CONCEPTUAL DRAFT SAMPLING PLAN

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT
LAVACA BAY

GALVESTON, TEXAS

SEPTEMBER 2022

Prepared for:

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Conceptual Draft Sampling Plan
Matagorda Ship Channel Improvement Project

I. Project Overview

The Matagorda Ship Channel Improvement Project (MSCIP) consists of two over-arching objectives that are intended to improve transportation safety and improve environmental features of the site and adjacent areas. The two objectives are to deepen and widen the existing ship lane and enlarge the existing turning basin. The existing waterway is currently dredged on a 2 to 3-year cycle and the MSCIP has considered the future dredging needs and future placement areas of dredged sediment. In addition, the MSCIP has developed plans to manage the dredged material resulting from the project into seven new placement areas and create 162 acres of oyster reef to mitigate existing oyster reef acreage that will likely be impacted during the project construction phase. In addition, clean sand will be used to create a sand trap and a sand engine to combat beach erosion near the project. A sand engine is a relatively new, unique approach developed to nourish beaches in a natural, low-carbon way that also reduces disturbances to the seabed. A sand trap collects wind-blown sand along the shoreline.

Lavaca Bay is an estuary of the Matagorda Bay system with a surface area of approximately 60 square miles, approximately 4.5 miles wide by 12 miles long, that is fed by the Lavaca River and several smaller creeks and opens to the Matagorda Bay through a 2.5-mile-wide pass. A part of the MSCIP involves dredging sediment in the Lavaca Bay Closed Area, an area with restricted use due to mercury in sediment. Any dredged material containing mercury above 0.5 parts per million (ppm) will be handled by the Aluminum Company of America (Alcoa) under a Record of Decision and as outlined in the approved approach in the Sediment Management Framework (Figure 2-24, p. 2-109) in the Final Feasibility Study (Alcoa, May 2001). The pre-construction engineering and design (PED) process is currently being executed by the U.S. Army Corps of Engineers (USACE) for the MSCIP portion in the area of Lavaca Bay that includes conducting additional sampling, where warranted, to confirm historical data used during earlier phases of the planning process. This Conceptual Draft Sampling Plan (CDSP) was developed after a USACE-Regional Planning and Environmental Center (RPEC) review of historical data sets from November 2005, April 2007, April 2012, March 2019, July 2021, March 2022, and May 2022. The overall goal of this CDSP plan is to confirm historical data trends for the PED process.

II. Current Data

The Matagorda Ship Channel crosses the Lavaca Bay Superfund Site, where there is potential for encountering mercury-impacted sediments during dredging activities. The Alcoa facility was the source of mercury contamination between 1966 and 1970. Since then, efforts have been made to restore the area and the open water clean-up goals were achieved in 2005. A summary of historic data concerning the presence of mercury in Matagorda Ship Channel sediments as it relates to the MSCIP is as follows:

<u>Matagorda Channel Sediment, Water, and Elutriate Sampling Study February 2007</u>
Source: Appendix E2 Matagorda Ship Channel Construction Material Contaminants Assessment. April 2007

The purpose of this sampling event was to assess the potential environmental impact from the dredging of sediment from the MSC and placing it in the Ocean Dredged Material Disposal Site (ODMDS). Fifteen channel sites and 9 reference sites were sampled (see Figure A-1 in Appendix A) for water and sediment and later composited. This location is in open water and for that reason, the applicable screening criteria for mercury in this sampling were National Oceanic and Atmospheric Administration's (NOAAs) Effects Range Low (ERL) 0.15 mg/kg. All samples were reported as below the detection limit (<0.02 mg/kg) and thus well below the ERL. However, these sample locations are not located within the Lavaca Bay Closed Area and no data from this study was relied upon to develop this CDSP.

MSC Improvement Project 2009 Environmental Impact Statement

Source: *Engineering Appendix Revised July 2014 Matagorda Ship Channel Improvement Project*

Approval of the MSC Expansion project required the submission of an Environmental Impact Statement (EIS) in 2009, where data from a sediment study conducted in November 2005 by Alcoa was referenced. The data is comprised of 38 sediment samples collected from 23 sampling stations (Figure A-2). Discrete sediment samples were collected at depths of approximately 2.0 ft and 4.5 ft below mud line within the proposed turning basin and proposed channel improvement areas in Lavaca Bay (within Closed Area and the wider Lavaca Bay). Approximately 22 data points were utilized to develop expected standard deviation for this CDSP.

Concentrations ranged from 0.0024 mg/kg to a maximum concentration of 0.543 mg/kg, with 0.5 mg/kg being the Environmental Protection Agency's (EPA's) remedial action objective. Two samples exceeded the remediation value of 0.5 mg/kg set for the Alcoa Site: one outside the project area (LNG0018; Hg = 0.543 mg/Kg), and a second (LNG 0016; Hg = 0.502) located at the western edge of the turning basin area. Both sediment samples were obtained at a depth between 0 and 2 ft below mudline.

USACE 2012 Sampling Event

Source: *Matagorda Ship Channel – Entrance Channel Contaminant Assessment. April 2012*

The purpose of this sampling event was to determine the potential environmental impact of Matagorda Ship Channel Entrance Channel (MSC-EC) dredged material during operations/placement. Core samples were taken at nine channel sites and three Placement Area (PA) sites (Figure A-3). Samples for sediment, water and elutriate analyses or bioassessment were taken between 0 and 3 ft below mudline and later composited into three channel samples and one PA sample. Since sampling locations are in open water, it was determined that the screening criteria for this effort would be the Texas Water Quality Standard (TWQS) - Saltwater Acute Criteria (2.1 µg/L). For sediment samples screening criteria was the remediation value of 0.5 mg/kg. All sediment samples present mercury levels below contract required detection limits. Nonetheless, the sample locations from this study are not within the Lavaca Bay Closed Area and were not used to develop this CDSP.

USACE 2018 Sampling Event

Source: *Sampling and Chemical Analysis Matagorda Ship Channel – Matagorda Peninsula to Point Comfort, Calhoun County, Texas. March 2019*

This sampling effort was intended to inform routine maintenance dredging operations within MSC from Matagorda Peninsula to Point Comfort, to comply with requirements of the Clean Water Act. Sediment, water, and elutriate samples were collected from sixty-five locations throughout Matagorda Ship Channel. Sediment was collected at a depth of 0.5 ft to 1.0 ft below mudline to represent the maintenance dredging prism. The sediment samples located within the existing federal channel were composited to create twenty-two samples (Figure A-4) for analysis. All sediment samples present mercury levels below EPA's remedial action objective of 0.5 mg/kg established for the Alcoa Site. Eight data points are within the Lavaca Bay Closed Area and were used to compute an expected standard deviation to develop this CDSP.

Elutriate testing provides information on mercury that may be dissolved into the water column during dredging and open-water placement and/or presents "worst case" in the elutriate discharge from an Upland Confined Placement Area. The screening criteria for this analysis was the Texas Surface Water Quality Standard 2.1 µg/L. Mercury levels in all elutriate samples were below the detection limit of 0.150 µg/L.

Calhoun Port Authority / Alcoa Corporation Liquid Docks Project sampling March-July 2021

Source: *Alcoa correspondence to US EPA and TCEQ dated August 26, 2021 Re: Sediment Sample Results and Dredge Plan in Support of the Calhoun Port Authority (CPA) Liquid Docks Project*

In March of 2021, the CPA initiated pre-dredge sampling in advance of their planned Liquid Docks project along the South Peninsula, east of the proposed expansion of the MSC turning basin area (Figure 5). Seven samples were collected and analysis for mercury of six samples were below the EPA remedial action objective of 0.5 mg/Kg. The mercury measured in the sediment of six samples ranged between 0.030 mg/Kg and 0.161 mg/Kg. The seventh sample showed mercury content of 1.02 mg/Kg and this was communicated to the US EPA, TCEQ and the Alcoa Corporation. This sampling event had a similar DQO as this CDSP and the sample locations, while outside the MSCIP footprint, are within the harbor and in close proximity. For this reason, this data was used to calculate the standard deviation for the area used as an input parameter for the VSP software.

As a result of the pre-dredge sampling, three sampling events were planned in June and July 2021, where Alcoa sampled 54 locations in support of the Calhoun Port Authority Liquid Docks Project, at depths of 0-6 ft below sediment surface. Of these 54 samples, 11 were measured to have concentrations above the remedial action objective of 0.5 mg/kg established for the site. Three discrete areas were delineated and confined with silt curtains, and approximately 31,000 cubic yards (CY) of sediment were mechanically dredged and placed at Dredge Island. Because the DQO for this sampling was focused on delineation for remediation, the statistical parameters could not be used for this CDSP.

Calhoun Port Authority 2022

Source: *Calhoun Port Authority; Section 404 Sampling and Chemical Analysis, Matagorda Ship Channel improvement Project – May 2022*

In January 2022, twenty environmental samples were taken throughout Matagorda Ship Channel for water, sediment and elutriate analyses. Sampling locations for this effort is based on sheet CN 126 of the January 30, 2022, Final Geotechnical Report prepared by Tolunay-Wong Engineers, Inc. All samples were taken inside of the federal channel (existing and proposed). Core samples were drilled from mudline to depths that represents the dredging prism.

All sediment samples present mercury levels below 0.048 mg/Kg, well below EPA's remedial action objective of 0.5 mg/kg set for the Alcoa Site. Elutriate testing was performed to simulate both mixing at the dredge site and decant water from a placement site. Mercury levels in elutriate were below the detection limit of 0.150 µg/L. The screening criteria for this analysis was the Texas Surface Water Quality

Standard 2.1 µg/L. Water, elutriate and sediment analyses show no mercury concerns with sediment dredging/resuspension and placement operations. Three locations of sediment sampling are located within the Lavaca Bay Closed Area and were used to calculate the standard deviation for the area. Two are within the MSCIP footprint and are incorporated in this CDSP.

Source: *Calhoun Port Authority, South Peninsula - Levee and Access Channel Sediment Sampling, March 2022*

In March 2022, seven environmental samples were taken for the Calhoun Port Authority Liquid Docks Project, South Peninsula. Samples were collected from unconsolidated material in the sediment surface down to consolidated clay. An 8-foot polycarbonate core was driven into the sediment with a piston core sampler and once retrieved the entire content was homogenized. The minimum core length below sediment surface ranged from 1.3 feet to 3.5 feet. All sediment samples present mercury levels well below EPAs remedial action objective of 0.5 mg/kg established for the Alcoa Site, ranging from 0.00761 mg/kg to 0.114 mg/kg. These samples are outside the Lavaca Bay Closed Area and were not used to develop this CDSP.

III. Data Quality Objectives

The Data Quality Objectives (DQO) were developed by Dr. Ramon Roman-Sanchez, Dr. Konstantinos Kostarelos, and Section Chief Angela Lane following EPA guidance documents.[1,2] Seven elements were considered and are detailed in Attachment E of the CDSP. A brief summary of the seven elements are shown below:

Problem Statement – to confirm the historic data trends from prior sampling events with regard to the potential presence of mercury-laden sediment.

Decision Identification – establish the true mean of the area to be dredged does not contain mercury in sediment at a level above 0.5 mg/Kg with a high degree of confidence; if any locations with mercury levels above 0.5 mg/Kg are identified, Calhoun Port Authority (CPA) will be informed so removal can take place immediately by a third party. Dredging work will commence after any identified mercury-laden sediment has been removed.

Inputs to the Decision – Visual Sample Plan (VSP) software was used to develop the sampling plan. Historic data were studied for appropriateness and used to establish statistical parameters used in VSP. A total of 39 historic data points were used to establish a mean and standard deviation for sampling events within the harbor area in the vicinity of the MSCIP. Tests indicate that the data are not normally distributed and therefore, statistical analyses must use non-parametric tests.

Study Boundaries – The proposed sampling will be confined to the new turning basin and surrounding footprint in Port Lavaca, with sampling confined to the sediment only and not including underlying clay. This area is 5.7 million square feet and extends from approximately STA 110+000 to 118+324.92.

[1] U. S. Environmental Protection Agency. 1993. "Data Quality Objectives process for Superfund: Interim Final Guidance." EPA/540/G-93/071.

[2] U. S. Environmental Protection Agency. 2006. "Guidance on Systematic Planning Using the Data Quality Objectives Process." EPA/240/B-06/001.

Decision Rule – The CPA and EPA will be informed if any locations where sediment samples are determined to have mercury levels above 0.5 mg/kg to notify a third party, Alcoa, for their action. Alcoa's schedule for removal of any 'hot spots' will be requested and integrated into the PED for the project area.

Limits On Decision Errors – The parameter of interest for this effort is mercury concentration in sediment. The laboratory must provide data that is actionable within a range equal or less than 0.2 mg/Kg (or method LOD) to levels above 0.5 mg/Kg (EPA remedial action objective established for the Lavaca Bay Closed Area). If sample data is questionable, as determined by the project chemist, then samples are to be re-collected and re-analyzed and data validated before decision-making. Field efforts must follow industry standards for sediment sampling; laboratory analysis will be performed with current EPA methods and following EPA guidance.[3]

Acceptable limits for false positive or false negative decision errors will be based on the potential consequences of these decision errors (the environment or unnecessary expenditures for additional sampling) if specific contaminants are detected or are not detected above action levels. This effort presents the potential for two decision errors based on interpreting sampling and analytical data:

1) concluding that the concentration of mercury at the site is below the remedial action objective when its true mean is above, and;

2) concluding that the concentration of mercury at the site is greater than the remedial action objective when its true mean is below.

The consequence of the first error would lead to a decision to dredge material and place in new open water placement areas instead of placing onto Dredge Island. Consequences of the second error would result in unnecessary investigation(s) and expenditures to delineate a location that is below the action levels. Consequences of the first error are considered more serious because of the potential risk.

Optimize the Design for Obtaining Data – We will assume a 95% confidence that we will decide correctly that the true mean is below the regulatory limit of 0.5 mg/Kg with a 1% chance that the true mean is 0.7 mg/Kg (this assumes a clean site, not normally distributed data). Of the 39 historical data points in the project area, 10 are within the footprint of the project, are recently acquired, and thus can be relied upon. Once the number of samples required to satisfy the confidence desired is established, additional sampling points will be added if the number required is above the 10 (historic) data points. All added sample locations will be selected using the random selection function in VSP software and professional judgement in the turning area and in areas to be widened, as opposed to the area of the existing channel, the assumption being that maintenance-dredging of the existing channel will have removed the potential of encountering sediments impacted by mercury contamination. Confirmation samples are also desired in two areas where the historical samples were composited.

IV. Proposed Sampling Collection Technique and Analyses

a. *Sampler* – VibraCore, continuous core samples. This sampling technique is ideally suited for soft sediments found in the marine environment. The technique relies on vibration at the outer walls of the sampler to re-arrange sediment particles, allowing the sampler to advance vertically with minimal

[3] U.S. EPA, 1995. QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations," EPA/823/B-95/001.

force. The resulting core is usually continuous and can be sectioned upon retrieval. Since the sample collection is targeting the upper sediments overlying a layer of stiff clay, the VibraCore sampler will conveniently stop advancing when encountering refusal.

b. *Sample stations* – Coordinates, pre-loaded into a submeter Global Positioning System (GPS) will be used to navigate to each location. Once measured and sectioned, the sediment will be homogenized, and samples collected using clean, stainless-steel equipment. Field records will include location coordinates, water depth, sediment descriptions/depth, and sample date/time. Samples will be placed into clean sample jars provided by the analytical laboratory and the jars will be labeled, sealed in Ziploc-style bags, and placed in an insulated cooler with ice. Completed chain-of-custody forms will accompany the coolers to the lab.

c. *Depths* – from mudline to channel expansion depth or top of stiff clay (refusal); whichever is encountered first

d. *Intervals* – Core will be sectioned into intervals of approximately 3 feet in length and homogenized with respect to the interval. Where the sediment layer being sampled is at least 6 feet in thickness, the core will be sectioned into two 3-foot intervals yielding at least 2 samples for analyses (see Table C-1); where the layers are between 4 and 5 feet in thickness, the core will also be sectioned into 2 intervals ranging between 2 and 3 feet in length. The sectioning of the core will help to better delineate the presence of mercury-laden sediment, if detected, within upper or lower sediment layers.

e. *Analyses* – Sediment analyses will mirror previous mercury studies at the MSC. As such, U.S. EPA Method 200.8 or 245.1, found in the latest version of SW-846 Test Methods for the Evaluation of Solid Waste, must be followed. Both methods are suitable for sediment analysis and are sensitive enough (limit of detection - LOD 0.2 mg/kg) to meet the screening criteria for this effort (0.5 mg/kg). To ensure data is of the highest quality, contracted laboratories must be accredited by both the Texas Commission on Environmental Quality Laboratory Accreditation Program (TCEQ LAP) and the National Environmental Laboratory Accreditation Program (NELAP). Further sampling and analysis information can be found in the Sampling and Analysis Plan (SAP). See Appendix D.

V. Locations

The locations noted in Figure B-1 (see Appendix B) and detailed in Table C-1 (see Appendix C) are proposed after review of historic data. Proposed sampling locations considered the data resulting from prior sampling and analyses of sediment (2018 and 2022) to confirm data trends as a part of planning for the MSCIP. The VSP software selected about half the locations on a random basis and the remainder were selected using professional judgement. Since the area of the existing channel is currently dredged on a cycle of approximately 2-3 years, this sampling plan focused more sample locations in areas of new construction, *i.e.*, the turning area and along the flanks of the existing channel. The existing channel is shown in Figure B-2 along with the footprint of the MSCIP for reference.

VI. Schedule

USACE-RPEC will issue a task order to produce a sampling plan, field execution, and report development of the activities described in this CDSP. USACE-RPEC anticipates awarding a task order in late 2022, with field sampling occurring early 2023 and Final Report (analytical results) available mid-2023. This schedule assumes funding approval for USACE to move forward with investigations.

Appendix A

Historic Sample Locations

Figures A-1 through A-6

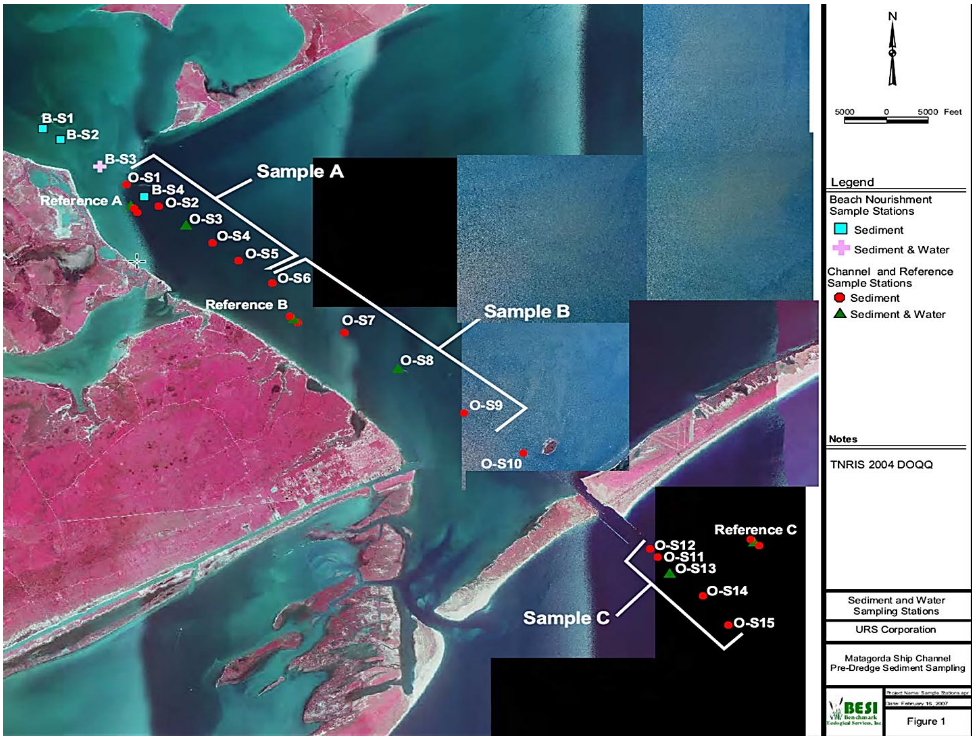


Figure A-1. Sediment and water sampling stations.

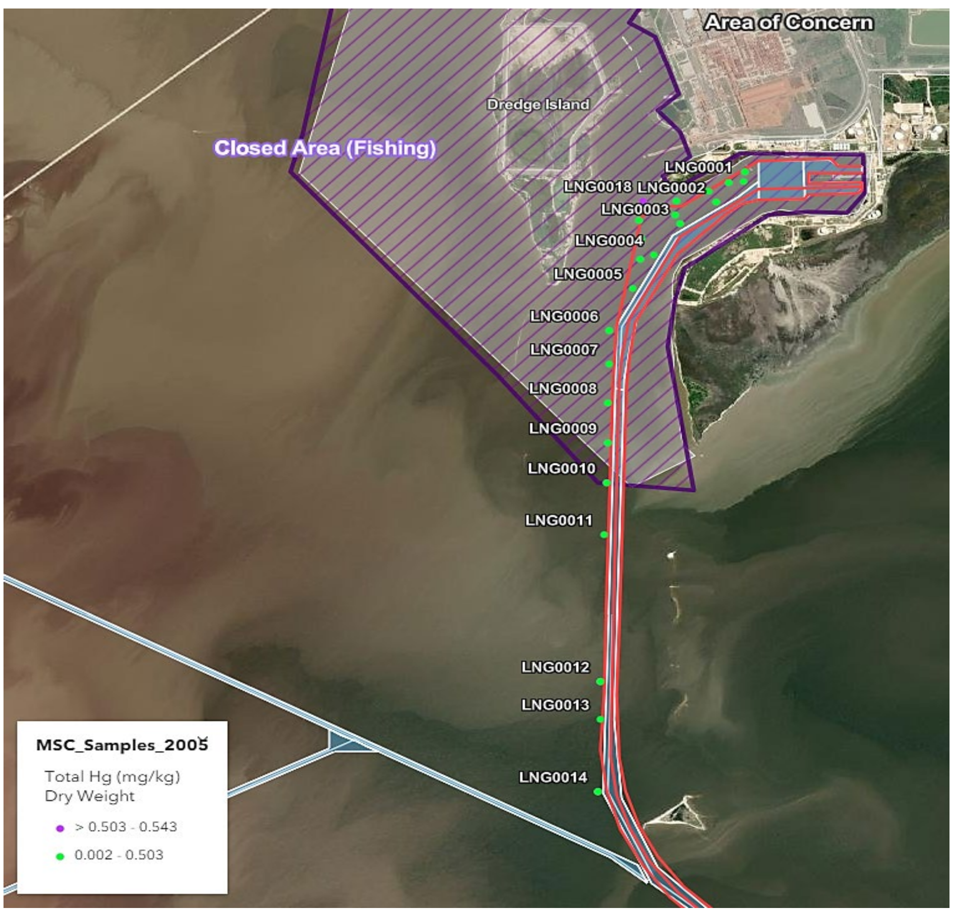


Figure A-2. Locations of the 2005 MSC core samples.

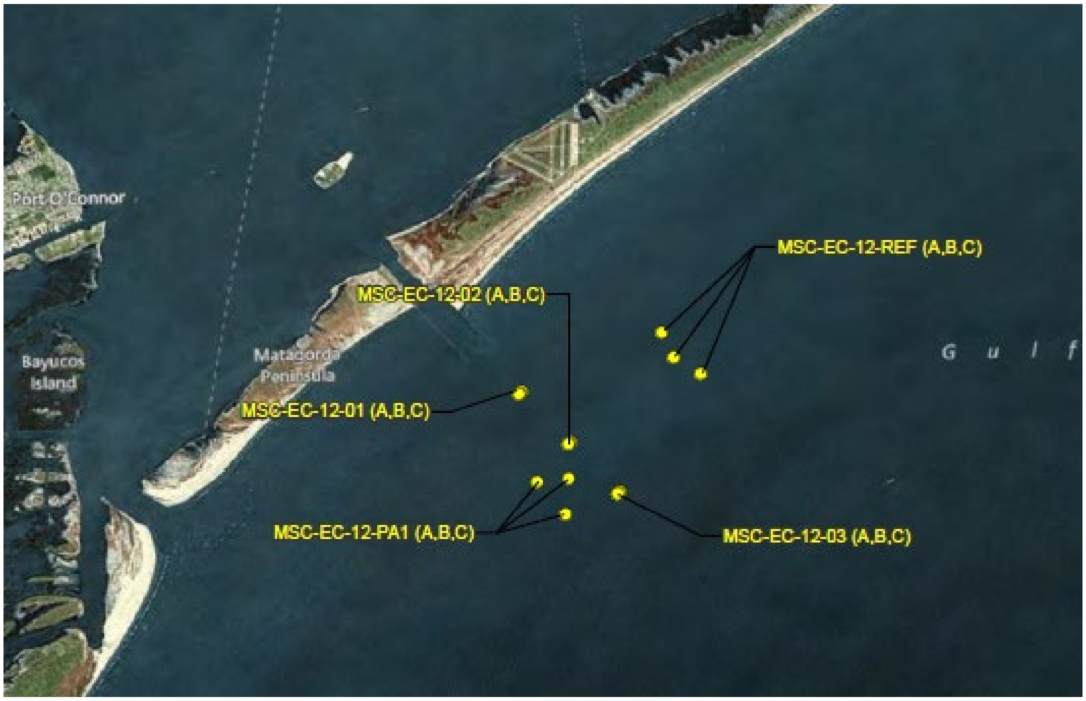


Figure A-3. MSC-EC sampling locations. ABC denotes composited samples.

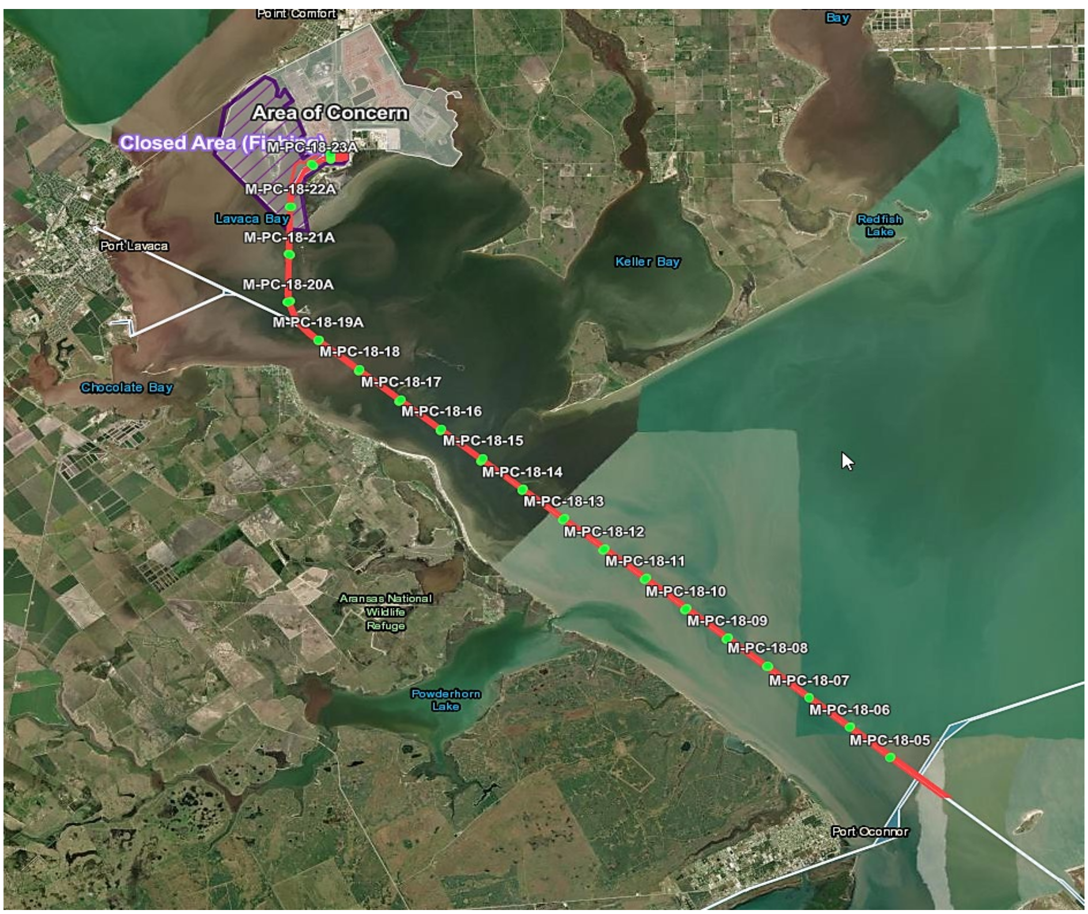


Figure A-4. Sample locations for the 2018 sampling event not including Placement Area or Reference Area samples.

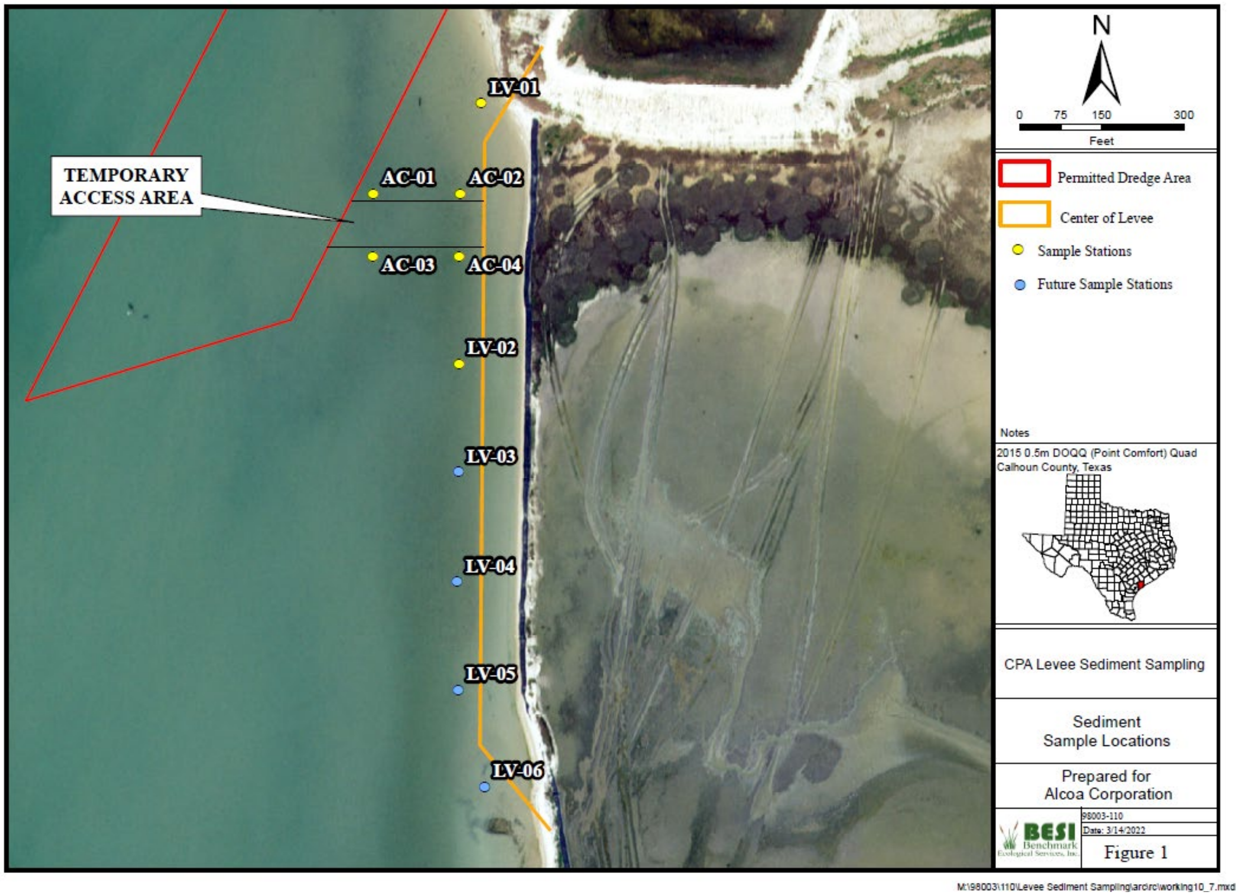


Figure A-5. Benchmark Ecological Services, Inc. sediment sampling event associated with the construction of an access channel and levee by the Calhoun Port Authority in the area shown in Figure 1 and conducted on 17 March 2022. Benchmark was contracted by Alcoa to collect 6 sediment samples from sample stations shown above and included one QA/QC duplicate sample for a total of 7 sediment samples.

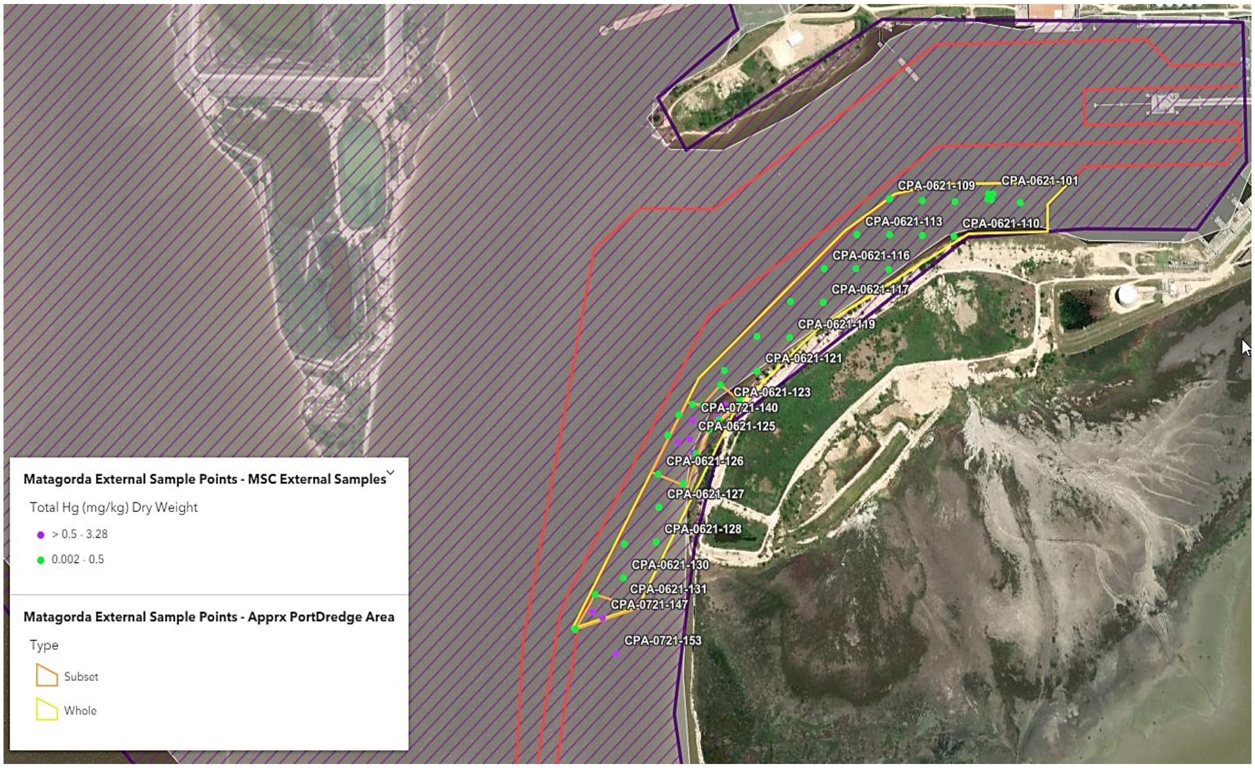


Figure A-6. Sampling locations and areas delineated/defined with silt curtains. Hot spots (purple icons) remediated under federal permit for the Calhoun Port Authority Liquid Docks Project (SWG-2016-01066).

Appendix B

Proposed Sample Locations

Figure B-1

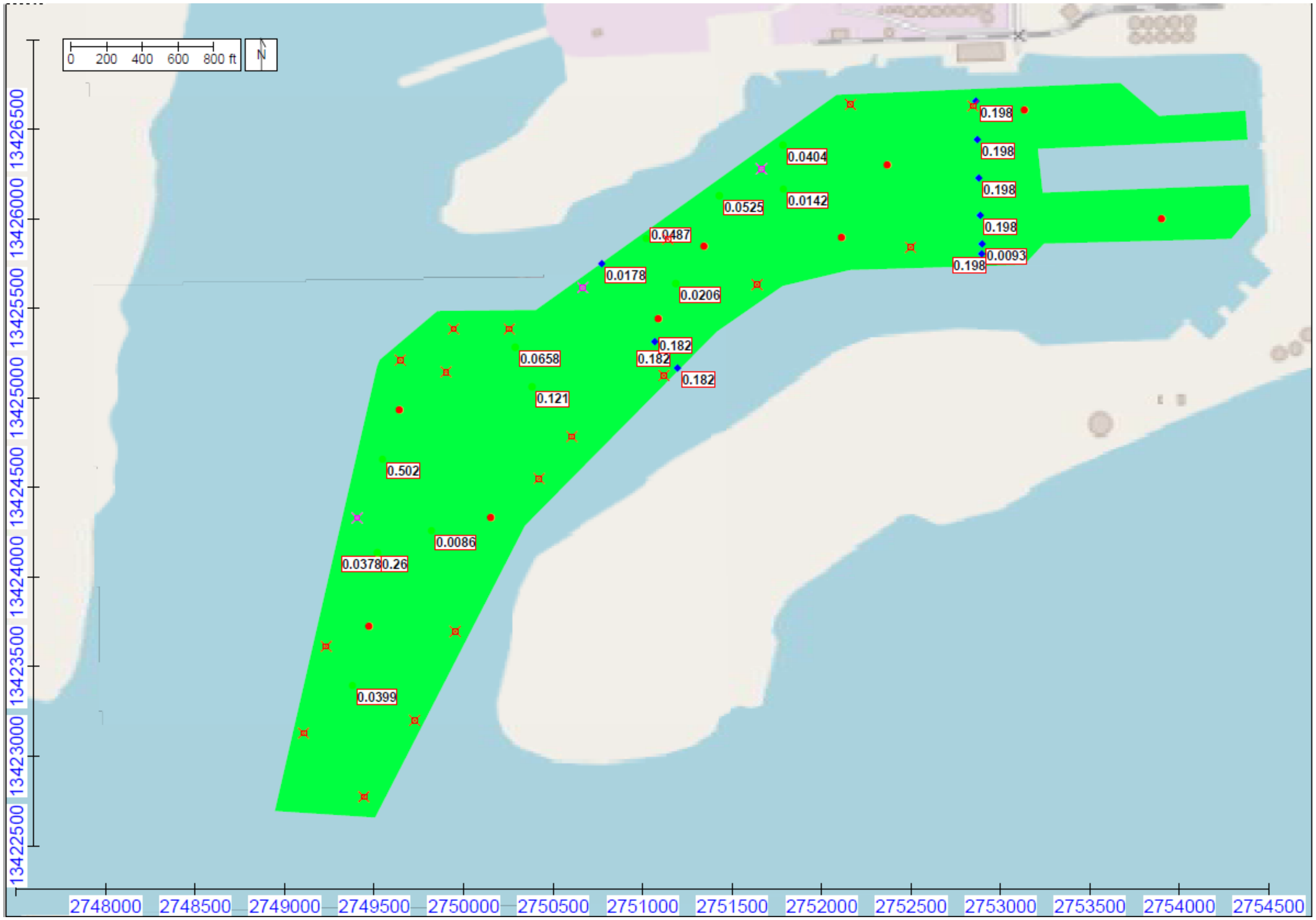


Figure B-1. Proposed Sample Locations. In addition to the 10 historic (blue diamonds labelled with mercury result) from the 2022 and 2018 sampling events, 12 randomly-located samples (circles) were added by VSP, and 17 judgement samples (cross) were added for a total of 39 samples recommended by VSP. Additional historic samples are shown (value only) without marker.

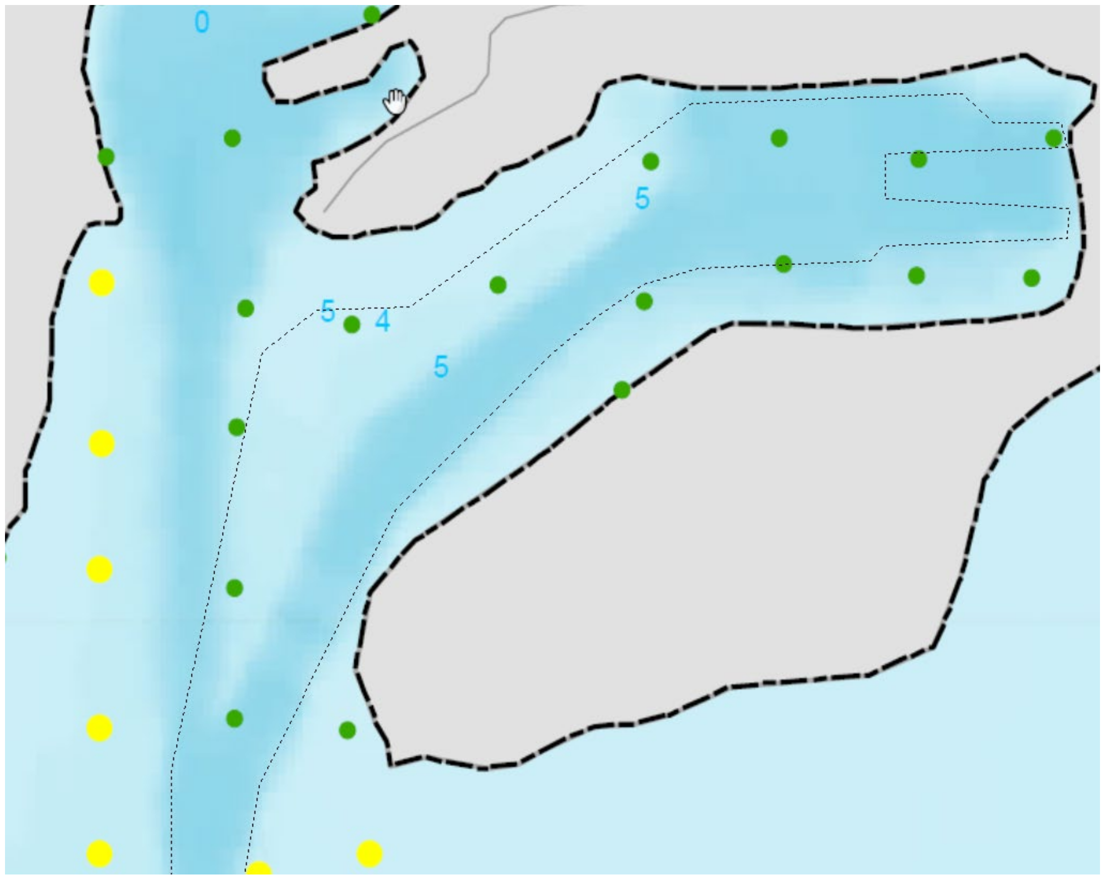


Figure B-2. Existing Matagorda Ship Channel (shaded) and outline of proposed deepened channel with turning area (Note: green and yellow markers are unrelated to the current CDSP.

Appendix C

Proposed Sampling Labels and Location Coordinates

Table C-1

Table C-1: Proposed Sampling Labels and Location Coordinates.

General Location (Station)	Proposed Sample Label[4]	Easting	Northing	Number of Samples[5]
	M-PC-22-01	2749639.7671	13424934.1818	TBD
	M-PC-22-02	2752366.1977	13426300.6625	TBD
	M-PC-22-03	2751343.7862	13425847.6682	TBD
	M-PC-22-04	2751664.8717	13426279.2657	TBD
	M-PC-22-05	2753899.8149	13425999.4994	TBD
	M-PC-22-06	2749469.3652	13423722.0315	TBD
	M-PC-22-07	2750150.9728	13424329.3562	TBD
	M-PC-22-08	2750665.6938	13425615.8770	TBD
	M-PC-22-09	2753133.0063	13426606.8242	TBD
	M-PC-22-10	2751088.1834	13425442.7850	TBD
	M-PC-22-11	2749404.4363	13424330.0496	TBD
	M-PC-22-12	2752110.5948	13425898.2786	TBD
	M-PC-22-13	2749943.9299	13425384.8236	TBD
	M-PC-22-14	2749645.6733	13425210.3333	TBD
	M-PC-22-15	2749901.3218	13425145.4067	TBD

[4] Legend for sample labeling: M=Matagorda; PC=Point Comfort; 22=2022; 01=location numbering; A=first interval regarding depth from mudline. Cores longer than 3 feet were sectioned into upper layer (*i.e.,* A) and lower layer (B).

[5] Locations where the sediment layer permits sectioning, the core will yield more than 1 sample; the estimated number of samples based on preliminary data of the sediment layer thickness may change depending on actual field conditions.

M-PC-22-16	2751640.3018	13425632.2570	TBD
M-PC-22-17	2751119.3103	13425125.3715	TBD
M-PC-22-18	2750604.5219	13424784.1291	TBD
M-PC-22-19	2752845.7882	13426629.1118	TBD
M-PC-22-20	2752497.5200	13425839.7366	TBD
M-PC-22-21	2749105.5514	13423129.2342	TBD
M-PC-22-22	2749443.0143	13422773.0233	TBD
M-PC-22-23	2749952.9583	13423695.4220	TBD
M-PC-22-24	2752162.5853	13426638.2671	TBD
M-PC-22-25	2750255.8223	13425384.8823	TBD
M-PC-22-26	2749725.8932	13423199.8319	TBD
M-PC-22-27	2749232.2605	13423613.6122	TBD
M-PC-22-28	2750422.7863	13424550.0624	TBD
M-PC-22-29	2751141.4573	13425885.7742	TBD
			29 total

Appendix D

Analytical Methods and Target Analytes

Table D-1

Table D-1. Analytical Methods and Target Analytes.

EPA 200.8 - Metals, Total	
Antimony	**Mercury**
Arsenic	Nickel
Beryllium	Selenium
Cadmium	Silver
Chromium	Thallium
Copper	Zinc
Lead	
EPA 350.2 - Total Kjeldahl Nitrogen	
Ammonia as N	
SW846 7196 - Cr(VI)	
Chromium, Hexavalent	
SW846 8081 - Organochlorine Pesticides	
4,4-DDD	Endosulfan II
4,4-DDE	Endosulfan sulfate
4,4-DDT	Endrin
a-BHC	Endrin aldehyde
a-Chlordane	Endrin ketone
Aldrin	g-BHC
b-BHC	Heptachlor
Chlordane	Heptachlor epoxide
d-BHC	Toxaphene
Dieldrin	y-Chlordane
Endosulfan I	
SW846 8082A - PCBs	
Total PCBs	
SW846 8270D - SVOCs	
1,2,4-Trichlorobenzene	Benzo(k)fluoranthene
1,2-Dichlorobenzene	Bis(2-chloroethoxy) methane
1,2-Diphenylhydrazine as Azobenzene	Bis(2-chloroethyl) ether
1,3-Dichlorobenzene	Bis(2-chloroisopropyl) ether
1,4-Dichlorobenzene	Bis(2-ethylhexyl)phthalate
2,4,6-Trichlorophenol	Butyl benzyl phthalate
2,4-Dichlorophenol	Chrysene
2,4-Dimethylphenol	Dibenzo(a,h)anthracene
2,4-Dinitrophenol	Diethyl phthalate
2,4-Dinitrotoluene	Dimethyl phthalate
2,6-Dinitrotoluene	Di-n-butyl phthalate
2-Chloronaphthalene	Di-n-octyl Phthalate
2-Chlorophenol	Fluoranthene
2-Nitrophenol	Fluorene
3,3-Dichlorobenzidine	Hexachlorobenzene
4,6-Dinitro-2-methylphenol	Hexachlorobutadiene
4-Bromophenyl phenyl ether	Hexachlorocyclopentadiene
4-Chloro-3-methylphenol	Hexachloroethane
4-Chlorophenyl phenyl ether	Indeno(1,2,3-cd)pyrene
4-Nitrophenol	Isophorone

Acenaphthene	Naphthalene
Acenaphthylene	Nitrobenzene
Anthracene	n-Nitrosodimethylamine
Benzidine	n-nitroso-di-n-propylamine
Benzo(a)anthracene	n-Nitrosodiphenylamine
Benzo(a)pyrene	Pentachlorophenol
benzo(b&k)fluoranthene	Phenanthrene
Benzo(b)fluoranthene	Phenol
Benzo(g,h,i)perylene	Pyrene
SW846 9014 - Cyanide	
Cyanide, Total	
SW846 9060A - TOC	
Total Organic Carbon	
TCEQ 1005 -Total Petroleum Hydrocarbons	
>C12-C28	C6-C12
>C12-C35	TPH, C6-C35
>C28-C35	
Miscellaneous Parameters	
Total Volatile Solids	Grain Size (clay)
Grain Size (sand)	Total Solids/ Dry Weight
Grain Size (silt)	Percent (%) Moisture

Appendix E

Data Quality Objectives

Data Quality Objectives for the MSCIP Conceptual Draft Sampling Plan

I. Problem Statement

The Matagorda Ship Channel (MSC) is a long deep-draft navigation channel, extending from the Gulf of Mexico, through a jettied inlet, across Matagorda Bay, to a turning basin at Port Lavaca. The Matagorda Ship Channel Improvement Project (MSCIP) will deepen and widen the existing channel and create a larger turning basin by removing over 4 million cubic yards of sediment and some of the underlying clay from within Lavaca Bay. Sediment within the project area may contain mercury from historic releases in Lavaca Bay, which is considered an enclosed area. Dredged material from Lavaca Bay will then be placed in two designated placement areas (PAs) in close proximity. The dredging process homogenizes the sediment prior to placement, so our objective is to confirm that mercury levels in sediment to be placed will be below the established level of 0.5 mg/Kg. Historic data used during the feasibility phase of this project indicate that the sediment in the area to be dredged are below this level. Thus, data obtained from this sampling event aims to validate historic data trends with regard to the potential presence of mercury-laden sediment.

The pre-construction engineering and design (PED) phase is underway for several segments of the channel, with design documents for some of the work nearly complete. Initial contracting efforts will target the offshore areas and work their way towards Lavaca Bay. The PED for the Lavaca Bay segment of the project is on-going. The Conceptual Draft Sampling Plan is being drafted to provide additional actionable, high-quality data in support of the MSCIP, specifically within the channel's turning basin and surrounding footprint in Port Lavaca.

II. Decision Identification

Where any sampled location presents elevated levels of mercury (>0.5 mg/kg) in sediment, Calhoun Port Authority (CPA) will be informed so removal can take place immediately. Dredging work will progress after any newly identified mercury-laden sediment has been removed.

III. Inputs to the Decision

Historical data from sediment samples collected in the project area indicate that low levels of mercury contamination remain. One sample that could be considered elevated (Sample ID: LNG 0016 from November 2005 ALCOA sediment study) was analyzed to have 0.502 mg/kg of mercury; new sampling and analysis of sediment is proposed to address the possibility that sediment containing elevated levels of mercury remains at this location for the CPA to address. In addition, some historical data show low levels of mercury in samples that were composited using sediment from 4-5 locations. In order to confirm that none of those locations contained elevated mercury levels, new sampling near these locations is also proposed.

An ideal sampling method for the proposed sediment sampling effort is VibraCoring. Sediment analyses will mirror previous mercury studies at the MSC. As such, U.S. EPA Method 200.8 or 245.1, found in the latest version of SW-846 Test Methods for the Evaluation of Solid Waste, must be followed. Both methods are suitable for sediment analysis and are sensitive enough (limit of detection - LOD 0.2 mg/kg) to meet the screening criteria for this effort (0.5 mg/kg). To ensure data is of the highest quality, contracted laboratories must be accredited by both the Texas Commission on Environmental Quality (TCEQ LAP) and the National Environmental Laboratory Accreditation Program (NELAP). Further sampling and analysis information can be found in the Sampling and Analysis Plan (SAP). See Appendix D of the CDSP for more detail.

IV. Study Boundaries

The proposed sampling will be confined to the channel's turning basin and surrounding footprint in Port Lavaca, with sampling confined to the sediment only and not including underlying clay. The sampling should ideally be scheduled as soon as possible so that any data obtained can be used by the PED team prior to completing the design documents for construction.

V. Decision Rule

The CPA will be informed of any locations where sediment samples present mercury levels above 0.5 mg/kg so that removal actions are initiated. The CPA schedule for any removal action will be requested and integrated into the PED for the project area.

VI. Limits on Decision Errors

The parameter of interest for this effort is mercury concentration in sediment. The laboratory must provide data that is actionable within a range equal or less than 0.2 mg/Kg (or method LOD) to levels above 0.5 mg/Kg (EPA remedial action objective established for the Lavaca Bay Closed Area). If the laboratory is unable to achieve this, then a new laboratory must handle analyses. If sample data is questionable, as determined by the project chemist, then samples are to be re-collected and re-analyzed and data validated before decision-making. Analytical data must be sufficient in terms of quality checks (standards, blanks, etc.) to confirm the dredged sediment will meets EPA remedial action objective when placed in NP-6 and NP-7. As such, field efforts must follow industry standards for sediment sampling. Laboratory analytical data should be definitive in nature and sufficient to screen against the remedial action objective. Therefore, laboratory analysis will be performed with current EPA methods and following EPA guidance.[6]

Acceptable limits for false positive or false negative decision errors will be based on the potential consequences of these decision errors (the environment or unnecessary expenditures for additional sampling) if specific contaminants are detected or are not detected above action levels. This effort presents the potential for two decision errors based on interpreting sampling and analytical data:

1) concluding that the concentration of mercury at the site is below the remedial action objective when its true mean is above, and;

2) concluding that the concentration of mercury at the site is greater than the remedial action objective when its true mean is below.

The consequence of the first error would lead to a decision to dredge material and place in new open water placement areas instead of placing onto Dredge Island. Consequences of the second error would result in unnecessary investigation(s) and expenditures to delineate a location that is below the action levels. Consequences of the first error are considered more serious because of the potential risk.

VII. Optimize the Design for Obtaining Data

For the two consequences (see above), we establish two hypotheses where we will assume a 95% confidence that we will decide correctly that the true mean is below the regulatory limit of 0.5 mg/Kg with a 1% chance that the true mean is 0.7 mg/Kg (this assumes a clean site, not normally distributed data). Of

[6] U.S. EPA, 1995. QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations," EPA/823/B-95/001.

the 39 historical data points in the project area, 27 are within the footprint of the project and can be relied upon to estimate an expected standard deviation for the site. Once the number of samples required to satisfy the desired confidence level is established, additional sampling points will be added if the number is above the 27 (historic) data points. The added sample locations will be selected using professional judgement in the new turning area and in areas that will be widened, as opposed to the area of the existing channel. Confirmation samples are also desired in two areas where the historic samples were composited.

Tests indicate that the historical data are not normally distributed and therefore, statistical analyses must use non-parametric tests. Because non-parametric and geo-statistical methods are not widely accepted, we will also assume normally distributed data but will increase the acceptable confidence to 97% of deciding correctly to compare with the selected limits detailed above.

References:

U. S. Environmental Protection Agency. 1993. "Data Quality Objectives process for Superfund: Interim Final Guidance." EPA/540/G-93/071.

U. S. Environmental Protection Agency. 2006. "Guidance on Systematic Planning Using the Data Quality Objectives Process." EPA/240/B-06/001.

Appendix F

Visual Sample Plan Report

Random sampling locations for comparing a median with a fixed threshold (non-parametric - MARSSIM)

Summary

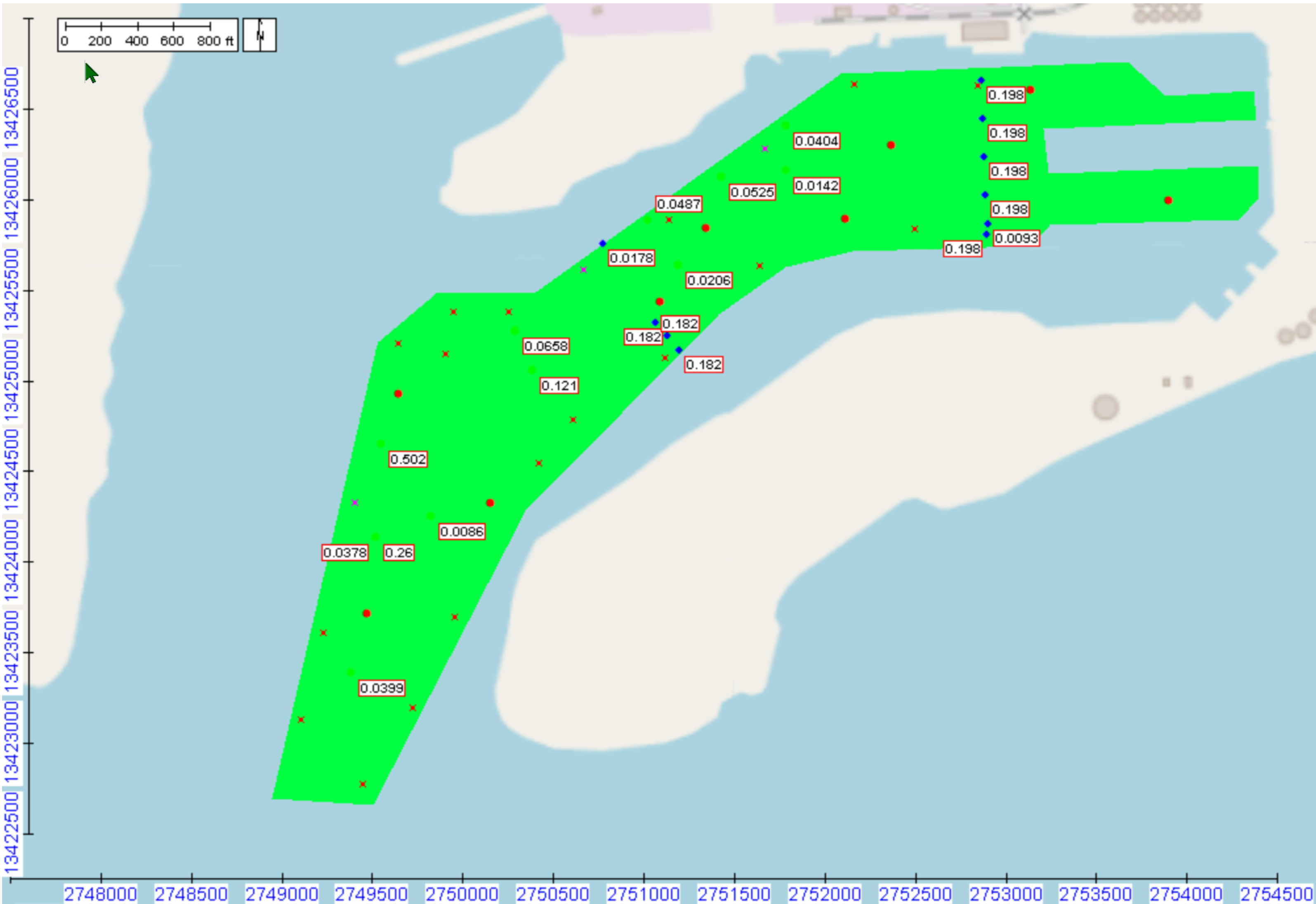
This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Simple random sampling
Working (Null) Hypothesis	The median(mean) value at the site is less than the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated number of samples	32
Number of samples adjusted for EMC	32
Number of samples with MARSSIM Overage	39
Number of samples on map [a]	51
Number of selected sample areas [b]	1
Specified sampling area [c]	5724941.23 ft^2

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.

MARSSIM - Multi-Agency Radiation Survey and Site Investigation Manual
EMC – Elevated Measurement Calculations



0 200 400 600 800 ft
N
0.198
0.198
0.198
0.198
0.0093
0.198
0.0404
0.0525
0.0142
0.0487
0.0178
0.0206
0.182
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0.121
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13422500
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2748500
2749000
2749500
2750000
2750500
2751000
2751500
2752000
2752500
2753000
2753500
2754000
2754500

Area: Project Footprint					
X Coord	**Y Coord**	**Label**	**Hg (mg/Kg)**	**Type**	**Historical**
2750771.8500	13425748.2300	M-PC-21-23A	0.0178	Historic	Y
2752898.6800	13425857.3400	M-PC-21-24	0.0093	Historic	Y
2751786.2890	13426411.3100	LNG-SE-08207	0.0319	Historic	Y
2751431.1390	13426127.1400	LNG-SE-08209	0.0209	Historic	Y
2751021.9070	13425888.7100	LNG-SE-08210	0.0487	Historic	Y
2750290.3480	13425281.1100	LNG-SE-08212	0.0136	Historic	Y
2749547.7840	13424657.1900	LNG-SE-08218	0.502	Historic	Y
2749519.6880	13424137.8200	LNG-SE-08220	0.0378	Historic	Y
2749380.3100	13423395.2900	LNG-SE-08188	0.0399	Historic	Y
2749820.4910	13424257.3500	LNG-SE-08185	0.0086	Historic	Y
2750383.2410	13425059.1100	LNG-SE-08184	0.014	Historic	Y
2751187.4810	13425639.2600	LNG-SE-08182	0.0083	Historic	Y
2751787.2660	13426165.0400	LNG-SE-08180	0.0142	Historic	Y
2752896.0000	13425804.0000	M-PC-18-23CE	0.198	Historic	Y
2752888.0000	13426017.0000	M-PC-18-23CD	0.198	Historic	Y
2752879.0000	13426229.0000	M-PC-18-23CC	0.198	Historic	Y
2752871.0000	13426441.0000	M-PC-18-23CB	0.198	Historic	Y
2752863.0000	13426654.0000	M-PC-18-23CA	0.198	Historic	Y
2751196.0000	13425167.0000	M-PC-18-23AC	0.182	Historic	Y
2751132.0000	13425241.0000	M-PC-18-23AB	0.182	Historic	Y
2751068.0000	13425315.0000	M-PC-18-23AA	0.182	Historic	Y
2751187.4810	13425639.2600	LNG-SE-08181	0.0206	Historic	Y
2750383.2410	13425059.1100	LNG-SE-08183	0.121	Historic	Y
2749519.6880	13424137.8200	LNG-SE-08219	0.260	Historic	Y
2750290.3480	13425281.1100	LNG-SE-08211	0.0658	Historic	Y
2751431.1390	13426127.1400	LNG-SE-08208	0.0525	Historic	Y
2751786.2890	13426411.3100	LNG-SE-08206	0.0404	Historic	Y
2749639.7671	13424934.1818			Random	
2752366.1977	13426300.6625			Random	
2751343.7862	13425847.6682			Random	
2751854.9920	13426303.1618			Random	
2753899.8149	13425999.4994			Random	
2749469.3652	13423722.0315			Random	
2750150.9728	13424329.3562			Random	

2750406.5757	13425240.3434			Random	
2753133.0063	13426606.8242			Random	
2751088.1834	13425442.7850			Random	
2749384.1642	13424531.7978			Random	
2752110.5948	13425898.2786			Random	
2749943.9299	13425384.8236			Judgement	
2749645.6733	13425210.3333			Judgement	
2749901.3218	13425145.4067			Judgement	
2751058.8617	13425273.5681			Judgement	
2751119.3103	13425125.3715			Judgement	
2750604.5219	13424784.1291			Judgement	
2752845.7882	13426629.1118			Judgement	
2752862.3211	13425785.9307			Judgement	
2749105.5514	13423129.2342			Judgement	
2749443.0143	13422773.0233			Judgement	
2749952.9583	13423695.4220			Judgement	
2752162.5853	13426638.2671			Judgement	
2750255.8223	13425384.8823			Judgement	
2749725.8932	13423199.8319			Judgement	
2749232.2605	13423613.6122			Judgement	
2750422.7863	13424550.0624			Judgement	
2751141.4573	13425885.7742			Judgement	

Primary Sampling Objective
The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The working hypothesis (or 'null' hypothesis) is that the median(mean) value at the site is less than the threshold. The alternative hypothesis is that the median(mean) value is equal to or exceeds the threshold. VSP calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

Selected Sampling Approach
A nonparametric random sampling approach was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

VSP offers many options to determine the locations at which measurements are made or samples are collected and subsequently measured. For this design, simple random point sampling was chosen. Locating the sample points randomly provides data that are separated by varying distances, providing good information about the spatial structure of the potential contamination. Knowledge of the spatial structure is useful for geostatistical analysis. However, it may not ensure that all portions of the site are equally represented.

Number of Total Samples: Calculation Equation and Inputs

The equation used to calculate the number of samples is based on a Sign test (see PNNL 13450 for discussion). For this site, the null hypothesis is rejected in favor of the alternative one if the median(mean) is sufficiently larger than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is:

$$n = \frac{\left(Z_{1-\alpha} + Z_{1-\beta}\right)^2}{4(SignP - 0.5)^2}$$

where

$$SignP = \Phi\left(\frac{\Delta}{S_{total}}\right)$$

$\Phi(z)$	is the cumulative standard normal distribution on (-•,z) (see PNNL-13450 for details),
n	is the number of samples,
S_{total}	is the estimated standard deviation of the measured values including analytical error,
Δ	is the width of the gray region,
α	is the acceptable probability of incorrectly concluding the site median(mean) exceeds the threshold,
β	is the acceptable probability of incorrectly concluding the site median(mean) is less than the threshold,
$Z_{1-\alpha}$	is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\alpha}$ is 1-α,
$Z_{1-\beta}$	is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\beta}$ is 1-β.

Note: MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user-supplied percent overage as discussed in MARSSIM (EPA 2000, p. 5-33).

For each analyte in the table, the values of these inputs that result in the calculated number of sampling locations are:

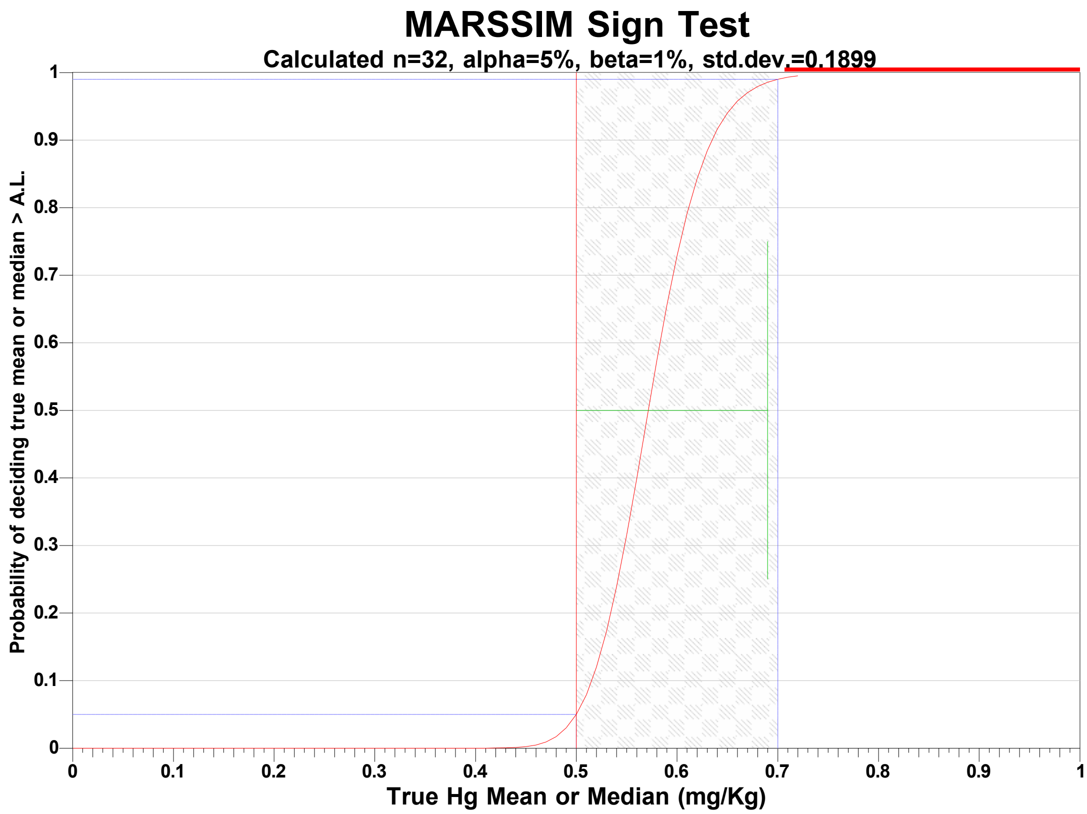
Analyte	n[a]	n[b]	n[c]	Parameter					
				S_{total}	Δ	α	β	$Z_{1-\alpha}$[d]	$Z_{1-\beta}$[e]
Hg	32	32	39	0.1899	0.2	0.05	0.01	1.64485	2.32635

[a] The number of samples calculated by the formula.
[b] The number of samples increased by EMC calculations.
[c] The final number of samples increased by the MARSSIM Overage of 20%.
[d] This value is automatically calculated by VSP based upon the user defined value of α.
[e] This value is automatically calculated by VSP based upon the user defined value of β.

Performance

The following figure is a performance goal diagram, described in EPA's QA/G-4 guidance (EPA, 2000). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of possible true median(mean) values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

The red vertical line is shown at the threshold (action limit) on the horizontal axis. The width of the gray shaded area is equal to ⍰; the lower horizontal dashed blue line is positioned at α on the vertical axis; the upper horizontal dashed blue line is positioned at 1-β on the vertical axis. The vertical green line is positioned at one standard deviation above the threshold. The shape of the red curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of Δ at α and the upper bound of Δ at 1-β. If any of the inputs change, the number of samples that result in the correct curve changes.



Statistical Assumptions

The assumptions associated with the formulas for computing the number of samples are:

1. the computed sign test statistic is normally distributed,
2. the variance estimate, S^2, is reasonable and representative of the population being sampled,
3. the population values are not spatially or temporally correlated, and
4. the sampling locations will be selected randomly.

The first three assumptions will be assessed in a post data collection analysis. The last assumption is valid because the sample locations were selected using a random process.

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the standard deviation, delta, beta (%), probability of mistakenly concluding that μ < action level and alpha (%), probability of mistakenly concluding that μ > action level. The following table shows the results of this analysis.

Number of Samples							
		α=5		α=10		α=15	
		s=0.3798	s=0.1899	s=0.3798	s=0.1899	s=0.37 98	s=0.1899
Δ=0.1	β=5	302	82	239	65	1	54
	β=10	239	65	184	50	0	41
	β=15	201	54	150	41	0	33
Δ=0.2	β=5	82	27	65	22	54	18
	β=10	65	22	50	17	41	14

	β=15	54	18	41	14	33	11
Δ=0.3	β=5	41	17	33	14	28	12
	β=10	33	14	26	11	21	9
	β=15	28	12	21	9	17	8

s = Standard Deviation
Δ = Delta
β = Beta (%), Probability of mistakenly concluding that μ < action level
α = Alpha (%), Probability of mistakenly concluding that μ > action level

Note: Values in table are not adjusted for EMC.

Data Analysis for Hg
The following data points were entered by the user for analysis.

Hg (mg/Kg)										
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
0	0.0083	0.0086	0.0093	0.0136	0.014	0.0142	0.0164	0.0178	0.0205	0.0206
10	0.0209	0.0319	0.0324	0.0378	0.0399	0.0404	0.0487	0.0525	0.055	0.0571
20	0.0658	0.0748	0.121	0.126	0.138	0.151	0.161	0.182	0.182	0.182
30	0.198	0.198	0.198	0.198	0.198	0.26	0.502	0.543	1.02	

SUMMARY STATISTICS for Hg	
n	39
Min	0.0083
Max	1.02
Range	1.0117
Mean	0.13483
Median	0.0571
Variance	0.036059
Std Dev	0.18989
Std Error	0.030407
Skewness	3.1924
Interquartile Range	0.1614

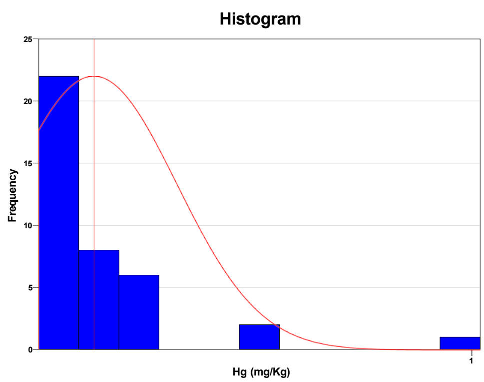
Percentiles								
1%	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**99%**
0.0083	0.0086	0.0136	0.0206	0.0571	0.182	0.26	0.543	1.02

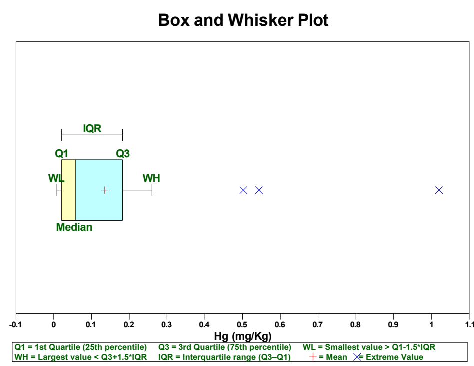
Data Plots
Three graphical displays of the data are shown below: the Histogram, the Box and Whiskers plot, and the Quantile-Quantile (Q-Q) plot.

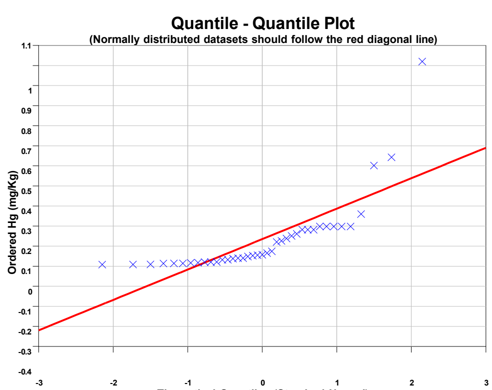
The Histogram is a plot of the fraction of the n observed data that fall within specified data "bins." A histogram is generated by dividing the x axis (range of the observed data values) into "bins" and displaying the number of data in each bin as the height of a bar for the bin. The area of the bar is the fraction of the n data values that lie within the bin. The sum of the fractions for all bins equals one. A histogram is used to assess how the n data are distributed (spread) over their range of values. If the histogram is more or less symmetric and bell shaped, then the data may be normally distributed.

The Box and Whiskers plot is composed of a central box divided by a line, and with two lines extending out from the box, called the "whiskers". The line through the box is drawn at the median of the n data observed. The two ends of the box represent the 25th and 75th percentiles of the n data values, which are also called the lower and upper quartiles, respectively, of the data set. The sample mean (mean of the n data) is shown as a "+" sign. The upper whisker extends to the largest data value that is less than the upper quartile plus 1.5 times the interquartile range (upper quartile minus the lower quartile). The lower whisker extends to the smallest data value that is greater than the lower quartile minus 1.5 times the interquartile range. Extreme data values (greater or smaller than the ends of the whiskers) are plotted individually. A Box and Whiskers plot is used to assess the symmetry of the distribution of the data set. If the distribution is symmetrical, the box is divided into two equal halves by the median, the whiskers will be the same length, and the number of extreme data points will be distributed equally on either end of the plot.

The Q-Q plot graphs the quantiles of a set of n data against the quantiles of a specific distribution. We show here only the Q-Q plot for an assumed normal distribution. The pth quantile of a distribution of data is the data value, x_p, for which a fraction p of the distribution is less than x_p. If the data plotted on the normal distribution Q-Q plot closely follow a straight line, even at the ends of the line, then the data may be assumed to be normally distributed. If the data points deviate substantially from a linear line, then the data are not normally distributed.







For more information on these three plots, consult *Guidance for Data Quality Assessment*, EPA QA/G-9, pp. 2.3-1 through 2.3-12. (http://www.epa.gov/quality/qa-docs.html).

Tests for Hg

Summary of Statistical Tests

The following table summarizes the data analysis results and is comparable to MARSSIM Table 8.2. This analysis applies to the discrete sample results (see MARSSIM 8.2.5).

All Measurements < $DCGL_W$	Average > $DCGL_W$	Sign Test Result	Conclusion
No	No	95% confident that the true mean Hg is less than 0.5 mg/Kg	**Sign Test indicates Survey Unit meets release criterion Check IL Comparison table to see whether further investigation is needed.**

Investigation Level (IL) Comparison		
Investigation Level	**Results > IL?**	**Conclusion**
0.5 mg/Kg	3 results exceed the IL (7.7% of all results)	Further investigation is needed to determine if the release criteria are met and/or the survey unit is appropriately classified based on the measurement data

MARSSIM Sign Test

The Sign test was performed in accordance with the guidance given in section 8.3.2 of MARSSIM. Each measurement (X_i) was subtracted from the action level to obtain *n* differences: $d_i = AL - X_i$. Any differences of zero were discarded from consideration and the sample size was reduced accordingly. The test statistic S+ was calculated by counting the negative differences. S+ was then compared with the critical value *k*, which was obtained from Table I.3 in Appendix I of MARSSIM.

If $S+ > k$, then the null hypothesis is rejected.

MARSSIM SIGN TEST		
Test Statistic S+	**95% Critical Value**	**Null Hypothesis**
3	25	Cannot Reject

The test did not reject the null hypothesis that the mean value at the site is less than the threshold, so conclude the site is clean.

Total Dose Calculation

The total dose from all sources was calculated based on the user-entered values below.

Total Dose From All Sources		
Area	**Average**	**DCGL**
Survey Unit	0.1348	0.5
Total Dose Sum of Fractions:		0.2696
Total dose from all sources is below release criteria. 0.2696 < 1		