THESE QUANTITIES WITH YOUR ANALYTICAL PROVIDER!! Miscellaneous sample size for sediment should be increased if auxiliary analytes that cannot be included as part of the organic or metal analyses are added to the list. The amounts shown are not intended as firm values; more or less tissue may be required depending on the analytes, matrices, detection limits, and particular analytical laboratory;

d All containers should be certified as clean according to EPA (1990);

e These holding times are for sediment, water, and tissue based on guidance that is sometimes administrative rather than technical in nature. There are no promulgated, scientifically based holding time criteria for sediments, tissues, or elutriates. References should be consulted if holding times for sample extracts are desired. Holding times are from the time of sample collection;

f NOAA (1989);

f(i) TCEQ (formerly TNRCC, Method 1005)

g Tetra Tech (1986a);

h Sample may be held for up to one year if at -20^{O}C;

i Polypropylene should be used if phthalate bioaccumulation is of concern;

k EPA (1987); 40 CFR Part 136, Table III;

l Plumb (1981);

m If samples are not preserved to pH<2, then aromatic compounds must be analyzed within 7 days;

n Tetra Tech (1986b);

Table 3: Target Detection Levelsa (TDLs), Screening Benchmarks and Analytical Methodology, Marine Water and Elutriate
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Chemical	CAS #	Units	TDLs (b)	Screening Benchmarks				EPA Method
			Marine Water/Elutriate	TSWQS (Marine Acute) (c)	EPA WQC (Marine Acute) (d)	NOAA (Marine Acute) (e)	Region 6 (Marine) (f)	
VOLATILES								
1,1,1-Trichloroethane	71-55-6	ug/L	-	-	-	31200	1560	8260B, GC-MS Mode
1,1,2,2-Tetrachloroethane	79-34-5	ug/L	-	-	-	9020	451	
1,1,2-Tetrachloro-1,2,2-trifluoroethane	76-13-1	ug/L	-	-	-	-	-	
1,1,2-Trichloroethane	79-00-5	ug/L	-	-	-	-	275	
1,1-Dichloroethane	75-34-3	ug/L	-	-	-	-	-	
1,1-Dichloroethene	75-35-4	ug/L		-	-	224000	12500	
1,2,3-Trichlorobenzene	87-61-6	u	-	-	-	-	-	
1,2,4-Trichlorobenzene	120-82-1	ug/L	0.9	-	-	160	22	
1,2-Dibromo-3-Chloropropane	96-12-8	ug/L	-	-	-	-	-	
1,2-Dibromoethane	106-93-4	ug/L	-	-	-	-	-	
1,2-Dichlorobenzene	95-50-1	ug/L	0.8	-	-	1970	99	
1,2-Dichloroethane	107-06-2	ug/L	-	-	-	11300	5650	
1,2-Dichloropropane	78-87-5	ug/L	-	-	-	10300	-	
1,3-Dichlorobenzene	541-73-1	ug/L	0.9	-	-	1970	142	
1,4-Dichlorobenzene	106-46-7	ug/L	1	-	-	1970	99	
1,4-Dioxane	123-91-1	ug/L	-	-	-	-	-	
2-Butanone	78-93-3	ug/L	-	-	-	-	-	
2-Hexanone	591-78-6	ug/L	-	-	-	-	-	
4-Methyl-2-Pentanone	108-10-1	ug/L	-	-	-	-	61500	
Acetone	67-64-1	ug/L	-	-	-	-	282000	
Benzene	71-43-2	ug/L	2	-	-	5100	109	
Bromodichloromethane	75-27-4	ug/L	-	-	-	-	-	
Bromoform	75-25-2	ug/L	-	-	-	-	1220	
Bromomethane	74-83-9	ug/L	-	-	-	-	600	
Carbon Disulfide	75-15-0	ug/L	-	-	-	-	-	
Carbon Tetrachloride	56-23-5	ug/L	-	-	-	50000	1500	
Chlorobenzene	108-90-7	ug/L	-	-	-	-	105	
Chloroethane	75-00-3	ug/L	-	-	-	-	-	
Chloroform	67-66-3	ug/L	2	-	-	-	4100	
Chloromethane	74-87-3	ug/L	-	-	-	-	13500	
cis-1,2-Dichloroethene	156-59-2	ug/L	-	-	-	224000	-	
cis-1,3-Dichloropropene	10061-01-5	ug/L	-	-	-	-	-	
Cyclohexane	110-82-7	ug/L	-	-	-		-	
Dibromochloromethane	124-48-1	ug/L	-	-	-	12000	-	
Dichlorodifluoromethane	75-71-8	ug/L	-	-	-	-	-	
Ethylbenzene	100-41-4	ug/L	5	-	-	430	249	
Isopropylbenzene	98-82-8	ug/L	-	-	-	-	-	
Methyl acetate	79-20-9	ug/L	-	-	-	-	-	
Methyl tert-butyl ether	1634-04-4	ug/L	-	-	-	-	-	
Methylcyclohexane	108-87-2	ug/L	-	-	-	-	-	
Methylene chloride	75-09-2	ug/L	-	-	-	-	5420	
o-Xylene	95-47-6	ug/L	-	-	-	-	-	
m&p-Xylene	179601-23-1	ug/L	-	-	-	-	-	
Styrene	100-42-5	ug/L	-	-	-	-	455	
Tetrachloroethene	127-18-4	ug/L	2	-	-	-	1450	
Toluene	108-88-3	ug/L	5	-	-	6300	480	
trans-1,2-Dichloroethene	156-60-5	ug/L	-	-	-	224000	-	
trans-1,3-Dichloropropene	10061-02-6	ug/L	-	-	-	-	-	
Trichloroethene	79-01-6	ug/L	2	-	-	2000	970	
Trichlorofluoromethane	75-69-4	ug/L	-	-	-	12000	-	
Vinyl chloride	75-01-4	ug/L	-	-	-	-	-	

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Houston Ship Channel, TX

Chemical	CAS #	Units	TDLs (b)	Screening Benchmarks				EPA Method
			Marine Water/Elutriate	TSWQS (Marine Acute) (c)	EPA WQC (Marine Acute) (d)	NOAA (Marine Acute) (e)	Region 6 (Marine) (f)	
SEMIVOLATILES								
1,2,4-Trichlorobenzene	120-82-1	ug/L	0.9 (g)	-	-	160	22	8270C, GC-MS SIM Mode
1,2-Dichlorobenzene	95-50-1	ug/L	0.8 (g)	-	-	1970	591	
1,2-Diphenylhydrazine	122-66-7	ug/L	1	-	-	-	-	
1,3-Dichlorobenzene	541-73-1	ug/L	0.9 (g)	-	-	1970	142	
1,4-Dichlorobenzene	541-73-1	ug/L	1 (g)	-	-	1970	99	
2,4,6-Trichlorophenol	95-95-4	ug/L	0.9 (g)	-	-	-	61	
2,4-Dichlorophenol	120-83-2	ug/L	0.8 (g)	-	-	-	-	
2,4-Dimethylphenol	105-67-9	ug/L	10	-	-	-	-	
2,4-Dinitrophenol	51-28-5	ug/L	5 (g)	-	-	4850	1330	
2,4-Dinitrotoluene	121-14-2	ug/L	2 (g)	-	-	590	-	
2,6-Dinitrotoluene	606-20-2	ug/L	2 (g)	-	-	-	-	
2-Chloronapthalene	91-58-7	ug/L	0.8 (g)	-	-	7.5	-	
2-Chlorophenol	95-57-8	ug/L	0.9 (g)	-	-	-	265	
2-Methylphenol	95-48-7	ug/L	10	3060	-	-	-	
2-Nitrophenol	88-75-5	ug/L	2 (g)	-	-	-	2940	
3,3-Dichlorobenzidine	91-4-1	ug/L	3 (g)	-	-	-	73	
4,6-Dinitro-o-cresol	534-52-1	ug/L	10	-	-	-	-	
4-Bromophenyl phenyl ether	101-55-3	ug/L	0.4 (g)	-	-	-	-	
4-Chloro-3-methylphenol	59-50-7	ug/L	0.7 (g)	-	-	-	-	
4-Chlorophenyl phenyl ether	7005-72-3	ug/L	0.6 (g)	-	-	-	-	
4-Methylphenol	106-44-5	ug/L	10	-	-	-	-	
4-Nitrophenol	100-02-7	ug/L	5 (g)	-	-	4850	717	
Acenaphthene	83-32-9	ug/L	0.75 (g)	-	-	970	40.4	
Acenaphthylene	208-96-8	ug/L	1.0 (g)	-	-	300	-	
Anthracene	120-12-7	ug/L	0.6 (g)	-	-	300	0. 18	
Benzidine	92-87-5	ug/L	1	-	-	-	-	
Benzo(a)anthracene	56-55-3	ug/L	0.4 (g)	-	-	300	-	
Benzo(a)pyrene	50-32-8	ug/L	0.3 (g)	-	-	300	-	
Benzo(b&k)fluoranthene	205-99-2	ug/L	0.6 (g)	-	-	300	-	
Benzo(e)pyrene	192-97-2	ug/L	-	-	-	-	-	
Benzo[g,h,i]perylene	191-24-2	ug/L	1.2 (g)	-	-	300	-	
Bis(2-chloroethoxy)methane	111-91-1	ug/L	1 (g)	-	-	12000	-	
Bis(2-chloroethyl)ether	111-44-4	ug/L	0.9 (g)			-	-	
Bis(2-chloroisopropyl)ether	108-60-1	ug/L	0.7 (g)	-	-	-	-	
Bis[2-ethylhexyl] Phthalate	117-81-7	ug/L	2 (g)	-	-	400	-	
Butyl Benzyl Phthalate	85-68-7	ug/L	4 (g)	-	-	2944	147	
Chrysene	218-01-9	ug/L	0.3 (g)	-	-	300	-	
Dibenzo[a,h]anthracene	53-70-3	ug/L	1.3 (g)	-	-	300	-	
Diethyl Phthalate	84-66-2	ug/L	1 (g)	-	-	2944	884	
Dimethyl Phthalate	131-11-3	ug/L	1 (g)	-	-	2944	580	
Di-n-butyl Phthalate	84-74-2	ug/L	1 (g)	-	-	2944	NA	
Di-n-octyl Phthalate	117-84-0	ug/L	3 (g)	-	-	2944	-	
Fluoranthene	206-44-0	ug/L	0.9 (g)	-	-	40	2.96	
Fluorene	86-73-7	ug/L	0.6 (g)	-	-	300	50	
Hexachlorobenzene	118-74-1	ug/L	0.4 (g)	-	-	160	-	
Hexachlorobutadiene	87-69-3	ug/L	0.9 (g)	-	-	32	0. 32	
Hexachlorocyclopentadiene	77-47-4	ug/L	3.0 (g)	-	-	7	0. 07	
Hexachloroethane	67-72-1	ug/L	0.9 (g)	-	-	940	9.4	
Indeno[1,2,3-c,d]pyrene	193-39-5	ug/L	1.2 (g)			300	-	

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Chemical	CAS #	Units	TDLs (b)	Screening Benchmarks				EPA Method
			Marine Water/Elutriate	TSWQS (Marine Acute) (c)	EPA WQC (Marine Acute) (d)	NOAA (Marine Acute) (e)	Region 6 (Marine) (f)	
Isophorone	78-59-1	ug/L	1	-	-	12900	1290	8270C, GC-MS SIM Mode
Naphthalene	91-20-3	ug/L	0.8 (g)	-	-	-	250	
Nitrobenzene	98-95-3	ug/L	0.9 (g)	-	-	6680	66.8	
N-Nitrosodimethylamine	62-75-9	ug/L	3.1 (g)	-	-	-	330000	
N-Nitrosodi-n-propylamine	621-64-7	ug/L	0.9 (g)	-	-	-	120	
N-Nitrosodiphenylamine	86-30-6	ug/L	2.1 (g)	-	-	3300000	330000	
Pentachlorophenol	87-86-5	ug/L	50	15.1	13	13	9.6	
Phenanthrene	85-01-8	ug/L	0.5 (g)	7.7	-	7.7	4.6	
Phenol	108-95-2	ug/L	10	-	-	5800	5500	
Pyrene	129-00-0	ug/L	1.5 (g)	-	-	300	0. 24	
PAH (Total)	130498-29-2	ug/L	-	-	-	-	-	
Total Petroleum Hydrocarbons	8012-95-1	ug/L	100	-	-	-	-	8021/TCEQ 1005
PESTICIDES								
4,4'-DDD	72-54-8	ug/L	0.1	-	-	3.6	0. 025	8081A
4,4'-DDE	72-55-9	ug/L	0.1	-	-	14	0. 14	
4,4'-DDT	50-29-3	ug/L	0.1	0.13	0.13 (G, ii)	0.065	0. 001	
Aldrin	309-00-2	ug/L	0.03 (g)	1.3	1.3 (G)	0.65	0. 13	
Alpha-BHC	319-84-6	ug/L	0.03	-	-	-	-	
Beta-BHC	319-85-7	ug/L	0.03	-	-	-	-	
Chlordane and Derivatives	57-74-9	ug/L	0.03 (g)	0.09	0.09 (G)	-	-	
Delta-BHC	319-86-8	ug/L	0.03	-	-	-	-	
Dieldrin	60-57-1	ug/L	0.03	0.71	0.71 (G)	0.355	0. 002	
Endosulfan I	115-29-7	ug/L	0.1	0.034	0.034 (G, Y)	0.017	-	
Endosulfan II	33213-65-9	ug/L	0.1	0.034	0.034 (G, Y)	0.017	-	
Endosulfan Sulfate	1031-07-8	ug/L	0.1	0.034	0.034 (G, Y)	0.017	-	
Endrin	72-20-8	ug/L	0.1	0.037	0.037 (G)	0.0185	0. 002	
Endrin Aldehyde	7421-93-4	ug/L	0.1	-	0.037 (G)	0.0185	0. 002	
Gamma-BHC (lindane)	58-89-9	ug/L	0.1	-	0.16 (G)	0.08	-	
Heptachlor	76-44-8	ug/L	0.1	0.053	0.053 (G)	0.0265	0. 004	
Heptachlor Epoxide	1024-57-3	ug/L	0.1	-	0.053 (G)	0.0265	0. 004	
Toxaphene	8001-35-2	ug/L	0.5	0.21	0.21	0.21	0. 0002	
POLYCHLORINATED BIPHENYLS								
Total PCB (l)	1336-36-3	ug/L	0.01		-	0.033	-	8082
METALS (l)								
Antimony	7440-36-0	ug/L	3 (0.03) (h)	-	-	1500	500	6010 or 6020 (k)
Arsenic	7440-38-2	ug/L	1 (0.011) (h)	149	69 (A, D)	69	78	
Barium	7440-39-3	ug/L	-	-	-	1000	-	
Beryllium	7440-41-7	ug/L	0.2	-	-	1500	-	
Cadmium	7440-43-9	ug/L	1 (0.01) (h)	40	40 (D)	40	-	
Chromium (total)	7440-47-3	ug/L	1	-	-	-	103	
Chromium (3+)	7440-47-3 (III)	ug/L	1	-	-	103000	-	EPA modified 7199
Chromium (6+) (k)	7440-47-3	ug/L	1	1090	1,100 (D)	1100	49.6	
Copper	7440-50-8	ug/L	1 (0.1) (h)	13.5	4.8 (D, cc)	4.8	3.6	6010 or 6020 (k)
Lead	7439-92-1	ug/L	1 (0.03) (h)	133	210 (D)	210	5.3	
Mercury	7439-97-6	ug/L	0.2 (0.0003) (h)	2.1	-	1.8	1.1	
Nickel	7440-02-0	ug/L	1 (0.1) (h)	118	74 (D)	74	13.1	
Selenium	7782-49-2	ug/L	2	564	290 (D, dd)	290	136	
Silver	7440-22-4	ug/L	1 (0.1) (h)	2	1.9 (D)	0.95	-	
Thallium	7440-28-0	ug/L	1 (0.03) (h)	-	-	2130	21.3	
Zinc	7440-66-6	ug/L	1 (0.5) (h)	92.7	90 (D)	90	84.2	

Table 3: Target Detection Levelsa (TDLs), Screening Benchmarks and Analytical Methodology, Marine Water and Elutriate
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Chemical	CAS #	Units	TDLs (b)	Screening Benchmarks				EPA Method
			Marine Water/Elutriate	TSWQS (Marine Acute) (c)	EPA WQC (Marine Acute) (d)	NOAA (Marine Acute) (e)	Region 6 (Marine) (f)	
DIOXINS/FURANS								
Dioxin/Furan Total TEQ	-	ug/L	-	-	-	-	-	8280/8290
MISCELLANEOUS PARAMETERS								
Ammonia	NH3	ug/L	30	-	-	-	-	350
Cyanides	57-12-5	ug/L	100 (i)	-	1 (Q)	1	5.6	9010B/9012A
Dissolved Organic Carbon	Q129	%	0.1	-	-	-	-	415.3
Total Organic Carbon	7440-44-0	%	0.1	-	-	-	-	9060
Total Sulfide	18496-25-8	ug/L	0.1	-	-	-	-	9030
Total Suspended Solids	TSS	mg/L	NA	-	-	-	-	SM 2540D

FOOTNOTES- lowercase footnotes were created by the table generator

a) The primary sources for this table were: TDLs - EPA 823-B-95-001, QA/QC Guidance for Sampling and Analysis of Sediments, Water and Tissues for Dredged Material Evaluations. USEPA/USACE, Regional Implementation Agreement, July 2003; US EPA SW-846 http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm;

b) Consult with your analtyical provider to ensure the laboratory MDL Study can detect VOC constituents to the concentrations noted in the screening

c) TSWQS Rule 307.6- (2014) https://www.tceq.texas.gov/waterquality/standards ; **NOTE**2018 TSWQSs were adopted by the commision on February 7, 2018, these Standards are effective for all state permits; however, until approved by USEPA, the 2014 Standards apply to federal permits.

d) EPA WQC- http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm; see EPA footnote section below for individual EPA

e) NOAA- http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html

f) Region 6 screening benchmarks come from TCEQ's ecological benchmarks for water, http://www.tceq.state.tx.us/assets/public/remediation/eco/0106eragupdate.pdf; these values are equivalent to TSWQS chronic values

g) These values are based on recommendations from the EPA Region 6 laboratory in Houston; these values were based on data or other technical basis;

h) The values in parentheses are based on EPA "clean techniques", (EPA 1600 series methods) which are applicable in instances where other TDLs are inadequate to assess EPA water quality criteria;

i) This value recommended by Houston lab using colorimetric method. This value is based upon FREE cyanide, not complexed as the method is designed to analyze for. If free cyanide is expected, consult the laboratory as to the best method for quantifying free cyanide;

j) Metals shall be expressed as Dissolved values in water samples, except for mercury and selenium, which shall be reported as Total Recoverable

k) 6010/6020 are not suitable Methods for Cr+6. If Cr+6 is suspected from past dredging history or industrial landuse in the vicinity, US EPA SW-846 Method 7199 (modified);

l) Total PCBs for Region 6 from "Update to Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas RG-263 (revised) January 2006; Total PCBs for NOAA from Squirt Table for Organics in Sediment;

EPA WQC footnotes- uppercase and double-lettered footnotes are directly from the NRWQC footnotes; only footnotes for constituents of concern are retained in this table

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

D) Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic life Metals Criteria (PDF)," (49 pp, 3MB) October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available on NSCEP's web site and 40CFR§131.36(b)(1). Conversion Factors applied in the table can be found in Appendix A to the Preamble- Conversion Factors for Dissolved Metals.

G) This Criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (PDF) (153 pp, 7.3MB) (EPA 440/5-80-019), Chlordane (PDF) (68 pp, 3.1MB) (EPA 440/5-80-027), DDT (PDF) (175 pp, 8.3MB) (EPA 440/5-80-038), Endosulfan (PDF) (155 pp, 7.3MB) (EPA 440/5-80-046), Endrin (PDF) (103 pp, 4.6MB) (EPA 440/5-80-047), Heptachlor (PDF) (114 pp, 5.4MB) (EPA 440/5-80-052), Hexachlorocyclohexane (PDF) (109 pp, 4.8MB) (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines (PDF) (104 pp, 3.3MB). If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

Q) This recommended water quality criterion is expressed as ug free cyanide (as CN)/l.

Y) This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

Table 3: Target Detection Levelsa (TDLs), Screening Benchmarks and Analytical Methodology, Marine Water and Elutriate
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Chemical	CAS #	Units	TDLs (b)	Screening Benchmarks				EPA Method
			Marine Water/Elutriate	TSWQS (Marine Acute) (c)	EPA WQC (Marine Acute) (d)	NOAA (Marine Acute) (e)	Region 6 (Marine) (f)	

cc) When the concentration of dissolved organic carbon is elevated, copper is substantially less toxic and use of Water-Effect Ratios might be

dd) Selenium criteria document (EPA 440/5-87-006, September 1987)states that if selenium is as toxic to saltwater fishes in the field as it is to freshwater fishes in the field, the status of the fish community should be monitored whenever the conc.of selenium exceeds 5.0 µg/l in salt water because the saltwater CCC does not take into account uptake via the food chain.

ii)This criterion applies to DDT and its metabolites (i.e., the total conc. DDT plus metabolites should not exceed this value).

Table 4: Target Detection Levelsa (TDLs), Screening Benchmarks and Analytical Methodology, Marine Sediment
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Chemical	CAS #	Units	TDL	Screening Benchmarks			EPA Method
			Marine Sediment (b)	NOAA (Marine-ERL) (d)	NOAA (Marine-ERM) (d)	Region 6 (Marine) (c)	
VOLATILES							
1,1,1-Trichloroethane	71-55-6	mg/kg	-	-	-	2.63	8260B, GC-MS Mode
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	-	-	-	0.61	
1,1,2-Tetrachloro-1,2,2-trifluoroethane	76-13-1	mg/kg	-	-	-	-	
1,1,2-Trichloroethane	79-00-5	mg/kg	-	-	-	0.3	
1,1-Dichloroethane	75-34-3	mg/kg	-	-	-	-	
1,1-Dichloroethene	75-35-4	mg/kg	-	-	-	15.41	
1,2,3-Trichlorobenzene	87-61-6	mg/kg	-	-	-	-	
1,2,4-Trichlorobenzene	120-82-1	mg/kg	0.01	-	-	0.39	
1,2-Dibromo-3-Chloropropane	96-12-8	mg/kg	-	-	-	-	
1,2-Dibromoethane	106-93-4	mg/kg	-	-	-	-	
1,2-Dichlorobenzene	95-50-1	mg/kg	0.02	-	-	0.74	
1,2-Dichloroethane	107-06-2	mg/kg	-	-	-	4.3	
1,2-Dichloropropane	78-87-5	mg/kg	-	-	-	2.82	
1,3-Dichlorobenzene	541-73-1	mg/kg	0.02	-	-	0.32	
1,4-Dichlorobenzene	106-46-7	mg/kg	0.02	-	-	0.7	
1,4-Dioxane	123-91-1	mg/kg	-	-	-	-	
2-Butanone	78-93-3	mg/kg	-	-	-	-	
2-Hexanone	591-78-6	mg/kg	-	-	-	-	
4-Methyl-2-Pentanone	108-10-1	mg/kg	-	-	-	45.34	
Acetone	67-64-1	mg/kg	-	-	-	167.23	
Benzene	71-43-2	mg/kg	0.01	-	-	-	
Bromodichloromethane	75-27-4	mg/kg	-	-	-	-	
Bromoform	75-25-2	mg/kg	-	-	-	1.78	
Bromomethane	74-83-9	mg/kg	-	-	-	-	
Carbon Disulfide	75-15-0	mg/kg	-	-	-	-	
Carbon Tetrachloride	56-23-5	mg/kg	-	-	-	3.67	
Chlorobenzene	108-90-7	mg/kg	-	-	-	-	
Chloroethane	75-00-3	mg/kg	-	-	-	-	
Chloroform	67-66-3	mg/kg	0.01	-	-	4.3	
Chloromethane	74-87-3	mg/kg	-	-	-	8.74	
cis-1,2-Dichloroethene	156-59-2	mg/kg	-	-	-	-	
cis-1,3-Dichloropropene	10061-01-5	mg/kg	-	-	-	-	
Cyclohexane	110-82-7	mg/kg	-	-	-	-	
Dibromochloromethane	124-48-1	mg/kg	-	-	-	-	
Dichlorodifluoromethane	75-71-8	mg/kg	-	-	-	-	
Ethyl benzene	100-41-4	mg/kg	0.01	-	-	0.65	
Isopropylbenzene	98-82-8	mg/kg	-	-	-	-	
Methyl acetate	79-20-9	mg/kg	-	-	-	-	
Methyl tert-butyl ether	1634-04-4	mg/kg	-	-	-	-	
Methylcyclohexane	108-87-2	mg/kg	-	-	-	-	
Methylene chloride	75-09-2	mg/kg	-	-	-	3.82	
m-Xylene	108-38-3	mg/kg	-	-	-	-	
o-Xylene	95-47-6	mg/kg	-	-	-	-	
p-Xylene	106-42-3	mg/kg	-	-	-	-	

Table 4: Target Detection Levelsa (TDLs), Screening Benchmarks and Analytical Methodology, Marine Sediment
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Chemical	CAS #	Units	TDL	Screening Benchmarks			EPA Method
			Marine Sediment (b)	NOAA (Marine-ERL) (d)	NOAA (Marine-ERM) (d)	Region 6 (Marine) (c)	
Styrene	100-42-5	mg/kg	-	-	-	-	8260B, GC-MS Mode
Tetrachloroethene	127-18-4	mg/kg	0.01	-	-	3.1	
Toluene	108-88-3	mg/kg	0.01	-	-	0.94	
trans-1,2-Dichloroethene	156-60-5	mg/kg	-	-	-	-	
trans-1,3-Dichloropropene	10061-02-6	mg/kg	-	-	-	-	
Trichloroethene	79-01-6	mg/kg	-	-	-	1.47	
Trichlorofluoromethane	75-69-4	mg/kg	-	-	-	-	
Vinyl chloride	75-01-4	mg/kg	-	-	-	-	
SEMIVOLATILES							
1,2,4-Trichlorobenzene	120-82-1	ug/kg	10	-	-	-	8270C; GC-MS in SIM mode
1,2-Dichlorobenzene	95-50-1	ug/kg	20	-	-	-	
1,2-Diphenylhydrazine	122-66-7	ug/kg	10	-	-	-	
1,3-Dichlorobenzene	541-73-1	ug/kg	20	-	-	-	
1,4-Dichlorobenzene	541-73-1	ug/kg	20	-	-	-	
2,4,6-Trichlorophenol	95-95-4	ug/kg	140 (e)	-	-	-	
2,4-Dichlorophenol	120-83-2	ug/kg	120 (e)	-	-	-	
2,4-Dimethylphenol	105-67-9	ug/kg	20	-	-	-	
2,4-Dinitrophenol	51-28-5	ug/kg	500 (e)	-	-	-	
2,4-Dinitrotoluene	121-14-2	ug/kg	200 (e)	-	-	-	
2,6-Dinitrotoluene	606-20-2	ug/kg	200 (e)	-	-	-	
2-Chloronapthalene	91-58-7	ug/kg	160 (e)	-	-	-	
2-Chlorophenol	95-57-8	ug/kg	110 (e)	-	-	-	
2-Methylphenol	95-48-7	ug/kg	50	-	-	63	
2-Nitrophenol	88-75-5	ug/kg	200 (e)	-	-	-	
3,3-Dichlorobenzidine	91-4-1	ug/kg	300 (e)	-	-	-	
4,6-Dinitro-o-cresol	534-52-1	ug/kg	600	-	-	-	
4-Bromophenyl phenyl ether	101-55-3	ug/kg	160 (e)	-	-	-	
4-Chloro-3-methylphenol	59-50-7	ug/kg	140 (e)	-	-	-	
4-Chlorophenyl phenyl ether	7005-72-3	ug/kg	170 (e)	-	-	-	
4-Methylphenol	106-44-5	ug/kg	100	-	-	670	
4-Nitrophenol	100-02-7	ug/kg	500 (e)	-	-	-	
Acenaphthene	83-32-9	ug/kg	20	16	500	16	
Acenaphthylene	208-96-8	ug/kg	20	44	640	44	
Anthracene	120-12-7	ug/kg	20	85.3	1100	85.3	
Benzidine	92-87-5	ug/kg	5	-	-	-	
Benzo(a)anthracene	56-55-3	ug/kg	20	261	1600	261	
Benzo(a)pyrene	50-32-8	ug/kg	20	430	1600	430	
Benzo(b&k)fluoranthene		ug/kg	20	-	-	-	
Benzo[g,h,i]perylene	191-24-2	ug/kg	20	-	-	-	
Bis(2-chloroethoxy)methane	111-91-1	ug/kg	170 (e)	-	-	-	
Bis(2-chloroethyl)ether	111-44-4	ug/kg	170 (e)	-	-	-	
Bis(2-chloroisopropyl)ether	108-60-1	ug/kg	140 (e)	-	-	-	
Bis[2-ethylhexyl] Phthalate	117-81-7	ug/kg	50	-	-	182 (i)	
Butyl Benzyl Phthalate	85-68-7	ug/kg	50	-	-	-	

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Chemical	CAS #	Units	TDL	Screening Benchmarks			EPA Method
			Marine Sediment (b)	NOAA (Marine-ERL) (d)	NOAA (Marine-ERM) (d)	Region 6 (Marine) (c)	
Chrysene	218-01-9	ug/kg	20	384	2800	384	8270C; GC-MS in SIM mode
Dibenzo[a,h]anthracene	53-70-3	ug/kg	20	63.4	260	63.4	
Diethyl Phthalate	84-66-2	ug/kg	50	-	-	-	
Dimethyl Phthalate	131-11-3	ug/kg	50	-	-	-	
Di-n-butyl Phthalate	84-74-2	ug/kg	50	-	-	-	
Di-n-octyl Phthalate	117-84-0	ug/kg	50	-	-	-	
Fluoranthene	206-44-0	ug/kg	20	600	5100	600	
Fluorene	86-73-7	ug/kg	20	19	540	19	
Hexachlorobenzene	118-74-1	ug/kg	10	-	-	-	
Hexachlorobutadiene	87-69-3	ug/kg	20	-	-	-	
Hexachlorocyclopentadiene	77-47-4	ug/kg	300 (e)	-	-	-	
Hexachloroethane	67-72-1	ug/kg	100	-	-	-	
Indeno[1,2,3-c,d]pyrene	193-39-5	ug/kg	20	-	-	-	
Isophorone	78-59-1	ug/kg	10	-	-	-	
Naphthalene	91-20-3	ug/kg	20	160	2100	160	
Nitrobenzene	98-95-3	ug/kg	160 (e)	-	-	-	
N-Nitrosodimethylamine	62-75-9	ug/kg	-	-	-	-	
N-Nitrosodi-n-propylamine	621-64-7	ug/kg	150 (e)	-	-	-	
N-Nitrosodiphenylamine	86-30-6	ug/kg	20	-	-	-	
Pentachlorophenol	87-86-5	ug/kg	100	-	-	-	
Phenanthrene	85-01-8	ug/kg	20	240	1500	240	
Phenol	108-95-2	ug/kg	100	-	-	-	
Pyrene	129-00-0	ug/kg	20	665	2600	665	
PAH Total	130498-29-2	ug/kg	20	4022	44792	4022	
Total Petroleum Hydrocarbons	8012-95-1	mg/kg	5	-	-	-	8021/TCEQ 1005
PESTICIDES							
4,4'-DDD	72-54-8	ug/kg	5 (e)	2	20	1.22	8081A
4,4'-DDE	72-55-9	ug/kg	5 (e)	2.2	27	2.07	
4,4'-DDT	50-29-3	ug/kg	5 (e)	1	7	1.19	
Aldrin	309-00-2	ug/kg	3 (e)	-	-	-	
Alpha-BHC	319-84-6	ug/kg	3 (e)	-	-	-	
Beta-BHC	319-85-7	ug/kg	3 (e)	-	-	-	
Chlordane and Derivatives	57-74-9	ug/kg	3 (e)	0.5	6	2.26 (i)	
Delta-BHC	319-86-8	ug/kg	3 (e)	-	-	-	
Dieldrin	60-57-1	ug/kg	5 (e)	0.02	8	0.715 (i)	
Endosulfan I	115-29-7	ug/kg	5 (e)	-	-	-	
Endosulfan II	33213-65-9	ug/kg	5 (e)	-	-	-	
Endosulfan Sulfate	1031-07-8	ug/kg	5 (e)	-	-	-	
Endrin	72-20-8	ug/kg	5 (e)	-	-	-	
Endrin Aldehyde	7421-93-4	ug/kg	5 (e)	-	-	-	
Gamma-BHC (Lindane)	58-89-9	ug/kg	3 (e)	-	-	0.32 (i)	

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Chemical	CAS #	Units	TDL	Screening Benchmarks			EPA Method
			Marine Sediment (b)	NOAA (Marine-ERL) (d)	NOAA (Marine-ERM) (d)	Region 6 (Marine) (c)	
Heptachlor	76-44-8	ug/kg	3 (e)	-	-	-	8081A
Heptachlor Epoxide	1024-57-3	ug/kg	3 (e)	-	-	-	
Toxaphene	8001-35-2	ug/kg	50	-	-	-	
POLYCHLORINATED BIPHENYLS							
Total PCB (f)	1336-36-3	ug/kg	1	22.7	180	22.7	8082
METALS (g)							
Antimony	7440-36-0	mg/kg	2.5	2	-	-	6010/6020 (h)
Arsenic	7440-38-2	mg/kg	0.3 (e)	8.2	70	8.2	
Barium	7440-39-3	mg/kg	-	-	-	-	
Beryllium	7440-41-7	mg/kg	1 (e)	-	-	-	
Cadmium	7440-43-9	mg/kg	0.1	1.2	9.6	1.2	
Chromium (total)	7440-47-3	mg/kg	1 (e)	81	370	81	
Chromium (3+)	7440-47-3 (III)	mg/kg	1	-	-	-	EPA modified 7199
Chromium (6+) (h)	7440-47-3 (Cr6+)	mg/kg	1	-	-	-	
Copper	7440-50-8	mg/kg	1 (e)	34	270	34	6010/6020 (h)
Lead	7439-92-1	mg/kg	0.3 (e)	46.7	218	46.7	
Mercury	7439-97-6	mg/kg	0.2	0.15	0.71	0.15	
Nickel	7440-02-0	mg/kg	0.5 (e)	20.9	51.6	20.9	
Selenium	7782-49-2	mg/kg	0.5 (e)	-	-	-	
Silver	7440-22-4	mg/kg	0.2	1	3.7	1	
Thallium	7440-28-0	mg/kg	0.2	-	-	-	
Zinc	7440-66-6	mg/kg	2 (e)	150	410	150	
DIOXINS/FURANS							
Dioxin/Furan Total TEQ	-	pg/g	-	-	-	-	8280/8290
MISCELLANEOUS PARAMETERS							
Ammonia	NH3	mg/kg	0.1	-	-	-	350
Atterburg Limits	-	-	-	-	-	-	ASTM D4318
Cyanides	57-12-5	mg/kg	2	-	-	-	9010B/9012A
Grain Size (sand, silt, clay)	-	%	1%	-	-	-	Sieve & Hydrometer
Percent Moisture	-	%	-	-	-	-	ASTM D2216
Specific Gravity	-	mg/kg	0.01	-	-	-	ASTM D854-00
Total Organic Carbon	Q129	%	0.10%	-	-	-	9060
Total Solids/Dry Weight	-	%	0.10%	-	-	-	ASTM D2216
Total Sulfide	18496-25-8	mg/kg	0.1	-	-	-	9030
Total Volatile Solids	-	%	10.0%	-	-	-	1684

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Chemical	CAS #	Units	TDL	Screening Benchmarks			EPA Method
			Marine Sediment (b)	NOAA (Marine-ERL) (d)	NOAA (Marine-ERM) (d)	Region 6 (Marine) (c)	

FOOTNOTES:

a) The primary sources for this table were: TDLs - EPA 823-B-95-001, QA/QC Guidance for Sampling and Analysis of Sediments, Water and Tissues for Dredged Material Evaluations. USEPA/USACE, Regional Implementation Agreement, July 2003; US EPA SW-846 http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm;

b) Consult with your analtyical provider to ensure the laboratory MDL Study can detect VOC constituents to the concentrations noted in the screening criteria.

c) Region 6 screening benchmarks come from TCEQ's ecological benchmarks for sediment, http://www.tceq.state.tx.us/assets/public/remediation/eco/0106eragupdate.pdf; unless otherwise noted, benchmarks are Effects Range Low (ERL) from: Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environ. Manage. 19(1):81-97; see footnote (i)

d) NOAA- http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html

e) These values are based on recommendations from the EPA Region 6 Laboratory in Houston; these values were based on data or other technical basis;

f) Total PCBs for Region 6 from "Update to Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas RG-263 (revised) January 2006; Total PCBs for NOAA from Squirt Table for Organics in Sediment

g) Metals shall be expressed as Dissolved values in water samples, except for mercury and selenium, which shall be reported as Total Recoverable Concentrations;

h) 6010/6020 are not suitable Methods for Cr+6. If Cr+6 is suspected from past dredging history or industrial landuse in the vicinity, US EPA SW-846 Method 7199 (modified);

i) Threshold Effects Level (TEL) from: Smith, S.L., D.D. MacDonald, K.A. Keenleyside, and C.L. Gaudet. 1996b. The Development and Implementation of Canadian Sediment Quality Guidelines. In: Development and Progress in Sediment Quality Assessment: Rationale, Challenges, Techniques & Strategies. Ecovision World Monograph Series. Munawar & Dave (Eds.).
Academic Publishing, Amsterdam, The Netherlands.

Attachments

STATEMENT OF WORK AND SAMPLING AND ANALYSIS PLAN

Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Attachment A: Selection of Sampling Locations for North of Morgan's Point

Attachment A: Selection of Sampling Locations for North of Morgan's Point

1.0 Objective

The objective of this memo is to use a technically justifiable, Lines-of-Evidence (LOE) to develop the sampling locations for the HSC New Work Predredging Evaluation study that covers the Bay Reach segment north of Morgan's Point through to the Main Turning Basin (TB) where dredged material is being considered for beneficial use and upland placement.

2.0 Approach

The geotechnical boring logs and locations from the Bay Reach north of Morgan's Point were evaluated in a stepwise manner to determine similarity in stratification for the purposes of grouping the Beaumont Clay formation in the project area into testing "ranges". This approach is project specific and site specific to the portions of the HSC associated with new work (widening and deepening) only.

The following evaluation steps are described in greater detail below:

1) Retain borings located in the ship channel and remove borings outside of the dredge prism footprint from further consideration
2) Isolate the project depth horizon on the boring logs
3) Evaluate the horizons in the dredge prism (from (2)) for the borings retained (from (1)) using laboratory classification designations and estimate percentages of the boring length that can be assigned to each the strata
4) Group borings by similarities and evaluate spatial distribution
5) Select sampling locations to represent major boring compositions

Table 1 presents the stepwise progression of sampling point selection. The rationale for this is presented below.

Sample locations selection for the portion of the HSC where geotechnical boring surveys are not available (Segments 5 and 6) are described in Section 2.4 below.

2.1 Tier 1 - Boring Selection

Supplemental Attachment A-1 shows the channel segments along with the boring locations and logs. Table A-1 summarizes the information from Supplemental Attachment A-1 and summarizes the selection process for the study. The study area has over 50 geotechnical boring locations in the 1963 and 1964 series that were considered in the evaluation where widening and/or deepening are considered for the channel improvements (Figures A-1 and A-2). Figure A-3 is included to show that no channel improvement are planned for the portion of the channel from Morgan's Point through to Station 700+00 in Segment 4. Figure A-3 also shows the approximate boundaries of the Study Area of Concern (AOC) associated with the San Jacinto Waste Pits.

Attachment A: Selection of Sampling Locations for North of Morgan's Point

The first screening step was to remove locations that were not located in the channel and did not have material within the project depth from further evaluation. Each retained boring location is presented in Table A-1. Boring identifiers and their depth can be found in columns 2 and 4. Each boring was analyzed to determine rough percentages of material that each geotechnical boring was comprised of. Columns 5, 6, 7, and 8 describe the texture of the boring.

2.2 Tier 2 - Boring Composition and Grouping

The 9 borings identified in the 1963 and 1964 series were retained for further evaluation and then reviewed for the type of material they were comprised of using the laboratory classifications assigned (Supplemental Attachment A-1). The borings were composed of five categories of material that were classified and defined as follows:

- CH = Clay with High Plasticity
- CL = Clay (inorganic and CL-ML (low plasticity)
- ML = Inorganic Silt and Fine Sand (slight plasticity)
- SM= Silty Sands/Sand Silt Mix
- SC= Clayey Sands, Sand-Clay Mix

Percentages of each type of material were estimated for each core (column 5) and then the borings were grouped into four categories by similarity of composition (column 6). This resulted in the 9 boring locations being grouped into four categories:

Green: 4 - locations comprised of Clay > 90%
Yellow: 2- location comprised of 90% > Clay > 70%
Orange:2 - location comprised of 70% > Clay > 50%
Red: 1 – location comprised of Clay < 50%

2.3 Spatial Evaluation of Borings by Composition Category

Since most of the project area is a clay texture (i.e., clay > 70%), sampling points from the other textural categories (i.e., clay < 70%) were selected as study collection locations and the remaining sampling points for study were picked from geotechnical locations that were distributed over the length of Segments 4/5/6 where they were present. These locations include or are near boring 3ST-37, 3ST-166, 3ST-169, 3St-173, 3ST-187 and 76-3 (Table A-1, Figures A-1 and A-2). No study samples are located in the stretch of the ship channel from Morgan's Point to Station 700+00 in Segment 4 (Figure A-3).

2.4 Sample Location Selection for Remaining Channel

For the portion of the HSC where geotechnical boring surveys were not available, such as the Mooring Basin and portions of Segments 5 and 6, sampling locations were chosen to be spatially distributed locations over the remaining lengths of the project area to ensure representative characterization of the dredging prim.

Attachment A: Selection of Sampling Locations for North of Morgan's Point

3.0 Summary

Based upon location and composition, eleven sample locations, assigned the names HSCNew-NMP-01, -02, -03, -04, -05, -06, -07, -08, -09, -10, and -11 will be collected from the project area north of Morgan's Point and tested (SAP Figure 2).

4.0 References

1963. *Houston-Galveston Navigation Channel, Navigation Channel Borings.*

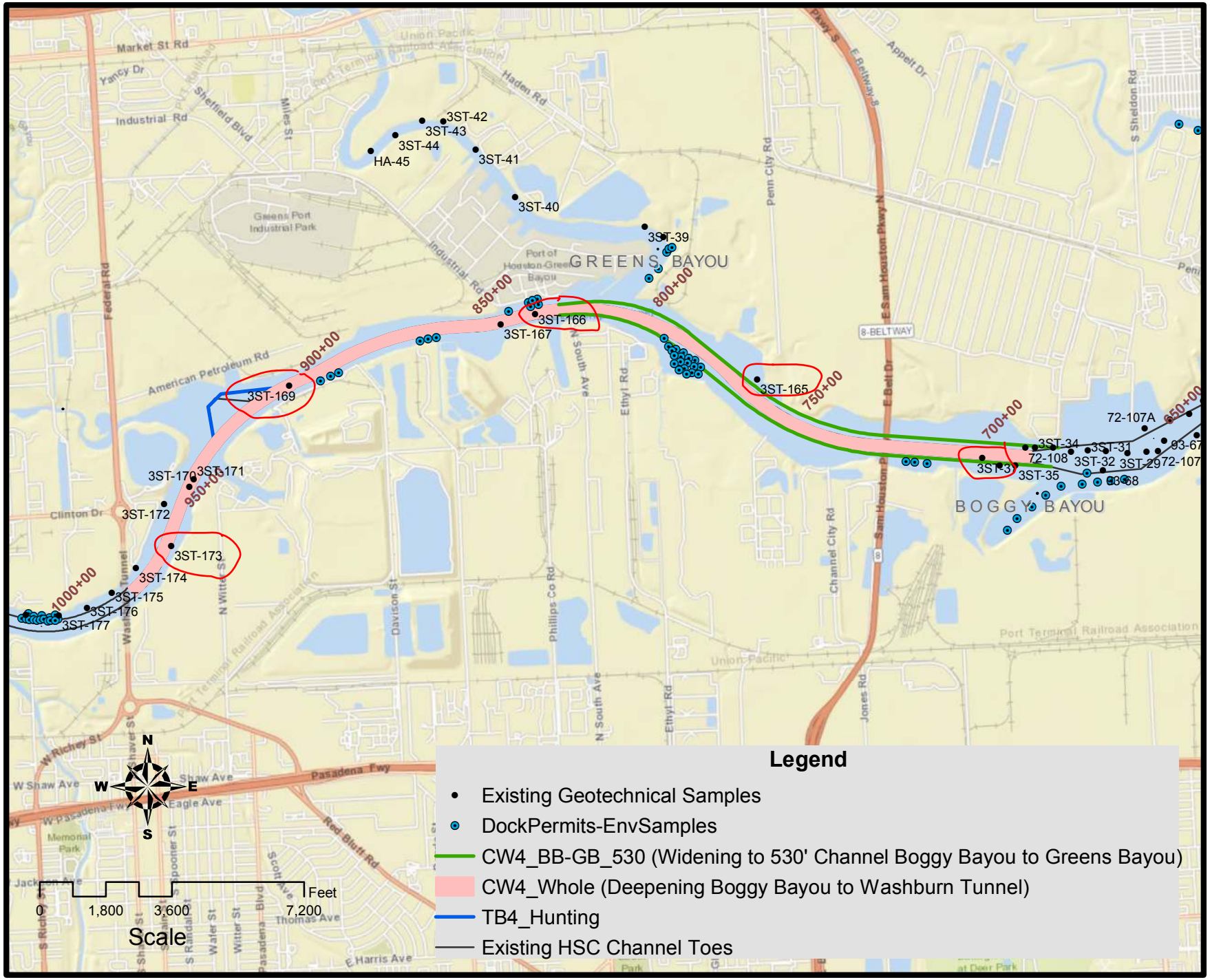
1964. *Houston-Galveston Navigation Channel, Navigation Channel Borings.*

USACE (2017) Houston Ship Channel Extension Channel Improvement Project, Harris, Chambers, and Galveston Counties, Texas. Draft Integrated Feasibility Report – Environmental Impact Statement USACE Galveston District, Southwest Division. August 2017.

Attachment A: Selection of Sampling Locations for North of Morgan's Point

Supplemental Attachment A-1: Geotechnical Boring Surveys (1963 and 1964)

Figure A-1: Segment 4 Geotech Borings and Proposed Dredge Prism
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP), Houston Ship Channel, TX



Imagery: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC,
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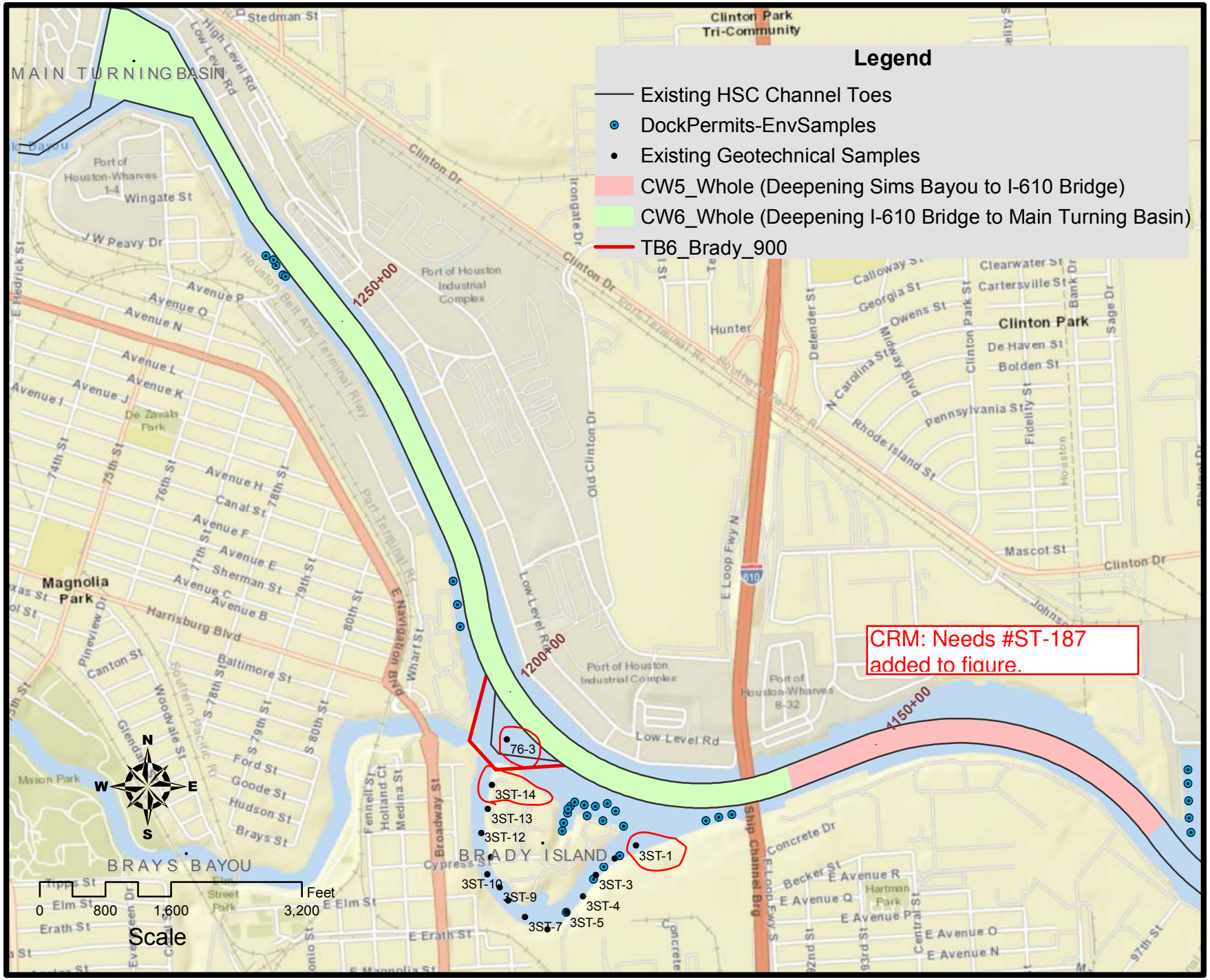
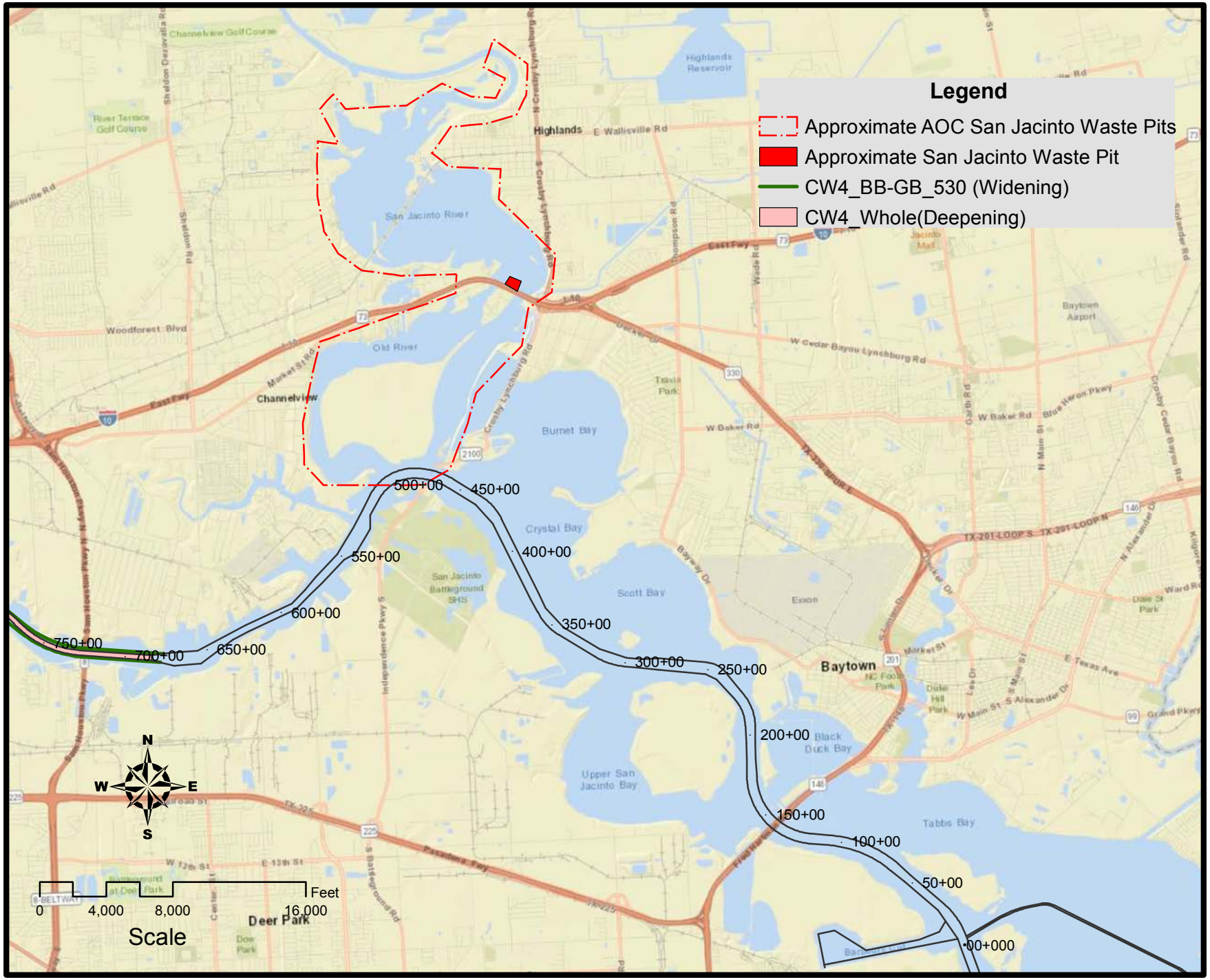
Figure A-2: Segments 5 & 6 Geotech Borings and Proposed Dredge Prism
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP), Houston Ship Channel, TX



Imagery: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

Figure A-3: San Jacinto Waste Pits AOC Boundary
Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP), Houston Ship Channel, TX



Imagery: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC,
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STATEMENT OF WORK AND SAMPLING AND ANALYSIS PLAN

Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Attachment B: Field Sample Collection, Preservation, Chain of Custody and Field Reporting

Attachment B: Field Sample Collection, Preservation, and Chain of Custody

TABLE OF CONTENTS

Attachment B: Field Sample Collection, Preservation, and Chain of Custody

1.0 General Quality Assurance

All physical and chemical tests/analyses will follow protocols described in this attachment, the main body of the SAP, the Inland Testing Manual and appropriate existing Standard Operating Procedures (SOPs) unless otherwise indicated. Any variations from the Inland Testing Manual, USEPA or ASTM methodologies will be approved by the Port of Houston Authority (POHA) and USACE/ERDC Project Managers (PM) prior to conducting the analyses/tests.

2.0 Deviations

All deviations from the procedures outlined in the main body of the SAP, in the following sections of this document and the effect/impact (e.g., change in sampling techniques, lack of preservative, non-representative sample collection, etc.) must be documented both in writing and photographically. This information must be included in the field data sheets and final report. A Project Manager from the FIELD CONTRACTOR and the ERDC PM/Technical POC are expected to be on the boat during sampling. If, at the time of sampling, field conditions require a major deviation from the approach outlined in this SAP, the deviation must be discussed with the ERDC PM/Technical POC who will be in contact with the USACE POC prior to application/implementation. Contact information for these individuals is:

ERDC Project Manager/Project Technical POC:
Dr. Cheryl R. Montgomery (ERDC, Environmental Laboratory, CEERD-EP-R)
W: 978-318-8644 (EST)
M: 781-530-8317 (EST)

ERDC Sample Coordinator POC:
Mr. Daniel Farrar (ERDC, Environmental Laboratory, CEERD-EP-R)
W: 601-634-2118
M: 601-529-8042

ERDC Analytical POC:
Dr. Anthony Bednar (ERDC, Environmental Laboratory, CEERD-EP-R)
W: 601-634-3652
M: 601-618-9164

3.0 Sample Location & Type

The proposed channel improvements for these segments are only to deepen the Mooring Basin in Segment 1, widen part of Segment 4 from 300 ft. to 530 ft., and deepen a portion of Segment 4 from 41.5 ft. to 46.5 ft. All Segments 5 and 6 are proposed to be only deepened from 37.5 ft. to 41.5 ft.

The evaluation of geotechnical borings (SAP, Attachment A) resulted in six (6) sampling locations representative of the dredge material in the new work dredge prism from Segments 4 and 5 being selected within the study area where widening and deepening are to be done. An additional 5 samples were selected over the Mooring Basin and remaining areas of Segments 5 and 6 to ensure characterization of

the Beaumont Clay formation over remaining project area to the Turning Basin (TB), where geotechnical borings were not available (SAP Figure 2 and Table 1).

Recent bathymetry will be used before field sampling to confirm adequate sediment is available for collection within the dredged prism. Exact sample coordinates for each sample location will be determined at the time of sampling in the field, using the coordinates provided in SAP Table 1 as a guide.

Ten channel sampling locations and one Mooring Basin sample location in the study area will be sampled for sediment, surface water, and bulk water. Each sediment sample is a composite of material representative of the proposed dredged area near that station and each water sample is representative of the individual sample location. Water depths are generally expected to be about anywhere <5 to 40+ feet for sample locations in the study area.

3.1 Sample collection

Surface water will be collected from the central location, mid-column within each sampling location.

For sediment collection, dredge material sampling will be collected as transects at any given sample location. In instances where scouring has occurred at the selected sample location, **sampling may shift to be longitudinal** to one side of the channel within the sampling area where new work material within the dredge prism is evident. **If a sample cannot be acquired at a designated location, the location will be moved the least distance possible, while remaining within the dredge prism and within the representative sample area.** At the time of sampling, the FIELD CONTRACTOR's project manager and ERDCs PM/Technical POC will jointly agree how/when to shift a sampling location if a location specified in the SAP cannot be collected because it is already below the new work dredge prism or insufficient material is present for efficient sample volume collection. Due to the minimal sampling plan, samples must be collected from all sample areas, so depth readings will be used to select alternate locations if necessary.

All field conditions and decisions made will be documented in the field notes, the field contractor's report, and the final project report.

The rational for each sampling point is described in Section 3.3 in the SAP. Numbers and types of samples are detailed in SAP Table 1, and summarized as follows:

Sample ID	Segment Identifier	Station	Media	Tests
HSCNew-NMP-01	Segment 1 (Mooring Basin)	500+00	SW, SD	physical, chemical, modified elutriate
HSCNew-NMP-02	Segment 4	720+00	SW, SD	physical, chemical, modified elutriate
HSCNew-NMP-03	Segment 4	800+00	SW, SD	physical, chemical, modified elutriate
HSCNew-NMP-04	Segment 4	912+00	SW, SD	physical, chemical, modified elutriate

HSCNew-NMP-05	Segment 4	970+00	SW, SD	physical, chemical, modified elutriate
HSCNew-NMP-06	Segment 5	1115+00	SW, SD	physical, chemical, modified elutriate
HSCNew-NMP-07	Segment 5	1160+00	SW, SD	physical, chemical, modified elutriate
HSCNew-NMP-08	Segment 6	1200+00	SW, SD	physical, chemical, modified elutriate
HSCNew-NMP-09	Segment 6	1230+00	SW, SD	physical, chemical, modified elutriate
HSCNew-NMP-10	Segment 6	1260+00	SW, SD	physical, chemical, modified elutriate
HSCNew-NMP-11	Segment 6	24+00	SW, SD	physical, chemical, modified elutriate

4.0 Sample Collection

4.1 Overview

The FIELD CONTRACTOR is responsible for collection and transportation of all sediment and water samples specified in this Scope of Work. The FIELD CONTRACTOR will collect sufficient surface water and sediment for all physical and chemical tests, as specified in Tables 2, 3, and 4 of the main body of the SAP. All sediment and water sample collection, handling, preservation, storage and tracking will be conducted in accordance with this SAP. Specific instructions on water (Section 4.2) and sediment (Section 4.3) are provided below.

4.1.1 Station Positioning

Latitude and longitude coordinates (recorded as NAD83) for all proposed sample locations are provided in Table 1 of the SAP. The FIELD CONTRACTOR will proceed to each sampling location; if a location does not indicate any need for sampling (i.e. location is scoured below project depth), the FIELD CONTRACTOR will discuss the condition(s) with the ERDC PM/Technical POC, who will be on-board and an agreed upon alternative location will be selected that remains within the dredge prism and the ample area. The exact coordinates of each sample location shall be determined and recorded by the FIELD CONTRACTOR at the time of sampling using a Differential Global Positioning System (DGPS) with +/- 6 foot accuracy and recorded as NAD83.

4.1.2 Conventional Water Quality Parameters and General Observations

Conventional water quality parameters at mid-water column depth will be measured and recorded from the central location within each sample location, including water temperature, salinity, pH, conductivity, ORP, turbidity and dissolved oxygen. Water depth, adjusted to MLLT, at each station will be noted and general site observations will be recorded (e.g., air temperature, wind speed, sea-state, etc.).

4.1.3 Sample Nomenclature

A sample numbering system that will provide a unique and unambiguous label for each sample will be decided upon and documented prior to going into the field. Labels will be preprinted with as much project information as possible prior to going into the field. Surplus labels should be available should the need arise to utilize them. Sample name convention is demonstrated in Table 1 of the SAP and is explained below.

All sample names will begin with HSCNew-NMP-, representing the Houston Ship Channel New Work North of Morgan's Point. Depending on the sample location and sample media type, additional suffixes will be added to the sample name as listed below:

- -01, -02, -03, -04, -05, -06, -07, -08, -09, -10, -11 represents the sample locations
- -SD, -SW, -EL represents media type; sediment, surface water, elutriate, respectively
- -QA represents quality assurance sample

Examples of full nomenclature demonstrated below:

- Bay Reach sediment quality assurance sample- HSCNew-NMP-04-SD-QA

4.1.4 Sample Preservation and Storage

A suitable method for preservation and shipment of all sediment and water samples will be used, as indicated in Table 2 of the SAP and according the ANALTYICAL PROVIDER/ERDC sample handling instructions. Such instructions must be obtained no later than the week preceding field work. The ANALYTICAL PROVIDER shall furnish clean, appropriately sized glass and/or plastic containers for sediment and water samples, labeled accordingly and containing preservatives, as appropriate. ERDC shall instruct the FIELD CONTRACTOR as to the nature, size, and precleaning of containers for the collection of bulk media.

All samples will be iced or refrigerated immediately after collection, and must be stored at 4 ± 1°C, never frozen, within 24 hours after collection. Samples will be protected from light during storage and transportation and must remain at 4 ± 1°C throughout transport and until received and logged in at ERDC.

4.1.5 Chain of Custody

A dated Chain of Custody document shall be furnished to record all collected samples and must accompany the samples from the field through all shipping to reporting and sample destruction. All Chain of Custody forms must clearly note the sample name, date and time of collection, container type, any special handling (i.e., filtering or acidification), type of analyses required by the laboratories, date relinquished, and signature of all individuals involved in the stages of sample collection, handling, and shipping.

Additional guidance on appropriate Chain of Custody protocols can be found in Section 5.2 below and reference guidance documents (USEPA, 1986; USEPA/USACE, 1995; USEPA/USACE, 1998; Plumb, 1981).

Attachment B: Field Sample Collection, Preservation, and Chain of Custody

THESE PROCEDURES MUST BE AGREED UPON AND DOCUMENTED PRIOR TO FIELD WORK COMMENCING.

Shipping and sample distribution to the testing facilities will be managed by the FIELD CONTRACTOR and overseen by ERDC staff (Section 5.1).

4.2 Water Sampling

Water samples will be collected from the central channel location for each of the 11- sample locations (Table 1 and Figures 2, 3, and 4) at mid-depth in the water column. Conventional water quality parameters will be measured and recorded at mid-depth in the water column at each sample location where the bulk of the sediment is collected (Figure 2, 3, and 4) as listed above in Section 4.1.2.

The depth of the water sample shall be mid-depth in the water column, but under no circumstances will the water intake hose end be any closer than 3 feet from the sediment surface.

Special care should be taken to avoid the introduction of contaminants from the sampling device and the containers. The FIELD CONTRACTOR shall collect water samples with a suitable non-contaminating water-sampling device, such as a metal-free bilge pump using tubing and materials designed to minimize the introduction of phthalates and other plasticizers. Prior to sample collection, an initial volume of water equaling at least 10 times the hose volume will be pumped through the sampling device and discarded. If cubitainers are used, they must be made of non-contaminating material and rinsed 10-times prior to filling.

Table 2 of the SAP summarizes surface water sampling parameters including sample volume, container type, handling, preservation, storage etc.

All water samples that will be submitted for any type of chemical analyses (with the exception of VOCs and Hg and Se) will be field filtered and placed into suitable pre-cleaned laboratory supplied polyethylene bottles or amber glass bottles with appropriate acid or base preservatives (Table 2). Water samples to be analyzed for metals, with the exception of Hg and Se, will be field filtered through a clean 0.45 µm filter prior to dispensing into containers with acid preservatives. All containers are to be filled completely, avoiding the presence of any head space in the sample bottles. The lids will then be tightly secured, and the containers will be placed into an ice chest with sufficient cushioning material to prevent breakage during shipment. Exact sampling position will be recorded for each sample collected. Water volumes collected for non-chemical (e.g., elutriate) testing need not be field filtered.

Water samples from individual locations must not be composited to create a single site sample. Each channel sample location must be sampled, analyzed, and reported as a distinct data point.

4.3 Sediment Sampling

Sediment samples will be collected from each of the 11 sample location (Table 1 and Figure 2, 3, and 4).

Attachment B: Field Sample Collection, Preservation, and Chain of Custody

For the 11 sample locations, sediment samples will be collected to the dredging prism depth. The sampling is expected to require a vibracore sampler with the rigid PVC liner; however, if sampling depths are short, other equipment may be utilized. Justification for the type of equipment used must be written in the field logs and documented in the final report. Regardless of the equipment used, all designated samples MUST BE COLLECTED and the material must be representative of the dredge prism; material collected below depth will be discarded and any debris within the retained sample will be discarded in such a manner as to not destroy the representativeness of the sample.

Prior to collection at each station, the core sampler will be washed with an Alconox solution, flushed with ambient water to remove all remnant sample material and then rinsed with de-ionized water to avoid cross-contamination among sample sites. **If contamination is suspected, a solvent rinse (acetone) will also be done.**

Table 2 in the main body of the SAP summarizes sediment sampling parameters including sample volume, container type, handling, storage etc.

4.3.1 Sampling Depths

Bay Reach north of Morgan's Point to the Main TB (HSCNew-NMP-01-SD through -11-SD): To be representative of new work material to match the dredge prism while accounting for 2 feet of advanced maintenance and 2 feet of allowable over dredge (-46.5 + 2 + 2 ft). The depth within the dredge prism will not exceed -50.5 ft for locations HSCNew-NMP-02, HSCNew-NMP-03, HSCNew-NMP-04, and HSCNew-NMP-05. The depth within the dredge prism will not exceed -45.5 ft for locations HSCNew-NMP-01, HSCNew-NMP-06, HSCNew-NMP-07, HSCNew-NMP-08, HSCNew-NMP-09, HSCNew-NMP-10, and HSCNew-NMP-11. If sample location is already to depth, **the location will be adjusted the least amount possible** to collect sediment representative of new work material while remaining in the dredge prism and the sample area; this can be accomplished through shifting the transect or by shifting to longitudinal sampling if scourging on one side of the sample area is below depth or will yield nominal amounts of dredge material. Exact sampling position will be recorded for each sample collection (See Section 2).

4.3.2 Field data

Field data from all sampling stations shall be described at the time of sampling and will include but not be limited to date, time, water depth adjusted to MLLT, sample appearance, odor, horizons, total length of core and horizons, stratifications, texture, plasticity measurements (hand rolled method), GPS coordinates, and photos. If sampling locations are referenced to a local coordinate grid, the local grid should be tied to the North American Datum (NAD 1983) to allow conversion to latitudes and longitudes.

4.3.3 Sediment Samples Collected for Chemical/Physical Analyses and Bioassays

At each channel sample location, each core collected within the correlated area will, in its entirety, be placed in appropriately labeled pre-cleaned containers, 5-gallon buckets or other suitable containers (SAP Table 2). It is expected that multiple cores will be required to obtain the required volume for both chemical, elutriate and physical analyses. All containers, regardless of size, will be filled completely to

avoid head space. The lids will then be tightly secured, and the containers will be placed into an ice chest or refrigerating unit with sufficient cushioning material to prevent leakage and breakage during shipment.

4.3.4 Bulk Sediment Samples Collected

Bulk samples will be collected in the field in precleaned pails and not homogenized. Bulk samples will be shipped to ERDC where compositing, homogenization, subsampling and other sample processing logistics will occur.

5.0 Sample Preservation, Storage, and Shipment

All sample containers will be supplied in advance by the ANALYICAL PROVIDER. The required chemical preservatives for aqueous samples will be added to the appropriate containers by the ANALYICAL PROVIDER prior to delivery to the field.

A label with a unique sample identifier will be attached to all sample containers at the time of sample collection. This sample coding system will be brought to the field and be available during sampling. The label will be preprinted **at a minimum** with the following information:

- Unique chain-of-custody control number
- Analyses requested
- Preservative used
- Date and time of sample collection
- Sampler's initials

The FIELD CONTRACTOR is responsible for ensuring delivery of all sediment and water samples to the ERDC Environmental Laboratory in the first stage of SAP execution. Shipping containers and packaging must be capable of protecting the sample containers from breakage and holding sample temperatures 4 ± 1°C through the collection, to the delivery of samples at ERDC. Table 2 of the SAP summarizes procedures for sample collection, preservation, and storage. Final study samples will be shipped within 1-day of completion of all sampling activities.

For the second stage of the SAP execution, where elutriate samples for chemical analyses are generated at ERDC, ERDC is responsible for ensuring that analytical holding times for all sample media for the second stage of distribution are not exceeded, and to coordinate a collection and delivery schedule for all samples with the ANALYICAL PROVIDER contact identified below.

Alternatively, shipments may be made by a CONTRACTOR-furnished refrigerator truck capable of maintaining temperatures 4 ± 1°C. The completed Chain of Custody must be included with sample delivery regardless of the selected shipment alternative.

Attachment B: Field Sample Collection, Preservation, and Chain of Custody

5. 1 Sample Distribution and Coordination

5.1.1 Water Samples

Water samples for both chemical/physical analyses (all field filtered) and bulk samples (all unfiltered) will be dispensed into pre-labeled, clean laboratory provided containers with appropriate preservatives. These samples will be shipped by commercial carrier with appropriate Chain-of-Custody documentation, directly to the ANALYTICAL PROVIDER from the field and be addressed to:

Attn: Dan Farrar
USACE ERDC EP-R
Building 6008
3909 Halls Ferry Road
Vicksburg, MS 39180
W: 601-634-2118 (CST)

Upon receipt, ERDC will log in the samples, noting the condition, temperature etc. of the samples upon arrival. While in their custody, sample storage requirements will be met. Samples will be distributed for testing.

5.1.2 Sediment Samples

All sediment will be shipped by commercial carriers with the Chain of Custody form, to the ERDC Environmental Laboratory and be addressed to:

Attn: Dan Farrar
USACE ERDC EP-R
Building 6008
3909 Halls Ferry Road
Vicksburg, MS 39180
W: 601-634-2118 (CST)

Upon receipt, ERDC will log in the samples, noting the condition, temperature etc. of the samples upon arrival. While in their custody, sample storage requirements will be met. Samples will be distributed for testing.

5.1.3 Elutriate Samples

Elutriate samples will be prepared at ERDC from the bulk homogenized sediment samples and site water samples. At the completion of test, the samples destined for chemical/physical analyses will be shipped to the ANALYTICAL PROVIDER. These samples will be shipped by commercial carrier with appropriate Chain-of-Custody documentation, directly to ERDC and be addressed to:

Attachment B: Field Sample Collection, Preservation, and Chain of Custody

Analytical Project POC:
Dr. Anthony Bednar
ERDC, Environmental Laboratory, CEERD-EP-C
W: 601-634-3652
C: 601-618-9164

5.2 Chain of Custody

Strict Chain-of-Custody procedures are required to ensure integrity is maintained from collection to final disposition. Chain-of-custody procedures include tracking and documentation during sample collection, shipment, and laboratory processing. A sample is considered to be in an individual's custody if it is: (1) in the physical possession of the responsible party; (2) in view of the responsible party after being in their possession; (3) secured to prevent tampering; or (4) placed in a designated, secure area that is controlled and restricted by the responsible party.

Custody will be documented throughout all sampling activities on the Chain-of-Custody record for each day of sampling and/or analysis. The record will accompany samples from the time of collection in the field, through arrival at, analyses, issuance of final report and ultimately disposal at the laboratory at the completion of the study.

All personnel with sample custody are required to sign, date, and note on the record the time when receiving and relinquishing samples from their immediate custody. Any discrepancies must be noted at this time. Courier bills of lading (e.g., FedEx Airbills and receipts) will be used as custody documentation during this time and will be retained as part of the permanent sample custody documentation. In some cases, samples may be hand delivered to the laboratory; hand delivery will be noted on the chain of custody form. Any subcontractor laboratory is responsible for sample custody once samples are received.

Chain-of-Custody forms will be used to document the integrity of all samples. To maintain a record of sample collection, transfer of samples between personnel, shipment of samples, and receipt of samples at the laboratory. Chain-of-Custody forms will be filled out for each sample/analysis at each sampling location. Information entered on the chain of custody includes:

- Project name, project number;
- Name and address of laboratory to receive the samples;
- Chain-of-custody control number;
- Sample type, sample method;
- Location ID, sample ID;
- Matrix code;
- Analyses requested;
- Field QC for MS/MSD, if applicable;
- Container type, size and number;
- Preservatives used;
- Turn-around-time for laboratory analysis;

- Comments or notes to Laboratory, if applicable;

Any corrections to the Chain-of-Custody form entries will be made by a single-line strike through the incorrect item, and then entering the correct entry adjacent to the strikeout item. Corrections will be initialed and dated by the person making the change. After the form has been inspected and determined to be satisfactorily complete, the sample collector will sign, date, and note the time of transfer and will reference a tracking number on the form. The Chain-of-Custody form will be placed in a resealable plastic bag and placed inside the cooler after the sample packer has detached or made an appropriate copy of the form.

Further custody transfers of samples will be recorded on the Chain-of-Custody form by signatures of the transferor (relinquisher) and the transferee (receiver). This procedure will be repeated, as necessary, until final delivery is made to the analytical laboratory.

STATEMENT OF WORK AND SAMPLING AND ANALYSIS PLAN

Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP)
Houston Ship Channel, TX

Attachment C: Chemical Laboratory Methods, Analyses and Reporting

Attachment C: Laboratory Methods, Analyses, and Reporting

Table of Contents

ATTACHMENTS

Attachment C: Laboratory Methods, Analyses, and Reporting

1.0 General Quality Assurance

All physical and chemical tests/analyses will follow protocols described in this attachment, the main body of the SAP, the Green Book, the Inland Testing Manual and appropriate existing Standard Operating Procedures (SOPs) or test methods unless otherwise indicated. Any variations from the Green Book, ITM, USEPA or ASTM methodologies will be approved by the PDT and Technical Team PMs prior to conducting the analyses/tests.

2.0 Deviations

All deviations from the procedures outlined in the main body of the SAP and in the following sections of this document and the effect/impact, must be documented in writing in the case files and the case narrative on an SDG specific basis. If, at the time of analyses and reporting, conditions require a major deviation from the approach outlined in the SAP, the deviation must be discussed with the ERDC PM/Technical POC who will be in contact with the USACE SWG POC (or alternate POC) prior to application/implementation. Additionally, anomalous, non-routine or sample specific manipulations and laboratory results (i.e., QC samples out of defined limits, dilutions required, matrix effects etc.) must be discussed with the ERDC Project Manager/Technical POC **AS THE SITUATIONS ARISE** before actions are taken and **NOT AFTER**. This applies to analyses conducted in-house at ERDC or with any of their selected sub-contractors. The ERDC Technical Project Manager will communicate these circumstances to the Project Delivery Team (PDT). Contact for the ERDC POC is:

ERDC Project Manager/Technical POC:
Dr. Cheryl R. Montgomery
ERDC, Environmental Laboratory, CEERD-EP-R
W: 978-318-8644 (EST)
C: 781-530-8317 (EST)

3.0 Sample and Laboratory Coordination, Shipping and Chain-of-Custody

3.1 Sample and Laboratory Coordination

Sample collection only is required in the field by the FIELD CONTRACTOR. Sample composting homogenizing, subsampling, etc., as required, will be conducted at the ERDC facility in Vicksburg. The POCs for these activities are as follows:

Field Contractor/PM POC:
Name XX
Company XX, Title XX
W:
C:

Attachment C: Laboratory Methods, Analyses, and Reporting

Sample Processing POCs at ERDC:
Mr. J. Daniel Farrar
ERDC, Environmental Laboratory, CEERD-EP-R
601-634-2118 (CST)

Mr. A. Kennedy, (Alternate)
ERDC, Environmental Laboratory, CEERD-EP-R
(601) 634-3344

It will be decided prior to collection if surface water samples for chemical/miscellaneous analyses will be field filtered or filtered in the lab. Surface water samples for analyses will be filtered with the exception of samples for TOC, TSS, VOCs, and metals for Hg and Se only. Samples will be collected in clean, laboratory provided bottles/containers. All other water samples (bulk) for modified elutriate testing do not require filtration. All water samples must be shipped directly from the field to the ERDC from the field station so that holding times are adhered to.

No field compositing or homogenizing of sediment will be conducted by the FIELD CONTRACTOR. Sediment samples for chemical/miscellaneous analyses will be placed in clean, laboratory provided bottles/containers that were shipped by ERDC at least one week prior to field sampling commencing. Sediment samples for chemical/physical analyses and sediment samples for preparation of the modified elutriate supernatant will be shipped directly from the field by the FIELD CONTRACTOR to ERDC at the contact names (Farrar/Kennedy) noted above. Upon sample receipt at ERDC, samples will be composited, homogenized, subsampled as appropriate.

A modified elutriate test (MET) will be prepared at ERDC by the analytical team according to guidance (USACE Tech Note EEDP 04-2) by mixing a calculated volume of sediment and dredging site water that should be approximately equal to 150 g/L. The well-mixed slurry will be aerated for 1 hour and allowed to settle for 24 hours (maximum) before extracting the supernatant. The supernatant will be centrifuged or filtered before following the proper preservation techniques required for all analyses. TSS, TOC, and mercury will be excluded from centrifugation or filtration. Chemical analyses will be coordinated by ERDC.

ERDC Analytical POC:
Dr. Anthony Bednar
ERDC, Environmental Laboratory, CEERD-EP-C
W: 601-634-3652
M: 601-618-9164

3.2 Shipping and Chain of Custody

Samples will be shipped from the field to ERDC in Vicksburg, MS on ice or by a truck equipped with refrigeration capable of maintaining 4 ± 1°C. Upon arrival at the laboratory, all samples will be stored unopened in darkened, commercial walk-in coolers at 4 ± 1°C. Appropriate Chain-of-Custody protocols will be followed beginning with collections of samples in the field. Chain-of-Custody will follow guidance

in USEPA, 1986; USEPA/USACE, 1995; USEPA/USACE, 1998; and Plumb, 1981. See Attachment B and Table 2 in the SAP for additional details on Chain-of-Custody requirements.

4.0 Chemical Analyses

All chemical analytical analyses shall be coordinated and/or performed by/through ERDC.

All analyses shall be performed within the holding period described in the referenced guidance documents and summarized in Table 2 of the SAP. Each surface water, modified elutriate, and sediment sample will undergo testing/analyses. The results will be summarized in tabular format and discussed in the final report. Chemical parameters to be analyzed for in each medium are listed in Tables 3 and 4 in the SAP, along with required Target Detection Limits (TDLs) and recommended analytical methods.

Alternate analytical methods are permissible, provided the analytical performance is equivalent to the method listed, all TDLs are met AND the ERDC Project Manager/Technical POC is advised **IN ADVANCE** of analyses proceeding. Sediment sample data will be reported as dry weight. If analytical TDLs cannot be met, the laboratory must inform USACE **PRIOR** to sample collection. If sample specific characteristics result in TDLs/RLs being elevated, or other analytical anomalies occur, the ANALYTICAL PROVIDER will consult with the ERDC POC **AS THEY OCCUR** and **PRIOR** to completing the analyses so that coordination with USACE SWG can be accomplished in a timely manner. The technical project managers' contact information is:

Project Manager/Project Technical POC:
Dr. Cheryl R. Montgomery
ERDC, Environmental Laboratory, CEERD-EP-R
W: 978-318-8644 (EST)
C: 781-530-8317 (EST)

All analyses will be performed on all sample media (i.e., surface water, sediment, and modified elutriate). Detected and non-detected analytes will be reported as numerical values in the laboratory deliverable.

5.0 Miscellaneous Parameter Analyses

Each of the miscellaneous parameters noted in Tables 3 and 4 will be analyzed for and reported as numerical values in the laboratory deliverable in tabular format and discussed in the report.

6.0 Laboratory Quality Control

The following laboratory QC program must include, but not be limited to:

a) Method Blanks: Shall be performed at a frequency of one per batch of samples, per matrix type, per sample extraction or preparation method
b) Laboratory Control Samples: Shall be analyzed at a minimum of 1 per batch of 20 or less samples per matrix type, per sample extraction or preparation method, except for analytes for which spiking solutions are not available

c) Matrix Spikes (MS)/Matrix Spike Duplicates (MSDs): Will be performed ***ON PROJECT MATERIAL AND NOT LABORATORY SAMPLES UNRELATED TO THE SITE*** at a frequency of 1 in 20 samples per matrix type, per sample extraction or preparation method, except for analytes for which spiking solutions are not available. The spike concentration shall be no greater than 25% to 50% of the maximum concentration along the linear segment of the instrument calibration curve for any analyte

d) Surrogates: Surrogate compounds must be added to all samples, standards, and blanks for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available

e) Field Equipment Blanks: Analysis shall be performed at a frequency of one per batch of samples collected

f) Instrument Performance: Calibration of instrumentation and performance of periodic instrument checks according to the manufacturer and USEPA recommendations, and appropriate SOPs

g) Laboratory Performance Evaluation: Participation in performance evaluation and method studies available from USEPA, American Society for Testing and Materials (ASTM), or other agency. Performance evaluation under such a program is to be conducted, at least, on a semiannual basis

h) Laboratory Contamination: Each new shipment or lot of solvent, reagent or adsorbent will be evaluated for purity in accordance with appropriate SOPs;

i) Laboratory Standards: Laboratory standards will be prepared and verified in accordance with appropriate SOPs

j) QC Limits: Calculation of QC limits and preparation of control charts will be performed inaccordance with appropriate SOPs

k) Deviations: Out of control events, or outlier data will be noted and corrective action will be taken in accordance with appropriate SOPs

Documentation of all quality control activities performed specifically in conjunction with this project will be furnished along with sample results. Copies of all raw data, lab notes, chromatograms, standard curves, etc., shall be furnished upon request. The laboratory will provide a case narrative of the analyses and any deviations or out of specification events that took place during the analyses.

7.0 Laboratory Report and Electronic Data Deliverables

Full laboratory deliverables are required for this project. These include:

- PDF files of all laboratory reports for chemical and physical analyses/characterization; these reports will provide a case narrative summarizing the work, including deviations, exceptions and any other noteworthy findings; qualifiers will be defined in the pdf laboratory reports
- Data verification for analytical performance, completeness, etc., will be completed (see Supplemental Attachment 3-1)
- Electronic Data Deliverable (EDD) in an Equis type sortable Excel or Access data deliverable of all study data, including QC samples, shall be provided; the specific fields for this database will, at a minimum include the fields outlined in the Supplemental Attachment 3-2

Attachment C: Laboratory Methods, Analyses, and Reporting

- One PDF hard copy of all reports for POHA and SWG
- Electronic versions on disc for POHA, SWG and USACE ERDC

Attachment C: Laboratory Methods, Analyses, and Reporting

Supplemental Attachment C-1: USEPA Region 6, Data Review and Validation Requirements Dredged Material Disposal Evaluation

EPA Region 6
Data Review and Validation Requirements
Dredged Material Disposal Evaluation

Project: _____

Project Initiation Date: _____

Project Sampling Dates:

Begin: _____

End: _____

Final Report Date: _____

Final Review Date: _____

I certify the review in this document conforms to all applicable regulatory and project-specific requirements.

_____
QA Officer

Project Review

The following sections must be completed prior to field sampling or laboratory analysis:

The SAP/QAPP was prepared and submitted for approval by the Corps of Engineers District Office and EPA Region 6.

Submitted by:
Date submitted:

The SAP/QAPP was approved by the Corps of Engineers District Office and EPA Region 6.

Approved by:

Any deviations from District-approved protocols for sampling or analysis were clearly stated to the District and approved by the District office and EPA Region 6.

Laboratory Information

Use one sheet for each laboratory that will perform analytical work for this project.

Laboratory Name/Identification:

Is lab NELAC certified? Yes/No If Yes, please supply certification number

Can lab meet the QC requirements below as specified in the SAP/QAPP?

Yes/No	
	Analytical requirement
	Instrumentation
	MDL's
	Precision and accuracy
	Required turnaround time

Note below any requirements the laboratory is unable to meet.

Sample Custody

Was all required information on the chain-of-custody form:

(Yes/No)	
	Did chain of custody forms accompany samples to subcontract lab?
	Is the project identification on the chain of custody?
	Are the analyses requested printed on the sample containers?
	Were all samples correctly identified?
	Were the analyses correctly identified on the chain of custody or an attached document listed on the chain of custody?
	Were sample dates and times listed on the chain of custody?
	Were the chains of custody signed by both the relinquisher and receiver of the samples?
	Was the carrier identified on the chain of custody?
	If more than one chain of custody was needed for samples, are the chains of custody clearly numbered?
	Were samples packed on wet ice, with an expected receipt temperature of 4 ± 2°C?
	Were any sample conditions or irregularities (broken bottles, improper temperature) noted on the chain of custody or accompanying paperwork?
	Was the chain of custody submitted as part of the report to the primary contractor?
	Were all requested analyses performed?
	Was adequate sample volume provided to the contractor lab?
	If any anomalous behavior of the samples was found, was it noted in the lab case narrative?

Additional sample custody issues or deficiencies:

Analytical Review Summary

Were all raw data included in the final report?

(Yes/No)

	Prep logs
	Analytical logs
	Data reduction logs
	Calculations
	Data report
	QC Package

Verify that samples were prepared according to the method specified.

	10% check
	100% check

Verify that samples were analyzed according to the method specified.

	10% check
	100% check

Verify that data were properly transferred from run to data report.

	10% check
	100% check

Verify that QC was calculated and within limits and complete the QC forms provided in this package.

	10% check
	100% check

Additional data quality issues:

List of Acronyms

CCV	continuing calibration verification
IC	initial calibration
ICB	initial calibration blank
ICV	initial calibration verification
IS	internal standard
LCS/DLCS	laboratory control sample/duplicate laboratory control sample
LDR	linear dynamic range
LFB	laboratory fortified blank
MB	method blank
MDL	method detection limit
MN	*Macoma nasuta*
MS/MSD	matrix spike/matrix spike duplicate
NV	*Neanthes virens*
RL	reporting limit
SAP/QAPP	Sampling and Analysis Plan/Quality Assurance Project Plan
RIA	EPA Region 6 - Regional Implementation Manual
SRM	standard reference material

Project Identification:

Reviewed by:

Review Date:

Parameter: Metals (e.g. Silver, Arsenic)

List Metals Analyzed:

Matrix: ☑ Sediment ☐ Water/Elutriate ☐ Tissue

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD	1 set per 20 samples or per batch	70 - 130% for spike limits 30% RSD for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by the provider		
LCS/LFB	1 per 20 samples or 1 per batch up to 20 samples	70 - 130% Recovery		
ICV	Immediately following calibration curve	90 - 110% Recovery		

Project Identification:

Reviewed by:

Review Date:

Parameter: Metals (e.g. Silver, Arsenic)

List Metals Analyzed:

Matrix: ☑ Sediment ☐ Water/Elutriate ☐ Tissue

Analytical Method Used:

CCV	Minimum - check calibration at middle and end of each batch or 1 per 10 analyses, whichever is greater	90 - 110% Recovery		
LDR	Verify LDR once per quarter for ICP analyses and one time for mercury analysis			
IC	Verify initial calibration for AA and mercury analysis performed daily	cc > 0.9950 for all calibrations		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Project Identification:

Reviewed by:

Review Date:

Parameter: Metals (e.g. Silver, Arsenic)

List Metals Analyzed:

Matrix: ☐ Sediment ☑ Water/Elutriate ☐ Tissue

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	70 - 130% for spike limits 30% RSD for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by the provider		
LCS/LFB	1 per 20 samples or 1 per batch up to 20 samples	70 - 130% Recovery		
ICV	Immediately following calibration curve	90 - 110% Recovery		

Project Identification:

Reviewed by:

Review Date:

Parameter: Metals (e.g. Silver, Arsenic)

List Metals Analyzed:

Matrix: ☐ Sediment ☑ Water/Elutriate ☐ Tissue

Analytical Method Used:

CCV	Minimum - check calibration at middle and end of each batch or 1 per 10 analyses, whichever is greater	90 - 110% Recovery		
LDR	Verify LDR once per quarter for ICP analyses and one time for mercury analysis			
IC	Verify initial calibration for AA and mercury analysis performed daily	cc > 0.9950 for all calibrations		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Project Identification:

Reviewed by:

Review Date:

Parameter: Metals (e.g. Silver, Arsenic)

List Metals Analyzed:

Matrix: ☐ Sediment ☐ Water/Elutriate ☑ Tissue

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	70 - 130% for spike limits 30% RSD for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by the provider		
LCS/LFB	1 per 20 samples or 1 per batch up to 20 samples	70 - 130% Recovery		

Project Identification:

Reviewed by:

Review Date:

Parameter: Metals (e.g. Silver, Arsenic)

List Metals Analyzed:

Matrix: ☐ Sediment ☐ Water/Elutriate ☑ Tissue

Analytical Method Used:

ICV	Immediately following calibration curve	90 - 110% Recovery		
CCV	Minimum - check calibration at middle and end of each batch or 1 per 10 analyses, whichever is greater	90 - 110% Recovery		
LDR	Verify LDR once per quarter for ICP analyses and one time for mercury analysis			
IC	Verify initial calibration for AA and mercury analysis performed daily	cc > 0.9950 for all calibrations		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☐ PAHs ☑ Pesticides ☐ PCBs
Matrix: ☑ Sediment ☐ Water/Elutriate ☐ Tissue

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	50 - 150% for spike limits 30% for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider		
ICV	Immediately following calibration curve	80 - 120% Recovery		
CCV	At the beginning of every 12 hours of analysis	<15% Difference		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☐ PAHs ☑ Pesticides ☐ PCBs
Matrix: ☑ Sediment ☐ Water/Elutriate ☐ Tissue

Analytical Method Used:

Surrogates	Every sample	30 - 150%		
Internal Standard	Every sample	30 - 150%		
IC	Verify after each initial calibration	<20% RSD for each analyte		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Additional Issues Related to Data Quality	

Project Identification:

Reviewed by:

Review Date:

Parameter: ☐ PAHs ☑ Pesticides/PCP ☐ PCBs
Matrix: ☐ Sediment ☑ Water/Elutriate ☐ Tissue

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	50 - 150% for spike limits 30% for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider		
ICV	Immediately following calibration curve	80 - 120% Recovery		
CCV	At the beginning of every 12 hours of analysis	<15% Difference		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☐ PAHs ☑ Pesticides/PCP ☐ PCBs
Matrix: ☐ Sediment ☑ Water/Elutriate ☐ Tissue

Analytical Method Used:

Surrogates	Every sample	30 - 150%		
Internal Standard	Every sample	30 - 150%		
IC	Verify after each initial calibration	<20% RSD for each analyte		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☐ PAHs ☐ Pesticides ☑ PCBs
Matrix: ☑ Sediment ☐ Water/Elutriate ☐ Tissue

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	50 - 150% for spike limits 30% for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider		
ICV	Immediately following calibration curve	80 - 120% Recovery		
CCV	At the beginning of every 12 hours of analysis	<15% Difference		
Surrogates	Every sample	30 - 150%		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☐ PAHs ☐ Pesticides ☑ PCBs
Matrix: ☑ Sediment ☐ Water/Elutriate ☐ Tissue

Analytical Method Used:

Internal Standard	Every sample	30 - 150%		
IC	Verify after each initial calibration	<20% RSD for each analyte		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☐ PAHs ☐ Pesticides ☑ PCBs
Matrix: ☐ Sediment ☐ Water/Elutriate ☑ Tissue

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	50 - 150% for spike limits 30% for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider		
ICV	Immediately following calibration curve	80 - 120% Recovery		
CCV	At the beginning of every 12 hours of analysis	<15% Difference		
Surrogates	Every sample	30 - 150%		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☐ PAHs ☐ Pesticides ☑ PCBs
Matrix: ☐ Sediment ☐ Water/Elutriate ☑ Tissue

Analytical Method Used:

Internal Standard	Every sample	30 - 150%		
IC	Verify after each initial calibration	<20% RSD for each analyte		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☑ PAHs & PCP ☐ Pesticides ☐ PCBs
Matrix: ☑ Sediment ☐ Water/Elutriate ☐ Tissue

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	50 - 150% for spike limits 30% for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider		
ICV	Immediately following calibration curve	80 - 120% Recovery		
CCV	At the beginning of every 12 hours of analysis	<15% Difference		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☑ PAHs & PCP ☐ Pesticides ☐ PCBs
Matrix: ☑ Sediment ☐ Water/Elutriate ☐ Tissue

Analytical Method Used:

Surrogates	Every sample	30 - 150%		
Internal Standard	Every sample	30 - 150%		
IC	Verify after each initial calibration	<20% RSD for each analyte		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☑ PAHs & PCP ☐ Pesticides ☐ PCBs
Matrix: ☐ Sediment ☑ Water/Elutriate ☐ Tissue

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	50 - 150% for spike limits 30% for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RPD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider		
ICV	Immediately following calibration curve	80 - 120% Recovery		
CCV	At the beginning of every 12 hours of analysis	<15% Difference		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☑ PAHs & PCP ☐ Pesticides ☐ PCBs
Matrix: ☐ Sediment ☑ Water/Elutriate ☐ Tissue

Analytical Method Used:

Surrogates	Every sample	30 - 150%		
Internal Standard	Every sample	30 - 150%		
IC	Verify after each initial calibration	<20% RSD for each analyte		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☑ PAHs ☐ Pesticides ☐ PCBs
Matrix: ☐ Sediment ☐ Water/Elutriate ☑ Tissue

Analytical Method Used: 8151 & 8270D SIM

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	50 - 150% for spike limits 30% for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	30% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider		
ICV	Immediately following calibration curve	80 - 120% Recovery		
CCV	At the beginning of every 12 hours of analysis	<15% Difference		

Project Identification:

Reviewed by:

Review Date:

Parameter: ☑ PAHs ☐ Pesticides ☐ PCBs
Matrix: ☐ Sediment ☐ Water/Elutriate ☑ Tissue

Analytical Method Used: 8151 & 8270D SIM

Surrogates	Every sample	30 - 150%		
Internal Standard	Every sample	30 - 150%		
IC	Verify after each initial calibration	<20% RSD for each analyte		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		
ICB	Immediately after initial calibration	No analyte should be detected > RL		

Project Identification:

Reviewed by:

Review Date:

Parameter: TOC

Matrix: Sediment

Analytical Method Used:

QC Measurement	Frequency	Acceptance Criteria	Criteria Met (Y/N)	Review Comments
MB	1 per 20 samples or 1 per batch up to 20 samples	No analyte should be detected > RL		
MS/MSD/MST	1 set per 20 samples or per batch	75 - 125% for spike limits 20% RSD for precision		
Duplicate	1 per 20 samples or 1 per batch up to 20 samples	20% RSD for precision		
SRM	1 per 20 samples or 1 per batch up to 20 samples	Within limits specified by provider		
ICV	Immediately following calibration curve	80 - 120% Recovery		
CCV	At the beginning of every 12 hours of analysis	90 - 110%		
IC	Verify after each initial calibration	cc > 0.9950 for all calibrations		
MDL	Verify MDL study once per year for each analyte of interest	Updated annually		

Project Identification:

Reviewed by:

Review Date:

Part I	**General Data Reporting Requirements**
SUMMARY TABULAR DATA AND PROJECT NARRATIVE **Each of the following elements should be present as described.**	
	A summary table listing the percent survival in all control, reference, and test samples
	A summary table containing the LC_{50}/EC_{50} values for the suspended particulate phase (SPP) tests and t-tests from the solid phase tests
	A narrative which summarizes all of the deviations from the Green Book and Regional Guidance Manual protocols. Deviations of sample handling, test conditions, ammonia purging procedures, control performance, reference toxicant test performance, organism handling/acclimation, and water quality parameters should be provided in this section.
	A summary table which documents collection dates and holding times for the test, control, and reference sediment samples. Holding times for site water, SPP, and lab saltwater for all tests should be included in this table.
	The data narrative should describe the major biological project activities and results. Computerized tables of results, water quality, and other pertinent information should be placed in this portion of the biological data package.

RAW BIOLOGICAL AND WATER QUALITY DATA FROM TESTS	
	Survival Data
	Water Quality Parameters
	Feeding Schedule and Amount (if applicable)
	Organism Observations
	Summary of Test Conditions

TEST ORGANISM HOLDING, HANDLING AND ACCLIMATION	
	Organism Shipping Data Sheet Provided by Supplier
	Copy of Overnight Shipping Airbill (if applicable)
	Internal Receiving and Distribution Data
	Holding/Acclimation Records (including water quality, renewals, and feeding)
	Mortality During Holding and Acclimation
	Taxonomic Identification for Each Species

REFERENCE TOXICANT DATA	
	Raw Bench Sheets For Reference Toxicant Tests
	Reference Toxicant Stock & Test Solution Preparation Sheet
	LC_{50}/EC_{50} Statistical Calculations
	Updated Reference Toxicant Control Charts with Acceptability Limits

STATISTICAL DATA FROM DREDGE MATERIAL TESTS	
	Provide all computer-generated LC_{50}, EC_{50}, and/or t-test Spreadsheets or graphical interpolations for the SPP and solid phase tests.

INVALID TEST DATA	
	If a test was repeated for any reason, the data from the original test must be included in the final report. If a serious deviation occurs which has the potential to affect test acceptability, USACE and EPA must be contacted immediately to determine if a retest is needed.

Part II	Test-Specific Information (additional to items specified in Part I)
AMPHIPOD SOLID PHASE TEST	
	Pretest Overlying Water Renewal Log and Total Porewater Ammonia Data
	Total/Unionized Porewater Ammonia Measured in Dummy Jars During Testing

POLYCHAETE SOLID PHASE TEST	
	Pretest Overlying Water Renewal Log and Total Porewater Ammonia Data
	Total/Unionized Overlying Unionized Ammonia Measured During Testing

SUSPENDED PARTICULATE PHASE TESTS (SPP)	
	SPP Preparation Log (All volumes, Mixing Times, Centrifuge Information etc.)
	Raw Data for Bivalve Gamete Collection and Preparation

BIOACCUMULATION TESTING	
	Daily Flow Calibration Log – Initial and Final Adjusted Flows
	Pre- and Post-test Depuration Logs – Time Started/Ended and Flow Rates
	Receiving Logs for All Natural Saltwater (If Collected)
	Preparation Logs for All Artificial Saltwater
	If Control Survival <90%, Provide Detailed Narrative for the 5 Factors
	Raw Statistical Data Comparing Test and Reference Tissue Chemistry

SAMPLING / SAMPLE HANDLING	
	Chain of Custody Forms for All Test, Control, and Reference Samples
	Field Data Sheets and/or Sampling Logs (Including Photos If Available)
	Log of Test Sediment Composite Preparation
	Sieving – Size of Mesh Used for Samples Used in Toxicity Tests/Bioaccumulation
	Holding Times for All Samples (Test, Reference, Control, Elutriate, Lab Saltwater) in Summary Chart Format

Project Identification:

Reviewed by:

Review Date:

Laboratory:	**Suspended Particulate Tests**			**Solid Phase Test**		**Bioaccumulation Tests**	
	Minnow	**Mysid**	**Zooplankton**	**Amphipod**	**Crustacean**	**Sand Worm**	**Clam**
Test Species: Identify each species used for toxicology in the cells to the right	***Menidia beryllina* 9-14 days old**	***Americamysis bahia* 1-5 days old**	***Americamysis bahia* ≤ 1 day old**	***Leptocheirus plumulosus***	***Americamysis bahia* 1-5 days old**	***Neanthes virens***	***Macoma nasuta***
Correct species used as stated in the SAP/QAPP? (Y/N)							
Test Condition Within Acceptable Limits? (Y/N)							
Control Survival (Y/N)							
Reference Toxicant Response within 2 standard deviations of long term mean (Y/N)							
Temperature (Y/N)							
Dissolved Oxygen (Y/N)							
pH (Y/N)							
Salinity (Y/N)							
Acclimation Procedures (Y/N)							
Sediment Holding Time <8 wks (Y/N)							
Statistical Analyses Appropriate (Y/N)							
Ammonia Management (Y/N)							

Attachment C: Laboratory Methods, Analyses, and Reporting

Supplemental Attachment C-2: Fields to Include in Laboratory Electronic Data Deliverables (EDDs)

Supplemental Attachment C-2A: Descriptors for Sample Results EDD File Column (Field) Names

Field Name	Field Description	Field Specs
Client	Name of Client	Text
Project	Name of Project	Text
Project_Number	Project number or "none" if one does not exist	Text
Lab_Name	Laboratory Name Code From Code Appendix	Text
Sample_Name	Same as used in SAP	Text
Lab_Sample_ID	Lab assigned sample number	Text
RPT_Matrix	report sediment, water, elutriate, tissue (as appropriate)	Text
Analytical_Matrix	matrix type: solid or liquid	Text
Sample_Date	Date sample collected	Date [MM/DD/YYY]
Sample_Time	Time sample collected	Time [HH24:MM]
Sample_Y	Sample Latitude - Where sample was collected from, reported in NAD83 to at least four decimal places	Number [DDMM.MMMM]
Sample_X	Sample Longitude - Where sample was collected from, reported in NAD83 to at least four decimal places	Number [DDMM.MMMM]
Date_Received	Date sample received by lab	Date [MM/DD/YYY]
Time_Recieved	Time sample received by lab	Time [HH24:MM]
Prep_Date	Date sample prepared for analysis	Date [MM/DD/YYY]
Prep_Time	Time sample prepared for analysis	Time [HH24:MM]
Analysis_Date	Date of analysis	Date [MM/DD/YYY]
Analysis_Time	Time of analysis	Time [HH24:MM]
QC_Batch_Number	QC Batch Number asociated with this analysis	Text
Lab_Method_Code	Laboratory Method Code	Text
Lab_Method_Name	Name of laboratory method ot test	Text
Prep_Name	Enter "NA" if not applicable	Text
Extraction_Date	Date sample was extracted for analysis	Date [MM/DD/YYY]
Extraction_Time	Time sample was extracted for analysis	Time [HH24:MM]
Analyte_Name	Name of parameter being analyzed, i.e., cadmium, grain size, etc.	Text
CAS_Number	CAS number	Number
Surrogate	Surrogate Name - spike of a known amount of a compound similar to the organic chemicals being analyzed. It is added before extraction and because it is normally not found in the environment, it is a valid test of the extraction and preparation of a sample for analysis. Results are reported the same as any other analyte.	Number

Supplemental Attachment C-2A: Descriptors for Sample Results EDD File Column (Field) Names

Field Name	Field Description	Field Specs
Result	Result or RL for non-detects - Non-detects should be reported as the RL and qualified with a U. The Result field shall not be left blank. If a result was not obtained (e.g., if an RPD cannot be calculated due to non-detects), enter "-999" and use the appropriate qualifier.	Number
Method_Detection_Limit	Most recent MDL (from annual MDL study) - 'The Method Detection Limit is required for all chemistry analyses. It is not required for physical analyses. Use same units as on TDL sheet.	Number
Target_Detection_Limit	Target Detection Limit (TDL) in approved SAP	Number
Reporting_Limit	Reporting limit - adjusted for moisture and dilution (lowest standard)	Number
Units	Use units specified inTDL sheet	Text
Result_Qualifier	From Code Appendix sheet or other qualifier defined in Lab Notes Sheet - This field is required if the data need to be qualified. Result qualifiers and descriptions can be taken from the appendix, or labs can enter their own codes and description identified in the Lab Notes sheet.	Text
RPToMDL	Report to MDL: report either True or False. Note: J-flagged data would fall between the RL and MDL.	Text
%_Moisture	percent	Number
Result_Dry_Weight	As corrected for percent moisture or solids	Number
Measurement Basis	report either wet or dry	Text
Dilution_Factor	If sample is not diluted, report a value of 1	Number
Spike_Level	Amount of spike added	Number
Recovery	percent	Number
Upper_CL	Upper Control Limit	Number
Lower_CL	Lower Control Limit	Number
Analyst	Name or initials of analyst	Text
PSOLIDS	Percent Solids	Number

Supplmental Attachment C-2B: Descriptors for QC Results for EDD File Column (Field) Names

Field Name	Field Description	Field Specs
Lab_Name	Laboratory Name Code From Code Appendix	Text
Sample_Name	Same as used in SAP	Text
Lab_Sample_ID	Lab assigned sample number	Text
QC_Type	QC type from Code Appendix	Text
Analytical Matrix	solid or liquid	Text
RPT_Matrix	report sediment, water, elutriate, tissue (as appropriate)	Text
Prep_Date	Date sample prepared for analysis	Date [MM/DD/YYY]
Prep_Time	Time sample prepared for analysis	Time [HH24:MM]
Analysis_Date	Date of analysis	Date [MM/DD/YYY]
Analysis_Time	Time of analysis	Time [HH24:MM]
QC_Batch_Number	QC Batch Number asociated with this analysis	Text
Lab_Method_Code	Laboratory Method Code	Text
Lab_Method_Name	Name of laboratory method or test	Text
Prep_Name	Laboratory method prep code/name	Text
Analyte_Name	Name of parameter being analyzed, i.e., cadmium, grain size, etc.	Text
CAS_Number	CAS number or reference number (from CAS Numbers sheet). Enter as a number without dashes	Number
Surrogate	Surrogate Name - spike of a known amount of a compound similar to the organic chemicals being analyzed. It is added before extraction and because it is normally not found in the environment, it is a valid test of the extraction and preparation of a sample for analysis. Results are reported the same as any other analyte.	Number
Result	Result or RL for non-detects - Non-detects should be reported as the RL and qualified with a U. The Result field shall not be left blank. If a result was not obtained (e.g., if an RPD cannot be calculated due to non-detects), enter "-999" and use the appropriate qualifier.	Number
Method_Detection_Limit	Most recent MDL (from annual MDL study) - 'The Method Detection Limit is required for all chemistry analyses. It is not required for physical analyses. Use same units as on TDL sheet.	
Reporting_Limit	Reporting limit - adjusted for moisture and dilution	Number
Target_Detection_Limit	Target Detection Limit (TDL) in approved SAP	Number
Units	Use units specified in Target Detection Limit sheet.	Text
Result_Qualifier	From Code Appendix sheet or other qualifier defined in Lab Notes Sheet - This field is required if the data need to be qualified. Result qualifiers and descriptions can be taken from the appendix, or labs can enter their own codes and description identified in the Lab Notes sheet.	Text

Supplmental Attachment C-2B: Descriptors for QC Results for EDD File Column (Field) Names

Field Name	Field Description	Field Specs
RPToMDL	From Code Appendix sheet or other qualifier defined in Lab Notes Sheet - This field is required if the data need to be qualified. Result qualifiers and descriptions can be taken from the appendix, or labs can enter their own codes and description identified in the Lab Notes sheet.	Text
%_Moisture	percent	Number
Result_Dry_Weight	Use if result is corrected for Dry Weight	Number
Basis	Dry, Wet, NA	Text
Dilution_Factor	If sample is not diluted, report a value of 1	Number
Source_ID		Number
Source_Res		Number
Spike_Level	Amount of spike added	Number
Recovery	percent	Number
RPD	Relative percent difference	Number
Upper_CL	Upper Control Limit	Number
Lower_CL	Lower Control Limit	Number
RPD_Control_Limit	RPD Control Limit	Number
Analyst	Name or initials of analyst	Text
PSOLIDS	Percent Solids	Number
QC origninal conc	Orignial concentration of QC sample	Number
QC spike measured	Spike concentration result	Number
QC dup original conc	Orignial concentration of duplicate QC sample	Number
QC dup spike added	Amount of spike added to duplicate QC sample	Number
QC dup spike measured	Duplicate spike concentration result	Number
QC dup spike recovered	Duplicate spike percent recovery	Number
QC spike lcl	QC spike lcl	Number
QC spike status	QC spike status	Number
QC dup spike status	QC dup spike status	Number
QC rpd status	QC rpd status	Number