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Site YF3 Intertidal Area Data Gaps Investigation and Baseline Ecological Risk Assessment Report

Former Naval Station Treasure Island
San Francisco, California

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TABLE OF CONTENTS

REVIEW AND APPROVAL vii

ACRONYMS AND ABBREVIATIONS viii

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1
  1.1 PURPOSE OF REPORT 1
  1.2 ECOLOGICAL RISK ASSESSMENT APPROACH 2
    1.2.1 Overview of the Tiered ERA Process 2
    1.2.2 ERA Steps Previously Completed at Site YF3 3
    1.2.3 Tier 2 BERA Methodology for Site YF3 4
  1.3 WEIGHT OF EVIDENCE EVALUATION 5
  1.4 ORGANIZATION OF REPORT 5

2.0 BACKGROUND 7
  2.1 INSTALLATION AND SITE BACKGROUND 7
  2.2 ENVIRONMENTAL SETTING 8
    2.2.1 Geology 8
    2.2.2 Hydrogeology 9
    2.2.3 Climate 9
    2.2.4 Ecology 10
  2.3 PREVIOUS INVESTIGATIONS AND ASSESSMENTS 12
    2.3.1 Corrective Action Plan for Inactive Fuel Lines 12
    2.3.2 Field Activities Report 13
    2.3.3 Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation 14

3.0 DATA GAPS INVESTIGATION METHODS AND FIELD ACTIVITIES 17
  3.1 PHASE I — TRIDENT PROBE SURVEY AND PORE WATER SAMPLING 17
  3.2 PHASE II — SEDIMENT SAMPLING 19
  3.3 DEVIATIONS FROM THE WORK PLAN 20
  3.4 INVESTIGATION-DERIVED WASTE MANAGEMENT 21

4.0 NATURE AND EXTENT OF CONTAMINATION 23
  4.1 PORE WATER ANALYTICAL RESULTS 23

TABLE OF CONTENTS (CONTINUED)

4.2 SEDIMENT ANALYTICAL RESULTS 23

4.3 PETROLEUM FINGERPRINTING....24

4.4 EVALUATION OF LIGHT NON-AQUEOUS PHASE LIQUID AT SITE YF3 24

4.4.1 Previous Evaluation and Results....25

4.4.2 Current TPH Sediment Data Analysis 26

4.4.3 Residual LNAPL Fate and Transport Mechanisms 29

4.5 CHARACTERIZATION SUMMARY 31

5.0 BASELINE ECOLOGICAL RISK ASSESSMENT PROBLEM FORMULATION 32

5.1 ECOLOGICAL CONCEPTUAL SITE MODEL....32

5.1.1 Stressors 32

5.1.2 Fate and Transport 32

5.1.3 Exposure Pathways and Exposure Routes 33

5.1.4 Assessment and Measurement Endpoints....34

5.2 DATA SET AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN....37

5.2.1 Statistical Analyses 37

5.2.2 Sediment 39

5.2.3 Pore Water 40

5.2.4 Additional Information Considered in the BERA 40

6.0 ANALYSIS OF EXPOSURE AND EFFECTS....41

6.1 EVALUATION OF EXPOSURE 41

6.1.1 Exposure to Aquatic Life....41

6.1.2 Exposure to Benthic Invertebrates 41

6.1.3 Exposure to Birds....43

6.2 EVALUATION OF EFFECTS 47

6.2.1 Effects on Aquatic Life....47

6.2.2 Effects on Benthic Invertebrates....48

6.2.3 Effects on Birds....51

7.0 RISK CHARACTERIZATION....52

7.1 RISK TO AQUATIC LIFE 52

7.2 RISK TO BENTHIC INVERTEBRATES....53

7.3 RISK TO BIRDS 54

8.0 UNCERTAINTY ANALYSIS 55

TABLE OF CONTENTS (CONTINUED)

8.1 ANALYTICAL DATA 55

8.2 IDENTIFICATION OF COPECS 56

8.3 USE OF SCREENING VALUES AND ESB EVALUATION 56

8.4 INTERPRETATION OF BIOASSAY RESULTS 57

8.5 UNCERTAINTIES ASSOCIATED WITH THE FOOD CHAIN MODEL 58
- 8.5.1 Receptor Exposure Parameters 58
- 8.5.2 Tissue Residue Data and Biota-Sediment Accumulation Factors 58
- 8.5.3 TRVs 59
- 8.5.4 Individual and Population Variation 59
- 8.5.5 Use of the Lesser of the Maximum Concentration and 95 UCL as Exposure Point Concentration 59

9.0 BERA CONCLUSIONS 61

10.0 UPDATED CONCEPTUAL SITE MODEL 62

11.0 OVERALL SITE YF3 CONCLUSIONS AND RECOMMENDATIONS 64

12.0 REFERENCES 66

FIGURES

1 Site Location

2 Navy Ecological Risk Assessment Tiered Approach

3 Ecological Conceptual Site Model

4 Site Layout

5 Sample Locations

6 TPH-Diesel and TPH-Motor Oil in Pore Water (2017)

7 PAHs in Pore Water (2017)

8 TPH-Diesel and TPH-Motor Oil in Surface Sediment

9 PAHs in Surface Sediment

10 Interpolated Pore Water TPH-d

11 Interpolated Pore Water TPH-mo

12 Interpolated Sediment TPH-d Concentrations Greater Than 1,000 mg/kg

13 Interpolated Sediment TPH-mo Concentrations Greater Than 1,000 mg/kg

14 Interpolated Pore Water and Sediment (Greater Than 1,000 mg/kg) TPH-d

15 Interpolated Pore Water and Sediment (Greater Than 1,000 mg/kg) TPH-mo

16 Cross-Sections of Percent Fines Through Sediment TPH-d Greater Than 1,000 mg/kg

17 Cross-Sections of Percent Fines Through Sediment TPH-mo Greater Than 1,000 mg/kg

18 PAH Potency Ratios in Surface Sediment

19 PAH Potency Ratios in Pore Water (2017)

TABLES

1 Summary Statistics for Sediment (0 to 1 foot bgs)

2 Summary Statistics for Sediment (1 to 5.5 feet bgs)

3 Summary Statistics for Sediment (5.5 to 10 feet bgs)

4 Summary Statistics for Sediment (1 to 10 feet bgs)

5 Summary Statistics for All Pore Water and Groundwater

6 Summary Statistics for 2017 Pore Water Samples

7 Comparison of Concentrations in 2017 Pore Water Samples with Screening Criteria

8 Calculation of Total Percent LNAPL Saturation and Estimates of LNAPL Mobility at Site YF3 (1997-2012 Data)

9 Calculation of Total Percent LNAPL Saturation and Estimates of LNAPL Mobility at Site YF3 (2017 Data)

10 Summary of PAH Benchmark Calculations for Sediment using the Equilibrium Partitioning Sediment Benchmark Approach

11 Calculation of PAH Benchmarks for Sediment using EPA Equilibrium Partitioning Sediment Benchmark Approach

12 Summary of PAH Benchmark Calculations for Pore Water using the Equilibrium Partitioning Sediment Benchmark Approach

13 Calculation of PAH Benchmarks for Pore Water using EPA Equilibrium Partitioning Sediment Benchmark Approach

14 Dose Parameters for the Spotted Sandpiper (*Actitis macularius*)

15 Dose Parameters for the Great Blue Heron (*Ardea herodias*)

16 Invertebrate BSAF Calculations and Statistics for Total HMW and Total LMW PAHs

17 Spotted Sandpiper Dose Calculations and Hazard Quotients

18 Great Blue Heron Dose Calculations and Hazard Quotients

APPENDICES

A Photographic Log

B Field Forms (Provided on CD)

  B-1 Chains of Custody

  B-2 Pore Water Sampling Logs

  B-3 Boring Logs

  B-4 Daily Summary Reports

  B-5 Daily Contractor Quality Control Reports

  B-6 Field Logbook

  B-7 Investigation-Derived Waste Manifests

C Tabulated Analytical Laboratory Data

  C-1 Sediment Analytical Results

  C-2 Pore Water Analytical Results

  C-3 Tissue Analytical Results

D Laboratory and Data Validation Reports (Provided on CD)

  D-1 Analytical Laboratory and Data Validation Reports

  D-2 Bioassay Laboratory Toxicity Test and Bioaccumulation Test Reports

  D-3 Petroleum Fingerprinting Laboratory and Data Validation Reports

REVIEW AND APPROVAL

Draft

Site YF3 Intertidal Area Data Gaps Investigation and Baseline Ecological Risk Assessment Report

Former Naval Station Treasure Island
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ACRONYMS AND ABBREVIATIONS

%	percent
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
3DVA	3-dimensional data visualization and analysis
95 UCL	95 percent upper confidence limit on the arithmetic mean
API	American Petroleum Institute
AST	aboveground storage tank
ASTM	American Society of Testing and Materials
BERA	baseline ecological risk assessment
bgs	below ground surface
BOC	biogenic organic compound
BRAC	Base Realignment and Closure
BSAF	biota-sediment accumulation factor
bss	below sediment surface
BTEX	benzene, toluene, ethylbenzene, and total xylene
CAP	corrective action plan
CCR	California Code of Regulations
cm	centimeter
CMG	Conger Moss Guillard
COPEC	chemical of potential ecological concern
CSM	conceptual site model
CTO	Contract Task Order
Dixon	Dixon Marine Services, Inc.
DTSC	Department of Toxic Substances Control
DVG	The Data Validation Group, Inc.
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
ER-L	effects range-low
ER-M	effects range-median
ERM-West	Environmental Resources Management-West, Inc.
ESA	Environmental Science Associates
ESAT	Environmental Services and Technologies
ESB	equilibrium partitioning sediment benchmark
EXWC	Expeditionary Warfare Center
FAR	field activities report
FCM	food chain model

ACRONYMS AND ABBREVIATIONS (CONTINUED)

g/cm^3	grams per cubic centimeter
HMW	high-molecular-weight
HQ	hazard quotient
ITRC	Interstate Technology Research Council
KCH	CH2M Hill Kleinfelder Joint Venture
kg	kilogram
kg/day	kilogram per day
KM	Kaplan-Meier
LMW	low-molecular-weight
LNAPL	light non-aqueous phase liquid
LOAEL	lowest observed adverse effects-level
LOE	line of evidence
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
MLLW	mean lower low water
mph	miles per hour
NAPL	non-aqueous phase liquid
NAVFAC	Naval Facilities Engineering Command
NAVSTA	Naval Station
Navy	Department of the Navy
NFA	no further action
NOEL	no effect level
PACE	Pace Analytical Energy Services
PAH	polycyclic aromatic hydrocarbon
PAL	project action limit
PMO	Program Management Office
PRC	PRC Environmental Management, Inc.
SAP	sampling and analysis plan
SLERA	screening level ecological risk assessment
SME	subject matter expert
SPAWARSYSCEN	Space and Naval Warfare Systems Center
Subtronic	Subtronic Corporation
SUF	site use factor
SVOC	semivolatile organic compound
SWRCB	State Water Resources Control Board
TestAmerica	TestAmerica Laboratories, Inc.
Tetra Tech	Tetra Tech, Inc.

ACRONYMS AND ABBREVIATIONS (CONTINUED)

TI	Treasure Island
TIDA	Treasure Island Development Authority
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TPH-d	total petroleum hydrocarbon quantified as diesel
TPH-e	total petroleum hydrocarbon - extractable
TPH-g	total petroleum hydrocarbon quantified as gasoline
TPH-mo	total petroleum hydrocarbon quantified as motor oil
TPH-p	total petroleum hydrocarbon - purgeable
TriEco-Tt	TriEco LLC and Tetra Tech Joint Venture
TRV	toxicity reference value
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compound
Water Board	San Francisco Bay Regional Water Quality Control Board
WBC	Wood Biological Consulting
WOE	weight of evidence
YBI	Yerba Buena Island

EXECUTIVE SUMMARY

The purpose of this report is to document the methodology and results of the 2017 intertidal area data gaps investigation and the baseline ecological risk assessment (BERA) for Site YF3 (the Site) at former Naval Station Treasure Island in San Francisco, California, and to provide recommendations for the path forward for Site YF3. Site YF3 was designated as a petroleum site to be addressed under California underground storage tank regulations (Title 23 of the California Code of Regulations, Article 11, Section 2720) (Tetra Tech, Inc. [Tetra Tech], 2003).

Site YF3 has been the subject of multiple prior investigations and assessments (Tetra Tech, 2003; TriEco LLC and Tetra Tech Joint Venture [TriEco-Tt], 2015; CH2M Hill Kleinfelder Joint Venture [KCH], 2013; Battelle and Tetra Tech, 2017). However, the data available prior to the 2017 intertidal area data gaps investigation were somewhat limited for the purpose of comprehensively assessing ecological risk. The 2017 intertidal area data gaps investigation was performed to fill data gaps from previous investigations. The BERA for Site YF3 was performed following the 2017 intertidal area data gaps investigation to thoroughly assess potential risks to ecological receptors associated with exposure to chemicals of potential ecological concern. This report documents the results of the 2017 intertidal area data gaps investigation, provides an assessment of the potential for light non-aqueous phase liquid (LNAPL) to be present and migrating as LNAPL and/or dissolved phase contamination to San Francisco Bay, presents the methodology and results of the BERA, and refines the overall Site YF3 conceptual site model (CSM). In addition, based on the investigation and BERA results, recommendations are made for the path forward for Site YF3.

The BERA builds upon the methodology of the screening-level ecological risk assessment (SLERA) and Step 3a risk refinement previously documented in the SLERA and Low-Threat Closure Analysis Report for Site YF3 (TriEco-Tt, 2015), and enhances the prior ecological risk assessment (ERA) activities with additional lines of evidence (LOE) and more Site-specific and ecologically relevant data collected in 2017 as part of the intertidal area data gaps investigation (Battelle and Tetra Tech, 2017).

Overview of the Ecological Risk Assessment Approach

The BERA documented in this report follows United States Department of the Navy (Navy) (Navy, 1999, 2004) and United States Environmental Protection Agency (EPA) (EPA, 1997, 2001) guidance for conducting ERAs. Navy policy for conducting ERAs involves a three-tiered approach that incorporates different levels of complexity (Navy, 1999, 2004). This approach consists of the following tiers: Tier 1 – SLERA; Tier 2 – BERA; and Tier 3 – Evaluation of Remedial Alternatives.

ERA Steps 1 through 3a (Tier 1 and the initial step of Tier 2) were conducted previously for Site YF3 in 2015 (TriEco-Tt, 2015). The Tier 2 BERA (Steps 3 to 7 of the EPA guidance), which is more rigorous and less conservative than the Tier 1 SLERA, recalculates risk after refining conservative exposure assumptions employed in Tier 1 and incorporates additional evaluations using a weight-of-evidence (WOE) approach.

At the conclusion of Tier 2, the BERA provides a characterization of any ecological risks posed by a site based on multiple LOEs and supports one of two possible ecological risk management decisions (Navy, 1999, 2004):

(1) No further evaluation or remediation is warranted from an ecological perspective if the site does not pose unacceptable risk; the site exits the ERA process.

(2) If the site poses unacceptable ecological risk, then additional evaluation in the form of remedy development and evaluation is appropriate, and the site proceeds to Tier 3.

Intertidal Area Data Gaps Investigation

In 2017, pore water and sediment sampling were conducted at Site YF3 to address data gaps identified during and after completion of the SLERA (TriEco-Tt, 2015). Pore water sampling was conducted at 20 locations using a Trident Probe at the 2 foot below sediment surface (bss) sampling depth. Sediment core samples were collected from three depths (target depths were 0 to 1, 4.5 to 5.5, and 9 to 10 feet bss) at 16 locations. In addition, shallow sediment was collected from 0 to 1 foot bss at five locations for laboratory toxicity tests and at three locations (collocated with three of the toxicity test locations) for laboratory bioaccumulation tests. Sediment and pore water samples were collected at two locations at 2 and 5 feet bss for petroleum fingerprinting analysis. Nine sediment cores were collected at low tide using a track-mounted sonic drill rig operating from land, one sediment core was collected with a hand auger, and six cores were collected at high tide from a barge operating offshore and using a vibracore sampler.

Nature and Extent of Contamination

Concentrations of residual petroleum hydrocarbons, and related polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOC), were detected in pore water and sediment collected throughout Site YF3. The highest detections of total petroleum hydrocarbons (TPH) in sediments were in deeper sediments located along the immediate shoreline of Site YF3. TPH-diesel (TPH-d) was detected in both sediment and pore water at lower concentrations at locations farther into Clipper Cove and away from the former source area than in locations closer to the former source (i.e., an aboveground storage tank [AST] used to store petroleum materials). Similarly, concentrations of total high-molecular-weight (HMW) PAHs and total low-molecular-weight (LMW) PAHs in pore water were also greatest near the former AST, while some locations farther removed had nondetect results for both HMW and LMW PAHs. VOCs were detected less frequently, and at lower concentrations, compared to TPH and PAHs.

Petroleum fingerprinting results indicate there has been aggressive weathering of petroleum compounds previously released from Site YF3 operations into the intertidal environment. The highly weathered nature of residual hydrocarbons detected in intertidal zone sediment and pore water supports the conclusion that non-aqueous phase liquid, where present, is at residual saturation with generally little mobility. Visual and olfactory observations made during the 2017 intertidal area data gaps investigation field activities indicate evidence of petroleum in the soil/sediment when it is disturbed, but not under undisturbed, in situ conditions. An analysis of the TPH data and other LOEs indicates limited potentially mobile LNAPL is present at Site YF3 and that there is a low likelihood that any residual LNAPL present is migrating.

Tier 2 BERA Methodology for Site YF3

Although no chemicals were identified as posing an unacceptable risk to ecological receptors after the Tier 1 SLERA and the Step 3a risk refinement, data gaps were identified and further evaluation of ecological risk in a Tier 2 BERA was recommended for Site YF3 (TriEco-Tt, 2015). Therefore, Step 3b was conducted during the development, review, and approval of the work plan for the 2017 intertidal area data gaps investigation (Battelle and Tetra Tech, 2017), Step 6 was conducted during the implementation of the 2017 intertidal area data gaps field investigation, and Step 7 has been conducted as part of this report.

Steps 3b through 7 of the Tier 2 BERA include problem formulation, development of a study design and data quality objectives, data collection and analysis, and risk characterization. Tier 2 BERA Step 8 consists of the risk management decision-making process. Steps 3b through 5 include project planning and study design and verification to focus the scope and magnitude of the BERA, which was completed as documented in the work plan (Battelle and Tetra Tech, 2017). Step 6 represents the field investigation and laboratory analysis, and Step 7 represents the risk characterization component of the BERA. In this step, the results obtained in Step 6 are used to characterize the nature, extent and ecological significance of potential ecological risks at a site; this characterization supports the decision criteria for potentially exiting Tier 2 (Navy, 2004).

BERA Results

The BERA includes assessment of the potential risks to aquatic life, benthic invertebrates, and birds at Site YF3 through a WOE approach. Based on the evaluation of exposure and effects, and other pertinent LOEs, the BERA concludes that chemicals in pore water and sediment do not pose unacceptable risk to ecological receptors. Therefore, no chemicals are recommended for further assessment of ecological risk.

Conclusions and Recommendations

Residual petroleum contamination remains in the sediment at Site YF3, as evidenced by visual and olfactory observations made during the 2017 intertidal area data gaps field investigation and the resulting analytical data and analyses. Residual petroleum contamination does not pose an unacceptable risk to ecological receptors or an immediate threat to the environment. However, there is the potential for a release of otherwise stable in situ residual contamination to the environment if Site YF3 is disturbed by aggressive land-altering or other intrusive activities. Currently, no construction or intrusive activity is planned at Site YF3 (Treasure Island Development Authority [TIDA], 2011). Therefore, there is no immediate need to actively address (e.g., contain or remove) petroleum contaminated sediment at this time. Subsurface disturbance should be avoided without evaluation and development of appropriate plans to mitigate environmental impacts to this site.

1.0 INTRODUCTION

This report documents the methodology and results of the 2017 intertidal area data gaps investigation and the baseline ecological risk assessment (BERA) for Site YF3 (herein also referred to as "the Site") at former Naval Station (NAVSTA) Treasure Island (TI) in San Francisco, California (Figure 1), and provides recommendations for the path forward for the Site. Site YF3 was historically designated as a petroleum site to be addressed under California underground storage tank (UST) regulations (Title 23 of the California Code of Regulations [CCR], Article 11, Section 2720) (Tetra Tech, Inc. [Tetra Tech], 2003).

This report was prepared on behalf of the United States Department of the Navy (Navy) by Battelle and Tetra Tech under Contract Task Order (CTO) Number 0103 of the Environmental Services and Technologies (ESAT) Contract (Contract Number N62583-11-D-0515). The 2017 intertidal area data gaps investigation was performed to fill data gaps from previous investigations. The BERA was performed following the 2017 intertidal area data gaps investigation at Site YF3 to thoroughly assess potential risks to ecological receptors associated with exposure to chemicals of potential ecological concern (COPEC). The 2017 intertidal area data gaps investigation activities were performed specifically on behalf of the Navy's Base Realignment and Closure (BRAC) Program Management Office (PMO) West. Naval Facilities Engineering Command (NAVFAC) Expeditionary Warfare Center (EXWC), which administers the ESAT Contract, provided contractual, administrative, and technical support. Tetra Tech is a teaming partner to Battelle under the ESAT Contract, and Battelle and Tetra Tech are collectively referred to as the Battelle Team for purposes of this report and the overall CTO. Space and Naval Warfare Systems Center (SPAWARSYSCEN) Pacific also supported the investigation through collection of specific data during the 2017 intertidal area data gaps investigation that are part of the BERA for Site YF3.

Site YF3 has been the subject of multiple prior investigations and assessments (Tetra Tech, 2003; TriEco LLC and Tetra Tech Joint Venture [TriEco-Tt], 2015; CH2M Hill Kleinfelder Joint Venture [KCH], 2013; Battelle and Tetra Tech, 2017). However, the data available prior to the 2017 intertidal area data gaps investigation were somewhat limited for the purpose of comprehensively assessing ecological risk. The 2017 intertidal area data gaps investigation was performed to fill data gaps from previous investigations and allow a more complete assessment of potential Site risk.

Typically, risk management decisions at a site are based on the results of paired assessment of human health and ecological risks; however, due to the lack of human exposure pathways, Site YF3 poses no unacceptable risk to human health (KCH, 2013; TriEco-Tt, 2015). Therefore, risk management decisions for Site YF3 are being made considering ecological risk conclusions only.

1.1 PURPOSE OF REPORT

The purpose of this report is to document the assessment of potential ecological risks posed by Site YF3 and provide recommendations for the path forward for the Site. This report summarizes the results of the 2017 intertidal area data gaps investigation, provides an assessment of the potential for light non-aqueous phase liquid (LNAPL) to be present and migrating to San Francisco

Bay, presents the methodology and results of the BERA, refines the Site YF3 conceptual site model (CSM) to reflect the results of the 2017 intertidal area data gaps investigation and the BERA, and provides a recommended path forward for Site YF3.

1.2 ECOLOGICAL RISK ASSESSMENT APPROACH

Within the overall ecological risk assessment (ERA) framework, the current BERA builds upon the methodology of the screening-level ecological risk assessment (SLERA) and Step 3a risk refinement conducted in 2015 in the SLERA and Low-Threat Closure Analysis Report for Site YF3 (TriEco-Tt, 2015), and enhances that prior assessment with additional lines of evidence (LOE) and more Site-specific and ecologically relevant data collected in 2017 as part of the intertidal area data gaps investigation (Battelle and Tetra Tech, 2017).

1.2.1 Overview of the Tiered ERA Process

The BERA for Site YF3 follows Navy (Navy, 1999, 2004) and United States Environmental Protection Agency (EPA) (EPA, 1997, 2001) guidance for conducting ERAs. Navy policy for conducting ERAs involves a three-tiered approach that incorporates different levels of complexity (Navy, 1999, 2004). This approach consists of the following tiers: Tier 1 – SLERA; Tier 2 – BERA; and Tier 3 – Evaluation of Remedial Alternatives. A flowchart of the Navy tiered ERA approach and its relationship with EPA's eight-step ERA process is shown in Figure 2.

The Tier 1 SLERA corresponds to Step 1 (Problem Formulation and Exposure Pathway Evaluation) and Step 2 (Exposure Estimation and Risk Calculation) of the EPA ERA guidance (EPA, 1997, 2001). Each step uses existing data and conservative assumptions regarding contaminant exposure. Two decision criteria control the outcome of a Tier 1 SLERA (Navy, 1999, 2004):

(1) Existence of a complete exposure pathway from chemical to receptor, and

(2) Chemical concentrations or doses that exceed the screening criteria used for comparison.

No further action (NFA) is warranted if neither or only one of the criteria is met. If both criteria are met, and a site is identified in the Tier 1 SLERA as posing potentially unacceptable risk, a Tier 2 BERA (or a remediation) is initiated.

The Tier 2 BERA, which is more rigorous and less conservative than the Tier 1 SLERA, recalculates risk after refining conservative exposure assumptions employed in Tier 1 and including additional evaluations in a weight-of-evidence (WOE) approach. The Tier 2 BERA consists of Steps 3 through 7 of the EPA ERA process and is designed to provide a scientifically based and defensible assessment of exposure and hazard to ecological resources that will support a risk management decision regarding site cleanup. The Tier 2 BERA steps include a reevaluation of the Tier 1 results using less conservative assumptions (Step 3a), problem formulation (Step 3b), development of a study design and project quality objectives, data collection and analysis, and risk characterization.

The first step in the BERA, Step 3a (risk refinement) may be performed to reevaluate the COPECs that were retained from Tier 1 for further evaluation in a Tier 2 BERA and to identify and eliminate from further consideration those COPECs that were retained because of the use of excessively conservative exposure scenarios. Using less conservative (but more realistic) assumptions, Tier 1 SLERA risk estimates are recalculated and the list of COPECs refined by removal of some or all of the COPECs from further consideration. Some sites may exit the ERA process at this step if all identified COPECs are eliminated.

If a site does not exit the ERA process on the basis of the Step 3a risk refinement, the remaining steps of Tier 2 must be completed. Step 3b (Problem Formulation) focuses the scope and magnitude of the BERA and provides the basis for study design (Navy, 2004).

At the conclusion of Tier 2, the BERA will provide a characterization of any ecological risks posed by a site. Unlike the Tier 1 SLERA, the comparison to screening criteria is not the only LOE used in the BERA. Instead, the determination of whether risk is acceptable or unacceptable is based on food chain models (FCM), toxicity information in available scientific literature, and consideration of frequency and magnitude of chemical detection at the site and in prey tissues. The information provided in the BERA supports one of two possible ecological risk management decisions (Navy, 1999, 2004):

(1) No further evaluation or remediation is warranted from an ecological perspective if the site does not pose unacceptable risk; the site exits the ERA process.

(2) If the site poses unacceptable ecological risk, then additional evaluation in the form of remedy development and evaluation is appropriate, and the site proceeds to Tier 3.

Step 8 (Risk Management) is incorporated throughout the tiered approach. As noted in Section 1.0, risk management decisions are typically based on the results of paired assessment of human health and ecological risks. However, Site YF3 poses no unacceptable risk to human health (KCH, 2013; TriEco-Tt, 2015). Therefore, risk management decisions for Site YF3 will be made considering ecological risk conclusions only.

1.2.2 ERA Steps Previously Completed at Site YF3

Steps 1 through 3a of the ERA process were conducted in the Site YF3 SLERA and Low-Threat Closure Analysis Report (TriEco-Tt, 2015). Specifically, a SLERA (Tier 1; Steps 1 and 2), including Step 3a risk refinement (the first step of Tier 2), was conducted using historical data collected at the Site between 1994 and 2012 (TriEco-Tt, 2015).

The Step 1 evaluation for Site YF3 included an examination of the environmental setting, review of previous investigations, and development of an ecological CSM (Figure 3). The Step 1 evaluation concluded that there are potentially complete exposure pathways from COPECs in sediment to ecological receptors onshore and from groundwater to aquatic life at the point of exposure from submarine discharge in the San Francisco Bay. Therefore, potential toxicity to ecological receptors from exposure to COPECs in sediment and groundwater at Site YF3 was assessed in Step 2.

The Step 2 evaluation included an estimation of exposure and risk by comparing maximum groundwater and sediment concentrations at the Site to relevant screening criteria for aquatic life and benthic invertebrates, and by estimating risk to birds and mammals using a FCM. The Step 2 evaluation identified a number of COPECs that pose potential risk to aquatic life, benthic invertebrates, and birds at Site YF3.

As the Tier 1 SLERA indicated potential risk posed to ecological receptors for some COPECs, a Step 3a risk refinement was conducted to identify COPECs that may require remedial action or further evaluation in a BERA. COPECs identified as posing potential risks and COPECs designated by default in the SLERA were reconsidered in Step 3a based on site-specific information and refined exposure point concentrations (EPC). Results of Step 3a indicated limited potential for exposure of ecological receptors to COEPCs in sediment at concentrations that would potentially cause adverse effects.

None of the COPECs detected at the Site were recommended by the SLERA for further evaluation (TriEco-Tt, 2015). However, comments received from the regulatory agencies on the draft SLERA report indicated there were data gaps that could be addressed by collecting additional samples, thus prompting the 2017 intertidal area data gaps investigation and this BERA (Battelle and Tetra Tech, 2017).

1.2.3 Tier 2 BERA Methodology for Site YF3

Although no chemicals were identified as posing an unacceptable risk in the Tier 1 SLERA and the Step 3a risk refinement conducted with the available Site data, data gaps were identified and further evaluation of ecological risk in a Tier 2 BERA was recommended for Site YF3 (TriEco-Tt, 2015). This section describes the Tier 2 BERA methodology to evaluate risk to ecological receptors at Site YF3 using historical and new data collected as part of the 2017 intertidal area data gaps investigation. Step 3b was conducted during the development, review, and approval of the intertidal area data gaps investigation work plan, Step 6 was conducted during the implementation of the field investigation, and Step 7 has been conducted as part of this report.

Steps 3b through 7 of the Tier 2 BERA include problem formulation, development of a study design and data quality objectives, data collection and analysis, and risk characterization. Tier 2 BERA Step 8 consists of the risk management decision-making process. Steps 3b through 5 include project planning and study design and verification; these steps serve to focus the scope and magnitude of the BERA, and were completed as documented in the work plan and associated sampling and analysis plan (SAP) (Battelle and Tetra Tech, 2017). The intent of these steps is to ensure that the assessment focuses on the important ecological concerns for a site and to ensure that the appropriate data are collected. Step 6 represents the field investigation and laboratory analysis, and Step 7 represents the risk characterization component of the BERA. In this step, the results obtained in Step 6 were used to characterize the nature, extent and ecological significance of ecological risks at the Site; this characterization supports the decision criteria for potentially exiting Tier 2 (Navy, 2004).

1.3 WEIGHT OF EVIDENCE EVALUATION

In the BERA risk characterization, multiple LOEs are considered in a WOE approach to characterize risk to ecological receptors at Site YF3. The following LOEs are considered in addition to results of receptor-specific evaluations:

- A comparison of Site COPEC concentrations to ambient conditions (if applicable);
- The spatial distribution of the data;
- The likelihood of exposure; and
- Available data from toxicity literature.

In addition to the BERA conclusions, the LNAPL evaluation and potential for contaminant transport and discharge to the San Francisco Bay are considered in making recommendations on the path forward for Site YF3.

Although the SLERA included an evaluation of Site YF3 according to the State Water Resources Control Board (SWRCB) criteria for closure prescribed by the *Low-Threat Underground Storage Tank Closure Policy* (SWRCB, 2012), the San Francisco Bay Regional Water Quality Control Board (Water Board) later indicated that policy should not be applied to Site YF3 (Water Board, 2015).

1.4 ORGANIZATION OF REPORT

This report is organized as follows:

- Section 1.0 provides an introduction, a summary of the objectives and methodology of the BERA, and the report organization.
- Section 2.0 provides facility and Site background including Site history, environmental setting, and previous investigations.
- Section 3.0 describes the 2017 intertidal area data gaps investigation.
- Section 4.0 briefly describes the nature and extent of contamination at Site YF3, including the results of laboratory chemical analyses, petroleum fingerprinting analysis, and an evaluation of the potential presence and migration of LNAPL.

- Section 5.0 describes the BERA problem formulation, including stressors and exposure pathways, measurement and assessment endpoints, and data considered in the assessment.

- Section 6.0 describes the analysis of exposure and effects on ecological receptors conducted as part of the BERA.

- Section 7.0 presents the BERA risk characterization, describing the potential for risk to be posed to ecological receptors by chemicals in sediment and pore water at Site YF3.

- Section 8.0 provides the uncertainty analysis associated with the BERA.

- Section 9.0 presents the conclusions of the BERA.

- Section 10.0 briefly describes the updated CSM for Site YF3.

- Section 11.0 provides overall conclusions and recommendations for Site YF3.

- Section 12.0 provides a list of references cited in this report.

- Figures and Tables are provided following Section 12.0.

- Appendix A provides the 2017 intertidal area data gaps investigation photographic log.

- Appendix B contains relevant field forms from the 2017 intertidal area data gaps investigation.

- Appendix C contains tabulated analytical laboratory data from the 2017 intertidal area data gaps investigation.

- Appendix D provides raw laboratory and data validation reports associated with the 2017 intertidal area data gaps investigation.

2.0 BACKGROUND

A description of site history, environmental setting, and previous investigations at Site YF3 is presented below.

2.1 INSTALLATION AND SITE BACKGROUND

Former NAVSTA TI is located in San Francisco Bay, midway between San Francisco and Oakland, California. Former NAVSTA TI consists of two contiguous islands: (1) TI, an approximately 400-acre manmade island constructed in 1936 and 1937 of materials dredged from San Francisco Bay; and (2) Yerba Buena Island (YBI), an approximately 160-acre natural island (Tetra Tech, 2003; Seifel Consulting Inc., 2011). YBI is located along and accessible by California Interstate 80 (the Bay Bridge), and is separated from TI by a narrow land bridge and Clipper Cove (Figure 1).

TI was initially constructed to be the location of the Golden Gate International Exposition in 1939 and 1940, and then the City of San Francisco's commercial airport. However, in response to the Navy's request in 1941, the City of San Francisco leased and subsequently transferred the land comprising NAVSTA TI to the Navy in exchange for United States Government-owned land south of San Francisco, where San Francisco International Airport was eventually built (Tetra Tech, 2003).

Military activity at former NAVSTA TI dates back to 1866, when the United States Government took possession of YBI for defensive fortifications. The United States Department of the Army occupied YBI until 1896, when the Navy assumed control and operated the first West Coast naval training station until 1923. YBI continued to function as a naval receiving station until World War II, when naval operations were transferred to TI. During World War II, NAVSTA TI became a major naval facility, processing and training thousands of military personnel. Later, the installation processed Pacific-bound and homecoming personnel and housed training schools for Navy personnel.

NAVSTA TI was an active, fully operational naval facility until 1997. Its official mission was to maintain and operate naval facilities as well as to provide services and material in support of the operating forces of the Navy and designated shore activities. NAVSTA TI also was used for Navy family housing. In 1993, NAVSTA TI was designated for closure under the Defense Base Closure and Realignment Act of 1990. The base was officially closed on September 30, 1997, and associated land is being transferred in stages to the City of San Francisco (Tetra Tech, 2003).

Site YF3 is on the north shore of YBI, adjacent to Clipper Cove, a part of San Francisco Bay. As shown on Figure 4, the Site consists of (1) a paved area that follows North Gate Road, and (2) a narrow, natural shoreline to the north below a retaining wall along North Gate Road. The primary area of concern at the site consists of a rocky intertidal area and a small zone of shallow soil located inland of intertidal area below the retaining wall (Tetra Tech, 2003). A steep, thin zone of brush consisting of the Northern Coast Scrub habitat and eucalyptus trees (Conger Moss Guillard

[CMG], Environmental Science Associates [ESA], and Wood Biological Consulting [WBC], 2009) is present along the margin between the base of the wall and the intertidal area. The intertidal area is fully inundated during flood tides.

The shoreline area of Site YF3 is the location of two former piers used for marine vessel oil transfer, refueling activities, and garbage disposal. This area also previously included former Building 214 (a heating plant) that dated back to 1945, and housed a 10,000-gallon diesel aboveground storage tank (AST) (AST 214). Both the building and the AST were demolished and removed during the 1980s (Tetra Tech, 2003). Building 213, located immediately outside of the southeastern end of Site YF3, dates back to 1907 and has been used as a library, recreation building, storage area, and most recently as a fire station (for 40 years, until 1994) (Environmental Resources Management-West, Inc. [ERM-West], 1995). A former 550-gallon AST (AST 213) associated with the building was reportedly used for diesel and was removed in 1971 (Tetra Tech, 2003; ERM-West, 1995). In addition, Building 245 (formerly Building 144) was used by the Navy as a trash and laundry facility, and was demolished no later than 1970 (Navy, 1996).

Six main fuel lines were installed on YBI as early as the 1940s to transport gasoline, diesel, Bunker C fuels, and other petroleum products. The fuel lines were reportedly removed from service by 1989 (Tetra Tech and Jonas and Associates, Inc., 1999). Three major fuel lines were installed in 1944 to carry fuel oil from storage tanks to steam boilers on YBI, and these lines have been inactive since 1980. Suspected and confirmed portions of Fuel Lines F01 and F03 at Site YF3 appear to have been connected at one time to AST 214. Former fuel line F03 was also associated with Building 213 (ERM-West, 1995; Tetra Tech, 2003). Approximately 220 linear feet of former Fuel Line F03 were removed from the eastern end of Site YF3 between 1997 and 1998 (KCH, 2013).

2.2 ENVIRONMENTAL SETTING

The following subsections summarize the environmental setting of former NAVSTA TI, YBI, and/or Site YF3, including geology, hydrogeology, climate, and ecology.

2.2.1 Geology

It is believed that YBI was uplifted by faulting along a branch of the Hayward Fault approximately 1 million years ago. Surface elevations at YBI are generally greater than 50 feet above San Francisco Bay (relative to mean lower low water [MLLW]), with a peak elevation of nearly 340 feet MLLW in the central portion of the island. A secondary peak at the northeast tip of the island is less than 100 feet MLLW in elevation. Nearer to the perimeter of the island, surface elevations dip relatively steeply to the San Francisco Bay.

Three geologic units are present at YBI. Landslide debris and an artificial fill consisting of gravelly sand with silt is the youngest geologic unit at YBI. Landslide debris is the result of downslope movement of unstable clayey, silty sand. The fill is predominantly present along the eastern shoreline of the island (Tetra Tech, 2003). Depths of native soils on YBI range from 10 to 40 inches, and these soils have been significantly altered through human activity on the island.

A sandy colluvial unit with minor silty, clayey, and gravelly interbeds underlies the landslide debris and fill, or otherwise forms the surface unit. The basal unit is the Franciscan Assemblage, a bedrock formation consisting of interbedded sandstone and shale. The Franciscan Assemblage unconformably underlies the landslide debris, fill, and colluvium of YBI. The YBI Franciscan Assemblage consists of shale and sandstone outcrops that strike northwest, dipping northeast (Dames and Moore, 1988; Tetra Tech, 2003).

At Site YF3, geology is comprised of the colluvial unit, generally consisting of gravelly sand, and the underlying Franciscan Assemblage bedrock. The Site YF3 intertidal area surface is largely covered with cobbles. Based on borings historically completed at the Site, bedrock has been encountered at 7 to 10 feet below ground surface (bgs), or shallower farther inland (3 feet bgs just south of former AST 214) (Tetra Tech, 2003).

2.2.2 Hydrogeology

The Franciscan Assemblage is relatively impervious except for localized fracturing, and generally serves as a boundary to groundwater flow (Phillips et al., 1992; Blum, 1993). Groundwater recharge at YBI occurs primarily from infiltration of precipitation, with some contribution from landscape irrigation. Perched groundwater conditions may exist locally as a result of the presence of relatively impermeable silt and clay lenses (Tetra Tech, 2003). Groundwater throughout YBI has been identified as brackish and, because of the small volume of fresh groundwater available, potentially prone to saltwater intrusion (PRC Environmental Management, Inc. [PRC], 1997; Tetra Tech, 2003).

Groundwater at Site YF3 has been encountered in gravelly sand at depths ranging from 6 to 8 feet bgs (Tetra Tech, 2003). No permanent monitoring wells are currently present at the Site, but based on topography, groundwater is assumed to flow toward the San Francisco Bay (Tetra Tech, 2003). Tidal mixing at Site YF3 exerts an influence on groundwater, but has not been quantified. A 72-hour tidal influence study conducted at former NAVSTA TI showed that fluctuations in groundwater levels ranged from 1.81 feet within 30 feet of San Francisco Bay to 0.12 feet at inland locations 250 feet from the Bay (PRC, 1995). Based on this information, changes in groundwater elevation at Site YF3 would be expected to be of a generally similar amplitude (i.e., less than 2 feet).

2.2.3 Climate

The climate at former NAVSTA TI is dominated by the Pacific Ocean, producing a maritime climate characterized by little variation in temperature. The average annual temperature is 56 to 58 degrees Fahrenheit (°F), and the annual frost-free period ranges from 300 to 330 days. The average annual precipitation is 25 to 30 inches. Ninety percent of the annual precipitation occurs between November and April. Localized showers are infrequent, and storms are moderate in duration and intensity. Mean annual evaporation is 48 inches. The greatest amount of evaporation occurs during July.

Relative humidity during the winter is 50 percent (%) to 60% during the day, increasing to 80% to 90% at night. Humidity decreases in spring; however, by summer, it increases, particularly at night or in the morning. Nightly fog, which can persist throughout the day, is common during the summer. Humidity is lowest in the fall, ranging from 50% during the day to 70% at night.

The prevailing wind direction for the San Francisco Bay area is from the northwest. Wind speed is less than 6 miles per hour (mph) more than 50% of the time and exceeds 12 mph only 10% of the time. The strongest winds are associated with winter storms. Winds from the north and east can bring lower temperatures to the San Francisco Bay area in the winter. Westerly winds dominate during the summer, when cool, marine air flows east toward the warm Central Valley region of California. These winds are strongest in the late afternoon and early evening.

While the climate of YBI is strongly controlled by marine influences, including prevailing winds from the northwest through the Golden Gate, the island also supports many microclimates (CMG, ESA, and WBC, 2009).

2.2.4 Ecology

Terrestrial vegetation on YBI comprises nine vegetative communities, including California Annual Grassland, Valley Wildrye Grassland, Central Coast Riparian Scrub, Northern Coastal Scrub, California Buckeye Woodland, Coast Life Oak Woodland, Coast Life Oak Woodland/Eucalyptus, Eucalyptus Woodland, and Ruderal/Landscaped (CMG, ESA, and WBC, 2009). The southwestern portion of YBI includes about one acre of grassland (PRC, 1997). Extensive goat grazing occurred from 1830 until the military occupied the island, and detrimental tree planting efforts began in 1887 and continued through the 1940s (CMG, ESA, and WBC, 2009). Overall, while all undeveloped habitat at former NAVSTA TI is located at YBI, YBI has undergone extensive human habitation and disturbance that has resulted in very little undeveloped habitat.

The San Francisco Bay and Delta estuary form the largest estuary on the West Coast, and hundreds of thousands of birds comprising nearly 300 species migrate over or near YBI as part of the Pacific Flyway, a corridor for migrating birds that extends from South America to the Arctic Circle. A large proportion of these migratory birds spend some time each year in the San Francisco Bay, and previous studies have documented the numerous species of birds that have been observed on YBI (CMG, ESA, and WBC, 2009). In addition, the American peregrine falcon (*Falco peregrinus*) and the double-crested cormorant (*Phalacrocorax auritus*) may roost in the area and presumably use YBI and surrounding waters for foraging (CMG, ESA, and WBC, 2009). The California least tern (*Sterna antillarum browni*) and California brown pelican (*Pelecanus occidentalis*) feed throughout the region and have been observed near former NAVSTA TI (Tetra Tech, 2003).

YBI supports two small terrestrial mammal species: Botta's pocket gopher (*Thomomys bottae*); and the California ground squirrel (*Otospermophilus beecheyi*). The common raccoon (*Procyon lotor*) may potentially occur on the island, and calls from Mexican free-tailed bats (*Tadarida brasiliensis*) have been detected. Two aquatic mammals, the harbor seal (*Phoca vitulina*) and the

California sea lion (*Zalophus californianus*), are known to use the open water habitat offshore of NAVSTA TI, and there is a year-round “haul-out” for harbor seals at YBI on the western and southwestern shores of the island. Neither the Botta’s pocket gopher nor California ground squirrel, both burrowing mammals, would live and forage in the intertidal portion of Site YF3, and although the raccoon may occasionally visit the Site, it is unlikely to forage at the Site due to the abundance of more readily accessible food sources on YBI and TI. The harbor seal and sea lion feed throughout the Bay.

The San Francisco Bay is used for sport and commercial fishing, although commercial fishing is uncommon near former NAVSTA TI. Marine fauna occurring in the Bay and around former NAVSTA TI include anadromous fish such as striped bass (*Morone saxatilis*), king salmon (*Oncorhynchus tshawytscha*), and sturgeon (*Acipenseridae*). Other fish common to the Bay around former NAVSTA TI include sole (*Parophrys vetulus*), flounder (*Platichthys stellatus*), leopard shark (*Triakis semifasciata*), rays (*Myliobatus californica*), croaker (*Genyonemus lineatus*), and perch (*Cymatogaster aggregata*). Common bait and forage fish include sardine, anchovy, herring, and smelt. Common shellfish include shrimp and crab (Tetra Tech, 2003).

As for invertebrates and herpetofauna, surveys have shown that YBI supports several butterflies and moths rarely found in San Francisco, including the umber (*Poanes melane*) and rural skipper (*Ochlodes agricola*), as well as western fence lizards (*Sceloporus occidentalis*) and garter snakes (*Thamnophis*). Other butterfly and moth species are likely to occur on YBI, as well as alligator lizards (*Elgaria multicarinata*), California slender salamander (*Batrachoseps attenuates*), arboreal salamander (*Aneides lugubris*), and Pacific gopher snakes (*Pituophis catenifer catenifer*) (CMG, ESA, and WBC, 2009).

YBI supports many microclimates that influence specific assemblages of plant species. The island has some areas of undeveloped habitat, but these are of limited size and support a relatively limited group of fauna (CMG, ESA, and WBC, 2009). YBI does provide extensive, highly diverse intertidal and offshore habitat and a related assortment of ecological niches (CMG, ESA, and WBC, 2009). The predominant marine habitat surrounding YBI is a rocky intertidal zone and a subtidal zone with unconsolidated mud bottom substrate. The most common benthic invertebrate species in these habitats are usually amphipods, clams, and polychaete worms. Some documented eelgrass habitat is present within Clipper Cove, offshore of YBI and near Site YF3 (Merkel and Associates, Inc., 2010). However, Clipper Cove can be subject to significant variability in eelgrass coverage as a result of minor environmental flux (Merkel and Associates, Inc., 2008). No special-status plants and no known breeding grounds for special-status wildlife have been documented on YBI (CMG, ESA, and WBC, 2009). No reported endangered or threatened plant species are found on YBI (Tetra Tech, 2003).

Site YF3 encompasses an intertidal area that was the focus of the 2017 data gaps investigation (Battelle and Tetra Tech, 2017), and a steep vegetated slope consisting of the Northern Coast Scrub habitat and eucalyptus trees. Specific plant species identified during site visits in 2013 and 2016 at Site YF3 include fennel (*Foeniculum vulgare*), eucalyptus, Canary Island Marguerite (*Argyranthemum foeniculaceum*), English ivy (*Hedera helix*), purple vetch (*Vicia benghalensis L.,* *Vicia atropurpurea*), French broom (*Genista monspessulana*), and toyon (*Heteromeles arbutifolia*).

2.3 PREVIOUS INVESTIGATIONS AND ASSESSMENTS

Several field investigations were implemented at Site YF3 between 1994 and 2000 to assess the nature and extent of petroleum hydrocarbon contamination in environmental media possibly resulting from leaks in former fuel lines F01 and F03 and former ASTs 213 and 214. These historical investigations include:

- Initial investigation of inactive fuel lines in 1994 (Subsurface Consultants, Inc., 1995)
- Geophysical investigation to locate suspected UST 213 in 1995 (ERM-West, 1996)
- Fuel line excavation and sampling activities between 1997 and 1998 (Cal, Inc., 1998; Tetra Tech and Jonas and Associates, 1999)
- Focused site characterization activities in 2000 (Tetra Tech and LFR, 2000)

Further investigation and assessment of contamination at Site YF3 was also been performed after 2000, as summarized in the subsections below. The 2017 intertidal area data gaps investigation is summarized in Sections 3.0 and 4.0.

Notably, although the area of contamination around former AST 214 is within the intertidal area, several previous reports documenting investigations at Site YF3 refer to all samples collected at the Site as "soil", regardless of whether they were terrestrial soil or sediment from the intertidal area.

2.3.1 Corrective Action Plan for Inactive Fuel Lines

The 2003 Corrective Action Plan (CAP) summarized field investigations implemented from 1994 to 2000 to provide information on the nature and extent of petroleum contamination at the 14 inactive fuel line sites throughout former NAVSTA TI (Tetra Tech, 2003). The CAP also determined whether corrective action would be needed at each of these sites, and, if so, provided an evaluation of corrective action alternatives (Tetra Tech, 2003). The primary objective of the CAP for Site YF3 was to assess the nature and extent of petroleum hydrocarbon contamination in soil and groundwater possibly resulting from leaks in former fuel lines F01 and F03 and former ASTs 213 and 214, based on data generated during the investigations performed between 1994 and 2000.

The presence of "free product" was reported below 9 feet bgs in a boring historically completed at Site YF3 (boring YF3HP021, which was collected within the footprint of former AST 214; Figure 5). Based on data from historical investigations completed at the Site, the term “free product” appears to have been used (as was common at the time) to describe visible presence of residual or partially sorbed, or mobile but non-migrating petroleum contamination, and not to designate confirmed, measurable quantities of mobile, migrating LNAPL. This interpretation is supported by results of a quantitative analysis performed using Site analytical data to determine LNAPL saturation and recovery potential (see Section 2.3.3).

In the shallow soil interval (0 to 6 feet bgs), TPH as gasoline range organics (TPH-gasoline [TPH-g]) and as diesel range organics (TPH-diesel [TPH-d]) were historically detected at concentrations lower than both residential and non-residential soil screening criteria. TPH as motor oil range organics (TPH-motor oil [TPH-mo]) was detected at concentrations lower than both residential and non-residential soil screening criteria in all but one shallow soil sample (from 1 to 1.5 feet bgs at boring YF3HP021) (Tetra Tech, 2003). The non-residential criteria were originally developed for the Presidio of San Francisco to be protective of recreational use and a park maintenance worker and groundskeeper (Montgomery Watson, 1996). TPH-g was detected in four of seven deep soil samples (ranging from 6 to 10 feet bgs), and TPH-d and TPH-mo were detected in all deep soil samples analyzed for TPH.

One soil sample was analyzed for metals, but no concentrations exceeded ambient concentrations or relevant soil screening criteria (Tetra Tech, 2003). In addition, two soil samples were analyzed for semivolatile organic compounds (SVOC), and no PAHs were detected (Tetra Tech, 2003). One groundwater sample was analyzed for petroleum hydrocarbons, and TPH-d was the only analyte detected. No groundwater samples were analyzed for SVOCs or metals (Tetra Tech, 2003).

The CAP offered the following recommendations for additional characterization at Site YF3:

- To further evaluate petroleum hydrocarbon contamination, advance a soil boring at former location YF3HP021 where “free product” (as described above) was historically reported; if contamination is not detected, collect a groundwater sample.
- Collect soil samples at both shallow and deeper depths down to bedrock, and analyze samples for purgeable TPH (TPH-p [includes TPH-g]), extractable TPH (TPH-e [includes TPH-d and TPH-mo]), volatile organic compounds (VOC), and PAHs.
- Advance two to four additional soil borings at locations downslope of the former AST 214 location to evaluate the potential extent of “free product” and better define the extent of contamination.
- Attempt to collect groundwater samples at all locations, documenting any bedrock refusal, and analyze all groundwater samples for the same suite of analytes as for soil samples.

2.3.2 Field Activities Report

The 2013 Field Activities Report (FAR) summarized field activities and results of a March 2012 investigation implemented to further evaluate soil and groundwater contamination associated with former fuel lines and former ASTs at Site YF3 (KCH, 2013). The 2012 field investigation was conducted in accordance with an approved work plan and SAP, which stated that "the findings of soil and groundwater sampling will be used to determine if a recommendation for further action or NFA is applicable" for the Site (KCH, 2011).

TPH concentrations reported in soil at location KCHYF3-1 (Figure 5) were lower than previously reported concentrations at historical sampling location YF3HP021. Concentrations of TPH-d and TPH-mo in soil samples collected at 2 and 5 feet bgs exceeded preliminary remediation criteria developed for ecological receptors at former NAVSTA TI (Tetra Tech, 2001). One sample collected at 2 feet bgs (location KCHYF3-3; Figure 5) also exceeded the ecological preliminary remediation criterion developed for TPH-g. In addition, fluorene and phenanthrene were reported at concentrations at or exceeding respective human health soil screening levels in one soil sample collected at 5 feet bgs (location KCHYF3-3). No ecological criteria were established for PAHs (KCH, 2013). The human health soil screening criteria used in the FAR were non-residential human health risk preliminary remediation criteria developed specifically for former NAVSTA TI (Tetra Tech, 2001). The project action limit (PAL) for all TPH fractions was 100 milligrams per kilogram (mg/kg) in soil, which was lower than the ecological and human health preliminary remediation criteria; the ecological criteria for soil were 315 mg/kg for TPH-gasoline, 1,500 m/kg for TPH-diesel, and 1,850 mg/kg for TPH-motor oil (KCH, 2011). Several PAHs and TPH-g, TPH-d, and TPH-mo exceeded the PALs established in the SAP.

Groundwater sampling found that TPH-d and TPH-mo exceeded the ecological preliminary remediation criterion of 1,400 micrograms per liter (µg/L) at three sampling locations (KCHYF3-1, KCHYF3-2, and KCHYF3-4) (Figure 5). PAHs and TPH-d and TPH-mo also exceeded PALs in groundwater samples (KCH, 2013). A sheen of fuel was observed in the temporary wells installed at the Site; however, measurable "free product" in the water column was not detected (KCH, 2013).

The FAR recommended that a SLERA be developed to determine if Site YF3 could be classified as a low-risk fuel site and a good candidate for closure, or whether additional investigation and possible corrective action would need to be considered (KCH, 2013).

2.3.3 Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation

A 2015 report documented the SLERA and low-threat closure evaluation for Site YF3 (TriEco-Tt, 2015). The purpose of the report was to present the methodology and results of the SLERA (SLERA and Step 3a risk refinement) for Site YF3, and to present an analysis of the Site according to the SWRCB criteria for closure prescribed by the *Low-Threat Underground Storage Tank Closure Policy* (SWRCB, 2012) based on available data. Both the SLERA and low-threat closure analysis were conducted to facilitate site closure decisions for Site YF3.

The SLERA conducted corresponded to Steps 1 and 2 of EPA ERA guidance (EPA, 1997, 2001). Per Navy guidance (Navy, 1999, 2004), the primary objectives of the two steps of a SLERA are:

- Step 1 – identify complete exposure pathways between chemicals and selected ecological receptors.

- Step 2 – characterize risks using screening ecotoxicity estimates and conservative exposure assumptions for those chemicals for which complete pathways are identified.

Sites identified in a SLERA (Tier 1) as posing potentially unacceptable risks proceed to a BERA (Tier 2), which corresponds to Steps 3 through 7 of the EPA ERA guidance. The BERA begins by refining conservative exposure assumptions employed in the SLERA and recalculating risk estimates. This refinement step is referred to as Step 3a (Navy, 2004), and was conducted for Site YF3 as part of the SLERA (TriEco-Tt, 2015).

The SLERA for Site YF3, which included the Step 3a refinement, evaluated whether concentrations of COPECs at the Site result in unacceptable risk to ecological receptors (aquatic life, benthic invertebrates, birds, and mammals). Data used to conduct the SLERA included reported concentrations of chemicals in shallow sediment (0 to 2 feet bgs), as this is the sediment to which ecological receptors are most likely exposed, and all groundwater data acquired at Site YF3. The data were interpreted as derived from "sediment" rather than "soil" in the SLERA because the area of contamination around former AST 214 is within the intertidal area rather than terrestrial habitat; as noted in Section 2.3 several previous reports documenting investigations at Site YF3 referred to all samples collected at the Site as "soil", regardless of whether they were terrestrial soil or sediment from the intertidal area. All detected chemicals were retained as COPECs in sediment and groundwater, with the exception of TPH and VOCs in sediment, which were not evaluated for risk to birds and mammals. TPH was not evaluated for birds and mammals because no toxicity reference values (TRV) have been established and little toxicity data are available; however, PAHs, which are considered TPH constituents, were evaluated as COPECs for all ecological receptors. VOCs are generally not considered highly toxic to wildlife, rapidly volatilize when exposed to air, and do not tend to bioaccumulate. All detected compounds in groundwater were considered COPECs for aquatic life.

No chemicals were identified as causing potentially unacceptable risk to ecological receptors in the SLERA and the Step 3a risk refinement conducted with the available Site data. However, comments received on the draft SLERA and low-threat assessment report indicated there may be data gaps at Site YF3. Therefore, further characterization and evaluation of ecological risk in a BERA were recommended in the SLERA for the Site. Due to the absence of human exposure pathways, the Site poses no unacceptable risk to human health.

Site YF3 was previously designated as a petroleum site to be addressed under California UST regulations (Title 23 CCR, Article 11, Section 2720) (Tetra Tech, 2003). As part of the SLERA, the potential presence of LNAPL was evaluated at the Site based on Site history and observations made and data generated during previous field investigations. Specifically, the potential for LNAPL to be present at the Site and migrating to the San Francisco Bay was assessed based on geologic, hydrogeologic, and marine influences, TPH soil data, and LNAPL fate and transport mechanisms generally known from industry knowledge, and academic research. Based on overall conditions and detections of TPH at the Site, potential areal and vertical extents of impact appeared to be very limited. Petroleum products stored and transferred at Site YF3 were reported to be diesel fuel (Tetra Tech, 2003), as was stored in former AST 214. Diesel fuel is typically in the "middle" hydrocarbon range of petroleum products, between lighter gasoline and heavier fuel oils (for example, No. 4 or No. 6 fuel oils), having viscosity, density, and interfacial tension (surface tension at the interface of two liquids) exceeding those of gasoline but less than those of No. 4 fuel oil. These fuels may be up to 50 times less mobile in the environment than gasoline (American Petroleum Institute, 2001). Overall, several LOEs presented in the SLERA report indicated that any LNAPL present at the Site would likely be at residual LNAPL saturation levels, and any residual LNAPL present would not be mobile.

3.0 DATA GAPS INVESTIGATION METHODS AND FIELD ACTIVITIES

Sampling of both pore water and sediment was conducted as part of the 2017 intertidal area data gaps investigation at Site YF3. The 2017 intertidal area data gaps investigation was conducted in accordance with the investigation work plan, including the SAP (Battelle and Tetra Tech, 2017). SPAWARSYSCEN Pacific first generated in situ measurements using a Trident Probe and collected pore water samples for laboratory analysis. The Battelle Team and its subcontractors collected sediment samples after reviewing the preliminary (i.e., unvalidated) pore water data and using those data to refine sediment sampling locations and the analytical suites targeted for specific sediment sampling locations.

Figure 5 shows the pore water and sediment sampling locations from the 2017 intertidal area data gaps investigation. Figure 5 also shows historical sampling locations for reference. Prior to performing the Phase I Trident Probe survey and pore water sampling activities, a utility locating subcontractor, Subtronic Corporation (Subtronic) of Martinez, California, assessed the Site for the potential presence of utilities and the safety of proposed sampling locations. The utility locator delineated the path of a high-voltage electric line that passes through Site YF3 and extends through Clipper Cove to TI. As a precaution, and to ensure the markout of the high-voltage electric line was preserved, Subtronic provided the same service prior to the Phase II sediment sampling activities.

Appendix A provides a photographic log of the sampling activities performed at Site YF3 during the 2017 intertidal area data gaps investigation. Appendix B contains various field forms generated during the 2017 intertidal area data gaps investigation, including daily production reports, daily quality control reports, sampling log sheets, and laboratory chains of custody.

3.1 PHASE I — TRIDENT PROBE SURVEY AND PORE WATER SAMPLING

The Trident Probe survey and pore water sampling activities were conducted by SPAWARSYSCEN Pacific between February 4 and February 9, 2017. The Trident Probe survey and pore water sampling activities were performed in accordance with the work plan and SAP developed by the Battelle Team (Battelle and Tetra Tech, 2017).

At each of 20 locations, the Trident Probe was inserted into the sediment to evaluate temperature and conductivity data using integrated temperature and conductivity sensors (Figure 5). The results of the utility survey were used to ensure the completion of Trident Probe survey points in safe locations. Based on differences in measured temperature and conductivity, and the interpretation of the data by SPAWARSYSCEN Pacific, the in situ Trident Probe survey identified potential groundwater discharge zones. With an understanding of the temperature and conductivity data, the appropriateness of the pore water sampling locations as proposed in the work plan and SAP was confirmed.

Pore water samples were collected using the Trident Probe at the 20 sampling locations, from a depth of approximately 2 feet below sediment surface (bss). The zone from 1 to 2 feet bss represents the most likely exposure interval for intertidal organisms; therefore, a pore water sample from approximately 2 feet bss is expected to represent the highest concentration of contaminants released by groundwater in the ecologically relevant interval (with shallower samples more diluted with surface water from San Francisco Bay).

The Trident Probe was equipped with a narrow-diameter stainless steel screen with a fine sand pack, and pore water samples were extracted using a small pump and tubing. The water samples were extracted directly into laboratory-provided sample containers. In some instances, a relatively substantial amount of entrained sediment was present in the collected pore water sample. Ultimately, no pore water samples were decanted or filtered prior to laboratory analysis.

Pore water samples were analyzed for various chemical parameters (Section 4.0), including petroleum fingerprinting analysis at two discrete locations. At the two discrete locations where pore water was collected for petroleum fingerprinting analysis, both the 2-foot bss interval and a deeper interval (approximately 5 feet bss) were targeted for sample collection. Ultimately, SPAWARSYSCEN Pacific was not able to use the Trident Probe to collect the 5-foot bss pore water samples, and these samples were instead collected in conjunction with the Phase II sediment sampling activities (see Sections 3.2 and 3.3).

Pore water sampling locations were arranged generally in a grid pattern, centered around the former location of AST 214, with actual locations adjusted in the field based on field conditions (e.g., the presence of large obstructions) and the marked out location of the high-voltage electric line.

The Trident Probe survey and pore water sampling activities were conducted by walking to the sampling location and manually pushing the Trident Probe to the 2 foot bss sampling depth. Sampling was performed on a falling tide, starting at the nearshore locations and moving out to farther offshore locations as the tide ebbed and exposed the offshore locations. Groundwater flow into intertidal sediment is expected to be highest during falling tides, therefore sampling during the falling tide would result in a pore water sample most likely impacted by groundwater.

Once pore water samples were collected by SPAWARSYSCEN Pacific, the Battelle Team took custody of the samples for delivery to the analytical laboratories and subsequent analysis. All pore water samples were delivered under proper chain of custody to the analytical laboratories. General chemical analysis of pore water samples was performed by TestAmerica Laboratories, Inc. (TestAmerica) of West Sacramento, California, and petroleum fingerprinting analysis was provided by Pace Analytical Energy Services (Pace) of Pittsburgh, Pennsylvania. Pore water analytical data were properly validated by a third-party data validator, The Data Validation Group, Inc. (DVG) of Rancho Santa Margarita, California. The petroleum fingerprinting PAH analyses underwent level 2A data validation, while the rest of the fingerprinting analyses underwent data verification only. The petroleum fingerprinting interpretive report was reviewed by a subject matter expert (SME) from the Battelle Team.

3.2 PHASE II — SEDIMENT SAMPLING

Sediment core samples were collected from three depths (target depths were 0 to 1, 4.5 to 5.5, and 9 to 10 feet bss) at 16 locations at Site YF3. In addition, shallow sediment was collected from 0 to 1 foot bss at five locations for laboratory toxicity tests, at three locations from 0 to 1 foot bss (collocated with three of the five toxicity test locations) for laboratory bioaccumulation tests, and at two locations at 2 and 5 feet bss for petroleum fingerprinting analysis. Sample locations are presented on Figure 5. Certain sediment sampling locations were adjusted in the field based on Site conditions (e.g., the presence of obstructions and the high-voltage electric line) and based on a preliminary review of the Trident Probe survey and pore water analytical data. The work plan and SAP for the 2017 intertidal area data gaps investigation specifically indicated that sediment sampling locations would be adjusted based on these factors (Battelle and Tetra Tech, 2017).

Nine sediment cores were collected at low tide using a track-mounted sonic drill rig, one sediment core was collected using a hand auger, and six sediment cores were collected at high tide from a barge operating offshore and using a vibracore sampler. Offshore coring with the vibracore was performed by Dixon Marine Services, Inc. (Dixon) of Inverness, California and onshore drilling with the sonic drill rig was performed by Cascade Drilling of West Sacramento, California. Dixon also provided general drilling support, including landing craft and tender vessel support to transport equipment and supplies.

The sediment cores collected using vibracore and the sonic drill rig were collected using flexible core liner bags or hard sleeves within an outer metal core barrel. Given space limitations and general safety issues, the initial sediment core processing location was established at the Clipper Cove Marina at TI, across Clipper Cove from Site YF3, and later sediment processing was conducted in Building 96 on TI. Intact sediment cores were delivered to the core processing location by the drilling team, where the core liners were opened, the sediment cores logged, and sediment samples collected into laboratory-provided sample containers. The exception to this process was the one hand augered core location, which was processed immediately at the Site and from which samples were placed directly into laboratory-provided sample containers.

As noted above in Section 3.1, the Trident Probe was unable to collect pore water from the 5-foot bss interval at those locations where the deeper pore water sample was needed for petroleum fingerprinting analysis. At these two locations, the sonic drill rig was used to obtain the water samples. A slotted water sampling tool was advanced by the sonic drill rig to the target sampling depth, and then the outer casing of the sampler withdrawn to expose a stainless steel screen. Tubing was placed into the sampler, and water was extracted directly into laboratory-provided sample containers using a pump.

To obtain additional sediment volume for the toxicity and bioaccumulation tests at locations accessible at low tide, shovels were used to manually collect sediment from 0 to 1 foot bss directly into clean buckets. In some cases, the drill rig was used to break ground and facilitate sediment collection. Rocks were removed from the toxicity test and bioaccumulation test samples by hand and using a ¼ inch sieve in the field.

All sediment samples were delivered under proper chain of custody to the analytical laboratories. Sediment samples were analyzed for various chemical parameters, along with specialty testing, as described in Section 4.0. General chemical analysis of sediment samples was performed by TestAmerica, petroleum fingerprinting analysis was provided by Pace, toxicity and bioaccumulation testing was performed by Aquatic Bioassay Consulting Laboratories, Inc. of Ventura, California, and analysis of tissue samples originating from the bioaccumulation testing protocol were analyzed by ALS Environmental in Kelso, Washington. Sediment and tissue analytical data were properly validated by DVG. Petroleum fingerprinting, toxicity testing, and bioaccumulation testing results were not specifically validated, but were assessed by SMEs from the Battelle Team.

The sediment cores were logged by a professional geologist using the Unified Soil Classification system as outlined in the work plan (Battelle and Tetra Tech, 2017). The boring logs are presented in Appendix B. With few exceptions, the upper 1 to 5 feet of material observed at sediment sampling locations consisted of silty sandy gravel. The gravel generally consisted of sub-angular to sub-rounded sandstone that was dark grey to black in color. In some cases, the gravel contained serpentinite, chert, brick, and glass fragments. Exceptions to this profile were cores from YF323, YF324, and YF325, in which the upper material consisted of silty sand rather than gravel. Below the surficial gravel the sediments generally consisted of poorly graded fine to very fine silty or clayey sand to the bottom of the borings (approximately 10 feet bss). The sand was dark green to grey in color, generally loose, wet, and contained 10 to 20% gravel and 10 to 40% fines. In two cases (YF308 and YF321), silty sandy gravel was present below 3.5 feet to the full depth of the borings and in three other cases (YF322, YF323, and YF324) sandy clay was present in the lower half of the borings. The gravel was mostly sub-angular to sub-rounded sandstone, loose, dark greenish grey to dark brown, wet, and had 10 to 40% sand or fines content. The sandy clay was dark greenish grey to black, wet, soft, and had 10 to 20% fine sand content. As noted on the logs for 10 of 16 locations, petroleum odor was present and organic vapor was measured at concentrations up to 253 parts per million. In some cases, petroleum product was observed in the sediment cores (YF304, YF308, YF311, and YF315). In several locations, a petroleum sheen and/or odor was observed during sample collection and processing (Appendix B).

3.3 DEVIATIONS FROM THE WORK PLAN

Sampling was generally performed as described in the work plan and SAP (Battelle and Tetra Tech, 2017), with the exception of deviations described below:

- The Trident Probe could not be manually advanced into the sediment without first removing large cobbles and debris at the sediment surface and creating an opening for the probe using a stronger metal rod. This necessary process resulted in greater disturbance of the sediment and pore water in situ conditions than simply advancing the Trident Probe.

- The two deeper pore water samples (5 feet bss) collected and analyzed for petroleum fingerprinting were collected as grab samples using the sonic drill rig rather than the Trident Probe as planned, because the probe could not penetrate the cobbles and debris in the sediment to 5 feet bss.

- The petroleum fingerprinting samples originally planned to be collected at YF312 were instead collected at YF308 based on field observations; the pore water collected at YF312 by the Trident Probe was very clear and had no petroleum odor, so location YF308 was selected for analysis to target a more impacted location.

- Onshore sampling using the track-mounted sonic drill rig was planned to be conducted one week before offshore sampling by barge using vibracore, and eight cores were anticipated to be completed using each approach. However, samples were first collected by the barge and vibracore based on scheduling constraints and the tidal cycle. This was ultimately beneficial, as the vibracore could not penetrate the cobbles present at much of the Site, and the track-mounted drill rig was able to complete cores at two locations nearer to shore that the vibracore was unable to penetrate. As a result, six cores were collected by barge and vibracore, and 10 were collected by the sonic drill rig (or by hand auger).

- Despite multiple attempts to collect a core at YF322 using the vibracore sampler, full recovery was not achieved, and the deepest sample was collected from 8.5 to 9.5 feet bss, rather than 9 to 10 feet bss. Similarly, full recovery was not achieved by the sonic drill rig at YF321, resulting in a deep sample collected from 7 to 8 feet bss.

- A sediment core could not be collected at location YF314, where pore water had been collected, because surface cobbles prevented advancement of the vibracore. Therefore, the sediment sample was collected approximately 15 feet to the northwest, at a location designated YF314A.

- The sediment core from location YF315 was collected by hand augering, and the deepest depth collected was from 8 to 9 feet bss, rather than 9 to 10 feet bss.

3.4 INVESTIGATION-DERIVED WASTE MANAGEMENT

During sampling activities, non-dedicated sampling equipment (e.g., stainless steel bowls and scoops used to mix and collect sediment samples) was decontaminated between uses to minimize the potential for cross-contamination. Decontamination activities consisted of scrubbing with potable water and a nonphosphate detergent, followed by rinsing with potable water and deionized water, in accordance with the work plan and SAP (Battelle and Tetra Tech, 2017). Residual decontamination fluids were containerized, pending characterization and disposal. In addition, residual sediment material from sediment coring activities was containerized, also pending characterization and disposal. Decontamination fluids and residual sediments were containerized in separate 55-gallon drums, and temporarily staged in a secure building at TI.

Both types of investigation-derived waste were characterized as non-hazardous, and non-hazardous waste profiles were developed in consultation with the Navy. At the conclusion of the 2017 intertidal area data gaps investigation activities, the drums of waste material were removed from storage and hauled for off-site disposal. Overall waste management support and waste hauling were provided by NRC Environmental Services, Inc. of Alameda, California. Wastes were hauled from TI, under proper manifest, to Crosby & Overton, Inc. of Long Beach, California for disposal. Copies of waste profiles and manifests are included in Appendix B.

4.0 NATURE AND EXTENT OF CONTAMINATION

The following subsections describe the nature and extent of residual contamination at Site YF3, based on the results of the 2017 intertidal area data gaps investigation and supported by historical data. Summary statistics for analytical results for pore water and sediment samples are presented in Tables 1 through 6. Appendix C contains tabulated analytical data resulting from the 2017 intertidal area data gaps investigation, and Appendix D contains raw laboratory reports and third-party data validation reports.

4.1 PORE WATER ANALYTICAL RESULTS

Concentrations of residual petroleum and related PAHs and VOCs were detected in pore water samples collected by the Trident Probe in 2017 throughout Site YF3 (no monitoring wells are present at the site) (Table 6). Detected concentrations of TPH-d ranged from 38.2 to 7,790 µg/L, with a mean of 2,160 µg/L and a 95 percent upper confidence limit on the arithmetic mean (95 UCL) of 2,950 µg/L. As depicted in Figure 6, concentrations of TPH-diesel were lower in locations farthest into Clipper Cove and away from the former source area (YF301, YF305, YF309, YF313, YF317) than in areas closer former AST 214, where several results exceeded the screening criterion for discharge to the San Francisco Bay of 1,440 µg/L (Table 7). Similarly, concentrations of total high-molecular-weight (HMW) PAHs and total low molecular-weight (LMW) PAHs were greatest near the former AST, while some locations farther removed have nondetect results for both HMW and LMW PAHs (YF313, YF317, YF319, YF320) (Figure 7). None of the 2017 detected PAH concentrations exceeded the 15µg/L screening criterion (Figure 7; Table 7), however, some of the historical grab samples collected at deeper depths did have results that exceeded the screening criterion for phenanthrene, total LMW PAHs, and total PAHs (Table 5). No VOCs were detected in the 2017 samples collected by the Trident Probe.

4.2 SEDIMENT ANALYTICAL RESULTS

Summary statistics for the analytical results for sediment samples, grouped by depth, are shown in Tables 1 through 4. Concentrations of residual petroleum and related PAHs and VOCs were detected in historical samplings and 2017 sediment samples. Figure 8 depicts concentrations of TPH-d, TPH-mo, as well as the sum of the two because while TPH-d is the main concern, THP-mo can produce a chromatographic pattern similar to TPH-d, as it did in some samples; TPH-g is not depicted because it is less of a potential risk concern at Site YF3 and was detected at much lower concentrations than TPH-d and TPH-mo. In surface sediment (0-1 foot bss), the depth of exposure for benthic invertebrates, the highest detected concentration of TPH-d was 11,500 mg/kg in location YF315 (Figure 8). Detected concentrations of TPH-d in surface sediment (0-1 foot bss) ranged from 10.4 to 11,500 mg/kg, with a mean of 1,500 mg/kg and a 95 UCL of 3,390 mg/kg. As depicted in Figure 8, surface sediment concentrations of TPH-d were generally lower in locations farthest into Clipper Cove and away from the former source area (YF322, YF323, YF324, YF314A, YF325, YF326) than in areas more proximal to former AST 214, where detected concentrations were more than an order of magnitude greater. The highest detections of TPH were in deeper sediments at locations YF311, YF315, and YF3HP019 (Tables 3 and 4). Concentrations of total HMW and total LMW PAHs in surface sediment do not mimic the distribution pattern of TPH, but the EPCs for both HMW PAHs (5.07 mg/kg) and LMW PAHs (1.39 mg/kg) were relatively low (Figure 9; Table 1). Concentrations of VOCs were detected at low frequency both in the surface and subsurface depth intervals (Tables 1 through 4).

4.3 PETROLEUM FINGERPRINTING

Petroleum 'fingerprinting' involves comparing the distribution of molecules detected in environmental samples to that present in fresh or aged known petroleum products (such as gasoline, diesel fuel, or coal tar) to determine the type and/or source of environmental contamination. Chemical 'fingerprints' were evaluated to identify potential sources and the degree of weathering of hydrocarbons in four pore water samples and four sediment samples collected from two locations (YF304 and YF308) in the intertidal area at Site YF3. The complete petroleum fingerprinting report is included in Appendix D. Weathering refers to changes in the composition of a multi-component chemical mixture over time due to evaporation (volatilization), water-washing (dissolution and leaching), and biodegradation. Weathering generally decreases concentrations of lower weight, small molecules relative to larger molecules over time due to the higher volatility, solubility, and degradability of small molecules.

Each sediment and pore water sample was analyzed using gas chromatography/mass spectrometry methods to provide full scans of C8 to C40+ carbon chain length hydrocarbons by American Society of Testing and Materials (ASTM) method D573 and quantitation of parent and alkylated PAHs by modified EPA Method 8270D (Appendix D). The sediment sample fingerprints revealed the presence of: (1) severely weathered diesel fuel in each sample, apparently due to aggressive weathering in the intertidal environment of product released from site operations; (2) coal tar residuals in one sediment sample; and (3) subordinate concentrations of refined heavy fuel oil components in three samples. Hydrocarbon signatures consistent with the presence of weathered diesel fuel were also evident in the pore water samples, which could not be analyzed with the same level of detail as the sediment samples due to effects of dilution and phase partitioning. The highly weathered nature of remaining residual hydrocarbons detected in intertidal zone sediment and pore water supports the conclusion that non-aqueous phase liquid (NAPL), where present, is at residual saturation with little mobility (except if disturbed by physical forces stronger than wave action).

4.4 EVALUATION OF LIGHT NON-AQUEOUS PHASE LIQUID AT SITE YF3

To further evaluate the environmental setting with respect to the presence and disposition of LNAPL, pore water samples were collected from twenty (20) locations from a depth of 2 feet below the top of sediment, and sediment samples were collected at 16 locations from three separate depth intervals: 0 to 1 foot, 4.5 to 5.5 feet, and 9 to 10 feet below the top of sediment. Grain size analysis was also performed at each sediment sampling location to evaluate grain size distribution and assist in analytical calculations of LNAPL saturation.

Regarding observations of a sheen upon disturbance of the sediment at multiple locations and in some samples collected at the site, if LNAPL is present, it would exist under one of the following conditions:

- Below residual water saturations – residual concentrations of LNAPL (residual LNAPL) that would not enter a well and are retained in the soil by capillary pressure and interfacial tension.
- Mobile – LNAPL concentrations that are above residual saturation levels, so LNAPL could enter a monitoring well; however, while LNAPL is mobile in the area adjacent to the well, it is not necessarily migrating. In addition, mobile LNAPL may or may not be recoverable and is a pore-scale adjustment of saturations within the footprint of the LNAPL.
- Migrating – An expanding footprint, typically occurring only when a source and LNAPL under hydraulic head influences are present (Interstate Technology Research Council [ITRC] 2009). Migrating LNAPL is a macro-scale advancement of contamination extent.

4.4.1 Previous Evaluation and Results

An initial evaluation of LNAPL at Site YF3 was conducted and reported in the SLERA (Tetra Tech, 2015). The evaluation was performed using multiple lines of evidence including: (1) geologic, hydrogeologic, and marine influences; (2) historic TPH soil data; and (3) LNAPL fate and transport mechanisms generally known from industry knowledge and academic research.

The analysis reported in the SLERA utilized historic TPH data from 29 soil and sediment samples. The specific carbon ranges for each analysis were assumed not to overlap and are likely to include C5-C12 for TPH-g, C13-C22 for TPH-d, and C23-C44 for TPH-mo. (Note: these ranges vary on a laboratory-specific basis, and therefore are presented for general reference.) The greater frequency and magnitude of detections of middle and heavy range fractions (TPH-d and TPH-mo) is consistent with diesel fuel as the source material, which tends to have more middle- to heavy-range carbon fraction components and smaller amounts of lighter range fractions.

The analysis of the historic TPH data was conducted using the following methodology: (1) calculating the summation of the three hydrocarbon fractions to derive a total TPH value, (2) calculating the percent LNAPL saturation from the total TPH data, (3) calculating the residual water saturation of the soils based on limited soil observations, and (4) comparing the percent LNAPL saturation to the residual water saturation (considered a conservative approach, as water will drain more easily than LNAPL).

The calculated residual LNAPL saturation values were equal to or greater than the calculated water residual saturation value of 6.5 percent for only two of the historical samples at YF3 (Table 8). The 6.5 percent calculated value is considered a conservative estimate for the following reasons:

- Water is the dominant wetting fluid in soils, and flows more easily within the pore spaces; thus, more water than residual LNAPL will drain (mobilize) from soils (American Petroleum Institute [API], 2001).

- LNAPL is more viscous, thus less mobile, than water.

- At low percentage LNAPL saturation (i.e. <10% percent), residual LNAPL will not be able to displace water (>90 percent) to be mobile.

- Intrusion of salt water in the intertidal area adds a third fluid competing for the soil pore space, which would further decrease the mobility of residual LNAPL (API, 2001).

The residual water saturation value of 6.5 percent for Site YF3 was calculated assuming sandy soil. Based on a comparison with the three highest calculated LNAPL percentages, only two samples had values equal to or greater than the calculated 6.5 percent saturation value: YF3HP019 (6.5- to 7.0-foot depth) at 9.7 percent and YF3HP021 (7.0- to 7.5-foot depth) at 6.5 percent. Therefore, calculated values for only two of 29 samples indicate potential LNAPL mobility as related to the hypothetical monitoring well.

The percent LNAPL to residual water saturation analysis concluded that the actual potential for LNAPL migration and moreover, recoverability, are negligible given the shallow groundwater gradient, long-term flushing of mobile LNAPL from tidal fluctuations in the intertidal area, lack of significant quantity of residual LNAPL, salt water intrusion mixing, and absence of a LNAPL hydraulic head.

4.4.2 Current TPH Sediment Data Analysis

The analysis of the recent sampling results was performed in a similar fashion to the analysis performed in the 2015 SLERA, with few variations.

To evaluate whether the site TPH concentrations are of LNAPL and the “state” of the LNAPL, the TPH soil concentrations were converted to a percentage of LNAPL saturation via calculations from industry standard LNAPL evaluation methodologies (API, 2004; ASTM, 2006; ITRC, 2012).

In essence, the calculations are a summation of the three TPH fractions in each sample converted to LNAPL saturation percentage using soil/sediment bulk density, fuel oil density, and the percent of soil pore space. The calculated LNAPL saturation percentage can then be compared to likely residual water saturation values to evaluate whether LNAPL could be observed in a monitoring well if one were to be installed in the immediate area of contamination. No permanent monitoring wells exist at Site YF3 that would allow confirmation of these values, given the compromising intertidal environment.

The following formula was used to calculate LNAPL saturation percentage from the TPH data:

$$s_n = \frac{\rho_b \cdot TPH}{\rho_n n(10^6)}$$

where:

s_n = LNAPL saturation (unitless)

ρ_b = dry soil bulk density (grams per cubic centimeter [g/cm^3])

TPH = total petroleum hydrocarbons (mg/kg)

ρ_n = NAPL density (g/cm^3)

n = porosity (unitless)

The formula used to calculate residual water saturation is:

$$\theta_{fc} = \emptyset \left(\frac{|\psi_{ae}|}{340} \right)^{1/b}$$

where:

θ_{fc} = Water content corresponding to a pressure head of 340 centimeters (cm)

ϕ = Porosity (unitless)

ψ_{ae} = Air-entry tension (cm)

b = Exponent describing the moisture-characteristic curve

When summing the TPH fractions, their respective detection limits were used as conservative surrogates for nondetect values.

The following parameters used in the calculations were based on literature values for fuel oil and the most permeable/conductive soil types observed at Site YF3:

- A fuel oil density of 0.87 was used and is conservatively assumed to be No. 2 fuel oil, which has a carbon range similar to TPH-d (API, 2004)
- Soil bulk density (including total soil porosity) was adjusted based on the soil type and included the following values (API, 2004)

- 1.59 g/cm^3 (sands and gravelly sands, calculated based on estimated rock density of 2.8 g/cm^3 and a porosity of 0.433)
- 1.63 g/cm^3 (gravel and sandy gravel, calculated based on estimated rock density of 2.8 g/cm^3 and a porosity of 0.417)
- 1.65 g/cm^3 (loamy sands, calculated based on estimated rock density of 2.8 g/cm^3 and a porosity of 0.410)
- 1.85 g/cm^3 (loamy sands, calculated based on estimated rock density of 2.8 g/cm^3 and a porosity of 0.340)

To evaluate potential for observation of mobile LNAPL in a hypothetical monitoring well, or for residual LNAPL to remain sorbed to soil or sediment at below residual water saturations, a likely residual water saturation for Site YF3 was calculated and then compared to the calculated LNAPL percentages. Using data and methods presented in Dingman (2002), a residual water saturation (sometimes referred to as field capacity in soil science manuals) was calculated. This model is for presumed behavior in a well, if one were to be installed, based on the uniformly applied assumptions described above.

Resultant water residual saturations were calculated to be the following:

- 6.50% for sands and gravelly sands
- 6.65% for sands with <10% fines
- 6.80% for sand with >10% fines

The percent calculated values are considered a conservative estimate for the following reasons:

- Water is the dominant wetting fluid in soils, and flows more easily within the pore spaces; thus, more water than residual LNAPL will drain (mobilize) from soils (API, 2001).
- LNAPL is more viscous, thus less mobile, than water.
- At low percentage saturation (6.5 percent), residual LNAPL will not be able to displace water (93.5 percent) to be mobile.
- Intrusion of salt water in the intertidal area adds a third fluid competing for the soil pore space, which would further decrease the mobility of residual LNAPL (API, 2001).

The results of the analysis are summarized on Table 9. As shown in Table 9 and described below, percent LNAPL saturation values were equal to or greater than the calculated water residual saturation values for only one sample at Site YF3 (YF311 at 9 to 10 feet). As there are variations in porosity and soil bulk density presented in many published literature reports, a sensitivity analysis was performed. The sensitivity evaluation (more conservative than the SLERA evaluation) identified the following samples that showed percent LNAPL saturations exceeding >50% of the residual water saturation: YF311 at 4.5 to 5.5 feet, YF315 at each sampling depth, and YF327 from 4.5 to 5.5 feet. These locations could represent conditions between residual and potentially mobile. Two of the three (YF311 and YF315) sampling locations are proximal to a former AST and fuel line close to shore and sampling locations more distal/seaward indicate that potentially mobile LNAPL is restricted to nearshore areas.

4.4.3 Residual LNAPL Fate and Transport Mechanisms

Based on the results of the former soil LNAPL evaluation and the current sediment LNAPL evaluation there appear to be limited locations that exceed the residual water saturation (Tables 8 and 9). These isolated intervals do not appear to be a part of a wide-spread or expanding LNAPL distribution.

Knowledge and technical guidance on delineation and remediation of LNAPL has changed substantially over time within the environmental industry (API, 2004). In general, the following are current remediation industry understandings of residual LNAPL fate and transport mechanisms within shallow subsurface environments, including within intertidal locations, drawn from several sources (API, 2004; ITRC, 2009, 2012):

- LNAPL typically is mobile only if an active, ongoing LNAPL source (LNAPL head) exists.

- As LNAPL is depleted by dissolution and degradation, two physiochemical transformations significant to its mobility occur: The fraction of pore space occupied by LNAPL decreases, and LNAPL flow paths become smaller and more tortuous, reducing its mobility.

- As depletion by dissolution and degradation occurs, LNAPL breaks into isolated ganglia that are discontinuous and immobile (residual LNAPL). Being composed of lower solubility, higher viscosity source compounds, residual LNAPL becomes increasingly less mobile.

- Residual LNAPL is a non-wetting fluid that attempts to displace the wetting fluid (i.e., water) from the interiors of pore spaces of soil grains.

- The "competition" for pore space between groundwater and residual LNAPL decreases the overall mobility and transmissivity of subsurface fluids and limits hydraulic recovery of LNAPL.

- Capillary pressure within pore spaces results from density and viscosity differentials between competing liquids, which significantly influences distribution and potential mobility of residual LNAPL in groundwater.

- Over extended periods, the most soluble compounds degrade, and the residual LNAPL (a mixture of lower solubility, higher viscosity source compounds) becomes less mobile and less soluble. Therefore, where residual LNAPL comes into contact with groundwater, typically only trace to low percent concentrations of organic compounds partition out of the residual LNAPL, and these concentrations are commonly attenuated via natural processes.

- Thickness of LNAPL measured in a monitoring well is an apparent thickness controlled by well effects, and is an over-approximation of the actual mass of LNAPL in the adjacent environment (API, 2001). Thus, measured thickness in a well is not an effective or reliable indicator of potential and need for recovery of LNAPL.

Overall, the analysis included the following summary of site observations that is generally consistent with the previous calculations and analyses. Several LOEs indicate limited potential for mobile LNAPL to occur at the site and even less probability that any residual LNAPL present would be migrating. Visual and olfactory observations made during the field activities do indicate evidence of petroleum in the soil/sediment when it is disturbed, but not under undisturbed or in situ conditions. No observations of surface water or sediment sheens were noted prior to disturbance of the site to collect samples. Also, the highly weathered nature (highly weathered diesel, coal tar, and heavy fuel oils) of remaining residual hydrocarbons detected in intertidal zone sediment and pore water supports the conclusion that NAPL, where present, is at residual saturation with little mobility (except if disturbed by physical forces stronger than wave action). The following is a list of observed and evaluated factors in a comparison of potential and minimal potential for an LNAPL site condition.

LNAPL Site Condition	**Observed Factors Indicating Potential for Site Condition**	**Evaluated Factors Indicating *Minimal* Potential for Site Condition**
LNAPL Presence	• A hydrocarbon sheen was observed in some samples and disturbed sediment	• Typically, the carbon ranges for the analyses do overlap, and the summation of the TPH ranges is likely an overestimation of the data used to calculate LNAPL saturation percentages (historic data). • Observation of a sheen is likely due to disturbance of the soil matrix artificially during drilling of the temporary wells or soil sampling allowing observation of the sheen. The action of sampling with direct-push technologies inherently disturbs soils at the tip and along the barrel of the tool. Disturbing soils with immobile residual LNAPL can change the capillary balance within pore spaces and release very small quantities of LNAPL or dissolved hydrocarbon compounds that are capable of producing a visible sheen on the groundwater. • The maximum calculated LNAPL saturations are isolated and typically within the range of likely residual water saturations and does not exceed the range's higher end value.

LNAPL Site Condition	Observed Factors Indicating Potential for Site Condition	Evaluated Factors Indicating *Minimal* Potential for Site Condition
Residual LNAPL Migration	• No indications observed	• LNAPL sources have been removed, and a LNAPL hydraulic head is no longer present to "push" LNAPL through the soil. • High pore volume flushing in the intertidal area has removed the mobile fraction of LNAPL as the remaining LNAPL has been fingerprinted and determined to be highly weathered diesel, coal tar, and fuel oils. • Low water table gradient indicates a low potential for groundwater flow-induced residual LNAPL migration. • Tidal fluctuating water table elevations continuously temporally affect pore fluid saturations that inhibit residual LNAPL mobility.

4.5 CHARACTERIZATION SUMMARY

The previous subsections presented the pore water and sediment analytical results, petroleum fingerprinting findings, and the evaluation of potential LNAPL mobility. A summary of the primary characterization conclusions that result from this evaluation is provided below.

Concentrations of residual petroleum and related PAHs and VOCs have been detected in pore water and sediment collected throughout Site YF3 (Tables 1 through 6). The highest detections of TPH were in deeper (4.5 to 10 ft bss) sediments at locations YF311, YF315, YF3HP019, and YF3HP021 (Tables 3 and 4, Appendix C; Figures 12 and 13). Figures 14 and 15 present an overlay of the pore water and sediment results for TPH-d and TPH-mo, respectively. Concentrations of TPH-d in both sediment and pore water are lower in locations farthest into Clipper Cove and landward closest to the island, with the greatest concentrations occurring within a narrower area parallel with the shoreline (Figures 6, 8, 10, and 11). Similarly, total HMW PAHs and total LMW PAHs were not detected in pore water farther removed from the area of the greatest concentrations of TPH (Figure 7). However, that pattern was not observed in concentrations of PAHs in sediment (Figure 9). VOCs were detected at low concentrations and less frequently than TPH and PAHs; VOCs were not detected in any 2017 pore water samples.

The petroleum fingerprinting results indicated there has been aggressive weathering in the intertidal environment of petroleum compounds released from site operations. The highly weathered nature of remaining residual hydrocarbons detected in intertidal zone sediment and pore water supports the conclusion that NAPL, where present, is at residual saturation with little mobility (except if disturbed by physical forces stronger than wave action). Visual and olfactory observations made during the field activities do indicate evidence of petroleum in the soil/sediment when it is disturbed, but not under undisturbed or in situ conditions. An analysis of the TPH data and other LOEs indicated limited potentially mobile LNAPL at the Site and a low likelihood any residual LNAPL present would be migrating.

5.0 BASELINE ECOLOGICAL RISK ASSESSMENT PROBLEM FORMULATION

Primary goals of the problem formulation phase of this BERA are to refine the ecological CSM and to identify: the chemicals known to exist at the site; chemical fate and transport mechanisms that might occur at the site; mechanisms of ecotoxicity associated with chemicals, and likely categories of receptors that could be affected; potentially complete exposure pathways (source to receptors) that might exist at the site; and the assessment and measurement endpoints to focus the assessment. These items are discussed in more detail in the following subsections.

5.1 ECOLOGICAL CONCEPTUAL SITE MODEL

The ecological CSM (illustrated on Figure 3) indicates exposure pathways to be evaluated in the BERA, and provides other key information such as chemical sources, release and transport mechanisms, and relative importance of exposure pathways to specific receptor groups. The ecological CSM includes the following components:

- Stressors
- Exposure pathways
- Fate and transport
- Assessment and measurement endpoints

The following sections briefly describe these components of the ecological CSM.

5.1.1 Stressors

A stressor can be defined as any factor that causes adverse ecological impacts at the site. Only chemical stressors were evaluated in the SLERA. The chemical stressors (COPEC) at the Site are PAHs, TPH-p, TPH-e, and VOCs. No chemicals were identified as posing unacceptable risk to ecological receptors in the SLERA. The suspected sources of contamination are the former AST and fuel lines; however, no spill was reported and there is no ongoing source of contamination at the site. There has been no sheen or petroleum odor observed during site walks in 2013, 2016, and 2017, but there was visible sheen and odor in several sample locations when the nearshore sediment was disturbed by hand digging or drilling, as noted in Section 3.2.

5.1.2 Fate and Transport

Physical fate processes of potential concern include transfer from groundwater to surface water and movement of contaminated sediment as suspended sediment particles in surface water. Chemicals may also be transported in animal tissues (biotic transport). For example, ingested by, and/or in the tissues of, mobile receptors such as migrating birds may be carried off site and deposited in other locations in the form of feces or corpses.

Although exposure is a simple concept, accurately describing fate and transport of chemicals from one or more sources to a site of toxic action in living organisms can be complicated. In general, for exposure to occur, a chemical must move from the environmental matrix across several biological membranes, and concentrate in a tissue to the extent that its toxic action is exerted. A chemical that can move from the environmental matrix to the tissue of a receptor is considered bioavailable. The BERA focuses on chemicals in the environment that are bioavailable or potentially bioavailable to receptors.

5.1.3 Exposure Pathways and Exposure Routes

A chemical must be able to travel from the source to the representative receptor and must be taken up by the receptor through one or more exposure routes for an exposure pathway to be considered complete. Complete exposure pathways present the greatest potential risk of adverse effects for receptors of concern at a site. Potential exposure pathways that may result in ecological receptor contact with chemicals include direct contact or ingestion of sediment, surface water, pore water, groundwater, air, and food chain transfer. Potential exposure pathways for ecological receptors at Site YF3 are shown on Figure 3.

Sediment and pore water are considered the most important exposure media at Site YF3, particularly for benthic invertebrates. Chemicals in sediment may be ingested or transferred via the food chain to ecological receptors. Pore water is an important pathway for contaminant uptake to benthic invertebrates and can exhibit a strong relationship with tissue concentrations and toxicity. In addition, chemicals in pore water (originating from groundwater) may enter Clipper Cove and the San Francisco Bay, where aquatic receptors could be exposed.

Exposure routes, or the point of entry of a chemical into a receptor, may include dermal contact and ingestion of contaminated sediment and food for animals. Independent of direct effects on benthic invertebrates, chemicals in invertebrate tissues may be transferred to higher trophic-level receptors. Such food chain transfer and associated bioaccumulation may result in unacceptably high doses of chemicals to higher-trophic-level consumers. Therefore, risk to receptors at each trophic level was addressed separately to account for specificity in exposure parameters.

Ingestion of chemicals in sediment and prey is considered the predominant exposure pathway for birds. Birds may ingest sediment directly while they feed and groom (Beyer, Connor, and Gerould, 1994). Sediment on or in the bodies of prey may also be consumed with the prey. For example, a bird feeding on benthic invertebrates may ingest sediment incidentally while probing for and eating the invertebrates. A food chain modeling approach was used to evaluate potential effects of ingestion of chemicals by representative birds. The dose assessment for higher-trophic-level receptors such as birds assumes that ingestion of contaminated prey and sediment is the dominant exposure route and that the contributions of other exposure routes are negligible (Suter, 1993). Biota-sediment accumulation factors (BSAF) were used to estimate the chemical burden in prey tissues for each of the chemicals based on Site sediment concentrations. BSAFs describe bioaccumulation in terms of the ratio between the lipid-normalized concentration of a substance in an organism caused by chemical uptake and the organic carbon-normalized concentration in the surrounding environment. Two types of invertebrate tissue (clam and worm) were obtained via the bioaccumulation tests implemented during the data gaps field investigation, and analyzed for PAHs to calculate Site-specific BSAFs for PAHs. The BSAFs to be used in the risk characterization are described in Section 6.1.3.

5.1.4 Assessment and Measurement Endpoints

Assessment endpoints are "explicit expressions of the actual environmental values (e.g., ecological resources) that are to be protected" (EPA, 1997). Assessment endpoints are environmental characteristics that, if significantly impaired, would indicate a need for action by risk managers. Various definitions of valuable ecological resources include those without which ecosystem function would be impaired, those that provide critical resources, such as habitat or fisheries, and those perceived by humans as being valuable, such as endangered species and other issues addressed by legislation. Useful assessment endpoints define both the valuable ecological entities at a site and a characteristic of the entity to protect, such as reproductive success or production per unit area.

Assessment endpoints for Site YF3 were selected to focus on those ecological receptors most likely to be affected given the fate and transport mechanisms of the chemicals, ecotoxicological properties of the chemicals, habitat at the Site, and potential for occurring at the Site.

The following assessment endpoints were used to evaluate potential ecological risks at Site YF3:

- **Protection and maintenance of aquatic life.** Aquatic life forms the basis of the food web at the Site and plays an important role in nutrient cycling. Adverse effects on aquatic life (organisms that live in the water column) could reduce the quantity and quality of food available to higher-trophic-level organisms. Therefore, the health of aquatic life is considered an ecological value to be protected at Site YF3.

- **Protection and maintenance of benthic invertebrates.** Benthic invertebrates (living in or on the bottom sediments of a water body) play an important role in nutrient cycling and in the food web at the Site. Adverse effects on invertebrates could reduce the quantity and quality of food available to higher-trophic-level organisms. Therefore, the health of invertebrates is considered an ecological value to be protected at Site YF3.

- **Protection and maintenance of invertivorous birds typical to the area.** Secondary avian consumers provide a food source for upper-trophic-level consumers, such as avian and mammalian carnivores, and influence the abundance and diversity of invertebrates. Adverse effects on these secondary consumers could reduce the amount of food available to higher-trophic-level organisms. Therefore, maintenance of secondary avian consumers is considered an ecological value to be protected at Site YF3.

- **Protection and maintenance of carnivorous birds typical to the area.** Carnivorous birds are important tertiary consumers at the Site and are susceptible to the effects of bioaccumulative chemicals. Adverse effects on these birds would be undesirable because the loss of predation could impair lower trophic levels. Therefore, maintenance of carnivorous birds is considered an ecological value to be protected at Site YF3.

Although protection and maintenance of omnivorous mammals (represented by the raccoon) was included as an assessment endpoint in the SLERA (TriEco-Tt, 2015), it was excluded from the BERA because raccoons are not likely to forage at Site YF3, and there are no other mammals that are likely to forage for macroinvertebrates or plants in the intertidal area of the Site (Battelle and Tetra Tech, 2017).

Measurement endpoints related to assessment endpoints were identified because assessment endpoints are usually not amenable to direct measurement. EPA defines a measurement endpoint as "*a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint and is a measure of biological effects (such as mortality, reproduction, or growth)*" (EPA, 1997). Measurement endpoints more closely reflect technical considerations in the risk assessment process; that is, measurement endpoints are focused on both direct measures of ecological effects such as toxicity tests and indirect measures such as food chain modeling that allow for an evaluation of risk to representative receptors. Measurement endpoints can include measures of exposure or effect, and are frequently numerical expressions of observations. Measurement endpoints are often expressed as statistical or arithmetic summaries of observations, and can include measures both of effect and of exposure. Each measurement endpoint correlates directly with one of the defined assessment endpoints and is based on available scientific literature on mechanisms of toxicity.

Each measurement endpoint for Site YF3 is based on the species or communities present or potentially present at the Site, adequacy of information regarding the specific endpoint based on literature research, and ability of the endpoint to suggest information about the related assessment endpoint. Measurement endpoints for the Site YF3 BERA are identified below.

The following measurement endpoints were used in evaluating potential ecological effects on the assessment endpoints identified for Site YF3:

- **For aquatic life, comparison of the concentrations of chemicals in pore water with toxicity-based screening levels for the protection of aquatic life.** Chemical concentrations in pore water were compared to screening criteria for the protection of aquatic life selected for use at former NAVSTA TI (Table 7). Potential risk to aquatic receptors are indicated where concentrations of COPECs in site pore water exceed the screening criteria.

- **For benthic invertebrates, the following three endpoints were selected:**

  - **Calculation of the chronic potency ratio with the equilibrium partitioning sediment benchmark (ESB) approach (EPA, 2003, 2010) using pore water alkylated PAH and benzene, toluene, ethylbenzene, and xylene (BTEX) data.** Potential risk to benthic invertebrates is indicated at sample locations where the chronic potency ratio (sum of PAH concentration for each chemical/chronic potency divisor) exceeds 1 (see Section 6.2.2.1).
  - **Calculation of the acute and chronic potency ratios with the ESB approach (EPA, 2003, 2010) using sediment alkylated PAH, BTEX, and total organic carbon (TOC) data.** Potential risk to benthic invertebrates is indicated at sample locations where the acute potency ratio (sum of PAH concentration for each chemical/acute potency divisor) or chronic potency ratio (sum of PAH concentration for each chemical/chronic potency divisor) exceeds 1 (see Section 6.2.2.2).
  - **Measurement of survival in *Neanthes arenaceodentata* and *Eohaustorius estuarius* in 10-day bioassays.** Potential risk to benthic invertebrates is indicated if significant adverse effects are observed in 10-day bioassays (see Section 6.2.2.3). Note: This measurement endpoint referenced growth in the work plan, but the laboratory has found the growth endpoint for *N. arenaceodentata* to be too variable to provide useable data and there is no growth endpoint for *E. estuarius*.

- **For birds, comparison of FCM-estimated doses, based on shallow sediment (0 to 1 foot bss) 95 UCL concentrations and site-specific invertebrate BSAFs, with TRVs.** Potential adverse effects were evaluated by calculating high TRV-based hazard quotients (HQs) (estimated daily dose/high TRV) and low TRV-based HQs (estimated daily dose/low TRV). Potential risk to birds is indicated where low TRV-based HQs are greater than 1. Potentially significant risk is indicated where high TRV-based HQs are greater than 1 (see Section 6.2.3).

The following receptors are considered to be representative of the various feeding guilds associated with Site YF3:

- The spotted sandpiper (*Actitis macularius*) was used as a surrogate to represent invertivorous birds; the spotted sandpiper is representative of birds that may forage along the shoreline for benthic invertebrates at Site YF3.

- The great blue heron (*Ardea herodias*) was used as a surrogate to represent carnivorous birds; the great blue heron is considered representative of birds that may forage for fish and macroinvertebrates, such as mollusks and crustaceans, along the shoreline of Site YF3.

5.2 DATA SET AND SELECTION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN

Historical and recently collected data from the 2017 data gaps investigation have been compiled and considered in the BERA. Summary statistics were calculated for each detected analyte in sediment and pore water, as shown in Tables 1 through 6, and described below. Selection of COPECs in sediment and pore water, along with additional data from toxicity and bioaccumulation testing, considered in the BERA are also described below. Appendix C presents the analytical data for Site YF3.

In addition to statistical analyses, a 3-dimensional data visualization and analysis (3DVA) was performed to evaluate contaminant distributions in relation to current conditions and historical site features, and to better understand their relationship in a spatially accurate context. The 3DVA was conducted by compiling the analytical data, verifying site feature and data coordinates in a geographic information system, and developing visualizations through data interpolation using C Tech Development Corporation's Earth Volumetric Studio software. The 3DVA was based on analytical pore water and sediment data, sediment grain size date, topographic and bathymetric data, and historical site features. Figures 10 through 17 were generated from the 3DVA.

5.2.1 Statistical Analyses

EPCs for sediment and pore water were calculated using ProUCL 5.1.002 software (EPA, 2015a). The data sets were processed as follows prior to calculating EPCs:

- Sediment was separated into 0 to 1 foot, 1 to 5.5 foot, 5.5 foot to 10 foot, and 1 to 10 foot depth ranges.

- Pore water was calculated for two data sets –all pore water samples collected in 2017 and all samples, including 2017 pore water and historical groundwater.

- Results for naphthalene for samples with more than one method with a naphthalene results were selected as follows:

    - If both sample results were detected, the “best” method was selected. “Best” method means that the SVOC method or PAH method was selected over the VOC method in these cases.
    - If only one sample result was detected, that result was selected.
    - If both sample results were nondetects (also referred to as censored results in Tables 1 through 6), the lower nondetect result was selected.

- Nondetect results for which the detection limit exceeded the highest detected value for each chemical of COPEC in each data set were removed. These results are also referred to as high censored results.

- For summed COPECs (Total LMW PAH, Total HMW PAH, and Total PAH), the values for nondetected results which had a summed value of zero were adjusted to the highest detection limit for a constituent of the group.

For COPECs with fewer than 6 detected values in a data set, the maximum value was selected as the EPC. Distribution testing was not conducted for these COPECs, and the mean and 95 UCL were not calculated.

For COPECs with 6 or more detected values in a data set, the 95 UCL recommended by ProUCL 5.1.002 was selected as the EPC. The 95 UCLs calculated by ProUCL are based on the distribution testing of detected data only. For data sets where ProUCL recommended more than one 95 UCL, the 95 UCL from the appropriate distribution (normal, gamma, lognormal, or nonparametric) was selected. When more than one distribution is identified as appropriate for the data set, ProUCL identifies the distribution as most appropriate in the order normal, gamma, lognormal, nonparametric from most preferred to least preferred. In certain cases, the 95 UCL recommended by ProUCL was not selected as the EPC; these cases are as follows:

- When the recommended UCL for a data set matched a given distribution by only one of the two distribution tests that ProUCL uses, the UCL based on that distribution was not selected. Instead, the first distribution for which both tests passed was used as a basis for selecting the 95 UCL.

- When the recommended UCL was a type that ProUCL recommends not be used when there were outliers, an outlier test was performed using ProUCL. If outliers were identified in the data set, the most appropriate UCL method without an outlier restriction was selected.

Tables 1 through 6 list the EPCs for sediment and pore water. The tables include the distribution, detection frequency, number of high censored results, range of detection limits (for censored data), range of detected data, location of the maximum detected concentration (and depth for sediment), the mean of the data set, the 95 UCL, the method used to select the EPC, and the EPC.

For data sets with nondetected values, the Kaplan-Meier (KM) product limit estimator was used to estimate the mean. The KM approach employs a well-studied method that has been used in the field of causal analysis for more than 50 years (Kaplan and Meier, 1958). For more details on the KM method, see the ProUCL Technical Guide (EPA, 2015a).

5.2.2 Sediment

Data for shallow sediment (0 to 1 foot bgs) and Trident Probe-collected shallow pore water (2 feet bss) were used to conduct the BERA, as these data are most representative of concentrations to which ecological receptors are most likely to be exposed; deeper sediments will not be accessible to ecological receptors via direct contact or food chain transfer. All chemicals detected were considered COPECs.

VOCs were evaluated as COPECs for benthic invertebrates, which may have direct contact with VOCs in sediment and sediment pore water, and for aquatic life, which may be exposed if VOCs enter the water column. However, because VOCs are generally not considered highly toxic to wildlife, rapidly partition to dissolved phase in large water bodies and volatilize when exposed to air, and do not tend to bioaccumulate, they were not evaluated for birds.

TPH constituents were considered COPECs for invertebrates and aquatic life, as some invertebrate toxicity studies and screening levels are available for consideration. However, no TRVs have been established for birds, and little toxicity data are available, so TPH constituents were not evaluated as COPECs for birds; however, PAHs, which are considered TPH constituents, and for which vertebrate toxicity studies have been conducted, were evaluated as COPECs for all ecological receptors.

The following totals were calculated to evaluate cumulative effects of chemical groups. All other analytes were evaluated individually:

- Total LMW PAHs, which are PAHs with molecular weights less than 200 atomic units, were calculated by summing detected concentrations of acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, phenanthrene, 1-methylnaphthalene, 2-methylnaphthalene, 1-methylphenanthrene, biphenyl, 2,6-dimethylnaphthalene, and 2,3,5-trimethylnaphthalene.

- Total HMW PAHs, which are PAHs with molecular weights exceeding 200 atomic units, were calculated by summing detected concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, pyrene, and perylene.

Historical sampling locations SCI-YB-07 (analyzed for metals and TPH; only detections were low concentrations of metals), 031YF3001 (analyzed for SVOCs and TPH; no detections), and 031YF30012 (analyzed for SVOCs and TPH; no detections) are within the overall Site YF3 boundary, but are not impacted by petroleum contamination and are at the elevation of North Gate Road, with no connection to the intertidal area (Figure 4). Therefore, these locations were not included in statistical analyses for the BERA, but are included in Appendix C.

5.2.3 Pore Water

Pore water samples collected during the 2017 intertidal data gaps investigation at 2 feet bss using the Trident Probe (no monitoring wells are present at the site) were analyzed for PAHs, TPH, and VOCs; all detected chemicals were considered COPECs for aquatic life. Pore water concentrations of alkylated PAHs and BTEX were also used in the ESB evaluation to assess risk to benthic invertebrates.

5.2.4 Additional Information Considered in the BERA

In addition to analytical chemistry results, whole sediment toxicity and sediment bioaccumulation test data were considered in the BERA. Site-collected sediment was shipped to a laboratory for the testing described below.

5.2.4.1 Toxicity Tests

Direct toxic effects on two species, a marine polycheate worm (*N. arenaceodentata*) and a marine amphipod (*E. estuarius*), was measured in 10-day direct exposure tests conducted with site-collected surface sediments from 5 locations (YF304, YF308, YF311, YF312, and YF315) using methods outlined in EPA (1994) and EPA and U.S. Army Corps of Engineers (USACE, 1998).

5.2.4.2 Sediment Bioaccumulation Tests

Bioaccumulation of PAHs in invertebrate tissue was assessed in laboratory tests conducted with site-collected sediment from 3 locations (YF308, YF311, and YF312) and two types of invertebrates: clams (*Macoma nasuta*) and polychaetes (*Nereis virens*). These results were used to calculate site-specific BSAFs used to estimate the potential for bioconcentration in invertebrates and exposure to birds via invertebrate prey (Burkhard, 2009).

6.0 ANALYSIS OF EXPOSURE AND EFFECTS

The analysis of risk focuses on estimates of two separate processes: (1) exposure of an organism to a chemical; and (2) adverse effect of the chemical to that organism. The CSM described in Section 5.1 provides the framework for the analysis, which focuses on the relationship between exposure and effect for a given pathway. The evaluation of exposure (Section 6.1) and effects (Section 6.2) leads logically into the risk characterization in Section 7.0.

6.1 EVALUATION OF EXPOSURE

This section evaluates exposure to ecological receptors of concern for Site YF3: aquatic life, benthic invertebrates, and birds.

6.1.1 Exposure to Aquatic Life

The evaluation of risk to aquatic life focused on the health of aquatic life in the water column. Aquatic receptors such as phytoplankton and zooplankton may be exposed via direct contact to chemicals in pore water, assuming they migrate to the water column. 95 UCL concentrations of COPECs in Trident Probe-collected pore water at Site YF3 were compared to surface water quality criteria for the protection of aquatic life to identify chemicals that pose a potentially unacceptable risk to aquatic life.

The pore water screening criteria for detected chemicals in pore water at Site YF3 are the same as those established for groundwater at former NAVSTA TI (Table 7) that have been compiled through comprehensive reviews of published regulatory standards, goals, and guidance, and other sources (Department of Toxic Substances Control [DTSC], 2006; Water Board, 1995, 2011, 2013a, 2013b; Tetra Tech, 2001; EPA, 2000, 2013).

HQs for aquatic life were calculated by dividing the 95 UCL pore water concentrations by screening values for COPECs. Chemicals with HQs exceeding 1 are considered COPECs for aquatic life. The magnitude of each HQ is considered along with other lines of evidence in Section 7.1 to make a risk management recommendation for aquatic life at the Site.

6.1.2 Exposure to Benthic Invertebrates

The evaluation of risk to benthic invertebrates focused on the effects of chemicals in sediment and pore water on survival. Several lines of evidence are available for evaluating risk to invertebrates at Site YF3:

- Sediment ESB evaluation;
- Pore water ESB evaluation;

- Toxicity tests using *N. arenaceodentata* (worm) and *E. estuarius* (amphipod); and
- Sediment bioaccumulation tests using *M. nasuta* (clam) and *N. virens* (worm).

Each line of evidence is discussed below.

6.1.2.1 Sediment and Pore Water Equilibrium Partitioning Sediment Benchmark Evaluations

Standard analysis of PAHs in sediment provides results for 16 PAHs. However, alkylated PAH compounds, which are not typically measured, are known to contribute substantially to sediment toxicity to benthic invertebrates (Di Toro and McGrath, 2000; EPA, 2003). Sediment and pore water samples were analyzed for the full suite of PAHs, including alkylated PAHs, and TOC, following EPA recommended methods (EPA, 2003, 2010, 2015b). The alkylated PAH results, in concert with BTEX results, were used to assess the potential toxicity of the sediments using a sediment equilibrium partition approach (Tables 10 through 13). The equilibrium partitioning approach assumes that chemicals in sediment are in equilibrium with pore water (or interstitial water); the pore water concentration is considered to represent the exposure pathway to receptors.

TOC can have a substantial influence on chemical equilibrium between sediment and pore water. PAHs have a strong affinity for organic carbon: the higher the percent organic carbon, the lower the PAH concentration in the pore water. This approach assumes that PAH mixtures, including alkylated PAHs, produce a similar toxicity response (narcosis), and therefore are additive. This enables an evaluation of the potential effect of all PAHs in a sediment sample on benthic receptors.

Potential toxicity of PAHs in sediment was evaluated using the protocol developed by EPA to assess the impacts of crude oil following the Deepwater Horizon spill in the Gulf of Mexico in 2010 (EPA, 2010). This protocol, which was modified from EPA (2003), assumes that the effects of PAHs are additive across all PAHs, including alkylated PAHs. Acute and chronic "potency divisors" are used in the calculations to represent the amount of an individual PAH that may cause an adverse effect. The ratio of the concentration in the sediment to the potency divisor is a toxicity unit. The sum of the toxicity units for all detected PAHs and BTEX represents the potential toxicity (see EPA, 2010, 2015b for potency divisors). A sum greater than 1.0 indicates potential chronic or acute toxicity. Potential toxicity associated with PAHs at Site YF3 sediment were estimated as follows:

1. Normalize the PAH concentration (micrograms per kilogram [µg/kg]) by dividing it by the fraction organic carbon (kilogram [kg] organic carbon/kg)
2. Divide the normalized PAH concentration (µg/kg organic carbon) by the potency divisor (µg/kg organic carbon) to derive a potency ratio.
3. Sum the potency ratios for all PAHs. The benchmark is exceeded when the sum exceeds 1.0.

Surface water chronic exposure standards are used in EPA's equilibrium partitioning approach for the evaluation of sediment, and these values are appropriate for evaluating exposure and effects to benthic invertebrates exposed to pore water. The potential toxicity of PAHs in sediment pore water was evaluated using a similar protocol as was used for sediment, also developed by EPA (2010):

1. Divide the PAH concentration (µg/L) by the chronic or acute potency divisor (µg/L) to derive the corresponding potency ratio.
2. Sum the potency ratios for all PAHs. The benchmark is exceeded when the sum exceeds 1.0.

6.1.2.2 *Toxicity Tests*

Direct toxic effects of surface sediments on two species, a marine polycheate worm (*N. arenaceodentata*) and a marine amphipod (*E. estuarius*), was measured in 10-day direct exposure tests using methods outlined in EPA (1994) and EPA and USACE (1998). Site-collected sediment from 5 locations (YF304, YF308, YF311, YF312, and YF315) was shipped to the laboratory for testing. Potential risk to benthic invertebrates is indicated if significant adverse effects are observed during these tests. These test species were used because they are known to be sensitive “benchmark” species and they are commonly used in toxicity tests. Benchmark organisms are those which have been designated by the EPA and USACE as appropriately sensitive and useful for determining biological data applicable to the real world. Test protocols with benchmark organisms are published, reproducible, and standardized (EPA and USACE, 1998; Dredged Material Management Office, 2001). In addition, the selected species are known to live in habitat similar to that of the intertidal zone at Site YF3. Laboratory reports for the 10-day toxicity tests are presented in Appendix D.

In addition to the 10-day toxicity tests, bioaccumulation of PAHs in invertebrate tissue was assessed in laboratory tests conducted with site-collected sediment from three locations (YF308, YF311, and YF312) and two types of invertebrates: clams (*M. nasuta*) and polychaetes (*N. virens*). Per EPA and USACE (1998), two species (rather than a single species) were used to assess potential bioaccumulation of HMW and LMW PAHs using a 28-day bioaccumulation test. Both of the selected species are recommended benchmark species (EPA and USACE, 1998). The invertebrate tissue concentrations and paired sediment concentrations were used to estimate the potential for bioconcentration in invertebrates and to calculate site-specific BSAFs that were used to estimate exposure to birds via invertebrate prey (Burkhard, 2009). The survival of the test organisms was considered in the evaluation of potential risk to benthic invertebrates.

6.1.3 Exposure to Birds

The evaluation of risk to birds for Site YF3 will be based on the selected assessment and measurement endpoints identified in Section 5.1.4. FCMs are used to assess exposure of birds to COPECs in their diet (for example, evaluation of exposure through the ingestion pathway).

FCMs are conceptually simple, focus on ecological receptors of concern, and are a reliable method of integrating ecological and COPEC information into the risk assessment process, especially for COPECs that tend to bioconcentrate or bioaccumulate (Pascoe, Blanchet, and Linder, 1996).

HMW PAHs and total LMW PAHs were identified as COPECs in the SLERA for birds. Therefore, the BERA risk evaluation for effects on birds focused on these chemicals. The following sections describe the model used to estimate ingested doses of total HMW and total LWM PAHs for birds using Site-specific chemical concentrations in sediment, Site-specific invertebrate BSAFs (spotted sandpiper and great blue heron), and estimated concentrations in fish (great blue heron only).

6.1.3.1 Quantitative Evaluation of Risk Using a FCM

FCMs for birds assume that exposure to COPECs is primarily through ingestion of contaminated sediment and prey. Exposure models estimate the mass of a COPEC internalized daily by a receptor per kilogram of body weight per day (milligrams per kilogram per day [mg/kg-day]) (the daily COPEC dosage). Estimates of exposure are generally based on knowledge of the spatial and temporal distribution of both COPECs and receptors, and on specific natural and life history characteristics that influence exposure to COPECs. Average ingested doses will be calculated for representative receptors using average values for exposure parameters such as body weight and ingestion rate. 95 UCL concentrations from sediment samples collected within 0 to 1 foot bss were used in the FCMs to estimate doses to birds. The parameters used in estimating total daily doses to the selected representative birds are provided in Tables 14 and 15.

Daily doses were estimated for each COPEC and representative receptor for total HMW and LMW PAHs. Avian TRVs have not been established by the Navy (1998); however, there are alternate toxicity data available that were used in the FCMs to estimate potential adverse biological effects on the receptor, as discussed in the TRV section below. The risk to each representative species was characterized using an HQ approach based on this comparison.

Total exposure from ingestion for each receptor of concern was calculated as the sum of the dietary exposure estimates. The following generic equation was adapted for each representative receptor:

$$\text{Dose}_{\text{total}} = \frac{([\text{IR}_{\text{prey}} \times \text{C}_{\text{prey}}] + [\text{IR}_{\text{soil}} \times \text{C}_{\text{soil}}]) \times \text{SUF}}{\text{BW}}$$

where:

$\text{Dose}_{\text{total}}$ = Estimated dose from ingestion (mg/kg-day)

IR_{prey} = Ingestion rate of prey (kg/day)

C_{prey} = Concentration in dry weight of COPEC in prey (mg/kg)

IR_{soil} = Ingestion rate of sediment (kg/day)
C_{soil} = 95 UCL concentration in dry weight of COPEC in sediment (mg/kg)
SUF = Site use factor (unitless)
BW = Adult mean body weight (kg)

Exposure will be assessed within the context of the following linear food chains to evaluate potential ecological effects on secondary consumer birds and mammals:

Sediment → Benthic Invertebrates → Spotted Sandpiper

Sediment → Fish and Benthic Invertebrates → Great Blue Heron

BSAFs and Tissue Concentrations

BSAFs were used to predict the amount of a chemical likely to be accumulated from sediment at equilibrium. Site-specific invertebrate BSAFs were used to estimate invertebrate concentrations of chemicals that were detected in both invertebrate tissue and the collocated sediment samples used in laboratory-conducted bioaccumulation tests, as described below. Literature-based fish BSAFs were obtained from the EPA Mid-Continent Ecology Division BSAF Database (EPA, 2008).

Invertebrate BSAFs were calculated for two types of invertebrates: clams (*M. nasuta*) and polychaetes (*N. virens*). Per EPA and USACE (1998), two species (rather than a single species) were used to assess potential bioaccumulation of PAHs using a 28-day bioaccumulation test (Section 6.1.2.2). Both of the selected species are recommended benchmark species (EPA and USACE, 1998).

Invertebrate tissue was obtained via 28-day bioaccumulation tests using Site sediment, and analyzed for PAHs, percent moisture, and percent lipids. BSAFs were calculated using the following formula using results from invertebrate tissue and collocated sediment (Burkhard, 2009):

$$BSAF = \frac{Ctissue \div fl}{Csed \div foc}$$

where:

BSAF = Biota-sediment accumulation factor (lipid-normalized wet weight concentration in tissue /organic carbon-normalized concentration in surface sediment) [unitless]
C_{sed} = Concentration of COPEC in sediment (mg/kg dry weight)
C_{tissue} = Concentration of COPEC in tissue (mg/kg wet weight)
f_l = the lipid content (fraction) in the wet tissue of the organism

f_{oc} = the total organic carbon content (fraction) of the dry sediment

BSAFs were calculated for each invertebrate species and sample, and for the combined species dataset, and are presented in Table 16. The average BSAF was used in the FCM.

The BSAFs used to estimate sediment-based bioaccumulation for COPECs in fish at Site YF3 were selected from available BSAFs for whole body marine fish using the EPA Mid-Continent Ecology Division BSAF Database (EPA, 2008). From this database, BSAFs were available for cunner (*Tautogolabrus adspersus*) and mummichog (*Fundulus heteroclitus*) fish for individual PAHs. As only BSAFs for individual PAHs were available, the most conservative (highest) individual PAH BSAF was used as a surrogate for the PAH groups in the Site YF3 evaluation. The values for HMW PAHs range from 0.000077 to 0.052; the highest HMW PAH BSAF is for perylene. The values for LMW PAHs range from 0.0041 to 0.53; the highest LMW PAH BSAF is for fluorene.

6.1.3.2 TRVs

TRVs represent a critical exposure level from a toxicological study and are supported by a data set of toxicological exposures and effects. A low TRV is a conservative value consistent with a chronic no observed adverse effects level. A high TRV represents an effects level for a COPEC where the toxic endpoint was ecologically relevant. Total HMW and LMW PAHs were considered COPECs for birds by default in the SLERA (TriEco-Tt, 2015) since there were no avian TRVs available. Therefore, data from other toxicological studies have been used in the BERA FCM as alternative TRVs, as indicated in the below table, to determine whether concentrations of PAHs pose risk to birds at Site YF3.

Study	Dose to Test Species (mg/kg-day)	Effect Type	Selected as Alternative TRV?
Bond et al., 1981	**0.10**	No effects	Yes, **low TRV**
Trust et al., 1994 (as cited in EPA, 2007)	2.0	No effects	No
Trust et al., 1994 (as cited in EPA, 2007)	**20.0**	Lowest observed adverse effect level	Yes, **high TRV**
Penn and Snyder, 1988	40.0	Increase in arterio-sclerotic plaques	No

6.1.3.3 HQ Approach

Site-specific daily ingestion dose estimates were compared to the selected alternative high and low TRVs to estimate the potential adverse biological effects on each receptor at Site YF3. The risk to representative receptors was characterized based on this comparison, conducted consistent with EPA's HQ methodology (EPA, 1986), as follows:

$$HQ = \frac{Dose}{TRV} = \frac{(mg/kg - day)}{(mg/kg - day)}$$

where:

Dose = COPEC-, receptor-, and Site-specific daily dose estimate (mg/kg-day dry weight)

TRV = COPEC- and receptor-specific TRV (mg/kg-day dry weight)

Because of differences in the degree of conservatism in TRVs selected for various COPECs and receptors, it is Navy policy that resulting HQ values should not be compared or added together between COPECs or receptors; instead, they should be considered individually (Navy, 1999).

By calculating both an $HQ_{(dose/high\ TRV)}$ and $HQ_{(dose/low\ TRV)}$, a risk manager can more definitively assess risk to the typical individual in the overall population.

The interpretation of each HQ is summarized as follows:

HQ Interpretation

HQ = Dose/TRV	Low TRV	High TRV	Between Low and High TRV
Ingested Dose	$HQ_{(dose/low\ TRV)} < 1$ indicates little or no risk to average receptor	$HQ_{(dose/high\ TRV)} > 1$ indicates potential significant risk to average receptor	$HQ_{(dose/high\ TRV)} < 1$ and $HQ_{(dose/low\ TRV)} > 1$ indicates potential for risk to average receptor. However, the magnitude of the potential risk is uncertain.

6.2 EVALUATION OF EFFECTS

This section evaluates effects to ecological receptors using the analyses introduced in Section 5.0.

6.2.1 Effects on Aquatic Life

All of the EPCs for PAHs were more than an order of magnitude lower than that screening criteria for protection of aquatic life (Table 7), with HQs ranging from 0.0005 to 0.043. The concentrations of TPH-d and TPH-mo did exceed their respective screening criteria with HQs of 2.1 and 1.8, respectively.

6.2.2 Effects on Benthic Invertebrates

The following sections describe the results of the sediment benchmark evaluations for sediment and pore water, and the results of the sediment toxicity tests performed to evaluate the potential for toxic effects on benthic invertebrates.

6.2.2.1 Sediment Equilibrium Partitioning Sediment Benchmark Evaluation Results

The expanded PAH analysis presented in this section factored in the presence of alkylated PAHs and TOC on the bioavailability of PAHs in sediment. When the sum of the potency ratios for each PAH compound in a sample exceeds 1.0, the sample may cause toxicity.

The potency ratios of alkylated PAHs indicate potential for PAH-mediated toxicity. Twenty-five percent of the sediment samples exhibited an acute potency ratio greater than 1.0, and fifty percent of the samples had a chronic potency ratio greater than 1.0 (Table 10; Figure 18). The majority of the samples exhibiting elevated toxicity potential were collected along the shoreline, particularly in the center and eastern portions of the sampling area, which corresponds to the former location of AST 214. The highest potency ratios for both acute and chronic toxicity are from samples YF311SEDA and YF315SEDA. These results indicate that PAHs may have measurable acute and chronic effects on benthic invertebrates in the upper (nearshore) intertidal zone. Calculations of potency ratios for sediment are provided in Table 11 and results summarized below.

Looking at individual PAH contributions to the potency ratios, the largest contributions derive from C1-, C2-, C3-, and C4-naphthalenes, phenanthrenes, and fluorenes.

Summary of PAH Acute and Chronic Potency Ratios in Sediment Samples

Location ID	Sum of Acute Potency Ratio	Sum of Chronic Potency Ratio
YF304SEDA	0.57	1.2
YF307SEDA	0.58	1.2
YF308SEDA	1.5	3.0
YF310SEDA	0.54	1.1
YF311SEDA	4.6	9.7
YF312SEDA	0.14	0.29
YF314ASEDA	0.09	0.19
YF315SEDA	4.5	9.4
YF319SEDA	0.44	0.9
YF321SEDA	0.61	1.3
YF322SEDA	0.45	0.93
YF323SEDA	0.13	0.26
YF324SEDA	0.16	0.33
YF325SEDA	0.15	0.31

Summary of PAH Acute and Chronic Potency Ratios in Sediment Samples

Location ID	Sum of Acute Potency Ratio	Sum of Chronic Potency Ratio
YF326SEDA	0.29	0.59
YF327SEDA	2.1	4.4
Maximum Potency Ratio	4.6	9.7
Minimum Potency Ratio	0.09	0.19
Percentage of Samples with Potency Ratio above 1.0	25	50
Total Number of Samples	16	16

Notes:

1.2	- Red highlight indicates sum of acute or chronic potency ratio is greater than 1.0.

References:

EPA. 2003. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks for the Protection of Benthic Organisms: PAH Mixtures. Office of Research and Development. EPA-600-R-02-013.

EPA. 2010. Explanation of PAH benchmark calculations using EPA PAH ESB approach, originally developed by Dave Mount, ORD Duluth. June 23. November. Office of Research and Development. EPA-600-R-02-013.

EPA. 2015b. Correction of Deepwater Horizon Acute Screening Benchmarks for Aquatic Life. February 15.Available online at: https://archive.epa.gov/bpspill/web/pdf/acute-benchmark-error-explanation-02-18-15.pdf.

6.2.2.2 Pore Water Equilibrium Partitioning Sediment Benchmark Evaluation Results

Pore water was extracted from 20 sediment samples with two duplicates and analyzed for the same chemicals as the sediment samples; results are summarized in Table 12 and shown below and in Figure 19.

PAHs in sediment pore water, including alkylated PAHs, were evaluated further using EPA protocols (EPA 2010) as described above. Results indicate that PAH concentrations in pore water may cause toxicity to benthic invertebrates. PAHs in about 19 percent of all pore water samples analyzed are expected to cause acute toxicity; 33 percent of samples exhibited PAH concentrations capable of causing chronic toxicity. However, both of the maximum concentrations are duplicate samples that had potency ratios substantially higher than the original sample. Duplicate samples were collected from the same location, approximately 24 hours after the original sample was collected, indicating that the potency of PAHs may vary over time and over small distances; however, within approximately 24 hours, the sediment had to be disturbed twice to use the Trident Probe to collect the paired samples, which may account for the substantially higher PAHs measured on the second day in the duplicate samples. The spatial distribution of the samples with potency ratios exceeding 1.0 was similar to the sediment samples, with sample locations concentrated in the nearshore area close to the former location of the diesel tank, however, the extent appears to be over a smaller area. Calculations of potency ratios for pore water are provided in Table 13 and results summarized below.

Looking at individual PAH contributions to the potency ratios, the largest contributions derive from C2-, C3-, and C4-chrysene and C4-phenanthrenes.

PAH Potency Ratios in Sediment Pore Water

Sampling Location	Acute Potency Ratio Result	Chronic Potency Ratio Result
YF301PW	0.27	0.55
YF302PW	0.22	0.45
YF303PW	0.80	1.7
YF304PW	0.22	0.44
YF305PW	0.17	0.36
YF306PW	0.31	0.62
YF307PW	0.27	0.55
YF308PW	2.5	5.1
YF309PW	0.24	0.49
YF310PW	1.6	3.3
YF311PW	0.63	1.3
YF312PW	0.18	0.37
YF312PWDUP	2.8	5.9
YF313PW	0.17	0.35
YF314PW	--*	--*
YF315PW	0.18	0.36
YF316PW	0.53	1.1
YF316PWDUP	2.6	5.3
YF317PW	0.18	0.36
YF318PW	0.36	0.72
YF319PW	0.21	0.42
YF320PW	0.21	0.42
Maximum Potency Ratio	2.8	5.9
Minimum Potency Ratio	0.17	0.35
Percentage of Potency Ratio Results Greater than 1.0	19	33
Total Number of Samples	21	21

Notes:

1.2 - Red highlight indicates sum of acute or chronic potency ratio is greater than 1.0.

Chronic Potency Ratio - Water Quality Criteria Toxic Unit for PAH, based on the FCV

*= Lab reported that a heavy emulsion in the sample was not able to be separated and the sample was subsequently lost.

References:

EPA. 2003. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks for the Protection of Benthic Organisms: PAH Mixtures. Office of Research and Development. EPA-600-R-02-013.

EPA. 2010. Explanation of PAH benchmark calculations using EPA PAH ESB approach, originally developed by Dave Mount, ORD Duluth. June 23. November. Office of Research and Development. EPA-600-R-02-013.

EPA. 2015b. Correction of Deepwater Horizon Acute Screening Benchmarks for Aquatic Life. February 15.Available online at: https://archive.epa.gov/bpspill/web/pdf/acute-benchmark-error-explanation-02-18-15.pdf.

6.2.2.3 Toxicity Test Results

No toxicity was observed in any of the 10-day *E. estuarius* and *N. arenaceodentata* sediment toxicity tests (Appendix D). Survival in individual test replicates ranged from 90 to 100 percent. In addition, there was no toxicity observed in the 28-day bioaccumulation tests. There was 100 percent survival of *M. nasuta* in all three bioaccumulation test samples, and between 96 and 98 percent survival of *N. virens* (Appendix D).

6.2.3 Effects on Birds

All HQs were less than 1.0, with the exception of the total HMW PAHs low TRV-based HQ of 2.2 for the spotted sandpiper (Table 17). The estimated daily dose to the spotted sandpiper of total HMW PAHs was 0.22 mg/kg/day, which exceeded the no effect level (NOEL)-based low TRV of 0.1 mg/kg/day, but was nearly two orders of magnitude lower than the lowest observed adverse effects-level (LOAEL)-based TRV. The estimated dose for the sandpiper assumes it forages solely at Site YF3 based on its small foraging range, though it is unlikely any birds forage exclusively at Site YF3. All HQs were less than 1.0 for the great blue heron (Table 18). Results of the FCM, for which the estimated daily dose to the sandpiper slightly exceeded the NOEL and was more than an order of magnitude lower than the LOAEL, suggest that concentrations of PAHs do not pose an unacceptable risk to birds at Site YF3.

7.0 RISK CHARACTERIZATION

Risk characterization focuses on the causal relationship between exposure and effects. The characterization incorporates what is known about potential exposure pathways to representative receptors at Site YF3 with evidence of chemical concentrations in sediment, pore water, and biota. Risk characterization consists of risk estimation (presented in Section 6.0) and risk description (presented below).

Risk estimation is a quantitative process that compares exposure concentrations and estimated doses with effect levels appropriate to the receptor and medium being evaluated. The resulting HQs are numerical estimates of risk, given the assumptions stated elsewhere in the BERA. Risk estimates are calculated for individual chemicals and receptors and do not take into account multiple exposures or indirect effects. More than one risk estimate was calculated for some receptors based on different exposure or effect assumptions. For example, risk estimates were calculated for benthic invertebrates using both sediment and pore water-based PAH potency ratios, and sediment toxicity tests. The particular assumptions associated with each type of risk estimate were explained in Section 6.0, where each line of evidence was introduced.

Risk description is a more qualitative evaluation of the numerical risk estimates and other factors that influence the realization of risk for each receptor. In the risk description, chemicals of greatest concern, or “risk drivers,” are identified based on the magnitude of the risk estimate and the confidence level in the exposure assessment. Similarly, chemicals of little to no concern may be identified based on the weight of evidence.

7.1 RISK TO AQUATIC LIFE

Based on the EPCs for PAHs in pore water all being well below the screening criterion of 15 µg/L, PAHs do not pose unacceptable risk to aquatic life exposed to pore water in the sediment or the water column.

The HQs for TPH-d (2.1) and TPH-mo (1.8) indicate a potential for risk, albeit relatively low since these are in situ sediment pore water concentrations being compared to levels that may result in toxicity in the water column. Approximately half of the TPH-d and TPH-mo results exceeded the screening criterion of 1,400 µg/L. The pore water samples are likely to overestimate the in situ concentrations to which benthic and aquatic organisms would actually be exposed because the sediment was disturbed with a rod to create a hole that the Trident Probe could then be advanced into, rather than directly advancing the probe itself into the sediment. It was noted while sampling that there is no visible sheen nor petroleum odor at the surface to indicate the presence of residual petroleum contamination, but substantial disturbance of the sediment did result in a sheen and odor, suggesting that the mechanical disturbance of the sediment mobilizes chemicals that are otherwise less mobile under in situ conditions. As described in Section 4.4 and shown in Tables 8 and 9, the data suggest that residual LNAPL has limited potential for mobility at Site YF3 and resulting low potential for migration to the point of exposure for invertebrates and fish that live in the water column. Given that the HQs for aquatic life are relatively low based on screening criteria for the bay and an overestimate of Clipper Cove water column concentrations, and negligible LNAPL mobility prevents risk to off-site receptors, TPH and PAHs in pore water at Site YF3 do not pose an unacceptable risk to aquatic life in the water column.

7.2 RISK TO BENTHIC INVERTEBRATES

The majority of the samples exhibiting elevated toxicity potential based on the sediment PAH concentrations were collected along the shoreline, particularly near the location of former AST 214. The highest potency ratios for both acute and chronic toxicity were from sediment samples YF311SEDA and YF315SEDA. The spatial distribution of the samples with pore water-based potency ratios exceeding 1.0 was similar to the sediment samples, with sample locations concentrated in the nearshore area close to the former location of former AST 214 (YF308, YF312, and YF316); however, the extent appears to be over a smaller area. These results indicate that PAHs may have measurable acute and chronic effects on benthic invertebrates in the upper (nearshore) intertidal zone.

No significant mortality was observed in the 10-day *E. estuarius* and *N. arenaceodentata* whole sediment toxicity tests or the 28-day *M. nasuta* and *N. virens* bioaccumulation tests. The 10-day toxicity tests were conducted with sediment collected from locations YF304, YF308, YF311, YF312, and YF315, which includes most of the locations indicated above as having the highest potency ratios based on sediment and pore water PAH concentrations. It also includes YF315, where the highest detected concentration of TPH-d in surface sediment (0-1 foot bss) (11,500 mg/kg) was detected. The BSAFs for HMW and LMW PAHs calculated from the 28-day test results from locations YF308, YF311, and YF312 were low, indicating that uptake in the food chain is likely limited.

The 95 UCLs for total LMW PAHs, total HMW PAHs, and total PAHs in the shallow 0-1 foot bss depth interval to which benthic invertebrates are exposed are shown below, alongside San Francisco Bay ambient values for sediments (San Francisco Estuary Institute, 2015) and toxicity benchmarks (effects range-low [ER-L] and effects range-median [ER-M]) developed from chemical and biological effects data from a wide variety of studies on invertebrates in marine and estuarine sediments (Long and Morgan, 1991; Long, et al., 1995; Long, Field, and MacDonald, 1998). The ER-L and ER-M represent the lower 10th and 50th percentile of the effects data, respectively. As shown below, few values exceed the ER-L and ER-M.

PAH Total	95 UCL for Surface Sediment (0-1 foot bss) (mg/kg)	ER-L (mg/kg)	Frequency of Exceedance of ER-L	ER-M (mg/kg)	Frequency of Exceedance of ER-M	San Francisco Bay Ambient Concentration (mg/kg)
Total HMW PAHs	5.07	1.7	4/16 (25%)	9.6	1/16 (6.25%)	3.87
Total LMW PAHs	1.39	0.552	6/16 (37.5%)	3.16	1/16 (6.25%)	0.574
Total PAHs	4.52	4.022	3/16 (18.75%)	44.79	0/16 (0%)	4.54

Although concentrations of PAHs in sediment and pore water resulted in some chronic and acute potency ratios greater than 1, the areal extent of the potency ratios greater than 1 is limited (Figures 18 and 19). Similarly, few PAH results exceeded the ER-L, and only one sample exceeded the ER-M. Furthermore, concentrations of total PAHs are consistent with ambient levels in San Francisco Bay sediments. There was no significant mortality in the toxicity tests conducted with indicator species and samples collected near the former AST, including those that had calculated potency ratios greater than 1, and bioaccumulation in the laboratory bioaccumulation tests indicates limited uptake and retention in invertebrate tissue. Therefore, Site YF3 is not considered to pose unacceptable risk to benthic invertebrates.

7.3 RISK TO BIRDS

As noted in Section 6.2.3, and shown in Tables 17 and 18, the only HQ greater than 1.0 was based on the estimated dose of total HMW PAHs to the spotted sandpiper (0.22 mg/kg/day) compared to the low TRV, which is not an effect level, but a level at which no effects were observed. The dose was nearly two full orders of magnitude lower than the LOAEL-based high TRV. The estimated dose for the sandpiper assumes it forages solely at Site YF3 based on its small foraging range, though it is unlikely any birds forage exclusively at Site YF3.

Other literature studies of weathered hydrocarbon toxicity in birds suggest that concentrations of HMW PAHs do not pose an unacceptable risk to birds at Site YF3. Furthermore, as described in Section 4.3, hydrocarbons at Site YF3 have been subject to extreme weathering. Although there is limited data on weathered petroleum impacts on birds via ingestion, and no TRVs for TPH, studies have suggested that weathered petroleum has little to no toxic effect on birds at concentrations in the diet that are similar to or greater the levels of TPH in sediment at Site YF3 (Stubblefield, 1995a, 1995b). Therefore, Site YF3 does not pose unacceptable risk to birds.

8.0 UNCERTAINTY ANALYSIS

Uncertainty is an unavoidable element of the ERA process and plays an important role in risk-based decision-making. Therefore, it is incorporated explicitly into the risk characterization process. Identifying known sources of uncertainty is a critical component of ecological risk assessment; by evaluating uncertainties, potential errors are made more explicit in the risk management process (Suter, 1993).

Three sources of uncertainty in ERAs are described in Suter (1993):

- Mistakes in execution of the assessment (errors such as incorrect measurements, data recording errors, and computational errors)
- Imperfect knowledge of factors that could be known (ignorance about some aspect of the ecosystem that may be relevant, such as assumptions used in dose models, practical constraints on ability to measure everything, and lack of knowledge of toxicological effects of all COPECs on all species)
- Inherent randomness of the world (stochasticity in physical or biological processes that may affect assumptions or actual risk such as variation in population parameters or rainfall patterns)

The ERA process is based on a number of assumptions and extrapolations to evaluate potential risk to ecological receptors. The BERA attempts to reduce the uncertainty inherent in the SLERA by incorporating more site-specific data and additional lives of evidence. However, despite the effort to replace conservative default assumptions of the SLERA with more realistic site-specific measures of exposure, numerous sources of uncertainty remain in the BERA. Conclusions of the ERA must be interpreted within the confines of existing uncertainty. Many sources of uncertainty are inherent in the risk assessment process and cannot be resolved. The following subsections discuss major uncertainties and assumptions associated with this BERA for Site YF3.

8.1 ANALYTICAL DATA

Data acquired at the site were used to evaluate conditions of the whole site; all concentrations measured are therefore reasonable estimates of concentrations that may occur at the site (with associated error). Complete analytical data available for Site YF3 are in Appendix C. Uncertainty in the sample dataset includes use of the existing dataset to represent the entire area of the site regardless of spatial and temporal variation.

Data used to characterize risk to benthic invertebrates and birds at Site YF3 included results from surface (0 to 1 foot bgs) sediment samples; pore water data collected using the Trident Probe from 2 feet bss were used to assess risk to aquatic life. As demonstrated by the two pore water duplicate samples at locations YF312 and YF316, environmental sampling has an inherent variability.

Any given sample is likely to exhibit higher or lower concentrations than an average ‘true’ value for the area, and the act of sampling requires disturbing in situ conditions. Selection of a particular sampling location or time may result in an underestimate or overestimate of risk, and the magnitude of this over- or underestimate is unknown. At Site YF3, due to cobbles and debris, the sediment had to be disturbed more than anticipated to advance the Trident Probe; therefore, the pore water samples, particularly the duplicate samples, are likely to overestimate in situ pore water concentrations. Sediment concentrations maybe overestimated or underestimated.

The TPH analyses were performed without silica gel cleanup. It is possible that non-petroleum-related biogenic organic compounds (BOC) could have been be present in samples and impacted the TPH results since no cleanup was conducted. The Water Board recommends analysis at a background location to evaluate the potential presence of BOCs (Water Board, 2016), particularly at heavily vegetated sites. Site YF3, particularly the intertidal area of impacted by petroleum, is not highly vegetated, and not expected to have a substantial proportion of BOCs in any reported TPH concentrations. However, it is possible that TPH concentrations are somewhat overestimated because no silica gel cleanup was conducted.

8.2 IDENTIFICATION OF COPECS

The suite of chemicals assessed in the BERA was selected based on known or suspected releases identified from previous investigations and historical sources. As a result, the data gaps investigation (Tetra Tech and Battelle, 2017) and BERA focused on PAHs, TPH, and BTEX. The BERA did not attempt to identify and quantify all potential chemical stressors at Site YF3. Furthermore, there are components of petroleum mixtures that have not been well studied and at this time cannot be compared to any regulatory threshold for the protection of ecological receptors (Water Board, 2016).

8.3 USE OF SCREENING VALUES AND ESB EVALUATION

Screening Values

The comparison of site-specific pore water concentrations to generic surface water screening criteria for the protection of aquatic life was used as an indicator of potential adverse effects. Bulk chemistry results from the site likely overestimate the bioavailable fraction. In addition, screening values were not developed using site-specific taxa. Use of these screening values may result in an overestimate or underestimate of risk.

Existing data are not sufficient to develop applicable TRVs for TPH. Potential effects of TPH on ecological receptors may vary based on composition of the mixture, length of time it has been in contact with the environment, biodegradation, and other site-specific physicochemical parameters (Efroymson, Sample, and Peterson, 2004). In addition, TPH results may vary by analytical method and their correlation with toxicity data will vary as well (Efroymson, Sample, and Peterson, 2004). Site-specific information regarding relative environmental health and potential for ecological exposure may be more helpful in assessing risk than comparisons to site concentrations to generic screening levels alone. The Washington State Department of Ecology (2017) has identified freshwater sediment cleanup screening levels for TPH-diesel (510 mg/kg) and TPH-residual (4,400 mg/kg), which are not necessarily appropriate for an intertidal site, as no marine values have been identified. There are few toxicological studies available to determine appropriate screening and cleanup levels.

ESB Evaluations

Concentrations used for the calculation of potency ratios assumed an estimated value of ½ the laboratory detection limit for nondetect results. Use of estimates of nondetect results may result in a slight overestimate or underestimate of the actual site concentrations and resulting risk.

The equilibrium partitioning sediment benchmark approach has numerous underlying assumptions used to derive values used in the calculations, such as the acute and chronic ratios and values. These assumptions are discussed at length in *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks for the Protection of Benthic Organisms: PAH Mixtures* (EPA, 2003). The assumptions do not reflect site-specific data and the site potency ratios may be greater or less than those reported above. In addition, analytes included in the calculations are limited to PAHs and BTEX, and do not include petroleum metabolites or account for other chemical stressors. The ESBs do not consider the potential additive, antagonistic, or synergistic effects of other chemicals in relation to the PAH mixtures. Therefore, the use of the ESB calculation may overestimate or underestimate risk to benthic invertebrates.

8.4 INTERPRETATION OF BIOASSAY RESULTS

The 10-day toxicity tests were conducted with site-collected sediment and two species obtained from commercial suppliers: a marine polycheate worm (*N. arenaceodentata*) and a marine amphipod (*E. estuarius*). These test species were used because they are known to be sensitive "benchmark" species commonly used in toxicity tests and designated by the EPA and USACE as appropriately sensitive and useful for generating data applicable to the real world. The selected species are also known to live in habitat similar to that of the intertidal zone at Site YF3. However, there is likely a potential for a wide array of species to be present in the sediment at Site YF3. These test organisms used as a surrogate for the native populations may not have the same level of sensitivity to the chemicals present in the sediments; the use of these test organisms as a surrogate for native populations could result in either an overestimation or underestimation of actual toxicity to native populations.

The toxicity tests represent an acute exposure to the sediment, and may nor may not represent the potential for effects from a chronic exposure. In addition, sublethal effects were not measured; the laboratory has found the growth endpoint for *N. arenaceodentata* to be too variable to provide useable data. As a result, the actual potential toxic effects of sediments at Site YF3 may be underestimated.

8.5 UNCERTAINTIES ASSOCIATED WITH THE FOOD CHAIN MODEL

The following discussion highlights uncertainties associated with the FCM used to evaluate risk to birds in Section 6.1.3. The overall effect of these uncertainties and conservative assumptions cannot be quantitatively calculated without site-specific information.

8.5.1 Receptor Exposure Parameters

The range of reported body weights and ingestion rates for wildlife varies significantly in the literature (Beyer et al., 1994; Nagy, 2001, EPA, 1993, 1999; Pascoe et al., 1996; Dunning, 1993). The values used in the FCM may not reflect the true attributes of these receptors. The risk may be either overestimated or underestimated as a result, depending on the difference between actual values and literature values.

The diet of the spotted sandpiper was assumed to consist of 100 percent benthic invertebrates, whereas the diet of the great blue heron was assumed to consist of 25 percent invertebrates and 75 percent fish. These estimates of dietary composition may result in an overestimate or underestimate of risk because of the varied diet of the receptors.

The BERA assumed that all receptors use the site proportionally as determined by the receptor home range. The SUF was calculated by dividing the Site acreage (1.35 acres) by the foraging range of the receptors to yield a more realistic prediction of the receptors' use of the Site and resulting exposure to COPECs. As a result, the spotted sandpiper was assumed to forage at Site YF3 at all times (SUF = 1) because of its small foraging range. The great blue heron, which forages over large areas and is not likely to be continuously exposed to COPECs in soil and prey at Site YF3, was assumed to forage for a much smaller percentage of its diet at the site (SUF = 0.065). This assumption is based on the home ranges determined in the literature, and the actual home range may be greater or less than the home range used to calculate the SUF. Therefore, the actual amount of soil or prey ingested from the site could be much less or potentially greater than the values used in the risk calculations, depending on the actual use of the site by birds. Consequently, the SUFs may result in an overestimate or underestimate of risk.

8.5.2 Tissue Residue Data and Biota-Sediment Accumulation Factors

BSAFs for invertebrate tissue were calculated based on the results of laboratory studies on site-collected samples, while BSAFs for fish were derived from literature sources, as described in Section 6.1.3.1.

The measurement of concentrations in invertebrate tissue after exposure to Site YF3 sediment to calculate BSAFs provide an empirical measure of the transfer of chemicals from environmental media to biological tissue. There is uncertainty associated with the small sample sizes, though the samples were biased toward the location of former AST 214.

Numerous sources of uncertainty are associated with the derivation, application, and interpretation of benthic invertebrate BSAFs. Judd et al. (2014) concluded a review of more than 200 BSAFs with words of caution against the over-reliance on BSAFs. In particular, BSAFs should not be extrapolated beyond the chemical concentration used as their basis because the relationship may not be linear. Likewise, the BSAF curve intercept may not be zero. Lastly, outlier concentrations can skew the BSAFs. While an understanding of the influence of lipid concentration on BSAFs may improve the interpretation of bioavailability for some lipophilic compounds, lipid concentrations in wild populations can vary dramatically with season, diet, and reproductive stage (Beckvar and Lotufo, 2011). Lipid-adjusted tissue concentrations are not reliably more predictive than standard wet weights for interpreting bioaccumulation processes or toxicity in wild organisms (Wenning et al., 2011). Nevertheless, investigators require some approach to measuring bioaccumulation, and BSAFs can be useful within the limits of these known liabilities (Judd et al., 2014).

The uncertainty associated with the literature-derived BSAFs for fish is much higher than for those of invertebrates, as they are not site-specific and may be more conservative than site-specific BSAFs. The estimates of prey concentrations may be either overestimated or underestimated because conditions at the site that impact exposure of fish to contaminants at Site YF3 are likely different from those in the literature.

8.5.3 TRVs

TRVs used in risk calculations were derived from available literature studies as described in Section 6.1.3.2. These studies were not conducted on the receptors used in this assessment. As a result, TRVs may not reflect the sensitivity of birds that forage at the site. The effect of this uncertainty cannot be estimated; it could result in an overestimation or underestimation of risk.

8.5.4 Individual and Population Variation

Individuals within a population vary in a number of life history and behavioral traits. The dose models incorporated some of this variability by estimating average values for most model parameters. Most of these models, however, are focused on adult individuals and may not accurately represent ingestion of COPECs by small juvenile stages that may feed in a different manner. Depending on the behavior and proportion of juveniles among the population, the risk may be overestimated or underestimated.

8.5.5 Use of the Lesser of the Maximum Concentration and 95 UCL as Exposure Point Concentration

The lesser of the maximum concentration and the 95 UCL concentration was used to estimate site-wide exposures and to ensure protectiveness for COPECs for which fewer than 6 detected results were available. As a result, the maximum concentration was used as the EPC for several VOCs. The samples collected at Site YF3 have been biased toward the area of the former release and previously identified petroleum contamination. The 95 UCL provides a more representative, but still conservative, estimate of exposure to populations of ecological receptors than any single point concentration. The use of EPCs derived as a statistical measure of central tendency is standard procedure for ecological risk assessments and for characterizing sediment sites. The 95 UCL is one of the most common such measures employed. The EPC may underestimate or overestimate COPEC concentrations throughout the site, depending on the actual distribution of chemical concentrations within Site YF3, and the resulting actual exposure to ecological receptors.

9.0 BERA CONCLUSIONS

The 2015 SLERA did not identify any COPECs as posing an unacceptable risk to ecological receptors at Site YF3 (TriEco-Tt 2015). However, several data gaps were identified and further investigation was conducted in 2017, as summarized in Section 3.0, to provide a more robust data set for assessing ecological risk. The investigation included further collection and analysis of pore water and sediment, as well as site-specific toxicity and bioaccumulation tests and petroleum fingerprinting. Sufficient data were available after the data gaps investigation to assess the potential for risk, despite the inherent uncertainties associated with the risk assessment described in Section 8.0.

The BERA included assessment of the potential risks to aquatic life, benthic invertebrates, and birds. Based on the lines of evidence presented in Sections 7.1, 7.2, and 7.3, chemicals in pore water and sediment do not pose unacceptable risk to ecological receptors. Therefore, none of the COPECs is recommended for further assessment of ecological risk.

10.0 UPDATED CONCEPTUAL SITE MODEL

Based on information available regarding Site history and operations, as well as observations at the Site and the comprehensive dataset available, the suspected mechanism for release of petroleum-related contamination at Site YF3 includes leaks from AST 214 and possibly former fuel lines F01 and F03.

Historical and more recent sampling has revealed the presence of petroleum-related contaminants in sediment, pore water, and groundwater generally throughout Site YF3, and evidence of petroleum material has been observed in groundwater, soil, and sediment based on visual and olfactory evidence. Concentrations of petroleum-associated contaminants tend to be lower in locations farthest into Clipper Cove and away from the former source area than in areas closer to former AST 214. Evidence of petroleum material also lessens with distance away from former AST 214. VOCs are detected less frequently than TPH and PAHs and at low concentrations.

Figures 16 and 17 present the interpolated TPH-d, and TPH-mo results greater than 1,000 mg/kg, along with cross-sections cut through the interpolation conveying the percentage of fine materials described in the boring logs. The figures indicate that petroleum hydrocarbons have migrated into areas of proportionally more fine materials (relatively low permeability areas) close to the source area and do not appear to have migrated down past these relatively low permeability areas. Petroleum hydrocarbons farther from the source appear to be limited in their migration within the relatively high permeability locations, and the low permeability locations appear to be limiting migration.

Petroleum fingerprinting results indicate there has been aggressive weathering in the intertidal environment of petroleum compounds released from historical Site operations. The highly weathered nature of remaining residual hydrocarbons detected in intertidal zone sediment and pore water supports the conclusion that NAPL, where present, is at residual saturation with little mobility (except if disturbed by physical forces stronger than wave action). Prior and current analysis of TPH data and other LOEs, including Site operational history, hydrogeology, and petroleum chemistry, indicates limited potentially mobile LNAPL at the Site and a low likelihood any residual LNAPL present would be migrating.

The SLERA and Step 3a risk refinement previously completed for Site YF3, which included an assessment of exposure for aquatic life, benthic invertebrates, birds, and mammals, did not reveal any chemicals responsible for potentially unacceptable ecological risk.

Further investigation conducted in 2017 provided a more robust data set for assessing ecological risk. The investigation included further collection and analysis of pore water and sediment, as well as Site-specific toxicity and bioaccumulation tests. Sufficient data are available after the data gaps investigation to assess the potential for risk, despite the inherent uncertainties associated with the risk assessment.

The BERA included assessment of the potential risks to aquatic life, benthic invertebrates, and birds. Based on multiple LOEs assembled into an overall WOE risk assessment, including the Site-specific toxicity and bioaccumulation testing, chemicals in pore water and sediment do not pose unacceptable risk to ecological receptors. Therefore, no COPECs are recommended for further assessment of ecological risk and it is concluded the Site is not characterized by potentially unacceptable ecological risk.

There are physical hazards and access limitations at the Site for human receptors based on the rugged terrain and coastal setting. Risks to human health would be incomplete or considered negligible as the rocky shoreline is often inundated by water from the tides and is only marginally accessible for short periods of time during the day. Human exposure to sediments would be negligible. Furthermore, there are no current or planned buildings or development at the Site (TIDA, 2011).

Given the relative location of Site YF3, the potential does exist for petroleum-related contaminants to reach the San Francisco Bay environment. However, the data available for the Site indicate the extent of contaminant impact and migration potential is limited. Evidence suggests that petroleum in the soil/sediment may be released from aggressive physical disturbance, but not under undisturbed, or in situ, conditions.

11.0 OVERALL SITE YF3 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this report is to present the BERA and provide recommendations for the path forward for Site YF3 at former NAVSTA TI. This report summarizes the results of the 2017 intertidal area data gaps investigation, provides an assessment of the potential for LNAPL to be mobile and migrating to San Francisco Bay, and presents the methodology and results of the BERA. Based on the outcome of the data gaps investigation and BERA, conclusions are drawn and recommendations are made below for the path forward for Site YF3.

As described in Section 4.0, COPECs (TPH, PAHs, and VOCs) were detected at varying levels in sediment and pore water throughout the site. The highest detections of TPH were in deeper sediments at locations YF311, YF315, and YF3HP019, below the depth of exposure to benthic invertebrates (Tables 3 and 4). Concentrations of TPH-d in both sediment and pore water are lower in locations farthest into Clipper Cove and away from the former AST 214 source area (Figures 6 and 8). Concentrations of total HMW PAHs and total LMW PAHs in pore water are greatest near former AST 214, while some locations farther removed had nondetect results for both HMW and LMW PAHs (Figure 7), though that pattern was not observed in the concentrations of PAHs in sediment (Figure 9). VOCs were detected less frequently than TPH and PAHs and at low concentrations in both sediment and pore water.

During the 2017 intertidal area data gaps investigation, visual and olfactory observations made during the field activities indicated the presence of petroleum in the soil/sediment when it was disturbed, but not under undisturbed, or in situ, conditions. The petroleum fingerprinting results indicate there has been aggressive weathering in the intertidal environment of petroleum compounds released from Site operations. The highly weathered nature of remaining residual hydrocarbons detected in intertidal zone sediment and pore water supports the conclusion that NAPL, where present, is at residual saturation with little mobility (except if disturbed by physical forces stronger than wave action). An analysis of the TPH data and other LOEs indicates limited potentially mobile LNAPL at the Site and a low likelihood any residual LNAPL present would be migrating. Since the petroleum fingerprinting results indicate that there has been weathering of the hydrocarbons in the sediment at Site YF3, there has demonstrably been some attenuation since the time of original release to the environment. Toxicity has then potentially been reduced since the lighter, more toxic compounds would have decreased in concentration over time. It is possible that the increasing percentage of fines in the sediments as they extend farther into the cove has, among other factors, limited the migration of petroleum toward Clipper Cove (Figures 16 and 17).

The BERA indicates that chemicals in pore water and sediment at Site YF3 do not pose unacceptable risk to ecological receptors, and further assessment of ecological risk is not recommended.

Residual petroleum contamination remains in the sediment at Site YF3, as evidenced by visual and olfactory observations made during the field investigation and the resulting analytical data and analyses. Although it does not pose an unacceptable risk to ecological receptors or an immediate threat to the environment, there is the potential for a release of otherwise stable in situ residual contamination to the environment if the Site is disturbed by aggressive land-altering or other intrusive activities. Currently, no construction or intrusive activity is planned at Site YF3 (TIDA, 2011). Therefore, there is no immediate need to contain or remove the contaminated sediment at this time. Subsurface disturbance should be avoided without evaluation and development of appropriate plans to mitigate environmental impacts to this site.

12.0 REFERENCES

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FIGURES

Notes:
Aerial imagery courtesy of
Geomatic Technologies Group,
May 2017.

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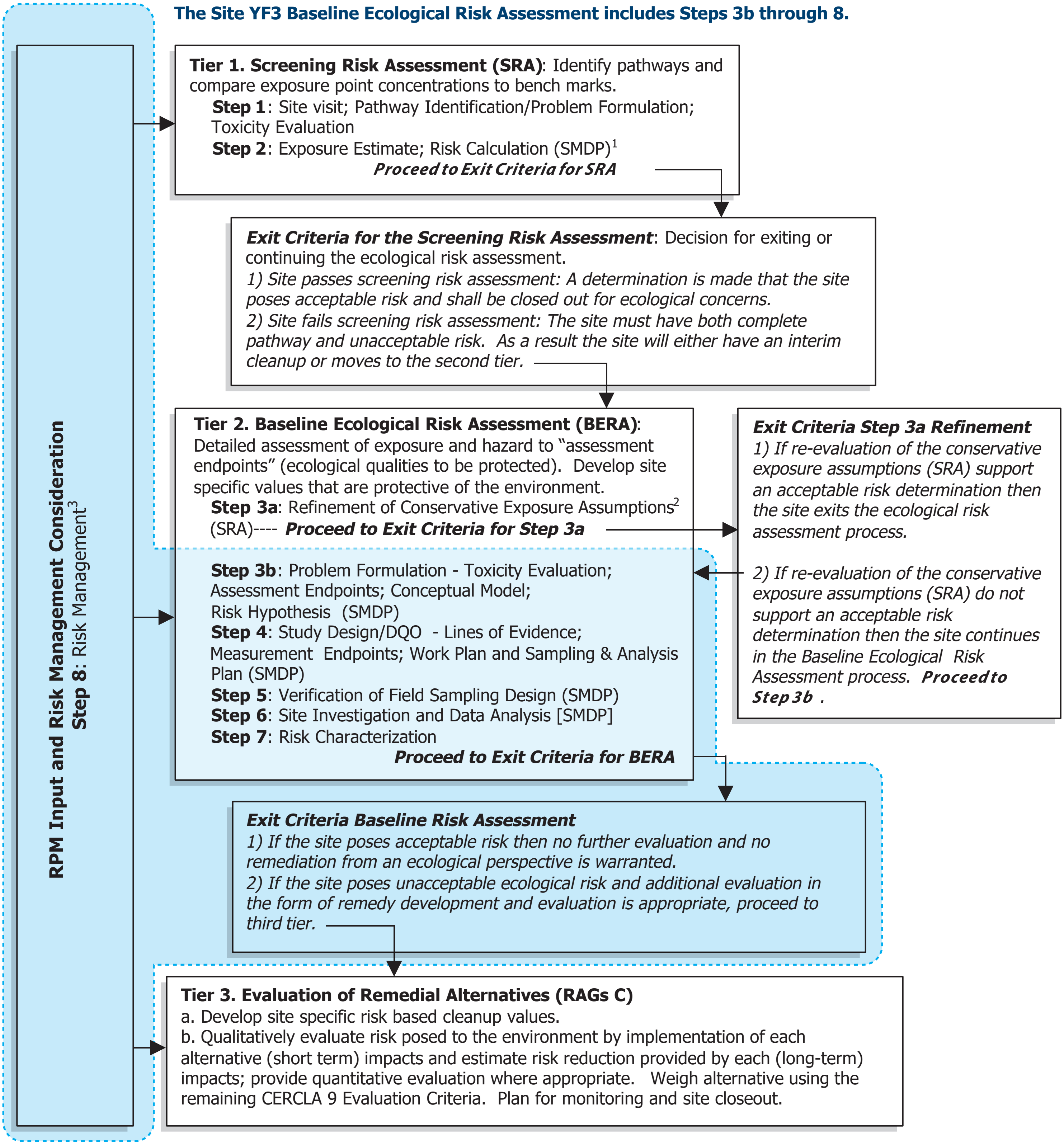
TETRA TECH

Former Naval Station Treasure Island
Department of the Navy, BRAC PMO West, San Diego, CA

FIGURE 1
SITE LOCATION

Site YF3 BERA



The Site YF3 Baseline Ecological Risk Assessment includes Steps 3b through 8.

RPM Input and Risk Management Consideration
Step 8: Risk Management[3]

Tier 1. Screening Risk Assessment (SRA): Identify pathways and compare exposure point concentrations to bench marks.
Step 1: Site visit; Pathway Identification/Problem Formulation; Toxicity Evaluation
Step 2: Exposure Estimate; Risk Calculation (SMDP)[1]
Proceed to Exit Criteria for SRA

Exit Criteria for the Screening Risk Assessment: Decision for exiting or continuing the ecological risk assessment.
1) Site passes screening risk assessment: A determination is made that the site poses acceptable risk and shall be closed out for ecological concerns.
2) Site fails screening risk assessment: The site must have both complete pathway and unacceptable risk. As a result the site will either have an interim cleanup or moves to the second tier.

Tier 2. Baseline Ecological Risk Assessment (BERA): Detailed assessment of exposure and hazard to "assessment endpoints" (ecological qualities to be protected). Develop site specific values that are protective of the environment.
Step 3a: Refinement of Conservative Exposure Assumptions[2] (SRA)---- ***Proceed to Exit Criteria for Step 3a***
Step 3b: Problem Formulation - Toxicity Evaluation; Assessment Endpoints; Conceptual Model; Risk Hypothesis (SMDP)
Step 4: Study Design/DQO - Lines of Evidence; Measurement Endpoints; Work Plan and Sampling & Analysis Plan (SMDP)
Step 5: Verification of Field Sampling Design (SMDP)
Step 6: Site Investigation and Data Analysis [SMDP]
Step 7: Risk Characterization
Proceed to Exit Criteria for BERA

Exit Criteria Step 3a Refinement
1) If re-evaluation of the conservative exposure assumptions (SRA) support an acceptable risk determination then the site exits the ecological risk assessment process.

2) If re-evaluation of the conservative exposure assumptions (SRA) do not support an acceptable risk determination then the site continues in the Baseline Ecological Risk Assessment process. ***Proceed to Step 3b .***

Exit Criteria Baseline Risk Assessment
1) If the site poses acceptable risk then no further evaluation and no remediation from an ecological perspective is warranted.
2) If the site poses unacceptable ecological risk and additional evaluation in the form of remedy development and evaluation is appropriate, proceed to third tier.

Tier 3. Evaluation of Remedial Alternatives (RAGs C)
a. Develop site specific risk based cleanup values.
b. Qualitatively evaluate risk posed to the environment by implementation of each alternative (short term) impacts and estimate risk reduction provided by each (long-term) impacts; provide quantitative evaluation where appropriate. Weigh alternative using the remaining CERCLA 9 Evaluation Criteria. Plan for monitoring and site closeout.

Notes:
1) See EPA's 8 Step ERA Process for requirements for each Scientific Management Decision Point (SMDP).
2) Refinement includes but is not limited to background, bioavailability, detection frequency, etc.
3) Step 8, Risk Management, is incorporated throughout the tiered approach.

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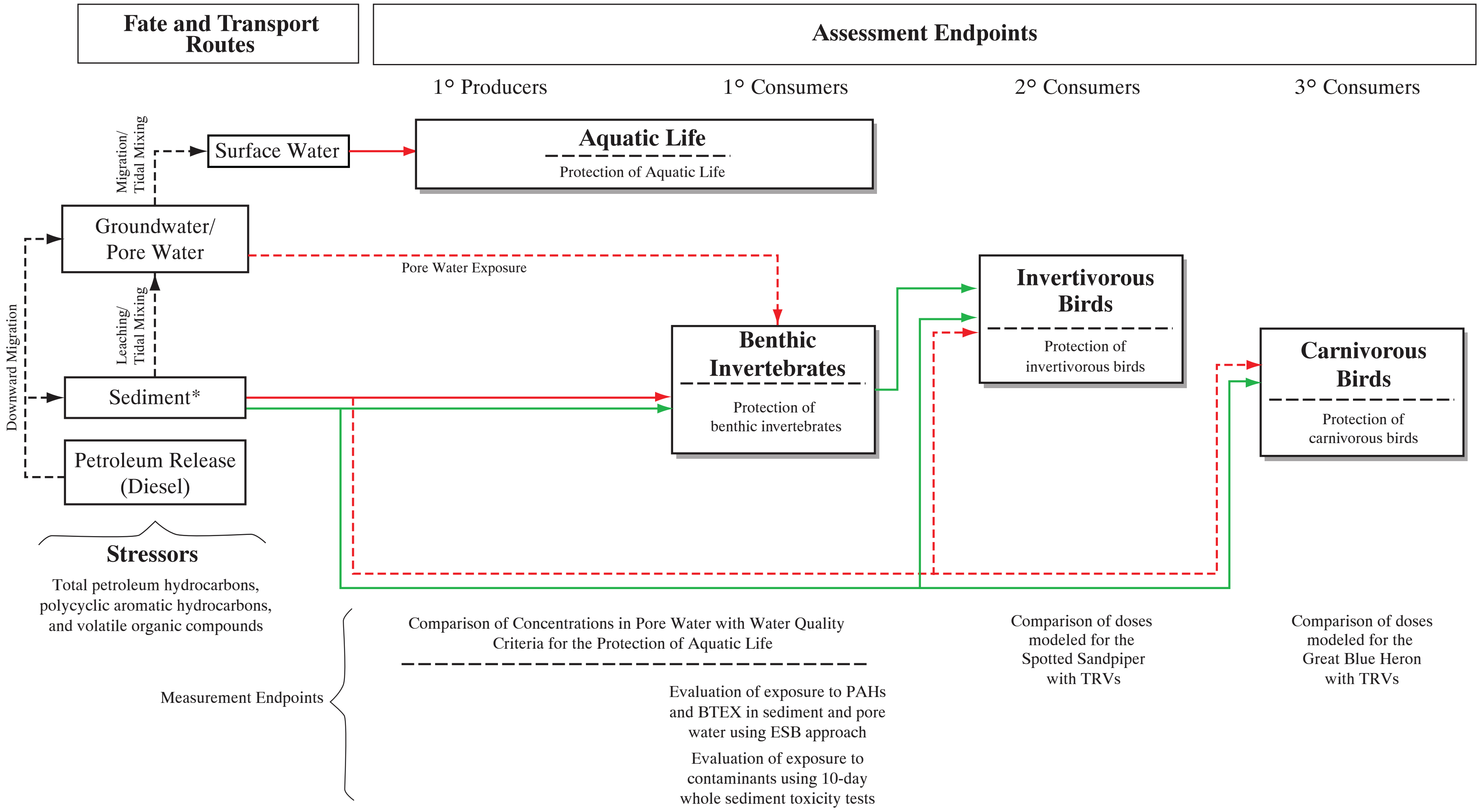
FIGURE 2
NAVY ECOLOGICAL RISK ASSESSMENT TIERED APPROACH
Site YF3 BERA



Legend

🟩	Ingestion exposure pathway
🟥	Direct contact exposure pathway
—	Transport route
(All colors) - - -	Minor transport routes and exposure pathway
—	Major transport routes and exposure pathway

BTEX	Benzene, toluene, ethylbenzene, xylene
ESB	Equilibrium partitioning sediment benchmark
PAH	Polycyclic aromatic hydrocarbons
TRV	Toxicity Reference Value

*All receptors are exposed to surface sediment (0 to 1 feet below sediment surface).

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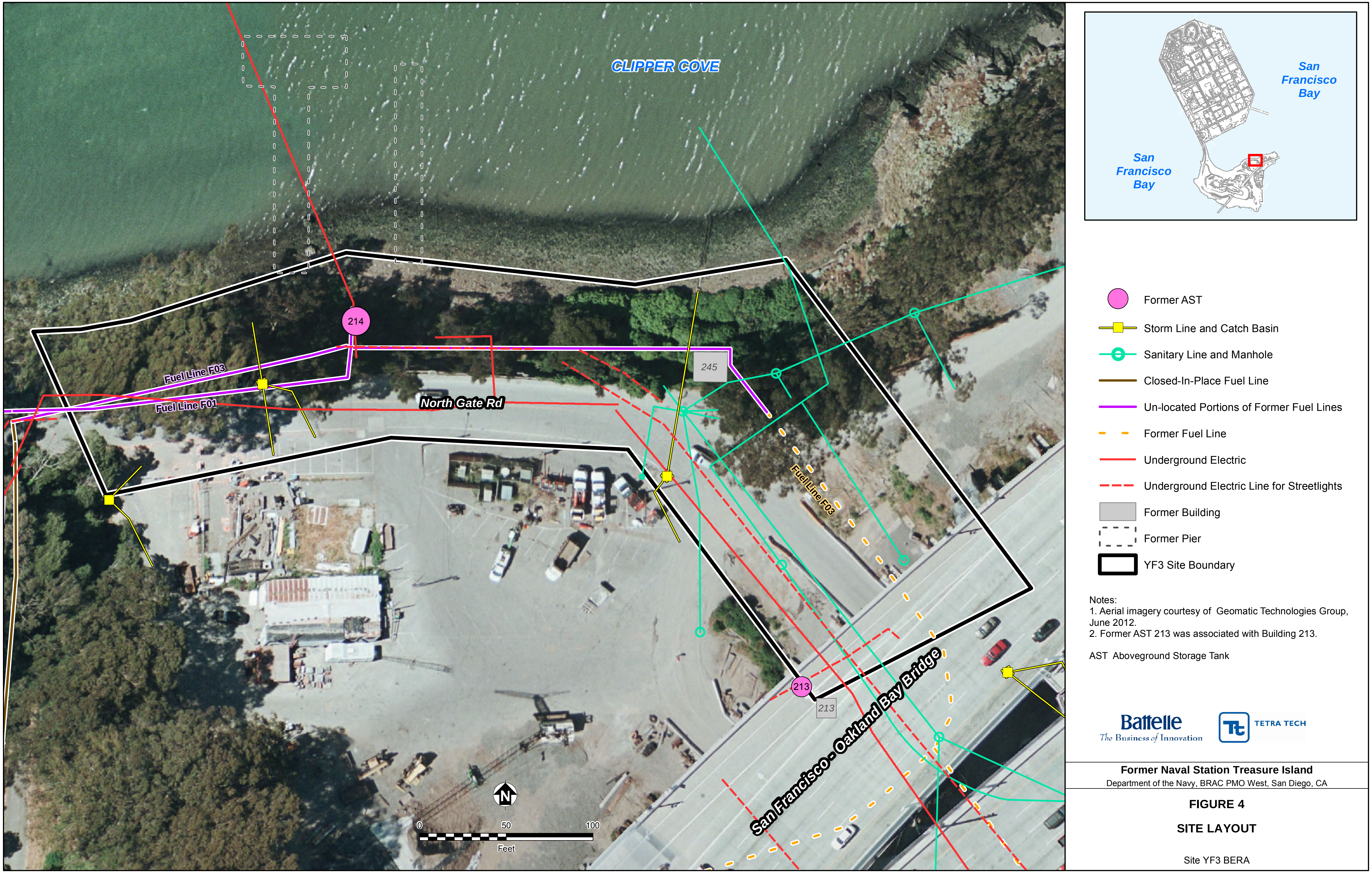
FIGURE 3
ECOLOGICAL CONCEPTUAL SITE MODEL
Site YF3 BERA



Notes:
1. Aerial imagery courtesy of Geomatic Technologies Group, June 2012.
2. Former AST 213 was associated with Building 213.

AST Aboveground Storage Tank

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FIGURE 4

SITE LAYOUT

Site YF3 BERA

8/9/2017 V:\Treasure Island\Projects\058_YF3_BERA\04_Site_Layout.mxd TtEMI-ABQ

△ Historical Soil Sampling Location*

○ Historical Groundwater Sampling Location*

● Pore Water Sampling Location

● Sediment Sampling Location

● Bioassay Sediment Sampling Location

● Bioaccumulation Test Sampling Location

● Petroleum Fingerprinting Sampling Location

○ Former Location of AST 214

— Underground Electric

- - Underground Electric Line for Streetlights

— Sanitary Sewer Line

— Mean Lower Low Water (zero elevation)

—■— Storm Line and Catch Basin

— Un-located Portions of Former Fuel Lines

▭ Site YF3 Boundary

Notes:

*	Historical samples were collected between 1997 and 2012. All other samples were collected in 2017.
AST	Aboveground storage tank

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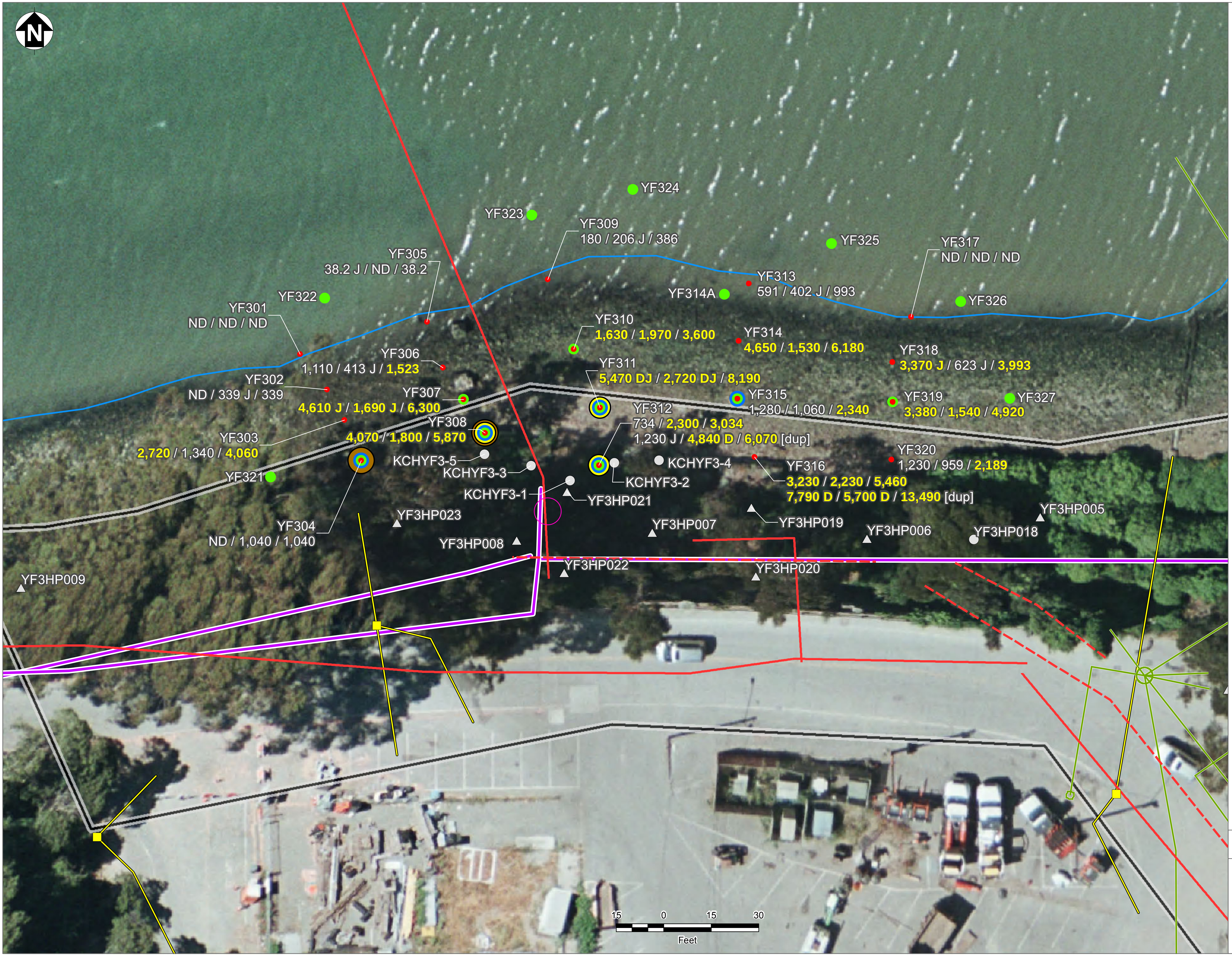
FIGURE 5

SAMPLE LOCATIONS

Site YF3 BERA

10/6/2017 V:\Treasure Island\Projects\058_YF3_BERA\05_Sample_Locations.mxd TtEMI-ABQ



Sample Location
TPH-Diesel / TPH-Motor Oil / Sum[1, 2]

●	Pore Water Sampling Location[3]
●	Sediment Sampling Location
●	Bioassay Sediment Sampling Location
●	Bioaccumulation Test Sampling Location
●	Petroleum Fingerprinting Sampling Location
△	Historical Soil Sampling Location[4]
●	Historical Groundwater Sampling Location[4]
○	Former Location of AST
—	Underground Electric
- - -	Underground Electric Line for Streetlights
—	Sanitary Sewer Line
—	Mean Lower Low Water (zero elevation)
—■—	Storm Line and Catch Basin
—	Un-located Portions of Former Fuel Lines
▭	Site YF3 Boundary

Notes:

1. All results are in µg/L.
2. Bold yellow values indicate exceedance of screening criterion (same for TPH-Diesel and TPH-Motor Oil) of 1,440 µg/L.
3. Pore water samples were collected at approximately 2 feet below sediment surface.
4. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017.

AST	Aboveground storage tank
D	Chromatographic pattern resembles diesel
dup	Duplicate sample
J	Estimated detection
ND	Not detected
µg/L	Micrograms per liter

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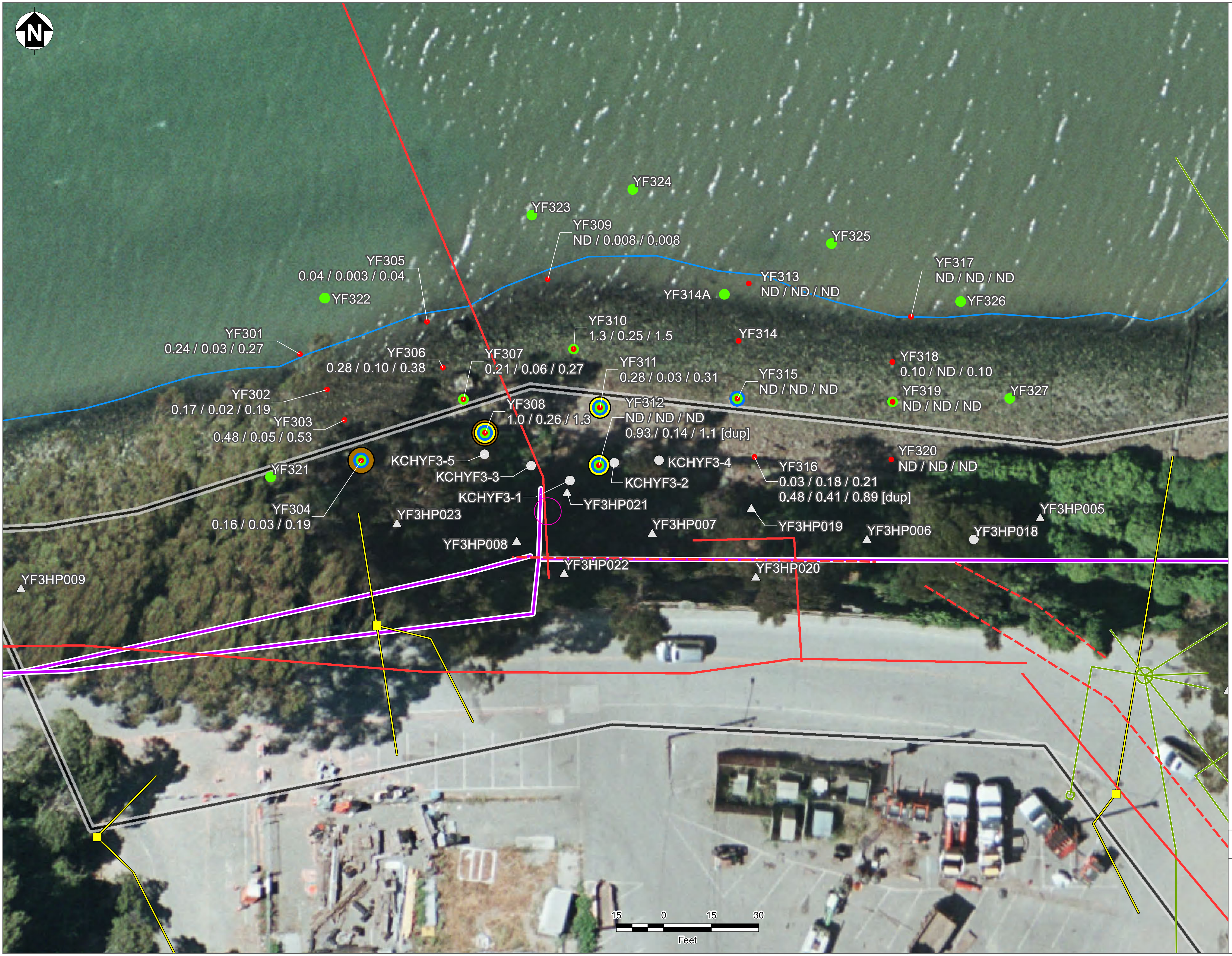
FIGURE 6
TPH-DIESEL AND TPH-MOTOR OIL IN PORE WATER (2017)

Site YF3 BERA

10/6/2017 V:\Treasure Island\Projects\058_YF3_BERA\06_TPH_Pore_Water.mxd TtEMI-ABQ



10/6/2017 V:\Treasure Island\Projects\058_YF3_BERA\07_PAH_Pore_Water.mxd TtEMI-ABQ

Sample Location
Total HMW PAHsl / Total LMW PAHs / Sum[1, 2]

- ● Pore Water Sampling Location[3]
- 🟢 Sediment Sampling Location
- 🔵 Bioassay Sediment Sampling Location
- 🟡 Bioaccumulation Test Sampling Location
- 🟤 Petroleum Fingerprinting Sampling Location
- △ Historical Soil Sampling Location[4]
- ○ Historical Groundwater Sampling Location[4]
- ○ Former Location of AST
- — Underground Electric
- - - Underground Electric Line for Streetlights
- — Sanitary Sewer Line
- — Mean Lower Low Water (zero elevation)
- ■ Storm Line and Catch Basin
- — Un-located Portions of Former Fuel Lines
- ▭ Site YF3 Boundary

Notes:

1. All results are in µg/L.
2. No results exceeded the screening criterion of 15 µg/L for discharge to the San Francisco Bay (Tetra Tech 2001).
3. Pore water samples were collected at approximately 2 feet below sediment surface.
4. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017.

AST	Aboveground storage tank
dup	Duplicate sample
HMW	Low molecular weight
LMW	High molecular weight
ND	Not detected
PAH	Polycyclic aromatic hydrocarbon
µg/L	Micrograms per liter

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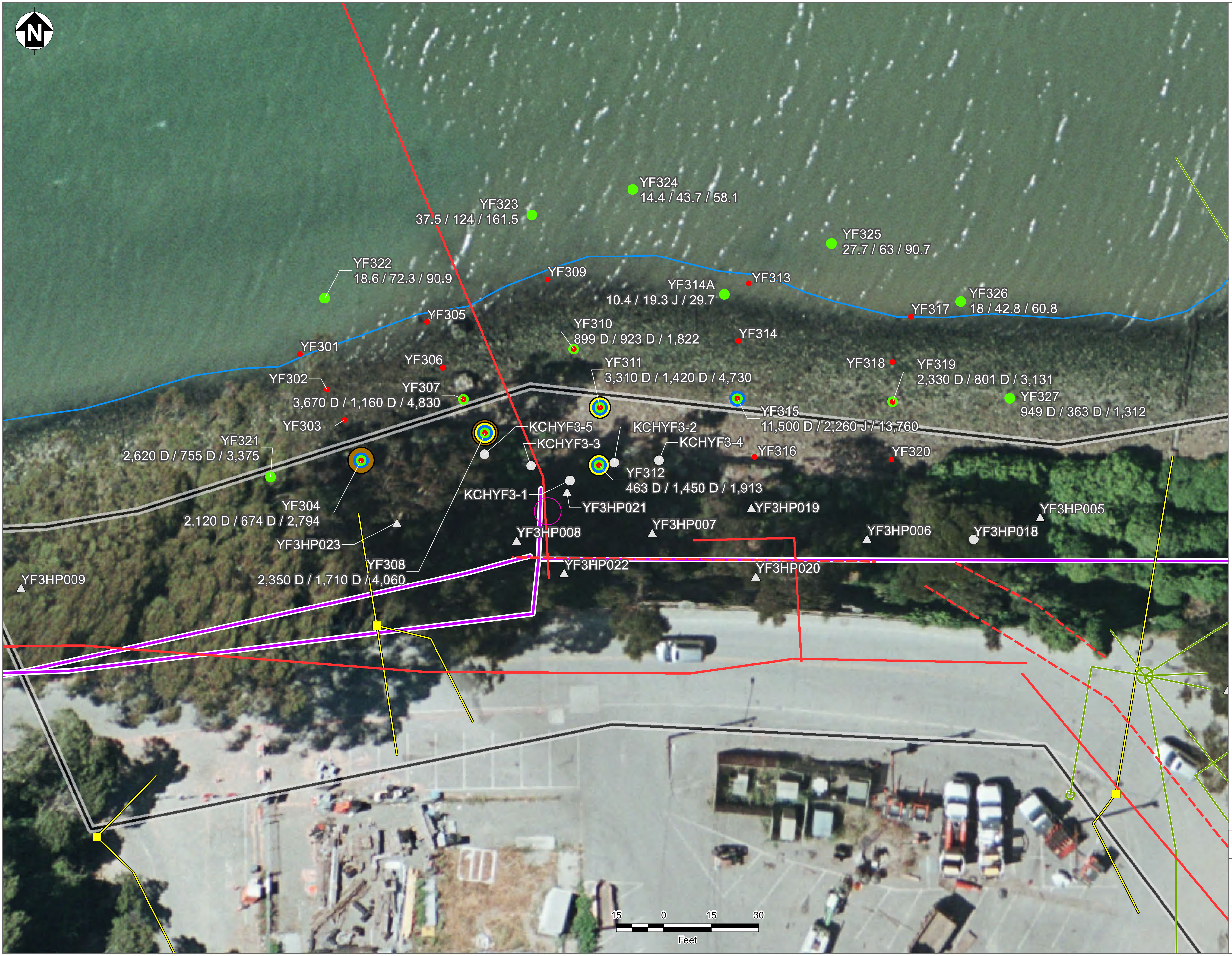
FIGURE 7

PAHS IN PORE WATER (2017)

Site YF3 BERA



Sample Location
TPH-Diesel / TPH-Motor Oil / Sum[1]

- ● Sediment Sampling Location[2]
- ● Pore Water Sampling Location
- ● Bioassay Sediment Sampling Location
- ● Bioaccumulation Test Sampling Location
- ● Petroleum Fingerprinting Sampling Location
- △ Historical Soil Sampling Location[3]
- ○ Historical Groundwater Sampling Location[3]
- ○ Former Location of AST
- Underground Electric
- Underground Electric Line for Streetlights
- Sanitary Sewer Line
- Mean Lower Low Water (zero elevation)
- Storm Line and Catch Basin
- Un-located Portions of Former Fuel Lines
- ▭ Site YF3 Boundary

Notes:
1. All results are in mg/kg.
2. Sediment samples were collected from 0-1 foot below sediment surface.
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017.

AST	Aboveground storage tank
D	Chromatographic pattern resembles diesel
dup	Duplicate sample
J	Estimated detection
mg/kg	Milligrams per kilogram
ND	Not detected

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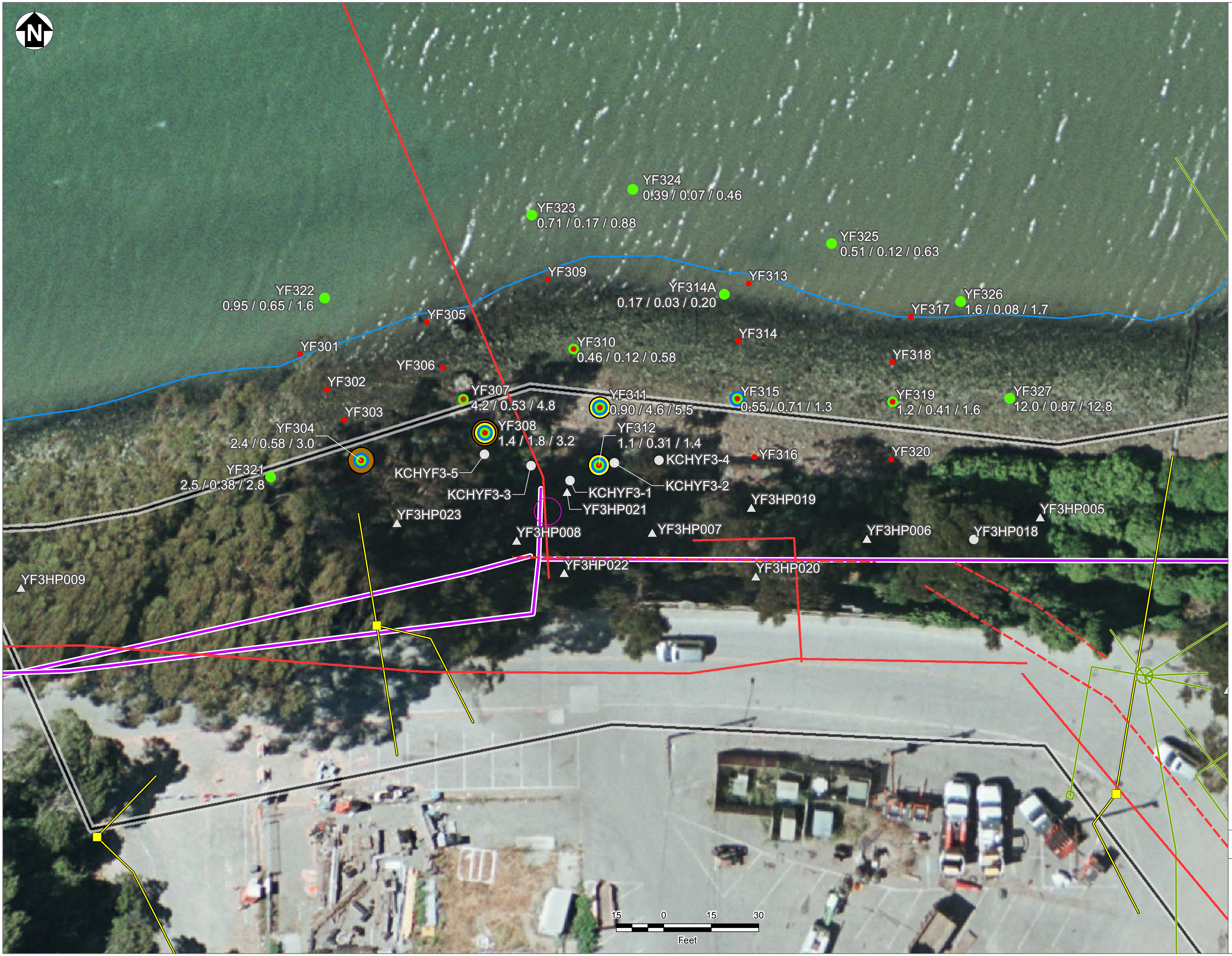
FIGURE 8
TPH-DIESEL AND TPH-MOTOR OIL IN SURFACE SEDIMENT

Site YF3 BERA

10/6/2017 V:\Treasure Island\Projects\058_YF3_BERA\08_TPH_Surface_Sediment.mxd TIEMI-ABQ



Sample Location
Total HMW PAHsl / Total LMW PAHs / Sum[1]

● Sediment Sampling Location[2]
• Pore Water Sampling Location
● Bioassay Sediment Sampling Location
● Bioaccumulation Test Sampling Location
● Petroleum Fingerprinting Sampling Location
△ Historical Soil Sampling Location[3]
● Historical Groundwater Sampling Location[3]
○ Former Location of AST
— Underground Electric
- - Underground Electric Line for Streetlights
— Sanitary Sewer Line
— Mean Lower Low Water (zero elevation)
■ Storm Line and Catch Basin
— Un-located Portions of Former Fuel Lines
▭ Site YF3 Boundary

Notes:
1. All results are in mg/kg.
2. Sediment samples were collected from 0-1 foot below sediment surface.
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017.

AST	Aboveground storage tank
D	Chromatographic pattern resembles diesel
dup	Duplicate sample
HMW	High molecular weight
J	Estimated detection
LMW	Low molecular weight
mg/kg	Milligrams per kilogram
ND	Not detected
PAH	Polycyclic aromatic hydrocarbon

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FIGURE 9

PAHS IN SURFACE SEDIMENT

Site YF3 BERA

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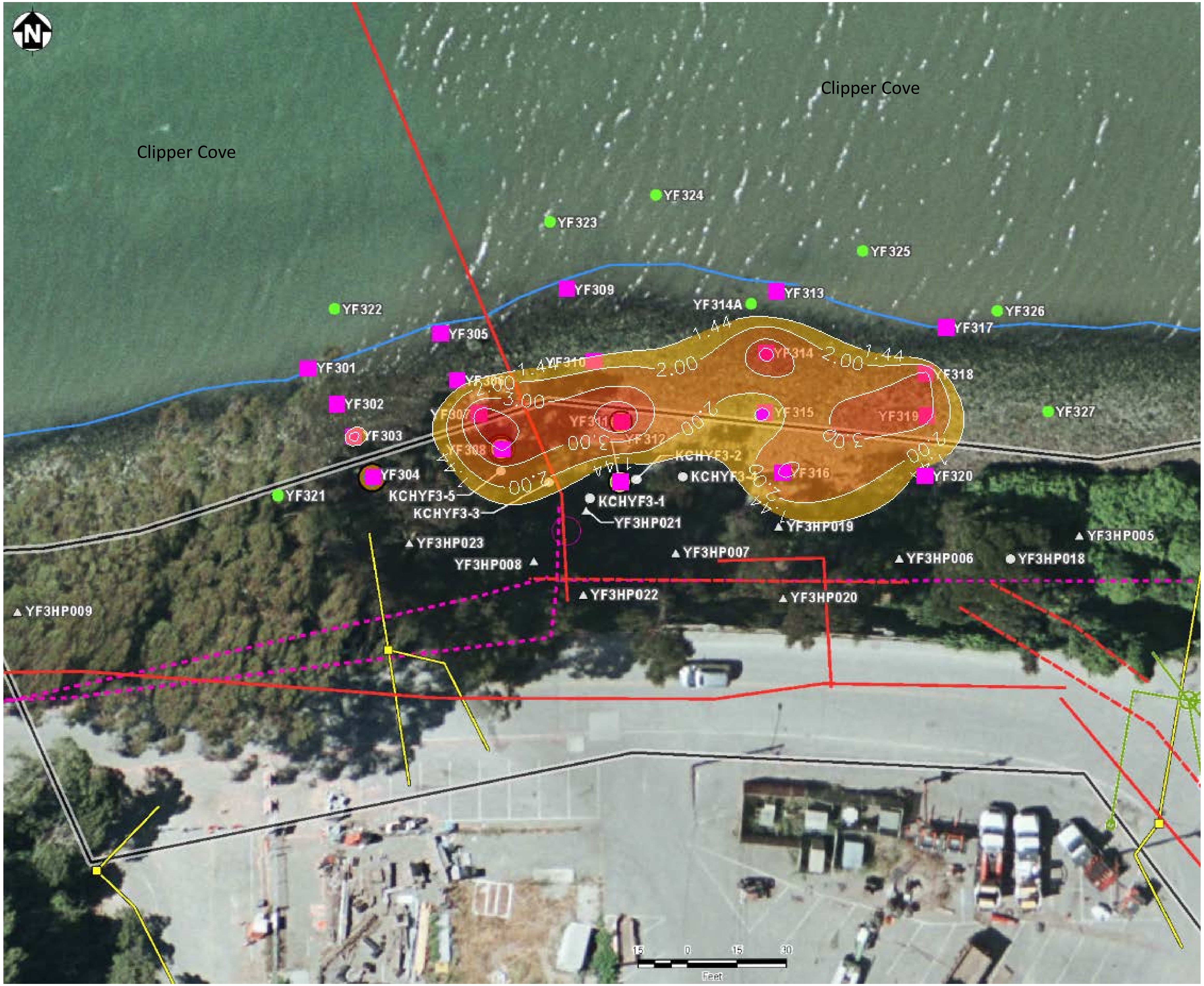

△ Historical Soil Sampling Location*

○ Historical Groundwater Sampling Location*

● Sediment Sampling Location

○ Former Location of AST 214

Underground Electric

Underground Electric Line for Streetlights

Sanitary Sewer Line

Mean Lower Low Water (zero elevation)

Storm Line and Catch Basin

Un-located Portions of Former Fuel Lines

▭ Site YF3 Boundary

■ Pore Water Sampling Location used for Interpolation

Contoured TPH-d

5 mg/L

4 mg/L

3 mg/L

2 mg/L

1 mg/L

Interpolated Data Below 1.44 mg/L Not Shown

Notes:

1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. AST= Aboveground Storage Tank
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017
4. mg/L = milligrams per liter

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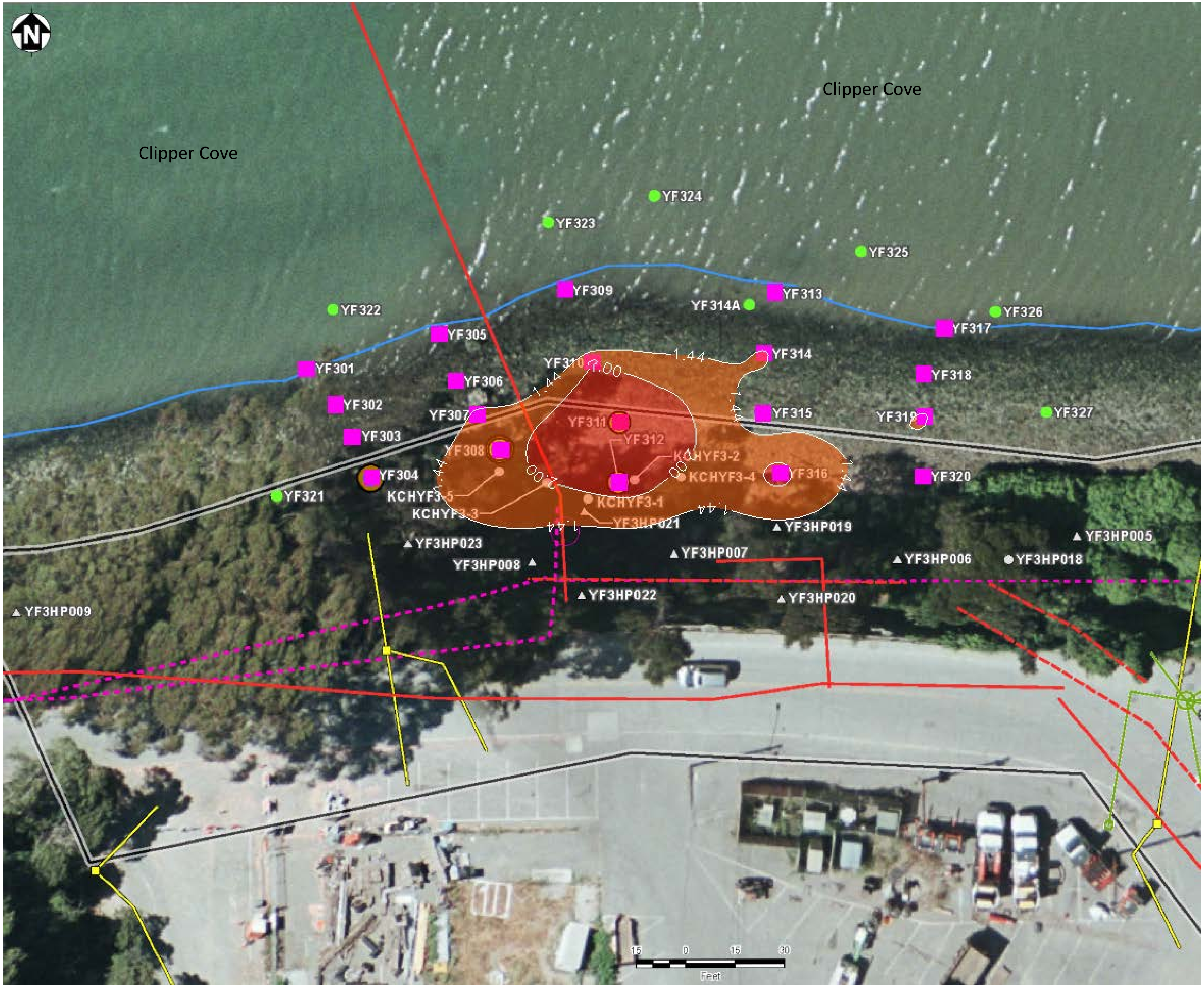
FIGURE 10
INTERPOLATED PORE WATER TPH-d



△ Historical Soil Sampling Location*

○ Historical Groundwater Sampling Location*

● Sediment Sampling Location

○ Former Location of AST 214

Underground Electric

Underground Electric Line for Streetlights

Sanitary Sewer Line

Mean Lower Low Water (zero elevation)

Storm Line and Catch Basin

Un-located Portions of Former Fuel Lines

▭ Site YF3 Boundary

■ Pore Water Sampling Location used for Interpolation

Contoured TPH-mo

3 mg/L

2 mg/L

1 mg/L

Interpolated Data Below 1.44 mg/L Not Shown B

Notes:

1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. AST= Aboveground Storage Tank
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017
4. mg/L = milligrams per liter

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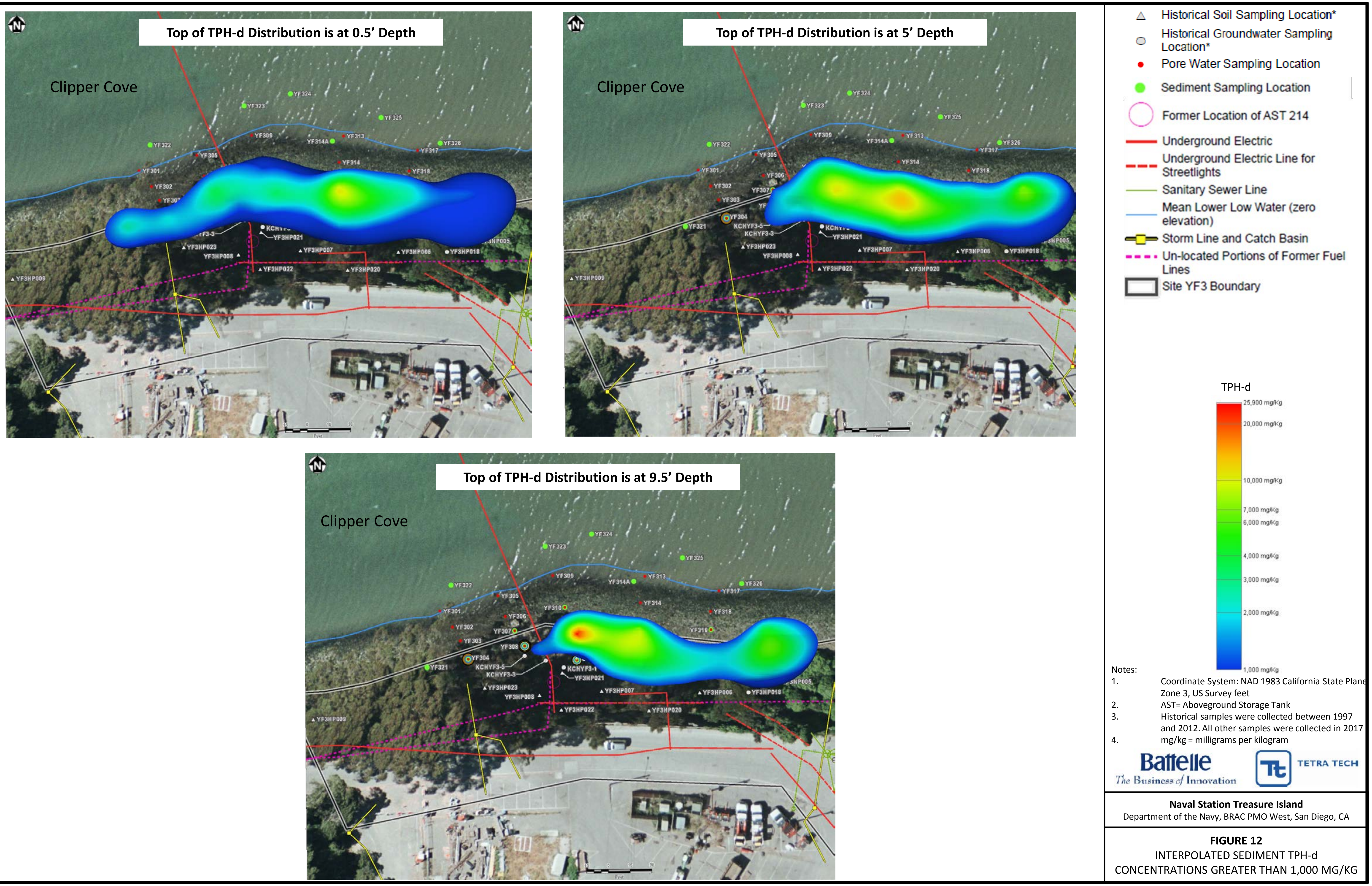
FIGURE 11
INTERPOLATED PORE WATER TPH-mo



Notes:

1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. AST= Aboveground Storage Tank
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017
4. mg/kg = milligrams per kilogram

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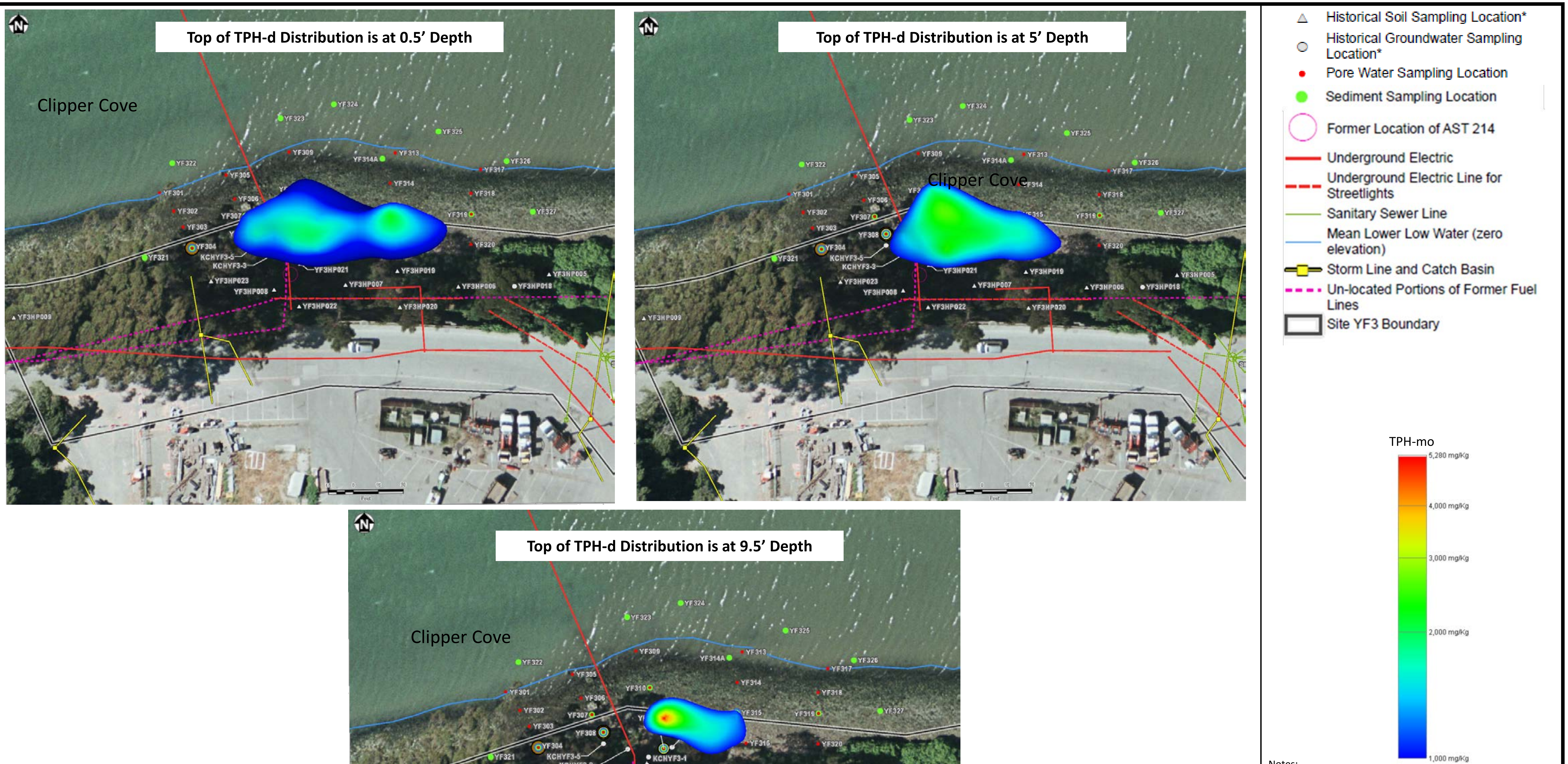
FIGURE 12
INTERPOLATED SEDIMENT TPH-d
CONCENTRATIONS GREATER THAN 1,000 MG/KG



Notes:

1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. AST= Aboveground Storage Tank
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017
4. mg/kg = milligrams per kilogram

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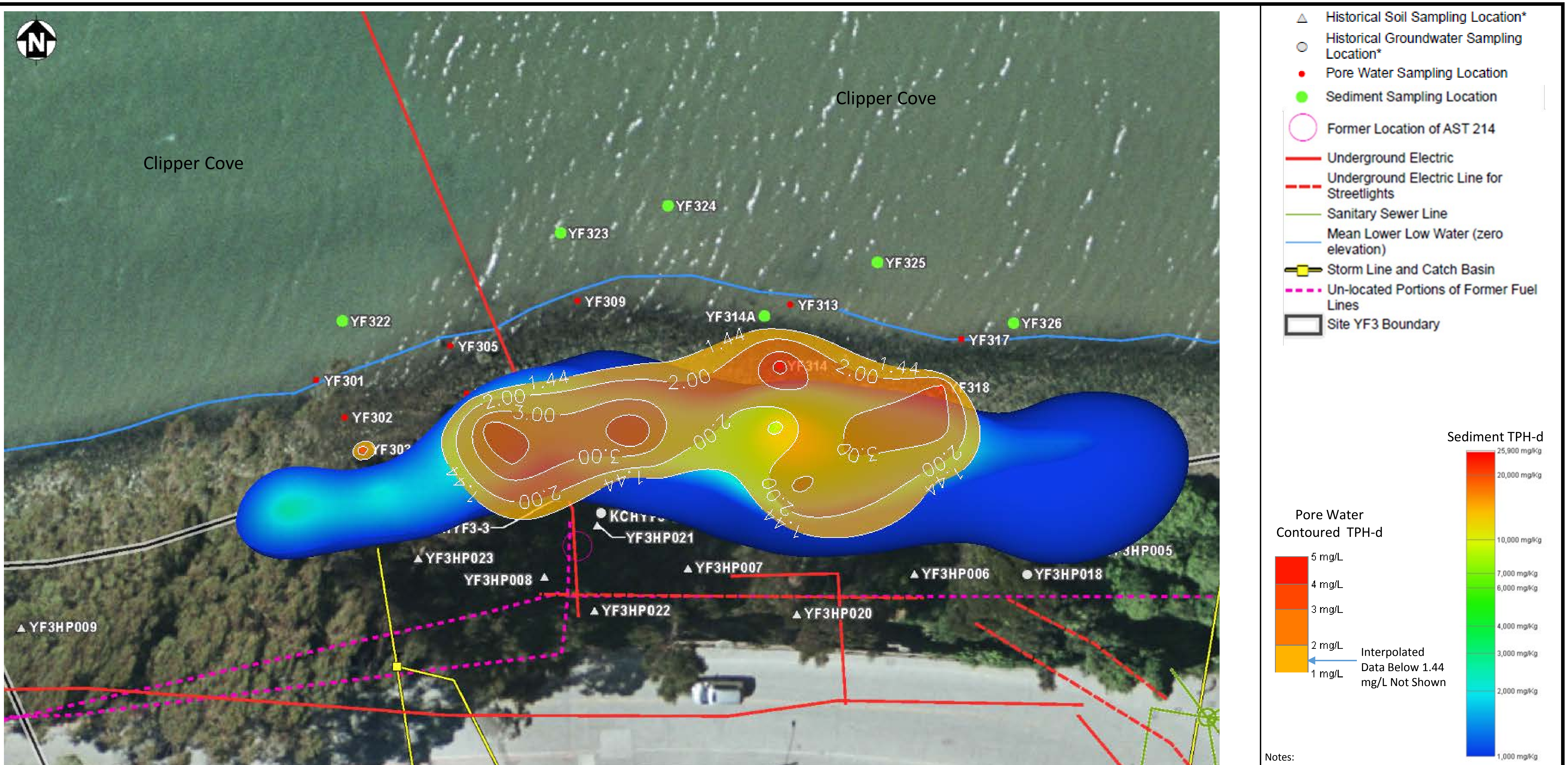
FIGURE 13
INTERPOLATED SEDIMENT TPH-mo
CONCENTRATIONS GREATER THAN 1,000 MG/KG



Notes:
1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. AST= Aboveground Storage Tank
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017
4. Pore Water concentrations below the screening criteria of 1.44 mg/L not shown

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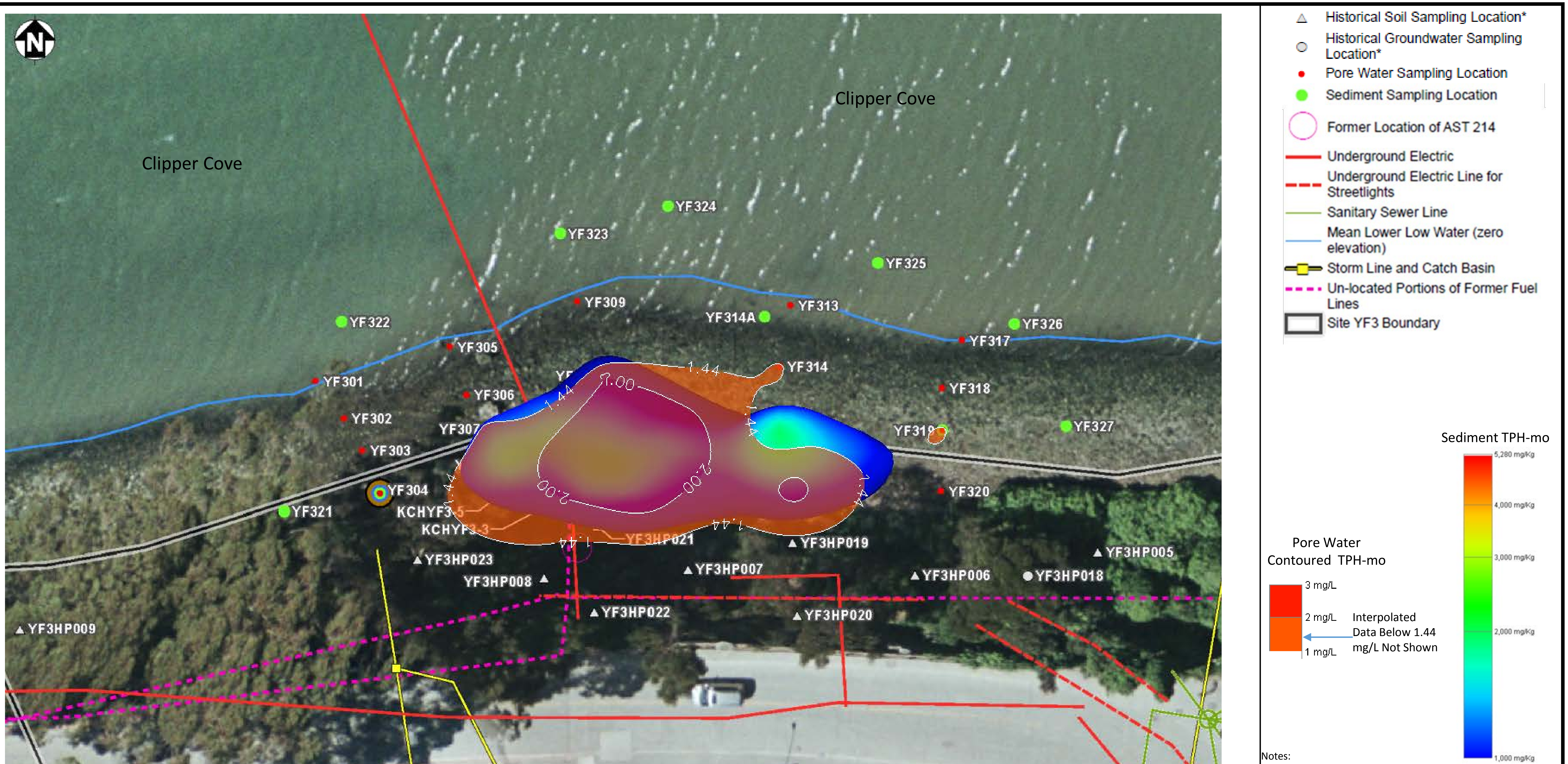
FIGURE 14
INTERPOLATED PORE WATER AND SEDIMENT (GREATER THAN 1,000 MG/KG) TPH-d



Notes:

1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. AST= Aboveground Storage Tank
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017
4. Pore Water concentrations below the Screening Criteria not shown

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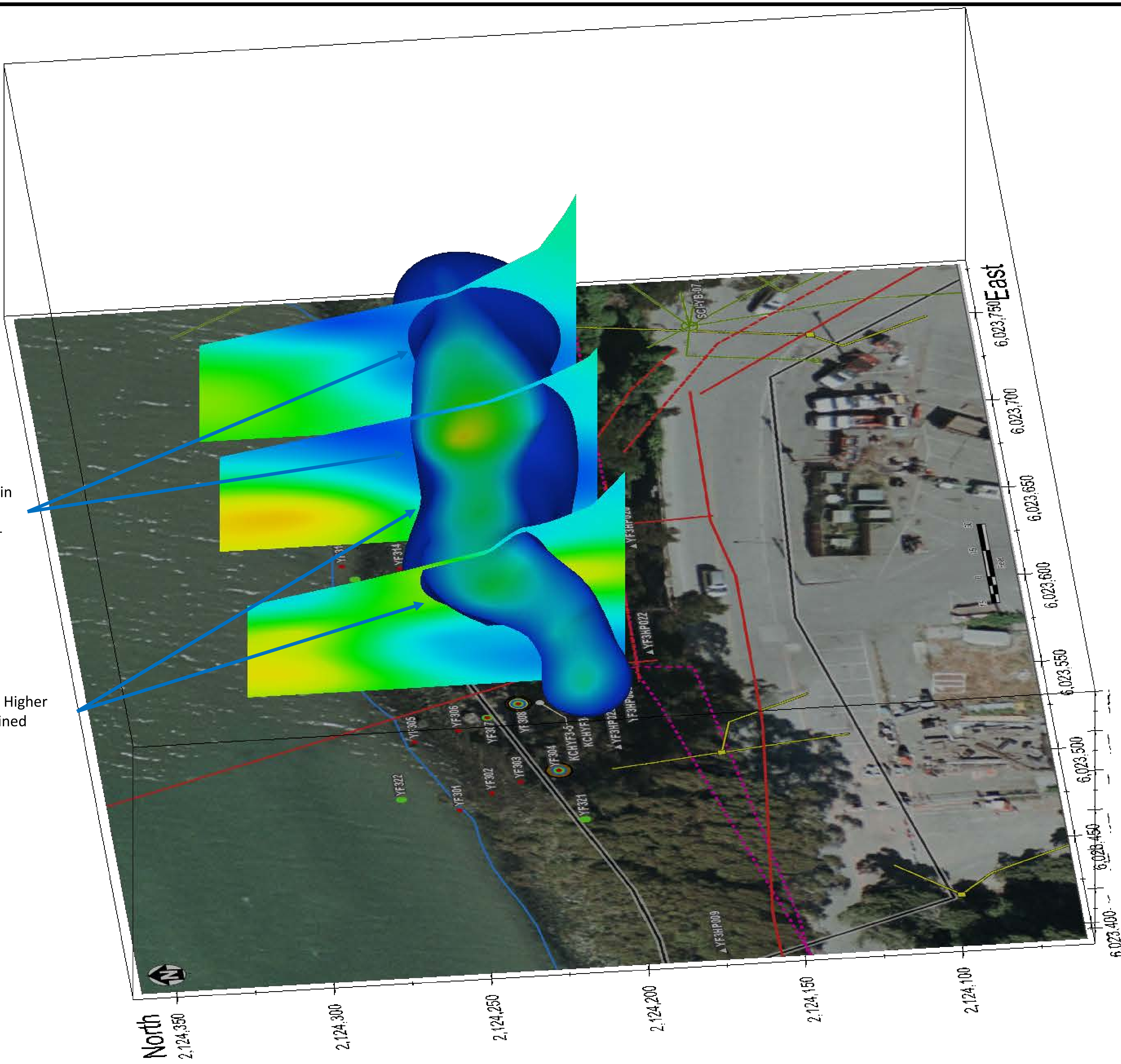
FIGURE 15
INTERPOLATED PORE WATER AND SEDIMENT (GREATER THAN 1,000 MG/KG) TPH-mo



Migration Restricted by Residual Water Saturation in Deposits With Relatively Lower Percentages of Fine-Grained Sediments

Migration Restricted by Deposits With Relatively Higher Percentages of Fine-Grained Sediments

- △ Historical Soil Sampling Location*
- ○ Historical Groundwater Sampling Location*
- ● Pore Water Sampling Location
- ● Sediment Sampling Location
- ○ Former Location of AST 214
- — Underground Electric
- - - Underground Electric Line for Streetlights
- — Sanitary Sewer Line
- — Mean Lower Low Water (zero elevation)
- ▭ Storm Line and Catch Basin
- - - Un-located Portions of Former Fuel Lines
- ▭ Site YF3 Boundary

Notes:
1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. AST= Aboveground Storage Tank
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017

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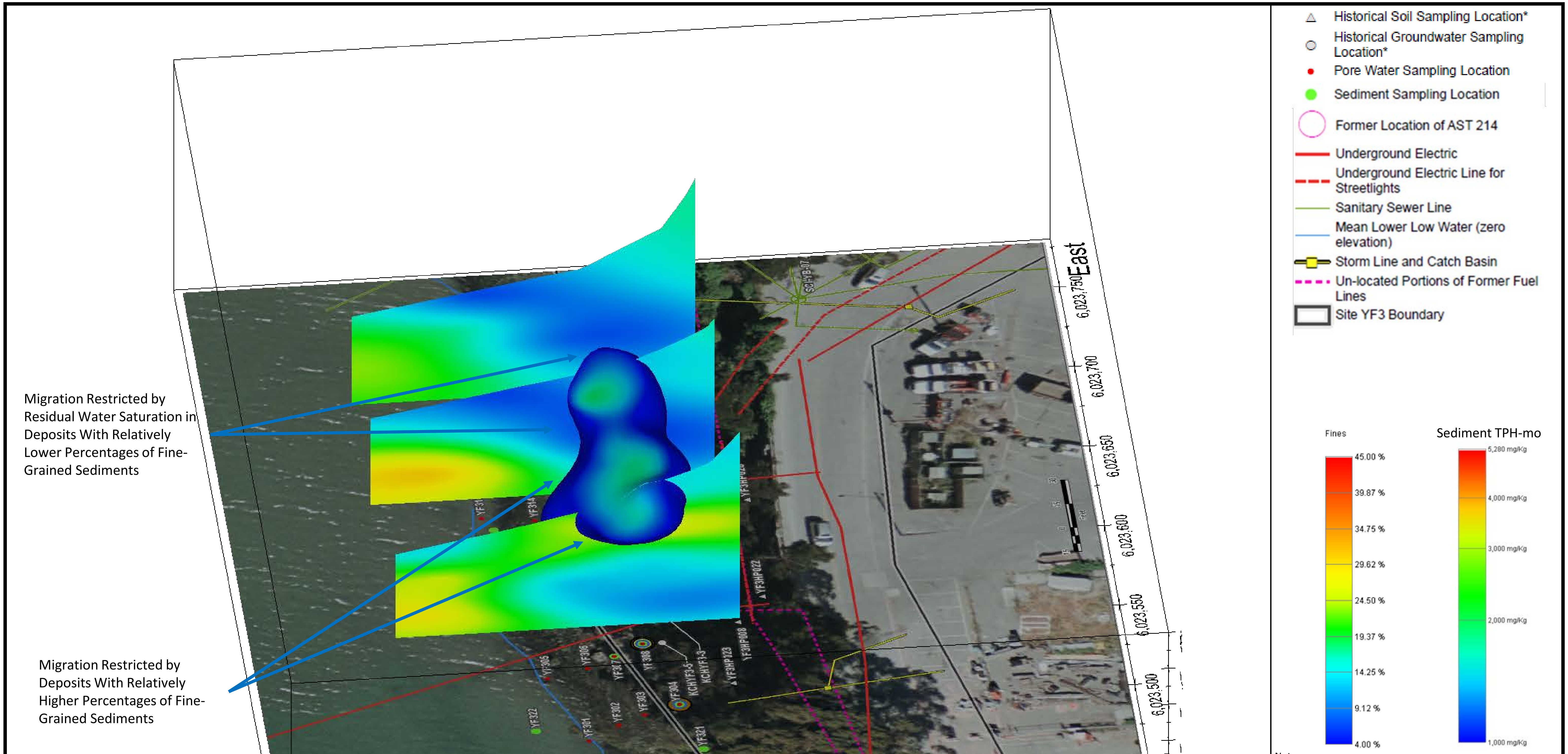
FIGURE 16
CROSS-SECTIONS OF PERCENT FINES THROUGH SEDIMENT TPH-d GREATER THAN 1,000 MG/KG



Migration Restricted by Residual Water Saturation in Deposits With Relatively Lower Percentages of Fine-Grained Sediments

Migration Restricted by Deposits With Relatively Higher Percentages of Fine-Grained Sediments

△ Historical Soil Sampling Location*
○ Historical Groundwater Sampling Location*
● Pore Water Sampling Location
● Sediment Sampling Location
○ Former Location of AST 214
— Underground Electric
- - Underground Electric Line for Streetlights
— Sanitary Sewer Line
— Mean Lower Low Water (zero elevation)
▭ Storm Line and Catch Basin
- - Un-located Portions of Former Fuel Lines
▭ Site YF3 Boundary

Notes:

1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. AST= Aboveground Storage Tank
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017

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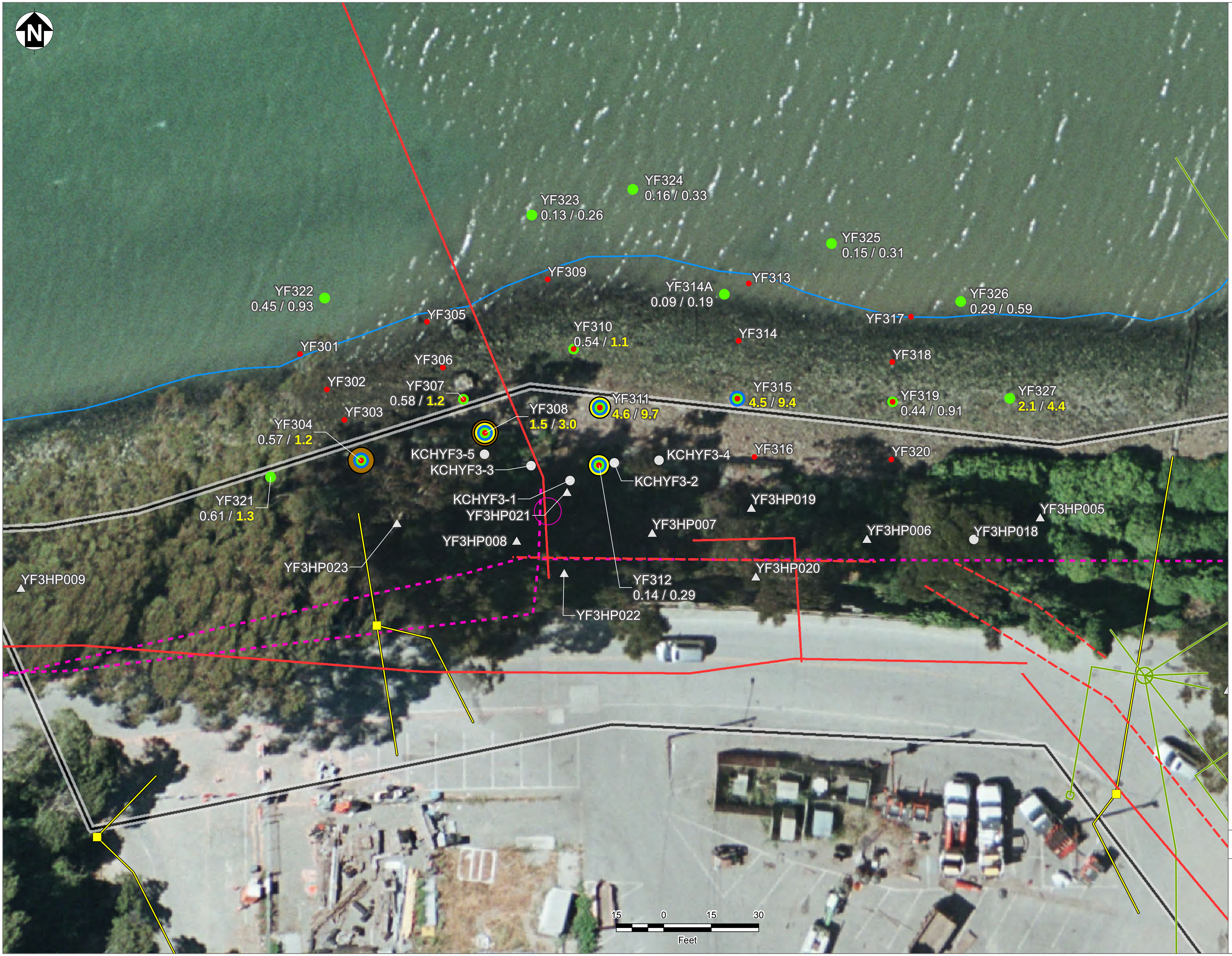
FIGURE 17
CROSS-SECTIONS OF PERCENT FINES THROUGH SEDIMENT TPH-mo GREATER THAN 1,000 MG/KG



Sample Location
Acute / Chronic PAH Potency Ratios[1]

- 🟢 Sediment Sampling Location[2]
- 🔴 Pore Water Sampling Location
- 🔵 Bioassay Sediment Sampling Location
- 🟡 Bioaccumulation Test Sampling Location
- 🟤 Petroleum Fingerprinting Sampling Location
- △ Historical Soil Sampling Location[3]
- ○ Historical Groundwater Sampling Location[3]
- ○ Former Location of AST 214
- Underground Electric
- Underground Electric Line for Streetlights
- Sanitary Sewer Line
- Mean Lower Low Water (zero elevation)
- Storm Line and Catch Basin
- Un-located Portions of Former Fuel Lines
- ▭ Site YF3 Boundary

Notes:

1. Potency ratios greater than 1 are in bold yellow font.
2. Sediment samples were collected from 0-1 foot below sediment surface.
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017.

AST Aboveground storage tank
PAH Polycyclic aromatic hydrocarbon

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FIGURE 18
PAH POTENCY RATIOS IN SURFACE SEDIMENT

Site YF3 BERA

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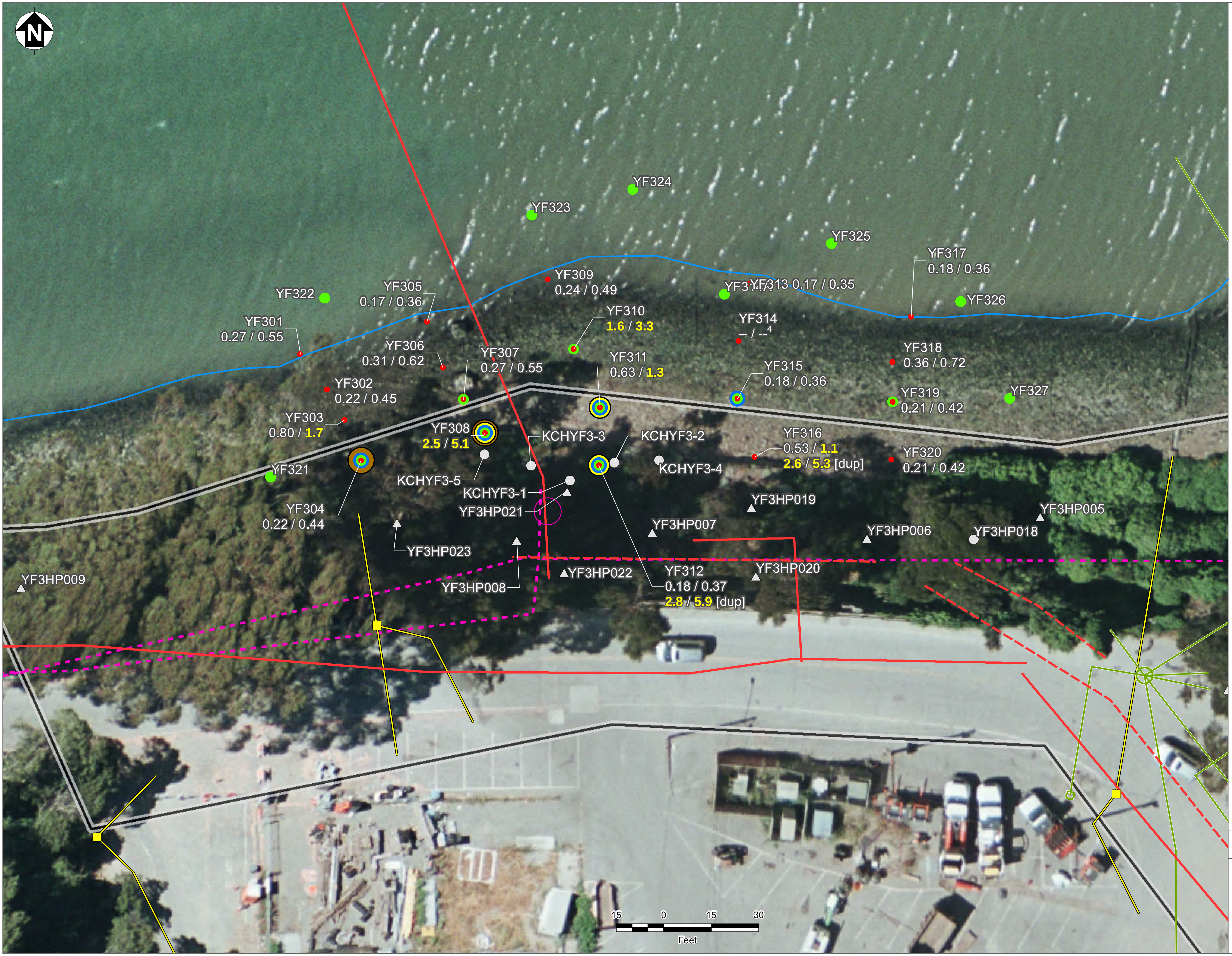

Sample Location
Acute / Chronic PAH Potency Ratios[1]

- ● Pore Water Sampling Location[2]
- ● Sediment Sampling Location
- ● Bioassay Sediment Sampling Location
- ● Bioaccumulation Test Sampling Location
- ● Petroleum Fingerprinting Sampling Location
- △ Historical Soil Sampling Location[3]
- ○ Historical Groundwater Sampling Location[3]
- ○ Former Location of AST 214
- ─ Underground Electric
- - - Underground Electric Line for Streetlights
- ─ Sanitary Sewer Line
- ─ Mean Lower Low Water (zero elevation)
- ─■─ Storm Line and Catch Basin
- - - Un-located Portions of Former Fuel Lines
- ▭ Site YF3 Boundary

Notes:

1. Potency ratios greater than 1 are in bold yellow font.
2. Pore water samples were collected at approximately 2 feet below sediment surface.
3. Historical samples were collected between 1997 and 2012. All other samples were collected in 2017.
4. Sample could not be analyzed due to heavy emulsion that was not able to be separated.

AST Aboveground storage tank
dup Duplicate sample
PAH Polycyclic aromatic hydrocarbon

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FIGURE 19
PAH POTENCY RATIOS IN PORE WATER (2017)

Site YF3 BERA

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TABLES

Table 1: Summary Statistics for Sediment (0 to 1 Foot bgs)

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Analyte Group	Chemical	Distribution [a]	Detection Frequency [b]	Number of High Censored Results [c]	Censored Data		Detected Data		Location of Maximum Concentration	Depth of Maximum Concentration	Mean [e]	95 UCL [e]	Method [e]	EPC
					Min	Max	Min	Max						
PAH	1-METHYLNAPHTHALENE	LN	13 / 16	0	1.36E-02	8.23E-02	1.56E-03 J	1.86E+00	YF311	0-1	1.64E-01	1.33E+00	(8)	1.33E+00
	2-METHYLNAPHTHALENE	G	12 / 16	0	1.36E-02	1.07E-01	6.51E-04 J	1.07E-01	YF311	0-1	3.09E-02	5.73E-02	(5)	5.73E-02
	ACENAPHTHENE	G	15 / 16	0	1.36E-02	1.36E-02	4.51E-04 J	3.18E-01	YF311	0-1	6.03E-02	1.45E-01	(5)	1.45E-01
	ACENAPHTHYLENE	G	15 / 16	0	8.03E-03	8.03E-03	1.98E-03	1.68E-01	YF307	0-1	4.26E-02	8.43E-02	(5)	8.43E-02
	ANTHRACENE	G	15 / 16	0	8.03E-03	8.03E-03	4.27E-03	1.85E-01 J	YF327	0-1	5.90E-02	1.06E-01	(5)	1.06E-01
	BENZO(A)ANTHRACENE	LN	14 / 16	0	8.23E-02	9.48E-02	1.52E-02	1.38E+00 J	YF327	0-1	1.51E-01	5.15E-01	(6)	5.15E-01
	BENZO(A)PYRENE	LN	16 / 16	0	--	--	1.73E-02	9.92E-01 J	YF327	0-1	1.96E-01	4.85E-01	(10)	4.85E-01
	BENZO(B)FLUORANTHENE	LN	16 / 16	0	--	--	1.81E-02	1.35E+00 J	YF327	0-1	1.90E-01	5.43E-01	(10)	5.43E-01
	BENZO(E)PYRENE	G	16 / 16	0	--	--	1.12E-02	6.97E-01 J	YF327	0-1	1.45E-01	2.54E-01	(4)	2.54E-01
	BENZO(G,H,I)PERYLENE	LN	16 / 16	0	--	--	5.62E-03	2.80E-01 J	YF327	0-1	6.90E-02	1.46E-01	(6)	1.46E-01
	BENZO(K)FLUORANTHENE	G	14 / 16	0	8.70E-02	9.48E-02	1.17E-02	1.03E+00 J	YF327	0-1	1.49E-01	3.97E-01	(5)	3.97E-01
	CHRYSENE	LN	16 / 16	0	--	--	1.70E-02	1.29E+00 J	YF327	0-1	1.75E-01	5.07E-01	(10)	5.07E-01
	DIBENZ(A,H)ANTHRACENE	G	15 / 16	0	9.48E-02	9.48E-02	1.79E-03	1.29E-01 J	YF327	0-1	2.72E-02	5.27E-02	(5)	5.27E-02
	FLUORANTHENE	NP	16 / 16	0	--	--	3.10E-02	2.30E+00 J	YF327	0-1	2.72E-01	8.70E-01	(10)	8.70E-01
	FLUORENE	LN	15 / 16	0	1.36E-02	1.36E-02	1.60E-03	6.65E-01	YF311	0-1	9.70E-02	2.86E-01	(6)	2.86E-01
	INDENO(1,2,3-CD)PYRENE	LN	16 / 16	0	--	--	5.77E-03	3.28E-01 J	YF327	0-1	6.44E-02	1.51E-01	(10)	1.51E-01
	NAPHTHALENE	G	10 / 16	0	2.20E-03	7.82E-03	1.13E-03 J	2.28E-01	YF308	0-1	4.25E-02	1.15E-01	(5)	1.15E-01
	PERYLENE	G	16 / 16	0	--	--	4.03E-03	2.63E-01 J	YF327	0-1	6.01E-02	1.07E-01	(4)	1.07E-01
	PHENANTHRENE	G	15 / 16	0	8.03E-03	8.03E-03	1.19E-02	1.29E+00	YF311	0-1	2.28E-01	5.23E-01	(5)	5.23E-01
	PYRENE	G	16 / 16	0	--	--	3.19E-02	1.94E+00 J	YF327	0-1	4.51E-01	7.84E-01	(4)	7.84E-01
	TOTAL HMW PAH	LN	16 / 16	0	--	--	1.73E-01	1.20E+01	YF327	0-1	1.94E+00	5.07E+00	(10)	5.07E+00
	TOTAL LMW PAH	G	16 / 16	0	--	--	2.56E-02	4.63E+00	YF311	0-1	7.16E-01	1.39E+00	(4)	1.39E+00
	TOTAL PAH	G	16 / 16	0	--	--	1.99E-01	1.28E+01	YF327	0-1	2.66E+00	4.52E+00	(4)	4.52E+00
TPH	DIESEL RANGE ORGANICS	G	20 / 21	0	1.10E+01	1.10E+01	1.04E+01	1.15E+04 D	YF315	0-1	1.50E+03	3.39E+03	(5)	3.39E+03
	GASOLINE RANGE ORGANICS	G	13 / 21	0	2.20E-01	3.30E-01	1.05E-01 J	1.69E+02 J	YF315	0-1	3.02E+01	7.13E+01	(5)	7.13E+01
	MOTOR OIL RANGE ORGANICS	N	20 / 21	0	5.70E+01	5.70E+01	1.93E+01 J	2.26E+03 J	YF315	0-1	7.65E+02	1.02E+03	(3)	1.02E+03
VOC	1,2,3-TRICHLOROBENZENE	--	1 / 16	0	1.74E-03	1.65E-02	1.95E-01	1.95E-01	YF308	0-1	--	--	(1)	1.95E-01
	1,2,4-TRIMETHYLBENZENE	--	4 / 16	0	1.74E-03	7.99E-03	1.52E-03 J	4.30E-02 J	YF308	0-1	--	--	(1)	4.30E-02
	1,3,5-TRIMETHYLBENZENE	--	1 / 16	0	8.71E-04	8.24E-03	1.13E-02 J	1.13E-02 J	YF308	0-1	--	--	(1)	1.13E-02
	BENZENE	--	1 / 16	6	8.71E-04	8.24E-03	1.54E-03 J	1.54E-03 J	YF310	0-1	--	--	(1)	1.54E-03
	ETHYLBENZENE	--	2 / 16	5	8.71E-04	1.65E-02	8.10E-04 J	9.27E-03 J	YF307	0-1	--	--	(1)	9.27E-03
	ISOPROPYLBENZENE	--	1 / 16	5	1.74E-03	8.24E-03	6.70E-03 J	6.70E-03 J	YF308	0-1	--	--	(1)	6.70E-03
	M,P-XYLENES	--	2 / 16	0	1.74E-03	1.65E-02	1.10E-02 J	2.19E-02 J	YF307	0-1	--	--	(1)	2.19E-02
	N-BUTYLBENZENE	--	2 / 16	0	1.74E-03	7.99E-03	3.97E-02 J	4.44E-02 J	YF308	0-1	--	--	(1)	4.44E-02
	N-PROPYLBENZENE	--	3 / 16	1	8.71E-04	1.60E-02	1.11E-03 J	1.57E-02 J	YF308	0-1	--	--	(1)	1.57E-02
	O-XYLENE	--	2 / 16	5	8.71E-04	1.65E-02	4.77E-04 J	1.14E-02 J	YF307	0-1	--	--	(1)	1.14E-02
	PARA-ISOPROPYL TOLUENE	--	3 / 16	0	1.90E-03	8.24E-03	7.78E-04 J	3.82E-02 J	YF308	0-1	--	--	(1)	3.82E-02
	SEC-BUTYLBENZENE	--	3 / 16	0	1.74E-03	7.99E-03	7.82E-04 J	1.88E-02 J	YF308	0-1	--	--	(1)	1.88E-02
	TOLUENE	--	2 / 16	0	1.74E-03	1.65E-02	1.44E-03 J	2.61E-02 J	YF307	0-1	--	--	(1)	2.61E-02

Table 1: Summary Statistics for Sediment (0 to 1 Foot bgs)

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Notes: Units are milligrams per kilogram.

--	Not applicable or no calculations of the mean or 95UCL for chemicals with fewer than six detected results.
95UCL	One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2013), this may be estimated by either a 95, 97.5, or 99 percent UCL depending on sample size, skewness, and detection frequency.
BCa	Bias-corrected accelerated
BSS	Below sediment surface
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration. The EPC is the lesser of the 95UCL and the maximum detected result. The maximum detected result is the default when there are fewer than 6 detected results.
HMW	High molecular weight
KM	Kaplan-Meier product limit estimator
LMW	Low molecular weight
Max	Maximum reported result
Min	Minimum reported result
PAH	Polycyclic aromatic hydrocarbon
TPH	Total petroleum hydrocarbon
UCL	Upper confidence limit
VOC	Volatile organic compound

[a] Tested for detected data only using the ProUCL Shapiro-Wilk W test (normal and lognormal distributions) and the Anderson-Darling, or Kolmogorov-Smirnov test (gamma distributions). A 5 percent level of significance was used in all tests. Testing conducted for chemicals with at least 6 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in calculations of the mean and 95UCL.   Distribution Codes: G= gamma, LN= lognormal, N= normal, NP= nonparametric

[b] Detection frequency for the raw data (includes high censored results, see footnote c). The detection frequency for totals is the proportion of samples where all congeners were detected. All totals (sums of individual congeners) were treated as detected results in calculations of the mean and 95UCL.

[c] Number of censored (nondetect) results that exceeded the maximum detected concentration. These results were excluded from calculations of the mean and 95UCL.

[d] The range for censored data following exclusion of high censored results (see footnote c)

[e] The mean and 95UCL calculated for all chemicals with at least six detected results following recommendations in EPA (2013). Some notes presented in the list of method codes below are not used; all notes are presented on each statistical table for consistency.

The Kaplan Meier product limit estimator method is used to estimate the mean and UCL for data sets with nondetect results. The method codes are defined as follows:

(1) Maximum detected concentration
(2) 95 percent UCL calculated using Student's *t* distribution
(3) 95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL
(4) 95 percent UCL calculated using the adjusted gamma method
(5) 95 percent UCL calculated using the KM mean and the adjusted gamma method
(6) 95 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(7) 97.5 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(8) 99 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(9) 95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL
(10) 95 percent UCL calculated using the nonparametric Chebyshev method to estimate the UCL

References:

EPA. 2002. Calculating Exposure Point Concentrations at Hazardous Waste Sites. Office of Solid Waste and Emergency Resposne 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

EPA. 2013. ProUCL Version 5.0.00 Technical Guide Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. September. Available on-line: http://www.epa.gov/osp/hstl/tsc/software.htm

Table 2: Summary Statistics for Sediment (1 to 5.5 feet bgs)

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Analyte Group	Chemical	Distribution [a]	Detection Frequency [b]	Number of High Censored Results [c]	Censored Data [d]		Detected Data		Location of Maximum Concentration	Depth of Maximum Concentration	Mean [e]	95 UCL [e]	Method [e]	EPC
					Min	Max	Min	Max						
PAH	1-METHYLNAPHTHALENE	LN	10 / 16	0	1.30E-03	1.27E-02	2.05E-03 J	1.90E+01	YF311	4.5-5.5	1.91E+00	1.55E+01	(8)	1.55E+01
	2-METHYLNAPHTHALENE	LN	17 / 26	0	1.30E-03	1.27E-02	3.13E-03 J	1.57E+00	YF311	4.5-5.5	1.35E-01	4.39E-01	(6)	4.39E-01
	ACENAPHTHENE	G	10 / 26	0	1.30E-03	2.43E-02	1.37E-03 J	2.22E+00	YF311	4.5-5.5	1.91E-01	6.56E-01	(5)	6.56E-01
	ACENAPHTHYLENE	G	12 / 26	0	2.00E-03	1.33E-01	1.70E-03 J	3.90E-01	KCHYF3-3	5-5	3.17E-02	9.03E-02	(5)	9.03E-02
	ANTHRACENE	G	14 / 26	0	1.80E-03	1.33E-01	5.05E-03 J	7.60E-01	KCHYF3-3	5-5	1.03E-01	2.10E-01	(5)	2.10E-01
	BENZO(A)ANTHRACENE	G	24 / 26	0	2.00E-03	2.00E-03	1.53E-02 J	3.85E-01	YF327	4.5-5.5	1.06E-01	1.65E-01	(5)	1.65E-01
	BENZO(A)PYRENE	G	26 / 26	0	--	--	1.50E-02	7.37E-01 J	YF323	4.5-5.5	1.44E-01	2.10E-01	(4)	2.10E-01
	BENZO(B)FLUORANTHENE	G	22 / 26	0	2.54E-02	2.66E-01	1.41E-02	4.55E-01 J	YF323	4.5-5.5	1.17E-01	1.73E-01	(5)	1.73E-01
	BENZO(G,H,I)PERYLENE	LN	24 / 26	0	4.13E-02	3.98E-01	1.18E-02 J	6.34E-01 J	YF323	4.5-5.5	1.31E-01	2.85E-01	(6)	2.85E-01
	BENZO(K)FLUORANTHENE	G	22 / 26	0	2.54E-02	2.66E-01	1.52E-02	4.50E-01 J	KCHYF3-1	2-2	1.21E-01	1.75E-01	(5)	1.75E-01
	CHRYSENE	G	24 / 26	0	1.80E-03	1.80E-03	1.47E-02 J	5.20E-01	KCHYF3-1	2-2	1.53E-01	2.33E-01	(5)	2.33E-01
	DIBENZ(A,H)ANTHRACENE	G	17 / 26	2	2.00E-03	3.98E-01	2.82E-03 J	1.09E-01 J	YF323	4.5-5.5	2.27E-02	3.66E-02	(5)	3.66E-02
	FLUORANTHENE	NP	22 / 26	0	2.60E-03	1.33E-01	3.02E-02 J	7.95E-01	YF327	4.5-5.5	1.83E-01	3.78E-01	(6)	3.78E-01
	FLUORENE	LN	12 / 26	0	1.30E-03	2.24E-02	7.61E-03 J	2.90E+00	KCHYF3-3	5-5	3.28E-01	1.40E+00	(7)	1.40E+00
	INDENO(1,2,3-CD)PYRENE	LN	24 / 26	0	1.38E-02	1.33E-01	1.00E-02	5.34E-01 J	YF323	4.5-5.5	1.15E-01	1.96E-01	(11)	1.96E-01
	NAPHTHALENE	LN	19 / 26	0	2.19E-03	6.88E-03	2.30E-03 J	1.54E+00	YF311	4.5-5.5	1.18E-01	3.94E-01	(6)	3.94E-01
	PHENANTHRENE	LN	20 / 26	0	2.40E-03	1.38E-02	8.00E-03 J	6.37E+00	YF311	4.5-5.5	6.37E-01	1.93E+00	(6)	1.93E+00
	PYRENE	G	26 / 26	0	--	--	3.41E-02 J	1.09E+00 J	YF323	4.5-5.5	3.71E-01	4.96E-01	(4)	4.96E-01
	TOTAL HMW PAH	G	26 / 26	0	--	--	1.82E-01	5.48E+00	YF323	4.5-5.5	1.44E+00	2.00E+00	(4)	2.00E+00
	TOTAL LMW PAH	LN	26 / 26	0	--	--	2.30E-03	3.53E+01	YF311	4.5-5.5	2.89E+00	1.26E+01	(7)	1.26E+01
	TOTAL PAH	LN	26 / 26	0	--	--	1.97E-01	3.68E+01	YF311	4.5-5.5	4.33E+00	1.12E+01	(10)	1.12E+01
TPH	DIESEL RANGE ORGANICS	G	32 / 32	0	--	--	2.18E+00 J	1.07E+04 D	YF311	4.5-5.5	1.86E+03	3.16E+03	(4)	3.16E+03
	GASOLINE RANGE ORGANICS	G	15 / 32	0	2.05E-01	8.80E-01	2.96E-01 J	6.67E+02 J	YF315	4.5-5.5	7.10E+01	1.80E+02	(5)	1.80E+02
	MOTOR OIL RANGE ORGANICS	G	30 / 32	0	3.60E+02	4.60E+02	7.54E+00 J	2.80E+03	KCHYF3-3	5-5	8.86E+02	1.23E+03	(5)	1.23E+03
VOC	1,2,4-TRIMETHYLBENZENE	--	4 / 25	1	2.19E-03	4.20E-01	2.01E-02 J	1.00E-01	KCHYF3-5	2-2	--	--	(1)	1.00E-01
	1,3,5-TRIMETHYLBENZENE	--	2 / 25	1	1.10E-03	2.60E-01	1.37E-02 J	3.80E-02 J	KCHYF3-5	2-2	--	--	(1)	3.80E-02
	2-BUTANONE	--	4 / 10	0	6.40E-02	7.80E-02	1.50E-01 J	1.70E+00 J	KCHYF3-3	2-2	--	--	(1)	1.70E+00
	2-CHLOROTOLUENE	--	1 / 25	1	2.19E-03	3.00E-01	6.02E-02 J	6.02E-02 J	YF311	4.5-5.5	--	--	(1)	6.02E-02
	ACETONE	N	6 / 10	1	3.00E-01	6.20E+00	1.80E-01 J	4.20E-01 J	KCHYF3-1	5-5	2.62E-01	3.22E-01	(3)	3.22E-01
	BENZENE	--	1 / 25	3	1.10E-03	3.60E-01	1.94E-02 J	1.94E-02 J	YF311	4.5-5.5	--	--	(1)	1.94E-02
	BROMOMETHANE	--	4 / 25	3	2.19E-03	5.20E-01	1.90E-02 J	3.80E-02 J	KCHYF3-1	2-2	--	--	(1)	3.80E-02
	CARBON DISULFIDE	N	6 / 10	1	2.20E-02	4.40E-01	2.10E-02 J	6.80E-02	KCHYF3-1	2-2	3.07E-02	4.06E-02	(3)	4.06E-02
	CHLOROMETHANE	N	6 / 25	4	1.10E-03	6.80E-01	1.80E-02 J	2.90E-02 J	KCHYF3-5	5-5	7.32E-03	1.14E-02	(3)	1.14E-02
	ETHYLBENZENE	--	5 / 25	1	1.10E-03	5.00E-01	8.15E-03 J	9.27E-02 J	YF311	4.5-5.5	--	--	(1)	9.27E-02
	ISOPROPYLBENZENE	--	3 / 25	1	2.19E-03	3.60E-01	2.60E-02 J	2.68E-01	YF311	4.5-5.5	--	--	(1)	2.68E-01
	M,P-XYLENES	--	5 / 25	1	2.19E-03	8.80E-01	1.69E-02 J	9.67E-02 J	YF311	4.5-5.5	--	--	(1)	9.67E-02
	METHYLENE CHLORIDE	NP	6 / 25	0	2.19E-03	4.10E-02	2.10E-02 J	7.80E-01 J	KCHYF3-3	2-2	4.14E-02	1.86E-01	(6)	1.86E-01
	N-BUTYLBENZENE	--	4 / 25	0	2.19E-03	3.20E-01	4.45E-02 J	9.70E-01	YF311	4.5-5.5	--	--	(1)	9.70E-01
	N-PROPYLBENZENE	--	5 / 25	0	1.10E-03	4.60E-01	9.06E-03 J	5.40E-01	YF311	4.5-5.5	--	--	(1)	5.40E-01
	O-XYLENE	--	5 / 25	1	1.10E-03	4.20E-01	8.65E-03 J	5.29E-02 J	YF311	4.5-5.5	--	--	(1)	5.29E-02
	PARA-ISOPROPYL TOLUENE	--	2 / 25	1	2.19E-03	2.60E-01	4.40E-02 J	8.86E-02 J	YF311	4.5-5.5	--	--	(1)	8.86E-02
	SEC-BUTYLBENZENE	--	5 / 25	0	2.19E-03	1.54E-02	9.09E-03 J	8.24E-01	YF311	4.5-5.5	--	--	(1)	8.24E-01
	TOLUENE	--	2 / 25	1	2.19E-03	3.80E-01	1.20E-02 J	6.58E-02 J	YF311	4.5-5.5	--	--	(1)	6.58E-02

Table 2: Summary Statistics for Sediment (1 to 5.5 feet bgs)

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Notes: Units are milligrams per kilogram.

--	Not applicable or no calculations of the mean or 95UCL for chemicals with fewer than six detected results.
95UCL	One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2013), this may be estimated by either a 95, 97.5, or 99 percent UCL depending on sample size, skewness, and detection frequency.
BCa	Bias-corrected accelerated
BSS	Below sediment surface
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration. The EPC is the lesser of the 95UCL and the maximum detected result. The maximum detected result is the default when there are fewer than 6 detected results.
HMW	High molecular weight
KM	Kaplan-Meier product limit estimator
LMW	Low molecular weight
Max	Maximum reported result
Min	Minimum reported result
PAH	Polycyclic aromatic hydrocarbon
TPH	Total petroleum hydrocarbon
UCL	Upper confidence limit
VOC	Volatile organic compound

[a] Tested for detected data only using the ProUCL Shapiro-Wilk W test (normal and lognormal distributions) and the Anderson-Darling, or Kolmogorov-Smirnov test (gamma distributions). A 5 percent level of significance was used in all tests. Testing conducted for chemicals with at least 10 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in calculations of the mean and 95UCL. Distribution Codes: G= gamma, LN= lognormal, N= normal, NP= nonparametric

[b] Detection frequency for the raw data (includes high censored results, see footnote c). The detection frequency for totals is the proportion of samples where all congeners were detected. All totals (sums of individual congeners) were treated as detected results in calculations of the mean and 95UCL.

[c] Number of censored (nondetect) results that exceeded the maximum detected concentration. These results were excluded from calculations of the mean and 95UCL.

[d] The range for censored data following exclusion of high censored results (see footnote c)

[e] The mean and 95UCL calculated for all chemicals with at least six detected results following recommendations in EPA (2013). Some notes presented in the list of method codes below are not used; all notes are presented on each statistical table for consistency. The Kaplan Meier product limit estimator method is used to estimate the mean and UCL for data sets with nondetect results. The method codes are defined as follows:

(1) Maximum detected concentration
(2) 95 percent UCL calculated using Student's *t* distribution
(3) 95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL
(4) 95 percent UCL calculated using the adjusted gamma method
(5) 95 percent UCL calculated using the KM mean and the adjusted gamma method
(6) 95 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(7) 97.5 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(8) 99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(9) 95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL
(10) 95 percent UCL calculated using the nonparametric Chebyshev method to estimate the UCL
(11) 95 percent UCL calculated using the KM mean and 95% H-UCL (KM -Log) to estimate the UCL

References:

EPA. 2002. Calculating Exposure Point Concentrations at Hazardous Waste Sites. Office of Solid Waste and Emergency Resposne 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

EPA. 2013. ProUCL Version 5.0.00 Technical Guide Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. September. Available on-line: http://www.epa.gov/osp/hstl/tsc/software.htm

Table 3: Summary Statistics for Sediment (5.5 to 10 feet bgs)

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Analyte Group	Chemical	Distribution [a]	Detection Frequency [b]	Number of High Censored Results [c]	Censored Data [d]		Detected Data		Location of Maximum Concentration	Depth of Maximum Concentration	Mean [e]	95 UCL [e]	Method [e]	EPC
					Min	Max	Min	Max						
PAH	1-METHYLNAPHTHALENE	LN	7 / 16	0	1.23E-03	2.32E-02	2.80E-03 J	2.04E+01	YF311	9-10	1.42E+00	7.22E+00	(6)	7.22E+00
	2-METHYLNAPHTHALENE	LN	9 / 21	0	1.23E-03	1.36E-01	2.63E-03 J	5.70E-01 J	KCHYF3-1	10-10	3.26E-02	1.54E-01	(6)	1.54E-01
	ACENAPHTHENE	LN	11 / 21	1	1.23E-03	1.13E-02	1.70E-03 J	4.37E+00	YF311	9-10	2.88E-01	2.44E+00	(8)	2.44E+00
	ACENAPHTHYLENE	G	10 / 21	0	1.23E-03	1.36E-01	1.60E-03 J	1.10E-01	KCHYF3-1	10-10	1.78E-02	3.78E-02	(5)	3.78E-02
	ANTHRACENE	G	15 / 21	0	1.23E-03	1.45E-03	3.55E-03 J	8.39E-01	YF311	9-10	1.15E-01	2.51E-01	(5)	2.51E-01
	BENZO(A)ANTHRACENE	N	16 / 21	0	1.28E-03	1.45E-03	1.42E-03 J	3.49E-01	YF304	9-10	8.87E-02	1.27E-01	(3)	1.27E-01
	BENZO(A)PYRENE	N	15 / 21	0	1.28E-03	6.13E-02	1.47E-03 J	3.78E-01	YF304	9-10	8.25E-02	1.21E-01	(3)	1.21E-01
	BENZO(B)FLUORANTHENE	N	12 / 21	1	2.46E-03	2.73E-01	5.00E-03 J	2.50E-01 J	KCHYF3-2, KCHYF3-2-5	10-10	6.29E-02	9.46E-02	(3)	9.46E-02
	BENZO(G,H,I)PERYLENE	N	12 / 21	2	3.69E-03	4.09E-01	2.60E-03 J	1.83E-01	YF304	9-10	4.37E-02	6.47E-02	(3)	6.47E-02
	BENZO(K)FLUORANTHENE	G	12 / 21	0	2.46E-03	2.73E-01	6.10E-03 J	3.10E-01 J	KCHYF3-2, KCHYF3-2-5	10-10	7.58E-02	1.41E-01	(5)	1.41E-01
	CHRYSENE	G	16 / 21	0	1.28E-03	1.45E-03	1.44E-03 J	7.81E-01	YF311	9-10	1.18E-01	2.37E-01	(5)	2.37E-01
	DIBENZ(A,H)ANTHRACENE	N	8 / 21	3	2.00E-03	4.09E-01	2.87E-03 J	4.30E-02 J	YF304	9-10	1.06E-02	1.57E-02	(3)	1.57E-02
	FLUORANTHENE	G	17 / 21	0	1.34E-03	6.83E-03	7.53E-04 J	8.14E-01	YF304	9-10	1.90E-01	3.40E-01	(5)	3.40E-01
	FLUORENE	LN	13 / 21	0	1.23E-03	1.36E-01	3.40E-03 J	1.32E+00	YF315	8-9	1.18E-01	4.07E-01	(6)	4.07E-01
	INDENO(1,2,3-CD)PYRENE	N	13 / 21	0	1.23E-03	1.36E-01	2.60E-03 J	1.90E-01	YF304	9-10	4.37E-02	6.43E-02	(3)	6.43E-02
	NAPHTHALENE	G	12 / 21	0	1.23E-03	6.65E-03	1.23E-03 J	2.72E-01	YF315	8-9	4.04E-02	1.04E-01	(5)	1.04E-01
	PHENANTHRENE	LN	16 / 21	0	1.34E-03	7.26E-03	1.30E-03 J	8.35E+00	YF311	9-10	5.77E-01	3.05E+00	(7)	3.05E+00
	PYRENE	G	17 / 21	0	1.34E-03	7.26E-03	1.57E-03 J	1.15E+00	YF311	9-10	2.78E-01	4.83E-01	(5)	4.83E-01
	TOTAL HMW PAH	G	17 / 21	0	4.01E-03	7.26E-03	2.32E-03	3.77E+00	YF304	9-10	9.69E-01	1.65E+00	(5)	1.65E+00
	TOTAL LMW PAH	NP	16 / 21	0	1.34E-03	7.26E-03	1.30E-03	3.41E+01	YF311	9-10	2.27E+00	1.25E+01	(7)	1.25E+01
	TOTAL PAH	G	17 / 21	0	4.01E-03	7.26E-03	3.62E-03	3.71E+01	YF311	9-10	3.24E+00	1.08E+01	(5)	1.08E+01
TPH	DIESEL RANGE ORGANICS	NP	30 / 30	0	--	--	1.12E+00 D	2.59E+04 D	YF311	9-10	2.40E+03	6.70E+03	(10)	6.70E+03
	GASOLINE RANGE ORGANICS	LN	18 / 29	0	1.90E-01	8.40E-01	1.09E-01 J	4.89E+02 D	YF311	9-10	6.44E+01	3.39E+02	(8)	3.39E+02
	MOTOR OIL RANGE ORGANICS	LN	26 / 30	0	1.29E+01	4.20E+02	5.94E+00 J	1.00E+04 LM	YF3HP019	6.5-7	1.01E+03	2.80E+03	(6)	2.80E+03
VOC	1,2,4-TRICHLOROBENZENE	--	1 / 21	17	1.92E-03	5.20E-02	2.16E-03 J	2.16E-03 J	YF307	9-10	--	--	(1)	2.16E-03
	1,2,4-TRIMETHYLBENZENE	--	1 / 20	1	1.92E-03	4.60E-02	4.31E-02 J	4.31E-02 J	YF327	9-10	--	--	(1)	4.31E-02
	1,3,5-TRIMETHYLBENZENE	--	1 / 20	7	9.61E-04	3.00E-02	1.35E-02 J	1.35E-02 J	YF327	9-10	--	--	(1)	1.35E-02
	1,4-DICHLOROBENZENE	--	1 / 21	20	1.92E-03	4.60E-02	1.48E-03 J	1.48E-03 J	YF307	9-10	--	--	(1)	1.48E-03
	ACETONE	--	1 / 5	4	3.20E-01	6.80E-01	2.50E-01 J	2.50E-01 J	KCHYF3-5	10-10	--	--	(1)	2.50E-01
	BENZENE	--	1 / 20	19	9.61E-04	4.00E-02	7.77E-04 J	7.77E-04 J	YF304	9-10	--	--	(1)	7.77E-04
	CARBON DISULFIDE	--	1 / 5	4	2.20E-02	4.80E-02	1.50E-02 J	1.50E-02 J	KCHYF3-3	10-10	--	--	(1)	1.50E-02
	CHLOROMETHANE	--	2 / 20	3	9.61E-04	7.60E-02	2.00E-02 J	2.10E-02 J	KCHYF3-3	10-10	--	--	(1)	2.10E-02
	ETHYLBENZENE	--	1 / 20	7	9.61E-04	5.60E-02	2.49E-02 J	2.49E-02 J	YF327	9-10	--	--	(1)	2.49E-02
	ISOPROPYLBENZENE	--	4 / 20	0	1.92E-03	1.98E-02	7.20E-03 J	6.50E-02 J	KCHYF3-1	10-10	--	--	(1)	6.50E-02
	M,P-XYLENES	--	2 / 20	3	1.92E-03	9.80E-02	3.14E-02 J	4.75E-02 J	YF327	9-10	--	--	(1)	4.75E-02
	METHYLENE CHLORIDE	--	4 / 20	0	1.92E-03	4.40E-02	2.40E-02 J	1.10E-01 J	KCHYF3-1	10-10	--	--	(1)	1.10E-01
	N-BUTYLBENZENE	--	3 / 20	0	1.92E-03	1.86E-02	1.15E-01	1.52E-01	YF315	8-9	--	--	(1)	1.52E-01
	N-PROPYLBENZENE	--	5 / 20	0	9.61E-04	2.60E-02	2.02E-02 J	8.50E-02 J	KCHYF3-1	10-10	--	--	(1)	8.50E-02
	O-XYLENE	--	2 / 20	6	9.61E-04	4.60E-02	1.19E-02 J	1.79E-02 J	YF327	9-10	--	--	(1)	1.79E-02
	PARA-ISOPROPYL TOLUENE	--	2 / 20	12	1.92E-03	3.00E-02	2.28E-03 J	2.65E-03 J	YF308	9-10	--	--	(1)	2.65E-03
	SEC-BUTYLBENZENE	--	4 / 20	0	1.92E-03	1.48E-02	2.60E-02 J	1.30E-01	KCHYF3-1	10-10	--	--	(1)	1.30E-01
	TERT-BUTYLBENZENE	--	1 / 20	0	1.92E-03	3.39E-02	4.75E-02 J	4.75E-02 J	YF311	9-10	--	--	(1)	4.75E-02
	TOLUENE	--	2 / 20	3	1.92E-03	4.20E-02	6.64E-04 J	2.46E-02 J	YF327	9-10	--	--	(1)	2.46E-02

Table 3: Summary Statistics for Sediment (5.5 to 10 feet bgs)

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Notes: Units are milligrams per kilogram.

--	Not applicable or no calculations of the mean or 95UCL for chemicals with fewer than six detected results.
95UCL	One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2013), this may be estimated by either a 95, 97.5, or 99 percent UCL depending on sample size, skewness, and detection frequency.
BCa	Bias-corrected accelerated
BSS	Below sediment surface
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration. The EPC is the lesser of the 95UCL and the maximum detected result. The maximum detected result is the default when there are fewer than 6 detected results.
HMW	High molecular weight
KM	Kaplan-Meier product limit estimator
LMW	Low molecular weight
Max	Maximum reported result
Min	Minimum reported result
PAH	Polycyclic aromatic hydrocarbon
TPH	Total petroleum hydrocarbon
UCL	Upper confidence limit
VOC	Volatile organic compound

a Tested for detected data only using the ProUCL Shapiro-Wilk W test (normal and lognormal distributions) and the Anderson-Darling, or Kolmogorov-Smirnov test (gamma distributions). A 5 percent level of significance was used in all tests. Testing conducted for chemicals with at least 10 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in calculations of the mean and 95UCL.   Distribution Codes: G= gamma, LN= lognormal, N= normal, NP= nonparametric

b Detection frequency for the raw data (includes high censored results, see footnote c). The detection frequency for totals is the proportion of samples where all congeners were detected. All totals (sums of individual congeners) were treated as detected results in calculations of the mean and 95UCL.

c Number of censored (nondetect) results that exceeded the maximum detected concentration. These results were excluded from calculations of the mean and 95UCL.

d The range for censored data following exclusion of high censored results (see footnote c)

e The mean and 95UCL calculated for all chemicals with at least six detected results following recommendations in EPA (2013). Some notes presented in the list of method codes below are not used; all notes are presented on each statistical table for consistency.
The Kaplan Meier product limit estimator method is used to estimate the mean and UCL for data sets with nondetect results. The method codes are defined as follows:

(1)	Maximum detected concentration
(2)	95 percent UCL calculated using Student's *t* distribution
(3)	95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL
(4)	95 percent UCL calculated using the adjusted gamma method
(5)	95 percent UCL calculated using the KM mean and the adjusted gamma method
(6)	95 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(7)	97.5 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(8)	99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(9)	95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL
(10)	95 percent UCL calculated using the nonparametric Chebyshev method to estimate the UCL

References:

EPA. 2002. Calculating Exposure Point Concentrations at Hazardous Waste Sites. Office of Solid Waste and Emergency Resposne 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

EPA. 2013. ProUCL Version 5.0.00 Technical Guide Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. September. Available on-line: http://www.epa.gov/osp/hstl/tsc/software.htm

Table 4: Summary Statistics for Sediment (1 to 10 feet bgs)

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Analyte Group	Chemical	Distribution [a]	Detection Frequency [b]	Number of High Censored Results [c]	Censored Data [d]		Detected Data		Location of Maximum Concentration	Depth of Maximum Concentration	Mean [e]	95 UCL [e]	Method [e]	EPC
					Min	Max	Min	Max						
PAH	1-METHYLNAPHTHALENE	LN	17 / 32	0	1.23E-03	2.32E-02	2.05E-03 J	2.04E+01	YF311	9-10	1.67E+00	1.08E+01	(8)	1.08E+01
	2-METHYLNAPHTHALENE	NP	26 / 47	0	1.23E-03	1.36E-01	2.63E-03 J	1.57E+00	YF311	4.5-5.5	8.93E-02	2.67E-01	(6)	2.67E-01
	ACENAPHTHENE	LN	21 / 47	0	1.23E-03	2.43E-02	1.37E-03 J	4.37E+00	YF311	9-10	2.34E-01	9.32E-01	(7)	9.32E-01
	ACENAPHTHYLENE	G	22 / 47	0	1.23E-03	1.36E-01	1.60E-03 J	3.90E-01	KCHYF3-3	5-5	2.54E-02	5.08E-02	(5)	5.08E-02
	ANTHRACENE	G	29 / 47	0	1.23E-03	1.33E-01	3.55E-03 J	8.39E-01	YF311	9-10	1.08E-01	1.74E-01	(5)	1.74E-01
	BENZO(A)ANTHRACENE	G	40 / 47	0	1.28E-03	2.00E-03	1.42E-03 J	3.85E-01	YF327	4.5-5.5	9.82E-02	1.33E-01	(5)	1.33E-01
	BENZO(A)PYRENE	G	41 / 47	0	1.28E-03	6.13E-02	1.47E-03 J	7.37E-01 J	YF323	4.5-5.5	1.17E-01	1.63E-01	(5)	1.63E-01
	BENZO(B)FLUORANTHENE	G	34 / 47	0	2.46E-03	2.73E-01	5.00E-03 J	4.55E-01 J	YF323	4.5-5.5	9.21E-02	1.26E-01	(5)	1.26E-01
	BENZO(G,H,I)PERYLENE	LN	36 / 47	0	3.69E-03	4.09E-01	2.60E-03 J	6.34E-01 J	YF323	4.5-5.5	9.24E-02	1.84E-01	(6)	1.84E-01
	BENZO(K)FLUORANTHENE	G	34 / 47	0	2.46E-03	2.73E-01	6.10E-03 J	4.50E-01 J	KCHYF3-1	2-2	1.01E-01	1.36E-01	(5)	1.36E-01
	CHRYSENE	G	40 / 47	0	1.28E-03	1.80E-03	1.44E-03 J	7.81E-01	YF311	9-10	1.37E-01	1.92E-01	(5)	1.92E-01
	DIBENZ(A,H)ANTHRACENE	G	25 / 47	4	2.00E-03	4.09E-01	2.82E-03 J	1.09E-01 J	YF323	4.5-5.5	1.73E-02	2.49E-02	(5)	2.49E-02
	FLUORANTHENE	G	39 / 47	0	1.34E-03	1.33E-01	7.53E-04 J	8.14E-01	YF304	9-10	1.86E-01	2.61E-01	(5)	2.61E-01
	FLUORENE	NP	25 / 47	0	1.23E-03	1.36E-01	3.40E-03 J	2.90E+00	KCHYF3-3	5-5	2.34E-01	6.64E-01	(6)	6.64E-01
	INDENO(1,2,3-CD)PYRENE	LN	37 / 47	0	1.23E-03	1.36E-01	2.60E-03 J	5.34E-01 J	YF323	4.5-5.5	8.34E-02	1.62E-01	(6)	1.62E-01
	NAPHTHALENE	LN	31 / 47	0	1.23E-03	6.88E-03	1.23E-03 J	1.54E+00	YF311	4.5-5.5	8.35E-02	2.40E-01	(6)	2.40E-01
	PHENANTHRENE	LN	36 / 47	0	1.34E-03	1.38E-02	1.30E-03 J	8.35E+00	YF311	9-10	6.10E-01	1.64E+00	(6)	1.64E+00
	PYRENE	G	43 / 47	0	1.34E-03	7.26E-03	1.57E-03 J	1.15E+00	YF311	9-10	3.29E-01	4.23E-01	(5)	4.23E-01
	TOTAL HMW PAH	G	43 / 47	0	4.01E-03	7.26E-03	2.32E-03 J	5.48E+00	YF323	4.5-5.5	1.23E+00	1.62E+00	(5)	1.62E+00
	TOTAL LMW PAH	LN	42 / 47	0	1.34E-03	7.26E-03	1.30E-03 J	3.53E+01	YF311	4.5-5.5	2.61E+00	9.57E+00	(7)	9.57E+00
	TOTAL PAH	NP	43 / 47	0	4.01E-03	7.26E-03	3.62E-03 J	3.71E+01	YF311	9-10	3.84E+00	8.91E+00	(6)	8.91E+00
TPH	DIESEL RANGE ORGANICS	G	62 / 62	0	--	--	1.12E+00 D	2.59E+04 D	YF311	9-10	2.12E+03	3.27E+03	(4)	3.27E+03
	GASOLINE RANGE ORGANICS	NP	33 / 61	0	1.90E-01	8.80E-01	1.09E-01 J	6.67E+02 J	YF315	4.5-5.5	6.79E+01	1.99E+02	(7)	1.99E+02
	MOTOR OIL RANGE ORGANICS	G	56 / 62	0	1.29E+01	4.60E+02	5.94E+00 J	1.00E+04 LM	YF3HP019	6.5-7	9.44E+02	1.43E+03	(5)	1.43E+03
VOC	1,2,4-TRICHLOROBENZENE	--	1 / 46	42	1.92E-03	4.60E-01	2.16E-03 J	2.16E-03 J	YF307	9-10	--	--	(1)	2.16E-03
	1,2,4-TRIMETHYLBENZENE	--	5 / 45	1	1.92E-03	4.20E-01	2.01E-02 J	1.00E-01	KCHYF3-5	2-2	--	--	(1)	1.00E-01
	1,3,5-TRIMETHYLBENZENE	--	3 / 45	1	9.61E-04	2.60E-01	1.35E-02 J	3.80E-02 J	KCHYF3-5	2-2	--	--	(1)	3.80E-02
	1,4-DICHLOROBENZENE	--	1 / 46	45	1.92E-03	4.20E-01	1.48E-03 J	1.48E-03 J	YF307	9-10	--	--	(1)	1.48E-03
	2-BUTANONE	--	4 / 15	0	6.40E-02	1.46E-01	1.50E-01 J	1.70E+00 J	KCHYF3-3	2-2	--	--	(1)	1.70E+00
	2-CHLOROTOLUENE	--	1 / 45	1	1.92E-03	3.00E-01	6.02E-02 J	6.02E-02 J	YF311	4.5-5.5	--	--	(1)	6.02E-02
	ACETONE	N	7 / 15	2	3.00E-01	6.20E+00	1.80E-01 J	4.20E-01 J	KCHYF3-1	5-5	2.54E-01	2.96E-01	(3)	2.96E-01
	BENZENE	--	2 / 45	5	9.61E-04	3.60E-01	7.77E-04 J	1.94E-02 J	YF311	4.5-5.5	--	--	(1)	1.94E-02
	BROMOMETHANE	--	4 / 45	6	1.92E-03	5.20E-01	1.90E-02 J	3.80E-02 J	KCHYF3-1	2-2	--	--	(1)	3.80E-02
	CARBON DISULFIDE	N	7 / 15	1	2.20E-02	4.40E-01	1.50E-02 J	6.80E-02	KCHYF3-1	2-2	2.58E-02	3.32E-02	(3)	3.32E-02
	CHLOROMETHANE	N	8 / 45	7	9.61E-04	6.80E-01	1.80E-02 J	2.90E-02 J	KCHYF3-5	5-5	5.43E-03	8.00E-03	(3)	8.00E-03
	ETHYLBENZENE	G	6 / 45	1	9.61E-04	5.00E-01	8.15E-03 J	9.27E-02 J	YF311	4.5-5.5	5.95E-03	1.30E-02	(5)	1.30E-02
	ISOPROPYLBENZENE	G	7 / 45	1	1.92E-03	3.60E-01	7.20E-03 J	2.68E-01	YF311	4.5-5.5	1.30E-02	3.55E-02	(5)	3.55E-02
	M,P-XYLENES	N	7 / 45	2	1.92E-03	8.80E-01	1.69E-02 J	9.67E-02 J	YF311	4.5-5.5	9.89E-03	1.54E-02	(3)	1.54E-02
	METHYLENE CHLORIDE	NP	10 / 45	0	1.92E-03	4.40E-02	2.10E-02 J	7.80E-01 J	KCHYF3-3	2-2	2.92E-02	1.08E-01	(6)	1.08E-01
	N-BUTYLBENZENE	LN	7 / 45	0	1.92E-03	3.20E-01	4.45E-02 J	9.70E-01	YF311	4.5-5.5	4.85E-02	1.96E-01	(11)	1.96E-01
	N-PROPYLBENZENE	LN	10 / 45	0	9.61E-04	4.60E-01	9.06E-03 J	5.40E-01	YF311	4.5-5.5	2.16E-02	7.69E-02	(6)	7.69E-02
	O-XYLENE	G	7 / 45	1	9.61E-04	4.20E-01	8.65E-03 J	5.29E-02 J	YF311	4.5-5.5	4.86E-03	8.73E-03	(5)	8.73E-03
	PARA-ISOPROPYL TOLUENE	--	4 / 45	1	1.92E-03	2.60E-01	2.28E-03 J	8.86E-02 J	YF311	4.5-5.5	--	--	(1)	8.86E-02
	SEC-BUTYLBENZENE	G	9 / 45	0	1.92E-03	1.54E-02	9.09E-03 J	8.24E-01	YF311	4.5-5.5	5.16E-02	1.34E-01	(5)	1.34E-01
	TERT-BUTYLBENZENE	--	1 / 45	1	1.92E-03	2.80E-01	4.75E-02 J	4.75E-02 J	YF311	9-10	--	--	(1)	4.75E-02
	TOLUENE	--	4 / 45	1	1.92E-03	3.80E-01	6.64E-04 J	6.58E-02 J	YF311	4.5-5.5	--	--	(1)	6.58E-02

Table 4: Summary Statistics for Sediment (1 to 10 feet bgs)

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Notes:	Units are milligrams per kilogram.
--	Not applicable or no calculations of the mean or 95UCL for chemicals with fewer than six detected results.
95UCL	One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2013), this may be estimated by either a 95, 97.5, or 99 percent UCL depending on sample size, skewness, and detection frequency.
BCa	Bias-corrected accelerated
BSS	Below sediment surface
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration. The EPC is the lesser of the 95UCL and the maximum detected result. The maximum detected result is the default when there are fewer than 6 detected results.
HMW	High molecular weight
KM	Kaplan-Meier product limit estimator
LMW	Low molecular weight
Max	Maximum reported result
Min	Minimum reported result
PAH	Polycyclic aromatic hydrocarbon
TPH	Total petroleum hydrocarbon
UCL	Upper confidence limit
VOC	Volatile organic compound

a Tested for detected data only using the ProUCL Shapiro-Wilk W test (normal and lognormal distributions) and the Anderson-Darling, or Kolmogorov-Smirnov test (gamma distributions). A 5 percent level of significance was used in all tests. Testing conducted for chemicals with at least 10 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in calculations of the mean and 95UCL.   Distribution Codes: G= gamma, LN= lognormal, N= normal, NP= nonparametric

b Detection frequency for the raw data (includes high censored results, see footnote c). The detection frequency for totals is the proportion of samples where all congeners were detected. All totals (sums of individual congeners) were treated as detected results in calculations of the mean and 95UCL.

c Number of censored (nondetect) results that exceeded the maximum detected concentration. These results were excluded from calculations of the mean and 95UCL.

d The range for censored data following exclusion of high censored results (see footnote c)

e The mean and 95UCL calculated for all chemicals with at least six detected results following recommendations in EPA (2013). Some notes presented in the list of method codes below are not used; all notes are presented on each statistical table for consistency.
The Kaplan Meier product limit estimator method is used to estimate the mean and UCL for data sets with nondetect results. The method codes are defined as follows:

(1)	Maximum detected concentration
(2)	95 percent UCL calculated using Student's *t* distribution
(3)	95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL
(4)	95 percent UCL calculated using the adjusted gamma method
(5)	95 percent UCL calculated using the KM mean and the adjusted gamma method
(6)	95 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(7)	97.5 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(8)	99 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(9)	95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL
(10)	95 percent UCL calculated using the nonparametric Chebyshev method to estimate the UCL
(11)	95 percent UCL calculated using the KM mean and a Bootstrap t to estimate the UCL

References:

EPA. 2002. Calculating Exposure Point Concentrations at Hazardous Waste Sites. Office of Solid Waste and Emergency Resposne 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

EPA. 2013. ProUCL Version 5.0.00 Technical Guide Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. September. Available on-line: http://www.epa.gov/osp/hstl/tsc/software.htm

Table 5: Summary Statistics for All Pore Water and Groundwater

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Analyte Group	Chemical	Distribution [a]	Detection Frequency [b]	Number of High Censored Results [c]	Censored Data [d]		Detected Data		Location of Maximum Concentration	Mean [e]	95 UCL [e]	Method [e]	EPC
					Min	Max	Min	Max					
PAH	1-METHYLNAPHTHALENE	LN	10 / 21	0	4.63E-03	1.98E-02	2.44E-03 J	3.66E-02	YF308	6.62E-03	1.46E-02	(6)	1.46E-02
	2-METHYLNAPHTHALENE	NP	12 / 27	0	4.63E-03	1.20E-01	3.12E-03 J	2.20E+00 J	KCHYF3-1	9.06E-02	4.53E-01	(6)	4.53E-01
	ACENAPHTHENE	G	11 / 27	0	9.35E-03	1.20E-01	1.54E-02 J	3.80E+00	KCHYF3-2	3.16E-01	9.49E-01	(5)	9.49E-01
	ACENAPHTHYLENE	LN	10 / 27	0	4.63E-03	1.20E-01	1.22E-02 J	2.70E+00	KCHYF3-2	1.76E-01	6.53E-01	(6)	6.53E-01
	ANTHRACENE	LN	12 / 27	0	4.63E-03	1.00E-01	4.69E-03 J	1.80E+00	KCHYF3-2	1.19E-01	4.34E-01	(6)	4.34E-01
	BENZO(A)ANTHRACENE	LN	13 / 27	0	4.67E-03	1.40E-01	8.76E-03 J	5.80E-01	KCHYF3-2	6.44E-02	1.95E-01	(6)	1.95E-01
	BENZO(A)PYRENE	G	13 / 27	0	4.67E-03	1.20E-01	2.98E-03 J	2.60E-01	KCHYF3-2	3.31E-02	6.39E-02	(5)	6.39E-02
	BENZO(B)FLUORANTHENE	G	13 / 27	0	4.67E-03	1.20E-01	1.05E-02 J	4.10E-01 J	KCHYF3-2	4.24E-02	9.21E-02	(5)	9.21E-02
	BENZO(E)PYRENE	G	11 / 21	0	4.67E-03	2.00E-02	8.11E-03 J	1.27E-01 J	YF312	2.56E-02	4.73E-02	(5)	4.73E-02
	BENZO(G,H,I)PERYLENE	G	10 / 27	0	4.67E-03	1.60E-01	6.72E-03 J	1.90E-01 J	KCHYF3-2	3.13E-02	5.82E-02	(5)	5.82E-02
	BENZO(K)FLUORANTHENE	G	13 / 27	0	9.35E-03	1.40E-01	9.36E-03 J	5.00E-01 J	KCHYF3-2	4.78E-02	1.10E-01	(5)	1.10E-01
	CHRYSENE	LN	14 / 27	0	4.67E-03	1.00E-01	1.04E-02 J	1.50E+00	KCHYF3-2	1.09E-01	3.73E-01	(6)	3.73E-01
	DIBENZ(A,H)ANTHRACENE	N	7 / 27	6	9.26E-03	1.00E-01	5.44E-03 J	2.62E-02	YF310	8.92E-03	1.13E-02	(3)	1.13E-02
	FLUORANTHENE	LN	15 / 27	0	9.35E-03	1.60E-01	1.38E-02 J	1.10E+00	KCHYF3-2	9.56E-02	2.81E-01	(6)	2.81E-01
	FLUORENE	G	11 / 27	0	9.26E-03	1.96E-02	8.22E-03 J	1.40E+01	KCHYF3-2	9.67E-01	3.38E+00	(5)	3.38E+00
	INDENO(1,2,3-CD)PYRENE	G	11 / 27	0	4.67E-03	1.40E-01	5.21E-03 J	2.20E-01	KCHYF3-2	2.44E-02	5.03E-02	(5)	5.03E-02
	NAPHTHALENE	G	8 / 29	0	4.72E-03	4.00E-01	2.86E-02	3.60E+00	KCHYF3-2	1.99E-01	8.22E-01	(5)	8.22E-01
	PERYLENE	NP	10 / 21	0	1.83E-02	2.04E-02	8.93E-03 J	6.86E-02	YF308	1.71E-02	3.15E-02	(6)	3.15E-02
	PHENANTHRENE	NP	16 / 27	0	9.43E-03	2.16E-02	1.67E-02 J	1.70E+01	KCHYF3-2	1.05E+00	5.22E+00	(7)	5.22E+00
	PYRENE	LN	16 / 27	0	9.43E-03	1.60E-01	1.52E-02 J	2.60E+00	KCHYF3-2	2.11E-01	6.45E-01	(6)	6.45E-01
	TOTAL HMW PAH	G	17 / 27	0	1.87E-02	1.60E-01	2.98E-02	7.36E+00	KCHYF3-2	6.45E-01	1.65E+00	(5)	1.65E+00
	TOTAL LMW PAH	LN	20 / 27	0	9.43E-03	2.04E-02	3.12E-03	4.47E+01	KCHYF3-2	2.93E+00	2.04E+01	(8)	2.04E+01
	TOTAL PAH	NP	21 / 27	0	1.87E-02	2.27E-02	7.77E-03	5.21E+01	KCHYF3-2	3.57E+00	1.63E+01	(7)	1.63E+01
TPH	DIESEL RANGE ORGANICS	G	23 / 29	0	4.68E+01	1.55E+02	3.82E+01 J	3.80E+04	KCHYF3-2	4.27E+03	9.04E+03	(5)	9.04E+03
	GASOLINE RANGE ORGANICS	N	9 / 29	0	1.72E+01	3.00E+02	9.20E+00 J	4.13E+02 J	YF311	7.87E+01	1.23E+02	(3)	1.23E+02
	MOTOR OIL RANGE ORGANICS	G	21 / 29	2	2.12E+02	1.06E+04	1.30E+02 J	5.70E+03 D	YF316	1.46E+03	2.23E+03	(5)	2.23E+03
VOC	2-BUTANONE	--	5 / 6	0	1.20E+00	1.20E+00	8.60E-01 J	3.40E+00 J	KCHYF3-2	--	--	(1)	3.40E+00
	4-METHYL-2-PENTANONE	--	1 / 6	5	3.80E+00	3.80E+00	2.00E+00 J	2.00E+00 J	KCHYF3-5	--	--	(1)	2.00E+00
	ACETONE	G	6 / 6	0	--	--	1.70E+01 J	5.30E+01 J	KCHYF3-5	2.70E+01	4.71E+01	(4)	4.71E+01
	BENZENE	N	6 / 6	22	4.00E-01	4.00E+00	1.60E-01 J	2.40E-01 J	KCHYF3-3	2.02E-01	2.23E-01	(2)	2.23E-01
	CARBON DISULFIDE	N	6 / 6	0	--	--	6.80E-01 J	5.90E+00	KCHYF3-2	3.41E+00	5.36E+00	(2)	5.36E+00
	ETHYLBENZENE	--	1 / 28	27	4.00E-01	4.00E+00	2.90E-01 J	2.90E-01 J	KCHYF3-3	--	--	(1)	2.90E-01
	ISOPROPYLBENZENE	--	5 / 28	19	3.20E-01	4.00E+00	2.20E-01 J	1.80E+00 J	KCHYF3-1	--	--	(1)	1.80E+00
	N-BUTYLBENZENE	--	4 / 27	19	3.00E-01	4.00E+00	3.00E-01 J	7.80E-01 J	KCHYF3-1	--	--	(1)	7.80E-01
	N-PROPYLBENZENE	--	4 / 28	19	4.00E-01	4.00E+00	7.70E-01 J	1.60E+00 J	KCHYF3-1	--	--	(1)	1.60E+00
	O-XYLENE	--	1 / 28	27	3.80E-01	4.00E+00	2.00E-01 J	2.00E-01 J	KCHYF3-1	--	--	(1)	2.00E-01
	SEC-BUTYLBENZENE	--	4 / 28	24	2.40E-01	4.00E+00	5.20E-01 J	1.20E+00 J	KCHYF3-1	--	--	(1)	1.20E+00
	TERT-BUTYLBENZENE	--	2 / 28	26	2.60E-01	4.00E+00	1.40E-01 J	1.70E-01 J	KCHYF3-1	--	--	(1)	1.70E-01

Table 5: Summary Statistics for All Pore Water and Groundwater

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Notes: Units are micrograms per liter.

--	Not applicable or no calculations of the mean or 95UCL for chemicals with fewer than six detected results.
95UCL	One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2013), this may be estimated by either a 95, 97.5, or 99 percent UCL depending on sample size, skewness, and detection frequency.
BCa	Bias-corrected accelerated
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration. The EPC is the lesser of the 95UCL and the maximum detected result. The maximum detected result is the default when there are fewer than 6 detected results.
HMW	High molecular weight
KM	Kaplan-Meier product limit estimator
LMW	Low molecular weight
Max	Maximum reported result
Min	Minimum reported result
PAH	Polycyclic aromatic hydrocarbon
TPH	Total petroleum hydrocarbon
UCL	Upper confidence limit
VOC	Volatile organic compound

[a] Tested for detected data only using the ProUCL Shapiro-Wilk W test (normal and lognormal distributions) and the Anderson-Darling, or Kolmogorov-Smirnov test (gamma distributions). A 5 percent level of significance was used in all tests. Testing conducted for with at least 10 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in calculations of the mean and 95UCL.   Distribution Codes: G= gamma, LN= lognormal, N= normal, NP= nonparametric

[b] Detection frequency for the raw data (includes high censored results, see footnote c). The detection frequency for totals is the proportion of samples where all congeners were detected. All totals (sums of individual congeners) were treated as detected results in calculations of the mean and 95UCL.

[c] Number of censored (nondetect) results that exceeded the maximum detected concentration. These results were excluded from calculations of the mean and 95UCL.

[d] The range for censored data following exclusion of high censored results (see footnote c)

[e] The mean and 95UCL calculated for all chemicals with at least six detected results following recommendations in EPA (2013). Some notes presented in the list of method codes below are not used; all notes are presented on each statistical table for consistency. The Kaplan Meier product limit estimator method is used to estimate the mean and UCL for data sets with nondetect results. The method codes are defined as follows:

(1) Maximum detected concentration
(2) 95 percent UCL calculated using Student's *t* distribution
(3) 95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL
(4) 95 percent UCL calculated using the adjusted gamma method
(5) 95 percent UCL calculated using the KM mean and the adjusted gamma method
(6) 95 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(7) 97.5 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(8) 99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(9) 95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL

References:

EPA. 2002. Calculating Exposure Point Concentrations at Hazardous Waste Sites. Office of Solid Waste and Emergency Resposne 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

EPA. 2013. ProUCL Version 5.0.00 Technical Guide Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. September. Available on-line: http://www.epa.gov/osp/hstl/tsc/software.htm

Table 6: Summary Statistics for 2017 Pore Water Samples

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Analyte Group	Chemical	Distribution [a]	Detection Frequency [b]	Number of High Censored Results [c]	Censored Data [d]		Detected Data		Location of Maximum Concentration	Mean [e]	95 UCL [e]	Method [e]	EPC
					Min	Max	Min	Max					
PAH	1-METHYLNAPHTHALENE	LN	10 / 21	0	4.63E-03	1.98E-02	2.44E-03 J	3.66E-02	YF308	6.62E-03	1.46E-02	(6)	1.46E-02
	2-METHYLNAPHTHALENE	G	11 / 21	0	4.63E-03	2.00E-02	3.12E-03 J	6.35E-02	YF308	9.51E-03	1.88E-02	(5)	1.88E-02
	ACENAPHTHENE	LN	6 / 21	0	9.35E-03	1.96E-02	1.54E-02 J	1.87E-01	YF316	2.63E-02	7.31E-02	(6)	7.31E-02
	ACENAPHTHYLENE	N	6 / 21	0	4.63E-03	1.98E-02	1.22E-02 J	4.28E-02	YF312	1.04E-02	1.48E-02	(3)	1.48E-02
	ANTHRACENE	G	8 / 21	0	4.63E-03	2.00E-02	4.69E-03 J	4.93E-02	YF316	1.00E-02	1.80E-02	(5)	1.80E-02
	BENZO(A)ANTHRACENE	G	10 / 21	0	4.67E-03	2.00E-02	8.76E-03 J	9.39E-02	YF310	1.66E-02	2.95E-02	(5)	2.95E-02
	BENZO(A)PYRENE	G	12 / 21	0	4.67E-03	2.00E-02	2.98E-03 J	1.28E-01	YF310	2.54E-02	4.57E-02	(5)	4.57E-02
	BENZO(B)FLUORANTHENE	G	10 / 21	0	4.67E-03	2.00E-02	1.05E-02 J	1.18E-01	YF310	2.15E-02	3.95E-02	(5)	3.95E-02
	BENZO(E)PYRENE	G	11 / 21	0	4.67E-03	2.00E-02	8.11E-03 J	1.27E-01 J	YF312	2.56E-02	4.73E-02	(5)	4.73E-02
	BENZO(G,H,I)PERYLENE	G	9 / 21	0	4.67E-03	2.00E-02	6.72E-03 J	1.74E-01 J	YF312	2.66E-02	5.44E-02	(5)	5.44E-02
	BENZO(K)FLUORANTHENE	G	10 / 21	0	9.35E-03	2.00E-02	9.36E-03 J	1.16E-01	YF310	2.18E-02	3.73E-02	(5)	3.73E-02
	CHRYSENE	G	11 / 21	0	4.67E-03	2.00E-02	1.04E-02 J	1.20E-01	YF310	2.13E-02	3.92E-02	(5)	3.92E-02
	DIBENZ(A,H)ANTHRACENE	N	7 / 21	0	9.26E-03	1.02E-02	5.44E-03 J	2.62E-02	YF310	8.92E-03	1.13E-02	(3)	1.13E-02
	FLUORANTHENE	G	12 / 21	0	9.35E-03	3.50E-02	1.38E-02 J	1.78E-01	YF310	3.68E-02	5.51E-02	(5)	5.51E-02
	FLUORENE	--	5 / 21	0	9.26E-03	1.96E-02	8.22E-03 J	2.58E-02	YF308	--	--	(1)	2.58E-02
	INDENO(1,2,3-CD)PYRENE	N	10 / 21	0	4.67E-03	2.00E-02	5.21E-03 J	7.28E-02	YF310	1.69E-02	2.48E-02	(3)	2.48E-02
	NAPHTHALENE	--	3 / 22	1	4.72E-03	4.00E-01	2.86E-02	3.61E-02	YF316	--	--	(1)	3.61E-02
	PERYLENE	NP	10 / 21	0	1.83E-02	2.04E-02	8.93E-03 J	6.86E-02	YF308	1.71E-02	3.15E-02	(6)	3.15E-02
	PHENANTHRENE	G	10 / 21	0	9.43E-03	2.16E-02	1.67E-02 J	1.18E-01	YF310	2.76E-02	3.74E-02	(5)	3.74E-02
	PYRENE	G	13 / 21	0	9.43E-03	4.51E-02	1.52E-02 J	4.52E-01	YF308	7.88E-02	1.46E-01	(5)	1.46E-01
	TOTAL HMW PAH	G	14 / 21	0	1.87E-02	2.27E-02	2.98E-02	1.29E+00	YF310	2.78E-01	5.15E-01	(5)	5.15E-01
	TOTAL LMW PAH	G	14 / 21	0	9.43E-03	2.04E-02	3.12E-03	4.05E-01	YF316	7.64E-02	1.49E-01	(5)	1.49E-01
	TOTAL PAH	G	15 / 21	0	1.87E-02	2.27E-02	7.77E-03	1.54E+00	YF310	3.49E-01	6.39E-01	(5)	6.39E-01
TPH	DIESEL RANGE ORGANICS	N	18 / 22	0	4.68E+01	1.55E+02	3.82E+01 J	7.79E+03 D	YF316	2.16E+03	2.95E+03	(3)	2.95E+03
	GASOLINE RANGE ORGANICS	N	6 / 22	0	3.00E+01	3.00E+02	1.82E+01 J	4.13E+02 J	YF311	1.22E+02	1.94E+02	(3)	1.94E+02
	MOTOR OIL RANGE ORGANICS	G	19 / 22	0	3.74E+02	3.80E+02	2.06E+02 J	5.70E+03 D	YF316	1.52E+03	2.54E+03	(5)	2.54E+03

Table 6: Summary Statistics for 2017 Pore Water Samples

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Notes: Units are micrograms per liter.

--	Not applicable or no calculations of the mean or 95UCL for chemicals with fewer than six detected results.
95UCL	One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2013), this may be estimated by either a 95, 97.5, or 99 percent UCL depending on sample size, skewness, and detection frequency.
BCa	Bias-corrected accelerated
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration. The EPC is the lesser of the 95UCL and the maximum detected result. The maximum detected result is the default when there are fewer than 6 detected results.
HMW	High molecular weight
KM	Kaplan-Meier product limit estimator
LMW	Low molecular weight
Max	Maximum reported result
Min	Minimum reported result
PAH	Polycyclic aromatic hydrocarbon
TPH	Total petroleum hydrocarbon
UCL	Upper confidence limit
VOC	Volatile organic compound

a Tested for detected data only using the ProUCL Shapiro-Wilk W test (normal and lognormal distributions) and the Anderson-Darling, or Kolmogorov-Smirnov test (gamma distributions). A 5 percent level of significance was used in all tests. Testing conducted for with at least 10 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in calculations of the mean and 95UCL.   Distribution Codes: G= gamma, LN= lognormal, N= normal, NP= nonparametric

b Detection frequency for the raw data (includes high censored results, see footnote c). The detection frequency for totals is the proportion of samples where all congeners were detected. All totals (sums of individual congeners) were treated as detected results in calculations of the mean and 95UCL.

c Number of censored (nondetect) results that exceeded the maximum detected concentration. These results were excluded from calculations of the mean and 95UCL.

d The range for censored data following exclusion of high censored results (see footnote c)

e The mean and 95UCL calculated for all chemicals with at least six detected results following recommendations in EPA (2013). Some notes presented in the list of method codes below are not used; all notes are presented on each statistical table for consistency. The Kaplan Meier product limit estimator method is used to estimate the mean and UCL for data sets with nondetect results. The method codes are defined as follows:

(1)	Maximum detected concentration
(2)	95 percent UCL calculated using Student's *t* distribution
(3)	95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL
(4)	95 percent UCL calculated using the adjusted gamma method
(5)	95 percent UCL calculated using the KM mean and the adjusted gamma method
(6)	95 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(7)	97.5 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(8)	99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(9)	95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL

References:

EPA. 2002. Calculating Exposure Point Concentrations at Hazardous Waste Sites. Office of Solid Waste and Emergency Response 9285.6-10. Office of Emergency and Remedial Resposne. Washington, DC. December.

EPA. 2013. ProUCL Version 5.0.00 Technical Guide Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. September. Available on-line: http://www.epa.gov/osp/hstl/tsc/software.htm

Table 7: Comparison of Concentrations in 2017 Pore Water Samples with Screening Criteria

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

		San Francisco Bay Basin Plan[a] (µg/L)		California Toxics Rule Criteria for Enclosed Bays and Estuaries[c] (µg/L)								National Recommended Water Quality Criteria[i] (µg/L)						National Ambient Water Quality Criteria (AWQC) for Protection of Saltwater Aquatic Life[g] (µg/L)								Other Criteria (footnotes indicate source) (µg/L)				
												Saltwater Aquatic Life						Lowest Observed Effect Level (LOEL)												
				Chronic[e]		Acute[e]			Instantaneous Maximum			Chronic[e]		Acute[e]				Chronic[f]		Acute[g]				Other[h]						
Detected Analyte	Pseudonym	Concentration	Footnotes	Concentration	Footnotes	Concentration	20% of Concentration[d]	Footnotes	Concentration	10% of Concentration[d]	Footnotes	Concentration	Footnotes	Concentration	20% of Concentration[d]	DTSC Recommended Screening Value[k]	Footnotes	Concentration	Footnotes	Concentration	20% of Concentration[d]	DTSC Recommended Screening Value[k]	Footnotes	Concentration	Footnotes	Other	Footnotes	Selected Toxicity Screening Criteria (µg/L)	Pore Water EPC (µg/L)	Hazard Quotient
1-Methylnaphthalene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30	l	30	0.01	0.0005
2-Methylnaphthalene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30	l	30	0.02	0.001
Acenaphthene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	710	--	970	--	--	--	500	(1)	--	--	15	0.07	0.005
Acenaphthylene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.01	0.001
Anthracene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.02	0.001
Benzo(a)anthracene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.03	0.002
Benzo(a)pyrene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.05	0.003
Benzo(b)fluoranthene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.04	0.003
Benzo(e)pyrene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.05	0.003
Benzo(g,h,i)perylene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.05	0.004
Benzo(k)fluoranthene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.04	0.002
Dibenz(a,h)anthracene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.01	0.001
Fluoranthene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16	--	40	--	--	--	--	--	--	--	15	0.06	0.004
Fluorene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.03	0.002
Indeno(1,2,3-cd)pyrene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.02	0.002
Naphthalene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,350	470	235	--	--	--	--	--	15	0.04	0.002
Phenanthrene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.04	0.002
Perylene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.03	0.002
Pyrene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.15	0.010
Total HMW PAHs		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.52	0.034
Total LMW PAHs		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(2)	--	--	--	--	15	0.15	0.010
Total PAHs		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15	0.64	0.043
TPH-Diesel	Diesel	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,400	j	1,400	2,953	**2.1**
TPH-Gasoline	Gasoline range organics; Gasoline	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,400	j	1,400	194	0.1
TPH-Motor Oil	Motor oil range organics; Motor Oil	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,400	j	1,400	2,544	**1.8**

Notes:	Footnotes and references are detailed below.
µg/L	Microgram per liter
--	No criterion available
bss	Below sediment surface
NAVSTA TI	Naval Station Treasure Island
TPH	Total petroleum hydrocarbon

Table 7: Comparison of Concentrations in 2017 Pore Water Samples with Screening Criteria

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Footnotes:

These criteria were developed for use in the baseline ecological risk assessment as screening criteria to evaluate potential risk to aquatic life (Battelle and Tetra Tech 2017).

a Marine Water Quality Objectives for Toxic Pollutants for Surface Water, from California Environmental Protection Agency, Regional Water Quality Control Board, San Francisco Bay Area Region (Water Board). 2013a. "San Francisco Bay Basin Water Quality Contro Plan." June 29.

b Water Board Basin Plan Marine Surface Water Quality Objective that applies basinwide unless there is a site-specific exception (Water Board 2013a).

c From "Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California" (CTR) (EPA 2000).

d Criterion made more suitably protective by means of standard convention of lowering acute values by 80 percent and instantaneous values by 90 percent to make them more appropriate for use under chronic exposure scenarios.

e An acute criterion (EPA identified as Criteria Maximum Concentration [CMC]) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. The chroni concentration (EPA identified as Criterion Continuous Concentration [CCC]) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The CMC and CCC are just two if the six parts of an aquatic life criterion; the other four parts are the acute averaging period, chronic averaging period, acute frequency of allowed exceedence, and chronic frequency of allowed exceedance. Because 304(a) aquatic life criteria are national guidance, they are intended to be protective of the vast majority of the aquatic communities in the United States (EPA 2013).

f California Environmental Protection Agency, Regional Water Quality Control Board, San Francisco Bay Area Region (Water Board). April 2011. "A Compilation of Water Quality Goals." EPA National "AWQC Lowest Observed Effect Level (Chronic)"

g EPA National "AWQC Lowest Observed Effect Level (Acute)" (Water Board 2011)

h EPA National "AWQC Lowest Observed Effect Level (Other)" (Water Board 2011)

i From "National Recommended Water Quality Criteria Priority Pollutants" (EPA 2013)

j Final Preliminary Remediation Criteria for Petroleum Constituents. Technical Memorandum. Naval Station Treasure Island. San Francisco California. Dated November 13, 2001.

k Derived using uncertainty factors (UF) from DTSC (For acute values: divide acute LOAEL by 10 to get a chronic LOAEL) (DTSC 2006).

l Basis: 10% US EPA SW Acute LOEL, Value: Lowest Marine Aquatic Habitat Goal. From "Table F-4a. Summary of Selected Aquatic Habitat Goals". (Water Board 2013b).

The following numbered footnotes are derived from "A Compilation of Water Quality Goals" (Water Board 2011).

1 Toxicity to algae occurs.

2 For polycyclic aromatic hydrocarbons

References:

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EPA. 2013. "National Recommended Water Quality Criteria." available online: http://www.epa.gov/ost/criteria/wqctable/

TABLE 8: CALCULATION OF TOTAL PERCENT LNAPL SATURATION AND ESTIMATES OF LNAPL MOBILITY AT SITE YF3 (1997-2012 DATA)

Site YF3 Baseline Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location	Sample Identification Number	TPH-diesel (mg/kg)	TPH-gasoline (mg/kg)	TPH-motor oil (mg/kg)	TPH-total Summation (mg/kg)	Soil Bulk Density (g/cm^3)	Fuel Oil Density (g/cm^3)	Total N percent (%)	LNAPL Saturation (%)	Water Residual Saturation (%)	Expected Disposition of LNAPL
031YF3001	031YF3001	11	100	11	122	1.68	0.87	40%	0.1%	6.5%	Residual
031YF3001	031YF3002	10	100	10	120	1.68	0.87	40%	0.1%	6.5%	Residual
KCHYF3-1	KCHYF3-1-2	2,200	3	2,100	4,303	1.68	0.87	40%	2.1%	6.5%	Residual
KCHYF3-1	KCHYF3-1-5	900	2	1,200	2,102	1.68	0.87	40%	1.0%	6.5%	Residual
KCHYF3-1	KCHYF3-1-10	820	33	420	1,273	1.68	0.87	40%	0.6%	6.5%	Residual
KCHYF3-2	KCHYF3-2-2	610	4	430	1,044	1.68	0.87	40%	0.5%	6.5%	Residual
KCHYF3-2	KCHYF3-2-5	950	0.76	640	1,591	1.68	0.87	40%	0.8%	6.5%	Residual
KCHYF3-2	KCHYF3-2-10	10	0.84	15	26	1.68	0.87	40%	0.0%	6.5%	Residual
KCHYF3-3	KCHYF3-3-2	990	440	550	1,980	1.68	0.87	40%	1.0%	6.5%	Residual
KCHYF3-3	KCHYF3-3-5	6,500	1.10	2,800	9,301	1.68	0.87	40%	4.5%	6.5%	Residual
KCHYF3-3	KCHYF3-3-10	120	6	67	193	1.68	0.87	40%	0.1%	6.5%	Residual
KCHYF3-4	KCHYF3-4-2	1,900	0.88	460	2,361	1.68	0.87	40%	1.1%	6.5%	Residual
KCHYF3-4	KCHYF3-4-5	990	0.74	650	1,641	1.68	0.87	40%	0.8%	6.5%	Residual
KCHYF3-4	KCHYF3-4-10	7	0.78	16	24	1.68	0.87	40%	0.0%	6.5%	Residual
KCHYF3-5	KCHYF3-5-2	3,200	7	2,200	5,407	1.68	0.87	40%	2.6%	6.5%	Residual
KCHYF3-5	KCHYF3-5-5	320	0.72	360	681	1.68	0.87	40%	0.3%	6.5%	Residual
KCHYF3-5	KCHYF3-5-10	100	2	70	172	1.68	0.87	40%	0.1%	6.5%	Residual
SCI-YB-07	SCI-YB-07	100	1.0	100	201	1.68	0.87	40%	0.1%	6.5%	Residual
YF3HP005	262YF3211	11	0.23	57	68	1.68	0.87	40%	0.0%	6.5%	Residual
YF3HP006	262YF3212	120	3	520	643	1.68	0.87	40%	0.3%	6.5%	Residual
YF3HP007	262YF3213	360	0.27	1,200	1,560	1.68	0.87	40%	0.8%	6.5%	Residual
YF3HP008	262YF3214	520	0.55	1,900	2,421	1.68	0.87	40%	1.2%	6.5%	Residual
YF3HP009	262YF3215	170	0.33	520	690	1.68	0.87	40%	0.3%	6.5%	Residual
YF3HP018	262YF3413	36	0.22	160	196	1.68	0.87	40%	0.1%	6.5%	Residual
YF3HP018	262YF3414	270	0.19	190	460	1.68	0.87	40%	0.2%	6.5%	Residual
YF3HP018	262YF3415	370	100	96	566	1.68	0.87	40%	0.3%	6.5%	Residual
YF3HP019	262YF3418	170	0.2	420	590	1.68	0.87	40%	0.3%	6.5%	Residual
YF3HP019	262YF3419	510	0.25	1,500	2,010	1.68	0.87	40%	1.0%	6.5%	Residual
YF3HP019	262YF3420	10,000	1.30	10,000	20,001	1.68	0.87	40%	9.7%	6.5%	Potentially Mobile
YF3HP020	262YF3423	670	0.21	1,000	1,670	1.68	0.87	40%	0.8%	6.5%	Residual
YF3HP020	262YF3424	1,200	3	470	1,673	1.68	0.87	40%	0.8%	6.5%	Residual
YF3HP021	262YF3428	600	0.22	2,000	2,600	1.68	0.87	40%	1.3%	6.5%	Residual
YF3HP021	262YF3429	7,500	220	5,800	13,520	1.68	0.87	40%	6.5%	6.5%	Potentially Mobile

TABLE 8: CALCULATION OF TOTAL PERCENT LNAPL SATURATION AND ESTIMATES OF LNAPL MOBILITY AT SITE YF3 (1997-2012 DATA)

Site YF3 Baseline Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location	Sample Identification Number	TPH-diesel (mg/kg)	TPH-gasoline (mg/kg)	TPH-motor oil (mg/kg)	TPH-total Summation (mg/kg)	Soil Bulk Density (g/cm^3)	Fuel Oil Density (g/cm^3)	Total N percent (%)	LNAPL Saturation (%)	Water Residual Saturation (%)	Expected Disposition of LNAPL
YF3HP021	262YF3430	10,000	450	890	11,340	1.68	0.87	40%	5.5%	6.5%	Residual
YF3HP022	262YF3433	210	0.24	730	940	1.68	0.87	40%	0.5%	6.5%	Residual
YF3HP023	262YF3438	480	0.23	1,800	2,280	1.68	0.87	40%	1.1%	6.5%	Residual
YF3HP023	262YF3439	810	0.25	3,100	3,910	1.68	0.87	40%	1.9%	6.5%	Residual

Notes:

1. All non-detect values were assumed to be equal to the detection limit and not measured values were conservatively assumed to be 100 mg/kg.

g/cm^3	Gram per cubic centimeter
LNAPL	Light non-aqueous phase liquid
mg/kg	Milligram per kilogram
N	Porosity
TPH	Total petroleum hydrocarbons

TABLE 9: CALCULATION OF TOTAL PERCENT LNAPL SATURATION AND ESTIMATES OF LNAPL MOBILITY AT SITE YF3 (2017 DATA)

Site YF3 Baseline Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location	Top of Sample Interval (feet)	Bottom of Sample Interval (feet)	Fine Materials (Silt and Clay (%)	Coarse Materials (Sand and Gravel) (%)	General Soil Type	TPH-Diesel (mg/kg)	TPH-Motor Oil (mg/kg)	TPH-Gasoline (mg/kg)	TPH-Total (mg/kg)	Soil Bulk Density (g/cm^3)	Oil Density (g/cm^3)	Total N (%)	LNAPL Saturation (%)	Water Residual Saturation (%)	Expected Disposition of LNAPL
YF304	0.00	1.00	13.70	86.30	SP-SM_f	2,120.00	674.00	2.89	2796.89	1.62	0.87	0.42	1.24%	6.65%	Residual
YF304	4.50	5.50	19.70	80.30	SM	68.40	34.70	0.30	103.396	1.65	0.87	0.41	0.05%	6.80%	Residual
YF304	9.00	10.00	25.30	74.70	SM	223.00	88.80	<0.262	312.062	1.65	0.87	0.41	0.14%	6.80%	Residual
YF307	0.00	1.00	14.50	85.50	SP-SM_f	3,670.00	1,160.00	107.00	4937	1.62	0.87	0.42	2.19%	6.65%	Residual
YF307	4.50	5.50	13.90	86.20	SP-SM_f	1,160.00	288.00	8.11	1456.11	1.62	0.87	0.42	0.65%	6.65%	Residual
YF307	9.00	10.00	16.90	83.20	SM	1.88	<12.9	<0.34	15.12	1.65	0.87	0.41	0.01%	6.80%	Residual
YF308	0.00	1.00	12.90	87.10	GP-GM	2,350.00	1,710.00	149.00	4209	1.85	0.87	0.34	2.63%	6.65%	Residual
YF308	4.50	5.50	31.00	69.00	SM	1,870.00	767.00	51.00	2688	1.65	0.87	0.41	1.24%	6.80%	Residual
YF308	9.00	10.00	12.90	87.10	SP-SM_f	723.00	421.00	7.27	1151.27	1.62	0.87	0.42	0.51%	6.65%	Residual
YF310	0.00	1.00	27.60	72.40	SM	899.00	923.00	1.52	1823.52	1.65	0.87	0.41	0.84%	6.80%	Residual
YF310	4.50	5.50	28.60	71.40	SM	3,040.00	1,790.00	74.70	4904.7	1.65	0.87	0.41	2.27%	6.80%	Residual
YF310	9.00	10.00	6.70	93.40	GP	355.00	258.00	2.57	615.57	1.63	0.87	0.42	0.28%	6.50%	Residual
YF311	0.00	1.00	9.50	90.40	SP_f	3,310.00	1,420.00	114.00	4844	1.59	0.87	0.43	2.04%	6.50%	Residual
YF311	4.50	5.50	19.30	80.70	SM	10,700.00	2,480.00	642.00	13822	1.65	0.87	0.41	6.40%	6.80%	Residual-Potentially Mobile
YF311	9.00	10.00	15.20	84.80	SM	25,900.00	5,280.00	489.00	31669	1.65	0.87	0.41	14.67%	6.80%	Potentially Mobile
YF312	0.00	1.00	16.10	83.90	GM	463.00	1,450.00	0.12	1913.119	1.85	0.87	0.34	1.20%	6.80%	Residual
YF312	4.50	5.50	23.30	76.70	SM	1,980.00	2,450.00	14.30	4444.3	1.65	0.87	0.41	2.06%	6.80%	Residual
YF312	9.00	10.00	13.40	86.60	SP-SM_f	254.00	213.00	3.81	470.81	1.62	0.87	0.42	0.21%	6.65%	Residual
YF314A	0.00	1.00	4.40	95.60	SP_f	10.40	19.30	<0.23	29.93	1.59	0.87	0.43	0.01%	6.50%	Residual
YF314A	4.50	5.50	14.40	85.60	SP-SM_f	6.41	20.70	<0.234	27.344	1.62	0.87	0.42	0.01%	6.65%	Residual
YF314A	9.00	10.00	22.70	77.30	SM	1.12	5.94	<0.229	7.289	1.65	0.87	0.41	0.00%	6.80%	Residual
YF315	0.00	1.00	13.00	87.00	SP-SM_f	11,500.00	2,260.00	169.00	13929	1.62	0.87	0.42	6.18%	6.65%	Residual-Potentially Mobile
YF315	4.50	5.50	7.70	92.40	SP_f	9,790.00	1,200.00	667.00	11657	1.59	0.87	0.43	4.91%	6.50%	Residual-Potentially Mobile
YF315	8.00	9.00	7.60	92.40	SP_f	8,470.00	1,260.00	437.00	10167	1.59	0.87	0.43	4.28%	6.50%	Residual-Potentially Mobile
YF319	0.00	1.00	9.60	90.40	SP_f	2,330.00	801.00	44.60	3175.6	1.59	0.87	0.43	1.34%	6.50%	Residual
YF319	4.50	5.50	8.90	91.20	SP_f	2,290.00	340.00	101.00	2731	1.59	0.87	0.43	1.15%	6.50%	Residual
YF319	9.00	10.00	5.90	94.20	SP_f	304.00	55.60	3.42	363.02	1.59	0.87	0.43	0.15%	6.50%	Residual
YF321	0.00	1.00	14.20	85.80	GP-GM	2,620.00	755.00	39.00	3414	1.85	0.87	0.34	2.13%	6.65%	Residual
YF321	4.50	5.50	19.40	80.60	SM	890.00	231.00	<0.205	1121.205	1.65	0.87	0.41	0.52%	6.80%	Residual
YF321	7.00	8.00	44.90	55.10	SM	40.20	22.20	0.37	62.77	1.65	0.87	0.41	0.03%	6.80%	Residual
YF322	0.00	1.00	7.60	92.50	SP_f	18.60	72.30	<0.239	91.139	1.59	0.87	0.43	0.04%	6.50%	Residual
YF322	4.50	5.50	14.20	85.80	SP-SM_f	2.61	12.60	<0.224	15.434	1.62	0.87	0.42	0.01%	6.65%	Residual
YF322	8.50	9.50	26.20	73.80	SM	1.18	9.21	<0.274	10.664	1.65	0.87	0.41	0.00%	6.80%	Residual
YF323	0.00	1.00	14.10	86.00	SP-SM_f	37.50	124.00	<0.231	161.731	1.62	0.87	0.42	0.07%	6.65%	Residual
YF323	4.50	5.50	25.60	74.50	SM	175.00	701.00	<0.278	876.278	1.65	0.87	0.41	0.41%	6.80%	Residual
YF323	9.00	10.00	27.50	72.50	SM	1.58	11.60	<0.713	13.893	1.65	0.87	0.41	0.01%	6.80%	Residual
YF324	0.00	1.00	9.20	90.80	SP-SM_f	14.40	43.70	<0.22	58.32	1.62	0.87	0.42	0.03%	6.65%	Residual
YF324	4.50	5.50	23.20	76.80	SM	60.40	224.00	<0.255	284.655	1.65	0.87	0.41	0.13%	6.80%	Residual
YF324	9.00	10.00	27.90	72.10	SM	1.66	13.10	<0.246	15.006	1.65	0.87	0.41	0.01%	6.80%	Residual

TABLE 9: CALCULATION OF TOTAL PERCENT LNAPL SATURATION AND ESTIMATES OF LNAPL MOBILITY AT SITE YF3 (2017 DATA)

Site YF3 Baseline Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location	Top of Sample Interval (feet)	Bottom of Sample Interval (feet)	Fine Materials (Silt and Clay (%)	Coarse Materials (Sand and Gravel) (%)	General Soil Type	TPH-Diesel (mg/kg)	TPH-Motor Oil (mg/kg)	TPH-Gasoline (mg/kg)	TPH-Total (mg/kg)	Soil Bulk Density (g/cm^3)	Oil Density (g/cm^3)	Total N (%)	LNAPL Saturation (%)	Water Residual Saturation (%)	Expected Disposition of LNAPL
YF325	0.00	1.00	11.60	88.40	SP-SM$_f$	27.70	63.00	0.11	90.805	1.62	0.87	0.42	0.04%	6.65%	Residual
YF325	4.50	5.50	16.70	83.30	SM	9.49	55.70	<0.233	65.423	1.65	0.87	0.41	0.03%	6.80%	Residual
YF325	9.00	10.00	31.70	68.30	SM	1.68	12.10	0.12	13.9	1.65	0.87	0.41	0.01%	6.80%	Residual
YF326	0.00	1.00	4.70	95.20	SP$_f$	18.00	42.80	<0.252	61.052	1.59	0.87	0.43	0.03%	6.50%	Residual
YF326	4.50	5.50	16.80	83.20	SM	2.18	7.54	<0.235	9.955	1.65	0.87	0.41	0.00%	6.80%	Residual
YF326	9.00	10.00	17.60	82.50	SM	2.80	7.10	0.11	10.009	1.65	0.87	0.41	0.00%	6.80%	Residual
YF327	0.00	1.00	11.10	88.90	GP-GM	949.00	363.00	1.79	1313.79	1.85	0.87	0.34	0.82%	6.65%	Residual
YF327	4.50	5.50	9.00	91.10	SP$_f$	6,810.00	737.00	254.00	7801	1.59	0.87	0.43	3.29%	6.50%	Residual-Potentially Mobile
YF327	9.00	10.00	7.70	92.40	SP$_f$	4,070.00	309.00	209.00	4588	1.59	0.87	0.43	1.93%	6.50%	Residual

Notes:

Soil Types:

GM	Gravel with >10% fines
GP-GM	Gravel with 5-10% fines
GP	Gravel
SM	Sand with >10% fines
SP-SM$_f$	Sand with 5-10% fines
SP$_f$	Sand, fine
g/cm^3	Gram per cubic centimeter
LNAPL	Light non-aqueous phase liquid
mg/kg	Milligram per kilogram
N	Porosity
TPH	Total petroleum hydrocarbon

Residual is <50% of Water Residual Saturation

Residual-Potentially Mobile is >50% and <Water Residual Saturation

Potentially Mobile is >Water Residual Saturation

Non-Detect surrogate values are equal to the reporting limit

Table 10. Summary of PAH Benchmark Calculations for Sediment using the Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Location ID	Sum of Acute Potency Ratio	Sum of Chronic Potency Ratio
YF304SEDA	0.57	1.2
YF307SEDA	0.58	1.2
YF308SEDA	1.5	3.0
YF310SEDA	0.54	1.1
YF311SEDA	4.6	9.7
YF312SEDA	0.14	0.29
YF314ASEDA	0.09	0.19
YF315SEDA	4.5	9.4
YF319SEDA	0.44	0.91
YF321SEDA	0.61	1.3
YF322SEDA	0.45	0.93
YF323SEDA	0.13	0.26
YF324SEDA	0.16	0.33
YF325SEDA	0.15	0.31
YF326SEDA	0.29	0.59
YF327SEDA	2.1	4.4
Maximum Potency Ratio	4.6	9.7
Total Samples	16	16

Notes

1.2 - Red highlight indicates sum of acute or chronic potency ratio is greater than 1.0.

PAH - Polycyclic aromatic hydrocarbons

Reference

EPA. 2010. Explanation of PAH benchmark calculations using EPA PAH ESB approach, originally developed by Dave Mount November. Office of Research and Development. EPA-600-R-02-013.

Table 11. Calculation of PAH Benchmark for Sediment using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval
Station Treasure Island,
San Francisco, California

Sample ID			YF304SEDA					YF307SEDA					YF308SEDA					YF310SEDA				
PAH	Acute Potency Factor (µg/kg$_{oc}$)	Chronic Potency Factor (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)
Acenaphthene	1,020,000	491,000	41.9		6126	0.00601	0.01248	80.5	J	7124	0.00698	0.01451	102		4513	0.00442	0.00919	11.9	J	2390	0.00234	0.00487
Acenaphthylene	940,000	452,000	117		17105	0.01820	0.03784	168		14867	0.01582	0.03289	37.4	J	1655	0.00176	0.00366	12.2	J	2450	0.00261	0.00542
Anthracene	1,235,000	594,000	82.4		12047	0.00975	0.02028	99.5	J	8805	0.00713	0.01482	165		7301	0.00591	0.01229	10	J	2008	0.00163	0.00338
Benzo(a)anthracene	1,750,000	841,000	102		14912	0.00852	0.01773	190		16814	0.00961	0.01999	107		4735	0.00271	0.00563	17		3414	0.00195	0.00406
Benzo(a)pyrene	2,010,000	965,000	377		55117	0.02742	0.05712	566		50088	0.02492	0.05191	79.2	J	3504	0.00174	0.00363	48		9639	0.00480	0.00999
Benzo(b)fluoranthene	2,035,000	979,000	246	J	35965	0.01767	0.03674	357	J	31593	0.01552	0.03227	94	J	4159	0.00204	0.00425	61.2	J	12289	0.00604	0.01255
Benzo(e)pyrene	2,010,000	967,000	259		37865	0.01884	0.03916	362		32035	0.01594	0.03313	114		5044	0.00251	0.00522	57.8		11606	0.00577	0.01200
Benzo(g,h,i)perylene	2,270,000	1,090,000	128	J	18713	0.00824	0.01717	148	J	13097	0.00577	0.01202	35.9	J	1588	0.00070	0.00146	20.2	J	4056	0.00179	0.00372
Benzo(k)fluoranthene	2,040,000	981,000	215		31433	0.01541	0.03204	321		28407	0.01393	0.02896	87	U	1925	0.00094	0.00196	17.5		3514	0.00172	0.00358
C1-Chrysenes	1,935,000	929,000	142	J	20760	0.01073	0.02235	563	J	49823	0.02575	0.05363	651	J	28805	0.01489	0.03101	117	J	23494	0.01214	0.02529
C1-Fluorenes	1,270,000	611,000	301	J	44006	0.03465	0.07202	107	U	4735	0.00373	0.00775	796	J	35221	0.02773	0.05765	100	J	20080	0.01581	0.03286
C1-Phenanthrenes/Anthracenes	1,395,000	670,000	130	J	19006	0.01362	0.02837	107	U	4735	0.00339	0.00707	2030	J	89823	0.06439	0.13406	75.6	J	15181	0.01088	0.02266
C1-Fluoranthenes/Pyrene	1,600,000	770,000	356	J	52047	0.03253	0.06759	1030	J	91150	0.05697	0.11838	1070	J	47345	0.02959	0.06149	260	J	52209	0.03263	0.06780
C2-Chrysenes	2,100,000	1,010,000	215	J	31433	0.01497	0.03112	1030	J	91150	0.04340	0.09025	987	J	43673	0.02080	0.04324	328	J	65863	0.03136	0.06521
C2-Fluorenes	1,425,000	686,000	228	J	33333	0.02339	0.04859	107	U	4735	0.00332	0.00690	2000	J	88496	0.06210	0.12900	142	J	28514	0.02001	0.04157
C2-Naphthalenes	1,060,000	510,000	151	J	22076	0.02083	0.04329	107	U	4735	0.00447	0.00928	5330	J	235841	0.22249	0.46243	207	J	41566	0.03921	0.08150
C2-Phenanthrenes/Anthracenes	1,550,000	746,000	134	J	19591	0.01264	0.02626	349	J	30885	0.01993	0.04140	3700	J	163717	0.10562	0.21946	215	J	43173	0.02785	0.05787
C3-Chrysenes	2,310,000	1,110,000	321	J	46930	0.02032	0.04228	881	J	77965	0.03375	0.07024	862	J	38142	0.01651	0.03436	299	J	60040	0.02599	0.05409
C3-Fluorenes	1,600,000	769,000	158	J	23099	0.01444	0.03004	853	J	75487	0.04718	0.09816	1900	J	84071	0.05254	0.10932	200	J	40161	0.02510	0.05222
C3-Naphthalenes	1,210,000	581,000	221	J	32310	0.02670	0.05561	107	U	4735	0.00391	0.00815	9370	J	414602	0.34265	0.71360	474	J	95181	0.07866	0.16382
C3-Phenanthrenes/Anthracenes	1,725,000	829,000	122	J	17836	0.01034	0.02152	547	J	48407	0.02806	0.05839	3220	J	142478	0.08260	0.17187	207	J	41566	0.02410	0.05014
C4-Chrysenes	2,515,000	1,210,000	109	J	15936	0.00634	0.01317	244	J	21593	0.00859	0.01785	224	J	9912	0.00394	0.00819	81.9	J	16446	0.00654	0.01359
C4-Naphthalenes	1,365,000	657,000	519	J	75877	0.05559	0.11549	107	U	4735	0.00347	0.00721	8430	J	373009	0.27327	0.56775	538	J	108032	0.07914	0.16443
C4-Phenanthrenes/Anthracenes	1,895,000	912,000	36	J	5263	0.00278	0.00577	621	J	54956	0.02900	0.06026	2640	J	116814	0.06164	0.12809	417	J	83735	0.04419	0.09181
Chrysene	1,755,000	844,000	119		17398	0.00991	0.02061	208		18407	0.01049	0.02181	274		12124	0.00691	0.01436	30.5		6124	0.00349	0.00726
Dibenz(a,h)anthracene	2,330,000	1,120,000	42.6	J	6228	0.00267	0.00556	56.4	J	4991	0.00214	0.00446	26	J	1150	0.00049	0.00103	9.37	J	1882	0.00081	0.00168
Fluoranthene	1,470,000	707,000	172		25146	0.01711	0.03557	192		16991	0.01156	0.02403	124		5487	0.00373	0.00776	34.8		6988	0.00475	0.00988
Fluorene	1,120,000	538,000	64.6		9444	0.00843	0.01755	47.8	J	4230	0.00378	0.00786	225		9956	0.00889	0.01851	16.3		3273	0.00292	0.00608
Indeno(1,2,3-cd)pyrene	2,310,000	1,110,000	115	J	16813	0.00728	0.01515	124	J	10973	0.00475	0.00989	33.5	J	1482	0.00064	0.00134	17.3	J	3474	0.00150	0.00313
Naphthalene	800,000	385,000	10.8	J	1579	0.00197	0.00410	107	U	4735	0.00592	0.01230	87	UJ	1925	0.00241	0.00500	15.2	UJ	1526	0.00191	0.00396
Perylene	2,010,000	967,000	88.3		12909	0.00642	0.01335	144		12743	0.00634	0.01318	141		6239	0.00310	0.00645	16.3		3273	0.00163	0.00338
Phenanthrene	1,240,000	596,000	233		34064	0.02747	0.05715	114		10088	0.00814	0.01693	516		22832	0.01841	0.03831	27.1		5442	0.00439	0.00913
Pyrene	1,450,000	697,000	585		85526	0.05898	0.12271	1550		137168	0.09460	0.19680	379		16770	0.01157	0.02406	129		25904	0.01786	0.03716
Benzene	1,680,000	660,000	0.871	UJ	64	0.00004	0.00010	7.55	U	334	0.00020	0.00051	8.16	U	181	0.00011	0.00027	1.54	J	309	0.00018	0.00047
Toluene	2,060,000	810,000	1.74	UJ	127	0.00006	0.00016	26.1	J	2310	0.00112	0.00285	16.3	U	361	0.00018	0.00045	1.44	J	289	0.00014	0.00036
Ethylbenzene	2,465,000	970,000	0.871	U	64	0.00003	0.00007	9.27	J	820	0.00033	0.00085	16.3	U	361	0.00015	0.00037	0.81	J	163	0.00007	0.00017
m,p-Xylenes	2,490,000	980,000	1.74	U	127	0.00005	0.00013	21.9	J	1938	0.00078	0.00198	11	J	487	0.00020	0.00050	2.08	U	209	0.00008	0.00021
o-Xylene	2,490,000	980,000	0.871	U	64	0.00003	0.00006	11.4	J	1009	0.00041	0.00103	16.3	U	361	0.00014	0.00037	0.477	J	96	0.00004	0.00010
Organic Carbon (total) (percent)			0.684					1.13					2.26					0.498				
Total Sum of Acute and Chronic Potency Ratios						0.57	1.2				0.58	1.2				1.5	3.0				0.54	1.1

Table 11. Calculation of PAH Benchmark for Sediment using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval
Station Treasure Island,
San Francisco, California

Sample ID			YF311SEDA					YF312SEDA					YF314ASEDA					YF315SEDA				
PAH	Acute Potency Factor (µg/kg$_{oc}$)	Chronic Potency Factor (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)
Acenaphthene	1,020,000	491,000	318		21060	0.02065	0.04289	22.4		1436	0.00141	0.00292	0.451	J	248	0.00024	0.00050	244		29398	0.02882	0.05987
Acenaphthylene	940,000	452,000	95.3		6311	0.00671	0.01396	17.7		1135	0.00121	0.00251	1.98		1088	0.00116	0.00241	8.03	U	484	0.00051	0.00107
Anthracene	1,235,000	594,000	165		10927	0.00885	0.01840	28.6		1833	0.00148	0.00309	4.27		2346	0.00190	0.00395	8.03	U	484	0.00039	0.00081
Benzo(a)anthracene	1,750,000	841,000	94.8	U	3139	0.00179	0.00373	114		7308	0.00418	0.00869	15.2		8352	0.00477	0.00993	18		2169	0.00124	0.00258
Benzo(a)pyrene	2,010,000	965,000	63.9	J	4232	0.00211	0.00439	106		6795	0.00338	0.00704	17.3		9505	0.00473	0.00985	30.2		3639	0.00181	0.00377
Benzo(b)fluoranthene	2,035,000	979,000	79.3	J	5252	0.00258	0.00536	96.3	J	6173	0.00303	0.00631	18.1		9945	0.00489	0.01016	45.6		5494	0.00270	0.00561
Benzo(e)pyrene	2,010,000	967,000	83.7	J	5543	0.00276	0.00573	94.4		6051	0.00301	0.00626	11.2		6154	0.00306	0.00636	40.8		4916	0.00245	0.00508
Benzo(g,h,i)perylene	2,270,000	1,090,000	32.4	J	2146	0.00095	0.00197	56.6	J	3628	0.00160	0.00333	5.62		3088	0.00136	0.00283	20.2		2434	0.00107	0.00223
Benzo(k)fluoranthene	2,040,000	981,000	94.8	U	3139	0.00154	0.00320	86.8		5564	0.00273	0.00567	14		7692	0.00377	0.00784	11.7		1410	0.00069	0.00144
C1-Chrysenes	1,935,000	929,000	356	J	23576	0.01218	0.02538	112	J	7179	0.00371	0.00773	5.17	J	2841	0.00147	0.00306	187	J	22530	0.01164	0.02425
C1-Fluorenes	1,270,000	611,000	1690	J	111921	0.08813	0.18318	26.8	J	1718	0.00135	0.00281	1.75	J	962	0.00076	0.00157	2040	J	245783	0.19353	0.40226
C1-Phenanthrenes/Anthracenes	1,395,000	670,000	2400	J	158940	0.11394	0.23722	142	J	9103	0.00653	0.01359	0.8	U	220	0.00016	0.00033	2060	J	248193	0.17792	0.37044
C1-Fluoranthenes/Pyrene	1,600,000	770,000	791	J	52384	0.03274	0.06803	154	J	9872	0.00617	0.01282	9.79	J	5379	0.00336	0.00699	498	J	60000	0.03750	0.07792
C2-Chrysenes	2,100,000	1,010,000	540	J	35762	0.01703	0.03541	108	J	6923	0.00330	0.00685	2.98	J	1637	0.00078	0.00162	243	J	29277	0.01394	0.02899
C2-Fluorenes	1,425,000	686,000	2800	J	185430	0.13013	0.27031	116	J	7436	0.00522	0.01084	0.8	U	220	0.00015	0.00032	3380	J	407229	0.28577	0.59363
C2-Naphthalenes	1,060,000	510,000	14800	J	980132	0.92465	1.92183	136	J	8718	0.00822	0.01709	10.3	J	5659	0.00534	0.01110	4210	J	507229	0.47852	0.99457
C2-Phenanthrenes/Anthracenes	1,550,000	746,000	3060	J	202649	0.13074	0.27165	237	J	15192	0.00980	0.02037	5.51	J	3027	0.00195	0.00406	5140	J	619277	0.39953	0.83013
C3-Chrysenes	2,310,000	1,110,000	424	J	28079	0.01216	0.02530	117	J	7500	0.00325	0.00676	2.22	J	1220	0.00053	0.00110	224	J	26988	0.01168	0.02431
C3-Fluorenes	1,600,000	769,000	2570	J	170199	0.10637	0.22132	93.1	J	5968	0.00373	0.00776	0.8	U	220	0.00014	0.00029	2910	J	350602	0.21913	0.45592
C3-Naphthalenes	1,210,000	581,000	29700	J	1966887	1.62553	3.38535	188	J	12051	0.00996	0.02074	13.4	J	7363	0.00608	0.01267	11200	J	1349398	1.11520	2.32254
C3-Phenanthrenes/Anthracenes	1,725,000	829,000	2540	J	168212	0.09751	0.20291	200	J	12821	0.00743	0.01547	2.8	J	1538	0.00089	0.00186	4310	J	519277	0.30103	0.62639
C4-Chrysenes	2,515,000	1,210,000	126	J	8344	0.00332	0.00690	57.7	J	3699	0.00147	0.00306	1.11	J	610	0.00024	0.00050	78.3	J	9434	0.00375	0.00780
C4-Naphthalenes	1,365,000	657,000	22500	J	1490066	1.09162	2.26799	219	J	14038	0.01028	0.02137	10.8	J	5934	0.00435	0.00903	11400	J	1373494	1.00622	2.09055
C4-Phenanthrenes/Anthracenes	1,895,000	912,000	1900	J	125828	0.06640	0.13797	178	J	11410	0.00602	0.01251	0.8	U	220	0.00012	0.00024	2510	J	302410	0.15958	0.33159
Chrysene	1,755,000	844,000	134		8874	0.00506	0.01051	139		8910	0.00508	0.01056	17		9341	0.00532	0.01107	65.4		7880	0.00449	0.00934
Dibenz(a,h)anthracene	2,330,000	1,120,000	94.8	UJ	3139	0.00135	0.00280	13.4	J	859	0.00037	0.00077	1.79		984	0.00042	0.00088	7.45	J	898	0.00039	0.00080
Fluoranthene	1,470,000	707,000	84.7	J	5609	0.00382	0.00793	152		9744	0.00663	0.01378	31		17033	0.01159	0.02409	123		14819	0.01008	0.02096
Fluorene	1,120,000	538,000	665		44040	0.03932	0.08186	28.4		1821	0.00163	0.00338	1.6		879	0.00078	0.00163	302		36386	0.03249	0.06763
Indeno(1,2,3-cd)pyrene	2,310,000	1,110,000	23.6	J	1563	0.00068	0.00141	39.2	J	2513	0.00109	0.00226	5.77		3170	0.00137	0.00286	13.7		1651	0.00071	0.00149
Naphthalene	800,000	385,000	94.8	UJ	3139	0.00392	0.00815	34.9		2237	0.00280	0.00581	1.81		995	0.00124	0.00258	19.4		2337	0.00292	0.00607
Perylene	2,010,000	967,000	52.3	J	3464	0.00172	0.00358	28.7		1840	0.00092	0.00190	4.03		2214	0.00110	0.00229	14.9		1795	0.00089	0.00186
Phenanthrene	1,240,000	596,000	1290		85430	0.06890	0.14334	110		7051	0.00569	0.01183	11.9		6538	0.00527	0.01097	8.03	U	484	0.00039	0.00081
Pyrene	1,450,000	697,000	346		22914	0.01580	0.03288	181		11603	0.00800	0.01665	31.9		17527	0.01209	0.02515	159		19157	0.01321	0.02748
Benzene	1,680,000	660,000	8.24	U	273	0.00016	0.00041	1.02	U	33	0.00002	0.00005	1.15	U	316	0.00019	0.00048	7.99	U	481	0.00029	0.00073
Toluene	2,060,000	810,000	16.5	U	546	0.00027	0.00067	2.04	U	65	0.00003	0.00008	2.3	U	632	0.00031	0.00078	16	U	964	0.00047	0.00119
Ethylbenzene	2,465,000	970,000	16.5	U	546	0.00022	0.00056	1.02	U	33	0.00001	0.00003	1.15	U	316	0.00013	0.00033	16	U	964	0.00039	0.00099
m,p-Xylenes	2,490,000	980,000	16.5	U	546	0.00022	0.00056	2.04	U	65	0.00003	0.00007	2.3	U	632	0.00025	0.00064	16	U	964	0.00039	0.00098
o-Xylene	2,490,000	980,000	16.5	U	546	0.00022	0.00056	1.02	U	33	0.00001	0.00003	1.15	U	316	0.00013	0.00032	16	U	964	0.00039	0.00098
Organic Carbon (total) (percent)			1.51					1.56					0.182					0.83				
Total Sum of Acute and Chronic Potency Ratios						4.6	9.7				0.14	0.29				0.09	0.19				4.5	9.4

Table 11. Calculation of PAH Benchmark for Sediment using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval
Station Treasure Island,
San Francisco, California

Sample ID			YF319SEDA					YF321SEDA					YF322SEDA					YF323SEDA				
PAH	Acute Potency Factor (µg/kg$_{oc}$)	Chronic Potency Factor (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)
Acenaphthene	1,020,000	491,000	34.7	J	5525	0.00542	0.01125	51.8	J	5078	0.00498	0.01034	3.77	J	1193	0.00117	0.00243	10.1		1813	0.00178	0.00369
Acenaphthylene	940,000	452,000	33.4	J	5318	0.00566	0.01177	118		11569	0.01231	0.02559	23.4		7405	0.00788	0.01638	9.99		1794	0.00191	0.00397
Anthracene	1,235,000	594,000	16.9	J	2691	0.00218	0.00453	67.3	J	6598	0.00534	0.01111	18.2		5759	0.00466	0.00970	40.3		7235	0.00586	0.01218
Benzo(a)anthracene	1,750,000	841,000	51.7		8232	0.00470	0.00979	82.3	U	4034	0.00231	0.00480	70.4		22278	0.01273	0.02649	53.5		9605	0.00549	0.01142
Benzo(a)pyrene	2,010,000	965,000	101		16083	0.00800	0.01667	395		38725	0.01927	0.04013	84.3		26677	0.01327	0.02764	69		12388	0.00616	0.01284
Benzo(b)fluoranthene	2,035,000	979,000	110	J	17516	0.00861	0.01789	265	J	25980	0.01277	0.02654	65.8		20823	0.01023	0.02127	64.2		11526	0.00566	0.01177
Benzo(e)pyrene	2,010,000	967,000	90.4		14395	0.00716	0.01489	286		28039	0.01395	0.02900	52.8		16709	0.00831	0.01728	42.1		7558	0.00376	0.00782
Benzo(g,h,i)perylene	2,270,000	1,090,000	41.5	J	6608	0.00291	0.00606	136	J	13333	0.00587	0.01223	49.2		15570	0.00686	0.01428	42.2		7576	0.00334	0.00695
Benzo(k)fluoranthene	2,040,000	981,000	96		15287	0.00749	0.01558	229		22451	0.01101	0.02289	65.3	J	20665	0.01013	0.02106	55.8	J	10018	0.00491	0.01021
C1-Chrysenes	1,935,000	929,000	107	J	17038	0.00881	0.01834	173	J	16961	0.00877	0.01826	44.7	J	14146	0.00731	0.01523	24.5	J	4399	0.00227	0.00473
C1-Fluorenes	1,270,000	611,000	39.1	U	3113	0.00245	0.00510	260	J	25490	0.02007	0.04172	11.3	J	3576	0.00282	0.00585	5.46	J	980	0.00077	0.00160
C1-Phenanthrenes/Anthracenes	1,395,000	670,000	163	J	25955	0.01861	0.03874	149	J	14608	0.01047	0.02180	98.9	J	31297	0.02244	0.04671	32.3	J	5799	0.00416	0.00866
C1-Fluoranthenes/Pyrene	1,600,000	770,000	358	J	57006	0.03563	0.07403	432	J	42353	0.02647	0.05500	84.2	J	26646	0.01665	0.03460	62.7	J	11257	0.00704	0.01462
C2-Chrysenes	2,100,000	1,010,000	221	J	35191	0.01676	0.03484	370	J	36275	0.01727	0.03592	25.8	J	8165	0.00389	0.00808	17.4	J	3124	0.00149	0.00309
C2-Fluorenes	1,425,000	686,000	39.1	U	3113	0.00218	0.00454	588	J	57647	0.04045	0.08403	9.87	J	3123	0.00219	0.00455	3.34	J	600	0.00042	0.00087
C2-Naphthalenes	1,060,000	510,000	250	J	39809	0.03756	0.07806	385	J	37745	0.03561	0.07401	58.2	J	18418	0.01738	0.03611	22.4	J	4022	0.00379	0.00789
C2-Phenanthrenes/Anthracenes	1,550,000	746,000	200	J	31847	0.02055	0.04269	274	J	26863	0.01733	0.03601	38.8	J	12278	0.00792	0.01646	16.6	J	2980	0.00192	0.00399
C3-Chrysenes	2,310,000	1,110,000	215	J	34236	0.01482	0.03084	343	J	33627	0.01456	0.03030	25.1	J	7943	0.00344	0.00716	18.8	J	3375	0.00146	0.00304
C3-Fluorenes	1,600,000	769,000	323	J	51433	0.03215	0.06688	718	J	70392	0.04400	0.09154	8.72	U	1380	0.00086	0.00179	3.01	U	270	0.00017	0.00035
C3-Naphthalenes	1,210,000	581,000	262	J	41720	0.03448	0.07181	987	J	96765	0.07997	0.16655	28.2	J	8924	0.00738	0.01536	12	J	2154	0.00178	0.00371
C3-Phenanthrenes/Anthracenes	1,725,000	829,000	258	J	41083	0.02382	0.04956	267	J	26176	0.01517	0.03158	12.5	UJ	1978	0.00115	0.00239	12.7	J	2280	0.00132	0.00275
C4-Chrysenes	2,515,000	1,210,000	51.6	J	8217	0.00327	0.00679	113	J	11078	0.00440	0.00916	13.4	J	4241	0.00169	0.00350	9.01	J	1618	0.00064	0.00134
C4-Naphthalenes	1,365,000	657,000	39.1	U	3113	0.00228	0.00474	997	J	97745	0.07161	0.14877	15.5	J	4905	0.00359	0.00747	8	J	1436	0.00105	0.00219
C4-Phenanthrenes/Anthracenes	1,895,000	912,000	365	J	58121	0.03067	0.06373	458	J	44902	0.02369	0.04923	8.72	U	1380	0.00073	0.00151	13.1	J	2352	0.00124	0.00258
Chrysene	1,755,000	844,000	98.3		15653	0.00892	0.01855	67.4	J	6608	0.00377	0.00783	103		32595	0.01857	0.03862	61.9		11113	0.00633	0.01317
Dibenz(a,h)anthracene	2,330,000	1,120,000	23.8	J	3790	0.00163	0.00338	53.2	J	5216	0.00224	0.00466	14.1		4462	0.00192	0.00398	9.48		1702	0.00073	0.00152
Fluoranthene	1,470,000	707,000	184		29299	0.01993	0.04144	72.5	J	7108	0.00484	0.01005	184		58228	0.03961	0.08236	114		20467	0.01392	0.02895
Fluorene	1,120,000	538,000	42.3		6736	0.00601	0.01252	50	J	4902	0.00438	0.00911	37		11709	0.01045	0.02176	15.1		2711	0.00242	0.00504
Indeno(1,2,3-cd)pyrene	2,310,000	1,110,000	38	J	6051	0.00262	0.00545	115	J	11275	0.00488	0.01016	43.9		13892	0.00601	0.01252	37		6643	0.00288	0.00598
Naphthalene	800,000	385,000	48.7		7755	0.00969	0.02014	82.3	U	4034	0.00504	0.01048	192		60759	0.07595	0.15782	7.62	UJ	684	0.00086	0.00178
Perylene	2,010,000	967,000	31.8	J	5064	0.00252	0.00524	93.1		9127	0.00454	0.00944	18		5696	0.00283	0.00589	15.6		2801	0.00139	0.00290
Phenanthrene	1,240,000	596,000	136		21656	0.01746	0.03634	87.8		8608	0.00694	0.01444	286		90506	0.07299	0.15186	81.7		14668	0.01183	0.02461
Pyrene	1,450,000	697,000	291		46338	0.03196	0.06648	753		73824	0.05091	0.10592	199		62975	0.04343	0.09035	141		25314	0.01746	0.03632
Benzene	1,680,000	660,000	7.82	U	623	0.00037	0.00094	7.82	U	383	0.00023	0.00058	1.19	U	188	0.00011	0.00029	1.15	U	103	0.00006	0.00016
Toluene	2,060,000	810,000	15.6	U	1242	0.00060	0.00153	15.6	U	765	0.00037	0.00094	2.39	U	378	0.00018	0.00047	2.31	U	207	0.00010	0.00026
Ethylbenzene	2,465,000	970,000	15.6	U	1242	0.00050	0.00128	15.6	U	765	0.00031	0.00079	1.19	U	188	0.00008	0.00019	1.15	U	103	0.00004	0.00011
m,p-Xylenes	2,490,000	980,000	15.6	U	1242	0.00050	0.00127	15.6	U	765	0.00031	0.00078	2.39	U	378	0.00015	0.00039	2.31	U	207	0.00008	0.00021
o-Xylene	2,490,000	980,000	15.6	U	1242	0.00050	0.00127	15.6	U	765	0.00031	0.00078	1.19	U	188	0.00008	0.00019	1.15	U	103	0.00004	0.00011
Organic Carbon (total) (percent)			0.628					1.02					0.316					0.557				
Total Sum of Acute and Chronic Potency Ratios						0.44	0.91				0.61	1.3				0.45	0.93				0.13	0.26

Table 11. Calculation of PAH Benchmark for Sediment using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island,
San Francisco, California

Sample ID			YF324SEDA					YF325SEDA					YF326SEDA					YF327SEDA				
PAH	Acute Potency Factor (µg/kg$_{oc}$)	Chronic Potency Factor (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)	Conc. (µg/kg dry wt.)		C_{OC} (µg/kg$_{oc}$)	Acute Potency Ratio (µg/kg$_{oc}$)	Chronic Potency Ratio (µg/kg$_{oc}$)
Acenaphthene	1,020,000	491,000	6.4		2550	0.00250	0.00519	1.8	J	549	0.00054	0.00112	13.6	U	1514	0.00148	0.00308	29.8	J	5428	0.00532	0.01106
Acenaphthylene	940,000	452,000	5.26		2096	0.00223	0.00464	6.66		2030	0.00216	0.00449	4.76	J	1060	0.00113	0.00235	25.9	J	4718	0.00502	0.01044
Anthracene	1,235,000	594,000	7.41		2952	0.00239	0.00497	30.4	J	9268	0.00750	0.01560	18.4		4098	0.00332	0.00690	185	J	33698	0.02729	0.05673
Benzo(a)anthracene	1,750,000	841,000	21.9		8725	0.00499	0.01037	39.6	J	12073	0.00690	0.01436	167		37194	0.02125	0.04423	1380	J	251366	0.14364	0.29889
Benzo(a)pyrene	2,010,000	965,000	36.7		14622	0.00727	0.01515	55	J	16768	0.00834	0.01738	115		25612	0.01274	0.02654	992	J	180692	0.08990	0.18725
Benzo(b)fluoranthene	2,035,000	979,000	34.3		13665	0.00672	0.01396	33.2	J	10122	0.00497	0.01034	127		28285	0.01390	0.02889	1350	J	245902	0.12084	0.25118
Benzo(e)pyrene	2,010,000	967,000	25.3		10080	0.00501	0.01042	30.8	J	9390	0.00467	0.00971	70.7		15746	0.00783	0.01628	697	J	126958	0.06316	0.13129
Benzo(g,h,i)perylene	2,270,000	1,090,000	27.5		10956	0.00483	0.01005	37.3	J	11372	0.00501	0.01043	43.8		9755	0.00430	0.00895	280	J	51002	0.02247	0.04679
Benzo(k)fluoranthene	2,040,000	981,000	23.3	J	9283	0.00455	0.00946	35.2	J	10732	0.00526	0.01094	105	J	23385	0.01146	0.02384	1030	J	187614	0.09197	0.19125
C1-Chrysenes	1,935,000	929,000	16	J	6375	0.00329	0.00686	16	J	4878	0.00252	0.00525	39.9	J	8886	0.00459	0.00957	419	J	76321	0.03944	0.08215
C1-Fluorenes	1,270,000	611,000	2.9	U	578	0.00045	0.00095	3.74	J	1140	0.00090	0.00187	13.6	U	1514	0.00119	0.00248	78.7	J	14335	0.01129	0.02346
C1-Phenanthrenes/Anthracenes	1,395,000	670,000	26.5	J	10558	0.00757	0.01576	25.9	J	7896	0.00566	0.01179	41.9	J	9332	0.00669	0.01393	316	J	57559	0.04126	0.08591
C1-Fluoranthenes/Pyrene	1,600,000	770,000	39.8	J	15857	0.00991	0.02059	37.7	J	11494	0.00718	0.01493	135	J	30067	0.01879	0.03905	1070	J	194900	0.12181	0.25312
C2-Chrysenes	2,100,000	1,010,000	17.8	J	7092	0.00338	0.00702	11	J	3354	0.00160	0.00332	16.2	J	3608	0.00172	0.00357	203	J	36976	0.01761	0.03661
C2-Fluorenes	1,425,000	686,000	2.9	U	578	0.00041	0.00084	3.53	U	538	0.00038	0.00078	13.6	U	1514	0.00106	0.00221	235	J	42805	0.03004	0.06240
C2-Naphthalenes	1,060,000	510,000	16.4	J	6534	0.00616	0.01281	13.6	J	4146	0.00391	0.00813	17.7	J	3942	0.00372	0.00773	153	J	27869	0.02629	0.05464
C2-Phenanthrenes/Anthracenes	1,550,000	746,000	10.3	J	4104	0.00265	0.00550	11	J	3354	0.00216	0.00450	27.4	J	6102	0.00394	0.00818	311	J	56648	0.03655	0.07594
C3-Chrysenes	2,310,000	1,110,000	23.7	J	9442	0.00409	0.00851	10.7	J	3262	0.00141	0.00294	13.6	U	1514	0.00066	0.00136	158	J	28780	0.01246	0.02593
C3-Fluorenes	1,600,000	769,000	2.9	U	578	0.00036	0.00075	3.53	U	538	0.00034	0.00070	13.6	U	1514	0.00095	0.00197	341	J	62113	0.03882	0.08077
C3-Naphthalenes	1,210,000	581,000	5.89	J	2347	0.00194	0.00404	7.21	J	2198	0.00182	0.00378	16.6	J	3697	0.00306	0.00636	478	J	87067	0.07196	0.14986
C3-Phenanthrenes/Anthracenes	1,725,000	829,000	6.25	UJ	1245	0.00072	0.00150	5.8	J	1768	0.00103	0.00213	14.9	J	3318	0.00192	0.00400	243	J	44262	0.02566	0.05339
C4-Chrysenes	2,515,000	1,210,000	10.2	J	4064	0.00162	0.00336	4.5	J	1372	0.00055	0.00113	13.6	U	1514	0.00060	0.00125	75.6	U	6885	0.00274	0.00569
C4-Naphthalenes	1,365,000	657,000	5.58	J	2223	0.00163	0.00338	5.38	J	1640	0.00120	0.00250	13.6	U	1514	0.00111	0.00231	1690	J	307832	0.22552	0.46854
C4-Phenanthrenes/Anthracenes	1,895,000	912,000	3.02	J	1203	0.00063	0.00132	4.68	J	1427	0.00075	0.00156	13.6	U	1514	0.00080	0.00166	109	J	19854	0.01048	0.02177
Chrysene	1,755,000	844,000	30.2		12032	0.00686	0.01426	41.9	J	12774	0.00728	0.01514	114		25390	0.01447	0.03008	1290	J	234973	0.13389	0.27840
Dibenz(a,h)anthracene	2,330,000	1,120,000	5.35		2131	0.00091	0.00190	7.61		2320	0.00100	0.00207	15.8		3519	0.00151	0.00314	129	J	23497	0.01008	0.02098
Fluoranthene	1,470,000	707,000	67.9		27052	0.01840	0.03826	82.4	J	25122	0.01709	0.03553	436		97105	0.06606	0.13735	2300	J	418944	0.28500	0.59257
Fluorene	1,120,000	538,000	6.25		2490	0.00222	0.00463	7.89		2405	0.00215	0.00447	13.6	U	1514	0.00135	0.00282	37	J	6740	0.00602	0.01253
Indeno(1,2,3-cd)pyrene	2,310,000	1,110,000	21.9		8725	0.00378	0.00786	29.3	J	8933	0.00387	0.00805	45.4		10111	0.00438	0.00911	328	J	59745	0.02586	0.05382
Naphthalene	800,000	385,000	5.07	UJ	1010	0.00126	0.00262	3.53	UJ	538	0.00067	0.00140	13.6	U	1514	0.00189	0.00393	75.6	U	6885	0.00861	0.01788
Perylene	2,010,000	967,000	10.3		4104	0.00204	0.00424	11.3		3445	0.00171	0.00356	28.3		6303	0.00314	0.00652	263	J	47905	0.02383	0.04954
Phenanthrene	1,240,000	596,000	35.7		14223	0.01147	0.02386	69.7	J	21250	0.01714	0.03565	60.1		13385	0.01079	0.02246	587	J	106922	0.08623	0.17940
Pyrene	1,450,000	697,000	85.7		34143	0.02355	0.04899	106	J	32317	0.02229	0.04637	347		77283	0.05330	0.11088	1940	J	353370	0.24370	0.50699
Benzene	1,680,000	660,000	1.1	U	219	0.00013	0.00033	1.19	U	181	0.00011	0.00027	1.26	U	140	0.00008	0.00021	0.952	U	87	0.00005	0.00013
Toluene	2,060,000	810,000	2.2	U	438	0.00021	0.00054	2.39	U	364	0.00018	0.00045	2.52	U	281	0.00014	0.00035	1.9	U	173	0.00008	0.00021
Ethylbenzene	2,465,000	970,000	1.1	U	219	0.00009	0.00023	1.19	U	181	0.00007	0.00019	1.26	U	140	0.00006	0.00014	0.952	U	87	0.00004	0.00009
m,p-Xylenes	2,490,000	980,000	2.2	U	438	0.00018	0.00045	2.39	U	364	0.00015	0.00037	2.52	U	281	0.00011	0.00029	1.9	U	173	0.00007	0.00018
o-Xylene	2,490,000	980,000	1.1	U	219	0.00009	0.00022	1.19	U	181	0.00007	0.00019	1.26	U	140	0.00006	0.00014	0.952	U	87	0.00003	0.00009
Organic Carbon (total) (percent)			0.251					0.328					0.449					0.549				
Total Sum of Acute and Chronic Potency Ratios						0.16	0.33				0.15	0.31				0.29	0.59				2.1	4.4

Table 12. Summary of PAH Benchmark Calculations for Pore Water using the Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Sampling Location	Acute Potency Ratio Result	Chronic Potency Ratio Result
YF301PW	0.27	0.55
YF302PW	0.22	0.45
YF303PW	0.80	1.7
YF304PW	0.22	0.44
YF305PW	0.17	0.36
YF306PW	0.31	0.62
YF307PW	0.27	0.55
YF308PW	2.5	5.1
YF309PW	0.24	0.49
YF310PW	1.6	3.3
YF311PW	0.63	1.3
YF312PW	0.18	0.37
YF312PWDUP	2.8	5.9
YF313PW	0.17	0.35
YF314PW	--*	--*
YF315PW	0.18	0.36
YF316PW	0.53	1.1
YF316PWDUP	2.6	5.3
YF317PW	0.18	0.36
YF318PW	0.36	0.72
YF319PW	0.21	0.42
YF320PW	0.21	0.42
Maximum Potency Ratio	2.8	5.9
Minimum Potency Ratio	0.17	0.35
Percentage of Potency Ratio Results Greater than 1.0	19.05	33.33
Total Number of Samples	21	21

Notes:

Chronic Potency Ratio - Water Quality Criteria Toxic Unit for PAH, based on the FCV

PAH - Polycyclic aromatic hydrocarbons

1.2 = Red highlight indicates chronic toxicity ratio is greater than 1.0.

* = Lab reported that a heavy emulsion in the sample was not able to be separated and the sample was subsequently lost.

Table 13. Calculation of PAH Benchmark for Pore Water using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island,
San Francisco, California

		Sample ID	YF301PW				YF302PW				YF303PW				YF304PW			
PAH	Acute Potency Factor (µg/L)	PAH Specific FCV (µg/L)	Conc. (µg/L)		Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)		Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)		Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)		Acute Potency Ratio unitless	Chronic Potency Ratio unitless
1-Methylnaphthalene	1	75.37	0.00472	U	0.0024	0.0000	0.00463	UJ	0.0023	0.0000	0.00271	J	0.0027	0.0000	0.003	J	0.0028	0.0000
2-Methylnaphthalene	1	72.16	0.00472	U	0.0024	0.0000	0.00463	UJ	0.0023	0.0000	0.0032	J	0.0032	0.0000	0.003	J	0.0034	0.0000
Acenaphthene	116.1	55.85	0.00943	U	0.0000	0.0001	0.0185	UJ	0.0001	0.0002	0.0189	UJ	0.0001	0.0002	0.009	U	0.0000	0.0001
Acenaphthylene	640	306.9	0.00472	U	0.0000	0.0000	0.00463	UJ	0.0000	0.0000	0.0193	J	0.0000	0.0001	0.005	U	0.0000	0.0000
Anthracene	43.1	20.73	0.00518	J	0.0001	0.0002	0.00463	UJ	0.0001	0.0001	0.0069	J	0.0002	0.0003	0.005	U	0.0001	0.0001
Benzo(a)anthracene	4.64	2.227	0.0153	J	0.0033	0.0069	0.0144	J	0.0031	0.0065	0.0117	J	0.0025	0.0053	0.01	J	0.0022	0.0046
Benzo(a)pyrene	1.99	0.9573	0.0192		0.0096	0.0201	0.0193		0.0097	0.0202	0.0568		0.0285	0.0593	0.015	J	0.0077	0.0160
Benzo(b)fluoranthene	1.41	0.6774	0.0189		0.0134	0.0279	0.0105	J	0.0074	0.0155	0.0334		0.0237	0.0493	0.012	J	0.0087	0.0182
Benzo(e)pyrene	1.87	0.9008	0.0153	J	0.0082	0.0170	0.0107	J	0.0057	0.0119	0.0407		0.0218	0.0452	0.012	J	0.0065	0.0134
Benzo(g,h,i)perylene	0.91	0.4391	0.0261		0.0287	0.0594	0.0185	UJ	0.0102	0.0211	0.0598		0.0657	0.1362	0.019	UJ	0.0104	0.0215
Benzo(k)fluoranthene	1.34	0.6415	0.0192		0.0143	0.0299	0.0112	J	0.0084	0.0175	0.0334		0.0249	0.0521	0.012	J	0.0090	0.0189
C1-Chrysenes	1.78	0.8557	0.0189	U	0.0053	0.0110	0.0185	U	0.0052	0.0108	0.0256	J	0.0144	0.0299	0.019	U	0.0053	0.0110
C1-Fluorenes	29.1	13.99	0.0189	U	0.0003	0.0007	0.0185	U	0.0003	0.0007	0.0189	U	0.0003	0.0007	0.019	U	0.0003	0.0007
C1-Phenanthrenes/Anthracenes	15.5	7.436	0.0189	U	0.0006	0.0013	0.0185	U	0.0006	0.0012	0.0189	U	0.0006	0.0013	0.019	U	0.0006	0.0013
C1-Fluoranthenes/Pyrene	10.2	4.887	0.0309	J	0.0030	0.0063	0.0343	J	0.0034	0.0070	0.16	J	0.0157	0.0327	0.023	J	0.0022	0.0047
C2-Chrysenes	1	0.4827	0.0189	U	0.0095	0.0196	0.0185	U	0.0093	0.0192	0.0616	J	0.0616	0.1276	0.019	U	0.0095	0.0196
C2-Fluorenes	11	5.305	0.0277	J	0.0025	0.0052	0.0194	J	0.0018	0.0037	0.0189	U	0.0009	0.0018	0.019	U	0.0009	0.0018
C2-Naphthalenes	63	30.24	0.0189	U	0.0002	0.0003	0.0185	U	0.0001	0.0003	0.0189	U	0.0002	0.0003	0.023	J	0.0004	0.0008
C2-Phenanthrenes/Anthracenes	6.65	3.199	0.0189	U	0.0014	0.0030	0.0185	U	0.0014	0.0029	0.0189	U	0.0014	0.0030	0.019	U	0.0014	0.0030
C3-Chrysenes	0.35	0.1675	0.0189	U	0.0270	0.0564	0.0185	U	0.0264	0.0552	0.0683	J	0.1951	0.4078	0.019	U	0.0270	0.0564
C3-Fluorenes	4	1.916	0.0189	U	0.0024	0.0049	0.0185	U	0.0023	0.0048	0.0189	U	0.0024	0.0049	0.019	U	0.0024	0.0049
C3-Naphthalenes	23.1	11.1	0.0273	J	0.0012	0.0025	0.0185	U	0.0004	0.0008	0.0189	U	0.0004	0.0009	0.019	U	0.0004	0.0009
C3-Phenanthrenes/Anthracenes	2.62	1.256	0.0189	U	0.0036	0.0075	0.0185	U	0.0035	0.0074	0.0407	J	0.0155	0.0324	0.019	U	0.0036	0.0075
C4-Chrysenes	0.15	0.07062	0.0189	U	0.0630	0.1338	0.0185	U	0.0617	0.1310	0.0278	J	0.1853	0.3937	0.019	U	0.0630	0.1338
C4-Naphthalenes	8.4	4.048	0.0373	J	0.0044	0.0092	0.0185	U	0.0011	0.0023	0.0189	U	0.0011	0.0023	0.019	U	0.0011	0.0023
C4-Phenanthrenes/Anthracenes	1.16	0.5594	0.0189	U	0.0081	0.0169	0.0185	U	0.0080	0.0165	0.0209	J	0.0180	0.0374	0.019	U	0.0081	0.0169
Chrysene	4.24	2.042	0.0161	J	0.0038	0.0079	0.0152	J	0.0036	0.0074	0.0143	J	0.0034	0.0070	0.013	J	0.0031	0.0064
Dibenz(a,h)anthracene	0.59	0.2825	0.00943	U	0.0080	0.0167	0.00926	U	0.0078	0.0164	0.0137	J	0.0232	0.0485	0.005	J	0.0092	0.0193
Fluoranthene	14.8	7.109	0.0398		0.0027	0.0056	0.0275		0.0019	0.0039	0.0235		0.0016	0.0033	0.03		0.0020	0.0042
Fluorene	81.8	39.3	0.00943	U	0.0001	0.0001	0.00926	UJ	0.00006	0.0001	0.00943	UJ	0.0001	0.0001	0.009	U	0.0001	0.0001
Indeno(1,2,3-cd)pyrene	0.57	0.275	0.0136	J	0.0239	0.0495	0.00893	J	0.0157	0.0325	0.0357		0.0626	0.1298	0.008	J	0.0135	0.0281
Naphthalene	402	193.5	0.0189	UJ	0.0000	0.0000	0.0185	UJ	0.0000	0.0000	0.0189	UJ	0.0000	0.0000	0.019	UJ	0.0000	0.0000
Perylene	1.87	0.9008	0.0112	J	0.0060	0.0124	0.0127	J	0.0068	0.0141	0.0249		0.0133	0.0276	0.012	J	0.0063	0.0131
Phenanthrene	39.8	19.13	0.0236		0.0006	0.0012	0.0224	J	0.0006	0.0012	0.0167	J	0.0004	0.0009	0.025		0.0006	0.0013
Pyrene	21	10.11	0.0447		0.0021	0.0044	0.0348		0.0017	0.0034	0.128		0.0061	0.0127	0.026		0.0012	0.0025
Benzene	13500	5300	4	U	0.0001	0.0004	4	U	0.0001	0.0004	4	U	0.0001	0.0004	4	U	0.0001	0.0004
Toluene	4070	1600	8	U	0.0010	0.0025	8	U	0.0010	0.0025	8	U	0.0010	0.0025	8	U	0.0010	0.0025
Ethylbenzene	2010	790	4	U	0.0010	0.0025	4	U	0.0010	0.0025	4	U	0.0010	0.0025	4	U	0.0010	0.0025
m,p-Xylenes	1780	700	4	U	0.0011	0.0029	4	U	0.0011	0.0029	4	U	0.0011	0.0029	4	U	0.0011	0.0029
o-Xylene	1780	700	4	U	0.0011	0.0029	4	U	0.0011	0.0029	4	U	0.0011	0.0029	4	U	0.0011	0.0029
Sum Total of Acute and Chronic Potency Ratios					0.27	0.55			0.22	0.45			0.80	1.7			0.22	0.44

Table 13. Calculation of PAH Benchmark for Pore Water using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island,
San Francisco, California

		Sample ID	YF305PW			YF306PW			YF307PW			YF308PW		
PAH	Acute Potency Factor (µg/L)	PAH Specific FCV (µg/L)	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless
1-Methylnaphthalene	1	75.37	0.005 U	0.0025	0.0000	0.005 J	0.0047	0.0001	0.004 J	0.0041	0.0001	0.037	0.0366	0.0005
2-Methylnaphthalene	1	72.16	0.003 J	0.0031	0.0000	0.008 J	0.0082	0.0001	0.006 J	0.0063	0.0001	0.064	0.0635	0.0009
Acenaphthene	116.1	55.85	0.01 U	0.0000	0.0001	0.026 J	0.0002	0.0005	0.015 J	0.0001	0.0003	0.009 U	0.0000	0.0001
Acenaphthylene	640	306.9	0.005 U	0.0000	0.0000	0.005 UJ	0.0000	0.0000	0.005 U	0.0000	0.0000	0.027	0.0000	0.0001
Anthracene	43.1	20.73	0.005 U	0.0001	0.0001	0.01 J	0.0002	0.0005	0.005 J	0.0001	0.0002	0.005 U	0.0001	0.0001
Benzo(a)anthracene	4.64	2.227	0.005 U	0.0005	0.0011	0.021	0.0044	0.0093	0.009 J	0.0019	0.0039	0.024 J	0.0051	0.0106
Benzo(a)pyrene	1.99	0.9573	0.003 J	0.0015	0.0031	0.021	0.0108	0.0224	0.012 J	0.0062	0.0130	0.073	0.0366	0.0760
Benzo(b)fluoranthene	1.41	0.6774	0.005 UJ	0.0018	0.0037	0.028	0.0200	0.0416	0.012 J	0.0082	0.0171	0.067	0.0474	0.0986
Benzo(e)pyrene	1.87	0.9008	0.005 UJ	0.0013	0.0028	0.017 J	0.0090	0.0187	0.008 J	0.0043	0.0090	0.083	0.0442	0.0918
Benzo(g,h,i)perylene	0.91	0.4391	0.005 UJ	0.0027	0.0057	0.021	0.0235	0.0487	0.007 J	0.0074	0.0153	0.054	0.0590	0.1223
Benzo(k)fluoranthene	1.34	0.6415	0.01 UJ	0.0037	0.0078	0.021	0.0158	0.0330	0.009 J	0.0070	0.0146	0.056	0.0418	0.0873
C1-Chrysenes	1.78	0.8557	0.02 U	0.0056	0.0117	0.02 U	0.0057	0.0119	0.019 U	0.0054	0.0112	0.088 J	0.0493	0.1025
C1-Fluorenes	29.1	13.99	0.02 U	0.0003	0.0007	0.02 U	0.0004	0.0007	0.031 J	0.0010	0.0022	0.019 U	0.0003	0.0007
C1-Phenanthrenes/Anthracenes	15.5	7.436	0.02 U	0.0006	0.0013	0.02 U	0.0007	0.0014	0.019 U	0.0006	0.0013	0.019 U	0.0006	0.0013
C1-Fluoranthenes/Pyrene	10.2	4.887	0.02 U	0.0010	0.0020	0.065 J	0.0064	0.0133	0.076 J	0.0075	0.0156	0.956 J	0.0937	0.1956
C2-Chrysenes	1	0.4827	0.02 U	0.0100	0.0207	0.02 U	0.0102	0.0211	0.019 U	0.0096	0.0199	0.25 J	0.2500	0.5179
C2-Fluorenes	11	5.305	0.02 U	0.0009	0.0019	0.02 U	0.0009	0.0019	0.06 J	0.0054	0.0112	0.019 U	0.0009	0.0018
C2-Naphthalenes	63	30.24	0.02 U	0.0002	0.0003	0.211 J	0.0033	0.0070	0.195 J	0.0031	0.0064	0.019 U	0.0002	0.0003
C2-Phenanthrenes/Anthracenes	6.65	3.199	0.02 U	0.0015	0.0031	0.02 U	0.0015	0.0032	0.019 U	0.0014	0.0030	0.019 U	0.0014	0.0030
C3-Chrysenes	0.35	0.1675	0.02 U	0.0286	0.0597	0.02 U	0.0291	0.0609	0.019 U	0.0274	0.0573	0.28 J	0.8000	1.6716
C3-Fluorenes	4	1.916	0.02 U	0.0025	0.0052	0.02 U	0.0026	0.0053	0.062 J	0.0154	0.0322	0.019 U	0.0024	0.0049
C3-Naphthalenes	23.1	11.1	0.02 U	0.0004	0.0009	0.128 J	0.0055	0.0115	0.085 J	0.0037	0.0076	0.019 U	0.0004	0.0009
C3-Phenanthrenes/Anthracenes	2.62	1.256	0.02 U	0.0038	0.0080	0.02 U	0.0039	0.0081	0.022 J	0.0085	0.0178	0.019 U	0.0036	0.0075
C4-Chrysenes	0.15	0.07062	0.02 U	0.0667	0.1416	0.02 U	0.0680	0.1444	0.019 U	0.0640	0.1359	0.087 J	0.5800	1.2319
C4-Naphthalenes	8.4	4.048	0.02 U	0.0012	0.0025	0.106 J	0.0126	0.0262	0.257 J	0.0306	0.0635	0.019 U	0.0011	0.0023
C4-Phenanthrenes/Anthracenes	1.16	0.5594	0.02 U	0.0086	0.0179	0.02 U	0.0088	0.0182	0.019 U	0.0083	0.0172	0.264 J	0.2276	0.4719
Chrysene	4.24	2.042	0.005 U	0.0006	0.0012	0.017 J	0.0041	0.0085	0.01 J	0.0025	0.0051	0.036	0.0085	0.0177
Dibenz(a,h)anthracene	0.59	0.2825	0.01 UJ	0.0085	0.0177	0.01 U	0.0086	0.0181	0.01 U	0.0082	0.0170	0.017 J	0.0293	0.0612
Fluoranthene	14.8	7.109	0.014 J	0.0009	0.0019	0.049	0.0033	0.0069	0.025	0.0017	0.0035	0.07 J	0.0048	0.0099
Fluorene	81.8	39.3	0.01 U	0.0001	0.0001	0.009 J	0.0001	0.0002	0.008 J	0.0001	0.0002	0.026	0.0003	0.0007
Indeno(1,2,3-cd)pyrene	0.57	0.275	0.005 UJ	0.0044	0.0091	0.013 J	0.0223	0.0462	0.005 J	0.0091	0.0189	0.038	0.0665	0.1378
Naphthalene	402	193.5	0.02 UJ	0.0000	0.0001	0.02 UJ	0.0000	0.0001	0.019 UJ	0.0000	0.0000	0.031	0.0001	0.0002
Perylene	1.87	0.9008	0.009 J	0.0048	0.0099	0.012 J	0.0064	0.0132	0.01 J	0.0054	0.0112	0.069	0.0367	0.0762
Phenanthrene	39.8	19.13	0.02 UJ	0.0003	0.0005	0.041 J	0.0010	0.0021	0.023	0.0006	0.0012	0.072	0.0018	0.0038
Pyrene	21	10.11	0.015 J	0.0007	0.0015	0.057	0.0027	0.0056	0.102	0.0049	0.0101	0.452	0.0215	0.0447
Benzene	13500	5300	4 U	0.0001	0.0004	4 U	0.0001	0.0004	4 U	0.0001	0.0004	4 U	0.0001	0.0004
Toluene	4070	1600	8 U	0.0010	0.0025	8 U	0.0010	0.0025	8 U	0.0010	0.0025	8 U	0.0010	0.0025
Ethylbenzene	2010	790	4 U	0.0010	0.0025	4 U	0.0010	0.0025	4 U	0.0010	0.0025	4 U	0.0010	0.0025
m,p-Xylenes	1780	700	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029
o-Xylene	1780	700	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029
Sum Total of Acute and Chronic Potency Ratios				0.17	0.36		0.31	0.62		0.27	0.55		2.5	5.1

Table 13. Calculation of PAH Benchmark for Pore Water using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island,
San Francisco, California

Sample ID			YF309PW			YF310PW			YF311PW			YF312PW		
PAH	Acute Potency Factor (µg/L)	PAH Specific FCV (µg/L)	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless
1-Methylnaphthalene	1	75.37	0.002 J	0.0024	0.0000	0.013 J	0.0131	0.0002	0.004 J	0.0044	0.0001	0.005 U	0.0024	0.0000
2-Methylnaphthalene	1	72.16	0.005 J	0.0053	0.0001	0.013 J	0.0125	0.0002	0.008 J	0.0082	0.0001	0.005 U	0.0024	0.0000
Acenaphthene	116.1	55.85	0.019 UJ	0.0001	0.0002	0.025	0.0002	0.0004	0.01 U	0.0000	0.0001	0.009 U	0.0000	0.0001
Acenaphthylene	640	306.9	0.005 U	0.0000	0.0000	0.031	0.0000	0.0001	0.015 J	0.0000	0.0000	0.005 U	0.0000	0.0000
Anthracene	43.1	20.73	0.005 U	0.0001	0.0001	0.013 J	0.0003	0.0006	0.005 U	0.0001	0.0001	0.005 U	0.0001	0.0001
Benzo(a)anthracene	4.64	2.227	0.019 UJ	0.0020	0.0042	0.094	0.0202	0.0422	0.02 UJ	0.0022	0.0045	0.005 U	0.0005	0.0011
Benzo(a)pyrene	1.99	0.9573	0.019 UJ	0.0047	0.0099	0.128	0.0643	0.1337	0.028	0.0142	0.0296	0.019 UJ	0.0047	0.0099
Benzo(b)fluoranthene	1.41	0.6774	0.019 UJ	0.0067	0.0140	0.118	0.0837	0.1742	0.02 UJ	0.0071	0.0148	0.005 U	0.0017	0.0035
Benzo(e)pyrene	1.87	0.9008	0.019 UJ	0.0051	0.0105	0.096	0.0513	0.1066	0.03	0.0159	0.0330	0.019 UJ	0.0051	0.0105
Benzo(g,h,i)perylene	0.91	0.4391	0.019 UJ	0.0104	0.0215	0.081	0.0892	0.1849	0.027	0.0296	0.0613	0.019 UJ	0.0104	0.0215
Benzo(k)fluoranthene	1.34	0.6415	0.009 U	0.0035	0.0073	0.116	0.0866	0.1808	0.02 UJ	0.0075	0.0156	0.009 U	0.0035	0.0073
C1-Chrysenes	1.78	0.8557	0.019 U	0.0053	0.0110	0.073 J	0.0407	0.0847	0.02 U	0.0056	0.0117	0.019 U	0.0053	0.0110
C1-Fluorenes	29.1	13.99	0.019 U	0.0003	0.0007	0.022 U	0.0004	0.0008	0.064 J	0.0022	0.0046	0.019 U	0.0003	0.0007
C1-Phenanthrenes/Anthracenes	15.5	7.436	0.019 U	0.0006	0.0013	0.022 U	0.0007	0.0015	0.053 J	0.0034	0.0071	0.019 U	0.0006	0.0013
C1-Fluoranthenes/Pyrene	10.2	4.887	0.02 J	0.0020	0.0041	0.357 J	0.0350	0.0731	0.298 J	0.0292	0.0610	0.019 U	0.0009	0.0019
C2-Chrysenes	1	0.4827	0.019 U	0.0095	0.0196	0.144 J	0.1440	0.2983	0.049 J	0.0493	0.1021	0.019 U	0.0095	0.0196
C2-Fluorenes	11	5.305	0.042 J	0.0038	0.0079	0.022 U	0.0010	0.0021	0.222 J	0.0202	0.0418	0.019 U	0.0009	0.0018
C2-Naphthalenes	63	30.24	0.205 J	0.0033	0.0068	0.022 U	0.0002	0.0004	0.02 U	0.0002	0.0003	0.019 U	0.0002	0.0003
C2-Phenanthrenes/Anthracenes	6.65	3.199	0.024 J	0.0036	0.0074	0.022 U	0.0017	0.0035	0.02 U	0.0015	0.0031	0.019 U	0.0014	0.0030
C3-Chrysenes	0.35	0.1675	0.019 U	0.0270	0.0564	0.142 J	0.4057	0.8478	0.057 J	0.1631	0.3409	0.019 U	0.0270	0.0564
C3-Fluorenes	4	1.916	0.02 J	0.0049	0.0102	0.022 U	0.0028	0.0058	0.261 J	0.0653	0.1362	0.019 U	0.0024	0.0049
C3-Naphthalenes	23.1	11.1	0.108 J	0.0047	0.0097	0.022 U	0.0005	0.0010	0.167 J	0.0072	0.0150	0.019 U	0.0004	0.0009
C3-Phenanthrenes/Anthracenes	2.62	1.256	0.019 U	0.0036	0.0075	0.072 J	0.0274	0.0571	0.02 U	0.0038	0.0080	0.019 U	0.0036	0.0075
C4-Chrysenes	0.15	0.07062	0.019 U	0.0630	0.1338	0.038 J	0.2553	0.5423	0.02 J	0.1340	0.2846	0.019 U	0.0630	0.1338
C4-Naphthalenes	8.4	4.048	0.221 J	0.0263	0.0546	0.022 U	0.0013	0.0027	0.02 U	0.0012	0.0025	0.019 U	0.0011	0.0023
C4-Phenanthrenes/Anthracenes	1.16	0.5594	0.019 U	0.0081	0.0169	0.022 U	0.0096	0.0198	0.02 U	0.0086	0.0179	0.019 U	0.0081	0.0169
Chrysene	4.24	2.042	0.005 U	0.0006	0.0012	0.12	0.0283	0.0588	0.02 UJ	0.0024	0.0049	0.005 U	0.0006	0.0012
Dibenz(a,h)anthracene	0.59	0.2825	0.009 U	0.0080	0.0167	0.026	0.0444	0.0927	0.01 U	0.0085	0.0177	0.009 U	0.0080	0.0167
Fluoranthene	14.8	7.109	0.019 UJ	0.0006	0.0013	0.178	0.0120	0.0250	0.028	0.0019	0.0039	0.009 U	0.0003	0.0007
Fluorene	81.8	39.3	0.009 U	0.0001	0.0001	0.011 J	0.0001	0.0003	0.01 U	0.0001	0.0001	0.009 U	0.0001	0.0001
Indeno(1,2,3-cd)pyrene	0.57	0.275	0.019 UJ	0.0166	0.0344	0.073	0.1277	0.2647	0.02 UJ	0.0175	0.0364	0.005 U	0.0041	0.0086
Naphthalene	402	193.5	0.019 UJ	0.0000	0.0000	0.029	0.0001	0.0001	0.02 UJ	0.0000	0.0001	0.005 U	0.0000	0.0000
Perylene	1.87	0.9008	0.019 UJ	0.0051	0.0105	0.034	0.0182	0.0379	0.02 UJ	0.0053	0.0111	0.019 UJ	0.0051	0.0105
Phenanthrene	39.8	19.13	0.019 UJ	0.0002	0.0005	0.118	0.0030	0.0062	0.02 UJ	0.0003	0.0005	0.009 U	0.0001	0.0002
Pyrene	21	10.11	0.019 UJ	0.0005	0.0009	0.226	0.0108	0.0224	0.169 J	0.0080	0.0167	0.009 U	0.0002	0.0005
Benzene	13500	5300	4 U	0.0001	0.0004	4 U	0.0001	0.0004	4 U	0.0001	0.0004	4 U	0.0001	0.0004
Toluene	4070	1600	8 U	0.0010	0.0025	8 U	0.0010	0.0025	8 U	0.0010	0.0025	8 U	0.0010	0.0025
Ethylbenzene	2010	790	4 U	0.0010	0.0025	4 U	0.0010	0.0025	4 U	0.0010	0.0025	4 U	0.0010	0.0025
m,p-Xylenes	1780	700	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029
o-Xylene	1780	700	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029
Sum Total of Acute and Chronic Potency Ratios				0.24	0.49		1.6	3.3		0.63	1.3		0.18	0.37

Table 13. Calculation of PAH Benchmark for Pore Water using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island,
San Francisco, California

		Sample ID	YF312PWDUP			YF313PW			YF315PW			YF316PW		
PAH	Acute Potency Factor (µg/L)	PAH Specific FCV (µg/L)	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless
1-Methylnaphthalene	1	75.37	0.008 J	0.0083	0.0001	0.005 U	0.0025	0.0000	0.0047 UJ	0.0023	0.0000	0.0183 UJ	0.0092	0.0001
2-Methylnaphthalene	1	72.16	0.017 J	0.0174	0.0002	0.005 U	0.0025	0.0000	0.0047 UJ	0.0023	0.0000	0.0183 UJ	0.0092	0.0001
Acenaphthene	116.1	55.85	0.016 J	0.0001	0.0003	0.02 UJ	0.0001	0.0002	0.0094 UJ	0.0000	0.0001	0.137 J	0.0012	0.0025
Acenaphthylene	640	306.9	0.043	0.0001	0.0001	0.005 U	0.0000	0.0000	0.0047 UJ	0.0000	0.0000	0.0183 UJ	0.0000	0.0000
Anthracene	43.1	20.73	0.012 J	0.0003	0.0006	0.02 UJ	0.0002	0.0005	0.0047 UJ	0.0001	0.0001	0.0463 J	0.0011	0.0022
Benzo(a)anthracene	4.64	2.227	0.043	0.0093	0.0193	0.005 U	0.0005	0.0011	0.0047 UJ	0.0005	0.0010	0.0183 UJ	0.0020	0.0041
Benzo(a)pyrene	1.99	0.9573	0.079 J	0.0396	0.0824	0.005 U	0.0012	0.0026	0.0047 UJ	0.0012	0.0024	0.0183 UJ	0.0046	0.0096
Benzo(b)fluoranthene	1.41	0.6774	0.06	0.0425	0.0884	0.005 U	0.0017	0.0036	0.0047 UJ	0.0017	0.0034	0.0183 UJ	0.0065	0.0135
Benzo(e)pyrene	1.87	0.9008	0.127 J	0.0679	0.1410	0.005 U	0.0013	0.0027	0.0047 UJ	0.0012	0.0026	0.0183 UJ	0.0049	0.0102
Benzo(g,h,i)perylene	0.91	0.4391	0.174 J	0.1912	0.3963	0.005 U	0.0027	0.0056	0.0047 UJ	0.0026	0.0053	0.0183 UJ	0.0101	0.0208
Benzo(k)fluoranthene	1.34	0.6415	0.052	0.0387	0.0807	0.01 U	0.0037	0.0076	0.0094 UJ	0.0035	0.0073	0.0183 UJ	0.0068	0.0143
C1-Chrysenes	1.78	0.8557	0.059 J	0.0329	0.0685	0.02 U	0.0055	0.0115	0.0187 UJ	0.0053	0.0109	0.0192 J	0.0108	0.0224
C1-Fluorenes	29.1	13.99	0.02 U	0.0003	0.0007	0.02 U	0.0003	0.0007	0.0187 UJ	0.0003	0.0007	0.0183 UJ	0.0003	0.0007
C1-Phenanthrenes/Anthracenes	15.5	7.436	0.084 J	0.0054	0.0112	0.02 U	0.0006	0.0013	0.0187 UJ	0.0006	0.0013	0.0547 J	0.0035	0.0074
C1-Fluoranthenes/Pyrene	10.2	4.887	0.202 J	0.0198	0.0413	0.02 U	0.0010	0.0020	0.0187 UJ	0.0009	0.0019	0.108 J	0.0106	0.0221
C2-Chrysenes	1	0.4827	0.14 J	0.1400	0.2900	0.02 U	0.0098	0.0203	0.0187 UJ	0.0094	0.0194	0.0264 J	0.0264	0.0547
C2-Fluorenes	11	5.305	0.147 J	0.0134	0.0277	0.02 U	0.0009	0.0018	0.0292 J	0.0027	0.0055	0.0183 UJ	0.0008	0.0017
C2-Naphthalenes	63	30.24	0.35 J	0.0056	0.0116	0.021 J	0.0003	0.0007	0.0349 J	0.0006	0.0012	0.0183 UJ	0.0001	0.0003
C2-Phenanthrenes/Anthracenes	6.65	3.199	0.098 J	0.0147	0.0306	0.02 U	0.0015	0.0031	0.0187 UJ	0.0014	0.0029	0.116 J	0.0174	0.0363
C3-Chrysenes	0.35	0.1675	0.298 J	0.8514	1.7791	0.02 U	0.0280	0.0585	0.0187 UJ	0.0267	0.0558	0.0183 UJ	0.0261	0.0546
C3-Fluorenes	4	1.916	0.085 J	0.0212	0.0442	0.02 U	0.0025	0.0051	0.0226 J	0.0057	0.0118	0.124 J	0.0310	0.0647
C3-Naphthalenes	23.1	11.1	0.069 J	0.0030	0.0062	0.033 J	0.0014	0.0030	0.0736 J	0.0032	0.0066	0.347 J	0.0150	0.0313
C3-Phenanthrenes/Anthracenes	2.62	1.256	0.116 J	0.0443	0.0924	0.02 U	0.0037	0.0078	0.0187 UJ	0.0036	0.0074	0.199 J	0.0760	0.1584
C4-Chrysenes	0.15	0.07062	0.142 J	0.9467	2.0108	0.02 U	0.0653	0.1388	0.0187 UJ	0.0623	0.1324	0.0183 UJ	0.0610	0.1296
C4-Naphthalenes	8.4	4.048	0.12 J	0.0143	0.0296	0.02 U	0.0012	0.0024	0.0733 J	0.0087	0.0181	0.885 J	0.1054	0.2186
C4-Phenanthrenes/Anthracenes	1.16	0.5594	0.117 J	0.1009	0.2092	0.02 U	0.0084	0.0175	0.0187 UJ	0.0081	0.0167	0.0611 J	0.0527	0.1092
Chrysene	4.24	2.042	0.067	0.0158	0.0328	0.005 U	0.0006	0.0012	0.0047 UJ	0.0006	0.0011	0.0238 J	0.0056	0.0117
Dibenz(a,h)anthracene	0.59	0.2825	0.019 J	0.0320	0.0669	0.01 U	0.0083	0.0173	0.0094 UJ	0.0079	0.0165	0.006 J	0.0101	0.0211
Fluoranthene	14.8	7.109	0.105	0.0071	0.0148	0.01 U	0.0003	0.0007	0.0094 UJ	0.0003	0.0007	0.035 UJ	0.0012	0.0025
Fluorene	81.8	39.3	0.01 U	0.0001	0.0001	0.02 UJ	0.0001	0.0002	0.0094 UJ	0.0001	0.0001	0.0183 UJ	0.0001	0.0002
Indeno(1,2,3-cd)pyrene	0.57	0.275	0.067 J	0.1175	0.2436	0.005 U	0.0043	0.0089	0.0047 UJ	0.0041	0.0085	0.0183 UJ	0.0161	0.0333
Naphthalene	402	193.5	0.02 UJ	0.0000	0.0001	0.02 UJ	0.0000	0.0001	0.0187 UJ	0.0000	0.0000	0.0183 UJ	0.0000	0.0000
Perylene	1.87	0.9008	0.042	0.0226	0.0468	0.02 UJ	0.0052	0.0109	0.0187 UJ	0.0050	0.0104	0.0183 UJ	0.0049	0.0102
Phenanthrene	39.8	19.13	0.046	0.0012	0.0024	0.02 UJ	0.0002	0.0005	0.0187 UJ	0.0002	0.0005	0.0216 UJ	0.0003	0.0006
Pyrene	21	10.11	0.091	0.0043	0.0090	0.02 UJ	0.0005	0.0010	0.0187 UJ	0.0004	0.0009	0.0451 UJ	0.0011	0.0022
Benzene	13500	5300	4 U	0.0001	0.0004	4 U	0.0001	0.0004	4 U	0.0001	0.0004	0.4 U	0.0000	0.0000
Toluene	4070	1600	8 U	0.0010	0.0025	8 U	0.0010	0.0025	8 U	0.0010	0.0025	0.8 U	0.0001	0.0003
Ethylbenzene	2010	790	4 U	0.0010	0.0025	4 U	0.0010	0.0025	4 U	0.0010	0.0025	0.4 U	0.0001	0.0003
m,p-Xylenes	1780	700	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029	0.4 U	0.0001	0.0003
o-Xylene	1780	700	4 U	0.0011	0.0029	4 U	0.0011	0.0029	4 U	0.0011	0.0029	0.4 U	0.0001	0.0003
Sum Total of Acute and Chronic Potency Ratios				2.8	5.9		0.17	0.35		0.18	0.36		0.53	1.1

Table 13. Calculation of PAH Benchmark for Pore Water using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island,
San Francisco, California

		Sample ID	YF316PWDUP			YF317PW			YF318PW			YF319PW		
PAH	Acute Potency Factor (µg/L)	PAH Specific FCV (µg/L)	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless	Conc. (µg/L)	Acute Potency Ratio unitless	Chronic Potency Ratio unitless
1-Methylnaphthalene	1	75.37	0.0194 J	0.0194	0.0003	0.0051 U	0.0026	0.0000	0.0198 UJ	0.0099	0.0001	0.0048 UJ	0.0024	0.0000
2-Methylnaphthalene	1	72.16	0.0289	0.0289	0.0004	0.0051 U	0.0026	0.0000	0.0198 UJ	0.0099	0.0001	0.0048 UJ	0.0024	0.0000
Acenaphthene	116.1	55.85	0.187	0.0016	0.0033	0.0102 U	0.0000	0.0001	0.0099 U	0.0000	0.0001	0.019 UJ	0.0001	0.0002
Acenaphthylene	640	306.9	0.0122 J	0.0000	0.0000	0.0051 U	0.0000	0.0000	0.0198 UJ	0.0000	0.0000	0.0048 UJ	0.0000	0.0000
Anthracene	43.1	20.73	0.0493	0.0011	0.0024	0.0051 U	0.0001	0.0001	0.005 U	0.0001	0.0001	0.0048 UJ	0.0001	0.0001
Benzo(a)anthracene	4.64	2.227	0.0388	0.0084	0.0174	0.0051 U	0.0005	0.0011	0.0198 UJ	0.0021	0.0044	0.019 UJ	0.0020	0.0043
Benzo(a)pyrene	1.99	0.9573	0.0253	0.0127	0.0264	0.0051 UJ	0.0013	0.0027	0.0198 UJ	0.0050	0.0103	0.019 UJ	0.0048	0.0099
Benzo(b)fluoranthene	1.41	0.6774	0.0252	0.0179	0.0372	0.0051 UJ	0.0018	0.0038	0.0198 UJ	0.0070	0.0146	0.019 UJ	0.0067	0.0140
Benzo(e)pyrene	1.87	0.9008	0.0259	0.0139	0.0288	0.0051 UJ	0.0014	0.0028	0.0198 UJ	0.0053	0.0110	0.019 UJ	0.0051	0.0105
Benzo(g,h,i)perylene	0.91	0.4391	0.0503	0.0553	0.1146	0.0051 UJ	0.0028	0.0058	0.0198 UJ	0.0109	0.0225	0.019 UJ	0.0104	0.0216
Benzo(k)fluoranthene	1.34	0.6415	0.0239	0.0178	0.0373	0.0102 UJ	0.0038	0.0080	0.0099 U	0.0037	0.0077	0.0095 U	0.0036	0.0074
C1-Chrysenes	1.78	0.8557	0.0718 J	0.0403	0.0839	0.0204 U	0.0057	0.0119	0.0198 U	0.0056	0.0116	0.019 UJ	0.0053	0.0111
C1-Fluorenes	29.1	13.99	0.257 J	0.0088	0.0184	0.0204 U	0.0004	0.0007	0.0198 U	0.0003	0.0007	0.019 UJ	0.0003	0.0007
C1-Phenanthrenes/Anthracenes	15.5	7.436	0.249 J	0.0161	0.0335	0.0204 U	0.0007	0.0014	0.0198 U	0.0006	0.0013	0.019 UJ	0.0006	0.0013
C1-Fluoranthenes/Pyrene	10.2	4.887	0.443 J	0.0434	0.0906	0.0204 U	0.0010	0.0021	0.223 J	0.0219	0.0456	0.0559 J	0.0055	0.0114
C2-Chrysenes	1	0.4827	0.0835 J	0.0835	0.1730	0.0204 U	0.0102	0.0211	0.0236 J	0.0236	0.0489	0.019 UJ	0.0095	0.0197
C2-Fluorenes	11	5.305	0.909 J	0.0826	0.1713	0.0204 U	0.0009	0.0019	0.0198 U	0.0009	0.0019	0.019 UJ	0.0009	0.0018
C2-Naphthalenes	63	30.24	0.654 J	0.0104	0.0216	0.0204 U	0.0002	0.0003	0.0198 U	0.0002	0.0003	0.019 UJ	0.0002	0.0003
C2-Phenanthrenes/Anthracenes	6.65	3.199	0.948 J	0.1426	0.2963	0.0204 U	0.0015	0.0032	0.0198 U	0.0015	0.0031	0.019 UJ	0.0014	0.0030
C3-Chrysenes	0.35	0.1675	0.0931 J	0.2660	0.5558	0.0204 U	0.0291	0.0609	0.0198 U	0.0283	0.0591	0.019 UJ	0.0271	0.0567
C3-Fluorenes	4	1.916	0.602 J	0.1505	0.3142	0.0204 U	0.0026	0.0053	0.0198 U	0.0025	0.0052	0.019 UJ	0.0024	0.0050
C3-Naphthalenes	23.1	11.1	2.03 J	0.0879	0.1829	0.0204 U	0.0004	0.0009	0.0198 U	0.0004	0.0009	0.019 UJ	0.0004	0.0009
C3-Phenanthrenes/Anthracenes	2.62	1.256	0.773 J	0.2950	0.6154	0.0204 U	0.0039	0.0081	0.111 J	0.0424	0.0884	0.019 UJ	0.0036	0.0076
C4-Chrysenes	0.15	0.07062	0.0253 J	0.1687	0.3583	0.0204 U	0.0680	0.1444	0.0198 U	0.0660	0.1402	0.019 UJ	0.0633	0.1345
C4-Naphthalenes	8.4	4.048	5.04 J	0.6000	1.2451	0.0204 U	0.0012	0.0025	0.0198 U	0.0012	0.0024	0.019 UJ	0.0011	0.0023
C4-Phenanthrenes/Anthracenes	1.16	0.5594	0.369 J	0.3181	0.6596	0.0204 U	0.0088	0.0182	0.0871 J	0.0751	0.1557	0.019 UJ	0.0082	0.0170
Chrysene	4.24	2.042	0.0538	0.0127	0.0263	0.0051 U	0.0006	0.0012	0.0198 UJ	0.0023	0.0048	0.019 UJ	0.0022	0.0047
Dibenz(a,h)anthracene	0.59	0.2825	0.0082 J	0.0139	0.0291	0.0102 UJ	0.0086	0.0181	0.0099 U	0.0084	0.0175	0.0095 U	0.0081	0.0168
Fluoranthene	14.8	7.109	0.0871	0.0059	0.0123	0.0204 UJ	0.0007	0.0014	0.0198 UJ	0.0007	0.0014	0.019 UJ	0.0006	0.0013
Fluorene	81.8	39.3	0.0204	0.0002	0.0005	0.0102 U	0.0001	0.0001	0.0099 U	0.0001	0.0001	0.0095 UJ	0.0001	0.0001
Indeno(1,2,3-cd)pyrene	0.57	0.275	0.0271	0.0475	0.0985	0.0051 UJ	0.0045	0.0093	0.0198 UJ	0.0174	0.0360	0.019 UJ	0.0167	0.0345
Naphthalene	402	193.5	0.0361	0.0001	0.0002	0.0204 UJ	0.0000	0.0001	0.0198 UJ	0.0000	0.0001	0.019 UJ	0.0000	0.0000
Perylene	1.87	0.9008	0.02 UJ	0.0053	0.0111	0.0204 UJ	0.0055	0.0113	0.0198 UJ	0.0053	0.0110	0.019 UJ	0.0051	0.0105
Phenanthrene	39.8	19.13	0.0514	0.0013	0.0027	0.0204 UJ	0.0003	0.0005	0.0198 UJ	0.0002	0.0005	0.019 UJ	0.0002	0.0005
Pyrene	21	10.11	0.116	0.0055	0.0115	0.0102 U	0.0002	0.0005	0.101	0.0048	0.0100	0.0227 UJ	0.0005	0.0011
Benzene	13500	5300	4 U	0.0001	0.0004	4 U	0.0001	0.0004	0.4 U	0.0000	0.0000	4 U	0.0001	0.0004
Toluene	4070	1600	8 U	0.0010	0.0025	8 U	0.0010	0.0025	0.8 U	0.0001	0.0003	8 U	0.0010	0.0025
Ethylbenzene	2010	790	4 U	0.0010	0.0025	4 U	0.0010	0.0025	0.4 U	0.0001	0.0003	4 U	0.0010	0.0025
m,p-Xylenes	1780	700	4 U	0.0011	0.0029	4 U	0.0011	0.0029	0.4 U	0.0001	0.0003	4 U	0.0011	0.0029
o-Xylene	1780	700	4 U	0.0011	0.0029	4 U	0.0011	0.0029	0.4 U	0.0001	0.0003	4 U	0.0011	0.0029
Sum Total of Acute and Chronic Potency Ratios				2.6	5.3		0.18	0.36		0.36	0.72		0.21	0.42

Table 13. Calculation of PAH Benchmark for Pore Water using EPA Equilibrium Partitioning Sediment Benchmark Approach

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island,
San Francisco, California

		Sample ID	YF320PW			
PAH	Acute Potency Factor (µg/L)	PAH Specific FCV (µg/L)	Conc. (µg/L)		Acute Potency Ratio unitless	Chronic Potency Ratio unitless
1-Methylnaphthalene	1	75.37	0.005	U	0.0025	0.0000
2-Methylnaphthalene	1	72.16	0.02	UJ	0.0100	0.0001
Acenaphthene	116.1	55.85	0.01	U	0.0000	0.0001
Acenaphthylene	640	306.9	0.005	U	0.0000	0.0000
Anthracene	43.1	20.73	0.02	UJ	0.0002	0.0005
Benzo(a)anthracene	4.64	2.227	0.005	U	0.0005	0.0011
Benzo(a)pyrene	1.99	0.9573	0.02	UJ	0.0050	0.0104
Benzo(b)fluoranthene	1.41	0.6774	0.005	U	0.0018	0.0037
Benzo(e)pyrene	1.87	0.9008	0.02	UJ	0.0053	0.0111
Benzo(g,h,i)perylene	0.91	0.4391	0.02	UJ	0.0110	0.0228
Benzo(k)fluoranthene	1.34	0.6415	0.01	U	0.0037	0.0078
C1-Chrysenes	1.78	0.8557	0.02	U	0.0056	0.0117
C1-Fluorenes	29.1	13.99	0.02	U	0.0003	0.0007
C1-Phenanthrenes/Anthracenes	15.5	7.436	0.02	U	0.0006	0.0013
C1-Fluoranthenes/Pyrene	10.2	4.887	0.02	U	0.0010	0.0020
C2-Chrysenes	1	0.4827	0.02	U	0.0100	0.0207
C2-Fluorenes	11	5.305	0.02	U	0.0009	0.0019
C2-Naphthalenes	63	30.24	0.02	U	0.0002	0.0003
C2-Phenanthrenes/Anthracenes	6.65	3.199	0.02	U	0.0015	0.0031
C3-Chrysenes	0.35	0.1675	0.02	U	0.0286	0.0597
C3-Fluorenes	4	1.916	0.02	U	0.0025	0.0052
C3-Naphthalenes	23.1	11.1	0.02	U	0.0004	0.0009
C3-Phenanthrenes/Anthracenes	2.62	1.256	0.02	U	0.0038	0.0080
C4-Chrysenes	0.15	0.07062	0.02	U	0.0667	0.1416
C4-Naphthalenes	8.4	4.048	0.02	U	0.0012	0.0025
C4-Phenanthrenes/Anthracenes	1.16	0.5594	0.02	U	0.0086	0.0179
Chrysene	4.24	2.042	0.005	U	0.0006	0.0012
Dibenz(a,h)anthracene	0.59	0.2825	0.01	U	0.0085	0.0177
Fluoranthene	14.8	7.109	0.02	UJ	0.0007	0.0014
Fluorene	81.8	39.3	0.01	U	0.0001	0.0001
Indeno(1,2,3-cd)pyrene	0.57	0.275	0.02	UJ	0.0175	0.0364
Naphthalene	402	193.5	0.02	UJ	0.0000	0.0001
Perylene	1.87	0.9008	0.02	UJ	0.0053	0.0111
Phenanthrene	39.8	19.13	0.02	UJ	0.0003	0.0005
Pyrene	21	10.11	0.02	UJ	0.0005	0.0010
Benzene	13500	5300	4	U	0.0001	0.0004
Toluene	4070	1600	8	U	0.0010	0.0025
Ethylbenzene	2010	790	4	U	0.0010	0.0025
m,p-Xylenes	1780	700	4	U	0.0011	0.0029
o-Xylene	1780	700	4	U	0.0011	0.0029
Sum Total of Acute and Chronic Potency Ratios					0.21	0.42

Table 14: Dose Parameters for the Spotted Sandpiper (*Actitis macularius*)

Site YF3 Baseline Ecological Risk Assessment
Former Naval Station Treasure Island, San Francisco, California

Parameter	Value	Units	Reference/Notes
Ingestion Rate$_{food}$	0.0093	kg/day	Calculated with body weight of 42.5 grams using the equation for the food requirement for intake of dry matter for Charadriiformes (food ingestion rate = [0.522(BW[grams])^0.769]/1,000) (Nagy 2001).
Ingestion Rate$_{invertebrates}$	0.0093	kg/day	Based on 100 percent of food ingestion rate.
Ingestion Rate$_{sediment}$	0.00168	kg/day	18 percent total ingestion rate based on the western sandpiper (Beyer and others 1994).
Sediment Concentrations	95 UCL Concentration	mg/kg	Based on existing data for sediment collected from the site (0 to 1 foot bss).
Diet Composition^{a}	100%	Invertebrate tissue	Prey is assumed to be 100 percent benthic invertebrates. This receptor is representative of invertivorous birds.
Foraging Range	0.62	acre	Based on territory size reported by Maxson and Oring 1980, as cited in EPA 1993.
Site Use Factor	1	unitless	Based on the site area (1.35 acres) divided by the foraging range. Maximum factor value is 1.
Body Weight	0.0425	kg	Based on median of mean adult male body weights (EPA 1993).

Notes:

a	The spotted sandpiper forages for invertebrates by probing, gleaning, and stalking (Zeiner 1990).
95UCL	One-sided 95 percent upper confidence limit of the mean
bss	Below sediment surface
BW	Body weight
EPA	U.S. Environmental Protection Agency
kg	Kilogram
kg/day	Kilogram per day
mg/kg	Milligram per kilogram

Sources:

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. "Estimates of Soil Ingestion by Wildlife." *Journal of Wildlife Management.* Volume 58, No. 2. Pages 375-382.

EPA. 1993. Wildlife Exposure Factors Handbook. December.

Nagy, K.A. 2001. "Food Requirements of Wild Animals: Predictive Equations for Free-Living Mammals, Reptiles, and Birds." *Nutrition Abstracts and Reviews, Series B.* Volume 71, No. 10. Pages 2R-12R.

Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White. 1990. "California's Wildlife: Volume II, Birds." CWHR System. State of California, the Resource Agency, California Department of Fish and Game. Sacramento, California.

Table 15: Dose Parameters for the Great Blue Heron (*Ardea herodias*)

Site YF3 Baseline Ecological Risk Assessment
Former Naval Station Treasure Island, San Francisco, California

Parameter	Value	Units	Reference/Notes
Ingestion Rate$_{food}$	0.132	kg/day	Calculated with body weight of 2,390 grams using the equation for the food requirement for intake of dry matter for all birds [0.638*(BW[grams])^0.685]/1000 (Nagy 2001).
Ingestion Rate$_{fish}$	0.099	kg/day	Based on 75 percent of food ingestion rate.
Ingestion Rate$_{invertebrates}$	0.033	kg/day	Based on 25 percent of food ingestion rate.
Ingestion Rate$_{sediment}$	0.0036	kg/day	2.7 percent of food ingestion rate, based on the median of the range of non-probing aquatic birds (Beyer and others 1994).
Sediment Concentrations	95 UCL Concentration	mg/kg	Based on existing data for sediment collected from the site (0 to 1 foot bss).
Diet Composition[a]	75%	Fish tissue	Prey is assumed to be 75 percent fish and 25 percent benthic invertebrates. This receptor is representative of carnivorous birds.
	25%	Invertebrate tissue	
Foraging Range	20.8	acres	Based on upper end of median of winter foraging ranges (8.4 hectares) from Bayer 1978, as cited in EPA 1993.
Site Use Factor	0.065	unitless	Based on the site area (1.35 acres) divided by the foraging range. Maximum factor value is 1.
Body Weight	2.39	kg	Mean body weight of both sexes (Dunning 1993).

Notes:

a	The great blue heron primarily consumes fish, as well as invertebrates like crabs and other crustaceans (Zeiner 1990).
95UCL	One-sided 95 percent upper confidence limit of the mean
bss	Below sediment surface
BW	Body weight
EPA	U.S. Environmental Protection Agency
kg	Kilogram
kg/day	Kilogram per day
mg/kg	Milligram per kilogram

Sources:

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. "Estimates of Soil Ingestion by Wildlife." *Journal of Wildlife Management.* Volume 58, No. 2. Pages 375-382.

Dunning, J.B. 1993. CRC Handbook of Avian Body Masses. CRC Press. Boca Raton, Florida.

EPA. 1993. "Wildlife Exposure Factors Handbook." December. 1993

Nagy, K.A. 2001. "Food Requirements of Wild Animals: Predictive Equations for Free-Living Mammals, Reptiles, and Birds." *Nutrition Abstracts and Reviews*, Series B. Volume 71. Pages 21R-31R.

Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White. 1990. "California's Wildlife: Volume II, Birds." CWHR System. State of California, the Resource Agency, California Department of Fish and Game. Sacramento, California.

Table 16: Invertebrate BSAF Calculations and Statistics for Total HMW and LMW PAHs

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Analyte	Tissue Type	Sediment Sample	Tissue Sample	Sediment (mg/kg dry weight)	Sediment TOC (%)	Tissue (mg/kg wet weight)	Lipids (%)	BSAF [1,2]
Total HMW PAHs	MN	YF311SEDA	YF311MN	0.90	1.51	0.0055	0.38	*0.024*
	NV	YF311SEDA	YF311NV	0.90	1.51	0.026	1.3	*0.034*
	MN	YF312SEDA	YF312MN	1.11	1.56	0.0050	0.5	0.014
	NV	YF312SEDA	YF312NV	1.11	1.56	0.0096	1.3	0.010
	MN	YF315SEDA	YF315MN	0.55	0.83	0.0058	0.48	0.018
	NV	YF315SEDA	YF315NV	0.55	0.83	0.010	1.2	0.013
Total LMW PAHs	MN	YF311SEDA	YF311MN	4.63	1.51	0.0028	0.38	0.0024
	NV	YF311SEDA	YF311NV	4.63	1.51	0.0074	1.3	0.0019
	MN	YF312SEDA	YF312MN	0.31	1.56	0.0031	0.5	*0.031*
	NV	YF312SEDA	YF312NV	0.31	1.56	0.0078	1.3	*0.030*
	MN	YF315SEDA	YF315MN	0.71	0.83	0.0028	0.48	0.0069
	NV	YF315SEDA	YF315NV	0.71	0.83	0.0062	1.2	0.0061

Analyte	Tissue Type	Minimum BSAF	Average BSAF [3]	Maximum BSAF
Total HMW PAHs	MN	0.014	0.019	0.024
	NV	0.010	0.019	0.034
	All	0.010	**0.019**	0.034
Total LMW PAHs	MN	0.0024	0.013	0.031
	NV	0.0019	0.013	0.030
	All	0.0019	**0.013**	0.031

Table 16: Invertebrate BSAF Calculations and Statistics for Total HMW and LMW PAHs

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

Notes:

1 BSAF = lipid normalized invertebrate tissue (wet weight)/ TOC normalized surface sediment (dry weight)

The BSAF is defined (Ankley et al., 1992) as

$$BSAF = \frac{C_o / f_\ell}{C_s / f_{soc}}$$

where

C_o is the chemical concentration in the organism (µg/kg wet weight)

f_ℓ is the lipid fraction of the organism (g lipid/g wet weight)

C_s is the chemical concentration in surficial sediment (µg/kg dry weight)

f_{soc} is the total organic carbon content (fraction) of the sediment (generally dry weight)

2 Text in *italics* indicates the highest BSAF for each chemical group.

3 **Bold text** indicates the selected BSAF for each chemical group for use in the food chain model.

µg/kg	Microgram per kilogram
%	Percent
BSAF	Biota-sediment accumulation factor
g	Gram
HMW	High molecular weight
LMW	Low molecular weight
mg/kg	Milligram per kilogram
MN	*Macoma nasuta*
NV	*Nereis virens*
PAH	Polycyclic aromatic hydrocarbon
TOC	Total organic carbon

References:

Ankley, G.T., P.M. Cook, A.R. Carlson, D.J. Call, J.A. Swenson, H.F. Corcoran, and R.A. Hoke. 1992. Bioaccumulation of PCBs from sediments by oligochaetes and fishes: Comparison of laboratory and field studies. Can. J. Fish. Aquat. Sci. 49:2080–2085.

Table 17: Spotted Sandpiper Dose Calculations and Hazard Quotients

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

COPEC	Total Prey Ingestion Rate[1] (kg/day)	Benthic Invertebrate Ingestion Rate[2] (kg/day)	Benthic Invertebrate BSAF[3] (unitless)	Benthic Invertebrate Concentration[4] (mg/kg)	Benthic Invertebrate Daily Dose[5] (mg/day)	Sediment Ingestion Rate[6] (kg/day)	Sediment Concentration[7] (mg/kg)	Sediment Daily Dose[8] (mg/day)	SUF	Body Weight[9] (kg)	Total Daily Dose[10] (mg/kg/day)	TRV[11] (mg/kg/day)	HQ[12]
TOTAL HMW PAHS													
Dose/High TRV	9.33E-03	9.33E-03	1.90E-02	9.63E-02	8.98E-04	1.68E-03	5.07E+00	8.51E-03	1.00E+00	4.25E-02	2.21E-01	2.00E+01	1.11E-02
Dose/Low TRV	9.33E-03	9.33E-03	1.90E-02	9.63E-02	8.98E-04	1.68E-03	5.07E+00	8.51E-03	1.00E+00	4.25E-02	2.21E-01	1.00E-01	**2.21E+00**
TOTAL LMW PAHS													
Dose/High TRV	9.33E-03	9.33E-03	1.30E-02	1.80E-02	1.68E-04	1.68E-03	1.39E+00	2.33E-03	1.00E+00	4.25E-02	5.87E-02	2.00E+01	2.94E-03
Dose/Low TRV	9.33E-03	9.33E-03	1.30E-02	1.80E-02	1.68E-04	1.68E-03	1.39E+00	2.33E-03	1.00E+00	4.25E-02	5.87E-02	1.00E-01	5.87E-01

1 See Table 14 for total prey ingestion rate calculation.

2 See Table 14 for benthic invertebrate ingestion rates.

3 Field-collected sediment samples and laboratory organisms were used to calculate BSAFs for benthic invertebrates. SeeTable 16 for BSAF calculations.

4 The benthic invertebrate concentrations were calculated by multiplying the maximum sediment concentration by the respective BSAF.

5 The benthic invertebrate daily doses were calculated by multiplying the ingestion rate (see note 2) by the respective tissue concentration (see note 4).

6 See Table 14 for sediment ingestion rate.

7 The 95 UCL for site collected surface sediment concentration (0 to 1 feet below sediment surface) was used.

8 The sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by the sediment concentration (see note 7).

9 See Table 14 for source of body weight.

10 Total daily dose is calculated using the following equation: total daily dose = ([benthic invertebrate daily dose + sediment daily dose]*SUF)/receptor species body weight.

11 The high TRV is based on a no effect level from Bond et al. (1981). The high TRV is based on a lowest observed adverse effects level from Trust et al. (1994, as cited in EPA 2007).

12 HQs were calculated using the following equation: HQ = total daily dose/TRV.

95UCL	95 percent upper confidence limit of the mean
BSAF	Biota sediment accumulation factor
COPEC	Chemical of potential ecological concern
HMW	High molecular weight
HQ	Hazard Quotient
kg	Kilogram
kg/day	Kilogram per day
LMW	Low molecular weight
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
PAH	Polycyclic aromatic hydrocarbon
SUF	Site use factor
TRV	Toxicity reference value

Reference:

Bond J.A., A.M. Gown, H.L. Yang, R.P. Benditt, and M.R. Juchau. 1981. “Further Investigations on the Capacity of Polynuclear Aromatic Hydrocarbons to Elicit Atherosclerotic Lesions.” Journal of Toxicological and Environmental Health. Volume 7. Pages 327-335.

U.S. Environmental Protection Agency (EPA). 2007. “Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons (PAHs), Interim Final. OSWER Directive 9285.7-78.” June.

Table 18: Great Blue Heron Dose Calculations and Hazard Quotients

Site YF3 Baseline Ecological Risk Assessment, Former Naval Station Treasure Island, San Francisco, California

COPEC	Total Prey Ingestion Rate[1] (kg/day)	Fish Ingestion Rate[2] (kg/day)	Fish BSAF[4] (unitless)	Fish Concentration[5] (mg/kg)	Fish Daily Dose[6] (mg/day)	Invertebrate Ingestion Rate[2] (kg/day)	Invertebrate BSAF[3] (unitless)	Invertebrate Concentration[4] (mg/kg)	Invertebrate Daily Dose[6] (mg/day)	Sediment Ingestion Rate[7] (kg/day)	Sediment Concentration[8] (mg/kg)	Sediment Daily Dose[9] (mg/day)	SUF	Body Weight[10] (kg)	Total Daily Dose[11] (mg/kg/day)	TRV[12] (mg/kg/day)	HQ[13]
TOTAL HMW PAHS																	
Dose/High TRV	1.32E-01	9.86E-02	5.20E-02	2.63E-01	2.60E-02	3.29E-02	1.90E-02	9.63E-02	3.17E-03	3.55E-03	5.07E+00	1.80E-02	6.51E-02	2.39E+00	1.28E-03	2.00E+01	6.42E-05
Dose/Low TRV	1.32E-01	9.86E-02	5.20E-02	2.63E-01	2.60E-02	3.29E-02	1.90E-02	9.63E-02	3.17E-03	3.55E-03	5.07E+00	1.80E-02	6.51E-02	2.39E+00	1.28E-03	1.00E-01	1.28E-02
TOTAL LMW PAHS																	
Dose/High TRV	1.32E-01	9.86E-02	5.30E-01	7.35E-01	7.25E-02	3.29E-02	1.30E-02	1.80E-02	5.92E-04	3.55E-03	1.39E+00	4.92E-03	6.51E-02	2.39E+00	2.12E-03	2.00E+01	1.06E-04
Dose/Low TRV	1.32E-01	9.86E-02	5.30E-01	7.35E-01	7.25E-02	3.29E-02	1.30E-02	1.80E-02	5.92E-04	3.55E-03	1.39E+00	4.92E-03	6.51E-02	2.39E+00	2.12E-03	1.00E-01	2.12E-02

1 See Table 15 for total prey ingestion rate calculation.
2 See Table 15 for benthic invertebrate and fish ingestion rates.
3 Field-collected sediment samples and laboratory organisms were used to calculate BSAFs for benthic invertebrates. See Table 16 for BSAF calculations.
4 Literature sources were used for fish BSAFs. As BSAFs vary for individual PAHs, the most conservative (i.e. the highest value) PAH BSAF was selected as a surrogate for each group. These surrogate BSAFs were derived for perylene (HMW) and fluorene (LMW).
5 The benthic invertebrate and fish concentrations were calculated by multiplying the maximum sediment concentration by the respective BSAF
6 The benthic invertebrate and fish daily doses were calculated by multiplying the respective ingestion rate (see note 2) by the respective tissue concentration (see note 4).
7 See Table 15 for sediment ingestion rate.
8 The 95 UCL for site collected surface sediment concentration (0 to 1 foot below sediment surface) was used for both receptors.
9 The sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by the sediment concentration (see note 7).
10 See Table 15 for source of body weight.
11 Total daily dose is calculated using the following equation: total daily dose = ([benthic invertebrate daily dose + fish daily dose + sediment daily dose]*SUF)/receptor species body weight.
12 The high TRV is based on a no effect level from Bond et al. (1981). The high TRV is based on a lowest observed adverse effects level from Trust et al. (1194, as cited in EPA 2007).
13 HQs were calculated using the following equation: HQ = total daily dose/TRV.

95UCL	95 percent upper confidence limit of the mean
BSAF	Biota sediment accumulation factor
COPEC	Chemical of potential ecological concern
HMW	High molecular weight
HQ	Hazard Quotient
kg	Kilogram
kg/day	Kilogram per day
LMW	Low molecular weight
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
PAH	Polycyclic aromatic hydrocarbon
SUF	Site use factor
TRV	Toxicity reference value

Reference:

Bond J.A., A.M. Gown, H.L. Yang, R.P. Benditt, and M.R. Juchau. 1981. “Further Investigations on the Capacity of Polynuclear Aromatic Hydrocarbons to Elicit Atherosclerotic Lesions.” Journal of Toxicological and Environmental Health. Volume 7. Pages 327-335.
U.S. Environmental Protection Agency (EPA). 2007. “Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons (PAHs), Interim Final. OSWER Directive 9285.7-78.” June.

APPENDIX A
PHOTOGRAPHIC LOG

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

	**Photo 1** **Date: 2/3/2017** **Direction: Southeast** **Description: Utility location of high voltage line at Site YF3.**
	**Photo 2** **Date: 2/3/2017** **Direction: Southeast** **Description: Utility marking of high voltage line on rock at Site YF3.**

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

<table>
<tr><td rowspan="2"></td><td>Photo 3</td></tr>
<tr><td>Date: 2/4/2017
Direction: NA
Description: Pore water sampling at YF320.</td></tr>
<tr><td rowspan="2"></td><td>Photo 4</td></tr>
<tr><td>Date: 2/4/2017
Direction: Southwest
Description: Pore water sampling at location YF318.</td></tr>
</table>

Photo 5

Date: 2/8/2017

Direction: South

Description: Pore water sampling at YF308.

Photo 6

Date: 2/7/2017

Direction: North

Description: Installing Trident probe.

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

	**Photo 7** **Date: 2/7/2017** **Direction: Northeast** **Description: Installing Trident probe into subsurface.**
	**Photo 8** **Date: 2/4/2017** **Direction: Northeast** **Description: Trident probe at location YF319.**

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

<table>
<tr><td rowspan="2"></td><td>Photo 9</td></tr>
<tr><td>Date: 2/7/2017
Direction: Northwest
Description: Recording data during pore water sampling at YF311.</td></tr>
<tr><td rowspan="2"></td><td>Photo 10</td></tr>
<tr><td>Date: 2/7/2017
Direction: Northeast
Description: Using the Trident Probe in the tidal zone at location YF317.</td></tr>
</table>

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

Photo 11

Date: 2/8/2017

Direction: Northeast

Description: Pore water sampling at YF307.

Photo 12

Date: 2/7/2017

Direction: Northeast

Description: Site YF3.

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

Photo 13

Date: 3/27/2017

Direction: East-northeast

Description: Site YF3 from the boat during high tide during the offshore investigation.

Photo 14

Date: 3/27/2017

Direction: East

Description: Retrieving the sediment sample at location YF322 using Vibracore technology from the sampling barge.

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

Photo 15

Date: 3/27/2017

Direction: East

Description: Labeling the retrieved sediment core at location YF322.

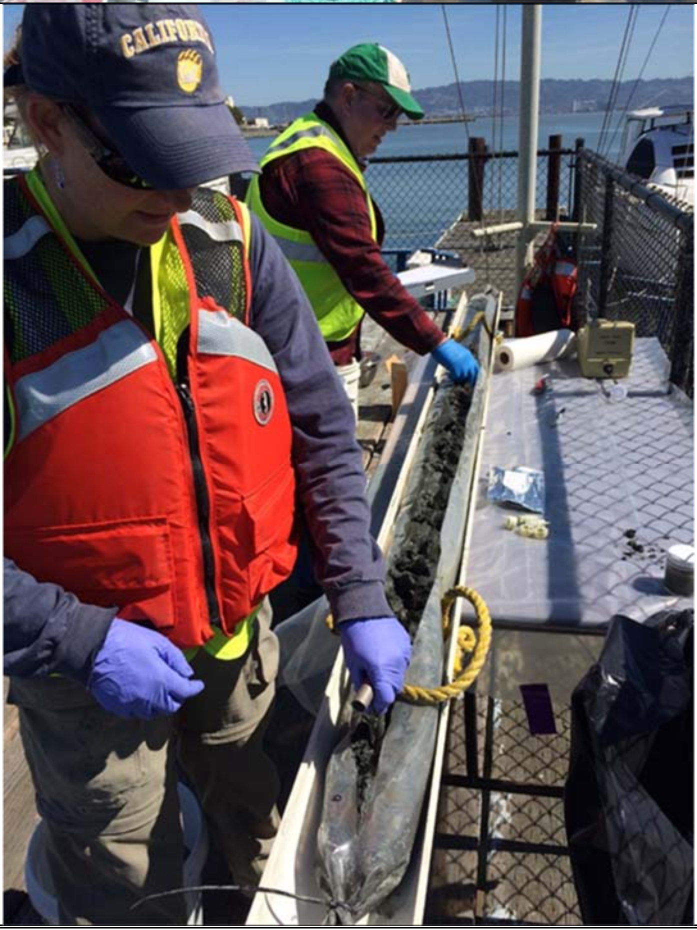

Photo 16

Date: 3/28/2017

Direction: North

Description: Logging cores and collecting Encore samples in sediment core YF325.

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

<table>
<tr><td rowspan="2"></td><td>Photo 17</td></tr>
<tr><td>Date: 3/28/2017

Direction: Northwest

Description: Homogenizing sediment from all three depth intervals.</td></tr>
<tr><td rowspan="2"></td><td>Photo 18</td></tr>
<tr><td>Date: 3/28/2017

Direction: Northeast

Description: Decontaminating the homogenization bowls.</td></tr>
</table>

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

Photo 19

Date: 4/5/2017

Direction: Northeast

Description: Marking and staking sampling locations at Site YF3.

Photo 20

Date: 4/5/2017

Direction: NA

Description: Collecting the sediment sample for bioassays (0 to 1 foot below surface) at location YF315.

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

Photo 21

Date: 4/5/2017

Direction:

Description: Collecting sediment core with Sonic drill rig at location YF307.

Photo 22

Date: 4/6/2017

Direction: North

Description: Site YF3 at beginning of the day, 1 hour after high tide.

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

<table>
<tr><td rowspan="2"></td><td>Photo 23</td></tr>
<tr><td>Date: 4/6/2017
Direction: West
Description: Collecting the sediment sample for bioassays (0 to 1 foot below surface) at location YF312 using the drill rig.</td></tr>
<tr><td rowspan="2"></td><td>Photo 24</td></tr>
<tr><td>Date: 4/6/2017
Direction: NA
Description: Sieving the bioassay sediment.</td></tr>
</table>

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

Photo 25

Date: 4/6/2017

Direction: Northeast

Description: Collecting the pore water sample at YF308 using a bailer.

Photo 26

Date: 4/6/2017

Direction: East

Description: Preparing to collect sediment core using hard liner at YF308.

PHOTOGRAPHIC LOG
Site YF3 Data Gaps Investigation

Photo 27

Date: 4/6/2017

Direction: West

Description: Safety skiff.

Photo 28

Date: 5/4/2017

Direction: Northwest

Description: Collecting subsurface sediment samples at location YF315.

Photo 29

Date: 5/4/2017

Direction: NA

Description: Extracting subsurface sediment from hand auger barrel into bucket at YF315.

APPENDIX B
FIELD FORMS

B-1 Chains of Custody

SPAWAR SYSTEMS CENTER PACIFIC
ADVANCED SYSTEMS & APPLIED SCIENCES DIVISION
ENERGY AND ENVIRONMENTAL SUSTAINABILITY BRANCH,
CODE 71760
53475 STROTHE ROAD
SAN DIEGO, CA 92152-5000

Chain of Custody Record

Date: 6-Feb-2017
Page: 1 of 1 ~~2~~ ~~3~~

Project Title/Project Number:	Site YF3 CCMM-Trident Porewater Sampling Assessment	**SPAWAR Project PI:**	Dr. James Leather
Remarks	Battelle PO # 0000558626	**Contact:**	Joel Guerrero
Sampler(s): (Signature)	Joel Guerrero / James Leather (Code 71760)	**Contact Tel:**	(619) 850-2109

Tel: 619-553-4169 | **Fax:** 619-553-6305 | **Email:** joel.guerrero@navy.mil

Special Instructions/Comments:
Water samples; kept dark & cold (4 °C)

Field Sample Identification	Start Date Collection	Start Time (local)	Matrix	Type	№ Containers	TPH-e (extractable) [8015B / 3510C]	Alkylated PAHs [8270D-SIM / 3510 / BR-MS-003]	Alkylated PAHs [8270-MOD / M5-EXTPAH-1.1]	Ammonia [350.1 / TA-WC-0111]	pH 9041	VOCs (8260B)	PAH (8270 SIM)	TPH-P 8260 (CA LUFT)
RB1020417	04Feb2017	0918	DA ~~Pore~~water	~~Grab~~ QC	~~3~~ 6 *	x	~~x~~ DA	~~x~~ DA	x		X	X	X
EB1020417	04Feb2017	1000	DA ~~Pore~~water	~~Grab~~ QC	~~3~~ 6 *	x	~~x~~ DA	~~x~~ DA	x		X	X	X
YF320PW	04Feb2017	1215	Porewater	Grab	~~3~~ 6 *	x	x	~~x~~ DA	x		X		X
YF318PW	04Feb2017	1331	Porewater	Grab	~~3~~ 0 *	x	x	~~x~~ DA	x		X		X
YF319PW	04Feb2017	1526	Porewater	Grab	~~4~~ 7 *	x	x	~~x~~ DA	x	x	X		X
TB1020417	04Feb2017	1200	water	QC	2 w/ HCL						X		X

* 3 of the containers are preserved w/ HCL; 1 container preserved w/ H_2SO_4

50506

TOTAL 16

Relinquished by: Joel Guerrero	**(Signature)** Joel G	**Date:** 2/6/2017	**Time:** 1030
Received by: D.Aragon / C.Breene / K.Henry - TetraTech	**(Signature)**	**Date:** 2/6/2017	**Time:** 1500

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Chain of Custody Record

Date: 7-Feb-2017
Page: 1 of ~~3~~ 2

Project Title/Project Number:	Site YF3 CCMM-Trident Porewater Sampling Assessment	***SPAWAR Project PI:***	Dr. James Leather
Remarks	Battelle PO 0000558626	***Contact:***	Joel Guerrero
Sampler(s): (Signature)	Joel Guerrero / James Leather (Code 71760)	***Contact Tel:***	(619) 850-2109

Tel: 619-553-4169 | ***Fax:*** 619-553-6305 | ***Email:*** *joel.guerrero@navy.mil*

Special Instructions/Comments:
Water samples; kept dark & cold (4 °C)

Analyses

Field Sample Identification	***Start Date Collection***	***Start Time (local)***	***Matrix***	***Type***	***№ Containers*** *	TPH-e (extractable) [8015B / 3510C]	Alkylated PAHs [8270D-SIM / 3510 / BR-MS-003]	Alkylated PAHs [8270-MOD / M5-EXTPAH-1.1]	Ammonia [350.1 / TA-WC-0111]	PAH SIM 8270	
EB2020617	06Feb2017	0800	Porewater	~~Grab~~ QC	3	x	~~x~~ DA	~~x~~ DA	x	X	
YF316PW	06Feb2017	1140	Porewater	Grab	3	x	x	~~x~~ DA	x		
YF315PW	06Feb2017	1315	Porewater	Grab	3	x	x	~~x~~ DA	x		
YF314PW	06Feb2017	1415	Porewater	Grab	3	x	x	~~x~~ DA	x		
YF313PW	06Feb2017	1517	Porewater	Grab	3	x	x	~~x~~ DA	x		
* 1 of the containers is	preserved	w/ H_2SO_4									
					TOTAL	15					

Relinquished by: ***Joel Guerrero***	***(Signature)***	***Date:*** 2/7/2017	***Time:*** ***1030***
Received by: ***D.Aragon / C.Breene - TetraTech***	***(Signature)***	***Date:*** 2/7/17	***Time:*** 1500 (Sent via FedEx)
Received by: ***- Test America PACE***	***(Signature)***	***Date:***	***Time:***

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Chain of Custody Record

Date: ~~6~~7-Feb-2017
Page: 2 of ~~2~~2

Project Title/Project Number:	Site YF3 CCMM-Trident Porewater Sampling Assessment	***SPAWAR Project PI:***	Dr. James Leather
Remarks	Battelle PO 0000558626	***Contact:***	Joel Guerrero
Sampler(s): (Signature)	Joel Guerrero / James Leather (Code 71760)	***Contact Tel:***	(619) 850-2109
Tel: 619-553-4169	***Fax:*** 619-553-6305	***Email:*** *joel.guerrero@navy.mil*	

Special Instructions/Comments:
Water samples; kept dark & cold (4 °C)

Field Sample Identification	***Start Date/Time Collection***	***№ VOA Containers***	***Matrix***	***Type***	***Pres.*** *** samples acidified, pH<2*	***Analyses*** TPH-*p* (Purgable) [8260B-CALUFT/ 5030B]	VOCs [8260B / 5030B]				
EB2020617	2/6/17 0800	3	~~Pore~~water	~~Grab~~ QC	HCl	x	x				
YF316PW	2/6/17 1140	3	Porewater	Grab	HCl	x	x				
YF315PW	2/6/17 1315	3	Porewater	Grab	HCl	x	x				
YF314PW	2/6/17 1415	3	Porewater	Grab	HCl	x	x				
YF313PW	2/6/17 1517	3	Porewater	Grab	HCl	x	x				
TB2020617	2/6/17 1100	2	water	QC	HCl	X	X				
					TOTAL	15					

Relinquished by: ***Joel Guerrero***	***(Signature)***	***Date:*** 2/7/2017	***Time:*** ***1030***
Received by: ***D.Aragon / C.Breene - TetraTech***	***(Signature)***	***Date:*** 2/7/17	***Time:*** 1500 (Sent Fed
Received by: ***- Test America PACE***	***(Signature)***	***Date:***	***Time:***

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Battelle PO: 0000558626

Chain of Custody Record

Date: 8-Feb-2017
Page: 1 of 2

Project Title: Site YF3 CCMM-Trident Porewater Sampling Assessment

SPAWAR Project PI: Dr. James Leather

Remarks: (i) AG bottles for TPH-e & Alkylated PAHs; (ii) PC bottle for Ammonia & pH

Contact: Joel Guerrero

Sampler(s): (Signature) Joel Guerrero / James Leather (Code 71760)

Contact Tel: (619) 850-2109

Tel: 619-553-4169

Fax: 619-553-6305

Email: *joel.guerrero@navy.mil*

Special Instructions/Comments:
Water samples; kept dark & cold (4 °C); Ammonia sample (PC bottle) preserved w/ H_2SO_4

						Analyses					
Field Sample Identification	**Start Date Collection**	**Start Time (local)**	**Matrix**	**Type**	**№ Containers**	**TPH-e (extractable) [8015B / 3510C]**	**Alkylated PAHs [8270D-SIM / 3510 / BR-MS-003]**	~~**Alkylated PAHs [8270-MOD / M5-EXTPAH-1.1]**~~	**Ammonia [350.1 / TA-WC-0111]**	**pH [9045]**	PAH SIM 8270
EB3020717	07Feb2017	0856	CB ~~Pore~~water	~~Grab~~ QC CB	3	x	~~x~~ CB	~~x~~ CB	x		X
YF312PW	07Feb2017	1117	Porewater	Grab	3	x	x	~~x~~ CB	x		
YF316PWDUP	07Feb2017	1150	Porewater	Grab	3	x	x	~~x~~ CB	x		
YF311PW	07Feb2017	1315	Porewater	Grab	4	x	x	~~x~~ CB	x	x	
YF317PW	07Feb2017	1545	Porewater	Grab	3	x	x	~~x~~ CB	x		
YF309PW	07Feb2017	1616	Porewater	Grab	3	x	x	~~x~~ CB	x		
YF310PW	07Feb2017	1707	Porewater	Grab	3	x	x	~~x~~ CB	x		
TB302~~0717~~ 0717	07Feb2017	1100	water	QC	~~2~~ 0						
					TOTAL	22					

Relinquished by: Joel Guerrero	**(Signature)**	**Date:** 2/8/2017	**Time:** 1030
Received by: D.Aragon / C.Breene - TetraTech	**(Signature)** CBreene	**Date:** 2/8/17	**Time:** 1445
Received by: - Test America PACE	**(Signature)**	**Date:**	**Time:**

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Battelle PO: 0000558626

Chain of Custody Record

Date: 8-Feb-2017
Page: 2 of 2

Project Title/Project Number:	Site YF3 CCMM-Trident Porewater Sampling Assessment	***SPAWAR Project PI:***	Dr. James Leather
Remarks		***Contact:***	Joel Guerrero
Sampler(s): (Signature)	Joel Guerrero / James Leather (Code 71760)	***Contact Tel:***	(619) 850-2109
Tel: 619-553-4169	***Fax:*** 619-553-6305 ***Email:*** *joel.guerrero@navy.mil*		***Analyses***

Special Instructions/Comments:
Water samples; kept dark & cold (4 °C)

Field Sample Identification	***Start Date/Time Collection***	***№ VOA Vials***	***Matrix***	***Type***	***Pres.*** *** samples acidified, pH<2*	**TPH-*p* (Purgable) [8260B-CALUFT/ 5030B]**	**VOCs [8260B / 5030B]**				
EB3020717	2/7/17 0856	3	~~Pore~~water DI	~~Grab~~ QC	HCl	x	x				
YF312PW	2/7/17 1117	3	Porewater	Grab	HCl	x	x				
YF316PWDUP	2/7/17 1150	3	Porewater	Grab	HCl	x	x				
YF311PW	2/7/17 1315	3	Porewater	Grab	HCl	x	x				
YF317PW	2/7/17 1545	3	Porewater	Grab	HCl	x	x				
YF309PW	2/7/17 1606	3	Porewater	Grab	HCl	x	x				
YF310PW	2/7/17 1707	3	Porewater	Grab	HCl	x	x				
TB03020717	2/7/17 ~~1400~~ 1100	2	water	QC	HCl	X	X				
					TOTAL	21					

Relinquished by: ***Joel Guerrero***	***(Signature)***	***Date:*** ***2/8/2017***	***Time:*** ***1030***
Received by: ***D.Aragon / C.Breene - TetraTech***	***(Signature)***	***Date:*** 2/8/17	***Time:*** 1445
Received by: ***- Test America PACE***	***(Signature)***	***Date:***	***Time:***

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Chain of Custody Record

Battelle PO: 0000558626

Date: 9-Feb-2017
Page: 1 of 2 CB

Project Title:	Site YF3 CCMM-Trident Porewater Sampling Assessment	***SPAWAR Project PI:***	Dr. James Leather
Remarks: (i) AGBs for TPH-e, TPH-FID, & Alkylated PAHs; (ii) PC bottles for NH_3 & pH		***Contact:***	Joel Guerrero
Sampler(s): (Signature)	Joel Guerrero / James Leather (Code 71760)	***Contact Tel:***	(619) 850-2109
Tel: 619-553-4169	***Fax:*** 619-553-6305	***Email:*** *joel.guerrero@navy.mil*	***Analyses***

Special Instructions/Comments: Water samples; kept dark & cold (4 °C); NH_3 (PC) preserved w/ H_2SO_4. PW sampling depth for Fingerprinting (FP) samples - 2 ft.

Field Sample Identification	***Start Date Collection***	***Start Time (local)***	***Matrix***	***Type***	***№ Containers***	**TPH-e (extractable) [8015B / 3510C]**	**Alkylated PAHs [8270D-SIM / 3510 / BR-MS-003]**	**~~Alkylated PAHs [8270-MOD / M5-EXTPAH-1.1]~~**	**Ammonia [350.1 / TA-WC-0111]**	**pH [9045]**	**TPH-FID Chromatogram**
EB4020817	08Feb2017	0907	~~Pore~~water CB	~~Grab~~ QC CB	5	x	~~x~~ CB	~~x~~ CB	x		
YF312PWDUP	08Feb2017	1110	Porewater	Grab	4	x	x	~~x~~ CB	x	x	
YF312PWDUP MS	08Feb2017	1317	Porewater	Grab	3	x	x	~~x~~ CB	x		
YF312PWDUP MSD	08Feb2017	1530	Porewater	Grab	3	x	x	~~x~~ CB	x		
YF308PW	08Feb2017	1228	Porewater	Grab	4	x	x	~~x~~ CB	x	x	
~~***YF308PWFPA***~~	~~08Feb2017~~	~~1420~~	~~Porewater~~	~~Grab~~	~~1~~		~~x~~				
~~***YF308PWFPB***~~	~~08Feb2017~~	~~1509~~	~~Porewater~~	~~Grab~~	~~1~~						~~x~~
YF307PW	08Feb2017	1350	Porewater	Grab	4	x	x	~~x~~ CB	x	x	
YF306PW	08Feb2017	1659	Porewater	Grab	3	x	x	~~x~~ CB	x		
YF305PW	08Feb2017	1632	Porewater	Grab	3	x	x	~~x~~ CB	x		
TB4020817	08Feb2017	1100	Water	QC	0						
					TOTAL	31					

Relinquished by: ***Joel Guerrero***	***(Signature)***	***Date:*** 2/9/2017	***Time:*** ***1030***
Received by: ***D.Aragon - TetraTech*** / Cynthia Greene	***(Signature)*** C Greene	***Date:*** 2/9/17	***Time:*** 1515
Received by: ***- Test America PACE***	***(Signature)***	***Date:***	***Time:***

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Chain of Custody Record

Battelle PO: 0000558626

Date: 9-Feb-2017

Page: 2 of 2
3

Project Title/Project Number:	Site YF3 CCMM-Trident Porewater Sampling Assessment	***SPAWAR Project PI:***	Dr. James Leather
Remarks		***Contact:***	Joel Guerrero
Sampler(s): (Signature)	Joel Guerrero / James Leather (Code 71760)	***Contact Tel:***	(619) 850-2109

Tel: 619-553-4169 ***Fax:*** 619-553-6305 ***Email:*** *joel.guerrero@navy.mil*

Special Instructions/Comments:
Water samples; kept dark & cold (4 °C)

Field Sample Identification	***Start Date/Time Collection***	***№ VOA Vials***	***Matrix***	***Type***	***Pres.*** *** samples acidified, pH<2*	**Analyses** **TPH-*p* (Purgable) [8260B-CALUFT/ 5030B]**	**VOCs [8260B / 5030B]**	PAH SIM & 8270			
EB4020817	2/8/17 0907	3	~~Pore~~water	~~Grab~~ QC	HCl	x	x	X			
YF312PWDUP	2/8/17 1110	3	Porewater	Grab	HCl	x	x				
YF312PWDUP MS	2/8/17 1317	3	Porewater	Grab	HCl	x	x				
YF312PWDUP MSD	2/8/17 1530	3	Porewater	Grab	HCl	x	x				
YF308PW	2/8/17 1228	3	Porewater	Grab	HCl	x	x				
YF307PW	2/8/17 1350	3	Porewater	Grab	HCl	x	x				
YF306PW	2/8/17 1659	3	Porewater	Grab	HCl	x	x				
YF305PW	2/8/17 1632	3	Porewater	Grab	HCl	x	x				
TB4020817	2/8/17 1100	2	water	QC	HCl	X	X				
					TOTAL	24					

Relinquished by: ***Joel Guerrero***	***(Signature)*** JGuerrero	***Date:*** *2/9/2017*	***Time:*** ***1030***
Received by: ***D.Aragon - TetraTech*** / Cynthia Breene	***(Signature)*** CBreene	***Date:*** 2/9/17	***Time:*** 1515
Received by: ***- Test America PACE***	***(Signature)***	***Date:***	***Time:***

Tetra Tech EM Inc.
San Francisco Office

135 Main St. Suite 1800
San Francisco. CA 94105
415-543-4880
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Chain of Custody Record No. 7031

Page 1 of 1

Lab PO#: Battelle 0000558631	**Lab:** PACE	
Project name: Site YF3 TI	**TtEMI technical contact:** Debora Kutsal	**Field samplers:** Joel Guerrero James Leather
Project (CTO) number: 0103	**TtEMI project manager:** Katie Henry	**Field samplers' signatures:**

Preservative Added: NONE, NONE

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	VOA	SVOA	Pest/PCBs	Metals	TPH Purgeables	TPH Extractables	Alkylated PAHs 8270D MOD	TPH w/ EID chromatogram
YF308PWFPA		2/8/17	1420	Porewater			1L										X	X
~~YF308PWFPB~~		~~2/8/17~~	~~1509~~	~~Porewater~~			~~1~~										~~X~~	~~X~~
YF304PWFPB		2/9/17	1205	Porewater			1L										X	X
~~YF304PWFPB~~		~~2/9/17~~	~~1330~~	~~Porewater~~			~~1~~										~~X~~	~~X~~

	Signature	Name (print)	Company Name	Date	Time
Relinquished by:	Cynthia Breene	Cynthia Breene	Tetra Tech	2/9/17	1700
Received by:					
Relinquished by:					
Received by:					
Relinquished by:					
Received by:					

Turnaround time/remarks:

Fed Ex #:

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Battelle PO 000055826

Chain of Custody Record

Date: 10-Feb-2017
Page: 1 of 2 cb

Project Title: Site YF3 CCMM-Trident Porewater Sampling Assessment		***SPAWAR Project PI:***	Dr. James Leather
Remarks: (i) AGBs for TPH-e & Alkylated PAHs; (ii) PC bottles for NH_3 & pH		***Contact:***	Joel Guerrero
Sampler(s): (Signature) Joel Guerrero / James Leather (Code 71760)		***Contact Tel:***	(619) 850-2109
Tel: 619-553-4169	***Fax:*** 619-553-6305 ***Email:*** *joel.guerrero@navy.mil*	***Analyses***	

Special Instructions/Comments:
Water samples; kept dark & cold (4 °C); Ammonia (PC) preserved with H_2SO_4

Field Sample Identification	***Start Date Collection***	***Start Time (local)***	***Matrix***	***Type***	***№ Containers***	**TPH-e (extractable) [8015B / 3510C]**	**Alkylated PAHs [8270D-SIM / 3510 / BR-MS-003]**	**~~Alkylated PAHs [8270-MOD / M5-EXTPAH-1.1]~~ cb**	**Ammonia [350.1 / TA-WC-0111]**	**pH [9045]**	PAH SIM 8270
EB5020917	09Feb2017	0905	~~Pore~~water cb	~~Grab~~ QC cb	5	x	~~x~~ cb	~~x~~ cb	x		X
YF304PW	09Feb2017	1334	Porewater	Grab	4	x	x	~~x~~ cb	x	x	
YF303PW	09Feb2017	1435	Porewater	Grab	3	x	x	~~x~~ cb	x		
YF302PW	09Feb2017	1525	Porewater	Grab	3	x	x	~~x~~ cb	x		
YF301PW	09Feb2017	1610	Porewater	Grab	3	x	x	~~x~~ cb	x		
TB5020917	09Feb2017	1100	Water	QC	0						
					TOTAL	18					

Relinquished by: Joel Guerrero	***(Signature)***	***Date:*** 2/10/2017	***Time:*** 1030
Received by: D.Aragon / C.Breene - TetraTech	***(Signature)*** DAragon	***Date:*** 2/10/17	***Time:*** 1030
Received by: - Test America PACE	***(Signature)***	***Date:***	***Time:***

SPAWAR
Systems Center
PACIFIC

SPAWAR SYSTEMS CENTER PACIFIC
ADVANCED SYSTEMS & APPLIED SCIENCES DIVISION
ENERGY AND ENVIRONMENTAL SUSTAINABILITY BRANCH,
CODE 71760
53475 STROTHE ROAD
SAN DIEGO, CA 92152-5000

Battelle PO 000055826

Chain of Custody Record

Date: 10-Feb-2017
Page: 2 of 2 cb

Project Title/Project Number:	Site YF3 CCMM-Trident Porewater Sampling Assessment	***SPAWAR Project PI:***	Dr. James Leather
Remarks		***Contact:***	Joel Guerrero
Sampler(s): (Signature)	Joel Guerrero / James Leather (Code 71760)	***Contact Tel:***	(619) 850-2109
Tel: 619-553-4169	***Fax:*** 619-553-6305	***Email:*** *joel.guerrero@navy.mil*	***Analyses***

Special Instructions/Comments:
Water samples; kept dark & cold (4 °C)

Field Sample Identification	***Start Date/Time Collection***	***№ VOA Vials***	***Matrix***	***Type***	***Pres.*** *** samples acidified, pH<2*	**TPH-*p* (Purgable) [8260B-CALUFT/ 5030B]**	**VOCs [8260B / 5030B]**				
~~EB5020917~~ EB5020917	2/9/17 0905	3	cb ~~Pore~~water	cb ~~Grab~~ QC	HCl	x	x				
cb YF304PW	2/9/17 1334	3	Porewater	Grab	HCl	x	x				
YF303PW	2/9/17 1425	3	Porewater	Grab	HCl	x	x				
YF302PW	2/9/17 1525	3	Porewater	Grab	HCl	x	x				
YF301PW	2/9/17 1610	3	Porewater	Grab	HCl	x	x				
TB5020917	2/9/17 1100	2	water	QC	HCl	x	x				
TOTAL						15					

Relinquished by: ***Joel Guerrero***	***(Signature)***	***Date:*** *2/10/2017*	***Time:*** *1030*
Received by: ***D.Aragon / C.Breene - TetraTech***	***(Signature)***	***Date:*** 2/10/17	***Time:*** 1030
Received by: ***- Test America PACE***	***(Signature)***	***Date:***	***Time:***

Revised (tests added) 3/29/17 (DA)

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Chain of Custody Record

No. 7032

Page 1 of 1

Lab PO#: Battelle PO 00005558626

Lab: Test America

Project name: Site YF3 Intertidal Data Gaps Investigation

TtEMI technical contact: Deborah Kotral

Field samplers: Dayna Aragon, Victor Early

Project (CTO) number: 0103 103IG4507.0302

TtEMI project manager: Katie Henry / Battelle: Andy Bullard

Field samplers' signatures: Dayna

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar 4oz	~~[illegible]~~	250ml amber w H2SO4	Encore	VOA (8260B)	SVOA PAH (8270 SIM)	Pest/PCBs	Metals	TPH Purgeables (~~VOA~~*)	TPH Extractables (8015B)	Alkylated PAH (8270 SIM)	TOC (9060)	Ammonia (350.1)	pH	Percent moisture (ASTM D2216)	Grain size (ASTM D422)
													Soil/water	None/HCl	None			None/HCl	None	None	None/None	None/H2SO4		None	None
~~YF351~~ YF322SEDA	YF322, 0-1	3/27/17	1345	sediment			1			3			3	X				X	X	X	X	X		X	X
YF322SEDB	~~YF~~322, 4.5-5.5		1350				1			2			3	X	X			X	X		X			X	X
YF322SEDC	YF~~322~~, ~~9-10~~ 8.5-9.5		1355				1			2			3	X	X			X	X		X			X	X
YF323SEDA	YF323 0-1		1430				1			3			3	X				X	X	X	X	X		X	X
YF323SEDB	4.5-5.5		1435				1			2			3	X	X			X	X					X	X
YF323SEDC	9-10		1440				1			2			3	X	X			X	X					X	X
YF324SEDA	YF324 0-1		1515				1			3			3	X				X	X	X	X	X		X	X
YF324SEDB	4.5-5.5		1520				1			2			3	X	X			X	X					X	X
YF324SEDC	9-10		1525				1			2			3	X	X			X	X	~~X~~ (DA)				X	X
ER20170327	equip rinsate		1630	water		3	6					1		X	X			X	X	X		X			
SWB20170327	source water blank		1545			3	6					1		X	X			X	X	X		X			
TB20170327	trip blank		1353			3								X				X							

	Signature	Name (print)	Company Name	Date	Time
Relinquished by:	Dayna	Dayna Aragon	Tetra Tech	3/28/17	1115
Received by:		Robert McAteer	TA	3/28/17	1115
Relinquished by:					
Received by:					
Relinquished by:					
Received by:					

Turnaround time/remarks:

*TPH-p by 8260B/CALUFT-8260B)

Fed Ex #:

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Chain of Custody Record No. 7033

Page 1 of 1

Lab PO#: Battelle PO# 0000558626

Lab: Test America

Project name: Site YF3 Intertidal Data Gaps Investigation

TtEMI technical contact: Deborah Kutsal

Field samplers: Dayra Anaya, Victor Early

Project (CTO) number: 0103/ 103IG4507.03.02

TtEMI project manager: Katie Henry / Battelle Andy Billard

Field samplers' signatures:

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve 250 ml amber w/ HCl	Glass Jar 8oz	Glass, or 4oz	Encore	~~250ml amber w/ HCl~~	VOA (8260B)	SVOA (8270 SIM)	Pest/PCBs	Metals	TPH Purgeables 8260B full	TPH Extractables (8015B)	Alkylated PAH (8270SIM)		TOC (9060)		pH (9045)		Ammonia (350.1)	Percent moisture	grain size	
Preservative Added													Soil/water	None/HCl	None/None			None/HCl	None/None	None/None		None/		None/		None/H2SO4	None/	None/	
TB20170328	trip blank	3/28/17	1130	water	⊛	3								X				X	X	X	(DA)								
YF325 SEDA	YF325, 0-1		1145	sediment	X		1			1	4	3		X	X	(DA)		X	X	X		X		X		X	X	X	
YF325 SEDB	YF325, 4.5-5.5		1150				1			1		3		X	X			X	X			X					X	X	
YF325 SEDC	YF325, 9-10		1155				1			1		3		X	X			X	X								X	X	
YF326 SEDA	YF326, 0-1		1240				1			2		3		X				X	X	X		X				X	X	X	
YF326 SEDB	YF326, 4.5-5.5		1245		X		1			2	2	9		X	X			X	X								X	X	
YF326 SEDC	YF326, 9-10		1250				1			1		3		X	X			X	X								X	X	
YF314A SEDA	YF314A 0-1		1420				1			1	1	3		X				X	X	X		X				X	X	X	
YF314A SEDB	YF314A, 4.5-5.5		1425				1			1		3		X	X			X	X			X					X	X	
YF314A SEDC	YF314A 9-10		1430	↓			1			1		3		X	X			X	X								X	X	
EB20170328	equip rinsate	↓	1500	water		3	6		1				~~X~~ (DA)	X	X			X	X	X						X			

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayra Anaya	Tetra Tech	3/29/17	1030
Received by:	[illegible]	TA	3/29/17	[illegible]
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

⊛ MS/MSD for alkylated PAHs only. (Sample YF325SEDA)

Fed Ex #:

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Page 1 of 1

Lab PO#: Battelle PO 0000558626

Lab: TestAmerica

Project name: Site YF3 Data Gaps

TtEMI technical contact: Deborah Kutsal

Field samplers: Dayna Aragon, Victor Early

Project (CTO) number: 103IG4507.03.02

TtEMI project manager: Katie Henry / Battelle PM. Andy Billard

Field samplers' signatures:

Preservative Added

VOA (8260B)	SVOA ~~(8270 SIM)~~	Pest/PCBs	Metals	TPH Purgeables *	TPH Extractables 8015B	Alkylated PAHs	TOC (9060)	pH (9045)	Ammonia (350.1)	percent moisture					
|	|				|	|	|	|	|	|					

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar 8oz	jar 4oz			VOA (8260B)	SVOA ~~(8270 SIM)~~	Pest/PCBs	Metals	TPH Purgeables *	TPH Extractables 8015B	Alkylated PAHs	TOC (9060)	pH (9045)	Ammonia (350.1)	percent moisture					
YF315SEDA	YF315, 0-1	4/15/17	1200	sediment						1	2			X				X	X	X	X	X	X	X					

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayna Aragon	Tetra Tech	4/10/17	1400
Received by:				
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

* TPH-p by 8260B (CALUFT)

sediment sample sent via Aquatic Bioassay Lab in Ventura, CA

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Page 1 of 2

Lab PO#: Battelle 0000~~55~~558626	**Lab:** TestAmerica	
Project name: Site YF3 DataGaps	**TtEMI technical contact:** Deborah Kotal	**Field samplers:** ~~Victor~~ Emily Victor Early Dayra Aragon Shawn Magee Katie Henry
Project (CTO) number: 103IG4507.03.02	**TtEMI project manager:** / Battelle Katie Henry / Andy Billard	**Field samplers' signatures:**

Sample ID	**Sample Location (Pt. ID)**	**Date**	**Time**	**Matrix**	**MS/-/MSD**	**No./Container Types**								**Analysis Required**															
						40 ml VOA	**1 liter Amber**	**500 ml Poly**	**Sleeve**	**Glass Jar** 16oz	Glass jar 8oz	Glass jar 4oz	Encore	**VOA** (8260B)	**SVOA** (8270 SIM)	**Pest/PCBs**	**Metals**	**TPH Purgeables** 8260B-Cal LUFT	**TPH Extractables** 8015C	Alkylated PAH (8270 SIM)	TOC (9060)	pH (9045)	Ammonia (350.1)	Direct monitor	grain size				
Preservative Added													soil/water	-/HCl	-/-			-/HCl	-/-	-/-	-	-	/H2SO4	-	-				
YF307SEDA	YF307, 0-1	4/6/17	1330	sediment						1	2	1	3	X				X	X	X	X		X	X	X				
YF307SEDB	YF307, 4.5-5.5		1335							1	1		3	X	X			X	X					X	X				
YF307SEDC	YF307 9-10		1340							1	1		3	X	X			X	X					X	X				
YF319SEDA	YF319, 0-1		1205							1	2	1	3	X				X	X	X	X		X	X	X				
YF319SEDB	YF319 4.5-5.5		1210							1	1		3	X	X			X	X					X	X				
YF319SEDC	YF319 9-10		1215							1	1		3	X	X			X	X					X	X				
YF310SEDA	YF310 0-1		1245							1	2	1	3	X				X	X	X	X		X	X	X				
YF310SEDB	↓ 4.5-5.5		1250							1	1		3	X	X			X	X	X	X			X	X				
YF310SEDC	9-10		1255							1	1		3	X	X			X	X	ⓐ	X			X	X				
YF311SEDA	YF311 0-1		1545							1	1	2	3	X				X	X	X	X		X	X	X				
YF311SEDB	↓ 4.5-5.5		1550							1	1		3	X	X			X	X					X	X				
YF311SEDC	↓ 9-10	↓	1555	↓						1	1		3	X	X			X	X					X	X				

		Name (print)	**Company Name**	**Date**	**Time**
Relinquished by:	Dayra	Dayra Aragon	Tetra Tech	4/7/17	1050
Received by:			TA TestAmerica	4/7/17	1650
Relinquished by:					
Received by:					
Relinquished by:					
Received by:					

Turnaround time/remarks:

Fed Ex #:

2 + 2 +

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Page 2 of 3

Lab PO#: Battelle PO 0000558626

Lab: Test America

Project name: Site YF3 Data Gaps

TtEMI technical contact: Deborah Kutlal

Field samplers: Katie Henry, Victor Early, Dayra Aragon, Shawn Myers

Project (CTO) number: 103IG450703.02

TtEMI project manager: Battelle Katie Henry / Andy Bullard

Field samplers' signatures:

						No./Container Types								**Analysis Required**														
													soil/water Preservative Added	-/HCl	-/-			-/HCl	-/-	-/-	|	|	-/H2SO4	|	|			
Sample ID	**Sample Location (Pt. ID)**	**Date**	**Time**	**Matrix**	**MS / MSD**	**40 ml VOA**	**1 liter Amber**	**500 ml Poly**	**Sleeve** 250ml AG w/H2SO4	**Glass Jar** 16oz	Jar 8oz	Jar 4oz	Encore	**VOA** (8260B)	**SVOA** (8270 SIM)	**Pest/PCBs**	**Metals**	**TPH Purgeables** 8260B (all)	**TPH Extractables** 8015B	Alkylated PAH (8270 SIM)	TOC (9060)	pH (9045)	Ammonia (350.1)	percent moisture	grain size			
YF308SEDA	YF308, 0-1	4/6/17	1645	sediment						1	1	2	3	X				X	X	X	X	X	X	X	X			
YF308 SEDB	↓ 4.5-5.5	|	1650	|						1	1		3	X	X			X	X			X		X	X			
YF308 SEDC	↓ 9-10	|	1655	|						1	1		3	X	X			X	X			X		X	X			
YF312SEDA	YF312, 0-1	|	1730	|						1	1	2	3	X				X	X	X	X	X	X	X	X			
YF312 SEDB	↓ 4.5-5.5	|	1735	|						1	1		3	X	X			X	X			X		X	X			
YF312 SEDC	↓ 9-10	↓	1740	↓	X					1	2		9	X	X			X	X			X		X	X			
YF3 TB 20170406	~~YF31~~ trip blank	↓	1100	water		3								X				X										
~~YF3~~ ER20170406	equip rinsate	4/7/17	0830	water		3	6		1					X	X			X	X	X	X		X					
~~YF3 EWB30 YF3ER20170407~~		~~4/7/17~~		~~water~~		~~3~~	~~6~~		~~1~~					~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~		~~X~~					
YF321SEDA	0-1' YF321	|	0955	sediment						1	1	2	3	X				X	X	X	X	X	X	X	X			
YF321 SEDB	4.5-5.5' YF321	|	1000	|						1	1		3	X	X			X	X			X		X	X			
YF321 SEDC	7-8' YF321	↓	1005	↓						1	1		3	X	X			X	X			X		X	X			

	Name (print)	**Company Name**	**Date**	**Time**
Relinquished by:	Dayra Aragon	Tetra Tech	4/7/17	1050
Received by:	Gary Sears	Test America	4/7/17	10:50
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

Fed Ex #:

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Chain of Custody Record No. 7038

Page 3 of 3

Lab PO#: Battelle PO 0000558626

Lab: Test America

Project name: Site YF3 Data Gaps

TtEMI technical contact: Deborah Kutzel

Field samplers: Dayna Aragon, Shaun Myers, Victor Early, Katie Henry

Project (CTO) number: 103IG4507 03.02

TtEMI project manager: Katie Henry / Battelle PM Andy Billard

Field samplers' signatures: Dayna

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	~~500 ml Poly~~ 250 AGW w/H2SO4	Sleeve	Glass Jar 16oz	Jar, 8oz	Jar 4oz	Encores	VOA (8260B)	SVOA (8270 SIM)	Pest/PCBs	Metals	TPH Purgeables 8260B Cal LUFT	TPH Extractables 8015B	Alkylated PAH (8270 SIM)	TOC (9060)	pH (9045)	Ammonia (350.1)	Percent moisture	grain size				
Preservative Added				soil/water										-/HCl	-/-			-/HCl	-/-	-/-	-/-	-/-	-/H2SO4	-/-	-/-				
YF327SEDA	YF327, 0-1	4/7/17	1030	Sediment	X	*				1	2	1+2 (MS)	3	X				X	X	X	X		X	X	X				
YF327SEDB	↓ 4.5-5.5	↓	1035	↓						1	1		3	X	X			X	X					X	X				
YF327 SEDC	↓ 9-10		1040							1	1		3	X	X			X	X					X	X				
YF304SEDA	YF304 0-1		1130							1	2	1	3	X				X	X	X	X		X	X	X				
YF304SEDB	↓ 4.5-5.5		1135							1	1		3	X	X			X	X		X			X	X				
YF304 SEDC	↓ 9-10	↓	1140	↓	X	⊕				1	1		3	X	X			X	X		X			X	X				
TB20170407	trip blank	↓	1100	water		3								X				X											
EB20170407	equip rinsate	↓	1200	water		3	6	1						X	X			X	X	X			X						

	Name (print)	Company Name	Date	Time
Relinquished by: Dayna	Dayna Aragon	Tetra Tech	~~6~~ 4/7/17	1500
Received by:		Battelle		
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

* MS/MSD for alkylated PAHs only
⊕ MS/MSD for TOC only

Fed Ex #:

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Chain of Custody Record No. 7040

Page 1 of 1

Lab PO#: Battelle 0000558626

Lab: TestAmerica

Project name: YF3 Data Gaps Investigation

TtEMI technical contact: Deborah Kutral

Field samplers: Dayna Arazen, Katie Henry

Project (CTO) number: 103IG4507

TtEMI project manager: Katie Henry / Battelle PM Andy Ballard

Field samplers' signatures: Dayna

						No./Container Types								Analysis Required															
													Preservative Added	–/HCl	–			–/HCl	–	–	–	–	/H2	–	–				
Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly Amber/H2SO4	Sleeve	Glass Jar 16oz	glass jar 8oz	glass jar 4oz	Encore	VOA (8260B)	SVOA (8270SIM)	Pest/PCBs	Metals	TPH Purgeables 8260B/(CA-LUFT)	TPH Extractables 8015B	Alkylated PAHs 8270 MOD	TOC (9060)	pH (9045)	Ammonia (350.1)	percent moisture	grain size				
YF315SEDA	YF315, 0-1	5/4/17	1130	sediment						1	1	1	3	X				X	X	X	X		X	X	X				
YF315SEDB	YF315, 4.5-5.5	↓	1200	↓						1	1		3	X	X			X	X		X		~~X~~	X	X				
YF315SEDC	YF315 8-9	↓	1230	↓						1	1		3	X	X			X	X				DA	X	X				
EB20170504	equip rins	↓	1330	water		3	6	1						X	X	DA		X	X	X			X						
TB20170504	trip blank	↓	1100	water		3								X				X	~~X~~	~~X~~			~~X~~		DA				

	Name (print)	Company Name	Date	Time
Relinquished by: Dayna	Dayna Arazen	Tetra Tech	5/5/17	1335
Received by:	Robert McAleer	TA	5/5/17	1335
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

5 day TAT

Fed Ex #:

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Chain of Custody Record No. 7034

Page 1 of 1

Lab PO#: Battelle 0000565170

Lab: Aquatic Bioassay

Project name: Site YF3 Intertidal Data Gaps

TtEMI technical contact: Deborah Kotsal

Field samplers: Dayra Aragon, Victor Early, Shawn Mayers

Project (CTO) number: 103IG4107.03.02

TtEMI project manager: / Battelle Kate Henry Andy Billard

Field samplers' signatures: Dayra

						No./Container Types								Analysis Required															
Preservative Added																						None		None		None		None	
Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	~~Sediment~~ Bag	5 gallon bucket		VOA	SVOA	Pest/PCBs	Metals	TPH Purgeables	TPH Extractables	Bioaccumulation 1*		Bioaccumulation 2*		10-day tox test 1*		10-day tox test 2*			
YF308SEDA	YF308, 0-1	4/5/17	1215	Sediment							1	1								X		X		X		X			
YF311SEDA	YF311, 0-1	↓	1100	↓							1	1								X		X		X		X			
YF312SEDA	YF312, 0-1	↓	1130	↓							1	1								X		X		X		X			
YF304SEDA	YF304, 0-1	↓	1300	↓								1												X		X			
YF315SEDA	YF315, 0-1	↓	1200	↓								1												X		X			
												1																	

		Name (print)	Company Name	Date	Time
Relinquished by:	Dayra	Dayra Aragon	Tetra Tech	4/5/17	1130
Received by:		VACUE PETROVIC	ABC LAB	4/6/17	1130
Relinquished by:					
Received by:					
Relinquished by:					
Received by:					

Turnaround time/remarks:

* Bioaccumulation test - Nereis virens 28-day = Bioaccumulation 1
Bioaccumulation test - Macoma nasuta 28-day = Bioaccumulation 2
10-day tox test - Eohaustorius estuarius = Tox test 1
10-day tox test - Nereis arenaceodentata = Tox test 2

Courier needed to return to pick up additional 5 gallon buckets for YF311 + YF308

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Chain of Custody Record No. 7037

Page 1 of 1

Lab PO#: Battelle PO0000558631

Lab: Pace Analytical

Project name: Site YF3 Data Gaps

TtEMI technical contact: Deborah Kutsal

Field samplers: Victor Early, Shaun Myers, Dayra Aragon, Katie Henry

Project (CTO) number: 103IG4507.03.02

TtEMI project manager: Katie Henry / Andy Billard Battelle PM

Field samplers' signatures: Dayra

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar 8oz	VOA	SVOA	Pest/PCBs	Metals	TPH Purgeables	TPH Extractables	Alkylated PAHs (8270D SIM)	TPH w/ FID chromatogram
~~YF304PWPFA~~		~~4/6/17~~	~~14~~															
YF304PWPFB	YF304 5-5	4/6/17	1425	pore water			2										X	X
YF308~~PW~~SEDPFA	YF308 ~~0-1~~ 1-2	↓	1700	sediment						1							X	X
YF308SEDPFB	YF308 5-5		1705	sediment						1							X	X
YF308PWPFB	YF308 5-5		1340	pore water			2										X	X
YF304SEDPFA	YF304 0-1	4/7/17	1145	sediment						1							X	X
YF304SEDPFB	YF304 5-5	↓	1150	sediment						1							X	X

Preservative Added

	Name (print)	Company Name	Date	Time
Relinquished by: Dayra	Dayra Aragon	Tetra Tech		
Received by:				
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

Fed Ex #:

WHITE-Laboratory Copy YELLOW-Sample Tracker PINK-File Copy

Tetra Tech EM Inc.
San Francisco Office

135 Main St. Suite 1800
San Francisco. CA 94105
415-543-4880
Fax 415-543-5480

Chain of Custody Record No. 7041

Page 1 of 1

Lab PO#: Battelle 000055@626

Lab: Test America

Project name: YF3 Data Gaps Investigation

TtEMI technical contact: Deborah Kitsul

Field samplers: Dayna Aragon

Project (CTO) number: 103IG4507

TtEMI project manager: Kate Henry / Battelle PM Andy Ballard

Field samplers' signatures: Dayna

						No./Container Types								Analysis Required					
													Preservative Added soil/water	-/HCl	-/-		-/HNO3	-/HCl	-/-
Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly L/HNO3	Sleeve	Glass Jar		Encore		VOA 8260B	SVOA 8270	Pest/PCBs	Metals 6010/7471 Hg	TPH Purgeables 8015M	TPH Extractables 8015M
IDW05042017W		~~8~~ 5/4/17	1400	water		3	4	1		~~2~~	2A			X	X		X	X	X
IDW05042017S		5/4/17	1410	soil						2		3		X	X		X	X	X

	Name (print)	Company Name	Date	Time
Relinquished by: Dayna	Dayna Aragon	Tetra Tech	5/5/17	1335
Received by:	Robert McAlea	TA	5/5/17	1335
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

standard TAT

Fed Ex #:

WHITE-Laboratory Copy YELLOW-Sample Tracker PINK-File Copy

B-2 Pore Water Sampling Logs

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: Start 1557
(on station) End 1745

Survey Date 9 Feb. 2016

Water Depth (ft) 3.5 low tide

FIELD ID:
YF3 01

Sediment Depth Profile
Silty
Sand

WAAS Diff. GPS (decimal degrees)
Lat ° N **37.81412**
Long ° W **122.36323**

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF301PW**			
Trident Probe / Water Sampling: **Depth** (ft)	2 bss			≥ 0.5 bws
Trident **Temperature** [^oC]	11.955			12.407
Trident **Conductivity** (mS/cm)	6.083			9.909
UltraMeter **Temperature** [^oC]	13.7			
UltraMeter **TDS** NaCl [ppt]	15.06			
UltraMeter **Conductivity** KCl (mS/cm)	26.88			
UltraMeter **pH**	6.85			
UltraMeter **ORP** (mV)	102			
Time: Sample **Collected**/Analyzed for **WQ**	1610	1721		

pw: porewater; **bss:** below sediment surface **sw:** surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; purge > 100 mL

SPAWAR
Systems Center
PACIFIC

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1521
End 1715

Survey Date 9 Feb. 2016

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81409**
Long ° W **122.36320**

FIELD ID:
YF3 02

Water Depth (ft) NA - low tide

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			*SURFACE WATER (sw)*
Sample LABEL ID	**YF302PW**			
Trident Probe / Water Sampling: **Depth** (ft)	1.5 bss			*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [°C]	12.484			12.729
Trident **Conductivity** (mS/cm)	1.341		Ave.	19.550
UltraMeter **Temperature** [°C]	14.1	14.0	14.1	
UltraMeter **TDS** NaCl [ppt]	3.641	2.143	2.892	
UltraMeter **Conductivity** KCl (mS/cm)	7.245	4.381	5.813	
UltraMeter **pH**	6.00	7.11	6.56	
UltraMeter **ORP** (mV)	192	202	197	
Time: Sample **Collected**/Analyzed for **WQ**	1525	1543	1534	

pw: porewater; **bss:** below sediment surface

sw: surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific, Energy & Environmental Sustainability Branch, c/ 71760; water quality (wq) measured twice; light oil sheens; slight fuel smell; purge > 100 mL

SPAWAR Systems Center PACIFIC

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1401
End 1540

Survey Date 9 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81405**
Long ° W **122.36316**

FIELD ID:
YF3 03

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF303PW**	
Trident Probe / Water Sampling: **Depth** (ft)	1.5 bss	*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [^{o}C]	12.369	12.576
Trident **Conductivity** (mS/cm)	2.041	18.677
UltraMeter **Temperature** [^{o}C]	14.0	
UltraMeter **TDS** NaCl [ppt]	5.599	
UltraMeter **Conductivity** KCl (mS/cm)	10.79	
UltraMeter **pH**	8.00	
UltraMeter **ORP** (mV)	5	
Time: Sample **Collected**/Analyzed for **WQ**	1435 1520	

pw: porewater; **bss:** below sediment surface **sw:** surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; visible oil sheens; fuel smell; purge > 100 mL

SPAWAR
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PACIFIC

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1334
End 1438

Survey Date 9 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81401**
Long ° W **122.36313**

FIELD ID:
YF3 04

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF304PW**	
Trident Probe / Water Sampling: **Depth** (ft)	1.5 bss	*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [^{o}C]	12.910	12.650
Trident **Conductivity** (mS/cm)	0.113	19.372
UltraMeter **Temperature** [^{o}C]	14.5	
UltraMeter **TDS** NaCl [ppt]	1.368	
UltraMeter **Conductivity** KCl (mS/cm)	2.845	
UltraMeter **pH**	6.80	
UltraMeter **ORP** (mV)	219	
Time: Sample **Collected**/Analyzed for **WQ**	1334 1304	

pw: porewater; **bss:** below sediment surface **sw:** surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1138
End 1254

Survey Date 9 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N	**37.81401**
Long ° W	**122.36313**

FIELD ID:
YF3 04

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			*SURFACE WATER (sw)*
Sample LABEL ID	**YF304PWFPA**			
Trident Probe / Water Sampling: **Depth** (ft)	1.5 bss			
Trident **Temperature** [^{o}C]				
Trident **Conductivity** (mS/cm)				
UltraMeter **Temperature** [^{o}C]				
UltraMeter **TDS** NaCl [ppt]				
UltraMeter **Conductivity** KCl (mS/cm)				
UltraMeter **pH**				
UltraMeter **ORP** (mV)				
Time: Sample **Collected**/Analyzed for **WQ**	1205			

pw: porewater; **bss:** below sediment surface **sw:** surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SSC-Pacific, c/ 71760; pw sample for fingerprinting (FP) analysis; pw sampling depth at 1.5 ft; Trident probe & water quality data NOT available/measured; purge > 100 mL

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PACIFIC

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1254
End 1333

Survey Date 9 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81401**
Long ° W **122.36313**

FIELD ID:
YF3 04

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF304PWFPB**			
Trident Probe / Water Sampling: **Depth** (ft)	1.5 bss			
Trident **Temperature** [^{o}C]				
Trident **Conductivity** (mS/cm)				
UltraMeter **Temperature** [^{o}C]				
UltraMeter **TDS** NaCl [ppt]				
UltraMeter **Conductivity** KCl (mS/cm)				
UltraMeter **pH**				
UltraMeter **ORP** (mV)				
Time: Sample **Collected**/Analyzed for **WQ**	1255			

pw: porewater; bss: below sediment surface
sw: surface water; bws: below water surface

Comments/Observations: **James Leather** & **Joel Guerrero**: US Navy SSC-Pacific, c/ 71760; pw sample for fingerprinting (FP) analysis; pw sampling depth at 1.5 ft; Trident probe & water quality data NOT available/measured; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1618
End 1753

Survey Date 8 Feb. 2016

Water Depth (ft) 3 low tide

WAAS Diff. GPS (decimal degrees)
Lat ° N **37.81415**
Long ° W **122.36313**

FIELD ID:
YF3 05

Sediment Depth Profile
Sandy
Silt

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF305PW**	
Trident Probe / Water Sampling: **Depth** (ft)	2 bss	≥ 0.5 bws
Trident **Temperature** [°C]	11.974	12.074
Trident **Conductivity** (mS/cm)	8.222	13.261
UltraMeter **Temperature** [°C]		
UltraMeter **TDS** NaCl [ppt]		
UltraMeter **Conductivity** KCl (mS/cm)		
UltraMeter **pH**		
UltraMeter **ORP** (mV)		
Time: Sample **Collected**/Analyzed for **WQ**	1632	

pw: porewater; bss: below sediment surface sw: surface water; bws: below water surface

James Leather & **Joel Guerrero**: US Navy SPAWARSYSCEN Pacific, Energy & Environmental Sustainability Branch

Comments/Observations: c/ 71760; debris field on sampling location; water quality data NOT available/measured; purge 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (*on station*)
Start 1531
End 1805

Survey Date 8 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81410**
Long ° W **122.36308**

FIELD ID:
YF3 06

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF306PW**	
Trident Probe / Water Sampling: **Depth** (ft)	2 bss	*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [°C]	11.866	12.959
Trident **Conductivity** (mS/cm)	5.344	18.866
UltraMeter **Temperature** [°C]		
UltraMeter **TDS** NaCl [ppt]		
UltraMeter **Conductivity** KCl (mS/cm)		
UltraMeter **pH**		
UltraMeter **ORP** (mV)		
Time: Sample **Collected**/Analyzed for **WQ**	1659	

pw: porewater; bss: below sediment surface

sw: surface water; bws: below water surface

Comments/Observations: **James Leather** & **Joel Guerrero**: US Navy SPAWARSYSCEN Pacific, Energy & Environmental Sustainability Branch, c/ 71760; water quality data NOT available/measured; visible oil sheens; fuel smell; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station) Start 1327
End 1549

Survey Date 8 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81406**
Long ° W **122.36305**

FIELD ID:
YF3 07

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF307PW**	
Trident Probe / Water Sampling: **Depth** (ft)	2 bss	*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [^oC]	12.143	12.651
Trident **Conductivity** (mS/cm)	5.070	20.368
UltraMeter **Temperature** [^oC]	15.7	
UltraMeter **TDS** NaCl [ppt]	15.49	
UltraMeter **Conductivity** KCl (mS/cm)	27.56	
UltraMeter **pH**	7.33	
UltraMeter **ORP** (mV)	-80	
Time: Sample **Collected**/Analyzed for **WQ**	1350 1444	

pw: porewater; bss: below sediment surface   sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, c/ 71760; surface of sampling location covered with black tar & porcelein bricks; visible oil sheens; fuel smell; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (*on station*)
Start 1130
End 1415

Survey Date 8 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81402**
Long ° W **122.36302**

FIELD ID:
YF3 08

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	*SURFACE WATER (sw)*
Sample LABEL ID	**YF308PW**	
Trident Probe / Water Sampling: **Depth** (ft)	2 bss	*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [^{o}C]	12.215	12.305
Trident **Conductivity** (mS/cm)	3.725	18.863
UltraMeter **Temperature** [^{o}C]	15.2	
UltraMeter **TDS** NaCl [ppt]	7.624	
UltraMeter **Conductivity** KCl (mS/cm)	14.48	
UltraMeter **pH**	7.67	
UltraMeter **ORP** (mV)	175	
Time: Sample **Collected**/Analyzed for **WQ**	1228 1550	

pw: porewater; **bss:** below sediment surface   **sw:** surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; visible oil sheens; fuel smell; purge > 100 mL

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station) Start *1130*
End *1415*

Survey Date *8 Feb. 2016*

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81402**
Long ° W **122.36302**

FIELD ID:
YF3 08

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF308PWFPA**			
Trident Probe / Water Sampling: **Depth** (ft)	2 bss			
Trident **Temperature** [^{o}C]				
Trident **Conductivity** (mS/cm)				
UltraMeter **Temperature** [^{o}C]	15.2			
UltraMeter **TDS** NaCl [ppt]	7.624			
UltraMeter **Conductivity** KCl (mS/cm)	14.48			
UltraMeter **pH**	7.67			
UltraMeter **ORP** (mV)	175			
Time: Sample **Collected**/Analyzed for **WQ**	1228	1550		

pw: porewater; **bss:** below sediment surface

sw: surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SSC-Pacific, c/ 71760; pw sample for fingerprinting (FP) analysis; pw sampling depth at 2 ft; Trident probe data NOT measured; visible oil sheens; fuel smell; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station) **Start** 1509
End 1555

Survey Date 8 Feb. 2016

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81402**
Long ° W **122.36302**

FIELD ID:
YF3 08

Water Depth (ft) NA - low tide

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	*SURFACE WATER (sw)*
Sample LABEL ID	**YF308PWFPB**	
Trident Probe / Water Sampling: **Depth** (ft)	2 bss	
Trident **Temperature** [^{o}C]		
Trident **Conductivity** (mS/cm)		
UltraMeter **Temperature** [^{o}C]		
UltraMeter **TDS** NaCl [ppt]		
UltraMeter **Conductivity** KCl (mS/cm)		
UltraMeter **pH**		
UltraMeter **ORP** (mV)		
Time: Sample **Collected**/Analyzed for **WQ**	1509	

pw: porewater; bss: below sediment surface   sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: USN SSC-Pacific, c/ 71760; pw sample for fingerprinting (FP) analysis; pw sampling depth at 2 ft; Trident probe & wq data NOT measured; visible oil sheens; fuel smell; purge > 100 mL

SPAWAR
Systems Center
PACIFIC

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1546
End 1647

Survey Date 7 Feb. 2016

Water Depth (ft) 1.5 low tide

WAAS Diff. GPS (decimal degrees)
Lat ° N **37.81417**
Long ° W **122.36293**

FIELD ID:
YF3 09

Sediment Depth Profile
Sandy
Silt

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF309PW**			
Trident Probe / Water Sampling: **Depth** (ft)	2 bss			≥ 0.5 bws
Trident **Temperature** [°C]	11.746			12.446
Trident **Conductivity** (mS/cm)	5.840			27.557
UltraMeter **Temperature** [°C]	13.6			
UltraMeter **TDS** NaCl [ppt]	17.51			
UltraMeter **Conductivity** KCl (mS/cm)	30.82			
UltraMeter **pH**	8.04			
UltraMeter **ORP** (mV)	15			
Time: Sample **Collected**/Analyzed for **WQ**	1616	1620		

pw: porewater; bss: below sediment surface   sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: Start 1330
(on station) End 1745

Survey Date 7 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81411**
Long ° W **122.36290**

FIELD ID:
YF3 10

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF310PW**	
Trident Probe / Water Sampling: **Depth** (ft)	> 1.5 bss	*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [^oC]	11.780	12.811
Trident **Conductivity** (mS/cm)	4.374	28.215
UltraMeter **Temperature** [^oC]	13.0	
UltraMeter **TDS** NaCl [ppt]	15.07	
UltraMeter **Conductivity** KCl (mS/cm)	26.82	
UltraMeter **pH**	8.12	
UltraMeter **ORP** (mV)	-191	
Time: Sample **Collected**/Analyzed for **WQ**	1707 1719	

pw: porewater; **bss:** below sediment surface **sw:** surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; visible sheens, fuel smell; purge > 100 mL

SPAWAR
Systems Center
PACIFIC

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: *(on station)*
Start 1230
End 1613

Survey Date 7 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.814106**
Long ° W **122.36287**

FIELD ID:
YF3 11

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			*SURFACE WATER (sw)*
Sample LABEL ID	**YF311PW**			
Trident Probe / Water Sampling: **Depth** (ft)	> 1.5 bss			*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [°C]	12.517			12.635
Trident **Conductivity** (mS/cm)	0.990			28.143
UltraMeter **Temperature** [°C]	13.5			
UltraMeter **TDS** NaCl [ppt]	5.537			
UltraMeter **Conductivity** KCl (mS/cm)	10.68			
UltraMeter **pH**	7.52			
UltraMeter **ORP** (mV)	200			
Time: Sample **Collected**/Analyzed for **WQ**	1315	1640		

pw: porewater; bss: below sediment surface
sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific, c/ 71760; wq data measured from pH sample collection; debris field on sampling location; visible sheens; strong fuel smell; purge > 100 mL

SPAWAR
Systems Center
PACIFIC

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: *(on station)*
Start 1100
End 1316

Survey Date 8 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N	**37.81401**
Long ° W	**122.36287**

FIELD ID:
YF3 12Dup

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			*SURFACE WATER (sw)*
Sample LABEL ID	**YF312PWDUP**			
Trident Probe / Water Sampling: **Depth** (ft)	~ 2 *bss*			
Trident **Temperature** [°C]				
Trident **Conductivity** (mS/cm)				
UltraMeter **Temperature** [°C]	14.8			
UltraMeter **TDS** NaCl [ppt]	2.573			
UltraMeter **Conductivity** KCl (mS/cm)	5.203			
UltraMeter **pH**	6.94			
UltraMeter **ORP** (mV)	195			
Time: Sample **Collected**/Analyzed for **WQ**	1110	1154		

pw: porewater; **bss:** below sediment surface

sw: surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, c/ 71760; field duplicate (DUP) QC sample; debris field on sampling location; Trident probe data NOT measured; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: Start 1316
(on station) End 1549

Survey Date 8 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N	**37.81401**
Long ° W	**122.36287**

FIELD ID:
YF3 12Dup

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF312PWDUP MS**			
Trident Probe / Water Sampling: **Depth** (ft)	~ 2 bss			
Trident **Temperature** [^{o}C]				
Trident **Conductivity** (mS/cm)				
UltraMeter **Temperature** [^{o}C]	16.0			
UltraMeter **TDS** NaCl [ppt]	1.184			
UltraMeter **Conductivity** KCl (mS/cm)	2.492			
UltraMeter **pH**	6.81			
UltraMeter **ORP** (mV)	204			
Time: Sample **Collected**/Analyzed for **WQ**	1317	1440		

pw: porewater; bss: below sediment surface

sw: surface water; bws: below water surface

Comments/Observations: J.Leather & J.Guerrero: US Navy SSC-PAC c/ 71760; pw collected from field duplication location; lab QA Matrix Spike (MS) sample; debris on sampling location; Trident probe data NOT measured; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: **Start** 1549
(on station) **End** 1746

Survey Date 8 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81401**
Long ° W **122.36287**

FIELD ID:
YF3 12Dup

Sediment Depth Profile

Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF312PWDUP MSD**	
Trident Probe / Water Sampling: **Depth** (ft)	~ 2 bss	
Trident **Temperature** [^{o}C]		
Trident **Conductivity** (mS/cm)		
UltraMeter **Temperature** [^{o}C]		
UltraMeter **TDS** NaCl [ppt]		
UltraMeter **Conductivity** KCl (mS/cm)		
UltraMeter **pH**		
UltraMeter **ORP** (mV)		
Time: Sample **Collected**/Analyzed for **WQ**	1549	

pw: porewater; bss: below sediment surface

sw: surface water; bws: below water surface

Comments/Observations: J.Leather & J.Guerrero:US Navy SSC-PAC, c/ 71760; collected on field duplicate (DUP) station; lab QA Matrix Spike Duplicate (MSD) sample; debris on sampling location; Probe & wq data NOT measured; purge > 100 mL

SPAWAR
Systems Center
PACIFIC

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (*on station*)
Start 1050
End 1353

Survey Date 7 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81401**
Long ° W **122.36287**

FIELD ID:
YF3 12

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF312PW**	
Trident Probe / Water Sampling: **Depth** (ft)	2 bss	*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [^{o}C]	12.232	12.566
Trident **Conductivity** (mS/cm)	1.352	24.398
UltraMeter **Temperature** [^{o}C]	14.6	
UltraMeter **TDS** NaCl [ppt]	1.617	
UltraMeter **Conductivity** KCl (mS/cm)	3.346	
UltraMeter **pH**	6.89	
UltraMeter **ORP** (mV)	181	
Time: Sample **Collected**/Analyzed for **WQ**	1117 1205	

pw: porewater; bss: below sediment surface
sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; purge > 100 mL

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Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

WAAS Diff. GPS (decimal degrees)
Lat ° N **37.81417**
Long ° W **122.36271**

TIME: *(on station)*
Start 1500
End 1630

Survey Date 6 Feb. 2016

FIELD ID:
YF3 13

Water Depth (ft) 2.5 low tide

Sediment Depth Profile
Silty
Sand

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF313PW**			
Trident Probe / Water Sampling: **Depth** (ft)	2 bss			≥ 0.5 bws
Trident **Temperature** [°C]	11.508			12.764
Trident **Conductivity** (mS/cm)	4.382			24.398
UltraMeter **Temperature** [°C]	13.3			
UltraMeter **TDS** NaCl [ppt]	16.95			
UltraMeter **Conductivity** KCl (mS/cm)	29.95			
UltraMeter **pH**	7.68			
UltraMeter **ORP** (mV)	-164			
Time: Sample **Collected**/Analyzed for **WQ**	1517	1555		

pw: porewater; **bss:** below sediment surface
sw: surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1345
End 1546

Survey Date 6 Feb. 2016

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81412**
Long ° W **122.36272**

FIELD ID:
YF3 14

Water Depth (ft) NA - low tide

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF314PW**			
Trident Probe / Water Sampling: **Depth** (ft)	1.5 bss			*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [°C]	11.588			12.914
Trident **Conductivity** (mS/cm)	7.023			21.144
UltraMeter **Temperature** [°C]	13.5			
UltraMeter **TDS** NaCl [ppt]	23.74			
UltraMeter **Conductivity** KCl (mS/cm)	40.35			
UltraMeter **pH**	8.02			
UltraMeter **ORP** (mV)	-288			
Time: Sample **Collected**/Analyzed for **WQ**	1415	1525		

pw: porewater; bss: below sediment surface

sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; visible sheens, fuel smell; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: Start 1205
(on station) End 1430

Survey Date 6 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81407**
Long ° W **122.36272**

FIELD ID:
YF3 15

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF315PW**	
Trident Probe / Water Sampling: **Depth** (ft)	1.5 bss	*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [^oC]	11.602	12.657
Trident **Conductivity** (mS/cm)	2.207	24.169
UltraMeter **Temperature** [^oC]	14.8	
UltraMeter **TDS** NaCl [ppt]	10.82	
UltraMeter **Conductivity** KCl (mS/cm)	20.05	
UltraMeter **pH**	7.62	
UltraMeter **ORP** (mV)	-53	
Time: Sample **Collected**/Analyzed for **WQ**	1315 1411	

pw: porewater; bss: below sediment surface

sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; visible sheens, fuel smell; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1040
End 1312

Survey Date 6 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81402**
Long ° W **122.36270**

FIELD ID:
YF3 16

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF316PW**	
Trident Probe / Water Sampling: **Depth** (ft)	2 bss	*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [^{o}C]	11.366	12.515
Trident **Conductivity** (mS/cm)	5.884	23.051
UltraMeter **Temperature** [^{o}C]	13.9	
UltraMeter **TDS** NaCl [ppt]	8.641	
UltraMeter **Conductivity** KCl (mS/cm)	16.26	
UltraMeter **pH**	7.19	
UltraMeter **ORP** (mV)	168	
Time: Sample **Collected**/Analyzed for **WQ**	1140 1246	

pw: porewater; **bss:** below sediment surface   **sw:** surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; visible oil sheens; fuel smell; purge > 100 mL

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Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1120
End 1420

Survey Date 7 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81402**
Long ° W **122.36270**

FIELD ID:
YF3 16Dup

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF316PWDUP**			
Trident Probe / Water Sampling: **Depth** (ft)	2 bss			*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [°C]	11.681			12.881
Trident **Conductivity** (mS/cm)	7.451			27.025
UltraMeter **Temperature** [°C]	14.7			
UltraMeter **TDS** NaCl [ppt]	8.831			
UltraMeter **Conductivity** KCl (mS/cm)	16.61			
UltraMeter **pH**	7.40			
UltraMeter **ORP** (mV)	-13			
Time: Sample **Collected**/Analyzed for **WQ**	1150	1253		

pw: porewater; bss: below sediment surface
sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, c/ 71760; field duplicate (DUP) QC sample; debris field on sampling location; light sheen; slight fuel smell; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station) Start 1516
End 1706

Survey Date 7 Feb. 2016

Water Depth (ft) 1.5 low tide

WAAS Diff. GPS (decimal degrees)
Lat ° N **37.81417**
Long ° W **122.36253**

FIELD ID:
YF3 17

Sediment Depth Profile
Sandy
Silt

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF317PW**			
Trident Probe / Water Sampling: **Depth** (ft)	2 bss			≥ 0.5 bws
Trident **Temperature** [°C]	11.858			12.438
Trident **Conductivity** (mS/cm)	6.618			28.010
UltraMeter **Temperature** [°C]	13.5			
UltraMeter **TDS** NaCl [ppt]	16.19			
UltraMeter **Conductivity** KCl (mS/cm)	28.70			
UltraMeter **pH**	7.72			
UltraMeter **ORP** (mV)	-2			
Time: Sample **Collected**/Analyzed for **WQ**	1545	1630		

pw: porewater; **bss:** below sediment surface **sw:** surface water; **bws:** below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: Start 1221
(on station) End 1503

Survey Date 4 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81412**
Long ° W **122.36255**

FIELD ID:
YF3 18

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			***SURFACE WATER (sw)***
Sample LABEL ID	**YF318PW**			
Trident Probe / Water Sampling: **Depth** (ft)	2 bss			*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [^{o}C]	11.416			12.632
Trident **Conductivity** (mS/cm)	4.770			23.377
UltraMeter **Temperature** [^{o}C]	14.3			
UltraMeter **TDS** NaCl [ppt]	18.32			
UltraMeter **Conductivity** KCl (mS/cm)	32.12			
UltraMeter **pH**	7.95			
UltraMeter **ORP** (mV)	-245			
Time: Sample **Collected**/Analyzed for **WQ**	1331	1342		

pw: porewater; bss: below sediment surface sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific, Energy & Environmental Sustainability Branch, c/ 71760; debris field on sampling location; visible oil sheens; strong fuel smell; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: (on station)
Start 1353
End 1610

Survey Date 4 Feb. 2016

Water Depth (ft) NA - low tide

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81407**
Long ° W **122.36255**

FIELD ID:
YF3 19

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			*SURFACE WATER (sw)*
Sample LABEL ID	**YF319PW**			
Trident Probe / Water Sampling: **Depth** (ft)	1.5 bss			*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [°C]	13.763			12.769
Trident **Conductivity** (mS/cm)	0.825			24.406
UltraMeter **Temperature** [°C]	14.2			
UltraMeter **TDS** NaCl [ppt]	3.741			
UltraMeter **Conductivity** KCl (mS/cm)	7.446			
UltraMeter **pH**	7.84			
UltraMeter **ORP** (mV)	98			
Time: Sample **Collected**/Analyzed for **WQ**	1526	1527		

pw: porewater; bss: below sediment surface sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific, Energy & Environmental Sustainability Branch, c/ 71760; debris field on porewater sampling location; light sheen; slight fuel smell; purge > 100 mL

Naval Station Treasure Island, CA

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: *(on station)*
Start 1150
End 1320

Survey Date 4 Feb. 2016

WAAS Diff. GPS (decimal degrees)

Lat ° N **37.81402**
Long ° W **122.36255**

Water Depth (ft) NA - low tide

FIELD ID:
YF3 20

Sediment Depth Profile
Sandy - Cleared very heavy debris field prior to Trident probe screening & porewater sampling

	POREWATER (pw)			*SURFACE WATER (sw)*
Sample LABEL ID	**YF320PW**			
Trident Probe / Water Sampling: **Depth** (ft)	2 bss			*SW sample collected along shoreline, nearest to low tide mark; measured by reference probe*
Trident **Temperature** [°C]	12.049			12.623
Trident **Conductivity** (mS/cm)	0.447			12.139
UltraMeter **Temperature** [°C]	14.1			
UltraMeter **TDS** NaCl [ppt]	2.403			
UltraMeter **Conductivity** KCl (mS/cm)	4.881			
UltraMeter **pH**	6.97			
UltraMeter **ORP** (mV)	273			
Time: Sample **Collected**/Analyzed for **WQ**	1215	1253		

pw: porewater; bss: below sediment surface   sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Energy & Environmental Sustainability Branch, c/ 71760; very heavy debris field on porewater sampling location; purge > 100 mL

Clipper Cove
Yerba Buena Island (YBI)
Porewater Sampling & Assessment

TIME: Start
(on station) End

Survey Date Feb. 2016

WAAS Diff. GPS (decimal degrees)
Lat ° N **37.**
Long ° W **122.**

FIELD ID:
YF3

Water Depth (ft)

Sediment Depth Profile
Surface
Layer

	POREWATER (pw)	***SURFACE WATER (sw)***
Sample LABEL ID	**YF3 PW**	
Trident Probe / Water Sampling: **Depth** (ft)	*2 bss*	*≥ 0.5 bws*
Trident **Temperature** [°C]		
Trident **Conductivity** (mS/cm)		
UltraMeter **Temperature** [°C]		
UltraMeter **TDS** NaCl [ppt]		
UltraMeter **Conductivity** KCl (mS/cm)		
UltraMeter **pH**		
UltraMeter **ORP** (mV)		
Time: Sample Collected/Analyzed for WQ		

pw: porewater; bss: below sediment surface   sw: surface water; bws: below water surface

Comments/Observations: James Leather & Joel Guerrero: US Navy SPAWARSYSCEN Pacific - San Diego, Advanced Systems & Applied Sciences Division, Energy & Environmental Sustainability Branch, c/ 71760

B-3 Boring Logs

TETRA TECH EM, INC.

SEDIMENT BORING AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data Gaps Investigation

Time	PID Reading (ppm)	USCS Soil Symbol	Location	Hand-Dug Excavations Description
1200	39.2	GW	**311**	0’’-8’’ Cobble (Brick, SS, Concrete) FFP Strong Petroleum Odor
		GM		8’’-12’’ Sandy Gravel (Fine-Very Fine Sand 40%) Very Dark Grey, Sub Angular/Sub-Rounded Wet FFP On GW
	78.0	GW	**315**	0’’-6’’ Cobble (Brick, SS, Concrete) FFP Strong Petroleum Odor
		GM		6’’-12’’ Sandy Gravel (Fine-Very Fine Sand 40%) Very Dark Grey, Sub Angular/Sub Rounded Wet, Petroleum Odor FFP On GW (<1/16’’)
	13.3	GW	**312**	0’’-6’’ Gravel/Cobble (Serpentinite, SS, Concrete)
		GM		6’’-12’’ Clayey Sandy Gravel Sub Angular/Sub Rounded Dark Brown/Green 30% Stringers of Green Clayey Silty Very Fine Sand Petroleum Odor, Moist, Loose
1400	11.8	GW	**308**	0’’-8’’ Gravel/Cobble (Brick, SS, Concrete), Dark Brown FFP Strong Petroleum Odor
		GM		8’’-12’’ Sandy Gravel (Fine-Very Fine Sand 40%) Very Dark Grey, Sub Angular/Sub-Rounded Wet, Petroleum Odor FFP On GW
	13.5	GW	**304**	0’’-8’’ Cobble/Gravel (Brick, SS, Concrete) Strong Petroleum Odor
		GM		8’’-12’’ Sandy Gravel (Fine-Very Fine Sand 30%) Very Dark Grey, Sub Angular/Sub-Rounded Wet FFP On GW

Notes:
FFP – Free floating petroleum product
SS - sandstone

TETRA TECH EM, INC.

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF304	Date Started: 04/06/17
Drilling Method: Sonic	Date Completed: 04/06/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description	
1130				S		8.4	GM	Greenish Black GL1 2.5/1 10Y	Silty Sandy Gravel, Wet, Petrol Odor 20% Sand, 10% Fines
	2		20				SM	Dark Greenish/Grey GL1 4/1 5GY	Silty Sand, Wet, Petrol Odor 20% Gravel, 10% Fines
	4			S	N/A	3.1	GM GC	Dark Yellowish/Brown 10YR 4/6	Silty Sandy Gravel 20% Fines, 10% Very Fine Sand Wet/Moist, Petroleum Odor
	6		95						
	8		95						
			95				SM	Dark Greenish/Grey	Silty Clayey Sand, Moist
	10			S		1.3	SC	GL1 4/1 5GY	20% Fines, Very Fine
								Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data Gaps Investigation

Boring Number: YF307	Date Started: 04/05/17
Drilling Method: Sonic	Date Completed: 04/05/17
Outer Diameter of Boring: 4"	Logged By: Victor Early (on 04/06/17)
Outer Diameter of Casing: 3.8"	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description	
1315				S		18.2	GM	Dark Greenish/Grey	Sandy Silty Gravel
								GL1 4/1 5GY	20% Fine-Very Fine Sand, 20% Silt
			80						Wet Loose, Moist
	2								Petroleum Odor
			80						
	4		70						
							SP	Very Dark Greenish/Grey	Silty Sand, Fine-Very Fine
				S	N/A	9.5	SM	GL1 3/1 10GY	10% Fines, 10% Gravel & Mollusk Shell
									Wet Loose, Petroleum Odor
	6								
			10						
	8								
							SM	Dark Grey, 10YR 4/1	20% Fines
	10		90	S		2.5			
								Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF308	Date Started: 04/06/17
Drilling Method: Sonic	Date Completed: 04/06/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description
1645				S		13.1	GM	Very Dark Greenish/Grey GL 1 3/1 5GY Sandy Gravel 30% Very Fine Sand, 10% Fines Med-dense, Wet, Petroleum Odor
	2							
			80					
	4							
				S	N/A	56.6	GM	40% Very Fine Sand ↓
	6							
	8		90					
	10			S		10.3	GM	Bottom of Boring

TETRA TECH EM, INC.

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF310	Date Started: 04/05/17
Drilling Method: Sonic	Date Completed: 04/05/17
Outer Diameter of Boring: 4”	Logged By: Victor Early (ON 04/06/17)
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description	
1250				S		18.6	GC	Reddish Black 2.5YR 2.5/1	Clayey Sandy Gravel 30% Sand-Very Fine Sand, 10% Silt Wet , Loose, Moist, Petroleum odor
	2		100						
								Greenish Black GL1 2.5/5G	
	4		100				GM		
			100	S	N/A	0.8			
	6								
							SM	Very Dark Greenish/Grey GL1 3/1 5GY	Silty Sand, Fine-Very Fine 10% Fines, 10% Gravel Wet Loose, Petroleum odor
	8		100						
	10		100	S		1.6			
								Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF311	Date Started: 04/06/17
Drilling Method: Sonic	Date Completed: 04/06/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description	
1545				S		81.3	GC GM	Dark Greenish/Grey GL1 4/1 5GY	Clayey Sandy Gravel 20% Fine Sand, 20% Clay Petroleum Odor, Moist
	2								
			80						
	4						GC GM	Very Dark Greenish/Grey GL1 3/1 10GY	
				S	N/A	198.1			
							SM	Very Dark Greenish/Grey GL1 3/1 5G	Silty Sand, Fine-Very Fine 10% Fines, 10% Gravel & Mollusks Wet, Loose, Brown Petroleum Product
	6								
	8		70						
	10			S		77.0			
								Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data Gaps Investigation

Boring Number: YF312	Date Started: 04/06/17
Drilling Method: Sonic	Date Completed: 04/06/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description	
1730				S		1.3	GM	Brown 7.5YR 4/3	Sandy Clayey Gravel (brick, sandstone) 20% Fine Sand, 10% Fines Moist Loose
	2		90						
	4		80						
				S	N/A	6.2	SM SP	Very Dark Greenish/Grey GL1 3/1 5GY	Silty Gravelly Sand, Very Fine 20% Gravel, 10% Fines Wet, Petroleum Odor
	6								
	8		90						
	10			S		3.6			
								Bottom of Boring	

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF314A	Date Started: 03/28/17
Drilling Method: Sonic	Date Completed: 03/28/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Dixon Marine

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description Water Depth/Time: 5.5 Feet / 1300	
1300				S		0.0	GM	Dark Grey 4/N	Silty Gravel 20% Fine Sand, 10% Fines, Wet Loose
							SM	Dark Greenish/Grey 4/1 5GY	Silty Sand, Very Fine 10% Fines Wet Loose
	2								
	4								
			85	S	N/A	0.0	SM SC	Very Dark Greenish/Grey GL1 3/1 10GY	Silty Clayey Sand, Very Fine 20% Fines, 10% Shell Mollusk Shell Wet Loose -Rubber shoe heel-
	6								
	8								
	10			S		0.0			
								Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF315	Date Started: 05/04/17
Drilling Method: Hand Auger	Date Completed: 05/04/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description	
1200				S		135	GM	Greenish Black GL1 2.5/10GY	Silty Sandy Gravel, Very Fine Sand 30% 10% Fines, Wet, Petroleum Odor
			40				SM	Very Dark Greenish/Grey GL1 3/1 10GY	Silty Sand, Fine-Very Fine 10% Gravel, 10% Fines Wet, Soft, Loose
	2			S		206			
			60					-Petroleum Odor-	
			50						
	4			S		163			
									30% Fines
				S	N/A	148			
			40						
	6			S		253			10% Fines
			30						
				S		228			
			50						
	8								
			20						
				S		205			
								Bottom of Boring	
	10								

TETRA TECH EM, INC.

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF319	Date Started: 04/05/17
Drilling Method: Sonic	Date Completed: 04/05/17
Outer Diameter of Boring: 4”	Logged By: Victor Early (on 04/06/17)
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description	
1205				S		16.1	GM GC	Very Dark Greenish/Grey GL1 3/1 10Y	Clayey Sandy Gravel 30% Fine-Very Fine Sand & Clay Wet, Petroleum Odor
	2								
							GM	Very Dark Greenish/Grey GL1 3/1 10GY	Sandy Gravel 40% Fine-Very Fine Sand & Clay Wet, Loose, Petroleum Odor
	4								
			100	S	N/A	3.1			
							SM	Very Dark Greenish/Grey GL1 3/1 10Y	Silty Sand, Fine-Very Fine 10% Gravel, 20% Fines Wet, Very Loose
	6								
	8								
	10			S		2.1			
								Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF321	Date Started: 04/06/17
Drilling Method: Sonic	Date Completed: 04/06/17
Outer Diameter of Boring: 4”	Logged By: Victor Early (on 04/07/17)
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description	
0945				S		4.2	GM	Very Dark Grey GL1 3/1 N	Silty Gravel 20% Fines, 10% Sand, Med-dense, Moist, Petroleum Odor
							SM	Dark Greyish/Brown 10YR 4/1	Silty Sand, Fine-Very Fine 40% Fines, <5% Gravel Wet Loose
	2		95						
	4				N/A		GM	Dark Greyish/Brown GL1 4/1 10Y	Silty Sandy Gravel 30% Fines, 10% Sand Wet, Petroleum Odor
				S		5.4			
	6						GM		
			95						30% Sands, 20% Fines Moist, Dense
	8			S		2.1			
								Bottom of Boring	
	10								

TETRA TECH EM, INC.

SEDIMENT BORING AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data Gaps Investigation

Boring Number: YF322D	Date Started: 03/27/17
Drilling Method: Vibracore	Date Completed: 03/27/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Dixon Marine

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description Water Depth/Time: 7.0 feet / 1330	
1135				S		0.0	SM	Black Gravel Organic	Silty Sand 10% Silt & Gravel Gravel is chert, sandstone serpentinite Stained
	2								
								Very Dark Greenish/Grey	Very Loose, Wet
	4								
				S		0.0		3/1 10GY	
			95		N/A				
	6								20% Silt, 10% Gravel -White Mollusk Shell Layer-
							CH CL	Very Dark Greenish/Grey	Sandy Clay 20% Sand Fine, 10% Shell
	8								Mollusk Shell
								3/1 10GY	Very Soft
				S		0.0			
	10							Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF323B	Date Started: 03/27/17
Drilling Method: Vibracore	Date Completed: 03/27/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Dixon Marine

Time	**Depth (feet bgs)**	**Drive Interval**	**Recovered Interval %**	**Sample Depth**	**Well Construction**	**PID Reading (ppm)**	**USCS Soil Symbol**	**Description** Water Depth/Time: 6.2 Feet / 1355	
1355				S		0.0	SM	Greenish Black 3/1 10GY	Silty Sand, Very Fine 20% Fines, <5% Gravel(SS), <5% Shell Wet, Loose
	2								
	4						CL	Greenish Black 2.5/1 5G	Sandy Clay 20% Fine Sand, 10% Mollusk Shell Wet, Very Soft
				S		0.0			
			80		N/A				
	6								
							CL CH	Greenish Black 3/1 10GY	Sandy Clay 10% Fine Sand, 5% Mollusk Shell Wet, Soft
	8								
	10			S		0.0			
								Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF324	Date Started: 03/27/17
Drilling Method: Vibracore	Date Completed: 03/27/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Dixon Marine

Time	**Depth (feet bgs)**	**Drive Interval**	**Recovered Interval %**	**Sample Depth**	**Well Construction**	**PID Reading (ppm)**	**USCS Soil Symbol**	**Description** Water Depth/Time: 5.9 Feet / 1430	
1430				S		0.0	SM	Greenish Black 3/1 10GY	Silty Sand 5% Silt, 5% Gravel, 10% White Mollusk Shell Gravel, Sandstone, Siltstone
	2								
	4								
			100	S	N/A	0.0			
	6						SM	Greenish Black 2.5 5GY	Silty Sand 5% Shell, 20% Silt
							CL	Greenish Black 2.5/1 10GY	Sandy Clay 5% Fine Sand
	8								
	10								
				S		0.0			
								Bottom of Boring	

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF325	Date Started: 03/28/17
Drilling Method: Vibracore	Date Completed: 03/28/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Dixon Marine

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description Water Depth/Time: 5.5 Feet / 1115	
1115				S		0.0	SM	Very Dark Greenish/Grey GL1 3/1 5GY	Silty Sand, Very Fine 20% Fines, 10% Gravel, 5% Shell Wet, Soft, Loose
	2								
	4						SC	Very Dark Greenish/Grey GL1 3/1 5GY	Clayey Sand, Very Fine 40% Fines, 15% Mollusk Shell Wet, Soft, Loose
				S		0.0			
	6		90		N/A				
	8								
	10			S		0.0			
								Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF326	Date Started: 03/28/17
Drilling Method: Vibracore	Date Completed: 03/28/17
Outer Diameter of Boring: 4”	Logged By: Victor Early
Outer Diameter of Casing: 3.8”	Drilling Subcontractor: Dixon Marine

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	**Description** Water Depth/Time: 5.5 Feet / 1205	
1205				S		0.0	GM	Dark Reddish/Brown 25YR 3/2	Silty Gravel 10% Fines, 10% Fine Sand, Loose, Glass Brick
							SM	Very Dark Greenish/Grey 3/1 5GY	Silty Sand, Very Fine 30% Fines, 10% Mollusk Shell Wet, Loose
	2								
	4								
				S		0.0			
			100		N/A				
	6								-40% Mollusk Shell-
	8								
	10			S		0.0			
								Bottom of Boring	

TETRA TECH EM, INC.

SEDIMENT BORING
AND VISUAL CLASSIFICATION LOG

YF3 Intertidal Data
Gaps Investigation

Boring Number: YF327	Date Started: 04/06/17
Drilling Method: Sonic	Date Completed: 04/06/17
Outer Diameter of Boring: 4"	Logged By: Victor Early
Outer Diameter of Casing: 3.8"	Drilling Subcontractor: Cascade

Time	Depth (feet bgs)	Drive Interval	Recovered Interval %	Sample Depth	Well Construction	PID Reading (ppm)	USCS Soil Symbol	Description	
1030				S		39.2	GM	Grey/Dark Grey/Black 1GLEY 4/1	Silty Sandy Gravel 10% Sand, 10% Fines Med-dense, Sub round, Moist, Petroleum Stain
			90						
	2								
							SM SP	Very Dark Grey GL1 3/1	Silty Sand, Fine-Very Fine 10% Gravel, 10% Fines Mollusks
			80						
	4								↑
				S	N/A	33.8			
	6								-Petroleum Odor-
			90						
	8								↓
	10			S		60.4			
								Bottom of Boring	

B-4 Daily Summary Reports

DAILY PROGRESS REPORT

Site YF3
Former Naval Station Treasure Island
San Francisco, CA

Contract	N62583–11–D–0515
Task Order	0103
Project Location	Yerba Buena Island, Site YF3
Date	02/03/2017
Report Number	001
Project Manager – Navy	Mukesh Mehta
Project Manager – Battelle	Andrew Bullard

Activities Performed 02/03/2017

- Kickoff meeting in Building 1
- Utility location

Other Related Activities

- None

Orders/Directives/Notices

- None

Activities Planned for Week Ending 02/10/2017

- Sample shipping of pore water samples collected by SPAWAR at 20 locations.

Site YF3 Staffing

- Katie Henry – Battelle Team Technical Lead (Tetra Tech)
- Dayna Aragon – Battelle Team SSSO (Tetra Tech)
- Cynthia Breene – Battelle Team SHSO (Tetra Tech)
- Jim Leather – SPAWAR (work conducted under separate contract)
- Stefan Burns – Subtronic (subcontractor – utility location)

Site YF3 Navy and Visitor Log

- Tom Ivey – Navy Caretaker Site Office

Photograph 1. Utility location of high voltage line at Site YF3.

Photograph 2. Utility marking of high voltage line on rock at Site YF3.

DAILY PROGRESS REPORT
Site YF3
Former Naval Station Treasure Island
San Francisco, CA

Contract	N62583–11–D–0515
Task Order	0103
Project Location	Yerba Buena Island, Site YF3
Date	03/27/2017
Report Number	002
Project Manager – Navy	Mukesh Mehta
Project Manager – Battelle	Andrew Bullard

Activities Performed 03/27/2017

- Conducted kickoff meeting in Building 1
- Collected sediment at offshore sediment sampling locations YF322, YF323, and YF324.

Other Related Activities

- IDW management – stored in Building 96.

Orders/Directives/Notices

- None

Activities Planned for Week Ending 03/31/2017

- Conduct sediment sampling at offshore locations

Activities Planned for Week Ending 04/07/2017

- Conduct sediment sampling at onshore locations

Site YF3 Staffing

- Katie Henry – Battelle Team Technical Lead (Tetra Tech)
- Dayna Aragon – Battelle Team SSSO (Tetra Tech)
- Victor Early – Battelle Team Geologist (Tetra Tech)
- Andy Bullard – Battelle Team Project Manager (Battelle)

Site YF3 Navy, Subcontractor, and Visitor Log

- Tom Ivey – Navy Caretaker Site Office (participated in kickoff meeting only)
- Kalloch Fox – Dixon Marine Services
- Jeff Haran – Dixon Marine Services
- Ethan Livingston – Dixon Marine Services

Photograph 1. Site YF3 from the boat during high tide.

Photograph 2. Retrieving the sediment sample at location YF322 using Vibracore technology from the sampling barge.

Photograph 3. Labelling the retrieved sediment core at location YF322.

DAILY PROGRESS REPORT

Site YF3
Former Naval Station Treasure Island
San Francisco, CA

Contract	N62583–11–D–0515
Task Order	0103
Project Location	Yerba Buena Island, Site YF3
Date	03/28/2017
Report Number	003
Project Manager – Navy	Mukesh Mehta
Project Manager – Battelle	Andrew Bullard

Activities Performed 03/28/2017

- Collected sediment at offshore sediment sampling locations YF325, YF326, and YF314A.
- Attempted to collect sediment core at location YF310; substrate was too rocky for Vibracore to penetrate surface at proposed location and in the surrounding area.

Other Related Activities

- IDW management – stored in Building 96.

Orders/Directives/Notices

- None

Activities Planned for Week Ending 03/31/2017

- None

Activities Planned for Week Ending 04/07/2017

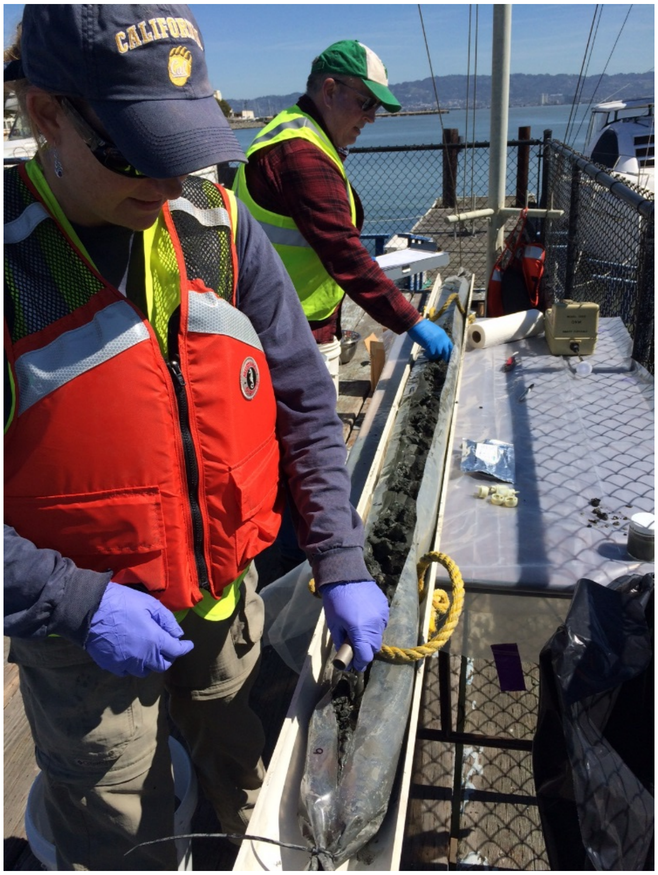
- Conduct kickoff meeting for onshore sampling phase (Monday 04/03/2017).
- Conduct sediment sampling at 10 onshore locations (beginning Tuesday 04/04/2017).

Site YF3 Staffing

- Katie Henry – Battelle Team Technical Lead (Tetra Tech)
- Dayna Aragon – Battelle Team SSSO (Tetra Tech)
- Victor Early – Battelle Team Geologist (Tetra Tech)
- Andy Bullard – Battelle Team Project Manager (Battelle)

Site YF3 Navy, Subcontractor, and Visitor Log

- Mukesh Mehta – Navy RPM (2pm – 3pm)
- Kalloch Fox – Dixon Marine Services
- Jeff Haran – Dixon Marine Services
- Ethan Livingston – Dixon Marine Services



Photograph 1. Logging cores and collecting Encore samples in sediment core YF325.

Photograph 2. Homogenizing sediment from all three depth intervals.

Photograph 3. Decontaminating the homogenization bowls.

DAILY PROGRESS REPORT

Site YF3
Former Naval Station Treasure Island
San Francisco, CA

Contract	N62583–11–D–0515
Task Order	0103
Project Location	Yerba Buena Island, Site YF3
Date	04/04/2017
Report Number	004
Project Manager – Navy	Mukesh Mehta
Project Manager – Battelle	Andrew Bullard

Activities Performed 04/04/2017

- Conducted kickoff meeting for onshore sampling in Building 1
- Mobilized Sonic drill rig to Site YF3 using barge.

Other Related Activities

- None

Orders/Directives/Notices

- None

Activities Planned for Week Ending 04/07/2017

- Conduct sediment sampling (samples for chemistry, bioassays, and petroleum fingerprinting) at onshore locations
- Collect pore water at 5 feet below surface at petroleum fingerprinting locations

Activities Planned for Week Ending 04/14/2017

- None

Site YF3 Staffing

- Katie Henry – Battelle Team Technical Lead (Tetra Tech)
- Dayna Aragon – Battelle Team SSHO (Tetra Tech) (via phone)
- Victor Early – Battelle Team Geologist (Tetra Tech)
- Shawn Majors – Battelle Team Project Manager (Battelle)

Site YF3 Navy, Subcontractor, and Visitor Log

- Tom Ivey – Navy Caretaker Site Office
- Mukesh Mehta – Navy RPM (via telephone)
- Kalloch Fox – Dixon Marine Services
- Jeff Haran – Dixon Marine Services
- Ethan Livingston – Dixon Marine Services

- Brett Arenas – Driller (Cascade Drilling)
- Gustavo Bustamonte – Driller (Cascade Drilling)
- Cornelio Mendoza – Driller (Cascade Drilling)

DAILY PROGRESS REPORT

Site YF3
Former Naval Station Treasure Island
San Francisco, CA

Contract	N62583–11–D–0515
Task Order	0103
Project Location	Yerba Buena Island, Site YF3
Date	04/05/2017
Report Number	005
Project Manager – Navy	Mukesh Mehta
Project Manager – Battelle	Andrew Bullard

Activities Performed 04/05/2017

- Collected sediment for bioassay samples.
- Collected sediment cores at locations YF307, YF310, and YF319 using Sonic drill rig. Had poor recovery at YF310 (did not recover 5-9 foot interval); will return to obtain it on 04/06/2017 if time permits.

Other Related Activities

- None

Orders/Directives/Notices

- None

Activities Planned for Week Ending 04/07/2017

- Conduct sediment sampling (samples for chemistry, bioassays, and petroleum fingerprinting) at onshore locations.
- Collect pore water at 5 feet below surface at petroleum fingerprinting locations using Hydropunch technology on Sonic drill rig.

Activities Planned for Week Ending 04/14/2017

- None

Site YF3 Staffing

- Katie Henry – Battelle Team Technical Lead (Tetra Tech)
- Dayna Aragon – Battelle Team SSSO (Tetra Tech) (via phone)
- Victor Early – Battelle Team Geologist (Tetra Tech)
- Shawn Majors – Battelle Team Project Manager (Battelle)

Site YF3 Navy, Subcontractor, and Visitor Log

- Ethan Livingston – Dixon Marine Services
- Nathan Mason – Dixon Marine Services

- Jeff Wanner – Dixon Marine Services
- Brett Arenas – Driller (Cascade Drilling)
- Gustavo Bustamonte – Driller (Cascade Drilling)
- Cornelio Mendoza – Driller (Cascade Drilling)

Photograph 1. Marking and staking sampling locations at Site YF3.

Photograph 2. Collecting the sediment sample for bioassays (0 to 1 feet below surface) at location YF315.

Photograph 3. Collecting sediment core with Sonic drill rig at location YF307.

DAILY PROGRESS REPORT
Site YF3
Former Naval Station Treasure Island
San Francisco, CA

Contract	N62583–11–D–0515
Task Order	0103
Project Location	Yerba Buena Island, Site YF3
Date	04/05/2017
Report Number	006
Project Manager – Navy	Mukesh Mehta
Project Manager – Battelle	Andrew Bullard

Activities Performed 04/06/2017

- Collected additional sediment for bioassay samples.
- Collected sediment cores at locations YF304, YF308, YF311, YF312, YF315, YF321, and YF327 using Sonic drill rig.
- Processed, logged, and collected samples from sediment cores YF307, YF308, YF310, YF311, YF312, YF315, and YF319.
- Collected pore water samples at petroleum fingerprinting locations YF304 and YF308 at 5 feet below sediment surface.

Other Related Activities

- None

Orders/Directives/Notices

- None

Activities Planned for Week Ending 04/07/2017

- Process, log, and collect remaining cores (YF304, YF321, and YF327) and ship all samples to laboratories.

Activities Planned for Week Ending 04/14/2017

- Demobilization of Sonic drill rig.

Site YF3 Staffing

- Katie Henry – Battelle Team Technical Lead (Tetra Tech)
- Dayna Aragon – Battelle Team SSSO (Tetra Tech) (via phone)
- Victor Early – Battelle Team Geologist (Tetra Tech)
- Shawn Majors – Battelle Team Project Manager (Battelle)

Site YF3 Navy, Subcontractor, and Visitor Log

- Jeff Haran – Dixon Marine Services

- Kalloch Fox – Dixon Marine Services
- Brett Arenas – Driller (Cascade Drilling)
- Gustavo Bustamonte – Driller (Cascade Drilling)
- Cornelio Mendoza – Driller (Cascade Drilling)

Photograph 1. Site YF3 at beginning of the day, one hour after high tide.

Photograph 2. Collecting the sediment sample for bioassays (0 to 1 feet below surface) at location YF312 using the drill rig.

Photograph 3. Sieving the bioassay sediment.

Photograph 4. Collecting the pore water sample at YF308 using a bailer.

Photograph 5. Preparing to collect sediment core using hard liner at YF308.

Photograph 6. Safety skiff.

DAILY PROGRESS REPORT

Site YF3
Former Naval Station Treasure Island
San Francisco, CA

Contract	N62583–11–D–0515
Task Order	0103
Project Location	Yerba Buena Island, Site YF3
Date	04/07/2017
Report Number	007
Project Manager – Navy	Mukesh Mehta
Project Manager – Battelle	Andrew Bullard

Activities Performed 04/07/2017

- Processed, logged, and collected samples from sediment cores YF304, YF321, and YF327.
- Shipped all samples to laboratories.

Other Related Activities

- None

Orders/Directives/Notices

- None

Activities Planned for Week Ending 04/14/2017

- Demobilization of Sonic drill rig.
- Collection of IDW samples.

Site YF3 Staffing

- Katie Henry – Battelle Team Technical Lead (Tetra Tech)
- Dayna Aragon – Battelle Team SSSO (Tetra Tech)
- Victor Early – Battelle Team Geologist (Tetra Tech)
- Shawn Majors – Battelle Team Field Support (Battelle)

Site YF3 Navy, Subcontractor, and Visitor Log

- Jeff Harron – Dixon Marine Services (brief visit to pick up equipment)
- Kalloch Fox – Dixon Marine Services (brief visit to pick up equipment)

Photograph 1. Decontamination of sampling equipment in Building 96.

DAILY PROGRESS REPORT

Site YF3
Former Naval Station Treasure Island
San Francisco, CA

Contract	N62583–11–D–0515
Task Order	0103
Project Location	Yerba Buena Island, Site YF3
Date	05/04/2017
Report Number	008
Project Manager – Navy	Mukesh Mehta
Project Manager – Battelle	Andrew Bullard

Activities Performed 05/04/2017

- Collected sediment samples at location YF315 using a hand auger.
- Processed and logged samples from 0-1, 4.5-5.5, 8-9 feet bgs.
- Collected water and soil IDW samples from drums.

Other Related Activities

- None

Orders/Directives/Notices

- None

Activities Planned for Week Ending 05/05/2017

- None.

Activities Planned for Week Ending 05/12/2017

- None.

Site YF3 Staffing

- Katie Henry – Battelle Team Technical Lead (Tetra Tech)
- Dayna Aragon – Battelle Team SSSO (Tetra Tech) (via phone)
- Victor Early – Battelle Team Geologist (Tetra Tech)

Site YF3 Navy, Subcontractor, and Visitor Log

- Brett Arenas – Driller (Cascade Drilling)
- Cornelio Mendoza – Driller (Cascade Drilling)

Photograph 1. Collecting subsurface sediment samples at location YF315.

Photograph 2. Extracting subsurface sediment from hand auger barrel into bucket.