ATTACHMENT 3

Sampling and Analysis Report / Dredged Material Evaluation

SAMPLING AND ANALYSIS REPORT

DREDGED MATERIAL EVALUATION FOR MAINTENANCE DREDGING IN THE NORTHERN INNER APRA HARBOR AREA

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degree Celsius
1-D	one-dimensional
µg	microgram
ADDAMS	Automated Dredging and Disposal Management System
BP	bioaccumulation potential
CFR	Code of Federal Regulations
cm	centimeter
COC	chain-of-custody
cy	cubic yard
DGPS	differential global positioning system
DO	dissolved oxygen
E2	Element Environmental, LLC
EC_{50}	median effective concentration
ERL	effects range low
ERM	effects range median
Eurofins	Eurofins Calscience, Inc.
g	gram
G-DODS	Deep Ocean Disposal Site
HDPE	high-density polyethylene
HEM	n-hexane extractable material
HMW	High molecular weight
IRD	inhalation reference dose
ITM	*Evaluation for Dredged Material Proposed for Discharge in Waters of the U.S. – Inland Testing Manual*
KAPL	Knolls Atomic Power Laboratory
kg	kilogram
L	liter
LC_{50}	median lethal concentration
LPC	limiting permissible concentration
MDL	method detection limit
mg	milligram

mL	milliliter
MLLW	mean lower low water
MS	matrix spike
MSD	matrix spike duplicate
NAD83	North American Datum 1983
NAVFAC Pacific	Naval Facilities Engineering Command Pacific
Navy	Department of the Navy
NOEC	No Observed Effect Concentration
OTM	*Evaluation for Dredged Material Proposed for Ocean Disposal – Testing Manual*
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pg	picogram
QA	quality assurance
QC	quality control
RIM	*Regional Implementation Manual for the Requirements and Procedures for Evaluation of Dredged Material Proposed for Ocean Disposal in the State of Hawaii*
RL	reporting limit
s	second
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
SM	Standard Method
SOP	Standard Operating Practice
SP	solid phase
SPP	suspended particulate phase
SRF	Ship Repair Facility
SVOC	semi-volatile organic compound
TCLP	toxicity characteristic leaching procedure
TEQ	Toxic Equivalency Quotient
TOC	total organic carbon
TRPH	total recoverable petroleum hydrocarbon
TVS	total volatile solid

USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UTM	*Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual*
WGS84	World Geodetic System 1984
WQC	Water Quality Criteria

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EXECUTIVE SUMMARY

Project Description

Maintenance dredging is periodically required within Inner Apra Harbor, Guam, to ensure adequate navigation depth for draft requirements of current and future naval vessels. In May 2014, a hydrographic survey was performed to determine areas requiring dredging within the northern portion of Inner Apra Harbor. Based on the design dredge depths for Apra Harbor, the survey found maintenance dredging will be required at Lima, Mike, November, Alpha, and Bravo Wharves, the Inner Apra Harbor Turning Basin, and the Finger Piers located north of the Navy Shipyard.

Based on the proposed maintenance dredge depth of (-) 40 feet mean lower low water (MLLW) at Alpha/Bravo Wharves and the Turning Basin area, the estimated volume of material to be dredged in this area is 18,000 cubic yards (cy). With a design depth of (-) 35 ft MLLW, approximately 11,000 cy of material will need to be dredged from the Lima, Mike, and November Wharves area. For the Finger Piers area, maintenance dredging is proposed to (-) 10 ft MLLW, requiring the removal of 4,000 cy of material. With an allowable 2 feet of overdredge, an additional 24,000 cy of material may be dredged, increasing the potential total dredge volume to be managed to 57,000 cy (see Table ES-1).

Table ES-1

Proposed Dredged Material Volumes for the Northern Inner Apra Harbor Area

Area	Proposed Dredge Depth (feet MLLW)	Cut Volume (cy)	2-Feet of Allowable Overdredge Volume (cy)	Total Volume (cy)
Alpha/Bravo Wharves, Entrance Channel, Turning Basin	(-) 40	18,000	12,000	30,000
November Wharf	(-) 35	3,000	2,000	5,000
Lima/Mike Wharves	(-) 35	8,000	6,000	14,000
Finger Piers	(-) 10	4,000	4,000	8,000
Project Total	**NA**	**33,000**	**24,000**	**57,000**

Note: Dredge volumes are based on a May 2014 hydrographic survey. Volumes are estimated in areas where survey could not be completed due to berthed vessels.

Prior to dredging, a sediment investigation was required to characterize proposed dredged material for ocean disposal. Testing for ocean disposal included physical, chemical, and biological analyses per the *Regional Implementation Manual for the Requirements and Procedures for Evaluation of Dredged Material Proposed for Ocean Disposal in the State of Hawaii* (RIM; USEPA/USACE 1997) and the *Evaluation for Dredged Material Proposed for Ocean Disposal – Testing Manual* (OTM; USEPA/USACE 1991).

If determined suitable for ocean disposal, dredged material may be placed at the U.S. Environmental Protection Agency's (USEPA's) designated Guam Deep Ocean Disposal Site (G-DODS; USEPA 2010). If determined unsuitable for ocean disposal or logistic or cost constraints limit offshore placement, dredged material may be placed upland at the Field 5a dewatering site.

For the purposes of sampling and analysis activities, the project area was subdivided into four composite areas as shown in Table ES-1. The current water depth in these areas was mostly greater than the design depth, especially further offshore from the wharf faces. Shoaling has occurred in the project areas though, especially in the Finger Piers area north of the Navy Shipyard and close to the wharves.

This sediment investigation implemented a phased approach. Samples were initially analyzed for chemical and physical parameters and the solid phase (SP) and suspended particulate phase (SPP) biological tests. Bioaccumulation tests would be completed only after confirmation of solid phase (SP) and suspended particulate phase (SPP) test acceptability for ocean disposal. If the material was not found suitable for ocean disposal, further characterization would be conducted for upland placement alternatives.

Methods

Sediment collection and sample processing activities were conducted in accordance with the Sampling and Analysis Plan (SAP) (E2 et al. 2015). Sediment cores were collected within the project footprint between February 1 and 9, 2015. A vibracore was used to collect samples to the dredge depth plus 2 feet. Based on the available bathymetry prior to the project,

sediment was collected from 20 locations within the four project composite areas. Seven locations were sampled within the Alpha/Bravo Wharves and Turning Basin area (ABTB), five in the Lima/Mike Wharves area (LM), four in the November Wharf area (N), and four stations in the Finger Piers area (FP).

Material from all stations within a given area was mixed to create the four area composite sample for analysis.

Results and Conclusions

Data collected and reviewed for this evaluation show that some sediments comply with suitability determinations for ocean disposal while others do not. Based on the results of analyses, the following conclusions may be drawn:

- No sediment chemical parameters were detected at concentrations greater than their respective ERM values in the Alpha/Bravo/Turning Basin composite sample (AH-ABTB-COMP). However, multiple chemical parameters were detected at concentrations greater than their respective ERM values in composite samples collected from Finger Piers, Lima/Mike and November wharves (AH-FP-COMP, AH-LM-COMP, and AH-N-COMP, respectively). Copper, lead, zinc, and total PCBs were elevated above ERM values in all three composites. In addition, sample concentrations were elevated above ERM values for arsenic and mercury in AH-FP-COMP and AH-LM-COMP, for nickel and chlordane in AH-FP-COMP and AH-N-COMP, and for 4,4'-DDT in AH-LM-COMP and AH-N-COMP.
- The TEQ values for dioxins/furans from all four composite samples (AH-ABTB-COMP, AH-FP-COMP, AH-LM-COMP, and AH-N-COMP) were greater than the TEQ value for sediment comprising the G-DODS reference site.
- Mean survival in the 96-hour mysid shrimp SPP test was reduced by greater than 10 percent and significantly different than the control for AH-N-COMP test sediments. Test results indicate additional analyses (i.e., STFATE) would be required to determine appropriate dilution for ocean disposal; however, NAVFAC determined sediment from November wharf would only be considered for upland placement and therefore no STFATE modeling was conducted.
- Chemistry results from tissue analyzed after being exposed to test sediments for 28-

days (BP testing) were compared to FDA action levels, historical reference sediment tissue burdens from G-DODS, and ERED values:

- Comparison of tissue chemistry results to FDA action levels indicated no exceedances.
- Comparison of tissue chemistry results to G-DODS reference values indicated metals, PAHs, PCBs, and dioxin/furans were elevated in tissue samples exposed to Northern Inner Apra Harbor sediments from all four areas.
- Comparison of tissue chemistry results to ERED values indicated elevations in arsenic in all four areas and copper in samples from Finger Piers and Lima/Mike and November wharves. Day 0 concentrations of some analytes were elevated above the reference; therefore, mean test area concentrations were corrected based on the Day 0 tissue concentrations and then compared to the ERED value.
    - Comparison of corrected mean test concentrations to ERED values indicated only copper exceedances in samples from Finger Piers and Lima/Mike and November wharves (1.17, 1.46, and 12.04 times the ERED values, respectively).

Based on sediment and tissue chemistry and bioassay results, recommendations for the management of proposed dredge material from Northern Inner Apra Harbor are as follows:

- All material from Alpha/Bravo wharves and the Turning Basin is recommended to be considered suitable for ocean disposal.
- A portion of the material from Finger Piers is recommended to be considered suitable for ocean disposal, including areas represented by sediment samples AH-FP-01 and AH-FP-02. Areas represented by sediment samples AH-FP-03 and AH-FP-04 are not suitable for ocean disposal due to elevated copper concentrations in individual cores taken from these locations. Material from these areas may be assessed for upland placement.
- A portion of the material from Lima/Mike wharves is recommended to be considered suitable for ocean disposal, including areas represented by sediment samples AH-LM-01 and AH-LM-02. Areas represented by sediment samples AH-LM-03, AH-LM-04, and AH-LM-05 are not suitable for ocean disposal due to elevated copper and

mercury concentrations in individual cores taken from these locations. Material from these areas may be assessed for upland placement.

- All material from November wharf is recommended for upland placement due to multiple ERM exceedances at three locations adjacent to November wharf and low survival in the 96-hour mysid shrimp SPP test. Although no ERM exceedances were measured in the area represented by sample AH-N-03, the size of this proposed dredge area within November wharf is relatively small and therefore it would be more efficient to include this area with material being placed upland.

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1 INTRODUCTION

Located in the western Pacific Ocean, Guam serves as a forward deployed base for the United States Armed Forces. Apra Harbor, centrally located on Guam's west coast, serves as home base for Commander, U.S. Naval Forces Marianas and units supporting the U.S. Pacific Fleet, 7th Fleet, and 5th Fleet. Inner Apra Harbor provides access to mission support facilities for the Apra Harbor Naval Complex (Figure 1). The Department of the Navy (Navy) has proposed maintenance dredging for the northern portion of Inner Apra Harbor. Specifically, dredging is planned at Alpha, Bravo, Lima, Mike, and November Wharves, the Inner Harbor turning basin, the entrance channel, and the finger piers immediately west of the Inner Apra Harbor entrance (Figure 2).

This Sampling and Analysis Report (SAR) describes the dredge material evaluation performed by the Element Environmental (E2) team. It includes a summary of the sediment sampling and analysis performed and evaluates data results to determine recommendations and conclusions for disposal alternatives for dredged material from this area.

1.1 Project Summary

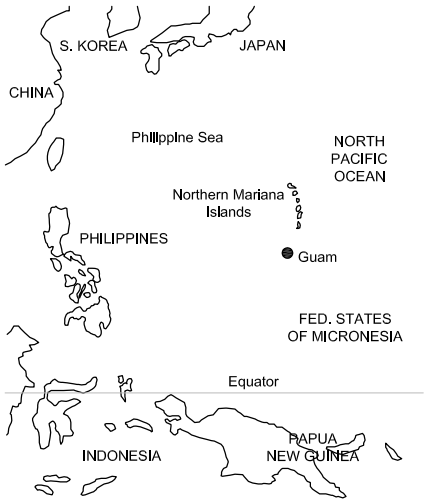
Based on a recent hydrographic survey (May 2014), maintenance dredging is needed to restore adequate navigational depths in the Northern Inner Apra Harbor area. The entrance channel, Alpha and Bravo Wharves, and the turning basin have a proposed dredge depth of (-) 40 feet mean lower low water (MLLW) requiring the removal of approximately 18,000 cubic yards (cy) of material. Maintenance dredging is planned to (-) 35 feet MLLW in the Lima, Mike, and November Wharves area with an estimated dredge volume of 11,000 cy. For the finger pier area, the proposed dredged depth is (-) 10 feet MLLW with an estimated dredge volume of 4,000 cy. Overall, the proposed project dredge volume is 33,000 cy, but with a two-foot overdredge allowance, the potential total dredge volume is approximately 57,000 cy.

1.2 Objectives of Sediment Investigation

The purpose of this sediment investigation was to characterize proposed dredged material for ocean disposal. Testing for ocean disposal included physical, chemical, and biological analyses per the *Regional Implementation Manual for the Requirements and Procedures*

for Evaluation of Dredged Material Proposed for Ocean Disposal in the State of Hawaii (RIM; U.S. Environmental Protection Agency/U.S. Army Corps of Engineers [USEPA/USACE] 1997) and the *Evaluation for Dredged Material Proposed for Ocean Disposal – Testing Manual* (OTM; USEPA/USACE 1991).

If determined suitable for ocean disposal, dredged material may be placed at the USEPA's designated Guam Deep Ocean Disposal Site (G-DODS; USEPA 2010). If determined unsuitable for ocean disposal or logistic or cost constraints limit offshore placement, dredged material may be placed upland at the Field 5a dewatering site.



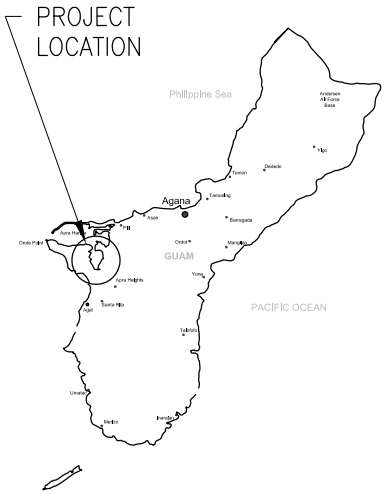


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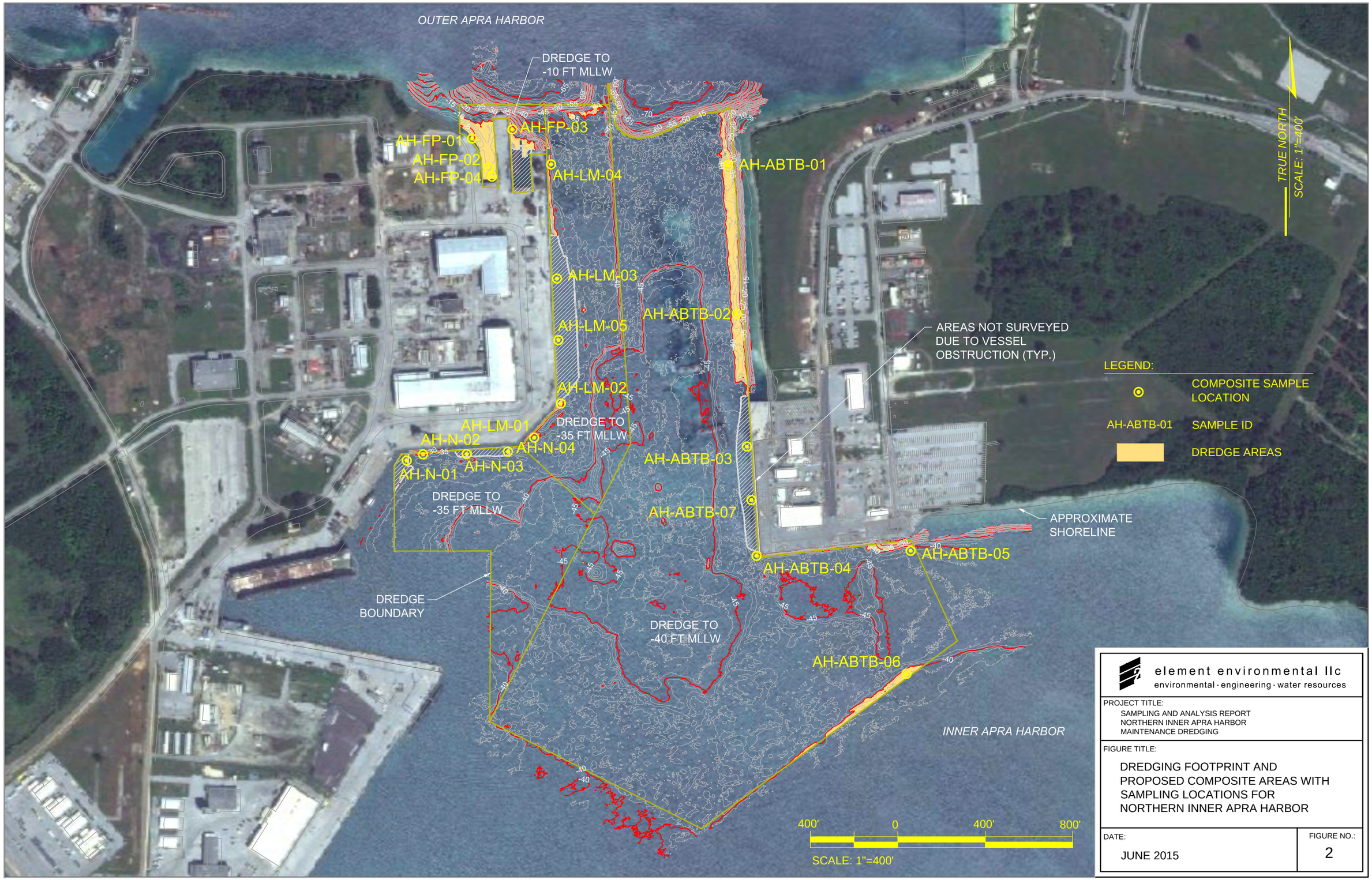
	FIGURE TITLE: PROJECT LOCATION MAP	FIGURE NO.: 1



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PROJECT TITLE:
SAMPLING AND ANALYSIS REPORT
NORTHERN INNER APRA HARBOR
MAINTENANCE DREDGING

FIGURE TITLE:
DREDGING FOOTPRINT AND PROPOSED COMPOSITE AREAS WITH SAMPLING LOCATIONS FOR NORTHERN INNER APRA HARBOR

DATE: JUNE 2015

FIGURE NO.: 2

2 METHODS

Sediment collection and sample processing activities were conducted by the E2 team in accordance with the Sampling and Analysis Plan (SAP; E2 et al. 2015). Field logs and core photographs are provided in Appendix A.

2.1 Sample Collection and Handling

Sediment core samples were collected from a total of 20 stations, located in four composite areas based on design dredge depths as described above. Cores were collected to the design depth plus 2 feet for overdredge allowance to evaluate proposed dredged material for ocean disposal. Seven locations were sampled within the Alpha/Bravo Wharves and Turning Basin area (ABTB), five in the Lima/Mike Wharves area (LM), four in the November Wharf area (N), and four stations in the Finger Piers area (FP). Material from all stations within a given area was mixed to create a total of four area composite samples for analysis.

This section details the methods of sample collection and handling, specifically addressing the sampling platform, navigation and vertical control, station locations, sample collection procedures, sample characterization, field equipment decontamination and waste disposal, sample shipping, sample processing, and chain-of-custody (COC) procedures.

2.1.1 Sampling Platform

Sampling was performed from a 40-foot pontoon boat modified for environmental sampling. The vessel was provided by Pacifica Workboats and conformed to U.S. Coast Guard safety standards.

2.1.2 Navigation and Vertical Control

A Garmin E-trex differential global positioning system (DGPS) was used to guide the vessel to pre-determined core sampling locations. Locations were accurate to within plus or minus 5 meters (16.4 feet). Horizontal positions were reported in latitude and longitude (World Geodetic System 1984 [WGS 84]) in degrees, minutes, and decimal seconds. Upon locating the sampling position, the station depth was measured using a lead line and confirmed using the vessel's fathometer. The MLLW depth was then determined by adding the tidal

elevation to the measured depth. All vertical elevations were reported to the nearest 0.1 foot relative to MLLW.

2.1.3 Station Locations

Station locations were chosen to accurately represent the physical and chemical characteristics of the sediment to be dredged. Sediment cores were collected at 20 locations placed in areas of shoaling within each of the four composite areas. Proposed station locations and target core lengths are shown in Table 1 below.

In addition to sediment, site water was collected for testing requirements. Site water was collected from the Inner Apra Harbor area. Reference sediment was previously collected from the G-DODS reference site (GO-5) as part of the G-DODS designation study (Weston 2008). Samples were collected using a deep-sea box core deployed from the research vessel *Melville*. No additional reference site sediment sampling was required for this effort.

2.1.4 Sample Collection Procedures

Sediment cores were collected using an electric vibracore provided and operated by Aquatic Blue Environmental, Inc. (Aquatic Blue). The vibracore was equipped with a 4-inch-outer-diameter aluminum barrel and stainless-steel cutterhead. A new liner was inserted into the core tube prior to sampling at each station to eliminate the possibility of cross contamination. Adequate sediment volumes were collected to allow for all testing described in the SAP (E2 et al. 2015).

Samples were collected to project depth plus two feet unless refusal was encountered. Refusal was defined as less than two inches of penetration per minute. If refusal was encountered, the vessel was moved and another core was attempted. If refusal was encountered again, additional cores were not attempted.

Table 1

Station Identifiers, Core Locations, and Estimated Target Core Lengths for Samples Collected During Sampling

Station Identifier	Latitude (Degrees, Minutes, Decimal Seconds/WGS84)	Longitude (Degrees, Minutes, Decimal Seconds/WGS84)	Estimated Existing Water Depth (feet MLLW)	Project Depth (feet MLLW)	Target Sampling Depth (Project Depth plus 2 feet; feet MLLW)	Estimated Target Core Length (feet)
AH-ABTB-01	13˚ 26’ 31.54” N	144˚ 40’ 00.10” E	37	(-) 40	(-) 42	5
AH-ABTB-02	13˚ 26’ 25.81” N	144˚ 40’ 00.30” E	37	(-) 40	(-) 42	5
AH-ABTB-03	13˚ 26’ 18.92” N	144˚ 40’ 01.11” E	38	(-) 40	(-) 42	4
AH-ABTB-04	13˚ 26’ 13.86” N	144˚ 40’ 01.66” E	37	(-) 40	(-) 42	5
AH-ABTB-05	13˚ 26’ 14.55” N	144˚ 40’ 08.54” E	35	(-) 40	(-) 42	7
AH-ABTB-06	13˚ 26’ 07.67” N	144˚ 40’ 08.43” E	39	(-) 40	(-) 42	3
AH-ABTB-07	13˚ 26’ 16.11” N	144˚ 40’ 01.43” E	38	(-) 40	(-) 42	4
AH-LM-01	13˚ 26’ 19.40” N	144˚ 39’ 51.33” E	34	(-) 35	(-) 37	3
AH-LM-02	13˚ 26’ 21.03” N	144˚ 39’ 52.73” E	32	(-) 35	(-) 37	5
AH-LM-03	13˚ 26’ 26.59” N	144˚ 39’ 52.76” E	33	(-) 35	(-) 37	4
AH-LM-04	13˚ 26’ 32.35” N	144˚ 39’ 52.49” E	34	(-) 35	(-) 37	3
AH-LM-05	13˚ 26’ 23.91” N	144˚ 39’ 52.69” E	33	(-) 35	(-) 37	4
AH-N-01	13˚ 26’ 18.09” N	144˚ 39’ 45.14” E	33	(-) 35	(-) 37	4
AH-N-02	13˚ 26’ 18.58” N	144˚ 39’ 46.02” E	33	(-) 35	(-) 37	4
AH-N-03	13˚ 26’ 18.66” N	144˚ 39’ 47.79” E	33	(-) 35	(-) 37	4
AH-N-04	13˚ 26’ 18.86” N	144˚ 39’ 49.76” E	33	(-) 35	(-) 37	4
AH-FP-01	13˚ 26’ 32.80” N	144˚ 39’ 49.12” E	6	(-) 10	(-) 12	6
AH-FP-02	13˚ 26’ 31.32” N	144˚ 39’ 49.51” E	8	(-) 10	(-) 12	4
AH-FP-03	13˚ 26’ 32.57” N	144˚ 39’ 51.62” E	8	(-) 10	(-) 12	4
AH-FP-04	13˚ 26’ 31.54” N	144˚ 39’ 51.15” E	8	(-) 10	(-) 12	4

1 Required sample composite volume for proposed Tier III analysis is approximately 100 L. Sufficient volume of sediment was collected to ensure opportunity to test additional amphipod species and upland disposal options, should it be required.
WGS84 = World Geodetic System 1984

2.1.5 Sample Characterization

Sediment core samples were classified and logged according to the Unified Soil Classification System on the individual sediment core collection form. The geologic description of each core included the texture, odor, color, approximate grain size distribution, plasticity characteristics of the fine-grained fraction, and any evident stratification of the sediment. A representative core from each location was photographed. Field logs and core photos are provided in Appendix A.

After characterization, some material from each location was placed into glass jars for chemical and physical analysis while the remainder of the material was placed into food-grade polyethylene bags for biological testing. The samples were sealed airtight and placed into a cooler with ice. Samples were maintained at 4 degrees plus or minus 2 degrees Celsius (°C) until received at the laboratory.

2.1.6 Field Equipment Decontamination and Waste Disposal

All sampling equipment was decontaminated prior to use and between stations using site water and a phosphate-free biodegradable soap solution, as described in the SAP (E2 et al. 2015). All disposable sampling materials and personnel protective equipment (such as disposable gloves and paper towels) were placed into heavy-duty garbage bags and then placed into a refuse container for disposal as solid waste.

2.1.7 Sample Shipping

Samples for chemical and physical analysis were securely packed inside coolers with ice packs and shipped by overnight courier to Eurofins Calscience, Inc. (Eurofins) in Garden Grove, California (Table 2). Sample jars were wrapped in bubble wrap to prevent breakage. The original signed COC forms and soil shipping permit were placed in sealed plastic bags and taped to the inside lid of the cooler. Subsamples for toxicity testing (solid phase [SP] and suspended particulate phase [SPP]) and subsequent bioaccumulation testing were delivered to Environ International Corporation (Environ) in Port Gamble, Washington. Subsamples for sediment radiation analysis were shipped to Knolls Atomic Power Laboratory (KAPL) in Niskayuna, New York (Table 2). Core sample archives were shipped directly to Eurofins.

Table 2
Analytical Laboratories, Points of Contact, and Shipping Information

Laboratory	Volume Sediment per Sample	Analyses Performed	Point of Contact	Shipping Information
Eurofins	8 L	Sediment and tissue chemistry	Danielle Gonsman (714) 895-5494	7440 Lincoln Way Garden Grove, California 92841
KAPL	500 mL	Sediment radiation analysis	Richard Marvin (202) 781-6090	(UIC:Q94151) Building M-2 Warehouse (NPD-12) 2401 River Road Niskayuna, New York 12309
Environ	90 L	Bioassay and bioaccumulation testing	Brian Hester (360) 297-6045/ David Moore (760) 497-4252	4770 NE View Drive Port Gamble, Washington 98364

Notes:
L = liter
mL = milliliter

2.1.8 Sample Processing

Sediment from each station was individually homogenized to a uniform consistency in a stainless-steel bowl or high-density polyethylene (HDPE) bucket lined with a food-grade polyethylene bag. A 500-milliliter (mL) subsample of sediment homogenized for each individual station was archived to allow for additional chemical analysis, if necessary. A proportionate volume of the homogenized sediment from each station within a given area was combined to form a single composite sample for each area within the project dredge footprints. Table 3 presents the sediment sample processing and testing strategy for the four composite samples, AH-ABTB-COMP, AH-LM-COMP, AH-N-COMP and AH-FP-COMP. After completion of compositing, sediment was placed into pre-cleaned, labeled jars appropriate for physical and chemical analyses, and all jars were firmly sealed. Sediment for biological testing was placed in food-grade polyethylene bags. Samples were stored at approximately 4°C plus or minus 2°C until chemical, physical, and biological testing was initiated.

Table 3
Sediment Sample Processing and Testing Strategy

Composite Sample Identifier	Core Identifier	Archive	Sediment Physical and Chemical Analyses	Sediment Radiation Analysis	Toxicity Testing	Bioaccumulation Testing
AH-ABTB-COMP	AH-ABTB-01 AH-ABTB-02 AH-ABTB-03 AH-ABTB-04 AH-ABTB-05 AH-ABTB-06 AH-ABTB-07	Individual cores and composite sample	Yes	Yes	SP and SPP testing	Yes, if sediment chemistry and SP testing indicate potential suitability for ocean disposal
AH-LM-COMP	AH-LM-01 AH-LM-02 AH-LM-03 AH-LM-04 AH-LM-05	Individual cores and composite sample	Yes	Yes	SP and SPP testing	Yes, if sediment chemistry and SP testing indicate potential suitability for ocean disposal
AH-N-COMP	AH-N-01 AH-N-02 AH-N-03 AH-N-04	Individual cores and composite sample	Yes	Yes	SP and SPP testing	Yes, if sediment chemistry and SP testing indicate potential suitability for ocean disposal
AH-FP-COMP	AH-FP-01 AH-FP-02 AH-FP-03 AH-FP-04	Individual cores and composite sample	Yes	Yes	SP and SPP testing	Yes, if sediment chemistry and SP testing indicate potential suitability for ocean disposal

2.2 Chain-of-Custody Procedures

COC procedures were followed for all samples throughout the collection, handling, and analysis process. COC forms were the principal documents used to detail the possession and transfer of samples. A COC form accompanied each cooler of samples to the analytical and biological laboratories. Each person who had custody of the samples signed the COC form and ensured that the samples were not left unattended unless properly secured. Completed COC forms are presented in the laboratory analytical reports in Appendix B.

2.3 Physical and Chemical Analyses

The four composite samples were tested to determine suitability for ocean disposal. Additionally, individual station samples from the November, Lima/Mike, and Finger Piers dredge areas were analyzed for metals and PCBs to further delineate contamination. All physical and chemical analyses in this testing program were selected to provide data on chemicals of potential concern in project area sediment in accordance with the RIM (USEPA/USACE 1997) and OTM (USEPA/USACE 1991). All analytical methods used followed USEPA, Standard Method (SM), or ASTM protocols. Specific chemical and conventional analytes measured for this sediment evaluation, including target reporting limits, are presented in the SAP (E2 et al. 2015).

2.3.1 Physical Analyses

Physical analyses of sediments included grain size, Atterberg limits, specific gravity, moisture content, total volatile solids (TVS), and total solids. Analytical methods for each physical parameter are presented in the SAP (E2 et al. 2015).

2.3.2 Chemical Analyses

Sediment samples were analyzed for total organic carbon (TOC), ammonia, sulfides, cyanide, oil and grease, total recoverable petroleum hydrocarbons (TRPH), metals, semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), organotins, polychlorinated biphenyls (PCBs), pesticides, dioxins and furans. Analytical methods and target reporting limits for sediment (reported in dry weight) are presented in the SAP (E2 et al. 2015), with one revision. USEPA 376.2M instead of USEPA 9030B/9034 was used for total and dissolved sulfides.

To determine suitability for ocean disposal, analytical chemistry results for the four composite samples were compared to the G-DODS reference site values (USEPA 2010). In addition, results were compared to effects range low (ERL) and effects range median (ERM) values developed by Long et al. (1995). Effects range values are helpful in assessing the potential significance of elevated sediment-associated contaminants of concern and their

potential for adverse biological effects.[1] While these values are useful for identifying elevated sediment-associated contaminants, they should not be used to infer causality because of the inherent variability and uncertainty of the approach. For certain pesticide compounds (i.e., chlordane and dieldrin), ERL and ERM values are so low as to make it largely impractical to detect them in typical marina sediments using routine analytical procedures. Accordingly, having non-detect results that are greater than ERL values, ERM values, or method detection limits (MDLs) would not require reanalysis.

2.3.3 Sediment Radiation Analyses

The four composite samples were tested for radiation levels. Analytical methods and target reporting limits for sediment (reported in dry weight) are presented in the SAP (E2 et al. 2015).

2.3.4 Tissue Residues

Chemical analysis of tissue residues was conducted to determine the bioaccumulation of sediment contaminants. Based on the results of sediment chemistry, a subset of chemicals was approved for analysis by USEPA. Tissue samples were analyzed for lipids, metals (including mercury), PAHs, PCBs, and dioxins/furans (Table 4). Composite samples from each replicate were analyzed separately. Analytical methods and target reporting limits (RLs) for tissue (reported in wet weight) are presented in Table 7 of the SAP (E2 et al. 2015).

Table 4
Summary of Analysis Performed on Tissue Samples

Sample	Tissue Analysis
Time Zero (T0)	Lipids, metals (including mercury), PAHs, PCBs, dioxins/furans
AH-FP-COMP	Lipids, metals (including mercury), PAHs, PCBs, dioxins/furans
AH-ABTB-COMP	Lipids, metals (including mercury), PAHs, PCBs

[1] These values were developed from a large dataset where results of both benthic organism effects (e.g., toxicity tests and benthic assessments) and chemical concentrations were available for individual samples. To derive these guidelines, chemical values for paired data demonstrating benthic impairment were sorted in ascending chemical concentration. The 10th percentile of this rank order distribution was identified as the ERL value and the 50th percentile as the ERM value.

Sample	Tissue Analysis
AH-N-COMP	Lipids, metals (including mercury), PAHs, PCBs, dioxins/furans
AH-LM-COMP	Lipids, metals (including mercury), PAHs, PCBs

Notes:
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls

Results of chemical analysis of tissue residues were initially compared against applicable Food and Drug Administration (FDA) action levels for poisonous or deleterious substances in fish and shellfish for human food, when such levels have been set. In the absence of action levels, or if tissue contaminant concentrations were less than action levels, results were compared to historical reference data collected from the G-DODS reference site (Weston 2008). If tissue concentrations of organisms exposed to test sediment were elevated compared to historical reference data, a weight-of-evidence approach was used. This approach included a comparison to residue-effects values provided in the USACE/USEPA Environmental Residue-Effects Database (ERED; USACE/USEPA 2010) to determine whether toxic effects could be expected at concentrations measured in tissue of exposed organisms.

2.4 Biological Testing

Biological testing was conducted on AH-ABTB-COMP, AH-LM-COMP, AH-N-COMP, and AH-FP-COMP to determine suitability for ocean disposal. Testing was conducted using a phased approach. The first phase included solid phase (SP) and suspended particulate phase (SPP) testing to determine whether anthropogenic contaminants of potential concern are present at concentrations such that ocean disposal of dredged material would pose an unacceptable risk of toxicity to biota. The second phase included bioaccumulation potential (BP) testing, which was initiated based on the results of SP and SPP testing. A summary of biological testing performed on sediment from the Northern Inner Apra Harbor area is provided in Table 5.

The evaluation of material for open-ocean disposal followed methods described in the OTM (USEPA/USACE 1991). Concurrent reference sediment testing was not required for this sediment investigation. Instead, SP test results and BP tissue data were compared to

historical data collected on sediment from the G-DODS reference site (Weston 2008). All testing was performed in accordance with the OTM (USEPA/USACE 1991) and the *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.: Testing Manual* (ITM; USEPA/USACE 1998), as well as other available guidance (ASTM 1998, 1999, 2000, 2003; USEPA 1994). Specific test methods, conditions, and acceptability criteria are presented in the SAP (E2 et al. 2015).

Table 5
Biological Testing for the Project Composite Samples

Test Type	Organism		Reference Sediment	Control Material	Reference Toxicant Test
	Type	Taxon			
SP	Amphipod	*Eohaustorius estuarius*	Results compared to reference envelope[1]	Native or clean sediment	Ammonium chloride
	Polychaete	*Neanthes arenaceodentata*	Results compared to reference envelope[1]	Native or clean sediment	Ammonium chloride
SPP	Bivalve larvae	*Mytilus galloprovincialis*	NA	Dilution water	Ammonium chloride
	Inland Silverside Fish	*Menidia beryllina*	NA	Dilution water	Ammonium chloride
	Mysid shrimp	*Americamysis bahia*	NA	Dilution water	Ammonium chloride
BP	Clam	*Macoma nasuta*	Results compared to reference envelope[1]	Native or clean sediment	NA
	Polychaete	*Neanthes virens*	Results compared to reference envelope[1]	Native or clean sediment	NA

Notes:
BP = bioaccumulation potential
NA = not applicable
SP = solid-phase
SPP = suspended particulate-phase
1 G-DODS Site GO-5 historical data (Weston 2008)

2.4.1 Quality Assurance/Quality Control

Biological tests incorporated standard quality assurance/quality control (QA/QC) procedures per the OTM (USEPA/USACE 1991) and ITM (USEPA/USACE 1998) to ensure valid test results. Standard QA/QC procedures included the use of negative controls (laboratory control treatments), positive controls (reference toxicant tests), replicates, and water quality measurements during testing.

The negative control was used to establish the health of the test organisms and ensure acceptability criteria were met. Control material consisted of clean sediment (i.e., native) or filtered seawater, where appropriate. Reference toxicant tests were used for SP and SPP testing to establish the sensitivity of test organisms. Relevant guidance documents recommend that reference toxicant median lethal concentration (LC_{50}) or median effective concentrations (EC_{50}) should fall within two standard deviations of the historical laboratory mean.

Water quality was measured during testing to ensure test conditions were maintained and that organisms did not experience undue stress unrelated to test sediments. Laboratory equipment was maintained, and all instruments were calibrated regularly. Laboratory procedures were documented on approved datasheets according to test methods detailed in laboratory Standard Operating Procedures (SOPs). Laboratory personnel receive regular documented training in all SOPs and test methods.

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3 RESULTS

Stations were positioned in areas of shoaling relative to the project design dredge depths. Sediment was collected to the target core depth at each of these locations. Based on the chemical and biological testing results for the area composite samples, it was determined that additional chemical testing of individual stations within three of the composite areas was appropriate to further delineate contamination. Specifically, material from individual stations within the November Wharf, Lima/Mike Wharves, and Finger Piers areas was tested for metals and PCBs. These results are presented in Section 3.4 below.

3.1 Sample Collection and Handling

Sediment core samples were collected in the project areas from February 1 to 9, 2015. Core samples were collected to the target core depth of (-) 42 feet MLLW in Area AH-ABTB, (-) 12 feet MLLW in Area AH-FP, and (-) 37 feet MLLW in Areas AH-LM and AH-N. An electric vibracore was used to collect the samples. Final station locations are illustrated in Figures 3, 4, and 5. Station coordinates, mudline elevation, estimated penetration, and retrieved core lengths for each station location are summarized in Table 6. Field logs are provided in Appendix A.

3.2 Physical and Chemical Analyses

Results of physical and chemical analyses of composite sediments from the project areas are presented in Tables 7 and 8. All results are expressed in dry weight unless otherwise indicated. Target reporting limits were provided in the SAP (E2 et al. 2015). The actual reporting limits and raw data for the analyses are provided in Appendix B.

3.2.1 Alpha/Bravo Wharves and the Turning Basin

The AH-ABTB-COMP sample consisted of sediment from seven stations located in areas of shoaling along Alpha and Bravo Wharves and within the Inner Apra Harbor Turning Basin. The sediment grain size in this area consisted of 19.2 percent fines (silt and clay), 74.1 percent sand, and 6.7 percent gravel (Table 7). The liquid limit was 40.8 percent, and there was no plasticity. Atterberg classification of the sediment was NP (Non-plastic).

TOC was measured at a concentration of 1.3 percent, total solids at 54.4 percent, and TVS at 2.5 percent. Ammonia measured 0.51 mg/kg (milligrams per kilogram) and dissolved sulfide was not detected. TRPH and n-hexane extractable material (HEM; i.e., oil and grease) were measured at concentrations of 46 and 43 mg/kg, respectively.

Metals, PAHs, pesticides, SVOCs, PCBs, dioxins, and furans were detected in sediment from AH-ABTB-COMP (Table 7). Concentrations of metals were lower than corresponding ERL values except copper, lead, and zinc. These three metals exceeded ERL values but were below ERM values. The only PAH detected at a value greater than the corresponding ERL value was acenaphthylene, measuring 51 µg/kg (micrograms per kilogram). High molecular weight (HMW) PAHs exceeded the corresponding ERL value but the total PAH measurement was less than the ERL. Several organochlorine pesticides were detected but none at values exceeding their respective ERL value. Several SVOCs were detected including bis(2-ethylhexl) phthalate which measured 800 µg/kg. Several individual PCB congeners were measured and the total PCB congener value was 135.4 µg/kg, greater than the corresponding ERL value of 22.7 µg/kg. For dioxins/furans, the total Toxic Equivalency Quotient (TEQ) reported for AH-ABTB-COMP was 8.6 picograms per gram (pg/g), as compared to the G-DODS reference site TEQ value of 0.04 pg/g (Table 8).

3.2.2 Finger Piers

The AH-FP-COMP sample consisted of sediment from four locations within the finger pier area immediately north of the former Naval Ship Repair Facility (SRF). The sediment grain size in this area consisted of 7.5 percent fines, 80.8 percent sand, and 11.7 percent gravel (Table 7). The liquid limit was 22.2 percent, and there was no plasticity. Atterberg classification of the sediment was NP.

TOC measured 0.7 percent while the total solids and TVS values were 69.4 and 1.9 percent, respectively. Ammonia measured 0.4 mg/kg and dissolved sulfide was not detected. TRPH was measured at a concentration of 600 mg/kg and oil and grease at 770 mg/kg.

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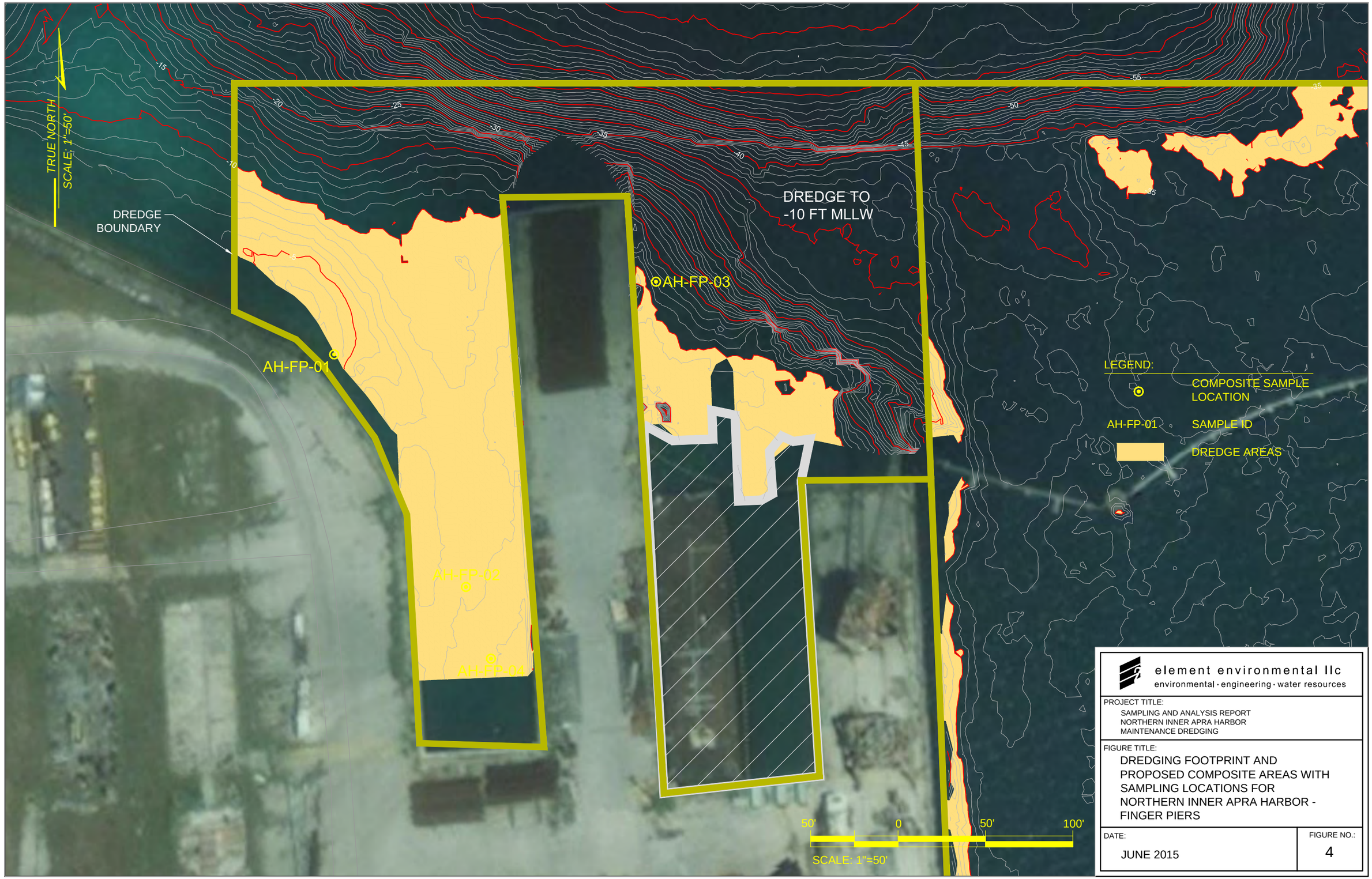
FIGURE TITLE:
DREDGING FOOTPRINT AND PROPOSED COMPOSITE AREAS WITH SAMPLING LOCATIONS FOR NORTHERN INNER APRA HARBOR - ALPHA AND BRAVO WHARVES, AND TURNING BASIN

DATE:
JUNE 2015

FIGURE NO.:
3


TRUE NORTH
SCALE: 1"=50'
DREDGE BOUNDARY
DREDGE TO
-10 FT MLLW
AH-FP-01
AH-FP-02
AH-FP-03
AH-FP-04
LEGEND:
COMPOSITE SAMPLE LOCATION
AH-FP-01
SAMPLE ID
DREDGE AREAS
50'
0
50'
100'
SCALE: 1"=50'
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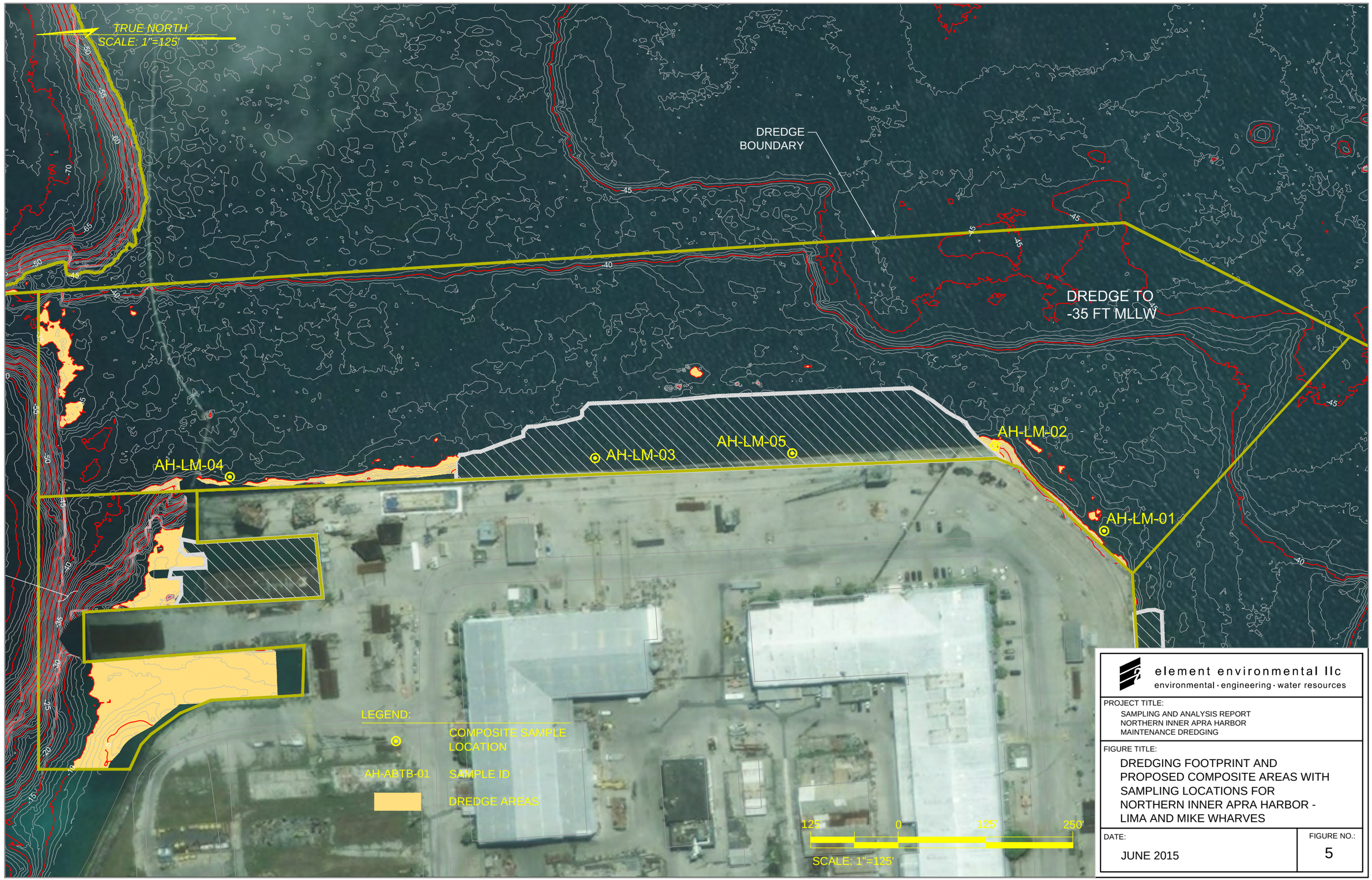
PROPOSED COMPOSITE AREAS WITH
SAMPLING LOCATIONS FOR
NORTHERN INNER APRA HARBOR -
FINGER PIERS
DATE:
JUNE 2015
FIGURE NO.:
4



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DREDGING FOOTPRINT AND PROPOSED COMPOSITE AREAS WITH SAMPLING LOCATIONS FOR NORTHERN INNER APRA HARBOR - LIMA AND MIKE WHARVES

DATE:	FIGURE NO.:
JUNE 2015	5

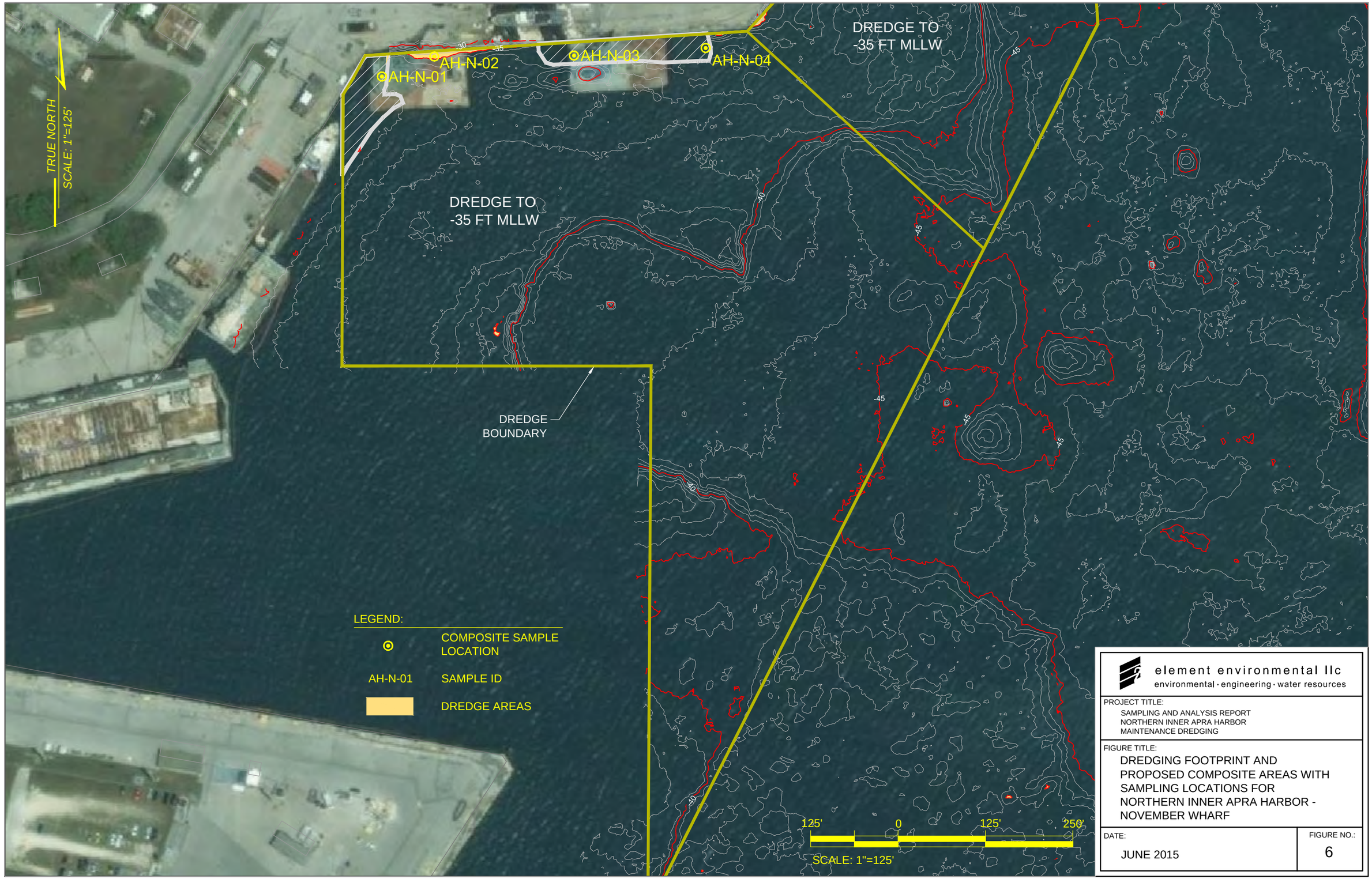

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FIGURE TITLE:
DREDGING FOOTPRINT AND PROPOSED COMPOSITE AREAS WITH SAMPLING LOCATIONS FOR NORTHERN INNER APRA HARBOR - NOVEMBER WHARF

DATE: JUNE 2015

FIGURE NO.: 6

Table 6

Station Coordinates, Mudline Elevation, Target Core Length, and Retrieved Core Lengths of Samples

Station ID	Attempt Number	Latitude (Degrees, Minutes, Decimal Seconds; NAD83)	Longitude (Degrees, Minutes, Decimal Seconds; NAD83)	Mudline Elevation (feet MLLW)	Maximum Dredging Depth Including Overdepth (feet MLLW)	Target Core Length (feet)	Retrieved Core Length (feet)	Core Length for Analysis (feet)[1]	Comments
AH-ABTB-01	1	13˚ 26′ 31.5″ N	144˚ 40′ 00.1″ E	-38.0	-42	4.0	4.6	4.0	
AH-ABTB-01	2	13˚ 26′ 31.5″ N	144˚ 40′ 00.1″ E	-38.0	-42	4.0	5.0	4.0	
AH-ABTB-02	1	13˚ 26′ 25.1″ N	144˚ 40′ 00.8″ E	-36.6	-42	5.4	5.4	5.4	
AH-ABTB-02	2	13˚ 26′25.1″ N	144˚ 40′ 00.8″ E	-36.6	-42	5.4	5.4	5.4	
AH-ABTB-03	1	13˚ 26′ 18.9″ N	144˚ 40′ 01.5″ E	-38.6	-42	3.4	5.0	3.4	
AH-ABTB-03	2	13˚ 26′ 18.9″ N	144˚ 40′ 01.5″ E	-38.6	-42	3.4	2.8	2.8	
AH-ABTB-04	1	13˚ 26′ 13.9″ N	144˚ 40′ 01.7″ E	-38.0	-42	4.0	4.0	4.0	
AH-ABTB-04	2	13˚ 26′ 13.9″ N	144˚ 40.01.7″ E	-38.0	-42	4.0	4.0	4.0	
AH-ABTB-05	1	13˚ 26′ 14.4″ N	144˚ 40.08.9″ E	-38.0	-42	4.0	4.0	4.0	
AH-ABTB-05	2	13˚ 26′ 14.4″ N	144˚ 40.08.9″ E	-38.0	-42	4.0	5.0	4.0	
AH-ABTB-06	1	13˚ 26′ 07.7″ N	144˚ 40′ 08.4″ E	-37.7	-42	4.3	7.0	4.3	
AH-ABTB-06	2	13˚ 26′ 07.7″ N	144˚ 40′ 08.4″ E	-37.7	-42	4.3	4.6	4.3	
AH-ABTB-07	1	13˚ 26′ 16.5″ N	144˚ 40′ 01.7″ E	-39.7	-42	2.3	2.5	2.3	
AH-ABTB-07	2	13˚ 26′ 16.5″ N	144˚ 40′ 01.7″ E	-39.7	-42	2.3	2.1	2.1	
AH-ABTB-07	3	13˚ 26′ 16.5″ N	144˚ 40′ 01.7″ E	-39.7	-42	2.3	2.3	2.3	
AH-LM-01	1	13˚ 26′ 19.4″ N	144˚ 39′ 51.3″ E	-33.2	-37	3.8	3.0	2.5	Rock rubble from -2.5 to -3.0 ft, not collected. Station relocated.
AH-LM-01	2	13˚ 26′ 19.5″ N	144˚ 39′ 51.4″ E	-33.2	-37	3.8	4.0	2.5	Rock rubble from -2.5 to -3.8 ft, not collected. Station relocated.
AH-LM-01	3	13˚ 26′ 19.4″ N	144˚ 39′ 51.4″ E	-33.2	-37	3.8	3.5	3.5	
AH-LM-02	1	13˚ 26′ 21.0″ N	144˚ 39′ 52.7″ E	-32.0	-37	5.0	5.0	5.0	
AH-LM-02	2	13˚ 26′ 21.0″ N	144˚ 39′ 52.7″ E	-32.0	-37	5.0	5.2	5.0	
AH-LM-02	3	13˚ 26′ 21.0″ N	144˚ 39′ 52.7″ E	-32.0	-37	5.0	5.0	5.0	
AH-LM-03	1	13˚ 26′ 26.6″ N	144˚ 39′ 52.8″ E	-33.8	-37	3.2	2.6	2.6	Diver core due to ship at wharf
AH-LM-03	2	13˚ 26′ 26.6″ N	144˚ 39′ 52.8″ E	-33.8	-37	3.2	3.0	3.0	Diver core due to ship at wharf
AH-LM-03	3	13˚ 26′ 26.6″ N	144˚ 39′ 52.8″ E	-33.8	-37	3.2	3.5	3.2	Diver core due to ship at wharf
AH-LM-04	1	13˚ 26′ 31.9″ N	144˚ 39′ 52.3″ E	-33.9	-37	3.1	7.5	3.1	
AH-LM-04	2	13˚ 26′ 31.9″ N	144˚ 39′ 52.3″ E	-33.9	-37	3.1	4.0	3.1	
AH-LM-04	3	13˚ 26′ 31.9″ N	144˚ 39′ 52.3″ E	-33.9	-37	3.1	3.1	3.1	
AH-LM-05	1	13˚ 26′ 23.9″ N	144˚ 39′ 52.7″ E	-33.0	-37	4.0	3.6	3.6	Diver core due to ship at wharf

Station ID	Attempt Number	Latitude (Degrees, Minutes, Decimal Seconds; NAD83)	Longitude (Degrees, Minutes, Decimal Seconds; NAD83)	Mudline Elevation (feet MLLW)	Maximum Dredging Depth Including Overdepth (feet MLLW)	Target Core Length (feet)	Retrieved Core Length (feet)	Core Length for Analysis (feet)[1]	Comments
AH-LM-05	2	13˚ 26′ 23.9″ N	144˚ 39′ 52.7″ E	-33.0	-37	4.0	4.0	4.0	Diver core due to ship at wharf
AH-LM-05	3	13˚ 26′ 23.9″ N	144˚ 39′ 52.7″ E	-33.0	-37	4.0	4.0	4.0	Diver core due to ship at wharf
AH-N-01	1	13˚ 26′ 18.5″ N	144˚ 39′ 45.5″ E	-33.4	-37	3.6	3.6	3.6	
AH-N-01	2	13˚ 26′ 18.5″ N	144˚ 39′ 45.5″ E	-33.4	-37	3.6	3.2	3.2	
AH-N-01	3	13˚ 26′ 18.5″ N	144˚ 39′ 45.5″ E	-33.4	-37	3.6	1.5	1.5	
AH-N-01	4	13˚ 26′ 18.5″ N	144˚ 39′ 45.5″ E	-33.4	-37	3.6	5.0	3.6	
AH-N-02	1	13˚ 26′ 18.6″ N	144˚ 39′ 46.0″ E	-33.0	-37	4.0	3.8	3.8	Abundant debris
AH-N-02	2	13˚ 26′ 18.6″ N	144˚ 39′ 46.0″ E	-33.0	-37	4.0	3.0	3.0	Abundant debris
AH-N-02	3	13˚ 26′ 18.6″ N	144˚ 39′ 46.0″ E	-33.0	-37	4.0	2.8	2.8	Abundant debris
AH-N-02	4	13˚ 26′ 18.6″ N	144˚ 39′ 46.0″ E	-33.0	-37	4.0	4.5	4.0	Abundant debris
AH-N-03	1	13˚ 26′ 18.7″ N	144˚ 39′ 47.8″ E	-32.9	-37	4.1	7.0	4.1	
AH-N-03	2	13˚ 26′ 18.7″ N	144˚ 39′ 47.8″ E	-32.9	-37	4.1	4.7	4.1	
AH-N-03	3	13˚ 26′ 18.7″ N	144˚ 39′ 47.8″ E	-32.9	-37	4.1	2.4	2.4	Loss during recovery
AH-N-03	4	13˚ 26′ 18.7″ N	144˚ 39′ 47.8″ E	-32.9	-37	4.1	5.8	4.1	
AH-N-04	1	13˚ 26′ 18.9″ N	144˚ 39′ 49.8″ E	-33.2	-37	3.8	4.2	3.8	
AH-N-04	2	13˚ 26′ 18.9″ N	144˚ 39′ 49.8″ E	-33.2	-37	3.8	4.0	3.8	
AH-N-04	3	13˚ 26′ 18.9″ N	144˚ 39′ 49.8″ E	-33.2	-37	3.8	3.8	3.8	
AH-N-04	4	13˚ 26′ 18.9″ N	144˚ 39′ 49.8″ E	-33.2	-37	3.8	3.2	3.2	
AH-FP-01	1	13˚ 26′ 33.1″ N	144˚ 39′ 48.4″ E	-8.8	-12	3.2	3.2	3.2	
AH-FP-01	2	13˚ 26′ 33.1″ N	144˚ 39′ 48.4″ E	-8.8	-12	3.2	3.0	3.0	
AH-FP-01	3	13˚ 26′ 33.1″ N	144˚ 39′ 48.4″ E	-8.8	-12	3.2	2.6	2.6	
AH-FP-01	4	13˚ 26′ 33.1″ N	144˚ 39′ 48.4″ E	-8.8	-12	3.2	2.8	2.8	
AH-FP-01	5	13˚ 26′ 33.1″ N	144˚ 39′ 48.4″ E	-8.8	-12	3.2	3.2	3.2	
AH-FP-02	1	13˚ 26′ 31.3″ N	144˚ 39′ 49.5″ E	-9.0	-12	3.0	2.8	2.8	
AH-FP-02	2	13˚ 26′ 31.3″ N	144˚ 39′ 49.5″ E	-9.0	-12	3.0	3.5	3.0	
AH-FP-02	3	13˚ 26′ 31.3″ N	144˚ 39′ 49.5″ E	-9.0	-12	3.0	3.0	3.0	
AH-FP-02	4	13˚ 26′ 31.3″ N	144˚ 39′ 49.5″ E	-9.0	-12	3.0	3.0	3.0	
AH-FP-02	5	13˚ 26′ 31.3″ N	144˚ 39′ 49.5″ E	-9.0	-12	3.0	3.0	3.0	
AH-FP-03	1	13˚ 26′ 33.4″ N	144˚ 39′ 50.5″ E	-9.0	-12	3.0	3.0	3.0	
AH-FP-03	2	13˚ 26′ 33.4″ N	144˚ 39′ 50.5″ E	-9.0	-12	3.0	3.0	3.0	
AH-FP-03	3	13˚ 26′ 33.4″ N	144˚ 39′ 50.5″ E	-9.0	-12	3.0	3.0	3.0	

Station ID	Attempt Number	Latitude (Degrees, Minutes, Decimal Seconds; NAD83)	Longitude (Degrees, Minutes, Decimal Seconds; NAD83)	Mudline Elevation (feet MLLW)	Maximum Dredging Depth Including Overdepth (feet MLLW)	Target Core Length (feet)	Retrieved Core Length (feet)	Core Length for Analysis (feet)[1]	Comments
AH-FP-03	4	13˚ 26′ 33.4″ N	144˚ 39′ 50.5″ E	-9.0	-12	3.0	3.0	3.0	
AH-FP-04	1	13˚ 26′ 31.9″ N	144˚ 39′ 51.0″ E	-8.0	-12	4.0	3.6	3.6	Station repositioned due to lines
AH-FP-04	2	13˚ 26′ 31.9″ N	144˚ 39′ 51.0″ E	-8.0	-12	4.0	2.5	2.5	
AH-FP-04	3	13˚ 26′ 31.9″ N	144˚ 39′ 51.0″ E	-8.0	-12	4.0	4.0	4.0	
AH-FP-04	4	13˚ 26′ 31.9″ N	144˚ 39′ 51.0″ E	-8.0	-12	4.0	4.0	4.0	

Note:
1 Sediment collected deeper than the project depth plus 2 feet over dredge was discarded and not used for analysis.

Metals, PAHs, pesticides, SVOCs, organotins, PCBs, dioxins, and furans were detected in sediment from AH-FP-COMP (Table 7). Concentrations of all metals except cadmium and chromium exceeded their corresponding ERM values. Cadmium was not detected and the chromium concentration exceeded its respective ERL value. Dibenz (a,h) Anthracene was the only PAH detected at a value greater than its corresponding ERL value, however, total HMW PAHs also exceeded the respective ERL value. The concentration of total PAHs was below the corresponding ERL value. For pesticides, the total DDT concentration exceeded the corresponding ERL value and the concentration of chlordane was greater than the respective ERM value. Numerous individual PCB congeners were detected and total PCB congeners exceeded the corresponding ERM value. The total TEQ for dioxins/furans in AH-FP-Comp was 26.9 pg/g (Table 8).

3.2.3 Lima and Mike Wharves

The AH-LM-COMP sample consisted of sediment from five stations located in areas of shoaling along Lima and Mike Wharves, adjacent to the former Naval SRF. The sediment grain size in this area consisted of 8.2 percent fines, 81.1 percent sand, and 10.7 percent gravel (Table 7). The liquid limit was 20.4 percent, and there was no plasticity. Atterberg classification of the sediment was NP.

TOC was measured at a concentration of 0.7 percent. Total solids and TVS were measured at concentrations of 69.9 and 1.8 percent, respectively. Ammonia was measured at a concentration of 0.4 percent and dissolved sulfide was not detected. TRPH and oil and grease were both measured at a concentration of 240 mg/kg.

Metals, PAHs, pesticides, SVOCs, organotins, PCBs, dioxins, and furans were detected in sediment from AH-LM-COMP (Table 7). Concentrations of all metals except cadmium exceeded their corresponding ERL values. Arsenic, copper, lead, mercury, and nickel were also greater than their corresponding ERM values. Several PAHs were detected at concentrations exceeding their respective ERL values but none were greater than ERM values. The concentration of total PAHs (4,983 µg/kg) was greater than its corresponding ERL value (4,022 µg/kg) but well below the ERM value (44,792 µg/kg). Two pesticides were measured at values exceeding their corresponding ERL values and the chlordane

concentration exceeded the corresponding ERM value. Numerous individual PCB congeners were detected and total PCB congeners (233 µg/kg) was greater than its corresponding ERM value (180 µg/kg). The total TEQ for dioxins/furans in AH-N-Comp was 8.6 pg/g (Table 8).

3.2.4 November Wharf

The AH-N-COMP sample consisted of sediment from four stations located in areas of shoaling along November Wharf. Grain size in this area consisted of 28.4 percent fines, 66.9 percent sand, and 4.7 percent gravel (Table 7). The liquid limit was 28.0 percent, and there was no plasticity. Atterberg classification of the sediment was NP.

TOC was measured at a concentration of 1.3 percent, total solids at 63.2 percent, and TVS at 1.7 percent. Ammonia and dissolved sulfide were not detected. TRPH and oil and grease were both measured at a concentration of 1500 mg/kg.

Metals, PAHs, pesticides, SVOCs, organotins, PCBs, dioxins, and furans were detected in sediment from AH-N-COMP (Table 7). Concentrations of all metals exceeded their corresponding ERL values. Copper, lead, nickel, and zinc were also greater than their corresponding ERM values. Several PAHs were detected in sediment from AH-N-COMP at concentrations exceeding their respective ERL values, but none were greater than ERM values. The concentration of total PAHs (4,518 µg/kg) was greater than its corresponding ERL value. Several pesticides exceeded their corresponding ERL values. The pesticides 4,4'-DDE and chlordane (both measuring 11 µg/kg) also exceeding their respective ERM values. Numerous individual PCB congeners were detected and total PCB congeners (672 µg/kg) was greater than its corresponding ERM value (180 µg/kg). The total TEQ for dioxins/furans in AH-N-Comp was 12.9 pg/g (Table 8).

Table 7
Results of Physical and Chemical Analyses of Sediment

Parameters	ERL	ERM	AH-ABTB-Comp 2/9/2015	AH-FP-COMP 2/9/2015	AH-LM-COMP 2/9//2015	AH-N-COMP 2/9/2015	G-DODS Reference Sediment Station GO-5
Conventional Parameters							
Total organic carbon (%)			**1.3**	**0.73**	**0.69**	**1.3**	**0.8**
Total solids (%)			**54.4**	**69.4**	**69.9**	**63.2**	**53.3**
Total volatile solids (%)			**2.5**	**1.9**	**1.8**	**1.7**	**-**
HEM: Oil and Grease (mg/kg)			**43**	**770**	**240**	**1500**	**-**
Sulfide, total (mg/kg)			**0.74**	**1.3**	**1**	**5.4**	**-**
Sulfide, dissolved (mg/L)			<0.017	<0.017	<0.017	<0.017	-
TRPH (µg/kg)			**46**	**600**	**240**	**1500**	**-**
Ammonia (as N) (mg/kg)			**0.51**	**0.4**	**0.4**	<0.017	**0.5**
Total Cyanide (mg/kg)			<0.41	<0.32	<0.32	<0.35	**-**
Grain Size (%)							
Clay (less than 0.00391 mm)			**5.54**	**1.57**	**1.89**	**8.12**	**8.75**
Coarse sand (0.5 to 1 mm)			**25.2**	**27.61**	**34.27**	**28.02**	-
Fine sand (0.125 to 0.25 mm)			**12.13**	**7.63**	**4.82**	**5.5**	-
Gravel (greater than 2 mm)			**6.7**	**11.7**	**10.69**	**4.72**	**0.0**
Medium sand (0.25 to 0.5 mm)			**24.36**	**20.55**	**15.17**	**17.82**	-
Silt (0.00391 to 0.0625 mm)			**13.63**	**5.95**	**6.33**	**20.3**	**33.96**
Total silt and clay (0 to 0.0625 mm)			**19.16**	**7.52**	**8.21**	**28.42**	**42.7**
Very coarse sand (1 to 2 mm)			**7.93**	**22.49**	**24.99**	**9.19**	-
Very fine sand (0.0625 to 0.125 mm)			**4.51**	**2.5**	**1.86**	**6.33**	-
Total Sand			**74.13**	**80.78**	**81.11**	**66.86**	**57.3**
Atterberg Limits							
Atterberg limit - liquid limit			40.8	22.2	20.4	28.0	-

Parameters	ERL	ERM	AH-ABTB-Comp 2/9/2015	AH-FP-COMP 2/9/2015	AH-LM-COMP 2/9//2015	AH-N-COMP 2/9/2015	G-DODS Reference Sediment Station GO-5
Atterberg limit - plastic limit			-	-	-	-	-
Plasticity index			NP	NP	NP	NP	-
Metals (mg/kg)							
Arsenic	8.2	70	**5.54**	**73.8**	**532**	**37.7**	**6.012**
Cadmium	1.2	9.6	<0.105	<0.0825	<0.0819	**1.58**	**0.11**
Chromium	81	370	**61.5**	**198**	**172**	**232**	**61.2**
Copper	34	270	**83.8**	**450**	**741**	**547**	**39.02**
Lead	46.7	218	**63.9**	**320**	**423**	**441**	**3.05**
Mercury	0.15	0.71	<0.0108	**1.34**	**1.11**	**0.668**	**0.06**
Nickel	20.9	51.6	**18.5**	**185**	**38.6**	**64.7**	**46.36**
Zinc	150	410	**178**	**1630**	**1340**	**1290**	**35.97**
Organotins (µg/kg)							
Monobutyltin			<2.6	< 2	<2	<2.2	< 1
Dibutyltin			<1.3	**9.7**	**18**	**8.1**	< 1
Tetrabutyltin			<1.4	< 1.1	<1.1	<1.2	< 1
Tributyltin			<2.7	**4.1 J**	**9.5**	**13**	< 1
Total butyltins (ND = 0)			<2.7	**13.8**	**27.5**	**21.1**	< 1
Pesticides (µg/kg)							
2,4'-DDD	2	20	<0.089	<0.07	**0.55**	**1.6**	<1
2,4'-DDE	2.2	27	<0.088	**0.5**	<0.069	<0.076	<1
2,4'-DDT	1	7	<0.058	< 0.046	< 0.046	< 0.51	< 1
4,4'-DDD	2	20	**0.2 J**	< 0.061	**2.1**	**9**	<1
4,4'-DDE	2.2	27	**0.19 J**	**1.9**	**1.3**	**3.1**	<1
4,4'-DDT	1	7	**0.16 J**	< 0.12	**8.2**	**11**	<1
Total DDTs (ND = 0)	1.58	46.1	<0.55	**2.4**	**12.15**	**24.7**	< 1
alpha-BHC			< 0.12	< 0.092	< 0.092	<0.1	<1
beta-BHC			< 0.12	< 0.097	< 0.097	<0.11	<1
delta-BHC			<0.085	< 0.066	<0.067	<0.073	<1
gamma-BHC (Lindane)			<0.089	<0.07	<0.07	<0.077	< 1
Aldrin			<0.082	< 0.064	<0.065	<0.071	<1
Oxichlordane			<0.14	<0.11	<0.11	<0.12	<1
Chlordane	0.5	6	**1.3**	**7.4 J**	<1	**11 J**	<1
Dieldrin	0.02	8	<0.16	< 013	<0.13	<0.014	< 1

Parameters	ERL	ERM	AH-ABTB-Comp 2/9/2015	AH-FP-COMP 2/9/2015	AH-LM-COMP 2/9//2015	AH-N-COMP 2/9/2015	G-DODS Reference Sediment Station GO-5
Endosulfan sulfate			<0.14	< 0.11	<0.11	<0.12	<1
Endosulfan-alpha (I)			<0.11	< 0.089	<0.089	<0.098	<1
Endosulfan-beta (II)			<0.15	< 0.11	<0.11	<0.13	<1
Endrin			<0.16	< 0.13	< 0.13	< 0.14	< 1
Endrin aldehyde			<0.15	< 0.12	< 0.12	< 0.13	<1
Endrin ketone			<0.16	< 0.12	<0.012	<0.13	<1
Heptachlor			<0.11	< 0.083	< 0.083	< 0.091	<1
Heptachlor epoxide			<0.1	< 0.08	< 0.08	**1.1**	< 1
Methoxychlor			<0.11	< 0.83	< 0.083	< 0.091	<1
Toxaphene			<1.1	<0.9	< 0.9	< 0.99	< 1
PAH (µg/kg)							
1-Methylnaphthalene			<6.9	<5.4	<5.3	**6 J**	< 1
2-Methylnaphthalene	70	670	<6.6	<5.2	<5.1	**5.9 J**	< 1
Acenaphthene	16	500	<8.7	<6.8	**7 J**	**53**	< 1
Acenaphthylene	44	640	**51**	**27**	**24**	**37**	< 1
Anthracene	85.3	1100	**60**	**41**	**62**	**69**	< 1
Benzo (a) anthracene	261	1600	**78**	**99**	**340**	**190**	< 1
Benzo (a) pyrene	430	1600	**290**	**330**	**590**	**680**	< 1
Benzo (b) fluoranthene			**290**	**460**	**730**	**880**	< 1
Benzo (g,h,i) perylene			**170**	**260**	**400**	**460**	< 1
Benzo (K) fluoranthene			**320**	**380**	**650**	**670**	< 1
Chrysene	384	2800	**220**	**160**	**440**	**270**	< 1
Dibenz (a,h) anthracene	63.4	260	**60**	**78**	**130**	**140**	< 1
Fluoranthene	600	5100	**100**	**180**	**490**	**180**	< 1
Fluorene	19	540	<9.4	<7.4	<7.3	**17**	< 1
Indeno (1,2,3-c,d) pyrene			**170**	**270**	**440**	**470**	< 1
Naphthalene	160	2100	<7	<5.5	<5.4	**32**	< 1
Phenanthrene	240	1500	**40**	**48**	**120**	**48**	< 1
Pyrene	665	2600	**140**	**190**	**560**	**310**	< 1
Total HMW PAHs (ND = 0)	1700	9600	**1838**	**2407**	**4770**	**4250**	< 1
Total LMW PAHs (ND = 0)	552	3160	**151**	**116**	**213**	**267.9**	< 1

Parameters	ERL	ERM	AH-ABTB-Comp 2/9/2015	AH-FP-COMP 2/9/2015	AH-LM-COMP 2/9//2015	AH-N-COMP 2/9/2015	G-DODS Reference Sediment Station GO-5
Total PAHs (ND = 0)	4022	44792	**1989**	**2523**	**4983**	**4517.9**	< 1
SVOCs – Phenols (µg/kg)							
2,4,6-Trichlorophenol			< 6.7	<5.3	<5.2	<5.7	-
2,4-Dichlorophenol			<4.9	<3.9	<3.8	<4.2	-
2,4-Dimethylphenol			<5.7	**8.4 J**	<4.4	<4.9	-
2,4-Dinitrophenol			<100	< 78	<77	<85	-
2-Chlorophenol			<6.2	< 4.9	<4.8	<5.3	-
2-Nitrophenol			<4.4	< 3.5	<3.4	<3.8	-
3/4-Methylphenol			<4.7	**120**	<3.7	<4.1	-
4,6-Dinitro-2-methylphenol			<130	< 100	<99	<110	-
4-Nitrophenol			<120	< 93	<92	<100	-
SVOCs – Phthalates (µg/kg)							
Bis(2-ethylhexyl) phthalate			**800 B**	**370 B**	**160 B**	**3200 B**	-
Butyl benzyl phthalate			**14 J**	< 6.4	<6.3	<7	-
Di-n-Butyl Phthalate			**71 B**	**71 B**	**28 B**	<8.1	-
Di-n-octyl Phthalate			<8.7	< 6.9	<6.8	<7.5	-
Diethyl phthalate			<9.2	< 7.3	<7.1	<7.9	-
Dimethyl phthalate			<9.9	< 7.8	<7.7	<8.5	-
Pentachlorophenol			<2.4	<1.9	<1.8	<2	-
Phenol			<6.8	<5.4	<5.3	<5.8	-
PCB Congeners (µg/kg)							
PCB003			<0.086	< 0.067	<0.067	<0.075	< 1
PCB005/008			**0.83**	< 0.067	**3.1**	<0.074	< 1
PCB018			**1.7**	< 0.056	**7.7**	<0.062	<1
PCB028			**0.9**	<0.079	**3.8**	<0.088	< 1
PCB031			<0.054	<0.042	**2.7**	<0.047	< 1
PCB033			<0.063	< 0.049	**3.1**	**12**	<1
PCB037			<0.065	< 0.051	<0.05	<0.056	< 1
PCB044			**0.49**	**1.6**	**3.9**	**4.3**	< 1
PCB049			**1.6**	**2.1**	**3.6**	**15**	<1
PCB052			**1.8**	**3.6**	**8**	**15**	< 1
PCB056			<0.088	<0.068	<0.068	<0.076	< 1
PCB060			<0.12	< 0.089	< 0.089	<0.1	<1

Parameters	ERL	ERM	AH-ABTB-Comp 2/9/2015	AH-FP-COMP 2/9/2015	AH-LM-COMP 2/9//2015	AH-N-COMP 2/9/2015	G-DODS Reference Sediment Station GO-5
PCB066			**0.44**	**0.82**	**1.6**	**3**	< 1
PCB070			<0.089	**1.9**	**3.9**	**3.9**	< 1
PCB074			**0.31 J**	**0.76**	**1.8**	**3.9**	<1
PCB077			<0.16	**2**	**2**	<0.14	<1
PCB081			<0.12	< 0.091	< 0.091	<0.1	< 1
PCB087			<0.075	**2.2**	**4.5**	**3.4**	< 1
PCB095			**2.7**	**8**	**12**	**24**	<1
PCB097			**0.99**	**3.6**	**4.5**	**9.7**	< 1
PCB099			**1.5**	**4.3**	**5.7**	**14**	< 1
PCB101			**3.2**	**10**	**15**	**34**	<1
PCB105			**1.8**	4.4	**5.4**	**10**	< 1
PCB110			**1.3**	**6.1**	**12**	**18**	< 1
PCB114			<0.066	<0.051	<0.051	<0.057	<1
PCB118			**1.3**	**6.4**	**11**	**13**	< 1
PCB119			<0.084	**0.68**	<0.065	**3.8**	< 1
PCB123			<0.086	<0.067	<0.067	<0.075	<1
PCB126			<0.062	<0.048	<0.048	<0.054	< 1
PCB128			**0.52**	**1.7**	**2.4**	**4.9**	< 1
PCB132/153			**18**	**27**	**24**	**110**	<1
PCB138/158			**7**	**16**	**15**	**58**	< 1
PCB141			**1.7**	**3.5**	**3.5**	**14**	< 1
PCB149			**5.6**	**12**	**11**	**48**	<1
PCB151			**2.2**	**4**	**3.6**	**15**	< 1
PCB156			**0.61**	**1.1**	**1.5**	**5.2**	<1
PCB157			**0.23 J**	**0.88**	**0.61**	**3.8**	< 1
PCB167			**0.24 J**	**0.42**	**0.77**	**2.7**	< 1
PCB168			<0.082	<0.064	<0.064	<0.071	<1
PCB169			**1.3**	**1.1**	**0.92**	**3.8**	< 1
PCB170			**12**	**8.6**	**6.4**	**29**	< 1
PCB174			**6.3**	**7.4**	**6.3**	**29**	<1
PCB177			**3.1**	**2.9**	**2.6**	**12**	< 1
PCB180			**22**	**18**	**14**	**61**	< 1
PCB183			**4.7**	**4**	**3**	**14**	<1
PCB187			**9.5**	**8.8**	**7.3**	**32**	<1

Parameters	ERL	ERM	AH-ABTB-Comp 2/9/2015	AH-FP-COMP 2/9/2015	AH-LM-COMP 2/9//2015	AH-N-COMP 2/9/2015	G-DODS Reference Sediment Station GO-5
PCB189			**0.87**	<0.036	<0.036	<0.04	< 1
PCB194			**8.7**	**4.1**	**4.8**	**14**	< 1
PCB195			**5.2**	**2.8**	**3.7**	**6.3**	<1
PCB200			**1.3**	**0.72**	**0.7**	**1.7**	<1
PCB201			**0.91**	**0.68**	**0.73**	**2**	< 1
PCB206			**2.6**	**4.4**	**2.7**	**10**	< 1
PCB209			<0.12	**6**	**2.2**	**8.9**	<1
Total PCB Congeners (ND = 0)	22.7	180	**135.44**	**194.56**	**233.03**	**672.3**	<1

Notes:

PCB 138/158 analyzed together.

Detected concentration is greater than the ERL value.

Detected concentration is greater than the ERM value.

Bold = detected result

ND = not detected

< = less than listed MDL

J = indicates an estimated value

B = Analyte was present in the associated method blank.

mm= millimeter

Total Low PAH are the total of 1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene.

Total High PAHs are the total of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

Totals are calculated as the sum of all detected results.

Level I data validation.

Table 8

Results of Dioxin and Furan Analyses of Sediment with Total TEQ Values

Parameter	Units	TEQ (WHO 2005)	AH-ABTB-COMP	AH-FP-COMP	AH-LM-COMP	AH-N-COMP	G-DODS Reference Sediment Station GO-5
2,3,7,8-Tetra CDD	pg/g	1.00	0.138 U	0.354 U (1)	0.135 U	0.349 J	< 0.13
1,2,3,7,8-Penta CDD	pg/g	1.00	0.340 J	3.54 J	0.66 J	1.71 J	< 0.13
1,2,3,4,7,8-Hexa CDD	pg/g	0.100	1.50 J	7.76	1.26 J	2.80 J	< 0.16
1,2,3,6,7,8-Hexa CDD	pg/g	0.100	6.36	24.6	8.40	11.8	< 0.13
1,2,3,7,8,9-Hexa CDD	pg/g	0.100	8.55	31.2	8.41	14.5	< 0.16
1,2,3,4,6,7,8-Hepta CDD	pg/g	0.0100	447	892	318	396	< 1.4
Octa CDD	pg/g	0.000300	3190	6520 (2)	2660	2430	20.1
Total Tetra CDD	pg/g	N/A	0.262 J	5.06	1.63	5.31	< 0.33
Total Penta CDD	pg/g	N/A	11.6	81.3	36.7	60.5	2.67
Total Hexa CDD	pg/g	N/A	201	573	218	281	< 2.4
Total Hepta CDD	pg/g	N/A	1740	2440	984	1310	1.48
2,3,7,8-Tetra CDF	pg/g	0.100	0.812 J	3.04	1.83	2.51	0.30 J
1,2,3,7,8-Penta CDF	pg/g	0.0300	0.506 J	2.04 J	0.988 J	1.66 J	< 0.18
2,3,4,7,8-Penta CDF	pg/g	0.300	0.607 J	2.19 J	1.17 J	2.21 J	< 0.19
1,2,3,4,7,8-Hexa CDF	pg/g	0.100	2.26 J	13.0	4.27 J	6.49	< 0.13
1,2,3,6,7,8-Hexa CDF	pg/g	0.100	1.49 J	9.17	2.77 J	5.02	< 0.12
2,3,4,6,7,8-Hexa CDF	pg/g	0.100	1.03 J	5.41	1.69 J	4.07 J	< 0.14
1,2,3,7,8,9-Hexa CDF	pg/g	0.100	0.167 J	0.799 J	0.266 U (1)	0.388 J	< 0.17
1,2,3,4,6,7,8-Hepta CDF	pg/g	0.0100	26.6	185	60.5	71.2	< 1.9
1,2,3,4,7,8,9-Hepta CDF	pg/g	0.0100	2.19 J	14.8	5.42	4.17 J	< 0.14

Parameter	Units	TEQ (WHO 2005)	AH-ABTB-COMP	AH-FP-COMP	AH-LM-COMP	AH-N-COMP	G-DODS Reference Sediment Station GO-5
Octa CDF	pg/g	0.000300	94.2	461	197	113	1.55 J
Total Tetra CDF	pg/g	N/A	2.65	18.9	8.38	13.0	0.69
Total Penta CDF	pg/g	N/A	9.12	42.9	16.7	37.4	< 0.41
Total Hexa CDF	pg/g	N/A	39.7	277	119	126	0.55
Total Hepta CDF	pg/g	N/A	102	559	220	186	< 1.9
Total TEQ (ND = 0)	**pg/g**		**8.60**	**26.9**	**8.66**	**12.9**	**0.04**

Notes:
NA – Not applicable
ND = Not detected
J = Estimated concentration between the EDL & RDL
U = Undetected at the limit of quantitation
(1) = Peak detected does not meet ratio criteria and has resulted in an elevated detection limit
(2) = Diphenylether interference present caused dibenzofuran detected to become a "non-detect" with an elevated detection limit

3.2.5 Chemical Analyses for Individual Stations

Material from individual stations with the composite areas of November Wharf, Lima/Mike Wharves, and the Finger Piers area were analyzed for metals and PCBs based on results of the chemical and biological testing of the area composite samples. A total of 13 individual station samples were analyzed, five from composite area AH-LM-COMP, four from AH-N-COMP, and four from AH-FP COMP. The results are presented in Table 9.

As shown in Table 9, ERL values for total PCBs and most metals were exceeded at all stations. The ERM values for most of the metals were also exceeded at all stations except AH-FP-01, AH-LM-01, and AH-N-03. The ERM value for total PCBs was exceeded at all stations except AH-FP-01, AH-FP-03, AH-LM-01, AH-LM-03, and AH-N-03.

Based on the metal and PCB results for the individual stations analyzed, in combination with the area composite chemistry results, some level of contamination is present in three of the four project composite areas, AH-N, AH-LM, and AH-FP. Based on this information and the bioassay results discussed below, it was determined that the dredge material should be evaluated for upland placement.

3.2.6 Quality Assurance/Quality Control

Laboratory QA/QC samples included laboratory replicates, matrix spike/matrix spike duplicate (MS/MSD) samples, method blanks, laboratory control samples, and standard reference materials. Surrogates were included for all organic methods. QC objectives and the frequency of analysis for QA/QC samples are provided in the SAP (E2 et al. 2015). In addition, initial and ongoing calibrations were completed. All laboratory data were reviewed and verified by Anchor QEA, LLC (Anchor), to determine whether QC objectives had been met and that appropriate corrective actions were taken, when necessary (Appendix C).

Table 9

Metals and PCB Results for Individual Stations

	Sample ID			AH-FP-01	AH-FP-02	AH-FP-03	AH-FP-04	AH-LM-01	AH-LM-02	AH-LM-03	AH-LM-04	AH-LM-05	AH-N-01	AH-N-02	AH-N-03	AH-N-04
	Sample Date	ERL	ERM	2/18/2015	2/18/2015	2/18/2015	2/18/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015	2/17/2015
Conventional Parameters (%)																
	Total Solids			76	84.6	84.6	78.7	75.3	77.7	81.3	85.5	72.8	72.9	68	76.2	68.3
Metals (mg/kg)																
	Arsenic	8.2	70	32.9	34.7	113	74.2	13.3	49.9	684	254	1020	38.6	21.1	17.2	29.8
	Cadmium	1.2	9.6	0.359	0.776	0.598	0.571	0.223	0.662	1.17	1.42	1	2.05	2.52	0.281	1.3
	Chromium	81	370	57.7	137	99.8	395	36.1	54.8	136	113	114	137	406	35	101
	Copper	34	270	163	296	1050	1920	154	742	1210	756	1160	700	425	66	547
	Lead	46.7	218	110	251	384	462	67.4	273	603	526	604	396	533	90.5	247
	Mercury	0.15	0.71	0.331	0.976	0.446	0.399	0.215	1.03	0.353	3.3	0.455	0.472	0.877	0.35	4.52
	Nickel	20.9	51.6	33.1	57.9	111	227	21.6	24.8	53.3	54.6	43.3	122	84.6	18.9	60.6
	Zinc	150	410	402	932	2790	1870	168	641	2900	2610	2440	1370	2260	129	988
PCB Congeners (ug/kg)																
	PCB003			0.11 U	0.1 U	0.1 U	0.11 U	0.12 U	0.11 U	0.11 U	0.1 U	0.53	0.12 U	0.13 U	0.11 U	0.13 U
	PCB005/008			0.19 U	0.17 U	0.17 U	0.19 U	0.19 U	0.19 U	0.18 U	0.17 U	0.2 U	0.2 U	0.21 U	0.19 U	0.21 U
	PCB018			0.094 U	0.084 U	0.084 U	0.091 U	0.095 U	0.091 U	2	0.084 U	2.6	0.098 U	0.1 U	0.094 U	0.1 U
	PCB031			0.066 U	0.059 U	0.058 U	0.063 U	0.066 U	0.064 U	0.061 U	0.058 U	1.9	0.068 U	0.073 U	0.066 U	0.073 U
	PCB033			0.16 U	0.15 U	0.15 U	0.16 U	0.17 U	0.16 U	0.15 U	0.15 U	2	0.17 U	0.18 U	0.16 U	0.18 U
	PCB037			0.08 U	0.071 U	0.071 U	0.077 U	0.081 U	0.077 U	0.075 U	0.071 U	0.083 U	0.083 U	0.088 U	0.08 U	0.088 U
	PCB044			0.11 U	4	1.2	3	0.12 U	2.8	1	3.8	24	7.2	7.7	2.3	4
	PCB049			0.89	8.4	0.68	1.4	0.15 U	5.4	0.8	7.2	7.7	27	20	1.4	8.3
	PCB052			1	10	2.4	6.4	0.084 U	5.8	1.7	8.4	59	22	30	2.3	9
	PCB056			0.17 U	0.15 U	0.15 U	0.16 U	0.17 U	0.16 U	0.16 U	0.15 U	6.6	0.17 U	0.18 U	0.17 U	0.18 U
	PCB060			0.19 U	0.17 U	0.17 U	0.18 U	0.19 U	0.18 U	0.18 U	0.17 U	5.8	0.2 U	0.21 U	0.19 U	0.21 U
	PCB066			0.14 U	3.2	0.7	1.4	0.14 U	1.7	0.6	3.1	9.4	5.3	5.1	0.77	3.1
	PCB070			0.079 U	3.3	1.1	3.8	0.08 U	3.4	0.68	4.1	39	7.3	8.3	1.1	6.2
	PCB074			0.11 U	3.6	1	1.6	0.12 U	0.11 U	0.41	3	8.2	4.8	0.13 U	0.11 U	4.6
	PCB077			1.1	5.1	0.091 U	3.1	0.1 U	0.099 U	0.096 U	0.091 U	7.6	13	0.11 U	0.1 U	0.11 U
	PCB081			0.16 U	0.14 U	0.14 U	0.15 U	0.16 U	0.15 U	0.15 U	0.14 U	0.16 U	0.17 U	0.18 U	0.16 U	0.18 U
	PCB087			0.45	3.4	1.5	5.8	0.14 U	2.7	0.82	2.7	46	8.5	3.8	0.65	2
	PCB095			3.9	20	5.7	15	2.7	18	3	13	89	60	36	3.7	10
	PCB097			1.1	9	3.5	6.3	0.18 U	7.9	1.2	6	43	8.4	12	2.6	7.6
	PCB099			2.5	9.5	2.4	5.4	0.99	14	1.4	6.9	40	31	18	1.8	7.1
	PCB101			4	25	6.8	19	2.3	19	3.5	16	120	77	38	4.7	13
	PCB105			1.1	8.4	3.4	7.7	0.073 U	11	1.7	8.8	41	18	0.08 U	0.072 U	0.08 U
	PCB110			1.2	14	5.6	16	1.4	12	2.5	10	110	35	27	3.3	10
	PCB114			0.11 U	0.097 U	0.096 U	0.1 U	0.11 U	0.11 U	0.1 U	0.096 U	2.8	0.11 U	0.12 U	0.11 U	0.12 U
	PCB118			1	12	4.6	11	0.99	6.6	1.9	8.9	100	26	20	3.2	11
	PCB119			0.55	4.6	0.11 U	0.12 U	0.57	0.12 U	0.12 U	3	1.8	6.6	0.14 U	0.12 U	0.14 U
	PCB123			0.14 U	0.12 U	0.12 U	0.13 U	0.14 U	2.6	0.13 U	0.12 U	0.14 U	0.14 U	0.15 U	0.14 U	0.15 U
	PCB126			0.11 U	0.095 U	0.094 U	0.1 U	0.11 U	0.1 U	0.099 U	0.094 U	0.11 U	0.11 U	0.12 U	0.11 U	0.12 U
	PCB128			0.81	5.3	1.2	5.7	0.14 U	4.2	0.9	2.5	23	13	6.8	0.13 U	0.15 U
	PCB132/153			22	72	13	73	7.7	56	10	33	120	260	81	9.7	27
	PCB138/158			11	44	9.1	52	4.8	36	6.5	19	110	150	52	6	18
	PCB141			1.8	12	2.2	13	0.15 U	10	1.3	6.3	18	40	18	1.3	3.4
	PCB149			9.6	39	7.1	31	4.8	33	5.1	17	59	130	53	5.6	17
	PCB151			2.9	12	1.9	9.2	1.6	11	1.5	6.4	11	38	19	1.7	6.9
	PCB156			0.65	3.1	0.99	4.7	0.077 U	1.6	0.69	0.068 U	15	8.8	0.084 U	0.076 U	0.084 U
	PCB157			0.069 U	0.062 U	0.061 U	0.067 U	0.07 U	4	0.065 U	0.061 U	4.4	0.072 U	0.076 U	0.069 U	0.076 U
	PCB167			0.19 J	0.073 U	0.072 U	1.7	0.082 U	0.079 U	0.076 U	0.072 U	4.9	4.7	0.09 U	0.081 U	0.09 U
	PCB168			0.064 U	0.058 U	0.057 U	0.062 U	0.065 U	0.062 U	0.06 U	0.057 U	0.067 U	0.067 U	0.071 U	0.064 U	0.071 U
	PCB169			0.7	0.072 U	0.072 U	2.9	0.44	0.078 U	0.54	1.1	0.083 U	8.1	0.089 U	0.08 U	0.089 U
	PCB170			7	20	3.8	33	3.2	19	3.6	9.4	13	71	23	3.3	9.7
	PCB174			5.7	18	3.7	30	0.19 U	15	3.5	8.6	9.6	66	23	3.1	7.8
	PCB177			2.9	7.3	1.3	14	1.1	7	1.5	3.7	4.5	32	10	1.7	3.8
	PCB180			16	44	8.7	77	6	35	7.9	21	22	160	52	5.9	18
	PCB183			3.9	10	1.8	17	1.3	7.8	2.1	4.5	5.4	37	11	2	3.8
	PCB184			0.14 U	0.12 U	0.12 U	0.13 U	0.14 U	0.13 U	0.13 U	0.12 U	0.14 U	0.14 U	0.15 U	0.14 U	0.15 U
	PCB187			8.1	22	4.4	32	3.3	17	4	11	10	74	31	3.9	11
	PCB189			0.44	0.072 U	0.072 U	1.4	0.081 U	0.078 U	0.075 U	0.072 U	1.1	0.084 U	0.089 U	0.08 U	0.089 U
	PCB194			3.8	9.6	2.4	15	1.8	8.4	2	4.4	3.7	29	19	1.4	4.6
	PCB195			1.6	2.9	0.8	6.6	0.16 U	2.1	1.4	1.2	0.16 U	15	5.6	0.15 U	0.17 U
	PCB200			0.43	1.6	0.35	2.4	0.18 U	0.18 U	0.17 U	1	0.19 U	4.5	2.6	0.18 U	0.2 U
	PCB201			0.71	1.9	0.38	2.2	0.82	2.4	0.61	1.1	2	4.6	4.5	0.13 U	1.1
	PCB206			0.84	7.1	1.5	3.6	1.6	9.8	1.5	3.6	4.6	15	24	1.3	11
	PCB209			1.7	9.9	0.17 U	1.5	0.19 U	28	0.18 U	7.3	2.9	7.2	29	1.9	14
	Total PCB Congeners (ND = 0	22.7	180	121.56 J	485.2	105.2	535.8	47.41	420.2	77.85	267	1212.03	1525	690.4	76.62	253

Note:

Bold = detected

Detected concentration is greater than ERL

Detected concentration is greater than ERM

3.3 Radiation Analyses

Radiological tests conducted on the four composite samples showed radiation levels were substantially less than International Atomic Energy Agency *de minimis* concentration (IAEA 2003). Cobalt 60 was not detected in samples; however, very low levels of both naturally occurring uranium 235 and non-naturally occurring radioactivity were identified (Table 10). The low level of uranium 235 was consistent with the normal trace concentrations of natural uranium in the environment. The very low levels of cesium, plutonium, and americium are consistent with levels detectable throughout the world due to fallout from historical atmospheric weapons testing. The full Navy report evaluating radiological analyses of proposed dredged material within Apra Harbor is presented in Appendix D.

Table 10
Radiation Analytical Results of Proposed Dredged Material from the Northern Inner Apra Harbor Project Area

Radionuclide	Maximum Specific Activity (pCi/g)	IAEA *de minimis* Concentration (pCi/g)
Cesium 137	0.008	33.4
Plutonium 239/240	0.055	96.5
Americium 241	0.014	117.5
Cobalt 60	<0.009	4.5
Plutonium 238	0.004	104
Uranium 235	0.063	10.9

Note:
pCi/g = average picocuries per gram

3.4 Results of Biological Testing

Results of biological testing of sediments from the Northern Inner Apra Harbor area are summarized in this section. The laboratory report, including detailed results and raw data, is provided in Appendix E. SP test results were compared to historical reference data collected from the G-DODS reference site (Weston 2008). The reference envelope for sediment collected from the G-DODS reference site is presented in Table 11.

Table 11
Reference Envelope for Sediment Collected from G-DODS Reference Site

Test Type	Type of Organism	Species	Reference Envelope Survival (%)	Basis for Comparison
SP	Amphipod	*Eohaustorius estuarius*	87	Only acceptable survival result (greater than 85%)
	Polychaete	*Neanthes arenaceodentata*	98.5	Mean reference survival

Note:
SPP = suspended particulate-phase

3.4.1 Solid Phase Testing

SP testing included the amphipod survival and juvenile polychaete survival bioassays. Test results are summarized in this section.

3.4.1.1 Amphipod Survival Bioassay

Test results for the 10-day amphipod (*Eohaustorius estuarius*) SP test are presented in Table 12. Mean survival in the control was 100%, which met the control acceptability criterion. Mean survival in test sediments ranged from 70 to 82%, which were within 20% of the reference envelope value (87%). These results indicate sediments from the Northern Inner Apra Harbor area are not acutely toxic to amphipods and meet limiting permissible concentration (LPC) requirements for ocean disposal.

Water quality measurements were within recommended limits. The LC_{50} for the ammonia reference toxicant test was within two standard deviations of the historical laboratory mean, indicating test organisms were of similar sensitivity to those previously tested at the laboratory. Ammonia concentrations measured in test treatments were below the No

Observed Effect Concentration (NOEC) values derived from the concurrent ammonia reference toxicant test, indicating ammonia likely did not affect test results.

Table 12
Summary of Amphipod Bioassay Results

Site	Mean Survival (%)	Standard Deviation (%)	Ocean Disposal Suitability Threshold (%)[1]	Significant Biological Effect?[2]
Control	100	0	—	—
AH-ABTB-COMP	75	13	67	No
AH-LM-COMP	81	11		No
AH-N-COMP	82	10		No
AH-FP-COMP	70	20		No

Notes:
1 Threshold equals reference envelope value (established based on historical G-DODS reference site data in conjunction with U.S. Environmental Protection Agency) minus 20%.
2 Test treatment mean survival is reduced by at least 20% of the reference envelope value.

3.4.1.2 Juvenile Polychaete Survival Bioassay

Test results for the 10-day polychaete (*Neanthes arenaceodentata*) SP test are presented in Table 13. Mean survival in the control was 100%, which met the control acceptability criterion. Mean survival in test sediments ranged from 94 to 98%, which were within 10% of reference envelope value (98.5%). These results indicate sediments from the Northern Inner Apra Harbor area are not acutely toxic to polychaetes and meet LPC requirements for ocean disposal.

Water quality measurements were within recommended limits. The LC_{50} for the ammonia reference toxicant test was within two standard deviations of the historical laboratory mean, indicating test organisms were of similar sensitivity to those previously tested at the laboratory. Ammonia concentrations measured in the test treatments were below the NOEC values derived from the concurrent ammonia reference toxicant test, indicating ammonia likely did not affect test results.

Table 13
Summary of Polychaete Bioassay Results

Site	Mean % Survival	Standard Deviation (%)	Ocean Disposal Suitability Threshold (%)[1]	Significant Biological Effect?[2]
Control	100	0	—	—
AH-ABTB-COMP	94	6	88.5	No
AH-LM-COMP	98	5		No
AH-N-COMP	96	6		No
AH-FP-COMP	94	6		No

Notes:
1 Threshold equals reference envelope value (established based on historical G-DODS reference site data in conjunction with U.S. Environmental Protection Agency) minus 10%.
2 Test treatment mean survival is reduced by at least 10% of the reference envelope value.

3.4.2 Suspended Particulate Phase Testing

SPP testing included the bivalve larval development, mysid shrimp, and juvenile fish bioassays. Test results are summarized in this section.

3.4.2.1 Bivalve Larval Development Bioassay

Test results for the 48-hour bivalve (*Mytilus galloprovincialis*) SPP test are presented in Table 14. Mean combined normal development in the control was 100%, which met the control acceptability criterion. Mean combined normal development in the 100% concentration of the test treatments ranged from 91.2 to 97.3% and were not significantly different than the control. These results indicate that test sediments from the Northern Inner Apra Harbor area are not acutely toxic to bivalve larvae and meet LPC requirements for ocean disposal.

Water quality measurements were within recommended limits. The LC_{50} for the ammonia reference toxicant test was within two standard deviations of the historical laboratory mean, indicating test organisms were of similar sensitivity to those previously tested at the laboratory. Ammonia concentrations measured in the test treatments were below the NOEC values derived from the concurrent ammonia reference toxicant test, indicating ammonia likely did not affect test results.

Table 14
Summary of Bivalve Larval Bioassay Results

Treatment Site	Dilution Series (%)	Mean Combined Normal Development (%)[1]	Standard Deviation (%)	Significantly Less than Control?	EC_{50} (%)
Control	—	100	0	—	—
AH-ABTB-COMP	1	99.9	0.2	—	> 100
	10	99.3	1.7	—	
	50	98.1	2.5	—	
	100	97.3	2.5	No	
AH-LM-COMP	1	100	0.0	—	> 100
	10	96.1	4.6	—	
	50	99.8	0.6	—	
	100	96.9	3.1	No	
AH-N-COMP	1	98.8	1.6	—	> 100
	10	98.4	2.9	—	
	50	97.4	2.6	—	
	100	96.5	5.7	No	
AR-FP-COMP	1	95.8	6.3	—	> 100
	10	100	0	—	
	50	95.5	4.1	—	
	100	91.2	5.7	No	

Notes:
EC_{50} median effective concentration
1 Mean combined normal development is a combined endpoint calculated as the number of surviving, normally developed embryos divided by the mean stocking density.

3.4.2.2 Mysid Shrimp Bioassay

Test results for the 96-hour mysid shrimp (*Americamysis bahia*) SPP test are presented in Table 15. Mean survival in the control was 100%, which met the control acceptability criterion. Mean survival in the 100% concentration of the test treatments ranged from 78 to 100%. Test sediment results were not significantly different from the control, with one exception; sediment from November Wharf (AH-N-COMP) was statistically lower than the control. The LC_{50} was greater than 100% for all test treatments

Test results indicate additional analyses (i.e., STFATE) would be required to determine suitability of November Wharf sediments if sediment from this area would be considered for ocean disposal. However, NAVFAC determined that this sediment will be evaluated for

upland disposal only and, thus, no STFATE modeling was performed. Sediments from Alpha-Bravo Turning Basin (AH-ABTB-COMP), Lima and Mike Wharves (AH-LM-COMP), and Finger Pier (AH-FP-COMP) are not acutely toxic to mysid shrimp and meet LPC requirements for ocean disposal.

Water quality measurements were within recommended limits, with one exception. Dissolved oxygen (DO) was below the target limit on Day 1; aeration was then added, and DO remained within the target range for the duration of the test. The LC_{50} for the ammonia reference toxicant test was within two standard deviations of the historical laboratory mean, indicating test organisms were of similar sensitivity to those previously tested at the laboratory. Ammonia concentrations measured in the test treatments were below the NOEC values derived from the concurrent ammonia reference toxicant test, indicating ammonia likely did not affect test results.

Table 15
Summary of Mysid Shrimp Bioassay Results

Treatment	Dilution Series (%)	Mean % Normal Survival	Standard Deviation	Significantly Less than Control?	LC_{50} (%)
Control	—	100	0	—	—
AH-ABTB-COMP	10	100	0	—	> 100
	50	98	4	—	
	100	100	0	No	
AH-LM-COMP	10	94	9	—	> 100
	50	100	0	—	
	100	100	0	No	
AH-N-COMP	10	90	10	—	> 100
	50	74	29	—	
	100	78	11	**Yes**	
AH-FP-COMP	10	100	0	—	> 100
	50	94	13	—	
	100	98	4	No	

Note:
LC_{50} median lethal concentration

3.4.2.3 Juvenile Fish Bioassay

Test results for the 96-hour juvenile fish (*Menidia beryllina*) SPP test are presented in Table 16. Mean survival in the control was 100%, which met control acceptability criterion. Mean survival in the 100% concentration of the test sediments ranged from 96 to 100% and were not significantly different than the control. These results indicate that test sediments from the Northern Inner Apra Harbor area are not acutely toxic to fish and meet LPC requirements for ocean disposal.

Water quality measurements were within recommended limits, with one exception. DO was below the target limit on Day 1; aeration was then added, and DO remained within the target range for the duration of the test. The LC_{50} for the ammonia reference toxicant test was within two standard deviations of the historical laboratory mean, indicating test organisms were of similar sensitivity to those previously tested at the laboratory. Ammonia concentrations measured in the test treatments were below the NOEC values derived from the concurrent ammonia reference toxicant test, indicating ammonia likely did not affect test results.

Table 16
Summary of Juvenile Fish Bioassay Results

Treatment	Dilution Series (%)	Mean % Normal Survival	Standard Deviation	Significantly Less than Control?	LC_{50} (%)
Control	—	100	0	—	—
AH-ABTB-COMP	10	94	5	—	> 100
	50	100	0	—	
	100	100	0	No	
AH-LM-COM	10	98	4	—	> 100
	50	96	5	—	
	100	98	4	No	
AH-N-COMP	10	94	9	—	> 100
	50	98	4	—	
	100	96	9	No	
AH-FP-COMP	10	100	0	—	> 100
	50	100	0	—	
	100	100	0	No	

Note:
LC_{50} median lethal concentration

3.4.3 Bioaccumulation Potential Testing

BP tests were conducted with *Macoma nasuta* (clam) and *Neanthes virens* (polychaete). After a 28-day test exposure, organisms were placed into clean seawater for 24 hours to allow them to depurate the test sediment. After this purging process, tissue was shipped frozen to Eurofins for chemical analysis of contaminants of concern. Tissue chemistry results are presented separately in Section 3.5. This section provides results of BP testing.

Test results for the BP tests are presented in Table 17. Mean survival in the controls was 93 and 95% for *M. nasuta* and *N. virens*, respectively. Mean survival in the test treatments ranged from 88 to 98% for *M. nasuta* and 95 to 99% for *N. virens*. Adequate tissue mass was available at test completion for chemical analyses.

Water quality measurements were within recommended limits except for minor deviations in temperature in the *N. virens* test. However, temperature remained within species tolerance levels and, given the high survival observed in the test, it is unlikely test results were impacted.

Table 17
Summary of Bioaccumulation Testing Results

Treatment	*Macoma nasuta*		*Neanthes virens*	
	Mean Survival (%)	Standard Deviation (%)	Mean Survival (%)	Standard Deviation (%)
Control	93	2	95	5
AH-ABTB-COMP	97	2	95	9
AH-LM-COM	88	11	95	5
AH-N-COMP	98	2	95	6
AH-FP-COMP	94	6	99	2

3.4.4 Quality Assurance/Quality Control

Biological testing was performed in adherence with standard QA/QC procedures including negative controls (laboratory control treatments) and positive controls (i.e., reference toxicant tests), test replicates, and water quality measurements during testing. Negative controls met acceptability criteria in all tests. Positive controls demonstrated organisms used

in the tests were of comparable sensitivity to those previously tested by the laboratory. Therefore, test results were accepted as reported.

QA procedures were consistent with methods described in the OTM (USEPA/USACE 1991) and ITM (USEPA/USACE 1998). Project sediments were stored at 4 ± 2 °C, and tests were initiated within the 56-day holding period, with one exception. BP testing for two cores (AH-N-01 and AH-N-02) was initiated 58 days post-collection. Sediment elutriates were prepared using site water. Tests were performed using high-quality natural seawater. Water quality parameters were monitored daily and were within acceptable ranges during testing, with only the minor exceptions previously noted. Laboratory instruments were calibrated daily according to laboratory SOPs, and calibration data were logged and initialed.

Overall, data quality was deemed acceptable; results indicated no tests needed to be rerun and no data qualifications were necessary.

3.5 Chemical Analysis of Tissue Residues

Sediment bioaccumulation tests were conducted using *Macoma nasuta* and *Nereis virens*. Chemical analysis of tissue residues was conducted to determine the bioaccumulation potential of sediment contaminants. Based on results of sediment chemistry, a subset of chemicals was selected for analysis that included metals (including mercury), PAHs, PCBs, and dioxins/furans (see Table 4). The data evaluation consisted of comparing tissue burdens to the following:

- FDA action levels
- Historical reference sediment tissue burdens from G-DODS (Weston 2008)
- ERED (USACE/USEPA 2010)

Results of chemical analysis of bivalve and polychaete tissue residues are presented in Tables 18 and 19, respectively. All results are expressed in wet weight. MDLs, RLs, and raw data for the analyses are provided in Appendix F.

3.5.1 Comparison of Tissue Burdens to U.S. Food and Drug Administration Action Levels

A comparison of FDA action levels for poisonous or deleterious substances in fish and shellfish for human food is presented in Tables 18 and 19. The FDA action level for mercury is 1 mg/kg of methyl mercury. Methyl mercury is only a fraction of the total mercury concentration. Concentrations of mercury in tissues exposed to Northern Inner Apra Harbor sediments were less than this action level. The FDA does not have an action level for PCBs. Total PCB concentrations were compared to the FDA tolerance level of 2,000 µg/kg. Concentrations of total PCBs in tissues exposed to Northern Inner Apra Harbor sediments were less than this tolerance level. No FDA action levels are available for PAHs; therefore, concentrations were compared to total PAH concentrations considered by USEPA to present a risk for human consumption of fish and shellfish (6,000 µg/kg wet weight; Oros et al. 2007). Concentrations of total PAHs in tissues exposed to Northern Inner Apra Harbor sediments were less than this value. FDA actions levels were not exceeded; therefore, results were also compared to tissue concentrations of organisms exposed to reference sediment.

Table 18

Results of Chemical Analyses of *Macoma nasuta* Tissue Residues

	FDA Action Level	MN AH-ABTB-COMP REP 1	MN AH-ABTB-COMP REP 2	MN AH-ABTB-COMP REP 3	MN AH-ABTB-COMP REP 4	MN AH-ABTB-COMP REP 5	MN AH-FP-COMP REP 1	MN AH-FP-COMP REP 2	MN AH-FP-COMP REP 3	MN AH-FP-COMP REP 4	MN AH-FP-COMP REP 5	MN AH-LM-COMP REP 1	MN AH-LM-COMP REP 2	MN AH-LM-COMP REP 3	MN AH-LM-COMP REP 4	MN AH-LM-COMP REP 5	MN AH-N-COMP REP 1	MN AH-N-COMP REP 2	MN AH-N-COMP REP 3	MN AH-N-COMP REP 4	MN AH-N-COMP REP 5	MN PRETEST REP 1
		4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	3/31/2015
Conventional Parameters (%)																						
Percent Lipids		1.2	1.4	1.2	1.3	1.8	0.91	1	0.94	0.89	0.87	0.7	1.1	1.8	1.2	1.1	2.4	1.5	1.8	1.8	1.9	0.96
Metals (mg/kg)																						
Arsenic		4	4.22	4.04	4.21	4.2	4.5	4.51	4.65	4.15	4.72	5	5.05	4.86	4.45	7.39	4.1	4.69	4.03	4.76	4.32	3.92
Cadmium		0.0436 J	0.0488 J	0.0548	0.0477 J	0.0452 J	0.0751	0.0566	0.0562	0.0402 J	0.0738	0.042 J	0.0563	0.0505	0.0583	0.132	0.0547	0.0589	0.0621	0.147	0.073	0.0579
Chromium		0.368	0.47	0.223	0.347	0.29	0.27	0.369	0.274	0.327	0.81	0.203	0.649	0.27	0.915	0.536	0.587	0.273	0.408	0.857	0.369	0.216
Copper		3.35	3.48	3.02	3.64	3.34	5.56	4.72	3.8	5.2	6.29	21.1	6.09	3.99	3.97	6.56	6.6	5.18	7.49	233	4.03	3.11
Lead		0.515	0.529	0.378	0.609	0.485	1.49	1.66	1.43	1.47	2.78	1.81	3.59	2.7	2.99	4.6	2.1	1.8	2	2.89	2.06	0.148
Mercury	1[1]	0.0096 U	0.0098 U	0.0099 U	0.0095 U	0.0093 U	0.0098 U	0.0097 U	0.0119 J	0.0097 U	0.0098 U	0.0109 J	0.0185 J	0.0095 U	0.0092 U	0.0159 J	0.0187 J	0.0099 U	0.0185 J	0.0202 J	0.0125 J	0.0097 U
Nickel		0.499	0.605	0.444	0.513	0.611	0.862	0.655	0.73	0.639	0.918	0.31	0.682	0.716	0.66	0.921	0.651	0.582	0.765	0.637	0.816	0.484
Zinc		23.3	20.2	17.4	20.4	20.2	21.8	23.1	22	22.7	25.9	20.4	22.1	20.2	22.9	39.4	23.5	23.3	22.3	50.1	23.5	16.1
Dioxins/Furans (ng/kg)																						
1,2,3,4,6,7,8-Hepta CDD		--	--	--	--	--	8.74 B	12.3 B	13.5 B	17.3 B	19.2 B	--	--	--	--	--	4.39	2.62	3.55	3.46	2.5	0.474
1,2,3,4,6,7,8-Hepta CDF		--	--	--	--	--	1.77	2.41	2.79	3.46	4.25	--	--	--	--	--	1.82	1.22	1.78	1.3	1.34	0.0305
1,2,3,4,7,8,9-Hepta CDF		--	--	--	--	--	0.188 J	0.17 J	0.219 J	0.259 J	0.337 J	--	--	--	--	--	0.0717 J	0.0489 J	0.0898	0.0563	0.0467	0.0117 U
1,2,3,4,7,8-Hexa CDD		--	--	--	--	--	0.2 J	0.294 J	0.251	0.376 J	0.326 J	--	--	--	--	--	0.0676	0.0377 U	0.0819 J	0.0619	0.042 U	0.0193 U
1,2,3,4,7,8-Hexa CDF		--	--	--	--	--	0.275	0.381	0.335	0.483	0.484	--	--	--	--	--	0.0959	0.106	0.118	0.0963	0.0698	0.0119 U
1,2,3,6,7,8-Hexa CDD		--	--	--	--	--	0.61	0.91	0.866	1.26	1.23	--	--	--	--	--	0.324	0.243	0.296	0.234	0.22	0.0363
1,2,3,6,7,8-Hexa CDF		--	--	--	--	--	0.226	0.337	0.299	0.467	0.437	--	--	--	--	--	0.123	0.107	0.166	0.116	0.114	0.025
1,2,3,7,8,9-Hexa CDD		--	--	--	--	--	0.4	0.635	0.566	0.921	0.793	--	--	--	--	--	0.145	0.162	0.171	0.131	0.127	0.0195 U
1,2,3,7,8,9-Hexa CDF		--	--	--	--	--	0.0815	0.031 U	0.0679	0.0354 U	0.0362 U	--	--	--	--	--	0.0403	0.0274 U	0.0429	0.0295 U	0.0474	0.0382
1,2,3,7,8-Penta CDD		--	--	--	--	--	0.0728 U	0.0824 U	0.0874 U	0.313 J	0.0771 U	--	--	--	--	--	0.201	0.0956	0.072 U	0.0686 U	0.0753 U	0.19
1,2,3,7,8-Penta CDF		--	--	--	--	--	0.0263 U	0.0249 U	0.507	0.395	0.35	--	--	--	--	--	0.182	0.137	0.252	0.214	0.163	0.018 U
2,3,4,6,7,8-Hexa CDF		--	--	--	--	--	0.325	0.475	0.421 J	0.753 J	0.723	--	--	--	--	--	0.149 J	0.131 J	0.137	0.146 J	0.114	0.0205
2,3,4,7,8-Penta CDF		--	--	--	--	--	0.0235 U	0.0211 U	0.218	0.0263 U	0.458	--	--	--	--	--	0.0828	0.167	0.0222 U	0.141	0.0899	0.015 U
2,3,7,8-Tetra CDD		--	--	--	--	--	0.0411 U	0.104	0.0567	0.0529 U	0.0529	--	--	--	--	--	0.0452 U	0.0435 U	0.0596	0.0465 U	0.0485 U	0.0345 U
2,3,7,8-Tetra CDF		--	--	--	--	--	0.0807	0.0616 U	0.0789 J	0.121 J	0.0974	--	--	--	--	--	0.134	0.0539 U	0.122	0.0763	0.0798	0.0359 U
OCDD		--	--	--	--	--	48.5	63.1	75.3	91.3	132	--	--	--	--	--	26.8	14.7	20.6	19.1	15.1	2.91 J

	FDA Action Level	MN AH-ABTB-COMP REP 1	MN AH-ABTB-COMP REP 2	MN AH-ABTB-COMP REP 3	MN AH-ABTB-COMP REP 4	MN AH-ABTB-COMP REP 5	MN AH-FP-COMP REP 1	MN AH-FP-COMP REP 2	MN AH-FP-COMP REP 3	MN AH-FP-COMP REP 4	MN AH-FP-COMP REP 5	MN AH-LM-COMP REP 1	MN AH-LM-COMP REP 2	MN AH-LM-COMP REP 3	MN AH-LM-COMP REP 4	MN AH-LM-COMP REP 5	MN AH-N-COMP REP 1	MN AH-N-COMP REP 2	MN AH-N-COMP REP 3	MN AH-N-COMP REP 4	MN AH-N-COMP REP 5	MN PRETEST REP 1
		4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	3/31/2015
OCDF		--	--	--	--	--	3.24	4.3	5.15	6.18	8.57	--	--	--	--	--	1.8	1.18	1.59	1.37	1.07	0.0869
Total HpCDD		--	--	--	--	--	30.2	43.7 B	47.6	60.5	61.5	--	--	--	--	--	19.6	9.57	16.1	13.7	11.1	1.36
Total HpCDF		--	--	--	--	--	5.94	8.05	9.02	11.1	13.3	--	--	--	--	--	4.17	2.87	4.15	3.14	3.08	0.0886
Total HxCDD		--	--	--	--	--	15.6	25.9	23.6	35.9	28.5	--	--	--	--	--	10.2	5.27	8.75	7.18	5.86	0.426
Total HxCDF		--	--	--	--	--	6.04	9.59	8.53	12.2	12.7	--	--	--	--	--	3.22	2.56	3.38	2.67	2.2	0.186
Total PeCDD		--	--	--	--	--	6.76	12.8	8.54	20	12.1	--	--	--	--	--	9.62	4.17	5.32	4.67	4.4	1.08
Total PeCDF		--	--	--	--	--	4.69	6.95	6.44	8.24	10.2	--	--	--	--	--	3.1	2.55	3.08	2.73	2.18	0.349
Total TCDD		--	--	--	--	--	1.53	2.75	1.62	3.11	3.38	--	--	--	--	--	1.6	1.1	1.74	1.21	1.05	0.252
Total TCDF		--	--	--	--	--	11.4	11.9	12.8	12.5	19.7	--	--	--	--	--	5.28	4.83	6.8	7.24	4.37	0.545
PAHs (µg/kg)																						
1-Methylnaphthalene		5.3 U	13 J	5.2 U	5.2 U	5.3 U	5.2 U	5.3 U	5.3 U	5.3 U	5.2 U	26 U	5.3 U	26 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U
2-Methylnaphthalene		5.3 U	30	5.2 U	5.2 U	5.3 U	5.2 U	5.3 U	5.3 U	5.3 U	5.2 U	26 U	6.7 J	26 U	5.3 U	5.3 U	7.9 J	5.3 U	5.3 U	5.3 U	9.9 J	5.3 U
Acenaphthene		5.3 U	5.3 U	5.2 U	5.2 U	5.3 U	5.2 U	5.3 U	5.3 U	5.3 U	5.2 U	26 U	5.3 U	26 U	6.6 J	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U
Acenaphthylene		2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	13 U	2.6 U	13 U	2.6 U	2.6 U	4.7 J	4.5 J	5.8 J	2.6 U	2.6 U	2.6 U
Anthracene		13 J	16	18	15	14	3.4 J	5.1 J	4.1 J	6.3 J	6.9 J	13 U	11 J	13 U	11 J	6.4 J	2.7 U	2.6 U	10 J	12 J	13 J	5.5 J
Benzo(a)anthracene		12 J	13 J	18	16	13 J	6.4 J	13 J	5.3 U	5.3 U	5.2 U	26 U	7.1 J	26 U	6.7 J	5.7 J	15	11 J	26	14	14	5.3 U
Benzo(a)pyrene		36	41	43	43	44	43	64	42	84	69	64 J	130	70	95	130	110	78	150	100	100	16
Benzo(b)fluoranthene		63	69	77	78	71	99	140	90	190	150	140	270	150	200	290	220	170	310	200	200	5.3 U
Benzo(g,h,i)perylene		6.3 J	7 J	6.9 J	7.1 J	6 J	11 J	15	9.7 J	16	15	26 U	27	26 U	22	25	18	12 J	19	16	21	50
Benzo(k)fluoranthene		29	34	34	35	34	47	58	31	75	61	49 J	80	53 J	68	95	110	57	150	97	89	5.3 U
Chrysene		19	20	21	22	19	6.2 J	9.3 J	4.7 J	6.3 J	8.5 J	13 U	12 J	13 U	18	11 J	12 J	9.5 J	25	11 J	11 J	9.4 J
Dibenz(a,h)anthracene		5.3 U	5.3 U	5.2 U	5.2 U	5.3 U	5.2 U	6.7 J	5.3 U	7.7 J	7 J	26 U	11 J	26 U	9.3 J	10 J	9.7 J	5.3 J	9.2 J	6.3 J	10 J	5.3 U
Fluoranthene		86	90	110	100	83	9.5 J	12 J	6.8 J	13	15	26 U	24	26 U	28	25	20	20	33	21	23	7.4 J
Fluorene		5.3 U	6.5 J	5.2 U	5.2 U	5.3 U	5.2 U	5.3 U	5.3 U	5.3 U	5.2 U	26 U	5.3 U	26 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U
Indeno(1,2,3-cd)pyrene		19	23	22	21	22	24	27	20	31	29	26 U	43	26 U	38	39	32	25	35	28	39	16
Naphthalene		5.3 U	38	6.4 J	5.2 U	9.3 J	5.2 U	5.3 U	7.5 J	5.3 U	5.2 U	26 U	7.5 J	26 U	12 J	5.3 U	12 J	13 J	11 J	7 J	21	7.2 J
Phenanthrene		26	31	31	27	20	5.2 U	6.3 J	5.3 U	6.1 J	7.8 J	26 U	8.4 J	26 U	11 J	6.7 J	5.3 U	7.8 J	8.1 J	6.5 J	13 J	5.3 U
Pyrene		73	75	96	82	73	7.9 J	13 J	6.7 J	11 J	11 J	26 U	24	26 U	25	25	38	35	73	40	53	8.9 J
Total PAHs (ND = 0)	6,000[2]	296.3 J	335.5 J	366.9 J	346.1 J	316 J	247.9 J	357.4 J	208.2 J	433.4 J	365.2 J	253 J	623.5 J	273 J	504 J	643.8 J	569.4 J	415.1 J	821.1 J	530.8 J	563 J	105.8 J
PCB Congeners (ng/g)																						
PCB003		0.00229 J	0.0016 U	0.0018 U	0.0018 U	0.011 U	0.0028 U	0.004 U	0.0032 U	0.0088 U	0.0048 U	0.0038 U	0.0028 U	0.0028 U	0.0022 U	0.0053 J	0.0021 U	0.0024 U	0.0026 U	0.0024 U	0.0025 U	0.0015 U
PCB008		1.46	1.19	1.1	1.12	0.735	0.086	0.123	0.14	0.03 U	0.243	0.239	0.161	0.149	0.15	0.233	0.252	0.239	0.37	0.267	0.347	0.0086 U
PCB018/030		0.792	0.555	0.828	0.383	0.59	0.0774	0.201	0.0955	0.287	0.134	0.193	0.189	0.165	0.155	0.244	0.321	0.142	0.511	0.283	0.422	0.0038 U
PCB020/028		0.906	0.394	0.555	0.751	0.64	0.297	0.347	0.396	0.658	0.633	0.465	0.467	0.399	0.337	0.592	0.511	0.38	0.622	0.447	0.637	0.00832 J
PCB021/033		0.704	0.277	0.437	0.602	0.438	0.114	0.133	0.161	0.281	0.253	0.207	0.208	0.205	0.154	0.278	0.192	0.138	0.217	0.167	0.236	0.00234 J
PCB031		0.41	0.141	0.221	0.326	0.246	0.122	0.148	0.178	0.293	0.275	0.18	0.18	0.169	0.134	0.263	0.25	0.188	0.33	0.228	0.338	0.0041 J

	FDA Action Level	MN AH-ABTB-COMP REP 1	MN AH-ABTB-COMP REP 2	MN AH-ABTB-COMP REP 3	MN AH-ABTB-COMP REP 4	MN AH-ABTB-COMP REP 5	MN AH-FP-COMP REP 1	MN AH-FP-COMP REP 2	MN AH-FP-COMP REP 3	MN AH-FP-COMP REP 4	MN AH-FP-COMP REP 5	MN AH-LM-COMP REP 1	MN AH-LM-COMP REP 2	MN AH-LM-COMP REP 3	MN AH-LM-COMP REP 4	MN AH-LM-COMP REP 5	MN AH-N-COMP REP 1	MN AH-N-COMP REP 2	MN AH-N-COMP REP 3	MN AH-N-COMP REP 4	MN AH-N-COMP REP 5	MN PRETEST REP 1
		4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	3/31/2015
PCB037		0.0149 J	0.0138 J	0.015 J	0.0149 J	0.0102 J	0.0058 J	0.0099 J	0.0075 J	0.0183 J	0.0115 J	0.014 U	0.014 U	0.018 J	0.0125 J	0.0239	0.0152 J	0.0113 J	0.0231	0.0129 J	0.0209	0.0015 U
PCB044/047/065		7.72	6.44	6.78	5.43	6.52	0.583	0.848	0.607	1.17	0.879	0.792	0.993	0.853	0.633	1.17	1.57	1.19	1.99	1.27	1.6	0.00849 J
PCB049/069		8.99	6.9	7.44	5.98	6.96	1.19	1.76	1.36	2.43	1.85	1.43	1.59	1.49	1.16	2.03	2.74	2.2	3.8	2.28	2.97	0.0049 J
PCB052		5.87	3.91	4.48	3.63	3.94	1.37	2.11	1.54	3.04	2.17	2.16	2.45	1.95	1.66	2.87	2.52	1.98	3.6	2.07	2.81	0.00924 J
PCB056		0.0688	0.0583	0.0592	0.0699	0.0568	0.118	0.144	0.146	0.245	0.214	0.177	0.264	0.202	0.167	0.317	0.17	0.135	0.217	0.148	0.199	0.0025 J
PCB060		0.0155 J	0.0145 J	0.0146 J	0.0183 J	0.0153 J	0.0451	0.0524	0.056	0.0893	0.0777	0.0777	0.109	0.0787	0.0671	0.128	0.0708	0.0528	0.0826	0.0607	0.0757	0.0023 J
PCB061/070/074/076		0.619	0.505	0.516	0.413	0.518	0.552	0.678	0.698	1.24	1.04	1.11	1.84	1.23	1.04	2.29	1.08	0.832	1.39	0.993	1.31	0.0143 J
PCB066		0.466	0.384	0.394	0.196	0.374	0.423	0.525	0.493	0.866	0.755	0.586	0.814	0.627	0.534	0.969	0.653	0.501	0.821	0.603	0.764	0.00537 J
PCB077		0.0194 J	0.0159 J	0.0176 J	0.0185 J	0.0144 J	0.0132 J	0.0179 J	0.015 J	0.0266	0.0218	0.0191 J	0.0253	0.0201 J	0.0166 J	0.032	0.0179 J	0.0134 J	0.0218	0.0163 J	0.022	0.0015 U
PCB081		0.0027 U	0.0017 U	0.0015 U	0.0017 U	0.0067 U	0.0032 J	0.0033 J	0.0031 J	0.0052 J	0.0046 J	0.0014 U	0.0071 U	0.0042 U	0.004 U	0.0052 U	0.0049 U	0.0054 U	0.005 U	0.0085 U	0.0041 U	0.0015 U
PCB083/099		4.49	3.61	3.7	3.4	4.04	1.73	2.33	1.51	2.63	1.93	1.49	2.18	1.61	1.46	2.44	2.41	1.81	2.72	1.79	2.8	0.0157 J
PCB086/087/097		0.988	0.786	0.815	0.784	0.814	1.05	1.44	0.993	1.78	1.26	1.2	1.88	1.33	1.1	2.2	1.08	0.851	1.28	0.814	1.25	0.00922 J
PCB090/101		5.28	4.21	4.32	4.17	4.45	2.61	3.68	2.52	4.3	3.04	2.63	3.6	2.84	2.44	4.23	3.57	2.74	4.11	2.81	4.22	0.0175 J
PCB095		1.49	1.2	1.23	1.16	1.23	1.24	2.02	1.2	2.43	1.78	1.55	2.31	1.74	1.66	2.62	1.85	1.39	2.17	1.49	1.91	0.0075 J
PCB105		0.155	0.135	0.142	0.148	0.122	0.352	0.459	0.453	0.707	0.593	0.416	0.877	0.499	0.423	0.95	0.32	0.231	0.346	0.261	0.332	0.00666 J
PCB110/115		1.29	1.02	1.07	1.14	1.02	1.97	2.66	1.78	3.13	2.36	2.47	3.69	2.75	2.19	4.24	2.2	1.76	2.55	1.7	2.46	0.0172 J
PCB114		0.0121 J	0.0107 J	0.0112 J	0.012 J	0.01 J	0.0173 J	0.0228	0.0237	0.0356	0.0296	0.023 J	0.0474	0.0286	0.0226	0.0528	0.0204	0.0144 J	0.0198	0.016 J	0.0199 J	0.00041 U
PCB118		0.989	0.803	0.849	0.906	0.761	1.08	1.44	1.43	2.19	1.92	1.28	2.36	1.51	1.28	2.64	1.33	0.988	1.41	1.04	1.41	0.0171 J
PCB123		0.0088 J	0.00525 J	0.0056 J	0.0083 J	0.0072 J	0.0096 J	0.0157 J	0.0144 J	0.0172 J	0.0211	0.014 U	0.0194	0.0139 J	0.0169 J	0.0208	0.0072 J	0.0086 J	0.0086 U	0.01 J	0.0109 J	0.00046 U
PCB126		0.0076 J	0.00631 J	0.0079 J	0.0068 J	0.0062 J	0.0045 U	0.0065 J	0.00543 J	0.01 J	0.00904 J	0.014 U	0.0047 J	0.0036 U	0.005 U	0.005 U	0.0072 J	0.005 U	0.0079 J	0.0081 U	0.0073 J	0.00042 U
PCB128/166		0.266	0.209	0.222	0.228	0.248	0.293	0.404	0.326	0.53	0.417	0.255	0.383	0.258	0.226	0.388	0.276	0.221	0.298	0.206	0.238	0.0043 J
PCB129/138		4.42	3.75	3.91	4.14	3.94	3.58	4.72	3.43	6.1	4.64	2.57	3.48	2.7	2.43	3.64	3.84	3.29	4.09	2.75	3.37	0.0303 J
PCB135/151		1.5	1.47	1.52	1.41	1.58	1.35	1.91	0.899	2.12	1.31	1.19	1.07	1.14	0.876	1.21	1.61	1.26	1.72	1.02	1.29	0.0048 J
PCB141		0.547	0.437	0.494	0.609	0.491	0.517	0.69	0.453	0.887	0.626	0.382	0.469	0.393	0.349	0.536	0.616	0.482	0.624	0.448	0.505	0.002 J
PCB147/149		4.84	4.14	4.55	4.97	4.54	3.96	5.37	2.94	6	4.29	2.9	3.17	2.72	2.27	3.59	3.81	2.99	4.17	2.83	3.55	0.0167 J
PCB153/168		9.16	7.77	8.26	8.28	8.35	4.13	5.55	3.69	7	5.2	2.96	3.52	3.1	2.77	3.93	5.03	4.04	5.25	3.71	4.19	0.0338
PCB156/157		0.168	0.149	0.155	0.182	0.149	0.154	0.215	0.225	0.306	0.274	0.135	0.252	0.163	0.14	0.248	0.188	0.134	0.184	0.146	0.171	0.00164 J
PCB158		0.345	0.29	0.307	0.316	0.296	0.249	0.329	0.257	0.445	0.342	0.192	0.262	0.189	0.169	0.267	0.259	0.217	0.275	0.187	0.225	0.0019 J
PCB167		0.123	0.103	0.11	0.118	0.102	0.081	0.112	0.112	0.159	0.142	0.0602	0.0909	0.0723	0.0638	0.0982	0.0916	0.065	0.0897	0.0698	0.0864	0.00073 U

	FDA Action Level	MN AH-ABTB-COMP REP 1	MN AH-ABTB-COMP REP 2	MN AH-ABTB-COMP REP 3	MN AH-ABTB-COMP REP 4	MN AH-ABTB-COMP REP 5	MN AH-FP-COMP REP 1	MN AH-FP-COMP REP 2	MN AH-FP-COMP REP 3	MN AH-FP-COMP REP 4	MN AH-FP-COMP REP 5	MN AH-LM-COMP REP 1	MN AH-LM-COMP REP 2	MN AH-LM-COMP REP 3	MN AH-LM-COMP REP 4	MN AH-LM-COMP REP 5	MN AH-N-COMP REP 1	MN AH-N-COMP REP 2	MN AH-N-COMP REP 3	MN AH-N-COMP REP 4	MN AH-N-COMP REP 5	MN PRETEST REP 1
		4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	3/31/2015
PCB169		0.0021 U	0.00065 U	0.0006 U	0.0016 U	0.002 U	**0.0028 J**	0.0025 U	0.00087 U	0.0009 U	**0.00488 J**	0.0013 U	0.006 U	0.0021 U	0.0039 U	0.0037 U	0.0023 U	0.0037 U	0.0019 U	0.0048 U	0.004 U	0.00073 U
PCB170		**0.98**	**0.808**	**0.868**	**0.99**	**0.891**	**0.507**	**0.688**	**0.607**	**1.01**	**0.86**	**0.291**	**0.512**	**0.358**	**0.418**	**0.569**	**0.71**	**0.504**	**0.675**	**0.54**	**0.6**	**0.0018 J**
PCB174		**1.14**	**0.898**	**1.05**	**1.1**	**0.914**	**0.654**	**0.929**	**0.795**	**1.44**	**1.12**	**0.375**	**0.587**	**0.496**	**0.493**	**0.671**	**0.844**	**0.632**	**0.816**	**0.62**	**0.721**	**0.0023 J**
PCB177		**0.765**	**0.613**	**0.703**	**0.728**	**0.63**	**0.334**	**0.485**	**0.421**	**0.745**	**0.587**	**0.212**	**0.334**	**0.289**	**0.26**	**0.378**	**0.517**	**0.387**	**0.495**	**0.381**	**0.444**	**0.0029 J**
PCB180/193		**2.54**	**1.84**	**2.23**	**2.39**	**2.24**	**1.24**	**1.7**	**1.34**	**2.29**	**1.89**	**0.7**	**1.14**	**0.878**	**0.998**	**1.28**	**1.68**	**1.22**	**1.6**	**1.24**	**1.38**	**0.0047 J**
PCB183		**1.05**	**0.85**	**0.993**	**0.972**	**0.882**	**0.479**	**0.678**	**0.555**	**0.998**	**0.764**	0.17 U	**0.411**	**0.323**	**0.342**	**0.458**	**0.604**	**0.443**	**0.594**	**0.432**	**0.522**	0.0028 U
PCB187		**2.45**	**1.76**	**1.99**	**1.67**	**1.9**	**1.01**	**1.5**	**1**	**2**	**1.44**	**0.682**	**0.789**	**0.789**	**0.643**	**0.902**	**1.36**	**1.08**	**1.3**	**0.9**	**1.04**	**0.0098 J**
PCB189		**0.0384**	**0.0339**	**0.036**	**0.0382**	**0.0285**	**0.016 J**	**0.0219**	**0.0226**	**0.0349**	**0.0303**	0.0081 U	**0.0139 J**	**0.0115 J**	**0.0124 J**	0.013 U	**0.0197**	**0.0146 J**	**0.0177 J**	**0.0136 J**	**0.0157 J**	0.00064 U
PCB194		**0.356**	**0.299**	**0.319**	**0.356**	**0.334**	**0.164**	**0.201**	**0.169**	**0.291**	**0.258**	**0.107**	**0.173**	**0.126**	**0.152**	**0.185**	**0.237**	**0.151**	**0.201**	**0.184**	**0.18**	0.0032 U
PCB195		**0.144**	**0.134**	**0.134**	**0.171**	**0.139**	**0.0588**	**0.0818**	**0.0753**	**0.124**	**0.118**	**0.0456**	**0.0696**	**0.0533**	**0.0564**	**0.0783**	**0.0952**	**0.0702**	**0.0929**	**0.0775**	**0.0772**	0.0033 U
PCB200		**0.0495**	**0.0353**	**0.0394**	**0.0424**	**0.0434**	**0.0209**	**0.0306**	**0.0323**	**0.054**	**0.0453**	**0.0213 J**	**0.0305**	**0.0245 J**	**0.026**	**0.0331**	**0.0487**	**0.031**	**0.0458**	**0.0342**	**0.0394**	0.0017 U
PCB201		**0.0845**	**0.064**	**0.0706**	**0.0663**	**0.0747**	**0.0368**	**0.0515**	**0.0408**	**0.0731**	**0.0603**	**0.0283**	**0.0395**	**0.0296**	**0.0308**	**0.0459**	**0.0597**	**0.041**	**0.0588**	0.038 U	**0.0445**	0.0018 U
PCB206		**0.0744**	**0.0715**	**0.071**	**0.0737**	**0.0709**	**0.0637**	**0.0827**	**0.082**	**0.123**	**0.118**	**0.062**	**0.105**	**0.0654**	**0.078**	**0.0993**	**0.18**	**0.108**	**0.144**	**0.134**	**0.131**	0.0015 U
PCB209		**0.0172 J**	**0.0153 J**	**0.0144 J**	**0.0144 J**	**0.0183 J**	**0.0541**	**0.0615**	**0.089**	**0.0905**	**0.104**	**0.0445**	**0.12**	**0.0449**	**0.055**	**0.0682**	0.12 U	**0.0654**	**0.0817**	**0.0825**	0.084 U	0.0032 U
Total PCB Congeners (ND = 0)	2,000[3]	**73.8264 J**	**58.3248 J**	**63.0545 J**	**59.5527 J**	**61.3799 J**	**34.0137 J**	**46.9855 J**	**33.3866 J**	**60.6997 J**	**46.1451 J**	**31.9077 J**	**43.2802 J**	**34.1008 J**	**29.6711 J**	**49.5138 J**	**45.2336 J**	**35.2417 J**	**51.4318 J**	**34.7825 J**	**44.9919 J**	**0.26968 J**

Notes: For totals, zeros were used for non-detect samples for summing. If all samples were non-detect, the highest method detection limit of all samples was used as the total result.
1. Action level for methyl mercury
2. No action levels for PAHs. Concentrations were compared to total PAH concentrations considered by the USEPA to present a risk for human consumption of fish and shellfish (Oros, D.R., J.R.M Ross, R.B. Spies, and T. Mumley, 2007. Polycyclic aromatic hydrocarbon (PAH) contamination in San Francisco Bay: A 10-year retrospective of monitoring in an urbanized estuary. Environmental Research 105(1):101-118. September 2007.).
3. Tolerance level for PCBs. No action level.
Bold = detected result
-- = results not reported or not applicable
µg/kg = micrograms per kilogram
CDD = Chloro Dibenzo-p-Dioxin
CDF = Chloro Dibenzo-p-furan
FDA = Food and Drug Administration
J = Estimated value
mg/kg = milligrams per kilogram
ND = non-detect
ng/g = nanograms per gram
ng/kg = nanograms per kilogram
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
U = Indicates the compound or analyte was analyzed for but not detected at or above the method detection limit

Table 19

Results of Chemical Analyses of *Nereis virens* Tissue Residues

	FDA Action Level	NV AH-ABTB-COMP REP 1	NV AH-ABTB-COMP REP 2	NV AH-ABTB-COMP REP 3	NV AH-ABTB-COMP REP 4	NV AH-ABTB-COMP REP 5	NV AH-FP-COMP REP 1	NV AH-FP-COMP REP 2	NV AH-FP-COMP REP 3	NV AH-FP-COMP REP 4	NV AH-FP-COMP REP 5	NV AH-LM-COMP REP 1	NV AH-LM-COMP REP 2	NV AH-LM-COMP REP 3	NV AH-LM-COMP REP 4	NV AH-LM-COMP REP 5	NV AH-N-COMP REP 1	NV AH-N-COMP REP 2	NV AH-N-COMP REP 3	NV AH-N-COMP REP 4	NV AH-N-COMP REP 5	NV PRETEST REP 1
		4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	3/31/2015
Conventional Parameters (%)																						
Percent Lipids		**1.3**	**1.2**	**0.95**	**1.1**	**1.2**	**0.95**	**1.4**	**1.3**	**1.1**	**1.2**	**1**	**1.4**	**1.5**	**1.1**	**1.3**	**0.94**	**0.94**	**0.43**	**0.94**	**0.96**	**0.9**
Metals (mg/kg)																						
Arsenic		**3.53**	**4.07**	**4.08**	**3.39**	**3.71**	**3.15**	**2.55**	**3.66**	**3.44**	**3.79**	**3.93**	**4.42**	**3.04**	**2.74**	**2.66**	**3.32**	**3.5**	**3.86**	**2.33**	**2.72**	**2.34**
Cadmium		**0.054**	**0.0593**	**0.0818**	**0.0648**	**0.0515**	**0.0502**	**0.0326 J**	**0.0571**	**0.0474 J**	**0.0613**	**0.0459 J**	**0.0701**	**0.0327 J**	**0.033 J**	**0.0404 J**	**0.0576**	**0.0632**	**0.0633**	**0.0384 J**	**0.0499**	**0.0321 J**
Chromium		**0.199**	**0.145 J**	**0.215**	**0.144 J**	**0.141 J**	**0.171 J**	**0.11 J**	**0.185 J**	**0.138 J**	**0.232**	**0.146 J**	**1.13**	**0.193 J**	**0.123 J**	**0.124 J**	**0.2**	**0.178 J**	**0.206**	**0.123 J**	**0.122 J**	**0.151 J**
Copper		**3.74**	**3.88**	**4.68**	**3.92**	**3.76**	**10.8**	**9.33**	**10.9**	**8.81**	**8.62**	**12.9**	**16.3**	**10.3**	**11.2**	**6.93**	**6.11**	**5.33**	**8.56**	**4.73**	**5.14**	**2.18**
Lead		**0.189**	**0.251**	**0.279**	**0.203**	**0.207**	**0.896**	**0.612**	**0.84**	**1.01**	**0.896**	**1.12**	**2.15**	**0.986**	**0.816**	**1.29**	**0.835**	**0.927**	**1.07**	**0.545**	**0.773**	**0.0755 J**
Mercury	1[1]	**0.0228 J**	**0.0198 J**	**0.0198 J**	**0.0253 J**	**0.024 J**	**0.0252 J**	**0.0233 J**	**0.0238 J**	**0.023 J**	**0.0223 J**	**0.0227 J**	**0.0254 J**	**0.0212 J**	**0.0191 J**	**0.0158 J**	**0.0195 J**	**0.0177 J**	**0.0235 J**	**0.0195 J**	**0.0237 J**	**0.0211 J**
Nickel		**0.587**	**0.515**	**0.519**	**0.377**	**0.489**	**0.42**	**0.35**	**0.488**	**0.446**	**0.433**	**0.494**	**1.77**	**0.354**	**0.277**	**0.306**	**0.709**	**0.824**	**0.686**	**0.519**	**0.598**	**0.438**
Zinc		**14.5**	**17.8**	**68**	**39.6**	**36.4**	**57.6**	**40.9**	**16.1**	**25**	**31.9**	**26.8**	**56.4**	**25**	**24.5**	**21.7**	**18**	**31.4**	**21.2**	**13.3**	**55.6**	**11.6**
Dioxins/Furans (ng/kg)																						
1,2,3,4,6,7,8-Hepta CDD		--	--	--	--	--	**16.1 B**	**13.9 B**	**13.3 B**	**15.2 B**	**16.7 B**	--	--	--	--	--	**5.25 B**	**4.92 B**	**5.46 B**	**5.34**	**4.4 J**	**2.62**
1,2,3,4,6,7,8-Hepta CDF		--	--	--	--	--	**3.22**	**2.73**	**2.34**	**3.03**	**3.28**	--	--	--	--	--	**1.34**	**1.61**	**1.68**	**1.16**	**1.49**	**0.976**
1,2,3,4,7,8,9-Hepta CDF		--	--	--	--	--	**0.241**	**0.196**	**0.168**	**0.219**	**0.216**	--	--	--	--	--	0.069 U	0.0648 U	0.0808 U	**0.0821**	0.0564 U	0.0313 U
1,2,3,4,7,8-Hexa CDD		--	--	--	--	--	**0.294**	**0.304 J**	**0.284**	**0.183**	**0.299 J**	--	--	--	--	--	0.113 U	0.116 U	**0.105**	**0.136**	0.113 U	**0.0525 J**
1,2,3,4,7,8-Hexa CDF		--	--	--	--	--	**0.429**	**0.381**	**0.373**	**0.426**	**0.39**	--	--	--	--	--	**0.0962**	**0.132**	0.0751 U	**0.0924**	**0.117**	**0.0703**
1,2,3,6,7,8-Hexa CDD		--	--	--	--	--	**0.964**	**0.856**	**0.875**	**0.55**	**0.78**	--	--	--	--	--	**0.435**	**0.475**	**0.307**	**0.438**	**0.573**	**0.18**
1,2,3,6,7,8-Hexa CDF		--	--	--	--	--	**0.352**	**0.422**	**0.142**	**0.413**	**0.193**	--	--	--	--	--	**0.105**	**0.234**	**0.109**	**0.114**	**0.179**	**0.104**
1,2,3,7,8,9-Hexa CDD		--	--	--	--	--	**0.576**	**0.483**	**0.335**	**0.587**	**0.516**	--	--	--	--	--	**0.18**	**0.223**	**0.187**	0.0933 U	**0.211**	**0.106**
1,2,3,7,8,9-Hexa CDF		--	--	--	--	--	**0.0469**	**0.114**	0.102 U	0.102 U	0.0914 U	--	--	--	--	--	0.0771 U	0.0919 U	0.0663 U	0.0703 U	0.0636 U	0.0372 U
1,2,3,7,8-Penta CDD		--	--	--	--	--	0.108 U	**0.776**	**0.261**	0.234 U	0.232 U	--	--	--	--	--	0.222 U	0.226 U	0.225 U	0.166 U	**0.22 J**	**0.098**
1,2,3,7,8-Penta CDF		--	--	--	--	--	**0.439**	**0.433**	**0.228**	**0.378**	**0.211**	--	--	--	--	--	**0.227**	**0.378**	**0.246**	0.0541 U	**0.186 J**	**0.164**
2,3,4,6,7,8-Hexa CDF		--	--	--	--	--	**0.499**	**0.416 J**	**0.393**	**0.412 J**	**0.438 J**	--	--	--	--	--	**0.168**	**0.194 J**	**0.113**	**0.119**	0.0633 U	**0.118**
2,3,4,7,8-Penta CDF		--	--	--	--	--	**0.258**	**0.521**	**0.257**	**0.286**	**0.35**	--	--	--	--	--	**0.201**	**0.162**	**0.163**	**0.36**	**0.264**	**0.248**
2,3,7,8-Tetra CDD		--	--	--	--	--	**0.065**	**0.109**	0.115 U	0.123 U	0.0859 U	--	--	--	--	--	0.0873 U	**0.146**	0.0882 U	0.09 U	0.102 U	0.0461 U
2,3,7,8-Tetra CDF		--	--	--	--	--	**0.862**	**1.13**	**0.593**	--	**0.707**	--	--	--	--	--	**0.645 J**	--	**0.865**	**0.392**	--	**0.793 J**
OCDD		--	--	--	--	--	**103**	**87.7**	**77.1**	**105**	**111**	--	--	--	--	--	**43.8**	**34.3**	**45.2**	**35.8**	**39.9**	**32.4**

	FDA Action Level	NV AH-ABTB-COMP REP 1	NV AH-ABTB-COMP REP 2	NV AH-ABTB-COMP REP 3	NV AH-ABTB-COMP REP 4	NV AH-ABTB-COMP REP 5	NV AH-FP-COMP REP 1	NV AH-FP-COMP REP 2	NV AH-FP-COMP REP 3	NV AH-FP-COMP REP 4	NV AH-FP-COMP REP 5	NV AH-LM-COMP REP 1	NV AH-LM-COMP REP 2	NV AH-LM-COMP REP 3	NV AH-LM-COMP REP 4	NV AH-LM-COMP REP 5	NV AH-N-COMP REP 1	NV AH-N-COMP REP 2	NV AH-N-COMP REP 3	NV AH-N-COMP REP 4	NV AH-N-COMP REP 5	NV PRETEST REP 1
		4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	3/31/2015
OCDF		--	--	--	--	--	**5.45**	**4.18**	**3.79**	**5.6**	**4.94**	--	--	--	--	--	**0.703**	**1.2**	**0.94**	**0.918**	**0.862**	**0.91**
Total HpCDD		--	--	--	--	--	**97.4 B**	**83.5**	**76.4**	**79.2**	**79.7**	--	--	--	--	--	**42.5**	**49.1**	**59.5**	**36**	**29.6**	**11.8**
Total HpCDF		--	--	--	--	--	**9.36**	**8**	**6.81**	**8.65**	**8.93**	--	--	--	--	--	**2.87**	**3.12**	**3.33**	**2.77**	**2.98**	**1.88**
Total HxCDD		--	--	--	--	--	**33.1**	**27.5**	**27.5**	**24.6**	**26.1**	--	--	--	--	--	**13.8**	**19.7**	**14.7**	**10.7**	**9.27**	**2.44**
Total HxCDF		--	--	--	--	--	**9.19**	**9.83**	**7.21**	**7.21**	**7**	--	--	--	--	--	**2.88**	**4.15**	**3.98**	**3.08**	**2.82**	**2.39**
Total PeCDD		--	--	--	--	--	**9.81**	**9.09**	**8.88**	**4.97**	**6.85**	--	--	--	--	--	**5.46**	**9.78**	**12.9**	**3.62**	**4.02**	**1.25**
Total PeCDF		--	--	--	--	--	**8.43**	**8.17**	**7.75**	**7.26**	**6.86**	--	--	--	--	--	**3.94**	**6.64**	**5.08**	**3.93**	**3.97**	**3.24**
Total TCDD		--	--	--	--	--	**1.11**	**1.74**	**1.12**	**0.956**	**0.96**	--	--	--	--	--	**0.975**	**1.46**	**0.61**	**1.11**	**1.47**	**0.457**
Total TCDF		--	--	--	--	--	**10.7**	**9.88**	**12.1**	**8.21**	**10.4**	--	--	--	--	--	**6.01**	**12.4**	**8.94**	**5.32**	**5.24**	**6.34**
PAHs (µg/kg)																						
1-Methylnaphthalene		5.3 U	5.2 U	5.2 U	5.2 U	5.3 U	5.3 U	5.2 U	5.2 U	5.3 U	5.3 U	26 U	26 U	26 U	26 U	27 U	5.2 U	26 U	27 U	26 U	26 U	5.3 U
2-Methylnaphthalene		5.3 U	5.2 U	5.2 U	5.2 U	5.3 U	5.3 U	5.2 U	5.2 U	5.3 U	5.3 U	26 U	26 U	26 U	26 U	27 U	5.2 U	26 U	27 U	26 U	26 U	5.3 U
Acenaphthene		5.3 U	5.2 U	5.2 U	5.2 U	5.3 U	5.3 U	5.2 U	5.2 U	5.3 U	5.3 U	26 U	26 U	26 U	26 U	27 U	5.2 U	26 U	27 U	26 U	26 U	5.3 U
Acenaphthylene		2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.7 U	13 U	13 U	13 U	13 U	13 U	2.6 U	13 U	13 U	13 U	13 U	2.6 U
Anthracene		**6 J**	**8.6 J**	**9.1 J**	**7 J**	**7.1 J**	**5 J**	**8 J**	**7.7 J**	**7.8 J**	**16**	13 U	13 U	13 U	13 U	13 U	**6.4 J**	13 U	13 U	13 U	13 U	**11 J**
Benzo(a)anthracene		5.3 U	5.2 U	5.2 U	5.2 U	5.3 U	5.3 U	5.2 U	5.2 U	5.3 U	5.3 U	26 U	26 U	26 U	26 U	27 U	5.2 U	26 U	27 U	26 U	26 U	5.3 U
Benzo(a)pyrene		**17**	**25**	**29**	**19**	**20**	**16**	**18**	**27**	**25**	**23**	26 U	26 U	26 U	26 U	27 U	**28**	26 U	27 U	26 U	26 U	**10 J**
Benzo(b)fluoranthene		**6.2 J**	5.2 U	**6 J**	**6.3 J**	**6.3 J**	**10 J**	**13 J**	**15**	**15**	**14**	26 U	26 U	26 U	26 U	27 U	**25**	26 U	27 U	26 U	26 U	5.3 U
Benzo(g,h,i)perylene		**6.9 J**	**5.6 J**	**5.6 J**	**6.1 J**	**6.8 J**	**6.7 J**	**7.6 J**	**8.3 J**	**8.2 J**	**7.7 J**	26 U	26 U	26 U	26 U	27 U	**8.1 J**	26 U	27 U	26 U	26 U	**7.4 J**
Benzo(k)fluoranthene		5.3 U	5.2 U	5.2 U	5.2 U	5.3 U	**5.8 J**	**8.1 J**	**9.7 J**	**6.9 J**	**8.2 J**	26 U	26 U	26 U	26 U	27 U	**11 J**	26 U	27 U	26 U	26 U	5.3 U
Chrysene		2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.7 U	13 U	13 U	13 U	13 U	13 U	2.6 U	13 U	13 U	13 U	13 U	2.6 U
Dibenz(a,h)anthracene		5.3 U	5.2 U	5.2 U	5.2 U	5.3 U	5.3 U	5.2 U	5.2 U	5.3 U	5.3 U	26 U	26 U	26 U	26 U	27 U	5.2 U	26 U	27 U	26 U	26 U	5.3 U
Fluoranthene		**10 J**	**15**	**14**	**13**	**12 J**	5.3 U	5.2 U	5.2 U	5.3 U	5.3 U	26 U	26 U	26 U	26 U	27 U	5.2 U	26 U	27 U	26 U	26 U	5.3 U
Fluorene		5.3 U	5.2 U	**7.3 J**	**6.7 J**	5.3 U	5.3 U	5.2 U	5.2 U	5.3 U	5.3 U	26 U	26 U	26 U	26 U	27 U	5.2 U	26 U	27 U	26 U	26 U	5.3 U
Indeno(1,2,3-cd)pyrene		**8.6 J**	**8.1 J**	**6.8 J**	**9 J**	**8.4 J**	**11 J**	**11 J**	**13**	**9.1 J**	**11 J**	26 U	26 U	26 U	26 U	27 U	**9.8 J**	26 U	27 U	26 U	26 U	**12 J**
Naphthalene		5.3 U	**29**	5.2 U	5.2 U	5.3 U	5.3 U	5.2 U	5.2 U	5.3 U	**7.1 J**	26 U	26 U	26 U	26 U	27 U	5.2 U	26 U	27 U	26 U	26 U	5.3 U
Phenanthrene		5.3 U	**7.2 J**	**12 J**	**5.8 J**	**6.8 J**	5.3 U	5.2 U	5.2 U	**5.9 J**	**8 J**	26 U	26 U	26 U	26 U	27 U	5.2 U	26 U	27 U	26 U	26 U	5.3 U
Pyrene		**10 J**	**13 J**	**12 J**	**12 J**	**12 J**	5.3 U	5.2 U	5.2 U	5.3 U	5.3 U	26 U	26 U	26 U	26 U	27 U	**10 J**	26 U	27 U	26 U	26 U	5.3 U
Total PAHs (ND = 0)	6,000[2]	**54.7 J**	**67.5 J**	**87.8 J**	**71.9 J**	**67.4 J**	**54.5 J**	**65.7 J**	**80.7 J**	**77.9 J**	**87.9 J**	26 U	26 U	26 U	26 U	27 U	**98.3 J**	26 U	27 U	26 U	26 U	**40.4 J**
PCB Congeners (ng/g)																						
PCB003		0.0036 U	0.0023 U	0.0029 U	0.023 U	0.031 U	0.0032 U	0.0045 U	0.0026 U	0.0034 U	0.0023 U	0.0039 U	0.0014 U	0.00086 U	0.006 U	0.0029 U	0.00049 U	0.00044 U	0.0007 U	0.0024 U	0.0012 U	0.0023 U
PCB008		0.18 U	0.17 U	0.044 U	0.14 U	0.2 U	0.1 U	0.17 U	0.14 U	0.16 U	0.12 U	0.016 U	0.045 U	0.011 U	0.13 U	0.053 U	0.0051 U	0.006 U	0.011 U	**0.011**	0.0083 U	0.0092 U
PCB018/030		**0.531**	**0.681**	**0.485**	**0.62**	**0.653**	**0.298**	**0.869**	**0.267**	**0.607**	**0.296**	**0.403**	**0.223**	**0.394**	**0.21**	**0.375**	**0.407**	**0.382**	**0.357**	**0.528**	**0.485**	**0.0085 J**

	FDA Action Level	NV AH-ABTB-COMP REP 1	NV AH-ABTB-COMP REP 2	NV AH-ABTB-COMP REP 3	NV AH-ABTB-COMP REP 4	NV AH-ABTB-COMP REP 5	NV AH-FP-COMP REP 1	NV AH-FP-COMP REP 2	NV AH-FP-COMP REP 3	NV AH-FP-COMP REP 4	NV AH-FP-COMP REP 5	NV AH-LM-COMP REP 1	NV AH-LM-COMP REP 2	NV AH-LM-COMP REP 3	NV AH-LM-COMP REP 4	NV AH-LM-COMP REP 5	NV AH-N-COMP REP 1	NV AH-N-COMP REP 2	NV AH-N-COMP REP 3	NV AH-N-COMP REP 4	NV AH-N-COMP REP 5	NV PRETEST REP 1
		4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	3/31/2015
PCB020/028		0.188	0.308	0.211	0.212	0.206	0.212	0.983	0.246	0.203	0.219	0.267	0.247	0.29	0.139	0.287	0.238	0.248	0.248	0.333	0.284	0.0252 J
PCB021/033		0.111	0.129	0.13	0.123	0.119	0.0221 J	0.0839	0.0239 J	0.114	0.0224 J	0.0319	0.0274	0.0186 J	0.0161 J	0.0247 J	0.0559	0.066	0.00041 U	0.0629	0.0533	0.0043 U
PCB031		0.0202	0.0358	0.0244	0.027	0.03	0.0256	0.181	0.034	0.0225	0.0239	0.0278	0.0232	0.0379	0.0212 J	0.0396	0.0417	0.0305	0.0313	0.0666	0.0421	0.0048 J
PCB037		0.0112 J	0.0169 J	0.01 J	0.023 U	0.032 U	0.0116 J	0.0568	0.0151 J	0.011 U	0.0133 J	0.0252	0.0214	0.0212	0.017 J	0.0305	0.0159	0.0192	0.0154	0.022	0.0234	0.0063 U
PCB044/047/065		3.45	3.43	3.01	3.77	3.75	0.69	2.11	0.702	3.63	0.626	0.931	0.647	0.75	0.493	0.871	1.07	1.31	1.01	1.65	1.31	0.0454 J
PCB049/069		2.64	2.88	2.38	2.93	3.09	0.894	3.03	0.996	2.71	0.806	0.983	0.73	1.01	0.554	0.924	1.2	1.25	1.09	1.95	1.55	0.0413
PCB052		3.45	3.28	2.74	3.36	3.5	2.29	6.18	2.28	3.37	1.99	2.75	2.01	2.1	1.69	2.69	2.3	2.72	2.11	2.78	2.42	0.0745
PCB056		0.0303	0.0407	0.0301	0.03	0.028 U	0.094	0.37	0.106	0.0305	0.0933	0.131	0.135	0.103	0.0834	0.136	0.1	0.126	0.0911	0.127	0.116	0.0194
PCB060		0.0158 J	0.0248	0.0142 J	0.021 U	0.028 U	0.052	0.194	0.0587	0.016 J	0.0512	0.0758	0.0727	0.0599	0.0479 J	0.0812	0.0495	0.0664	0.0448	0.0637	0.0579	0.0127 J
PCB061/070/074/076		0.0827	0.114	0.0902	0.084	0.094	0.186	1.09	0.242	0.0799 J	0.171	0.279	0.269	0.275	0.193 J	0.36	0.241	0.26	0.199	0.356	0.269	0.0506 J
PCB066		0.126	0.175	0.124	0.124	0.128	0.261	1.22	0.317	0.13	0.253	0.338	0.346	0.347	0.21	0.386	0.265	0.323	0.258	0.44	0.326	0.0546
PCB077		0.0124 J	0.0199 J	0.0168 J	0.023 U	0.03 U	0.018 J	0.083	0.0192 J	0.0145 J	0.0194	0.0253	0.0307	0.0241	0.0155 J	0.0298	0.0188	0.0281	0.02	0.0231	0.0247	0.0084 J
PCB081		0.01 U	0.0067 U	0.0031 U	0.023 U	0.031 U	0.011 U	0.015 J	0.0037 U	0.0067 U	0.0046 J	0.0024 U	0.004 J	0.00367 J	0.0039 U	0.0036 U	0.0025 J	0.0036 U	0.00352 J	0.0026 J	0.0022 J	0.0083 U
PCB083/099		1.94	1.96	1.92	2.33	2.11	1.4	4.25	1.28	1.89	1.27	1.34	1.2	1.4	0.957	1.5	1.24	1.97	1.29	1.84	1.52	0.254
PCB086/087/097		0.329	0.337	0.353	0.4	0.346	0.583	1.76	0.56	0.32	0.516	0.699	0.542	0.645	0.591	0.763	0.461	0.655	0.47	0.688	0.557	0.0765 J
PCB090/101		2.55	2.56	2.63	3.01	2.78	2.58	7.09	2.34	2.51	2.27	2.97	2.09	2.65	2.01	2.77	2.27	3.77	2.32	3.24	2.69	0.317
PCB095		1.07	1.05	0.939	1.15	1.08	2.18	5.87	2.04	0.999	1.99	2.89	1.78	2.03	1.89	2.37	1.79	2.88	1.7	2.15	1.92	0.157
PCB105		0.143	0.198	0.173	0.171	0.139	0.41	1.42	0.41	0.159	0.375	0.585	0.562	0.459	0.45	0.569	0.313	0.567	0.334	0.412	0.36	0.0962
PCB110/115		0.578	0.589	0.536	0.648	0.591	1.51	4.28	1.37	0.571	1.34	1.84	1.45	1.56	1.45	2.01	1.13	1.82	1.16	1.73	1.45	0.179
PCB114		0.01 J	0.0122 J	0.0119 J	0.025 U	0.026 U	0.02 J	0.0755	0.0206	0.0106 J	0.0182 J	0.0314	0.0292	0.0244	0.017 U	0.0305	0.0187	0.0381	0.0199	0.0249	0.02	0.0038 U
PCB118		0.343	0.497	0.399	0.399	0.346	0.73	3.12	0.775	0.367	0.696	0.889	0.997	0.969	0.714	1.06	0.652	1.06	0.695	0.946	0.777	0.226
PCB123		0.0085 U	0.0131 J	0.00639 J	0.028 U	0.029 U	0.019 J	0.0745	0.0126 J	0.0096 U	0.0118 J	0.0294	0.0188	0.0129	0.019 U	0.0131 J	0.00927 J	0.0164	0.0105 J	0.0117	0.00966 J	0.0042 U
PCB126		0.0078 U	0.0067 J	0.00679 J	0.025 U	0.027 U	0.0095 U	0.0249 J	0.0084 J	0.0088 U	0.0066 J	0.0078 U	0.0082 J	0.00815 J	0.018 U	0.00747 J	0.00776 J	0.0128	0.00758 J	0.0091 U	0.00861 J	0.0038 U
PCB128/166		0.19	0.226	0.26	0.244	0.197	0.368	0.973	0.34	0.21	0.309	0.528	0.361	0.448	0.369	0.459	0.33	0.845	0.323	0.439	0.334	0.089
PCB129/138		2.75	3.04	3.11	3.71	2.97	4.22	11.3	3.87	2.94	3.54	5.33	3.94	4.3	3.26	4.15	3.45	10.3	3.4	5.16	4.12	0.885
PCB135/151		0.863	0.78	0.897	1.08	0.974	1.24	3.31	1.02	0.881	0.939	1.65	1.18	1.44	1.09	1.31	1.08	3.33	1.03	1.86	1.48	0.163
PCB141		0.174	0.194	0.199	0.233	0.196	0.334	0.967	0.3	0.188	0.26	0.372	0.295	0.347	0.262	0.299	0.286	0.803	0.278	0.513	0.393	0.0338
PCB147/149		2.3	2.55	3.21	3.29	2.54	3.25	10.5	3	2.48	2.69	4.87	3.68	3.9	3.16	3.8	3.38	11.2	3.36	5.07	4.08	0.543
PCB153/168		4.91	5.18	6.34	7.15	5.28	4.97	15	4.63	5.1	4.23	7.06	5.46	5.56	4.17	5.32	4.9	14.8	4.82	7.21	5.9	1.18
PCB156/157		0.119	0.141	0.166	0.161	0.107	0.225	0.733	0.209	0.124	0.185	0.327	0.286	0.242	0.222	0.254	0.207	0.671	0.221	0.324	0.259	0.0539
PCB158		0.18	0.196	0.217	0.257	0.196	0.286	0.738	0.253	0.19	0.225	0.378	0.255	0.295	0.242	0.282	0.233	0.734	0.226	0.353	0.278	0.0482

	FDA Action Level	NV AH-ABTB-COMP REP 1	NV AH-ABTB-COMP REP 2	NV AH-ABTB-COMP REP 3	NV AH-ABTB-COMP REP 4	NV AH-ABTB-COMP REP 5	NV AH-FP-COMP REP 1	NV AH-FP-COMP REP 2	NV AH-FP-COMP REP 3	NV AH-FP-COMP REP 4	NV AH-FP-COMP REP 5	NV AH-LM-COMP REP 1	NV AH-LM-COMP REP 2	NV AH-LM-COMP REP 3	NV AH-LM-COMP REP 4	NV AH-LM-COMP REP 5	NV AH-N-COMP REP 1	NV AH-N-COMP REP 2	NV AH-N-COMP REP 3	NV AH-N-COMP REP 4	NV AH-N-COMP REP 5	NV PRETEST REP 1
		4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	4/29/2015	3/31/2015
PCB167		**0.0808**	**0.0928**	**0.113**	**0.114**	**0.075**	**0.131**	**0.41**	**0.119**	**0.0882**	**0.109**	**0.173**	**0.154**	**0.123**	**0.11**	**0.125**	**0.114**	**0.325**	**0.121**	**0.164**	**0.137**	**0.0304**
PCB169		0.0088 U	0.0045 U	0.0022 U	0.024 U	0.031 U	0.0062 U	0.011 U	0.0063 U	0.0077 U	0.006 U	0.0018 U	0.0021 U	0.0012 U	0.016 U	0.00059 U	0.0022 U	0.0011 U	0.0027 U	**0.0095 J**	0.0017 U	0.0052 U
PCB170		**0.722**	**0.782**	**1.08**	**1.14**	**0.673**	**1.2**	**3.04**	**0.901**	**0.702**	**0.822**	**1.19**	**1.09**	**0.834**	**0.692**	**0.716**	**0.969**	**3.96**	**0.99**	**1.27**	**0.995**	**0.205**
PCB174		**0.284**	**0.279**	**0.339**	**0.371**	**0.295**	**0.4**	**1.03**	**0.307**	**0.281**	**0.294**	**0.336**	**0.363**	**0.282**	**0.222**	**0.241**	**0.322**	**1.16**	**0.347**	**0.466**	**0.412**	**0.0575**
PCB177		**0.512**	**0.536**	**0.605**	**0.745**	**0.509**	**0.615**	**1.59**	**0.523**	**0.501**	**0.502**	**0.624**	**0.588**	**0.474**	**0.341**	**0.434**	**0.559**	**2.05**	**0.562**	**0.826**	**0.677**	**0.159**
PCB180/193		**2.05**	**2.14**	**3.03**	**3.15**	**1.92**	**3.07**	**8.14**	**2.44**	**2.01**	**2.19**	**3.18**	**2.92**	**2.33**	**1.83**	**2.04**	**2.6**	**9.69**	**2.59**	**3.58**	**2.81**	**0.545**
PCB183		**0.659**	**0.72**	**0.982**	**1.04**	**0.672**	**0.866**	**2.3**	**0.731**	**0.658**	**0.67**	**0.939**	**0.783**	**0.679**	**0.507**	**0.582**	**0.842**	**3.12**	**0.808**	**1.11**	**0.85**	**0.209**
PCB187		**1.75**	**1.84**	**2.29**	**2.66**	**1.88**	**2.09**	**5.33**	**1.78**	**1.75**	**1.63**	**2.36**	**1.82**	**1.94**	**1.39**	**1.79**	**2.08**	**6.43**	**1.96**	**2.75**	**2.32**	**0.5**
PCB189		**0.0265**	**0.0303**	**0.0439**	**0.042**	0.039 U	**0.0439**	**0.117**	**0.0347**	**0.026**	**0.0308**	**0.0456**	**0.0446**	**0.0355**	**0.0294 J**	**0.0276**	**0.0341**	**0.127**	**0.034**	**0.0492**	**0.0373**	**0.007 J**
PCB194		**0.426**	**0.459**	**0.674**	**0.667**	**0.378**	**0.64**	**1.59**	**0.492**	**0.429**	**0.445**	**0.652**	**0.555**	**0.441**	**0.385**	**0.373**	**0.448**	**1.41**	**0.501**	**0.679**	**0.531**	**0.116**
PCB195		**0.18**	**0.185**	**0.254**	**0.259**	**0.151**	**0.264**	**0.658**	**0.183**	**0.159**	**0.174**	**0.268**	**0.249**	**0.195**	**0.15**	**0.168**	**0.214**	**0.735**	**0.208**	**0.297**	**0.243**	**0.0683**
PCB200		**0.0224**	**0.0137 J**	**0.0165 J**	0.032 U	0.037 U	**0.0379**	0.07 U	**0.0244**	**0.0209**	**0.0134 J**	**0.0271**	**0.0287**	**0.025**	0.014 U	**0.022**	**0.0305**	**0.0798**	**0.0296**	0.039 U	**0.0421**	**0.0061 J**
PCB201		**0.0903**	**0.0961**	**0.108**	**0.124**	**0.093**	**0.123**	**0.304**	**0.0957**	**0.0868**	**0.0896**	**0.128**	**0.106**	**0.109**	**0.0742**	**0.0918**	**0.11**	**0.221**	**0.0934**	**0.137**	**0.127**	**0.0384**
PCB206		**0.305**	**0.361**	**0.372**	**0.35**	**0.341**	**0.442**	**1.26**	**0.426**	**0.352**	**0.377**	**0.506**	**0.477**	**0.399**	**0.375**	**0.397**	**0.552**	**0.792**	**0.586**	**0.679**	**0.616**	**0.222**
PCB209		**0.235**	**0.252**	0.24 U	**0.268**	**0.254**	**0.377**	**1.18**	**0.35**	**0.265**	**0.351**	**0.418**	**0.389**	**0.363**	**0.287**	**0.32**	**0.397**	**0.438**	**0.422**	**0.41**	**0.406**	**0.213**
Total PCB Congeners (ND = 0)	2,000[3]	**36.4606 J**	**38.452 J**	**40.5472 J**	**46.443**	**38.663**	**39.6791 J**	**114.901 J**	**36.1523 J**	**37.1959 J**	**33.1585 J**	**48.9035**	**38.4879 J**	**39.9543 J**	**30.9197 J**	**40.5293 J**	**37.0346 J**	**92.8393**	**36.3951 J**	**52.8142 J**	**43.3233 J**	**7.0237 J**

Notes:
For totals, zeros were used for non-detect samples for summing. If all samples were non-detect, the highest method detection limit of all samples was used as the total result.
1 Action level for methyl mercury
2 No action levels for PAHs. Concentrations were compared to total PAH concentrations considered by the U.S. Environmental Protection Agency to present a risk for human consumption of fish and shellfish (Oros, D.R., J.R.M Ross, R.B. Spies, and T. Mumley, 2007. Polycyclic aromatic hydrocarbon (PAH) contamination in San Francisco Bay: A 10-year retrospective of monitoring in an urbanized estuary. Environmental Research 105(1):101-118. September 2007.).
3 Tolerance level for PCBs. No action level.
Bold = detected result
-- = results not reported or not applicable
µg/kg = micrograms per kilogram
CDD = Chloro Dibenzo-p-Dioxin
CDF = Chloro Dibenzo-p-furan
FDA = Food and Drug Administration
J = Estimated value
mg/kg = milligrams per kilogram
ND = non-detect
ng/g = nanograms per gram
ng/kg = nanograms per kilogram
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
U = Indicates the compound or analyte was analyzed for but not detected at or above the method detection limit

3.5.2 Comparison of Tissue Burdens to Historical Reference Sediment Tissue Burdens

Tissue concentrations were compared to historical reference data collected from the G-DODS reference site (Weston 2008). A direct (non-statistical) comparison was made between the tissue burdens of animals exposed to the test sediments and those in the reference envelope. Test area mean tissue concentrations for *M. nasuta* and *N. virens* that exceeded those in the reference envelope are presented in Tables 20 and 21, respectively.

Metals, PAHs, PCBs, and dioxin/furans were elevated in *M. nasuta* tissue samples exposed to Northern Inner Apra Harbor sediments (Table 20). Arsenic, cadmium, chromium, copper, lead, nickel, and zinc were elevated in all test areas. Mean concentrations of metals ranged from 1.06 to 26.7 times greater than the reference. Several individual PAHs and total PAHs were elevated in all test areas. The magnitude of exceedance for total PAHs was low, with mean concentrations ranging from 1.74 to 3.13 times greater than the reference. Total PCBs were elevated in all test areas. Mean concentrations of total PCBs ranged from 7.54 to 12.6 times greater than the reference. Several dioxins/furans were elevated in test areas AH-FP and AH-N. Mean concentrations of dioxins/furans ranged from 1.5 to 64.7 times greater than the reference.

Metals, PAHs, PCBs, and dioxin/furans were elevated in *N. virens* tissue samples exposed to Northern Inner Apra Harbor sediments (Table 21). Chromium, copper, lead, and mercury were elevated in all test areas, while arsenic was elevated in test area AH-ABTB. Mean concentrations of metals ranged from 1.48 to 15.9 times greater than the reference. Several individual PAHs were elevated in all test areas. The magnitude of exceedance was low, with mean concentrations ranging from 1.09 to 4.4 times greater than the reference. Total PCBs were elevated in all test areas. Mean concentrations of total PCBs ranged from 7.59 to 10.5 times greater than the reference. Several dioxins/furans were elevated in test areas AH-FP and AH-N. Mean concentrations of dioxins/furans ranged from 1.29 to 51.7 times greater than the reference.

3.5.3 Comparison of Tissue Burdens to Environmental Residue Effects Database

Elevated concentrations in tissues exposed to Northern Inner Apra Harbor sediments were compared to residue-effects values provided in the ERED (USACE/USEPA 2010). The cited ERED values were based on the lowest effect level of relevant species and endpoints. The comparison of tissue burdens to residue-effects values for *M. nasuta* and *N. virens* is presented in Tables 20 and 21, respectively.

For *M. nasuta* tissue residues, all test area mean concentrations were less than ERED values with the exception of arsenic and copper. Mean tissue concentrations of arsenic exceeded the ERED value in all test areas (Table 20). Mean tissue concentrations of copper exceeded the ERED value in test areas AH-FP, AH-LM, and AH-N. Day 0 concentrations of some analytes were elevated above the reference; therefore, mean test area concentrations were corrected based on the Day 0 tissue concentrations and then compared to the ERED value (Table 20). All corrected mean tissue concentrations of arsenic were less than the ERED value. Corrected mean tissue concentrations of copper were less than the ERED value in test area AH-FP but exceeded the ERED value in test areas AH-LM and AH-N. For AH-LM and AH-N, the corrected mean tissue concentrations were 1.31 and 12.0 times greater than the ERED value, respectively.

For *N. virens* tissue residues, all test area mean concentrations were less than ERED values with the exception of arsenic and copper. Mean tissue concentrations of arsenic exceeded the ERED value in test area AH-ABTB (Table 21). Mean tissue concentrations of copper exceeded the ERED value in test areas AH-FP and AH-LM. Day 0 concentrations of some analytes were elevated above the reference; therefore, mean test area concentrations were corrected based on the Day 0 tissue concentrations and then compared to the ERED value (Table 21). The corrected mean tissue concentration of arsenic was less than the ERED value in test area AH-ABTB. Corrected mean tissue concentrations of copper exceeded the ERED value in test areas AH-FP and AH-LM. The corrected mean tissue concentrations were 1.17 and 1.46 times greater than the ERED value, respectively. It should be noted that the copper ERED value used for comparison is a No Observed Effect Dose (NOED), indicating that no effects were observed at this concentration. A relevant Lowest Observed Effect Dose (LOED) was not available for this species.

Table 20

Summary of Elevated *Macoma nasuta* Tissue Residues Relative to G-DODS Reference

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Database Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
AH-FP	Arsenic	mg/kg	0.0419 to 0.0423	3.92	1.5758	4.51	2.86	1.15	0.16	NOED = 3.6 mg/kg for mortality and growth in the mussel *Mytilus edulis*
	Cadmium	mg/kg	0.0099 to 0.01	0.0579	0.0454	0.060	1.33	1.04	0.00	NOED = 62 mg/kg for mortality in the marine polychaete worm *Neanthes arenaceodentata*. NOED = 3.8 mg/kg for reproduction. No significant difference in number of eggs/pair or length of time from pairing egg laying
	Chromium	mg/kg	0.0525 to 0.053	0.216	0.144	0.410	2.85	1.90	0.04	NOED = 4.4 mg/kg for reproduction (depressed brood size) in the polychaete worm *N. arenaceodentata*
	Copper	mg/kg	0.0751 to 0.0758	3.11	2.2882	5.11	2.23	1.64	0.50	LOED = 4 mg/kg for growth of the mussel *M. edulis*
	Lead	mg/kg	0.0063 to 0.0064	0.148	0.1174	1.77	15.0	11.9	0.40	NOED = 4 mg/kg for mortality of the amphipod *Monoporeia affinis*
	Nickel	mg/kg	0.0414 to 0.0422	0.484	0.3518	0.761	2.16	1.57	0.00	NOED = 79 mg/kg for mortality in the bivalve *Cerastoderma edule*
	Zinc	mg/kg	0.735 to 0.743	16.1	11.346	23.1	2.04	1.43	0.12	NOED = 60 mg/kg for mortality in the polychaete worm *Nephtys australiensis*
	Anthracene	µg/kg	2.6	5.5	5 U	5.16	1.03	0.94	0.00	6,740 µg/kg = effect on mortality of *Rhepoxynius abronius*
	Benzo(a)anthracene	µg/kg	5.2 to 5.3	2.65 U	5 U	5.46	1.09	2.06	0.00	5,940 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)pyrene	µg/kg	5.2 to 5.3	16	5 U	60.4	12.1	3.78	0.15	LOED = 300 µg/kg for reproduction of *M. edulis*
	Benzo(b)fluoranthene	µg/kg	5.2 to 5.3	2.65 U	5 U	134	26.8	50.5	-	-
	Benzo(g,h,i)perylene	µg/kg	5.2 to 5.3	50	5 U	13.3	2.67	0.27	-	No relevant species
	Benzo(k)fluoranthene	µg/kg	5.2 to 5.3	2.65 U	5 U	54.4	10.9	20.5	-	-
	Chrysene	µg/kg	2.6	9.4	5 U	7.00	1.40	0.74	0.00	1,280 µg/kg = effect on mortality of *R. abronius*
	Dibenz(a,h)anthracene	µg/kg	5.2 to 5.3	2.65 U	5 U	5.33	1.07	2.01	-	-
	Fluoranthene	µg/kg	5.2 to 5.3	7.4	9.52	11.3	1.18	1.52	0.02	LOED = 220 µg/kg for reproduction of *M. edulis*
	Indeno(1,2,3-cd)pyrene	µg/kg	5.2 to 5.3	16	5 U	26.2	5.24	1.64	-	
	Total PAHs (ND = 0)	µg/kg	2.6	105.8	185.42	322	1.74	3.05	0.32	676 µg/kg = effect on growth of the giant mussel *Chromytilus chorus*
	PCB153/168	ng/g	0.00066 to 0.0018	0.0338	5 U	5.11	1.02	151	0.00	LOED for PCB 153 = 126,310 µg/kg for mortality of the oligochaete *Lumbriculus variegatus*
	Total PCB Congeners (ND = 0)	ng/g	0.0028 to 0.0088	0.26968	5 U	44.2	8.85	164	0.03	NOED = 1,700 µg/kg for mortality and growth of the clam *Macoma nasuta.*
	1,2,3,4,6,7,8-Hepta CDD	ng/kg	0.0307 to 0.0476	0.474	0.744	14.2	19.1	30.0	-	-
	1,2,3,4,6,7,8-Hepta CDF	ng/kg	0.0156 to 0.0221	0.0305	0.3261 U	2.94	9.00	96.3	-	-

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Database Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
AH-FP (cont.)	1,2,3,4,7,8,9-Hepta CDF	ng/kg	0.0227 to 0.0301	0.00585 U	0.197 U	0.235	1.19	40.1	-	-
	1,2,3,4,7,8-Hexa CDD	ng/kg	0.0417 to 0.0514	0.00965 U	0.218 U	0.289	1.33	30.0	-	-
	1,2,3,4,7,8-Hexa CDF	ng/kg	0.0303 to 0.0375	0.00595 U	0.197 U	0.392	1.99	65.8	-	-
	1,2,3,6,7,8-Hexa CDD	ng/kg	0.042 to 0.0502	0.0363	0.235 U	0.975	4.15	26.9	-	-
	1,2,3,6,7,8-Hexa CDF	ng/kg	0.0274 to 0.0368	0.025	0.218 U	0.353	1.62	14.1	-	-
	1,2,3,7,8,9-Hexa CDD	ng/kg	0.0418 to 0.0481	0.00975 U	0.34	0.663	1.95	68.0	-	-
	1,2,3,7,8-Penta CDF	ng/kg	0.0249 to 0.0315	0.009 U	0.243 U	0.256	1.05	28.4	-	No relevant species[5]
	2,3,4,6,7,8-Hexa CDF	ng/kg	0.0291 to 0.039	0.0205	0.205 U	0.539	2.63	26.3	-	-
	OCDD	ng/kg	0.034 to 0.0528	2.91	4.16	82.0	19.7	28.2	-	-
	OCDF	ng/kg	0.0314 to 0.0368	0.0869	0.766	5.49	7.16	63.2	-	No relevant species[5]
	Total Hepta CDD	ng/kg	0.0307 to 0.0476	1.36	1.41	48.7	34.5	35.8	-	No relevant species[5]
	Total Hepta CDF	ng/kg	0.0185 to 0.0255	0.0886	0.3571 U	9.48	26.6	107	-	-
	Total Hexa CDD	ng/kg	0.0418 to 0.0499	0.426	0.34	25.9	76.2	60.8	-	-
	Total Hexa CDF	ng/kg	0.0277 to 0.0374	0.186	0.207 U	9.81	47.4	52.8	-	-
	Total Penta CDD	ng/kg	0.0728 to 0.0927	1.08	0.186 U	12.0	64.7	11.15	-	-
	Total Penta CDF	ng/kg	0.0228 to 0.0289	0.349	0.287	7.30	25.4	20.9	-	-
	Total Tetra CDD	ng/kg	0.0411 to 0.0529	0.252	0.196 U	2.48	12.6	9.83	0.00	No relevant marine species. NOED = 8,600 ng/kg for mortality in the water flea *Daphnia magna*
	Total Tetra CDF	ng/kg	0.0616 to 0.079	0.545	0.274	13.7	49.9	25.1	-	-
AH-ABTB	Arsenic	mg/kg	0.0417 to 0.0427	3.92	1.5758	4.13	2.62	1.05	0.06	NOED = 3.6 mg/kg for mortality and growth in the mussel *M. edulis*
	Cadmium	mg/kg	0.0099 to 0.0101	0.0579	0.0454	0.048	1.06	0.83	0.00	NOED = 62 mg/kg for mortality in the marine polychaete worm *N. arenaceodentata*. NOED = 3.8 mg/kg for reproduction. No significant difference in number of eggs/pair or length of time from pairing egg laying

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Database Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
AH-ABTB (cont.)	Chromium	mg/kg	0.0522 to 0.0535	0.216	0.144	0.340	2.36	1.57	0.03	NOED = 4.4 mg/kg for reproduction (depressed brood size) in the polychaete worm *N. arenaceodentata*
	Copper	mg/kg	0.0747 to 0.0766	3.11	2.2882	3.37	1.47	1.08	0.06	LOED = 4 mg/kg for growth of the mussel *M. edulis*
	Lead	mg/kg	0.0063 to 0.0064	0.148	0.1174	0.503	4.29	3.40	0.09	NOED = 4 mg/kg for mortality of the amphipod *M. affinis*
	Nickel	mg/kg	0.0414 to 0.0422	0.484	0.3518	0.534	1.52	1.10	0.00	NOED = 79 mg/kg for mortality in the bivalve *Cerastoderma edule*
	Zinc	mg/kg	0.732 to 0.75	16.1	11.346	20.3	1.79	1.26	0.07	NOED = 60 mg/kg for mortality in the polychaete worm *Nephtys australiensis*
	2-Methylnaphthalene	µg/kg	5.2 to 5.3	2.65 U	5 U	8.10	1.62	3.06	-	-
	Anthracene	µg/kg	2.6	5.5	5 U	15.2	3.04	2.76	0.00	6,740 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)anthracene	µg/kg	5.2 to 5.3	2.65 U	5 U	14.4	2.88	5.43	0.00	5,940 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)pyrene	µg/kg	5.2 to 5.3	16	5 U	41.4	8.28	2.59	0.08	LOED = 300 µg/kg for reproduction of *M. edulis*
	Benzo(b)fluoranthene	µg/kg	5.2 to 5.3	2.65 U	5 U	71.6	14.3	27.0	-	-
	Benzo(g,h,i)perylene	µg/kg	5.2 to 5.3	50	5 U	6.66	1.33	0.13	-	No relevant species
	Benzo(k)fluoranthene	µg/kg	5.2 to 5.3	2.65 U	5 U	33.2	6.64	12.5	-	-
	Chrysene	µg/kg	2.6	9.4	5 U	20.2	4.04	2.15	0.01	1,280 µg/kg = effect on mortality of *R. abronius*
	Fluoranthene	µg/kg	5.2 to 5.3	7.4	9.52	93.8	9.85	12.7	0.39	LOED = 220 µg/kg for reproduction of *M. edulis*
	Indeno(1,2,3-cd)pyrene	µg/kg	5.2 to 5.3	16	5 U	21.4	4.28	1.34	-	-
	Naphthalene	µg/kg	5.2 to 5.3	7.2	8.18	11.8	1.44	1.64	0.00	31,300 µg/kg = 50% reduction in feeding of *M. edulis*
	Phenanthrene	µg/kg	5.2 to 5.3	2.65 U	7.28	27.0	3.71	10.2	0.03	NOED = 780 µg/kg for mortality of *Nereis arenaceodentata*
	Total PAHs (ND = 0)	µg/kg	2.6	105.8	185.42	332	1.79	3.14	0.33	676 µg/kg = effect on growth of the giant mussel *C. chorus*
	PCB049/069	ng/g	0.0017 to 0.0046	0.0049	5 U	7.25	1.45	1480	-	-
	PCB153/168	ng/g	0.00092 to 0.0044	0.0338	5 U	8.36	1.67	247	0.00	LOED for PCB 153 = 126,310 µg/kg for mortality of the oligochaete *L. variegatus*
	Total PCB Congeners (ND = 0)	ng/g	0.00091 to 0.011	0.26968	5 U	63.2	12.6	234	0.04	NOED = 1,700 µg/kg for mortality and growth of the clam *M. nasuta.*
AH-LM	Arsenic	mg/kg	0.0417 to 0.0427	3.92	1.5758	5.35	3.40	1.36	0.40	NOED = 3.6 mg/kg for mortality and growth in the mussel *M. edulis*
	Cadmium	mg/kg	0.0099 to 0.0101	0.0579	0.0454	0.068	1.49	1.17	0.00	NOED = 62 mg/kg for mortality in the marine polychaete worm *N. arenaceodentata*. NOED = 3.8 mg/kg for reproduction. No significant difference in number of eggs/pair or length of time from pairing egg laying
	Chromium	mg/kg	0.0522 to 0.0535	0.216	0.144	0.515	3.57	2.38	0.07	NOED = 4.4 mg/kg for reproduction (depressed brood size) in the polychaete worm *N. arenaceodentata*

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Database Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
AH-LM (cont.)	Copper	mg/kg	0.0747 to 0.0766	3.11	2.2882	8.34	3.65	2.68	1.31	LOED = 4 mg/kg for growth of the mussel *M. edulis*
	Lead	mg/kg	0.0063 to 0.0064	0.148	0.1174	3.14	26.7	21.2	0.75	NOED = 4 mg/kg for mortality of the amphipod *M. affinis*
	Nickel	mg/kg	0.0412 to 0.042	0.484	0.3518	0.658	1.87	1.36	0.00	NOED = 79 mg/kg for mortality in the bivalve *C. edule*
	Zinc	mg/kg	0.732 to 0.75	16.1	11.346	25.0	2.20	1.55	0.15	NOED = 60 mg/kg for mortality in the polychaete worm *N. australiensis*
	1-Methylnaphthalene	µg/kg	5.3 to 26	2.65 U	5 U	6.79 U	1.36	2.56	-	No relevant species
	2-Methylnaphthalene	µg/kg	5.3 to 26	2.65 U	5 U	7.60	1.52	2.87	-	-
	Acenaphthene	µg/kg	5.3 to 26	2.65 U	5 U	7.58	1.52	2.86	0.00	29,400 µg/kg = 50% reduction in feeding of *M. edulis*
	Anthracene	µg/kg	2.6 to 13	5.5	5 U	8.28	1.66	1.51	0.00	6,740 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)anthracene	µg/kg	5.3 to 26	2.65 U	5 U	9.10	1.82	3.43	0.00	5,940 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)pyrene	µg/kg	5.3 to 26	16	5 U	97.8	19.6	6.11	0.27	LOED = 300 µg/kg for reproduction of *M. edulis*
	Benzo(b)fluoranthene	µg/kg	5.3 to 26	2.65 U	5 U	210	42.0	79.2	-	-
	Benzo(g,h,i)perylene	µg/kg	5.3 to 26	50	5 U	20.0	4.00	0.40	-	No relevant species
	Benzo(k)fluoranthene	µg/kg	5.3 to 26	2.65 U	5 U	69.0	13.8	26.0	-	-
	Chrysene	µg/kg	2.6 to 13	9.4	5 U	10.8	2.16	1.15	0.00	1,280 µg/kg = effect on mortality of *R. abronius*
	Dibenz(a,h)anthracene	µg/kg	5.3 to 26	2.65 U	5 U	11.3	2.25	4.25	-	-
	Fluoranthene	µg/kg	5.3 to 26	7.4	9.52	20.6	2.16	2.78	0.06	LOED = 220 µg/kg for reproduction of *M. edulis*
	Fluorene	µg/kg	5.3 to 26	2.65 U	5 U	6.79 U	1.36	2.56	0.00	No relevant marine species. NOED = 8,090 µg/kg for reproduction of *Hyalella azteca*
	Indeno(1,2,3-cd)pyrene	µg/kg	5.3 to 26	16	5 U	29.2	5.84	1.83	-	-
	Naphthalene	µg/kg	5.3 to 26	7.2	8.18	9.63	1.18	1.34	0.00	31,300 µg/kg = 50% reduction in feeding of *M. edulis*
	Phenanthrene	µg/kg	5.3 to 26	2.65 U	7.28	10.4	1.43	3.93	0.01	NOED = 780 µg/kg for mortality of *N. arenaceodentata*
	Total PAHs (ND = 0)	µg/kg	2.6 to 13	105.8	185.42	459	2.48	4.34	0.52	676 µg/kg = effect on growth of the giant mussel *C. chorus*
	Total PCB Congeners (ND = 0)	ng/g	0.002 to 0.0038	0.26968	5 U	37.7	7.54	140	0.02	NOED = 1,700 µg/kg for mortality and growth of the clam *M. nasuta.*
AH-N	Arsenic	mg/kg	0.0419 to 0.0427	3.92	1.5758	4.38	2.78	1.12	0.13	NOED = 3.6 mg/kg for mortality and growth in the mussel *M. edulis*
	Cadmium	mg/kg	0.0099 to 0.0101	0.0579	0.0454	0.079	1.74	1.37	0.00	NOED = 62 mg/kg for mortality in the marine polychaete worm *N. arenaceodentata*. NOED = 3.8 mg/kg for reproduction. No significant difference in number of eggs/pair or length of time from pairing egg laying
	Chromium	mg/kg	0.0525 to 0.0535	0.216	0.144	0.499	3.46	2.31	0.06	NOED = 4.4 mg/kg for reproduction (depressed brood size) in the polychaete worm *N. arenaceodentata*
	Copper	mg/kg	0.0751 to 0.379	3.11	2.2882	51.3	22.4	16.5	12.04	LOED = 4 mg/kg for growth of the mussel *M. edulis*

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Database Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
AH-N (cont.)	Lead	mg/kg	0.0063 to 0.0064	0.148	0.1174	2.17	18.5	14.7	0.51	NOED = 4 mg/kg for mortality of the amphipod *M. affinis*
	Nickel	mg/kg	0.0414 to 0.0422	0.484	0.3518	0.690	1.96	1.43	0.00	NOED = 79 mg/kg for mortality in the bivalve *C. edule*
	Zinc	mg/kg	0.735 to 0.75	16.1	11.346	28.5	2.52	1.77	0.21	NOED = 60 mg/kg for mortality in the polychaete worm *N. australiensis*
	2-Methylnaphthalene	µg/kg	5.3	2.65 U	5 U	5.15	1.03	1.94	-	-
	Anthracene	µg/kg	2.6 to 2.7	5.5	5 U	7.53	1.51	1.37	0.00	6,740 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)anthracene	µg/kg	5.3	2.65 U	5 U	16.0	3.20	6.04	0.00	5,940 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)pyrene	µg/kg	5.3	16	5 U	108	21.5	6.73	0.31	LOED = 300 µg/kg for reproduction of *M. edulis*
	Benzo(b)fluoranthene	µg/kg	5.3	2.65 U	5 U	220	44.0	83.0	-	-
	Benzo(g,h,i)perylene	µg/kg	5.3	50	5 U	17.2	3.44	0.34	-	No relevant species
	Benzo(k)fluoranthene	µg/kg	5.3	2.65 U	5 U	101	20.1	38.0	-	-
	Chrysene	µg/kg	2.6 to 2.7	9.4	5 U	13.7	2.74	1.46	0.00	1,280 µg/kg = effect on mortality of *R. abronius*
	Dibenz(a,h)anthracene	µg/kg	5.3	2.65 U	5 U	8.10	1.62	3.06	-	-
	Fluoranthene	µg/kg	5.3	7.4	9.52	23.4	2.46	3.16	0.07	LOED = 220 µg/kg for reproduction of *M. edulis*
	Indeno(1,2,3-cd)pyrene	µg/kg	5.3	16	5 U	31.8	6.36	1.99	-	-
	Naphthalene	µg/kg	5.3	7.2	8.18	12.8	1.56	1.78	0.00	31,300 µg/kg = 50% reduction in feeding of *M. edulis*
	Phenanthrene	µg/kg	5.3	2.65 U	7.28	7.61	1.05	2.87	0.01	NOED = 780 µg/kg for mortality of *N. arenaceodentata*
	Total PAHs (ND = 0)	µg/kg	2.6 to 2.7	105.8	185.42	580	3.13	5.48	0.70	676 µg/kg = effect on growth of the giant mussel *C. chorus*
	Total PCB Congeners (ND = 0)	ng/g	0.0021 to 0.0026	0.26968	5 U	42.3	8.47	157	0.02	NOED = 1,700 µg/kg for mortality and growth of the clam *M. nasuta*
	1,2,3,4,6,7,8-Hepta CDD	ng/kg	0.0277 to 0.0321	0.474	0.744	3.30	4.44	6.97	-	-
	1,2,3,4,6,7,8-Hepta CDF	ng/kg	0.0143 to 0.0178	0.0305	0.3261 U	1.49	4.58	48.9	-	-
	1,2,3,6,7,8-Hexa CDD	ng/kg	0.0384 to 0.0445	0.0363	0.235 U	0.263	1.12	7.26	-	-
	OCDD	ng/kg	0.0263 to 0.0348	2.91	4.16	19.3	4.63	6.62	-	-
	OCDF	ng/kg	0.0284 to 0.0321	0.0869	0.766	1.40	1.83	16.1	-	No relevant species[5]
	Total Hepta CDD	ng/kg	0.0277 to 0.0321	1.36	1.41	14.0	9.94	10.3	-	No relevant species[5]
	Total Hepta CDF	ng/kg	0.0168 to 0.021	0.0886	0.3571 U	3.48	9.75	39.3	-	-

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Database Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
	Total Hexa CDD	ng/kg	0.0378 to 0.0444	0.426	0.34	7.45	21.9	17.5	-	-
	Total Hexa CDF	ng/kg	0.0216 to 0.0302	0.186	0.207 U	2.81	13.6	15.1	-	-
	Total Penta CDD	ng/kg	0.0685 to 0.0768	1.08	0.186 U	5.64	30.3	5.22	-	-
	Total Penta CDF	ng/kg	0.0197 to 0.0239	0.349	0.287	2.73	9.51	7.82	-	-
	Total Tetra CDD	ng/kg	0.0435 to 0.0501	0.252	0.196 U	1.34	6.84	5.32	0.00	No relevant marine species. NOED = 8,600 ng/kg for mortality in the water flea *D. magna*
	Total Tetra CDF	ng/kg	0.0522 to 0.062	0.545	0.274	5.70	20.8	10.5	-	-

Notes:

Ratio of test area mean corrected for Day 0 to ERED value is greater than 1.0

Test area mean concentration is greater than ERED value

µg/kg = micrograms per kilogram
CDD = Chloro Dibenzo-p-Dioxin
CDF = Chloro Dibenzo-p-furan
ERED = Environmental Residue Effects Database
GDODS = Guam Deep Ocean Disposal Site
LOED = lowest observed effect dose
MDL = Method Detection Limit
mg/kg = milligrams per kilogram
ng/g = nanograms per gram
ng/kg = nanograms per kilogram
NOED = no observed effect dose
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
U = non-detect; half the detection limit shown

1 Reference mean concentrations from Weston Solutions, Inc., 2008. Field Report Baseline Studies Conducted for the Designation of an Ocean Dredged Material Disposal Site, Apra Harbor, Guam. Department of the Navy, NAVFAC PAC. July 2008.

2 Reference mean concentrations not available for total PAHs and total PCBs. For the purpose of comparing to test area mean concentrations, the reference total PAHs and total PCBs were calculated such that: 1) an individual non-detect analyte was set to half the MDL; and 2) a total is calculated using the sum of detected individuals, if any, or half of the highest MDL if all individuals are non-detect.

3 Test area mean concentrations were calculated as the mean across replicate samples, detected and non-detects included, where non-detects were handled such that: 1) an individual non-detect analyte was set to half the MDL, and 2) a total is calculated using the sum of detected individuals, if any, or half of the highest MDL if all individuals are non-detect.

4 Test area mean corrected for Day 0 is the test area mean concentration minus the Day 0 concentration.

5 It has been shown that a wide variety of invertebrates including amphipods, cladocerans, clams, grass shrimp, midges, mosquito larvae, sandworms, oligochaete worms, and snails are insenstive to 2,3,7,8-Tetra CDD induced toxicity (U.S. Environmental Protection Agency, 2008. Framework for Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furans, and Biphenyls in Ecological Risk Assessment. EPA/100/R-08/004. June 2008.)

Table 21

Summary of Elevated *Nereis virens* Tissue Residues Relative to G-DODS Reference

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
AH-FP	Chromium	mg/kg	0.0522 to 0.0535	0.151	0.0712	0.167	2.35	1.11	0.00	NOED = 4.4 mg/kg for reproduction (depressed brood size) in the polychaete worm *Neanthes arenaceodentata*
	Copper	mg/kg	0.0747 to 0.0766	2.18	1.908	9.69	5.08	4.45	1.17	NOED = 6.42 mg/kg for mortality in the polychaete worm *Cirriformia spirabrancha*
	Lead	mg/kg	0.0063 to 0.0064	0.0755	0.08	0.851	10.64	11.3	0.19	NOED = 4 mg/kg for mortality of the amphipod *Monoporeia affinis*
	Mercury	mg/kg	0.0094 to 0.0096	0.0211	0.014	0.024	1.68	1.11	0.00	NOED = 8.4 mg/kg for mortality of the mussel *M. edulis*
	Anthracene	µg/kg	2.6 to 2.7	11	5 U	8.90	1.78	0.81	0.00	6,740 µg/kg = effect on mortality of *Rhepoxynius abronius*
	Benzo(a)pyrene	µg/kg	5.2 to 5.3	10	5 U	21.8	4.36	2.18	0.04	LOED = 300 µg/kg for reproduction of *Mytilus edulis*
	Benzo(b)fluoranthene	µg/kg	5.2 to 5.3	2.65 U	5 U	13.4	2.68	5.06	-	-
	Benzo(g,h,i)perylene	µg/kg	5.2 to 5.3	7.4	5 U	7.70	1.54	1.04	-	No relevant species
	Benzo(k)fluoranthene	µg/kg	5.2 to 5.3	2.65 U	5 U	7.74	1.55	2.92	-	-
	Indeno(1,2,3-cd)pyrene	µg/kg	5.2 to 5.3	12	5 U	11.0	2.20	0.92	-	-
	PCB129/138	ng/g	0.0037 to 0.012	0.885	5 U	5.17	1.03	5.85	0.00	No relevant effects in the ERED for this species. NOED for PCB 138 = 946,000 µg/kg for mortality, growth, and reproduction of the fathead minnow *Pimephales promelas*.
	PCB153/168	ng/g	0.0028 to 0.0089	1.18	5 U	6.79	1.36	5.75	0.00	LOED for PCB 153 = 126,310 µg/kg for mortality of the oligochaete *Lumbriculus variegatus*
	Total PCB Congeners (ND = 0)	ng/g	0.0023 to 0.0045	7.0237	5 U	52.2	10.4	7.43	0.36	NOED = 127 µg/kg for growth of the white sea urchin *Lytochinus pictus*
	1,2,3,4,6,7,8-Hepta CDD	ng/kg	0.0498 to 0.162	2.62	2.071 U	15.0	7.26	5.74	-	-
	1,2,3,4,6,7,8-Hepta CDF	ng/kg	0.0218 to 0.0824	0.976	0.9511 U	2.92	3.07	2.99	-	-
	1,2,3,4,7,8,9-Hepta CDF	ng/kg	0.0296 to 0.112	0.01565 U	0.139 U	0.208	1.50	13.3	-	-
	1,2,3,4,7,8-Hexa CDD	ng/kg	0.0514 to 0.142	0.0525	0.187 U	0.273	1.46	5.20	-	-
	1,2,3,4,7,8-Hexa CDF	ng/kg	0.0396 to 0.109	0.0703	0.177 U	0.400	2.26	5.69	-	-
	1,2,3,6,7,8-Hexa CDD	ng/kg	0.0524 to 0.151	0.18	0.202 U	0.805	3.99	4.47	-	-
	1,2,3,6,7,8-Hexa CDF	ng/kg	0.0373 to 0.116	0.104	0.195 U	0.304	1.56	2.93	-	-
	1,2,3,7,8,9-Hexa CDD	ng/kg	0.0547 to 0.142	0.106	0.245	0.499	2.04	4.71	-	-
	1,2,3,7,8-Penta CDD	ng/kg	0.0923 to 0.234	0.098	0.171 U	0.265	1.55	2.70	-	No relevant species[5]
	1,2,3,7,8-Penta CDF	ng/kg	0.0317 to 0.091	0.164	0.165 U	0.338	2.05	2.06	-	No relevant species[5]
	2,3,4,6,7,8-Hexa CDF	ng/kg	0.0377 to 0.106	0.118	0.184 U	0.432	2.35	3.66	-	-
	2,3,4,7,8-Penta CDF	ng/kg	0.0266 to 0.0883	0.248	0.156 U	0.334	2.14	1.35	-	-

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
AH-FP (cont.)	2,3,7,8-Tetra CDF	ng/kg	0.0745 to 0.185	0.793	0.199	0.823	4.14	1.04	-	No relevant species[5]
	OCDD	ng/kg	0.0464 to 0.0928	32.4	17.5	96.8	5.53	2.99	-	-
	OCDF	ng/kg	0.0321 to 0.0639	0.91	1.7	4.79	2.82	5.27	-	No relevant species[5]
	Total Hepta CDD	ng/kg	0.0498 to 0.162	11.8	1.61	83.2	51.7	7.05	-	No relevant species[5]
	Total Hepta CDF	ng/kg	0.0251 to 0.0949	1.88	1.56	8.35	5.35	4.44	-	-
	Total Hexa CDD	ng/kg	0.0528 to 0.145	2.44	0.755	27.8	36.8	11.4	-	-
	Total Hexa CDF	ng/kg	0.0404 to 0.108	2.39	0.427	8.09	18.9	3.38	-	-
	Total Penta CDD	ng/kg	0.0923 to 0.234	1.25	0.4471 U	7.92	17.7	6.34	-	-
	Total Penta CDF	ng/kg	0.029 to 0.0896	3.24	0.161 U	7.69	47.8	2.37	-	-
	Total Tetra CDD	ng/kg	0.0454 to 0.123	0.457	0.153 U	1.18	7.69	2.58	0.00	No relevant marine species. NOED = 8,600 ng/kg for mortality in the water flea *Daphnia magna*
	Total Tetra CDF	ng/kg	0.0745 to 0.191	6.34	0.199	10.3	51.5	1.62	-	-
AH-ABTB	Arsenic	mg/kg	0.0417 to 0.0421	2.34	3.427	3.76	1.10	1.61	0.39	NOED = 3.6 mg/kg for mortality and growth in the mussel *M. edulis*
	Chromium	mg/kg	0.0522 to 0.0527	0.151	0.0712	0.169	2.37	1.12	0.00	NOED = 4.4 mg/kg for reproduction (depressed brood size) in the polychaete worm *N. arenaceodentata*
	Copper	mg/kg	0.0747 to 0.0755	2.18	1.908	4.00	2.09	1.83	0.28	NOED = 6.42 mg/kg for mortality in the polychaete worm *C. spirabrancha*
	Lead	mg/kg	0.0063	0.0755	0.08	0.226	2.82	2.99	0.04	NOED = 4 mg/kg for mortality of the amphipod *M. affinis*
	Mercury	mg/kg	0.0096 to 0.0099	0.0211	0.014	0.022	1.60	1.06	0.00	NOED = 8.4 mg/kg for mortality of the mussel *M.edulis*
	Anthracene	µg/kg	2.6	11	5 U	7.56	1.51	0.69	0.00	6,740 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)pyrene	µg/kg	5.2 to 5.3	10	5 U	22.0	4.40	2.20	0.04	LOED = 300 µg/kg for reproduction of *M. edulis*
	Benzo(b)fluoranthene	µg/kg	5.2 to 5.3	2.65 U	5 U	5.48	1.10	2.07	-	-
	Benzo(g,h,i)perylene	µg/kg	5.2 to 5.3	7.4	5 U	6.20	1.24	0.84	-	No relevant species
	Fluoranthene	µg/kg	5.2 to 5.3	2.65 U	5 U	12.8	2.56	4.83	0.05	LOED = 220 µg/kg for reproduction of *M. edulis*
	Indeno(1,2,3-cd)pyrene	µg/kg	5.2 to 5.3	12	5 U	8.18	1.64	0.68	-	-
	Naphthalene	µg/kg	5.2 to 5.3	2.65 U	4.64	7.90	1.70	2.98	0.00	31,300 µg/kg = 50% reduction in feeding of *M. edulis*
	Phenanthrene	µg/kg	5.2 to 5.3	2.65 U	5 U	6.89	1.38	2.60	0.01	NOED = 780 µg/kg for mortality of *Nereis arenaceodentata*
	Pyrene	µg/kg	5.2 to 5.3	2.65 U	5 U	11.8	2.36	4.45	0.00	Lowest relevant concentration. 189,000 µg/kg = 50% reduction in feeding of *M. edulis*
	PCB153/168	ng/g	0.00088 to 0.022	1.18	5 U	5.77	1.15	4.89	0.00	LOED for PCB 153 = 126,310 µg/kg for mortality of the oligochaete *L. variegatus*
	Total PCB Congeners (ND = 0)	ng/g	0.0023 to 0.031	7.0237	5 U	40.1	8.02	5.71	0.26	NOED = 127 µg/kg for growth of the white sea urchin *L. pictus*

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
AH-LM	Chromium	mg/kg	0.0527 to 0.0535	0.151	0.0712	0.343	4.82	2.27	0.04	NOED = 4.4 mg/kg for reproduction (depressed brood size) in the polychaete worm *N. arenaceodentata*
	Copper	mg/kg	0.0755 to 0.0766	2.18	1.908	11.5	6.04	5.29	1.46	NOED = 6.42 mg/kg for mortality in the polychaete worm *C. spirabrancha*
	Lead	mg/kg	0.0063 to 0.0064	0.0755	0.08	1.27	15.9	16.9	0.30	NOED = 4 mg/kg for mortality of the amphipod *M. affinis*
	Mercury	mg/kg	0.0096 to 0.0099	0.0211	0.014	0.021	1.49	0.99	0.00	NOED = 8.4 mg/kg for mortality of the mussel *M. edulis*
	1-Methylnaphthalene	µg/kg	26 to 27	2.65 U	5 U	13.1 U	2.62	4.94	-	No relevant species
	2-Methylnaphthalene	µg/kg	26 to 27	2.65 U	5.24	13.1 U	2.50	4.94	-	-
	Acenaphthene	µg/kg	26 to 27	2.65 U	5 U	13.1 U	2.62	4.94	0.00	29,400 µg/kg = 50% reduction in feeding of *M. edulis*
	Acenaphthylene	µg/kg	13	1.3 U	5 U	6.5 U	1.30	5.00	-	-
	Anthracene	µg/kg	13	11	5 U	6.5 U	1.30	0.59	0.00	6,740 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)anthracene	µg/kg	26 to 27	2.65 U	5 U	13.1 U	2.62	4.94	0.00	5,940 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)pyrene	µg/kg	26 to 27	10	5 U	13.1 U	2.62	1.31	0.01	LOED = 300 µg/kg for reproduction of *M. edulis*
	Benzo(b)fluoranthene	µg/kg	26 to 27	2.65 U	5 U	13.1 U	2.62	4.94	-	-
	Benzo(g,h,i)perylene	µg/kg	26 to 27	7.4	5 U	13.1 U	2.62	1.77	-	No relevant species
	Benzo(k)fluoranthene	µg/kg	26 to 27	2.65 U	5 U	13.1 U	2.62	4.94	-	-
	Dibenz(a,h)anthracene	µg/kg	26 to 27	2.65 U	5 U	13.1 U	2.62	4.94	-	-
	Fluoranthene	µg/kg	26 to 27	2.65 U	5 U	13.1 U	2.62	4.94	0.05	LOED = 220 µg/kg for reproduction of *M. edulis*
	Fluorene	µg/kg	26 to 27	2.65 U	7.12	13.1 U	1.84	4.94	0.00	No relevant marine species. NOED = 8,090 µg/kg for reproduction of *Hyalella azteca*
	Indeno(1,2,3-cd)pyrene	µg/kg	26 to 27	12	5 U	13.1 U	2.62	1.09	-	-
	Naphthalene	µg/kg	26 to 27	2.65 U	4.64	13.1 U	2.82	4.94	0.00	31,300 µg/kg = 50% reduction in feeding of *M. edulis*
	Phenanthrene	µg/kg	26 to 27	2.65 U	5 U	13.1 U	2.62	4.94	0.01	NOED = 780 µg/kg for mortality of *N. arenaceodentata*
	Pyrene	µg/kg	26 to 27	2.65 U	5 U	13.1 U	2.62	4.94	0.00	Lowest relevant concentration. 189,000 µg/kg = 50% reduction in feeding of *M. edulis*
	PCB153/168	ng/g	0.0017 to 0.003	1.18	5 U	5.51	1.10	4.67	0.00	LOED for PCB 153 = 126,310 µg/kg for mortality of the oligochaete *L. variegatus*
	Total PCB Congeners (ND = 0)	ng/g	0.00086 to 0.006	7.0237	5 U	39.8	7.95	5.66	0.26	NOED = 127 µg/kg for growth of the white sea urchin *L. pictus*
AH-N	Chromium	mg/kg	0.0525 to 0.0535	0.151	0.0712	0.166	2.33	1.10	0.00	NOED = 4.4 mg/kg for reproduction (depressed brood size) in the polychaete worm *N. arenaceodentata*
	Copper	mg/kg	0.0751 to 0.0766	2.18	1.908	5.97	3.13	2.74	0.59	NOED = 6.42 mg/kg for mortality in the polychaete worm *C. spirabrancha*
	Lead	mg/kg	0.0063 to 0.0064	0.0755	0.08	0.830	10.4	11.0	0.19	NOED = 4 mg/kg for mortality of the amphipod *M. affinis*
	Mercury	mg/kg	0.0093 to 0.0097	0.0211	0.014	0.021	1.48	0.98	0.00	NOED = 8.4 mg/kg for mortality of the mussel *M. edulis*
	1-Methylnaphthalene	µg/kg	5.2 to 27	2.65 U	5 U	11.02 U	2.20	4.16	-	No relevant species
	2-Methylnaphthalene	µg/kg	5.2 to 27	2.65 U	5.24	11.02 U	2.10	4.16	-	-

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
	Acenaphthene	µg/kg	5.2 to 27	2.65 U	5 U	11.02 U	2.20	4.16	0.00	29,400 µg/kg = 50% reduction in feeding of *M. edulis*
	Anthracene	µg/kg	2.6 to 13	11	5 U	6.48	1.30	0.59	0.00	6,740 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)anthracene	µg/kg	5.2 to 27	2.65 U	5 U	11.02 U	2.20	4.16	0.00	5,940 µg/kg = effect on mortality of *R. abronius*
	Benzo(a)pyrene	µg/kg	5.2 to 27	10	5 U	16.1	3.22	1.61	0.02	LOED = 300 µg/kg for reproduction of *M. edulis*
	Benzo(b)fluoranthene	µg/kg	5.2 to 27	2.65 U	5 U	15.5	3.10	5.85	-	-
	Benzo(g,h,i)perylene	µg/kg	5.2 to 27	7.4	5 U	12.1	2.42	1.64	-	No relevant species
	Benzo(k)fluoranthene	µg/kg	5.2 to 27	2.65 U	5 U	12.7	2.54	4.79	-	-
	Dibenz(a,h)anthracene	µg/kg	5.2 to 27	2.65 U	5 U	11.02 U	2.20	4.16	-	-
	Fluoranthene	µg/kg	5.2 to 27	2.65 U	5 U	11.02 U	2.20	4.16	0.04	LOED = 220 µg/kg for reproduction of *M. edulis*
	Fluorene	µg/kg	5.2 to 27	2.65 U	7.12	11.02 U	1.55	4.16	0.00	No relevant marine species. NOED = 8,090 µg/kg for reproduction of *H. azteca*
	Indeno(1,2,3-cd)pyrene	µg/kg	5.2 to 27	12	5 U	12.5	2.49	1.04	-	-
	Naphthalene	µg/kg	5.2 to 27	2.65 U	4.64	11.02 U	2.38	4.16	0.00	31,300 µg/kg = 50% reduction in feeding of *M. edulis*
	Phenanthrene	µg/kg	5.2 to 27	2.65 U	5 U	11.02 U	2.20	4.16	0.01	NOED = 780 µg/kg for mortality of *N. arenaceodentata*
	Pyrene	µg/kg	5.2 to 27	2.65 U	5 U	12.5	2.50	4.72	0.00	Lowest relevant concentration. 189,000 µg/kg = 50% reduction in feeding of *M. edulis*
	PCB129/138	ng/g	0.0007 to 0.0036	0.885	5 U	5.29	1.06	5.97	0.00	No relevant effects in the ERED for this species. NOED for PCB 138 = 946,000 µg/kg for mortality, growth, and reproduction of the fathead minnow *P. promelas*.
AH-N (cont.)	PCB147/149	ng/g	0.00067 to 0.0037	0.543	5 U	5.42	1.08	9.98	-	-
	PCB153/168	ng/g	0.00057 to 0.003	1.18	5 U	7.53	1.51	6.38	0.00	LOED for PCB 153 = 126,310 µg/kg for mortality of the oligochaete *L. variegatus*
	Total PCB Congeners (ND = 0)	ng/g	0.00044 to 0.0024	7.0237	5 U	52.5	10.5	7.47	0.36	NOED = 127 µg/kg for growth of the white sea urchin *L. pictus*
	1,2,3,4,6,7,8-Hepta CDD	ng/kg	0.0923 to 0.137	2.62	2.071 U	5.07	2.45	1.94	-	-
	1,2,3,4,6,7,8-Hepta CDF	ng/kg	0.0383 to 0.0527	0.976	0.9511 U	1.46	1.53	1.49	-	-
	1,2,3,6,7,8-Hexa CDD	ng/kg	0.0982 to 0.133	0.18	0.202 U	0.446	2.21	2.48	-	-
	1,2,3,7,8-Penta CDF	ng/kg	0.0541 to 0.0759	0.164	0.165 U	0.213	1.29	1.30	-	No relevant species[5]
	2,3,4,7,8-Penta CDF	ng/kg	0.0457 to 0.0666	0.248	0.156 U	0.230	1.47	0.93	-	-
	2,3,7,8-Tetra CDF	ng/kg	0.129 to 0.165	0.793	0.199	0.634	3.19	0.80	-	No relevant species[5]
	OCDD	ng/kg	0.0457 to 0.0751	32.4	17.5	39.8	2.27	1.23	-	-
	Total Hepta CDD	ng/kg	0.0923 to 0.137	11.8	1.61	43.3	26.9	3.67	-	No relevant species[5]
	Total Hepta CDF	ng/kg	0.0457 to 0.0638	1.88	1.56	3.01	1.93	1.60	-	-
	Total Hexa CDD	ng/kg	0.0928 to 0.12	2.44	0.755	13.6	18.1	5.59	-	-

Test Area	Analyte	Units	MDL	Day 0 Concentration	Reference Mean Concentration[1, 2]	Test Area Mean Concentration[3]	Ratio of Test Area Mean to Reference Database	Ratio of Test Area Mean to Day 0	Ratio of Test Area Mean Corrected for Day 0 to ERED[4]	Comparison to Relevant Environmental Residue-Effects Database Values
AH-N (cont.)	Total Hexa CDF	ng/kg	0.0559 to 0.0742	2.39	0.427	3.38	7.92	1.42	-	-
	Total Penta CDF	ng/kg	0.0495 to 0.071	3.24	0.161 U	4.71	29.3	1.45	-	-
	Total Tetra CDD	ng/kg	0.0873 to 0.112	0.457	0.153 U	1.13	7.35	2.46	0.00	No relevant marine species. NOED = 8,600 ng/kg for mortality in the water flea *D. magna*
	Total Tetra CDF	ng/kg	0.129 to 0.165	6.34	0.199	7.58	38.1	1.20	-	-

Notes:

Ratio of test area mean corrected for Day 0 to ERED value is greater than 1.0

Test area mean concentration is greater than ERED value

µg/kg = micrograms per kilogram
CDD = Chloro Dibenzo-p-Dioxin
CDF = Chloro Dibenzo-p-furan
ERED = Environmental Residue Effects Database
GDODS = Guam Deep Ocean Disposal Site
LOED = lowest observed effect dose
MDL = Method Detection Limit
mg/kg = milligrams per kilogram
ng/g = nanograms per gram
ng/kg = nanograms per kilogram
NOED = no observed effect dose
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
U = non-detect; half the detection limit shown

1 Reference mean concentrations from Weston Solutions, Inc., 2008. Field Report Baseline Studies Conducted for the Designation of an Ocean Dredged Material Disposal Site, Apra Harbor, Guam. Department of the Navy, NAVFAC PAC. July 2008.

2 Reference mean concentrations not available for total PAHs and total PCBs. For the purpose of comparing to test area mean concentrations, the reference total PAHs and total PCBs were calculated such that: 1) an individual non-detect analyte was set to half the MDL; and 2) a total is calculated using the sum of detected individuals, if any, or half of the highest MDL if all individuals are non-detect.

3 Test area mean concentrations were calculated as the mean across replicate samples, detected and non-detects included, where non-detects were handled such that: 1) an individual non-detect analyte was set to half the MDL; and 2) a total is calculated using the sum of detected individuals, if any, or half of the highest MDL if all individuals are non-detect.

4 Test area mean corrected for Day 0 is the test area mean concentration minus the Day 0 concentration.

5 It has been shown that a wide variety of invertebrates including amphipods, cladocerans, clams, grass shrimp, midges, mosquito larvae, sandworms, oligochaete worms, and snails are insenstive to 2,3,7,8-Tetra CDD induced toxicity (U.S. Environmental Protection Agency, 2008. Framework for Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furans, and Biphenyls in Ecological Risk Assessment. EPA/100/R-08/004. June 2008.)

3.5.4 Quality Assurance/Quality Control

A review of analytical results for tissues was conducted to evaluate the laboratories' performance in meeting QA/QC guidelines outlined in the SAP (E2 et al. 2015). Data validation reports generated by Anchor QEA are presented in Appendix C. All samples were analyzed within the appropriate holding times. Non-detected results were reported to the MDL. Detected results that were greater than the MDL but less than the RL were qualified by the laboratory with a "J" to indicate that they are estimated. By reporting non-detects to the MDL, all target RLs identified in the SAP were met, with the exception of PAHs in the five *N. virens* AH-LM-COMP replicates. MDLs in these samples were elevated due to matrix interference. Generally, QA/QC sample results were within the project-specified quality control limits, with the exception of those noted in the data validation report (Appendix C).

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4 CONCLUSIONS AND RECOMMENDED SUITABILITY DETERMINATIONS

Physical, chemical, and biological analyses were conducted to evaluate the suitability of proposed dredge material from Alpha/Bravo wharves and the Turning Basin, Finger Piers, Lima/Mike wharves, and November wharf for ocean disposal.

Data collected and reviewed for this evaluation show that some sediments comply with suitability determinations for ocean disposal while others do not. Based on the results of analyses, the following conclusions may be drawn:

- No sediment chemical parameters were detected at concentrations greater than their respective ERM values in the Alpha/Bravo/Turning Basin composite sample (AH-ABTB-COMP). However, multiple chemical parameters were detected at concentrations greater than their respective ERM values in composite samples collected from Finger Piers, Lima/Mike, and November wharves (AH-FP-COMP, AH-LM-COMP, and AH-N-COMP, respectively). Copper, lead, zinc, and total PCBs were elevated above ERM values in all three composites. In addition, sample concentrations were elevated above ERM values for arsenic and mercury in AH-FP-COMP and AH-LM-COMP, for nickel and chlordane in AH-FP-COMP and AH-N-COMP, and for 4,4'-DDT in AH-LM-COMP and AH-N-COMP.
- The TEQ values for dioxins/furans from all four composite samples (AH-ABTB-COMP, AH-FP-COMP, AH-LM-COMP, and AH-N-COMP) were greater than the TEQ value for sediment comprising the G-DODS reference site.
- Mean survival in the 96-hour mysid shrimp SPP test was reduced by greater than 10% and significantly different than the control for AH-N-COMP test sediments. Test results indicate additional analyses (i.e., STFATE) would be required to determine appropriate dilution for ocean disposal; however, NAVFAC determined sediment from November wharf would only be considered for upland placement, and therefore, no STFATE modeling was conducted.
- Chemistry results from tissue analyzed after being exposed to test sediments for 28 days (BP testing) were compared to FDA action levels, historical reference sediment tissue burdens from G-DODS, and ERED values:
  - Comparison of tissue chemistry results to FDA action levels indicated no exceedances.

- Comparison of tissue chemistry results to G-DODS reference values indicated metals, PAHs, PCBs, and dioxin/furans were elevated in tissue samples exposed to Northern Inner Apra Harbor sediments from all four areas.
- Comparison of tissue chemistry results to ERED values indicated elevations in arsenic in all four test areas and copper in samples from Finger Piers and Lima/Mike and November wharves. Day 0 concentrations of some analytes were elevated above the reference; therefore, mean test area concentrations were corrected based on the Day 0 tissue concentrations and then compared to the ERED value.
    - Comparison of corrected mean test concentrations to ERED values indicated only copper exceedances in samples from Finger Piers and Lima/Mike and November wharves (1.17, 1.46, and 12.04 times the ERED values, respectively).

Based on sediment and tissue chemistry and bioassay results, recommendations for the management of proposed dredge material from Northern Inner Apra Harbor are as follows:

- All material from Alpha/Bravo wharves and the Turning Basin is recommended to be considered suitable for ocean disposal.
- A portion of the material from Finger Piers is recommended to be considered suitable for ocean disposal, including areas represented by sediment samples AH-FP-01 and AH-FP-02. Areas represented by sediment samples AH-FP-03 and AH-FP-04 are not suitable for ocean disposal due to elevated copper concentrations in individual cores taken from these locations. Material from these areas may be assessed for upland placement.
- A portion of the material from Lima/Mike wharves is recommended to be considered suitable for ocean disposal, including areas represented by sediment samples AH-LM-01 and AH-LM-02. Areas represented by sediment samples AH-LM-03, AH-LM-04, and AH-LM-05 are not suitable for ocean disposal due to elevated copper and mercury concentrations in individual cores taken from these locations. Material from these areas may be assessed for upland placement.
- All material from November wharf is recommended for upland placement due to multiple ERM exceedances at three locations adjacent to November wharf and low survival in the 96-hour mysid shrimp SPP test. Although no ERM exceedances were

measured in the area represented by sample AH-N-03, the size of this proposed dredge area within November wharf is relatively small and therefore it would be more efficient to include this area with material being placed upland.

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ATTACHMENT 4

Sediment Management Framework, June 2014

SEDIMENT MANAGEMENT FRAMEWORK
APRA HARBOR NAVAL COMPLEX
APRA HARBOR, GUAM

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LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
CAD	confined aquatic disposal
CFR	Code of Federal Regulations
CVN	Carrier Vessel Nuclear
cy	cubic yard
DMMP	Dredged Material Management Plan
DMUPS	Dredged Material Upland Placement Study
DoD	Department of Defense
EIS	Environmental Impact Statement
G-DODS	Guam Deep Ocean Disposal Site
GovGuam	Government of Guam
mcy	million cubic yards
MLLW	mean lower low water
NAVFAC Pacific	Naval Facilities Engineering Command, Pacific
NMS	Naval Munitions Site
NSOD	not suitable for ocean disposal
ODMDS	ocean dredged material disposal site
OTM	*Evaluation of Dredged Material Proposed for Ocean Disposal*
PWC	Public Works Center
SLAMRAAM	Surface-Launched Medium Range Air-to-Air Missile
SMF	Sediment Management Framework
SOD	suitable for ocean disposal
TCLP	toxicity characteristic leaching procedure
THAAD	Theater High Altitude Area Defense
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

USMC	U.S. Marine Corps
ZSF	Zone of Siting Feasibility Study

FOREWORD

This *Sediment Management Framework* supersedes the previous *Sediment Management Framework for Apra Harbor Naval Complex, Apra Harbor, Guam* (SMF; Weston and TEC 2010). Since the development of the 2010 SMF, planned projects have been redesigned, constructed, and rescheduled; new projects have been identified; and additional information related to upland dewatering site capacities has become available. This document presents a more realistic approach to sediment management on Guam due to the availability of dredging equipment, a better understanding of the behavior of dewatered material, and program restrictions for individual dredging projects.

This document, where appropriate, references documents already developed for the management of dredged material on Guam. This document presents an approach to sediment management using the most up-to-date project descriptions and designs and is intended to be a useful and easily updated tool for the U.S. Department of Navy, Naval Facilities Engineering Command, Pacific (NAVFAC Pacific). In cases where project descriptions have not changed substantially, text from the 2010 SMF was used for consistency between the two documents.

This document includes several tables designed to track completed dredging project (see Table 1), upcoming maintenance and construction dredging projects (see Table 2), beneficial use projects (see Table 3), and upland dewatering site capacity (see Table 4). Several blank rows have been included in each table to track the ongoing generation, placement, and beneficial use of dredged material within Apra Harbor. The management strategy integrates these tables and is presented in Table 5. This table is also provided in Microsoft Excel format with instructions to allow the user to update and consider management alternatives.

1 PURPOSE AND NEED FOR FRAMEWORK

1.1 Introduction

The U.S. Navy's presence on Guam supports the U.S. Pacific Fleet that is home-ported or transiting the area. The U.S. Marine Corps (USMC) is planning a greater presence requiring ship support on Guam. The Naval Base at Apra Harbor operates and maintains wharves in Inner and Outer Apra Harbor. Projects are planned to improve existing wharves and construct new wharves. Maintenance and construction dredging will continue to be required to meet military operational requirements. Dredged material management planning is critical to identify and evaluate potential beneficial reuse and land disposal options.

1.2 Background

Management of dredged material from maintenance and construction dredging projects requires the identification of feasible dewatering placement sites at the Naval Complex and the potential beneficial use of the dewatered dredged material in planned construction projects. The evaluation of management alternatives (placement and beneficial use) included technical, logistical, and economic feasibility and consideration of the potential for environmental and social impacts.

A *Phase I Dredged Material Management Plan* (DMMP; MEC and Weston 2005) was developed to assist with completing proposed construction dredging projects in an efficient, environmentally sound, logistically feasible, and cost-effective manner. A DMMP for three construction dredging projects was necessary to establish the feasibility of potential placement and beneficial use options for an estimated total of 765,000 cubic yards (cy) of material. Six dewatering sites and four beneficial uses were determined to be feasible when evaluating whether they satisfied the needs and purpose of the DMMP; were technologically, logistically, and economically feasible; and did not result in any unacceptable environmental or social impacts. Each of the six potential dewatering sites (Polaris Point Field, Commercial Port Field 1, Public Works Center [PWC] Compound, and Fields 3, 4, and 5) was determined to be capable of accommodating the volume of at least one of the three proposed dredging projects, to have reasonable dewatering times, and to have minimal or no lasting environmental or social impacts. Each of the four beneficial uses (use of dredged material for berms surrounding ordnance magazines, construction fill in development of Charlie Wharf

and Commercial Port, and as daily landfill cover) was also determined to be feasible. Based on this preliminary investigation, all feasible beneficial use alternatives were recommended, assuming dewatered dredged material was chemically and geotechnically suitable.

Changes to waterfront functional plans and new mission preparedness objectives required a review and update of the Phase I DMMP. The purpose of the *Dredged Material Upland Placement Study* (DMUPS; Weston and TEC 2008) was to re-evaluate potential locations for dewatering facilities and beneficial use alternatives presented in the Phase I DMMP, determine if any additional locations for dewatering facilities or beneficial use alternatives had become available in the 3 years since the Phase I DMMP was completed, and provide sound management recommendations. In keeping with sustainable planning policies, a key component of the 2008 DMUPS was to identify management alternatives that dewater the maximum amount of dredged material and minimize the acreage of lands required, with little or no significant environmental impact. In the DMUPS, six dewatering sites and three beneficial use alternatives were considered technically, logistically, and economically feasible. Of the six potential dewatering sites (Polaris Point Field, Commercial Port Field 1, PWC Compound, and Fields 3, 4, and 5), all except Field 3 were determined to have the capacity to store material from at least one of the planned construction dredging projects. All three potential beneficial uses (magazine construction, landfill daily cover, and construction fill for Commercial Port expansion) were determined to be feasible. Based on the updated evaluation, all feasible beneficial use alternatives were recommended, assuming dewatered dredged material was chemically and geotechnically suitable.

The U.S. Environmental Protection Agency (USEPA) initiated a process to designate an ocean dredged material disposal site (ODMDS) offshore of Guam to provide an alternative management option for dredged material. This process began with a Zone of Siting Feasibility Study (ZSF; Weston and Belt Collins Hawaii 2006), which constrained available study areas for the siting of an ODMDS based on existing information (e.g., jurisdictional boundaries, navigational hazards, and sensitive resources). The ZSF identified two areas that met siting criteria; these two areas were subject to intensive field studies to further understand the environmental resources that may be impacted during offshore disposal activities. A preferred alternative was identified approximately 11 nautical miles northwest

from the entrance to Apra Harbor in water depths greater than 8,000 feet. The Guam Deep Ocean Disposal Site (G-DODS) was officially designated on August 31, 2010.

1.3 Purpose and Need

Dredging is required within Apra Harbor to maintain safe navigation for current and future operational needs. Dredged material will require management consistent with maintaining public safety and a sustainable environment. This SMF (herein referenced as 2014 SMF) evaluates the dredging needs from 2014 to 2033 and presents a scenario for dredged material management that emphasizes beneficial use of dredged material. This 2014 SMF is founded on previous dredged material management studies (MEC and Weston 2005; Weston and Belt Collins Hawaii 2005; Weston and Hawaii Pacific Engineers 2005a, 2005b; Weston and TEC 2008) and the previous SMF (Weston and TEC 2010; herein referenced as 2010 SMF). This 2014 SMF designates proposed upland dewatering sites to accept a specific classification of dredged material and illustrates that, although dredged material may be beneficially used or placed in an upland environment, ocean disposal, when necessary, is a practical and viable management alternative for dredged material determined to be suitable for ocean disposal (SOD; i.e., clean) in accordance with existing regulations (see Section 4.3). Effectively managing the placement of dredged material SOD at G-DODS maintains capacity at upland dewatering sites for dredged material determined to be not suitable for ocean disposal (NSOD).

2 HISTORICAL DREDGING AND PLACEMENT ACTIVITIES

A fundamental component of long-term sediment management is maintaining an accurate account of historical dredging and placement activities. Historical information may be used to calibrate estimates of future maintenance dredging requirements, calculate the remaining capacity at developed confined upland dewatering sites, and enable management and planning for upcoming beneficial use projects. Detailed lists of the origin, date, volume, and placement site of dredged material temporarily stored upland should be maintained. Dredged material evaluation reports detailing the physical and chemical characteristics should also be maintained in order to evaluate the suitability of dewatered material placed at any particular placement site for subsequent beneficial uses.

Table 1 presents a list of recent dredging projects within Apra Harbor. This list should be reviewed and updated after each dredging episode.

Table 1
Historical Dredging and Placement Activities

Project	Location	Date	Volume (cy)	Placement Site
	Victor and X-Ray Wharves	2003	16,000	Ship Repair Facility
	N/A[1]		54,500	Orote Airfield
P-431	Alpha and Bravo Wharves	2008	180,000	Field 5
P-502	Kilo Wharf	2008	12,000	Orote Airfield
	Victor Wharf	2011	7,300	Orote Airfield
	X-Ray Wharf	2012	3,300	Orote Airfield

Note:
1 The volume of material placed at Orote Airfield is documented; however, the source of the material is not available.

3 DREDGING REQUIREMENTS

3.1 Dredging Methods

Placement of dredged material at upland locations can be accomplished hydraulically or mechanically. Hydraulic placement is generally limited by distance, physical barriers, and environmental controls placed on return flows of water after settling and decanting. Mechanical placement is limited by size or availability of dewatering facilities and the expense of effort required to re-handle, dewater, and transport dried dredged material to its final location.

Hydraulic placement involves dredging material using a cutterhead (suction) dredge. Dredged material is then conveyed via pipeline to its ultimate destination. The contractor may employ booster pumps and add water to maintain flow of slurried dredged material. The pipeline and ancillary equipment (e.g., pumps and joints) requires continuous monitoring and maintenance to preclude problems due to leaking or catastrophic failure. The contractor shall rotate the pipeline to provide even internal wear, especially when abrasive material is dredged and conveyed. The end of the pipeline requires frequent repositioning to avoid mounding of material at the discharge point. The contractor shall employ manifolds and other methods to assist in the filling of individual cells at placement sites and employ training walls and submerged berms constructed of dredged material or native material to extend residence time and assist in the settling of dredged material. Weirs and other water control structures facilitate the return of decanted water to the receiving waterbody. Potential issues include contaminants in solution, turbidity, and total suspended solids.

Mechanical dredging and re-handling begins with dredging material using clamshell or bucket dredges. Dredged material is placed into a scow barge and conveyed to the re-handling site. If a dump barge is used, the unloading doors must be maintained in a closed position by positive means to prevent leakage en route or during offloading operations. The re-handling site must be located adjacent to the offloading (material transfer) site. The site should be sealed to prevent leakage of placed material. Precast modular concrete segments (k-rail) sealed with high-density polyethylene fabric, or some other impermeable material, were successfully employed during recent re-handling operations to contain dredged

material. The transfer of dredged material from the barge into the re-handling site is often accomplished via shore-mounted crane or a derrick barge equipped with clamshell lifting devices. The contractor shall preclude the inadvertent loss of material during transfer from the scow barge to the containment facility. A bridging device is often used to contain spilled material. Dredged material is generally dewatered within the containment facility by exposing it to the sun and wind via frequent manipulation with a front-end loader or other equipment. Dried material can be stockpiled on site while awaiting transport to its final destination. The contractor shall not over-dry the material to the point where it is lost (i.e., become wind-blown dust). Experience has shown that approximately 80 percent solids is optimal for re-handling and transportation operations, because the material is wet enough not to be blown off transporting equipment, yet dry enough not to flow onto roadways. Potential issues include contaminants in dredged material and air emissions associated with re-handling and transportation equipment.

Both the Phase I DMMP and 2008 DMUPS recommend mechanical dredging for future dredging projects. This recommendation was based on two key points: 1) historical dredging activities used mechanical dredging methods; and 2) the nature of mechanically dredged material is better suited for management alternatives identified in the Phase I DMMP, 2008 DMUPS, and 2010 SMF. Phase II DMMP evaluations (Weston and Hawaii Pacific Engineers 2005a, 2005b; Weston and Belt Collins Hawaii 2005) determined sediment characteristics and water content of mechanically dredged material did not result in a discharge of effluent from upland placement sites. Hydraulic dredging would likely generate much greater volumes of water, which would reduce capacity at the upland placement sites and would require additional management of effluent. Recent projects used mechanical dredging methods, with dredged material offloaded at a nearby wharf and trucked to nearby upland placement sites.

3.2 Future Projects

Currently, a total of 15 dredging projects (12 maintenance dredging and three construction dredging) are identified and scheduled in order to accommodate future operational needs. Maintenance dredging is scheduled at Uniform Wharf; Romeo, Sierra, and Tango wharves; Oscar, Papa, and Quebec wharves; the Inner Apra Harbor entrance channel; Finger Pier and

Lima, Mike, and November wharves; Victor Wharf; Alpha and Bravo wharves; Delta and Echo wharves; Kilo Wharf; the central Portion of Inner Apra Harbor; Victor and X-Ray wharves; and a new Carrier Vessel Nuclear (CVN)-capable berth at Polaris Point. Scheduled construction dredging projects include X-Ray Wharf, Sierra Wharf, and the new CVN-capable berth (Figure 1). Table 2 summarizes the projected dredging needs, and the following subsections describe these projects.

3.2.1 Maintenance Dredging

3.2.1.1 Uniform Wharf

Maintenance dredging is required at Uniform Wharf. The dredge footprint would encompass the area along the wharf (from the wharf face to approximately 300 feet offshore) and to a depth of -35 feet mean lower low water (MLLW; see Figure 1). Approximately 13,300 cy of dredged material would be generated in 2014, 2018, and every 5 years thereafter.

3.2.1.2 Romeo, Sierra, and Tango Wharves

Maintenance dredging is required at Romeo, Sierra, and Tango wharves. The dredge footprint would encompass the area along each wharf (from 10 feet offshore and extending to approximately 300 feet offshore) and to a depth of -35 feet MLLW (see Figure 1). Approximately 21,200 cy of dredged material would be generated every 5 years beginning in 2014.

3.2.1.3 Oscar, Papa, and Quebec Wharves

Maintenance dredging is required at Oscar, Papa, and Quebec wharves. The dredge footprint would encompass the area along each wharf (from the wharf face to approximately 300 feet offshore) and to a depth of -35 feet MLLW (see Figure 1). Approximately 7,000 cy of dredged material would be generated every 5 years beginning in 2015.

Table 2

Dredging Requirements (2014 to 2033)

Project/Location	Frequency (years)	Date(s)					Volume/ Episode (cy)	Volume/Episode plus 10% Contingency (cy)	Total Volume 2014 to 2033 (cy)
Maintenance Dredging									
Uniform Wharf	5[1]	2014	2018	2023	2028	2033	13,300	14,630	73,150
Romeo, Sierra, and Tango Wharves	5	2014	2019	2024	2029		21,200	23,320	93,280
Oscar, Papa, and Quebec Wharves	5	2015	2020	2025	2030		7,000	7,700	30,800
Inner Apra Harbor Entrance Channel	5	2015	2020	2025	2030		80,000	88,000	352,000
Finger Pier and Lima, Mike, and November Wharves	5	2015	2020	2025	2030		40,000	44,000	176,000
Victor Wharf	1	2016					7,300	8,030	8,030
Alpha and Bravo Wharves	5	2017	2022	2027	2032		56,000	61,600	246,400
Delta and Echo Wharves	5	2018	2023	2028	2033		5,000	5,500	22,000
Kilo Wharf	5	2019	2024	2029			5,000	5,500	16,500
Central Portion of Inner Apra Harbor	10	2020	2030				130,000	143,000	286,000
Victor and X-Ray Wharves	4	2020	2024	2028	2032		10,600	11,660	46,640
CVN-capable Berth (Polaris Point)	10	2028					40,000	44,000	176,000
Construction Dredging									
X-Ray Wharf	N/A	2016					231,000	254,100	254,100
CVN-Capable Berth	N/A	2018					608,000	668,800	668,800
Sierra Wharf	N/A	2026					327,000	359,700	359,700
								Total Dredge Material Requirements	**2,677,400**

Note:
1 Dredging will occur in 2014 and 2018 and then every 5 years thereafter.

SOURCE: Aerial from Bing maps.
HORIZONTAL DATUM: WGS 1984
UTM, Zone 55N, U.S. Feet.

LEGEND:

Maintenance Projects:

- Delta
- Uniform
- Kilo
- Victor
- Inner Apra Harbor Entrance Channel
- Central Portion of Inner Apra
- Echo
- Romeo, Sierra, and Tango
- Oscar, Papa, and Quebec
- Alpha/Bravo
- Finger Pier, Lima, Mike, and November

Construction Projects:

- CVN Alternative 1 (Polaris Point)
- X-Ray
- Sierra

L:\AutoCAD Project Files_Projects\0773-US Navy\Guam\Survey\0773-MDP 001.dwg FIG 1

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Figure 1
Planned Construction and Maintenance Dredging Projects (2014 to 2033)
Apra Harbor Naval Complex, Guam

3.2.1.4 Inner Apra Harbor Entrance Channel

Maintenance dredging is required at the Inner Apra Harbor entrance channel. The dredge footprint would encompass the eastern portion of the entrance channel bounded by Outer Apra Harbor to the north, the Lima Wharf dredge footprint to the west, and the Bravo Wharf and turning basin to the south to a depth of -40 feet MLLW (see Figure 1). Approximately 80,000 cy of dredged material would be generated every 5 years beginning in 2015.

3.2.1.5 Finger Pier and Lima, Mike, and November Wharves

Maintenance dredging is required at Finger Pier and Lima, Mike, and November wharves. The dredge footprint for Finger Pier would encompass both slips adjacent to Finger Pier and extend offshore to a depth of -35 feet MLLW. The dredge footprint along the wharves would encompass the area along each wharf (from the wharf face to approximately 300 feet offshore) and to a depth of -35 feet MLLW (see Figure 1). Approximately 40,000 cy of dredged material would be generated every 5 years beginning in 2015.

3.2.1.6 Victor Wharf

Maintenance dredging is required at Victor Wharf. The dredge footprint would encompass the area along the wharf (from the wharf face to approximately 300 feet offshore) and to a depth of -35 feet MLLW (see Figure 1). Approximately 7,300 cy of dredged material would be generated in 2016. Future maintenance dredging at Victor Wharf would coincide with X-Ray Wharf (see Section 3.2.1.11).

3.2.1.7 Alpha and Bravo Wharves

Maintenance dredging is required at Alpha and Bravo wharves. The dredge footprint would encompass the area along each wharf (from the wharf face to approximately 300 feet offshore) and to a depth of -40 feet MLLW (see Figure 1). Approximately 56,000 cy of dredged material would be generated every 5 years beginning in 2017.

3.2.1.8 Delta and Echo Wharves

Maintenance dredging is required at Delta and Echo wharves o. The dredge footprint would encompass the area along the wharf (from 10 feet offshore and extending to 200 feet from the wharf face) and to a depth of -45 feet MLLW (see Figure 1). Approximately 5,000 cy of dredged material would be generated every 5 years beginning in 2018.

3.2.1.9 Kilo Wharf

Maintenance dredging is required at Kilo Wharf. The dredge footprint would encompass the area along the wharf (from the wharf face to approximately 300 feet offshore) and to a depth of -45 feet MLLW (see Figure 1). Approximately 5,000 cy of dredged material would be generated every 5 years beginning in 2019.

3.2.1.10 Central Portion of Inner Apra Harbor

Maintenance dredging is required in the central portion of Inner Apra Harbor. The dredge footprint would encompass the turning basin to a depth of -40 feet MLLW (see Figure 1). Approximately 130,000 cy of dredged material would be generated every 10 years beginning in 2020.

3.2.1.11 Victor and X-Ray Wharves

Maintenance dredging is required at Victor and X-Ray wharves. The dredge footprint would encompass the area along each wharf (from the wharf face to approximately 300 feet offshore) and to a depth of -35 feet MLLW (see Figure 1). Approximately 10,600 cy of dredged material would be generated every 4 years beginning in 2020. In 2016, maintenance dredging would conducted at Victor Wharf (see Section 3.2.1.6) and construction dredging will occur at X-Ray Wharf (see Section 3.2.2.1).

3.2.1.12 CVN-Capable Berth at Polaris Point

Maintenance dredging is required in the CVN-capable berth (to be constructed in 2018). The dredge footprint would encompass the area fronting the wharf, a turning basin northwest of the site, and an access fairway extending from the turning basin northwest toward the Outer Apra Harbor entrance channel to a depth of -49.5 feet MLLW (see Figure

1). Approximately 40,000 cy of dredged material would be generated every 10 years beginning in 2028.

3.2.2 Construction Dredging

3.2.2.1 X-Ray Wharf

Construction dredging at X-Ray Wharf includes a dredge footprint that extends along the entire wharf face and an access fairway extending into central Inner Apra Harbor. Dredging is planned to a depth of -35 feet MLLW, with approximately 231,000 cy of dredge material generated in 2016.

3.2.2.2 CVN-Capable Berth

The new CVN-capable berth at Polaris Point will be located in Outer Apra Harbor at the northern end of Polaris Point in a cove situated east of the Inner Apra Harbor entrance channel. The dredge footprint includes the area fronting the wharf, a turning basin northwest of the site, and an access fairway extending from the turning basin northwest toward the Outer Apra Harbor entrance channel. Dredging will occur to -49.5 feet MLLW, with approximately 608,000 cy of material removed and managed from the area fronting the wharf, the turning basin, and the access fairway. The project is tentatively scheduled for 2018.

3.2.2.3 Sierra Wharf

Construction dredging adjacent to Sierra Wharf is expected to result in the removal of approximately 327,000 cy of material, including 2 feet of overdredge allowance. As part of the project design, dredging will occur adjacent to Sierra and Tango wharves, extending approximately 2,300 feet into central Inner Apra Harbor, to a depth of -38 feet MLLW. The project, originally scheduled for 2010, is tentatively scheduled to occur during 2026.

4 MANAGEMENT ALTERNATIVES

4.1 Beneficial Use Alternatives

Dredged material is a manageable and valuable resource. As such, beneficial use is a desired management option. Dredged material may be beneficially used as a resource in a variety of projects, such as construction fill material, magazine construction, daily landfill cover, and shoreline restoration. Factors that should be considered in the evaluation of beneficial use alternatives include:

- Local needs and opportunities for beneficial use
- Geotechnical and sediment chemistry requirements
- Distance from the dredging or dewatering site to the location of beneficial use
- Site accessibility
- Handling requirements
- Coordinated timing of the beneficial use and dredging projects
- Capacity of the beneficial use project in relation to the volume of dredged material available

For all beneficial use alternatives discussed in this report, the material would first be placed in an upland dewatering facility. After the material is sufficiently dry, the material would be available for beneficial use alternatives in planned construction or other use activities.

Table 3 summarizes beneficial use alternatives available to use dredged material on Guam, and the following subsections describe these projects.

Table 3
Beneficial Use Alternatives and Volumes of Material Required

Project	Location	Date	Volume/Episode (cy)	Total Volume 2014 to 2033 (cy)
Landfill Cover	PWC Landfill	2014-2015	20,000	40,000
Landfill Cover	Government of Guam Layon Landfill	Annually	20,000	400,000
Firing Ranges	Route 15 Training Complex	2014	160,000	160,000
Magazine Cover	Orote Peninsula	2015	102,000	102,000
Magazine Cover	Naval Munitions Site (1)	2019	47,000	47,000
Magazine Cover	Naval Munitions Site (2)	2019	53,000	53,000
Magazine Cover	Anderson Air Force Base (1)	2019	58,000	58,000
Magazine Cover	Anderson Air Force Base (2)	2020	17,000	17,000
Construction Fill	USMC Main Cantonment Site	NA	Unknown	Unknown
Total Material Potentially Required for Beneficial Use Projects				**877,000**

4.1.1 Landfill Cover

The PWC Landfill is available to accept dredged material for daily cover; a total of 40,000 cy of dredged material may be placed there through 2015. Approximately 20,000 cy of dredged material per year may be used as daily cover.

The Government of Guam's (GovGuam's) Layon Landfill opened in 2011. The Department of Defense (DoD) and GovGuam established agreements for the DoD to use the Layon Landfill for the disposal of municipal solid waste. Dredged material generated from Apra Harbor within the jurisdiction of the Apra Harbor Naval Complex is expected to be used as daily cover at the Layon Landfill. Further, the average capacity of landfill cover per year is anticipated to be equivalent to the PWC Landfill's average capacity of 20,000 cy per year. If 20,000 cy per year were applied to the Layon Landfill every year from present (2014) through 2033, then the total volume of landfill cover would be 400,000 cy.

4.1.2 Firing Ranges

The beneficial use of dewatered dredged material for construction of firing range backstops at the Route 15 Training Complex was identified as a potential beneficial use alternative.

Berms constructed as backstops would range in length from 35 to 255 feet, in width from 7 to 56 feet, and in height from 3 to 7 feet. Construction of these firing range backstops could beneficially use 160,000 cy of dewatered dredged material and is anticipated to occur in 2014.

4.1.3 Magazine Cover

Dredged material could be used to construct magazine (i.e., munitions storage areas) cover, such as earthen berms or barricades and cover. Barricades and earth cover are effective strategies for reducing risks associated with the storage of hazardous ordnance materials. The alternative would include the beneficial use of dredged material dewatered at one or more dewatering sites. After dewatering and consolidation, dredged material would be removed from the dewatering site and transported to the project site.

4.1.3.1 Orote Peninsula

Magazine construction at the Orote Peninsula was identified as a feasible beneficial use of dredged material in the Phase I DMMP and the 2008 DMUPS. Two ammunition storage site projects, including open ammunition storage and non-propagation wall/earth covered magazines, were identified in the Ordnance Function Plan for Orote Peninsula (HHFP 2003). Although identified for 2008, MCON P-425 has been categorized as a 2015 or beyond project; this study assumed magazine construction and the beneficial use of dredged material during magazine construction at Orote Peninsula will occur in 2015. The total volume of material for the two Orote Peninsula magazine construction projects is anticipated to be 102,000 cy, which assumes 20,000 cy would be used for barricades in the construction of six 9,350-square-foot open ammunition storage pads and 82,000 cy would be used for earth cover in the construction of 174,800-square-foot box magazines.

4.1.3.2 Naval Munitions Site

The potential beneficial use of dewatered dredged material for magazine construction at the Naval Munitions Site (NMS; formerly known as the Ordnance Annex) was identified and evaluated as a feasible alternative in the Phase I DMMP and 2008 DMUPS. The Ordnance Function Plan (HHFP 2003) proposed several construction projects, including container holding yards, open ammunition storage, and highly explosive magazines, to increase the

ordnance handling capacities and to provide for operational improvements at the NMS. Initially these projects were scheduled to start in 2008; however, construction of new magazines at NMS is now categorized as a 2016 or beyond project. This study assumes magazine construction, and the beneficial use of dredged material during magazine construction, at the NMS will occur in 2019. The beneficial use is estimated to have a total capacity of 47,000 cy, which includes the construction of earthen barricades bordering three container holding yards (requiring 5,000 cy of dredged material), earthen barricades between nine open ammunition storage pads (requiring 30,000 cy of dredged material), and earth cover for the construction of two highly explosive magazines (requiring 12,000 cy of dredged material). Designs were based on specifications obtained in the U.S. Department of the Navy's 2001 publication, *Naval Sea Systems Command (NAVSEA) OP5*.

The Military Relocation EIS (NAVFAC Pacific 2010) identified the need for additional munitions storage magazine at the NMS. This alternative includes the construction of 11 munitions storage magazines. Construction of these magazines is categorized as a 2016 or beyond project; this study assumes magazine construction, and the beneficial use of dredged material during magazine construction, at NMS will occur in 2019. Using a similar conceptual design as magazine construction at Orote Peninsula, approximately 53,000 cy of dewatered dredged material would be used in the construction of these additional magazines at NMS.

4.1.3.3 Andersen Air Force Base

The beneficial use of dewatered dredged material for magazine construction for two separate projects at Andersen Air Force Base (AFB) was identified as potential beneficial use alternatives. The first project includes the construction of 12 munitions storage magazines and support facilities. Magazine construction is categorized as a 2016 or beyond project; this study assumes magazine construction, and the beneficial use of dredged material during magazine construction, at Andersen AFB will occur in 2019. Using a similar conceptual design as magazine construction at Orote Peninsula, approximately 58,000 cy of dewatered dredged material would be used in magazine construction at Andersen AFB. The second project includes the construction of one Theater High Altitude Area Defense (THAAD) Launcher Storage, three Patriot/Avenger/Surface-Launched Medium Range Air-to-Air

Missile (SLAMRAAM) launcher storage, and four guided missile magazines. Construction of these storage units and magazines is categorized as a 2016 or beyond project; this study assumes magazine construction, and the beneficial use of dredged material during magazine construction, at Andersen AFB will occur in 2020. Construction of these units could beneficially use 17,000 cy of dewatered dredged material.

4.1.4 U.S. Marine Corps Main Cantonment Site

Development at the USMC Main Cantonment Site in the Finegayan area may include infrastructure and support facilities. Currently, planning documents suggest that on-site material would be sufficient for construction fill; however, additional material for construction fill may be required once final designs are completed. Dewatered dredged material from Apra Harbor may be suitable for beneficial use at the site; however, based on the existing information, this study assumes dewatered dredged material is not suitable and/or not required for construction activities at the USMC Main Cantonment Site.

4.2 Confined Upland Dewatering Sites

A confined upland dewatering site is an engineered structure for containment of dredged material. Typically, upland dewatering sites are bound by confinement structures or dikes to enclose the disposal area, thereby isolating the dredged material from its surrounding environment. The upland dewatering site design considers factors such as site location, type of material to be placed, volume of material to be placed, and placement method. However, depending on the dredged material's water content and chemical and geotechnical characteristics, the material may be placed in layers at an upland dewatering site if runoff and effluent does not require containment (i.e., if material characteristics indicate runoff and effluent would not occur). Historically, material dredged from Apra Harbor has been stiff sediments with minimal water content and Phase II DMMP evaluations did not result in a discharge of effluent from upland placement sites.

Capacities for the available confined upland dewatering sites used in this management strategy are presented in Table 4. Additional information relative to the design of each is included in the Phase I DMMP, 2008 DMUPS, and Phase II DMMP evaluations (Weston and Hawaii Pacific Engineers 2005a, 2005b; Weston and Belt Collins Hawaii 2005).

Table 4
Upland Dewatering Site Capacity from 2013 to 2032

Upland Site	Capacity (cy)	Current Volume (cy)	Remaining Capacity (cy)	Designated Material Type
Ship Repair Facility	16,000	16,000	0	SOD and suitable for beneficial use[3]
Orote Airfield	137,000[2]	77,000	60,000	SOD and suitable for beneficial use[3]
Field 5a	364,000	180,000	184,000	NSOD and suitable for beneficial use[4]
Field 5b	309,000	0	309,000	NSOD and not suitable for beneficial use[5]
Field 3	426,000	0	426,000	NSOD, not suitable for beneficial use, and fails TCLP criteria[6]
Polaris Point Cell A	151,000	0	151,000	Reserved for emergency dredging[7]
Polaris Point Cell B	290,000	0	290,000	Reserved for emergency dredging[7]
Total Capacities	1,627,900	208,900	1,419,000	
Total Available Capacities[1]	1,186,000		978,000	

Notes:
1 Does not include capacity at Polaris Point Cell; reserved for emergency dredging.
2 Orote Airfield capacity was adjusted relative to the 2010 SMF, based on two key points: 1) approximately 77,000 cy of material have been placed at Orote Airfield and observations suggest the site is approximately 50 percent full; and 2) a review of as-built drawings developed by Moffat and Nichol Engineers for P-502 project (2007) suggests Orote Airfield may be able to accept 137,000 cy of material.
3 Dredged material not evaluated for ocean disposal in accordance with the *Evaluation of Dredged Material Proposed for Ocean Disposal* (OTM; USEPA and USACE 1991). Dredged material not considered hazardous according to federal guidance (toxicity characteristics leaching procedure [TCLP] criteria). Dredged material may be used in beneficial use projects.
4 Dredged material determined to be NSOD but suitable for beneficial use. Dredged material not considered hazardous according to federal guidance (TCLP criteria).
5 Dredged material determined to be NSOD and not suitable for beneficial use but not considered hazardous material based on federal guidance (TCLP criteria).
6 Dredged material determined to be NSOD, not suitable for beneficial use, and does not pass federal guidance (TCLP criteria). Best management practices required in site development to maintain material, runoff, effluent, and leachate.
7 Sites reserved for any type of material if emergency dredging requires upland placement.

4.2.1 Existing Sites

Three confined upland dewatering sites have been developed: the Ship Repair Facility, Orote Airfield, and Field 5. Additional information regarding the development of these sites may be found in the Phase I DMMP and 2008 DMUPS.

4.2.1.1 Ship Repair Facility

The Ship Repair Facility confined upland dewatering site was constructed for the management of dredged material from Phase I of maintenance dredging at Victor and X-Ray wharves. The estimated capacity of the site is 16,000 cy. Currently, the site is at capacity.

4.2.1.2 Orote Airfield

The Orote Airfield confined upland dewatering site was constructed for the management of dredged material from Victor, X-Ray, Delta, and Echo wharves. The estimated capacity of the site is 137,000 cy. Approximately 77,000 cy of dredged material were previously placed at Orote Airfield. The remaining capacity of the site is 60,000 cy.

4.2.1.3 Field 5

The Field 5 confined upland dewatering site was constructed for the management of dredged material from the P-431 Alpha and Bravo wharves project. Originally, Field 5 was designed to have a maximum capacity of 2.1 million cubic yards (mcy); however, a reduced footprint consisting of two distinct cells (Field 5a and Field 5b) has since been proposed, with a maximum capacity of 364,000 cy and 309,000 cy, respectively. Approximately 180,000 cy of dredged material were previously placed at Field 5a. The remaining capacity of the Field 5a is 184,000 cy, and the remaining capacity of the Field 5b site is 309,000 cy.

4.2.2 Proposed Sites

Field 3 and Polaris Point confined upland dewatering sites were evaluated during the Phase I DMMP and 2008 DMUPS. These sites were determined to be feasible alternative dewatering sites. As such, descriptions of these sites in terms of size and capacity are summarized. For further details on each site, refer to the Phase I DMMP and 2008 DMUPS.

4.2.2.1 Field 3

The proposed confined upland dewatering site, referred to as Field 3, will be located on undeveloped lands south of the Commissary (Figure 2). The maximum capacity for Field 3 would be 426,000 cy, assuming a dike height of 18.5 feet and a lift height of 16.5 feet.

Field 3 is considered for the placement of dredged material NSOD, not suitable for beneficial use, and fails to meet toxicity characteristic leaching procedure (TCLP) criteria. Field 3 would require all applicable permits, appropriate design, and implementation of best management practices to accept this type of material. All other management alternatives are recommended to be considered prior to the construction of Field 3.

4.2.2.2 Polaris Point

The Polaris Point upland dewatering site is located on undeveloped lands at Polaris Point. This alternative was determined as a feasible alternative in both the Phase I DMMP and 2008 DMUPS. The originally proposed site would have a maximum capacity of 2.1 mcy, assuming a dike height of 31 feet and a lift height of 29 feet.

Due to changes in operational needs, a reduced footprint of the original alternative would be required at Polaris Point for placement of clean dredged material suitable for beneficial use. The reduced footprint includes two distinct cells (Cell A and Cell B). Polaris Point Cell A would have a total capacity of 151,000 cy, and Polaris Point Cell B would have a total capacity of 290,000 cy. A dike height of 17 feet and lift height of 15 feet is assumed for both cells. The reduced footprint and two cell design accommodates the placement of a helipad, support facilities, and additional sewage lines. It also eliminates the need to reroute existing sewage and potable water lines.

4.3 Ocean Disposal

Dredging is essential for maintaining safe navigation at port and naval facilities. Not all dredged material is suitable for beneficial reuse, and not all suitable material can be reused or stockpiled for future use. Therefore, a permanent ODMDS for Apra Harbor and other locations around Guam was needed as an alternative management option for dredged material SOD. The USEPA designated the G-DODS on August 31, 2010.

SOURCE: Aerial from Bing maps. Upland dewatering sites from Weston, September 2010.
HORIZONTAL DATUM: WGS 1984 UTM, Zone 55N, U.S. Feet.

LEGEND:

- SOD and Suitable for Beneficial Use
- Mixed SOD and NSOD, but Suitable for Beneficial Use
- NSOD and Not Suitable for Beneficial Use
- NSOD, Not Suitable for Beneficial Use, and Fails to Meet TCLP Criteria
- Not Designated

0 600
Scale in Feet

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Figure 2
Existing and Proposed Upland Dewatering Sites
Apra Harbor Naval Complex, Guam

Ocean disposal of dredged material requires specialized dredging equipment such as hopper dredges or bottom-dump scows. Currently, these types of dredging platforms are not located on Guam, and significant costs and effort to mobilize and demobilize this equipment would be required when considering ocean disposal. Further, vessels transporting dredged material to G-DODS must follow requirements established within a Site Management and Monitoring Plan, including the use of a silent inspector system.

4.3.1 Testing Requirements

To be determined SOD, dredged material must meet criteria defined in the *Evaluation of Dredged Material Proposed for Ocean Disposal* (OTM; USEPA and USACE 1991). Characterization of dredged material and its recommendation to be SOD must be approved by the USEPA in consultation with the Guam Environmental Protection Agency.

4.3.2 Annual Capacity

G-DODS is limited to a maximum disposal capacity of 1 mcy per calendar year.

5 SEDIMENT MANAGEMENT FRAMEWORK

5.1 Alternative Analysis Framework

This alternative analysis is based on the following three key elements:

- Dredging is required to maintain safe navigation within Apra Harbor, and material dredged requires management that is consistent with maintaining public safety, a sustainable environment, and operations.
- Dredged material is a viable resource that may be beneficially used.
- If beneficial use projects are not immediately available, upland placement of dredged material for future beneficial use projects may be considered, but the management of upland dewatering sites must maintain capacity for specific dredged material types or emergency dredging requirements. Dredged material may be placed at G-DODS if and only if beneficial use projects do not align with planned dredging projects or upland capacity is not sufficient. Material must meet specific regulatory criteria for ocean disposal.

This 2014 SMF follows the same framework for evaluating management alternatives of dredged material as the 2010 SMF (Figure 3) and as follows.

1. A need for dredging is determined (e.g., is maintenance dredging required to maintain safe navigation or is construction dredging necessary to increase water depths for the safe berthing of larger class vessels).
2. Once the need for dredging has been established, dredge volumes are calculated.
3. Beneficial use alternatives are evaluated as potential management options (e.g., does the schedule of dredging project align with local needs and opportunities for beneficial use, geotechnical and sediment chemistry requirements, distance from the dredging site or dewatering site to the location of beneficial use, site accessibility, handling requirements, and capacity of beneficial use in relation to the volume of dredged material available).
    - If beneficial use is a viable management option, dredged material may be further evaluated and placed into designated upland dewatering sites.

- If beneficial use is not a viable option and there is limited upland dewatering site capacity, dredged material may be evaluated for ocean disposal. Only dredged material found SOD may be placed at the ocean disposal site.

4. If a beneficial use project is not available and the material is NSOD, dredged material must be placed in an upland dewatering site specific to the classification of the material.

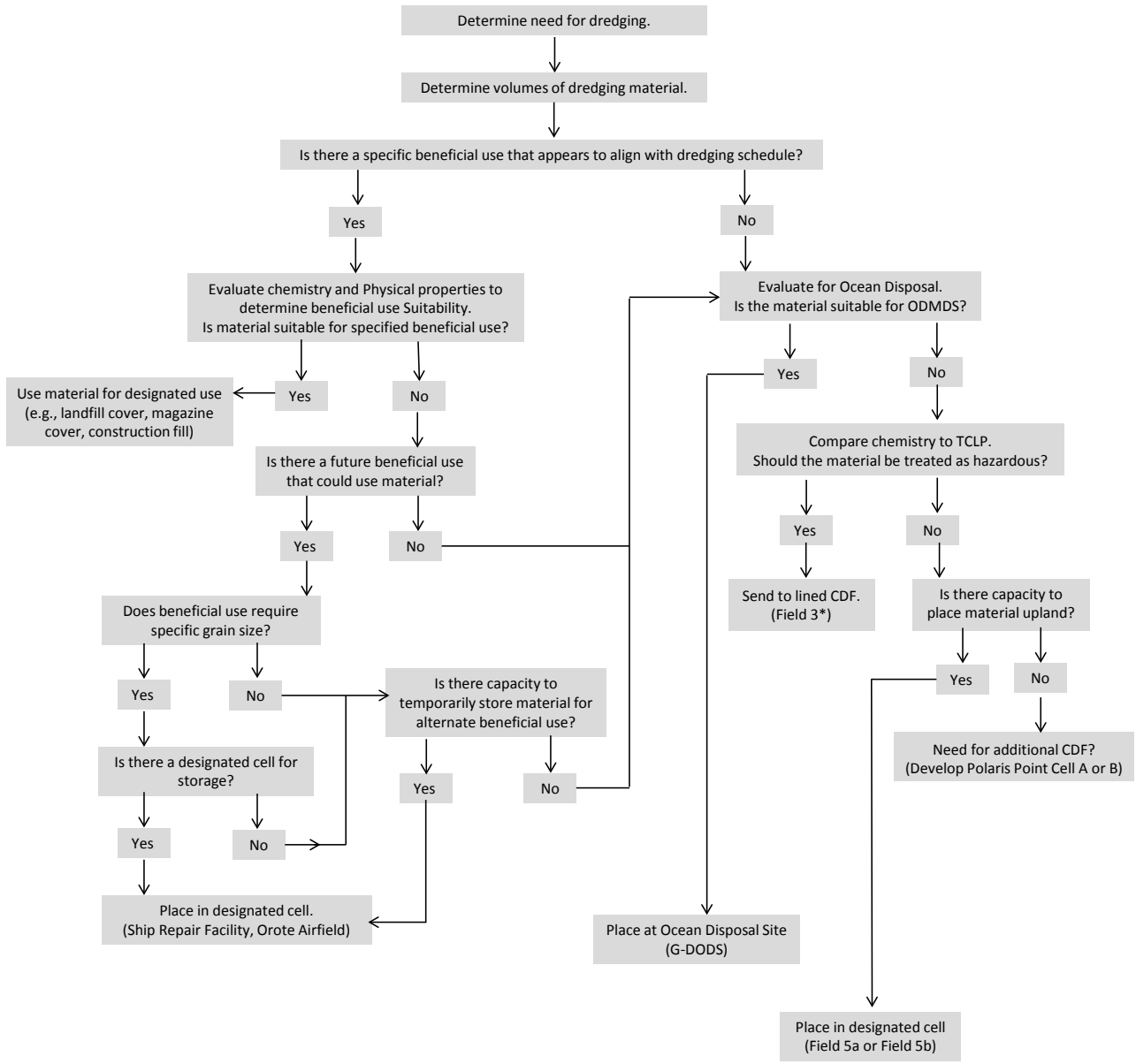
5.2 Dewatering Site Designation

Similar to the 2010 SMF, each site was designated to receive a specific classification of dredged material. Dredged material was grouped into one of four classifications:

1. *SOD and suitable for beneficial use.* To be determined SOD, dredged material must meet criteria defined in the *Evaluation of Dredged Material Proposed for Ocean Disposal* (OTM; USEPA/USACE 1991).[1] Further, any material determined to be SOD must meet site management criteria as defined in the *G-DODS Site Management and Monitoring Plan* (Weston 2010). For example, large reef fragments may not be disposed of, which may cause adverse changes to the seafloor. Material determined to be SOD is assumed to be suitable for beneficial use, provided it has suitable geotechnical properties.
2. *NSOD and suitable for beneficial use.* Material NOSD does not meet criteria listed in the OTM (USEPA/USACE 1991) for ocean disposal but meets TCLP criteria for all chemicals of concern; therefore, the material is not classified as hazardous according to the Code of Federal Regulations (CFR) Title 40, Part 261, Subpart C. The availability of this material for beneficial use projects is dependent on suitable geotechnical properties.
3. *NSOD and not suitable for beneficial use.* Material NOSD does not meet criteria listed in the OTM (USEPA/USACE 1991) for ocean disposal but meets TCLP criteria for all chemicals of concern; therefore, the material is not classified as hazardous according to CFR Title 40, Part 261, Subpart C. However, the material has been determined to be unsuitable for beneficial use due to geotechnical properties.

1 The term "clean" used in this document refers to material that has met the OTM criteria and has therefore been found to be SOD.

4. *NSOD, not suitable for beneficial use, and fails to meet TCLP criteria.* Material NOSD does not meet criteria listed in the OTM (USEPA/USACE 1991) for ocean disposal nor does it meet TCLP criteria for one of more chemicals of concern; therefore, the material is classified as hazardous according to the CFR Title 40, Part 261, Subpart C.



Notes
* Design and best management practices required for site to mange material classified as hazardous

Figure 3
Alternative Analysis Framework
Apra Harbor Naval Complex, Guam

Consistent with the 2010 SMF, this study assumes material found SOD will only be preferentially placed upland if there is: 1) sufficient upland capacity in an existing upland dewatering site; and 2) a beneficial use project that aligns with the dredging project. This assumption maintains consistency with the U.S. Navy's desire to beneficially use dredged material whenever feasible and to minimize the disposal of dredged material at G-DODS. This approach also minimizes the economic and operational requirements to maintain multiple upland dewatering sites for the storage of dredged material that may not be needed for beneficial use projects.

This study assumes the seven upland dewatering sites previously recommended are feasible options for the upland placement of dredged material. These sites, along with their designation, include the following:

- Ship Repair Facility: SOD and beneficial use
- Orote Airfield: SOD and beneficial use
- Field 5a: mixed SOD or NSOD disposal but suitable for beneficial use
- Field 5b: NSOD and not suitable for beneficial use
- Field 3: NSOD, not suitable for beneficial use, and fails to meet TCLP criteria
- Polaris Point Cell A: reserved for emergency dredging
- Polaris Point Cell B: reserved for emergency dredging

Dewatering sites designated suitable for beneficial use may be further classified to receive only fine or coarse-grained material. Separation of dredged material by grain size would further aid in the designating specific dredged material for beneficial use projects that require specific geotechnical properties. Although this study did not assume this separation is conducted, a scenario could be developed where Orote Airfield is designated to receive coarse-grained material. This scenario is not preferred because it requires additional re-handling of material already placed in Orote Airfield (e.g., material from Orote Airfield is transferred to another upland dewatering site in order to gain capacity specifically for coarse-grained material). Re-handling would increase project costs, which would need to be evaluated against the benefit of having coarse-grained specific material for future beneficial use.

5.3 Management Strategy

The following assumptions were used in determining likely dredging volumes, placement of material, and beneficial use of dewatered material:

- A bulking factor of 10 percent should be applied to dredge volumes during mechanical dredging. Dredge volumes used in the 2008 DMUPS did not include a bulking factor to be consistent with other studies being conducted concurrently (TEC Inc. JV 2008). Similarly, this study did not apply a 10-percent bulking factor; however, a 10-percent contingency was applied to all dredging projects.
- Twenty-five percent of all dredged material is NSOD. Of this amount, 60 percent (i.e., 15 percent of total dredge volume) is considered suitable for beneficial use and 40 percent (i.e., 10 percent of total dredge volume) is considered not suitable for beneficial use.
- Upland dewatering sites are built in layers as dredged material is placed at the site. The exception to this rule would be the development of Field 3, which was designated to receive material that was determined to be NSOD and failed to meet TCLP criteria.
- Based on historical sediment chemistry results, no material was considered hazardous (i.e., failed to meet TCLP criteria). Dredged material that fails to meet TCLP criteria would need to be disposed of in an upland confined disposal facility permitted to accept hazardous material.
- All clean dredged material is considered suitable for dike construction.
- All dredged material SOD and dredged material NSOD but suitable for beneficial use placed upland is suitable for whichever beneficial use alternative as required.
- Due to limited capacity, Polaris Point Cell A was reserved from the onset for placement of material related to emergency dredging needs or material identified as hazardous, assuming the site can be designed, permitted, and approved to accept hazardous material.

Table 5 presents the management strategy (i.e., allocation of dredged material to upland dewatering sites, dewatered material to beneficial use alternatives, and ocean disposal of suitable dredged material) for dredging needs in Apra Harbor from 2014 to 2033. It is recognized that this scenario is only one of many for the management of dredged material from Apra Harbor. This scenario illustrates the requirement to minimize the number of

upland dewatering sites being developed and maintained until required (i.e., additional upland dewatering sites are not constructed prior to their need), as well as to set aside locations for the placement of dewatering sites specific to the following four classifications of sediment: 1) SOD and beneficial use; 2) NSOD and suitable for beneficial use; 3) NSOD and not suitable for beneficial use; and 4) NSOD, not suitable for beneficial use, and fails to meet TCLP criteria. For the most part, minor changes to the proposed schedule (projects occurring plus or minus 1 or 2 years) should not change the overall placement decisions. However, a large construction dredging project or beneficial use project not accounted for in this study may significantly alter the volume of material requiring ocean disposal.

In 2014, maintenance dredging at Uniform Wharf (14,630 cy) and Romeo, Sierra, and Tango wharves (23,320 cy) would generate 37,950 cy of dredged material (accounting for a 10 percent contingency). Approximately 3,795 cy of this material would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (34,155 cy total) would be placed at Field 5a. Approximately 200,000 cy of dredged material would be removed from Orote Airfield and Field 5a. Most of this material (160,000 cy) would be used in the construction of firing ranges at the Route 15 Training Complex. The remaining 40,000 cy of removed material would be used for daily landfill cover at the PWC Landfill and the GovGuam Layon Landfill. Due to the large volume of material required for beneficial use projects in 2014, coordination of dredging activities and beneficial use projects would be required.

In 2015, maintenance dredging at Oscar, Papa, and Quebec wharves (7,700 cy), the Inner Apra Harbor entrance channel (88,000 cy), and Finger Pier and Lima, Mike, and November wharves (44,000 cy) would generate 139,700 cy of dredged material. Approximately 13,970 cy of the dredged material from these three projects would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (125,730 cy total) would be placed at Field 5a. An estimated 57,000 cy and 85,000 cy of material would be removed from Orote Airfield and Field 5a, respectively, for use as daily cover (20,000 cy at the PWC Landfill and 20,000 cy at the GovGuam Layon Landfill) and for magazine cover (102,000 cy) at Orote Peninsula. Due to the large volume of material required for beneficial use projects in 2015, coordination of dredging activities and beneficial use projects would be required.

Table 5
Updated Dredged Material Management Strategy (2014 to 2033)

Dredging and Placement Alternatives				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Maintenance Dredging Projects	Uniform Wharf				53,350																		
	Delta/Echo Wharves			5,500										5,500									
	MDP-01																		44,000				
	MDP-02									88,000										88,000			
	MDP-03					44,000										44,000							
	MDP-04									88,000										88,000			
	MDP-05						99,000																
	MDP-06										143,000										143,000		
	MDP-07					154,000										154,000							
	MDP-08													132,000									
	MDP-09										5,500										5,500		
Construction Dredging Projects	X-Ray Wharf			254,100																			
	Sierra Wharf																359,700						
	CVN Capable Berth								668,800														
Total Annual Dredging Requirements (Including 10% Contingency)				259,600	53,350	198,000	99,000	-	668,800	176,000	148,500	-	-	137,500	-	198,000	359,700	-	44,000	176,000	148,500	-	-
Beneficial Use Projects	Landfill Cover - PWC Landfill			20,000	20,000	20,000																	
	Landfill Cover - GovGuam Layon Landfill			20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
	Firing Ranges - Route 15 Training Complex				160,000																		
	Magazine Cover - Orote Peninsula					102,000																	
	Magazine Cover - Naval Munitions Site 1									47,000													
	Magazine Cover - Naval Munitions Site 2									53,000													
	Magazine Cover - Anderson Air Force Base 1									58,000													
	Magazine Cover - Anderson Air Force Base 2										17,000												
Total Annual Beneficial Use Requirements				40,000	200,000	142,000	20,000	20,000	20,000	178,000	37,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Upland Dewatering Sites	Ship Repair Facility		Planned Available Capacity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Planned Placement	-																			
	Total Site Capacity	Currently Placed	Planned Removal	-																			
	16,000	16,000	Planned Final Capacity	-																			
	Orote Airfield		Planned Available Capacity	60,000	74,500	94,500	110,500	130,500	130,500	130,500	130,500	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	119,500	119,500
			Planned Placement	5,500		44,000	-	-	-	-	5,500	-	-	-	-	-	-	-	-	-	5,500	-	-
	Total Site Capacity	Currently Placed	Planned Removal	20,000	20,000	60,000	20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	137,000	77,000	Planned Final Capacity	74,500	94,500	110,500	130,500	130,500	130,500	130,500	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	125,000	119,500	119,500	119,500
	Field 5a		Planned Available Capacity	184,000	204,000	330,650	258,650	159,650	179,650	199,650	201,650	95,650	115,650	135,650	18,150	38,150	58,150	78,150	98,150	74,150	94,150	114,150	134,150
			Planned Placement	-	53,350	154,000	99,000	-	-	176,000	143,000	-	-	137,500	-	-	-	-	44,000	-	-	-	-
	Total Site Capacity	Currently Placed	Planned Removal	20,000	180,000	82,000	-	20,000	20,000	178,000	37,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
	364,000	180,000	Planned Final Capacity	204,000	330,650	258,650	159,650	179,650	199,650	201,650	95,650	115,650	135,650	18,150	38,150	58,150	78,150	98,150	74,150	94,150	114,150	134,150	154,150
	Field 5b		Planned Available Capacity	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000
			Planned Placement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Site Capacity	Currently Placed	Planned Removal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	309,000	-	Planned Final Capacity	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000	309,000
	Field 3		Planned Available Capacity	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000
			Planned Placement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Site Capacity	Currently Placed	Planned Removal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	426,000	-	Planned Final Capacity	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000	426,000
	Polaris Point Cell A		Planned Available Capacity	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000
			Planned Placement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Site Capacity	Currently Placed	Planned Removal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	151,000	-	Planned Final Capacity	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000	151,000
	Polaris Point Cell B		Planned Available Capacity	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000
			Planned Placement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Site Capacity	Currently Placed	Planned Removal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	290,000	-	Planned Final Capacity	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000	290,000
Ocean	G-DODS			254,100					668,000							198,000	359,700			176,000	143,000		

Note:
All volumes in cubic yards (cy).

In 2016, maintenance dredging of Victor Wharf (8,030 cy) and construction at X-Ray Wharf (254,100 cy) would generate 262,130 cy of dredged material. Approximately 26,213 cy of the dredged material from these two projects would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. Orote Airfield would be filled to capacity with SOD material (137,000 cy). The remaining NSOD material and SOD material (98,917 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2017, maintenance dredging of Alpha and Bravo wharves would generate 61,600 cy of dredged material. Approximately 6,160 cy of the dredged material from this project would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (55,440 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2018, maintenance dredging at Uniform Wharf (14,630 cy) and Delta and Echo wharves (5,500 cy) and to construction of the CVN-capable berth at Polaris Point (668,800 cy) would generate 688,930 cy of dredged material. Approximately 68,893 cy of the dredged material from these three projects would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material (103,340 cy) would be placed at Field 5a. The SOD material (516,697 cy) would be disposed of at G-DODS. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2019, maintenance dredging at Romeo, Sierra, and Tango wharves (23,320 cy) and Kilo Wharf (5,500) would generate 28,820 cy of dredged material. Approximately 2,882 cy of the dredged material from these two projects would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (25,938 cy total) would be placed at Field 5a. Approximately 178,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill (20,000 cy) and magazine cover at Naval Munitions Site 1 and 2 (47,000 and 53,000 cy, respectively) and at Anderson AFB 1 (58,000 cy). Due to the large volume of material

required for beneficial use projects in 2019, coordination of dredging activities and beneficial use projects would be required.

In 2020, maintenance dredging at Oscar, Papa, and Quebec wharves (7,700 cy); the Inner Apra Harbor entrance channel (88,000 cy); Finger Pier and Lima, Mike, and November wharves (44,000 cy); the central portion of Inner Apra Harbor (143,000 cy), and Victor and X-Ray wharves (11,660 cy) would generate 294,360 cy of dredged material. Approximately 29,436 cy of the dredged material from these five projects would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material (44,154 cy) would be placed at Field 5a. The SOD material (220,770 cy) would be disposed of at G-DODS. Approximately 37,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill and magazine cover at Anderson AFB 2.

In 2021, no dredging is planned. Approximately 20,000 cy of dredged material would be removed from Field 5b and used as daily cover at the GovGuam Layon Landfill.

In 2022, maintenance dredging of Alpha and Bravo wharves would generate 61,600 cy of dredged material. Approximately 6,160 cy of the dredged material from this project would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (55,440 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2023, maintenance dredging at Uniform Wharf (14,630 cy) and Delta and Echo wharves (5,500 cy) would generate 20,130 cy of dredged material. Approximately 2,013 cy of the dredged material from this project would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (18,117 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2024, maintenance dredging at Romeo, Sierra, and Tango wharves (23,320 cy), Kilo Wharf (5,500 cy), and Victor and X-Ray wharves (11,660 cy) would generate 40,480 cy of dredged

material. Approximately 4,048 cy of the dredged material from these three projects would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (36,432 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2025, maintenance dredging at Oscar, Papa, and Quebec wharves (7,700 cy), the Inner Apra Harbor entrance channel (88,000 cy), and Finger Pier and Lima, Mike, and November wharves (44,000 cy) would generate 139,700 cy of dredged material. Approximately 13,970 cy of the dredged material from these three projects would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material (20,955 cy) would be placed at Field 5a. The SOD material (104,775 cy) would be disposed of at G-DODS. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2026, construction dredging at Sierra Wharf would generate 359,700 cy of dredged material. Approximately 35,970 cy of the dredged material from the project would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material (53,955 cy) would be placed at Field 5a. The SOD material (269,775 cy) would be disposed of at G-DODS. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2027, maintenance dredging of Alpha and Bravo wharves would generate 61,600 cy of dredged material. Approximately 6,160 cy of the dredged material from this project would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (55,440 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2028, maintenance dredging at Uniform Wharf (14,630 cy), Delta and Echo wharves (5,500 cy), Victor and X-Ray wharves (11,660 cy), and the CVN-capable berth (44,000 cy) would generate 75,790 cy of dredged material. Approximately 7,579 cy of the dredged material from this project would be considered NSOD and not suitable for beneficial use and

would be placed at Field 5b. The remaining NSOD material and the SOD material (68,211 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2029, maintenance dredging at Romeo, Sierra, and Tango wharves (23,320 cy) and Kilo Wharf (5,500 cy) would generate 28,820 cy of dredged material. Approximately 2,882 cy of the dredged material from these two projects would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (25,938 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2030, maintenance dredging at Oscar, Papa, and Quebec wharves (7,700 cy); the Inner Apra Harbor entrance channel (88,000 cy); Finger Pier and Lima, Mike, and November wharves (44,000 cy); and the central portion of Inner Apra Harbor (143,000 cy) would generate 282,700 cy of dredged material. Approximately 28,270 cy of the dredged material from these four projects would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material (42,405 cy) would be placed at Field 5a. The SOD material (212,025 cy) would be disposed of at G-DODS. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2031, no dredging is planned. Approximately 20,000 cy of dredged material would be removed from Field 5a and used as daily cover at the GovGuam Layon Landfill.

In 2032, maintenance dredging of Alpha and Bravo wharves (61,600 cy) and Victor and X-Ray wharves (11,660 cy) would generate 73,260 cy of dredged material. Approximately 7,326 cy of the dredged material from this project would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (65,934 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

In 2033, maintenance dredging at Uniform Wharf (14,630 cy) and Delta and Echo wharves (5,500 cy) would generate 20,130 cy of dredged material. Approximately 2,013 cy of the dredged material from this project would be considered NSOD and not suitable for beneficial use and would be placed at Field 5b. The remaining NSOD material and the SOD material (18,117 cy total) would be placed at Field 5a. Approximately 20,000 cy of material would be removed from Field 5a for use as daily cover at the GovGuam Layon Landfill.

6 FUTURE OPERATIONAL CONSIDERATIONS

Developing a programmatic management approach to coordinate multiple dredging projects for a single construction effort or to schedule dredging projects sequentially will spread the significant mobilization cost of bringing dredging equipment capable of transporting and disposing material at G-DODS to Guam. In this strategy, the use of G-DODS was only required for the following five times:

- 2018 (CVN-capable berth construction dredging and maintenance dredging at Uniform Wharf and Delta and Echo wharves)
- 2020 (maintenance dredging at Oscar, Papa, and Quebec wharves; the Inner Apra Harbor entrance channel; Finger Pier and Lima, Mike, and November wharves; the central portion of Inner Apra Harbor; and Victor and X-Ray wharves)
- 2025 (maintenance dredging at Oscar, Papa, and Quebec wharves; the Inner Apra Harbor entrance channel; and Finger Pier and Lima, Mike, and November wharves)
- 2026 (construction dredging at Sierra Wharf)
- 2030 (maintenance dredging at Oscar, Papa, and Quebec wharves; the Inner Apra Harbor entrance channel; Finger Pier and Lima, Mike, and November wharves; and the central portion of Inner Apra Harbor)

For each event, the estimated combined project volume of material was greater than 200,000 cy in all instances with one exception (2025 generating 104,775 cy). Ocean disposal was necessary in 2025 to provide sufficient capacity for dredged material to be placed at upland dewatering sites in subsequent years (2027, 2028, and 2029). Breakeven costs for ocean disposal can be developed and used to determine the optimal project size.

Although not a component of this strategy, preparation of any new upland dewatering sites may assume the top 1.5 feet of soil at each site would be used for dike construction, which would reduce the total amount of dredged material required for dike development.

This study relied on historical data that indicate no dredged material generated from Apra Harbor to date has been classified as hazardous. If future material does not pass TCLP criteria, then Field 3 will be designated to handle such material. Clean material from Field 5a may be used to develop the site.

The development of a confined aquatic disposal (CAD) cell or other temporary aquatic storage site could be considered for one of two disposal situations:

1. Dredge material is NSOD and no upland facility is available or the material has chemical or geotechnical characteristics that make it unsuitable for beneficial reuse.
2. Dredge material is SOD; however, the volume of material proposed for maintenance dredging does not warrant the high cost of mobilizing appropriate vessels for the disposal of dredged material at the G-DODS. Multiple, smaller maintenance dredging projects may be placed in a temporary aquatic storage site until sufficient volume has been generated to justify ocean disposal.

A feasibility study would be a required first step to determine if Inner Apra Harbor may be a suitable candidate site for a CAD cell or temporary aquatic storage site. The facility could be sized and managed such that it provided many decades of environmentally protective dredge material management.

7 CONCLUSIONS

This 2014 SMF evaluated dredging needs in Apra Harbor from 2014 through 2033 and presents a scenario for dredged material management with an emphasis on beneficial use of dredged material and practical upland dewatering site development. Instead of relying on the development of upland dewatering sites prior to project needs, as was the approach in the 2010 SMF, the strategy used in this study assumes maintenance and management of only the existing dewatering sites (with the exception of expanding the use of Field 5 into two cells). Designating upland dewatering sites to accept specific types of dredged material ensures capacity (i.e., ability to manage specific types of material) in future years.

This updated management strategy illustrates that existing dewatering sites and dedicated use of dredged material for beneficial use projects is sufficient for the management of approximately 1.3 mcy of dredged material. Ocean disposal, when necessary, was determined to be a practical and viable management alternative for suitable (i.e., clean) dredged material when beneficial use projects were not in alignment with dredging requirements. Approximately 1.4 mcy of dredged material were estimated to be placed at G-DODS.

8 REFERENCES

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ATTACHMENT 5

Biological Monitoring Plan

CONCEPTUAL BIOLOGICAL MONITORING PLAN

FY15 Maintenance Dredging, Inner Apra Harbor, Naval Base Guam

July 2015

Naval Facilities Engineering Command Marianas
PSC 455 Box 195
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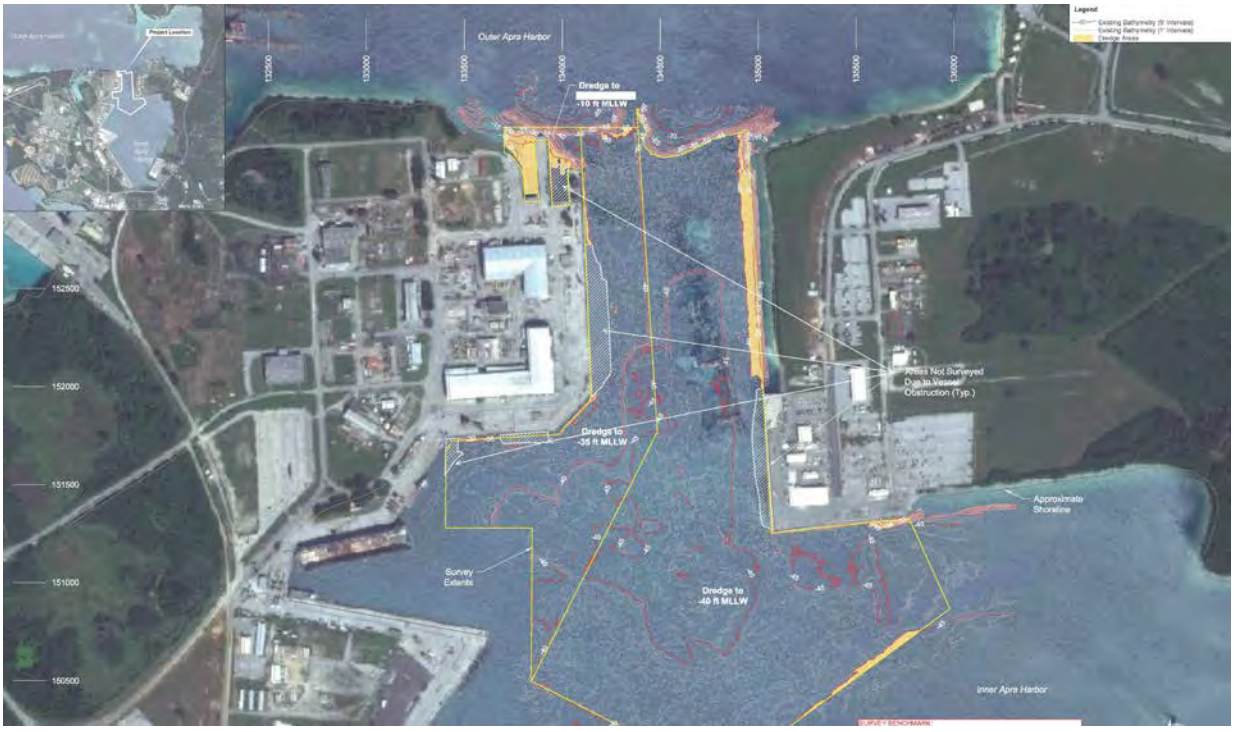
EXECUTIVE SUMMARY

This document presents the Biological Monitoring Plan for FY15 Maintenance Dredging located at Inner Apra Harbor, Naval Base Guam. The plan is conceptual because the US Army Corps of Engineers has not approved the transect locations and methodologies. The contractor will be supplied with this plan in a Microsoft Word format to adjust the transects or alter the language based on requirements following a US Army Corps of Engineers review.

The purpose of the biological monitoring program is to document sediment deposition and create a photographic record of the coral community. Sediment traps will be set and photographs/video will record the condition of the coral along a transect. The biological monitoring program will be conducted prior to dredging activity; monthly during dredging activity; and within 30 days after dredging activity has concluded.



1. INTRODUCTION

Maintenance dredging will be performed at Inner Apra Harbor, Naval Base Guam. The purpose of the maintenance dredging activity will be to restore the areas to the Mean Lower Low Water navigational depth

Pre-dredging, monthly during dredging, and post-dredging bio-monitoring will be performed that focuses on determining if turbidity and sedimentation levels in Inner Apra Harbor have affected the health of the coral.

Monitoring of sediment deposition and coral communities will be undertaken in Abo Cove and will include quantitative (using sediment traps) and qualitative (underwater photography and handheld video) measurement of sediment accumulation before and during dredging operations.

2. MONITORING STATION ESTABLISHMENT

All surveys will be conducted by a dive team following Navy diving safety requirements. The dive team will be instructed and managed by a biologists who will ensure quality control, analyze the data, and report.

2.1. SEDIMENT MONITORING

It is assumed that the quantitative and qualitative measurements of sediment deposition will generally follow those methods for measuring sediment deposition as presented in *Coral Reef Monitoring Manual for the Caribbean and Western Atlantic* (Rodgers et al., 1994) and for and conducting photographic sampling of coral communities as presented in *Monitoring Strategy and Preliminary Survey Design for Guam/CNMI Coral Reef Ecosystem Studies with a Focus on Apra Harbor and Kilo Wharf(NOAA* 2008).

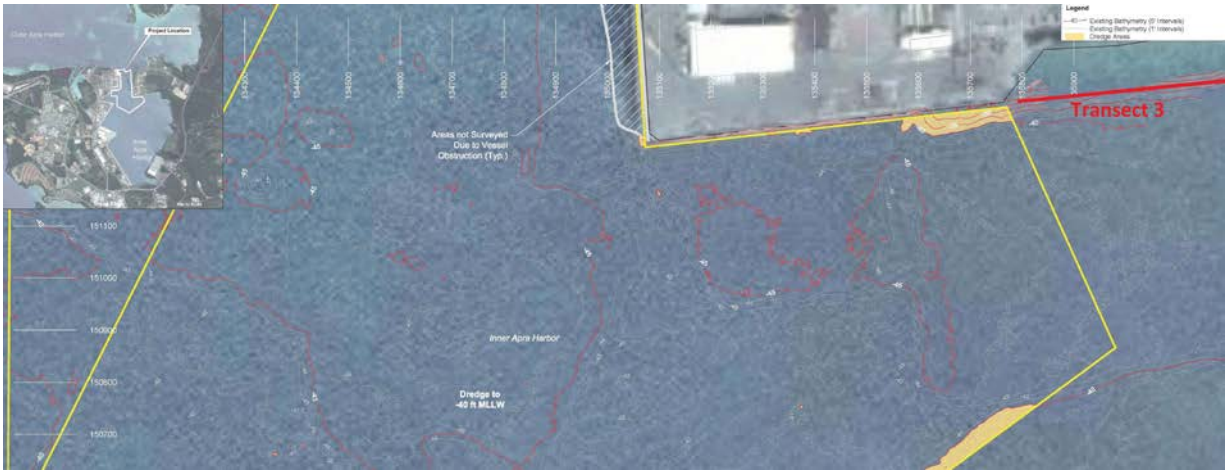
Quantitative sampling of sediment deposition will be collected at two depths within the water column (50 centimeters [cm] and 10 cm above the substrate) at three stations. Each sampling episode will include photographs captured at the sediment sampling stations. A camera with a minimum of 10 mega pixel (MP) resolution, properly white balanced, and with an appropriate field of view will be used. All photos will have a time and date stamp.

2.2 REEF MONITORING

Three transects will be established. Each transect start and end point will be located using GPS with sub-meter accuracy.

Photographs of the cove bottom along each transect will be captured at 1 m intervals using a camera with a minimum of 10 MP resolution, properly white balanced, and with an appropriate field of view. All photos will have a time and date stamp. Handheld video will be taken continuous along the entire transects.

Additionally, relative abundance of coral species and coral condition will be observed and recorded *in situ* from 0.5 m^2 quadrants placed along six points on each transect segment. Approximate location of the transects are shown below.



3. SAMPLING METHODS AND MONTIORING SCHEDULE

3.1 SEDIMENT DEPOSITION MONITORING METHODS

Sediment Deposition monitoring will be performed as follows:

1) Securely place straight-sided plastic jars (about 10-cm high and 8-cm diameter) to the reference stakes one jar at 50 cm and the other at 10 cm above the substrate. Collect three samples at each height at each location.

2) Collect the jars every 14 days and cap underwater. Once the jars are closed they should be brought to the laboratory for analysis. Remove any small organisms in the jar with tweezers prior to capping the jar.

3) After jars are collected place a new set of jars following the procedures described in Number 1.

4) Once the samples are back at the laboratory, use Weigh #2 Whatman filters and filter the samples by pouring the jar contents through the filter, using a Buchner funnel.

5) Rinse each filter several times by running distilled water gently through the filter in the funnel to remove the salts from the sediment.

6) Dry the sediment filters in a drying oven at 70 degrees Celsius until a constant weight is attained.

7) Calculate the sedimentation rate as mg of sediment per square centimeters (cm^2) per day. The sediment weight is the total weight minus the filter weight, and the area of the jar opening is nr^2 r =radius in cm).

Sedimentation Rate = $\frac{\textit{Sediment Weight}}{\textit{No. of days at site X 1er}^2}$

3.2 SEDIMENT DEPOSITION SAMPLING SCHEDULE

Sediment deposition samples will be collected within 30 days prior to dredging operations; monthly during dredging activities coordinated with the photographic diving; and within 30 days of post-dredging activities.

4. DATA REPORTING

Status reports will be submitted electronically on a weekly basis with an emphasis on the possibility of dredging affects. Status reports will discuss schedules and preparations for dives and progress on data analysis.

A field report will be completed and submitted within 7 days of each diving session. The field report will be used to give USACE real time feedback on the condition of the coral to assist USACE in determining the effectiveness of the dredging sediment controls. The field report will include a summary of the coral health status with representative photos to verify the summary and contain field data sheets and photos as an attachment. This report will be submitted electronically on four DVDs.

A coral monitoring summary report will be submitted within 60 days of the final post-construction survey. The summary report will include a comparison of pre-, during-, and post- monitoring dredging surveys, including a qualitative review of video footage and a quantitative treatment of in situ data. Five complete copies of underwater transect video from all surveys will be included with the report as will all survey still photographs. The report will be submitted electronically on five DVDs.

5. REFERENCES

Rodgers et al. 1994. *Coral Reef Monitoring Manual for the Caribbean and Western Atlantic*, June.

NOAA Pacific Islands Fisheries Science Center, Coral Reef Ecosystem Division. 2008. *Monitoring Strategy and Preliminary Survey Design for Guam/CNMI Coral Reef Ecosystem Studies with a Focus on Apra Harbor and Kilo Wharf*

ATTACHMENT 6

Anticipated Permit / Environmental Conditions

Approximately 4 weeks around July.

Special permit conditions anticipated.

1. Activities that may result in a discharge of sediment or other pollutants are prohibited during the primary hard coral spawning event each year ~~(July 15 through August 5)~~ and during the primary soft coral spawning event each year (21-days surrounding the May full moon event). ~~The Navy may contact NMFS PIRO HCD Guam Field Office for more information including spawning dates.~~

2. The Navy will minimize and reduce the potential for spread of nonnative organisms into the project area from vessels, equipment, or materials arriving from outside Guam's marine waters. Additionally, the Navy will take measures to ensure all in-water equipment and materials are free of pollutants prior to their use in water.

3. Discharges of sediment, debris and/or other pollutants outside of the project footprint shall be avoided and/or minimized to the maximum extent practicable through the employment of effective containment devices. This includes the employment of floating silt curtains/booms extended to maximum effective depths around work areas to contain suspended sediments and the implementation of the Water Quality Monitoring Plan approved by the Guam Environmental Protection Agency. Additionally, work shall cease during adverse tidal and/or weather conditions. Debris, trash, and/or excess construction materials shall not be stored, staged or disposed in waters of the U.S.

4. Design BMPs developed for this project to minimize adverse impacts to water quality from sediments, fuel, and/or other pollutants shall be employed and maintained before, during, and following construction activities to ensure that stormwater is effectively managed onsite. Spill prevention booms will be employed to contain any potential spills associated with fueling water based construction equipment (e.g., barges). Absorbent pads and other petroleum clean up material and/or equipment will be stored on site to ensure efficient and expeditious clean up procedures.

5. Sedimentation outside of the dredging footprint shall be avoided and minimized to the maximum extent practicable. This includes the employment of floating silt curtains/booms extended to the maximum effective depth within the water column. The Navy shall develop a turbidity monitoring plan, including employment of both visual and real time instrumentation and shut down procedures, to ensure that turbidity outside the work area does not exceed Guam Water Quality standards. The instrument monitoring plan shall involve lateral monitoring approximately 1 meter outside the perimeter of the silt curtains at a depth of approximately 1 meter above the seafloor.

2012 NATIONWIDE PERMIT GENERAL CONDITIONS

As excerpted from the *Federal Register* /Vol. 77, No. 34 /Tuesday, February 21, 2012 /Notices pp. 10282-10287

1. *Navigation.*

(a) No activity may cause more than a minimal adverse effect on navigation.

(b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.

(c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. *Aquatic Life Movements.*

No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

3. *Spawning Areas.*

Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. *Migratory Bird Breeding Areas.*

Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. *Shellfish Beds.*

No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. *Suitable Material.*

No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. *Water Supply Intakes.*

No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. *Adverse Effects From Impoundments.*

If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. *Management of Water Flows.*

To the maximum extent practicable, the preconstruction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the preconstruction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. ***Fills Within 100–Year Floodplains.***
The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. ***Equipment.***
Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. ***Soil Erosion and Sediment Controls.***
Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. ***Removal of Temporary Fills.***
Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be re-vegetated, as appropriate.

14. ***Proper Maintenance.***
Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. ***Single and Complete Project.***
The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. ***Wild and Scenic Rivers.***
No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a ''study river'' for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

17. ***Tribal Rights.***
No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. ***Endangered Species.***

(a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which ''may affect'' a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will

determine whether the proposed activity ‘‘may affect’’ or will have ‘‘no effect’’ to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps ‘determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have ‘‘no effect’’ on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species specific regional endangered species conditions to the NWPs.

(e) Authorization of an activity by a NWP does not authorize the ‘‘take’’ of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with ‘‘incidental take’’ provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where ‘‘take’’ means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word ‘‘harm’’ in the definition of ‘‘take’’ means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

(f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide web pages at *http://www.fws.gov/* or *http://www.fws.gov/ipac* and *http://www.noaa.gov/fisheries.html* respectively.

19. *Migratory Birds and Bald and Golden Eagles.*

The permittee is responsible for obtaining any ‘‘take’’ permits required under the U.S. Fish and Wildlife Service’s regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such ‘‘take’’ permits are required for a particular activity.

20. *Historic Properties.*

(a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the preconstruction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete preconstruction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic

properties (see 36 CFR 800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h–2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. ***Discovery of Previously Unknown Remains and Artifacts.***
If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. ***Designated Critical Resource Waters.***
Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

(a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. ***Mitigation.***
The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1⁄10-acre and require preconstruction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1⁄10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2)–(14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, and ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to an herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. ***Safety of Impoundment Structures.***

To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. ***Water Quality.***
Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. ***Coastal Zone Management.***
In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. ***Regional and Case-By-Case Conditions.***
The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. ***Use of Multiple Nationwide Permits.***
The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed1⁄3-acre.

29. ***Transfer of Nationwide Permit Verifications.***
If the permittee sells the property associated with nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature: ‘‘When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below:

_____ _____
(Transferee) (Date)

30. ***Compliance Certification.***
Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

(b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

(c) The signature of the permittee certifying the completion of the work and mitigation.

31. *Pre-Construction Notification*.

(a) *Timing.* Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

(2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is ''no effect'' on listed species or ''no potential to cause effects'' on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) *Contents of Pre-Construction Notification:* The PCN must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the United States expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);

(4) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

(5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and

(7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

(c) *Form of Pre-Construction Notification:* The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b) (1) through (7) of this general condition. A letter containing the required information may also be used.

(d) *Agency Coordination:*

(1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of intermittent and ephemeral stream bed, and for all NWP 48 activities that require pre-construction notification, the district engineer will immediately provide (e.g., via email, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the preconstruction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of preconstruction notifications to expedite agency coordination.

2012 NATIONWIDE PERMIT HONOLULU DISTRICT REGIONAL CONDITIONS

Honolulu District has adopted the following Regional Conditions as a means to ensure no more than minimal impacts, on an individual and/or cumulative basis, will occur in waters of the United States by projects authorized by nationwide permit (NWP). The following Regional Conditions are applicable unless the Honolulu District makes a written determination, based on project-specific information, that omitting or deviating from a particular Regional Condition is both merited and would not result in more than minimal impacts to the aquatic environment.

Coral Reef Advisory: Please be advised that coral reefs are special aquatic sites with complex ecosystems that may consist of many contributing biological assemblages, including sponges, macroalgae, seagrass, soft corals, gorgonians, etc., in addition to reef-building coral colonies. It should not be assumed that low live coral cover or the absence of live coral colonies in a particular sample or location indicates the absence of potential impacts to a coral reef by a given project. The Honolulu District determines, after coordinating with the appropriate resource agencies, the presence and magnitude of impacts to coral reef special aquatic sites, as well as appropriate and practicable compensatory mitigation requirements, commensurate with the scope and scale of specific authorized activities.

Regional Condition 1 – Exclusions

1. **Revoked Permits.**

The following NWPs may not be used to authorize activities within the geographic areas subject to the regulatory jurisdiction of the Honolulu District:

NWP 21 - Surface Coal Mining Activities
NWP 24 - Indian Tribe or State Administered Section 404 Programs
NWP 29 - Residential Developments
NWP 34 - Cranberry Production Activities
NWP 39 - Commercial and Institutional Developments
NWP 42 - Recreational Activities
NWP 44 - Mining Activities
NWP 49 - Coal Remining Activities
NWP 50 - Underground Coal Mining Activities
NWP 52 - Water-Based Renewable Energy Generation Pilot Projects

2. **Kihei Wetlands**.

The following NWPs may not be used to authorize activities on the island of Maui, Hawaii, within the area bounded by Mokulele Highway to the north, Kilohana Drive to the south, Piilani Highway to the east, and extending to the Pacific Ocean to the west:

NWP 7 – Outfall Structures and Associated Intake Structures
NWP 13 – Bank Stabilization

NWP 14 – Linear Transportation Projects
NWP 40 – Agricultural Activities
NWP 41 – Reshaping Existing Drainage Ditches
NWP 43 – Stormwater Management Facilities

3. **National Wildlife Refuges, Hawaii State Wildlife Sanctuaries, Hawaii Marine Life Conservation Districts, and Guam Marine Preserve Areas**.

NWPs may not be used to authorize activities within or directly affecting national wildlife refuges, Hawaii state wildlife sanctuaries, Hawaii marine life conservation districts, or Guam marine preserve areas, including wetlands adjacent to such designated areas, unless the Honolulu District determines after coordination with appropriate resource agencies that the activity would result in not more than minimal adverse impacts to aquatic resources.

4. **Anchialine pools, montane bogs, natural freshwater lakes and saline lakes**.

The following NWPs may not be used to authorize activities within anchialine pools, montane bogs, natural freshwater lakes, or saline lakes:

NWP 3 – Maintenance
NWP 7 – Outfall Structures and Associated Intake Structures
NWP 12 – Utility Line Activities
NWP 13 – Bank Stabilization
NWP 14 – Linear Transportation Projects
NWP 18 – Minor Discharges
NWP 19 – Minor Dredging
NWP 33 – Temporary Construction, Access, and Dewatering
NWP 40 – Agricultural Activities
NWP 41 – Reshaping Existing Drainage Ditches
NWP 43 – Stormwater Management Facilities

5. **Mangroves and Sea and Freshwater Caves, including Vadose Shafts, Sink Holes, Allogenic Streams, Stream Caves, Phreatic Zones, and Cenotes, in the Territories of Guam and American Samoa and the Commonwealth of the Northern Mariana Islands (CNMI)**.

The following NWPs may not be used to authorize any activity in Guam, American Samoa, or the Commonwealth of the Northern Mariana Islands (CNMI) within mangroves or sea or freshwater caves, including vadose shafts, sink holes, allogenic streams, stream caves, phreatic zones, and cenotes:

NWP 3 - Maintenance
NWP 7 - Outfall Structures and Associated Intake Structures
NWP 12 - Utility Line Activities
NWP 13 - Bank Stabilization
NWP 14 - Linear Transportation Projects
NWP 18 - Minor Discharges
NWP 19 - Minor Dredging

NWP 33 - Temporary Construction, Access, and Dewatering
NWP 40 - Agricultural Activities
NWP 41 - Reshaping Existing Drainage Ditches
NWP 43 - Stormwater Management Facilities

6. **Coral Reefs**.

No activity that directly results in a permanent loss of coral reef may be authorized by NWP if the District Engineer determines, after coordinating with appropriate resource agencies, that compensatory mitigation is required.

7. **Stream Modification**.

The following NWPs may not be used to authorize permanent stream channelization or the construction of dams that impound waters of the United States:

NWP 7 - Outfall Structures and Associated Intake Structures
NWP 12 - Utility Line Activities
NWP 14 - Linear Transportation Projects
NWP 18 - Minor Discharges
NWP 25 - Structural Discharges
NWP 40 - Agricultural Activities
NWP 41 - Reshaping Existing Drainage Ditches
NWP 51 - Land-Based Renewable Energy Generation Facilities

Regional Condition 2 – Regional Conditions that apply to all NWPs in the Honolulu District

1. **Pre-Construction Notification (PCN)**.

Notification to the Honolulu District is required, in accordance with General Condition 31, for any activity authorized by NWP that will take place within any of the geographic areas subject to the regulatory jurisdiction of the Honolulu District. You must obtain a written NWP verification from the Honolulu District before commencing the authorized activity.

2. **Compensatory Mitigation**.

Upland vegetation buffers may not be used as the primary or sole method to offset permanent losses of wetland or aquatic resources within the geographic areas subject to the regulatory jurisdiction of the Honolulu District. However, use of vegetated upland buffers is strongly encouraged as part of a compensatory mitigation plan that replaces lost aquatic resource functions through restoration, enhancement, and creation or, under exceptional circumstances, preservation of wetland and aquatic areas. Compensatory mitigation shall provide a minimum ratio of 1:1 replacement of unavoidable aquatic resource function losses or area. (Note: The

actual ratio may be larger in order to account for the impact plus temporal loss of area/functions and/or uncertainty of mitigation success.)

3. **Minimization Measures**

A plan employing the techniques listed below must be implemented to avoid or minimize disturbance to wetlands, riparian areas and beach fringes and/or to re-establish vegetation in such areas when disturbance cannot be avoided. Areas disturbed during project construction must be revegetated as soon as possible. Erosion protection must be provided and maintained until the soil is permanently stabilized.

a. Avoidance and minimization techniques may vary with site conditions and include, but are not limited to, the following:

(1) Planning construction access and scheduling work to avoid or minimize damage to wetland vegetation.

(2) Using crane matting or suitable geotextile material to protect vegetation from damage by heavy equipment.

(3) Insuring that anchorage of construction barges, equipment, and their anchor lines avoid coral reefs and seagrass beds.

b. Revegetation techniques may vary with site conditions and include, but are not limited to seeding, planting, replacement of reserved ground cover, and/or fertilizing of re-contoured ground to promote re-establishment of natural plant communities. Species to be used for seeding and planting, preferably those that provide the same functions as those species they are replacing, shall follow this order of preference: 1) species native to the site; 2) species native to the area; 3) species native to the state; 4) non-native non-invasive, species. Note: non-native species shall be used only when native species are not available. The following species are known to be highly invasive and shall not be used under any circumstances for revegetation under these NWPs: 1) species included on the USDA APHIS Plant Protection and Quarantine, Federal Noxious Weed List as of 6/7/99; 2) species included on the Hawaii Department of Agriculture, List of Plant Species Designated as Noxious Weeds for Eradication or Control Purposes (6/18/92); and 3) the University of Hawaii, Department of Botany, Distribution Maps of Alien Plants in Hawaii by island, Hawaiian Ecosystems at Risk (HEAR) Project (1/16/01); and 4) plants that score >1 and evaluated as 'Accept' on the Hawaii Weed Risk Assessment.

4. **Site Identification**

Prior to clearing and construction, project limits of authorized sites must be clearly identified in the field (e.g., by staking, flagging, silt fencing, buoys, existing footprint for maintenance activities, etc.) to ensure that impacts to waters of the United States (including wetlands) beyond project footprints are avoided. Such identification of project limits must be properly maintained until construction is completed and the soils have been stabilized.

5. **Protected or Endangered Species**

a. Constant vigilance shall be kept for the presence of protected species during all aspects of the proposed action. Protected species include plants and animals listed or proposed for listing as threatened or endangered under Endangered Species Act (ESA), birds covered under the Migratory Bird Conservation Act, as well as all marine mammals. Although the protected species potentially affected would be determined on a project-specific basis, protected species typically of concern in Hawaii include: Hawaiian stilt, Hawaiian coot, Hawaiian moorhen, Hawaiian duck, Hawaiian goose, green sea turtle, hawksbill sea turtle, and Hawaiian monk seal. In the Territory of Guam or the Commonwealth of the Northern Mariana Islands species include: nightingale wee-warbler, Mariana common moorhen, green sea turtle, and hawksbill sea turtle. In American Samoa species also include: green sea turtle and hawksbill sea turtle.

b. All on-site project personnel, irrespective of their employment arrangement or affiliation (e.g. employee, contractor, etc.), shall be apprised of the status of any protected species potentially present in the project area and the protections afforded to those species under Federal laws. Brochures explaining the laws and guidelines for listed species in Hawaii, American Samoa, and Guam may be downloaded from http://www.nmfs.noaa.gov/prot_res/MMWatch/hawaii.htm and http://www.fws.gov/pacificislands/species.html.

c. The project foreman shall designate an appropriate number of competent observers to survey the area adjacent to the proposed action for protected species. The project foreman shall also have in his/her possession at the jobsite a handout with photographs of protected species that may enter the construction site to assist with identification of the protected species. (U.S. Fish and Wildlife Service – Pacific Islands Fish and Wildlife Office (PIFWO) will provide the informational handout).

d. Surveys of the project area shall be made prior to the start of work each day, and prior to resumption of work following any break of more than one half hour, to ensure that no protected species are in the project area (typically within 50 yards of the proposed work). All work shall be postponed or halted when protected species are present, and shall only begin/resume after the animals have voluntarily departed the area. In the case of sessile species, a conservation plan shall be developed and approved between the Regulatory Branch, U.S. Army Corps of Engineers and PIFWO and/or National Marine Fisheries Service Pacific Islands Regional Office (PIRO).

e. If an onsite protected species does not depart the area on its own for 3 days or more, we recommend that the permittee, or responsible contractor, contact PIFWO for further technical assistance and guidance (808) 792-9400.

f. Any interaction with or incidental take of protected species shall be reported immediately to the Regulatory Branch, U.S. Army Corps of Engineers (808) 438-9258. Additionally, pursuant to the ESA, any take of ESA-listed species (other than marine

mammals) must be reported to the U.S. Fish and Wildlife Office of Law Enforcement in Honolulu at 1-808-861-8525. Any incidental take of marine mammals shall be reported immediately to the National Oceanic and Atmospheric Administration's (NOAA) 24-hour hotline at 1-888-256-9840. Information reported must include the name and phone number of a point of contact, location of the incident, and nature of the take and/or injury.

Note: Additional requirements may be designated by the Honolulu District as appropriate for specific projects, including all conservation measures and/or best management practices (BMPs) required by any ESA consultation for the project.

6. **Standard Best Management Practices (BMPs)**

Site-specific BMPs are generally a requirement of NWP verifications, either directly or by state water quality certification conditions, which are incorporated by reference. A permittee risks delays or enforcement action if work is commenced pursuant to a site-specific BMP plan that includes regulated activities, such as temporary access fill or stream diversions, that were not authorized under the NWP verification. To facilitate efficient review of a project, site-specific BMPs must be submitted as part of the PCN required for any activity requiring authorization under a NWP.

To the extent applicable, the following BMPs must be implemented to minimize the degradation of water quality and impacts to fish, coral reefs, and other aquatic resources:

a. Turbidity and sediment from project-related work must be minimized and contained to the immediate vicinity of the authorized activity through the appropriate use of effective sediment containment devices.

b. To the extent practicable, the work must be conducted in the dry season or when any affected stream has minimal or no flow. The site must be stabilized to prevent erosion and runoff and work must stop during flooding, intense rainfall, storm surge, or high surf conditions. To the extent practicable, shoreline work must be done during low tides.

c. To the extent practicable, work in the aquatic environment must be scheduled to avoid coral spawning and recruitment periods and sea turtle nesting and hatching periods. Coordination with federal resource agencies (U.S. Fish and Wildlife Service and/or NOAA) can assist in identifying these time periods.

d. Dredging and filling in the aquatic environment must be designed to avoid or minimize adverse impacts to or the loss of special aquatic sites (wetlands (swamps, marshes, bogs, etc.), mudflats, vegetated shallows/seagrass beds, coral reefs and/or riffle and pool complexes).

e. All project-related materials (fill, landscaping, etc.) and equipment (dredges, barges, backhoes, etc.) to be placed in any aquatic environment shall be inspected and cleaned of pollutants, organic matter, and invasive species (including snakes, frogs, and marine plants and animals, etc.) prior to use in any aquatic environment.

f. No project-related materials (fill, revetment rock, pipe etc.) shall be stockpiled in the aquatic environment (intertidal zones, reef flats, stream channels, wetlands etc.) or in close proximity such that materials could be carried into waters by wind, rain, or high surf.

g. All construction debris and material removed from the marine/aquatic environment shall be disposed of at an approved upland or alternative disposal site.

h. No contamination (by trash, debris, sediment, non-native species introductions, attractions of non-native pests, etc.) of adjacent waters of the United States, including special aquatic sites, shall result from project-related activities. Special attention must be paid to the fouling level on barges, vessels, and equipment whereas to minimize the transport and potential introduction and spread of aquatic non-native species. In addition, if dredged or excavated material or structural members are removed from the water or placed in the water, measures must be taken to prevent the spread or introduction of any aquatic non-native species. This shall be accomplished by implementing a litter-control plan and on a site or project specific need basis, developing a Hazard Analysis and Critical Control Point Plan (HACCP – see http://www.haccp-nrm.org/Wizard/default.asp) to prevent attraction and introduction of non-native species.

i. Fueling of project-related vehicles and equipment shall take place away from the water and a contingency plan to control petroleum products accidentally spilled during the project shall be developed. The plan shall be retained on site with the person charged with the responsibility of compliance with the plan. Absorbent pads and containment booms shall be stored on-site, if appropriate, to facilitate the clean-up of accidental petroleum releases.

j. To minimize turbidity in the aquatic environment, any under-layer fills used in the project shall be protected from erosion with suitable material (such as precast concrete armor or mat units) as soon after placement as practicable.

k. Any soil exposed near water as part of the project shall be protected from erosion (with suitable material such as geotextile, filter fabric, etc.) after exposure and stabilized as soon as practicable (with vegetation matting, hydroseeding etc.). Revegetation should follow the established standards in Regional Condition #10 (Minimization Measures).

l. Silt fences, silt curtains, or other diversion or containment structures shall be installed to contain sediment and turbidity at the work site (a) parallel to, and within 10 feet of, the toe of any fill or exposed soil which may introduce sediment to an adjacent aquatic site; and (b) adjacent to any fill placed or soil exposed within an aquatic site. All silt fences, curtains, and other structures shall be installed properly and maintained in a functioning manner for the life of the construction period and until the impact area is permanently stabilized, self sustaining, and/or turbidity levels, elevated due to construction, have returned to ambient levels.

m. When the discharge of fill material results in the replacement of wetlands or waters of the US with impervious surfaces, the authorized activity must not result in more than minimal degradation of water quality (in accordance with General Condition 25). To ensure NWPs do not cumulatively degrade water quality from increasing impervious area, projects should incorporate **low impact development stormwater practices** (e.g. native landscaping, bioretention and infiltration techniques, buffers, green roofs, and green spaces) to the extent practical to retain stormflows and pollutants on-site. More information including low impact stormwater concepts and definitions is available at: http://www.epa.gov/owow/NPS/lid/.

7. **State of Hawaii, Department of Health, Clean Water Branch (DOH) Requirements (Projects in the State of Hawaii Only)**

a. You must obtain a Clean Water Act (CWA) Section 401 Water Quality Certification (WQC) from the DOH before the Honolulu District can issue verification for proposed work requiring authorization under CWA Section 404. All conditions of a Section 401 WQC issued for a project are hereby incorporated into the project's NWP verification and are subject to discretionary enforcement by the Honolulu District. The permittee is strongly encouraged to submit a DOH WQC application to DOH, with site-specific BMPs, applicable monitoring plan, and any dredge spoils management plans.

b. You must contact the DOH to determine if a National Pollutant Discharge Elimination System (NPDES) permit is required. For work authorizations requiring verification solely under Section 10 of the Rivers and Harbors Act of 1899, any best management practices (BMPs) required or recommended by the DOH for purposes of avoiding and minimizing the discharge of pollutants, other than dredged or fill material, into state waters, including 303(d)-listed impaired waters, are hereby incorporated into the NWP verification. These conditions are subject to discretionary enforcement by the Honolulu District.

c. For projects directly impacting "Impaired Waters" as listed on the most recent CWA Section 303(d) list (*http://hawaii.gov/health/environmental/water/cleanwater/integrated/index.html*), the PCN shall:

(1) Identify the waterbody as an "Impaired Water" and,

(2) Identify mitigating measures or BMPs necessary to avoid further degradation of the impaired water.

d. You may dispose of dredged spoils at state permitted landfills, provided you comply with the landfill's acceptance criteria. Preapproval by the DOH-Solid and Hazardous Waste Branch is not required for this action. The generator shall provide documentation to DOH upon request. You may use dredge spoils at off-site locations, provided the dredged spoils meet the Hawaii DOH Soil Environmental Action Levels for unrestricted use. You must adequately characterize the dredged spoils, including conducting

sampling and analysis in accordance with the HEER Office Technical Guidance Manual and other relevant guidance documents. Sampling methodology and analytical results shall be documented, including a comparison to EALs, and maintained by the generator. The spoils shall also meet the definition of inert fill material, which generally includes "…earth, soil, rocks, and rock-like materials... [that do not] contain vegetation or other organic material, or other solid waste." The generator shall provide the documentation to the DOH upon request. Offsite placement of dredged spoils that do not meet the above criteria or occur without adequate records may be considered illegal dumping, subject to enforcement action.

Regional Condition 3 – Acreage Limitation

The maximum acreage loss of waters of the United States for the total project may not exceed 1/10-acre resulting from any discharge of dredged or fill material in a special aquatic site, including wetlands, if authorized by the following NWPs, or a combination of any of these NWPs:

NWP 3 - Maintenance
NWP 7 - Outfall Structures and Associated Intake Structures
NWP 40 - Agricultural Activities
NWP 41 - Reshaping Existing Drainage Ditches
NWP 43 - Stormwater Management Facilities
NWP 45 - Repair of Uplands Damaged by Discrete Events
NWP 46 - Discharges in Ditches
NWP 51 - Land-Based Renewable Energy Generation Facilities

Regional Condition 4 – Length Limitation

Any discharge of dredged or fill material in any stream, including intermittent and ephemeral streams, may not exceed 200 linear feet if authorized by the following NWPs:

NWP 12 - Utility Line Activities
NWP 13 - Bank Stabilization
NWP 14 - Linear Transportation Projects
NWP 40 - Agricultural Activities
NWP 45 - Repair of Uplands Damaged by Discrete Events
NWP 46 - Discharges in Ditches
NWP 51 - Land-Based Renewable Energy Generation Facilities

Regional Condition 5 – Sidecasting

Except for activities authorized under NWP 12, no activity may sidecast material into waters of the United States.

For any activity authorized under NWP 12, no material may be sidecast into flowing waters or waters subject to tidal action. Any material removed from an area suspected to contain contamination may not be sidecast for re-use, but must be disposed of in an upland location. All sidecast material must be completely removed at the earliest practicable date but no later than 30 days after its placement in waters of the United States.

Regional Condition 6 – Road Crossings

Use of embedded or bottomless arch culverts is required when practicable, especially where frequent culvert maintenance or replacement is needed, for any activity authorized under the following NWPs:

NWP 3 - Maintenance
NWP 14 - Linear Transportation Projects
NWP 27 - Aquatic Habitat Restoration, Establishment, and Enhancement Activities
NWP 37 - Emergency Watershed Protection and Rehabilitation
NWP 40 - Agricultural Activities
NWP 41 - Reshaping Existing Drainage Ditches
NWP 45 - Repair of Uplands Damaged by Discrete Events

Culverts must maintain the original and natural full bank capacity (cross-sectional volume) of the channel. If a bottomless culvert cannot be used, a rock apron with an appropriate slope (determined on a site or project specific basis), or other appropriate measures must be incorporated to prevent perching of the culvert or scouring that could obstruct up- and downstream native stream species migration. To preserve a natural stream bed, bridge designs that span the stream or river, including pier or pile supported spans, are encouraged.

Regional Condition 7 – Bank Stabilization.

Vertical walls and/or non permeable rigid structures such as pre-cast concrete, concrete rubble masonry, and cast-in-place structures may not be used for bank stabilization authorized under the following NWPs:

NWP 13 - Bank Stabilization
NWP 14 - Linear Transportation Projects
NWP 27 - Aquatic Habitat Restoration, Establishment, and Enhancement Activities
NWP 45 - Repair of Uplands Damaged by Discrete Events

Regional Condition 8 - Mooring Buoys.

Within 7 days of installation of a mooring buoy authorized by NWP 10, you must provide the as-built coordinates of its location to the Honolulu District and the U.S. Coast Guard.

Regional Condition 9 – Runways and Taxiways.

NWP 14 may not be used to authorize runways or taxiways.

DEFINITIONS

Allogenic streams - streams flowing from an impervious surface, such as volcanic rock into porous limestone. Example: in Northern Guam, such streams will percolate into the ground and can flow into the marine environment from subsurface channels.

Anchialine pools – marine or brackish water bodies that have no surface connection but that, through permeable substrates, have subsurface hydrologic connection to the ocean.

Cenotes - sinkholes open to the surface and extending into groundwater.

Coral Reefs - As defined at 40 CFR 230.44 (Clean Water Act, Section 404(b)(1) Guidelines), coral reefs consist of the skeletal deposit, usually of calcareous or silicaceous materials, produced by the vital activities of anthozoan polyps or other invertebrate organisms present in growing portions of the reef.

Phreatic zones - the zones along a coast where freshwater and saltwater mix usually causing rapid dissolution of limestone with a resulting cave formation

Sinkholes - caves formed when a water formed cave either collapses or is opened up by adequate dissolution of limestone by water.

Stream caves - a series of caves formed by water flowing through limestone usually structurally complex.

Vadose Shafts - vertical shafts in limestone that allows rapid passage of water into the ground water lens.

COMPLIANCE CERTIFICATION

PERMIT NO.: POH-XXXX-XXXXX, [INSERT Project Title]

DATE OF ISSUANCE: [INSERT Date]

NAME OF PERMITTEE: [INSERT Name]

In accordance with General Condition #30, the permittee must, upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

U.S. Army Corps of Engineers
Guam Field Office
PSC 455, Box 188
FPO AP 96540

Please note that your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with the terms and conditions of this permit, you are subject to permit suspension, modification or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

_____ _____
Signature of Permittee Date