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Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3

Naval Station Treasure Island
San Francisco, California

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Prepared by:
TriEco-Tt, a Joint Venture of TriEco LLC and
Tetra Tech EM Inc.
1230 Columbia Street, Suite 1000
San Diego, California 92101

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DEPARTMENT OF THE NAVY

REVIEW AND APPROVAL

Project Manager: _____ Date: March 2015
Marcie Rash, TriEco-Tt

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ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per liter
3DVA	3-dimensional visualization and analysis
95 UCL	95 percent upper confidence limit on the arithmetic mean
API	American Petroleum Institute
AST	Aboveground storage tank
ASTM	ASTM International
ATSDR	Agency for Toxic Substances and Disease Registry
BAF	Bioaccumulation factor
Bay	San Francisco Bay
BERA	Baseline ecological risk assessment
bgs	Below ground surface
CAP	Corrective Action Plan
cm	Centimeters
CMG	Conger Moss Guiard
COPEC	Chemical of potential ecological concern
CSM	Conceptual site model
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
EqP	Equilibrium partitioning
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
FAR	Field Activities Report
FCM	Food-chain model
FWS	U.S. Fish and Wildlife Service
g/cm3	Grams per cubic centimeter
HHR	Human Health Risk
HQ	Hazard quotient
HMW	High molecular weight
ITRC	Interstate Technology Research Council

ACRONYMS AND ABBREVIATIONS (CONTINUED)

KCH	CH2M Hill Kleinfelder Joint Venture
kg/day	Kilograms per day
KM	Kaplan-Meier
LC_{50}	Concentration lethal to 50 percent of the test population
LMW	Low molecular weight
LNAPL	Light non-aqueous phase liquid
mg/kg	Milligrams per kilogram
mg/kg-day	Milligrams per kilogram per day
MTBE	Methyl tertiary butyl ether
NAPL	Non-aqueous phase liquid
NAVSTA TI	Naval Station Treasure Island
Navy	Department of the Navy
NOAA	National Oceanic and Atmospheric Administration
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	Polycyclic aromatic hydrocarbon
PAL	Project action limit
PRC	Preliminary remediation criteria
PRC ECO	Preliminary remediation criteria for ecological receptors developed for Treasure Island
RAIS	Risk Assessment Information System
RI	Remedial Investigation
SLERA	Screening-level ecological risk assessment
State Water Board	California State Water Resources Control Board
SUF	Site use factor
SVOC	Semivolatile organic compound
Tetra Tech	Tetra Tech EM Inc.
TI	Treasure Island
TMZ	Tidal mixing zone
TPH	Total petroleum hydrocarbons
TPH-diesel	Total petroleum hydrocarbons-diesel range organics
TPH-gasoline	Total petroleum hydrocarbons-gasoline range organics
TPH-motor oil	Total petroleum hydrocarbons-motor oil range organics

ACRONYMS AND ABBREVIATIONS (CONTINUED)

TRV	Toxicity reference value
UCL	Upper confidence limit
USPHS	U.S. Public Health Service
UST	Underground storage tank
VI	Vapor intrusion
VOC	Volatile organic compound
Water Board	San Francisco Regional Water Quality Control Board
WBC	Wood Biological Consulting
WHO	World Health Organization
YBI	Yerba Buena Island

EXECUTIVE SUMMARY

This report presents the methodology and results of the screening-level ecological risk assessment (SLERA) and risk refinement conducted for Site YF3 on Yerba Buena Island (YBI) which is part of former Naval Station Treasure Island (NAVSTA TI) (Figure 1). The purpose of the SLERA was to evaluate whether chemicals of potential ecological concern (COPEC) at Site YF3 pose unacceptable risk to aquatic receptors, benthic invertebrates, and upper-trophic-level species. Site YF3 was designated as a petroleum site to be addressed under California underground storage tank (UST) regulations (Title 23 of the California Code of Regulations, Article 11, 2720) (Tetra Tech EM Inc. [Tetra Tech] 2003). This report also presents an analysis of whether the site presents a threat to human health, safety and the environment according to the "Low-Threat Underground Storage Tank Closure Policy," criteria for site closure (State Water Resources Control Board [State Water Board] 2012).

OVERVIEW OF NAVY POLICY FOR CONDUCTING ECOLOGICAL RISK ASSESSMENTS

Department of the Navy (Navy) policy for conducting ecological risk assessment's (ERA) 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 – baseline environmental risk assessment (BERA), and Tier 3 – Evaluation of remedial alternatives.

The Tier 1 SLERA corresponds to Steps 1 and 2 of the U.S. Environmental Protection Agency (EPA) guidance (EPA 1997, 2001). Sites identified in Tier 1 as posing potential unacceptable risks proceed to a Tier 2 BERA, which corresponds to Steps 3 to 7 of the EPA guidance. The Tier 2 BERA—more rigorous and much less conservative than the Tier 1 SLERA—begins by refining conservative exposure assumptions employed in Tier 1 and recalculating risk estimates. This refinement step is referred to as Step 3a (Navy 2004). Steps 1 and 2 of the Tier 1 SLERA are discussed below.

Per Navy guidance, the primary objectives of the two steps of a Tier 1 SLERA (Navy 1999, 2004) are:

- Step 1 – identify complete exposure pathways between chemicals and selected ecological receptors at the site.
- Step 2 – characterize risks using screening ecotoxicity estimates and conservative exposure assumptions for those chemicals for which complete pathways are identified.

Each step uses existing data and conservative assumptions regarding contaminant exposure.

Two decision criteria control the outcome of the Tier 1 SLERA (Navy 1999, 2004): (1) existence of a complete exposure pathway from the chemical to the receptor, and (2) chemical concentrations or doses that exceed the screening criteria used for comparison. If both criteria are met, either a Tier 2 evaluation or a remediation is initiated. No further action is

warranted if only one of the criteria is met. If the data evaluated in Steps 1 and 2 indicate risk to receptors at the site, the Navy will initiate the risk refinement step (Step 3a) of the BERA.

TIER 1 SLERA STEP 1: PROBLEM FORMULATION AND EXPOSURE PATHWAY EVALUATION

The Step 1 evaluation for Site YF3 includes an examination of the environmental setting, review of previous investigations, assessment of potential for presence and migration of light non-aqueous phase liquid (LNAPL), and development of an ecological conceptual site model (CSM). The CSM describes known and potential stressors, evaluates potential exposure pathways, discusses chemical fate and transport, and identifies assessment and measurement endpoints.

Environmental Setting and Site Background

NAVSTA TI is in San Francisco Bay (Bay), midway between San Francisco and Oakland, California, and consists of two contiguous islands: Treasure Island (TI), a 397-acre manmade island, and YBI, a 160-acre natural island (Tetra Tech 2003; Seifel Consulting Inc. 2011). While YBI has some areas of undeveloped habitat, these are of modest size and support a relatively limited group of fauna (Conger Moss Guiard [CMG], Environmental Science Associates [ESA], and Wood Biological Consulting [WBC] 2009). Site YF3 is on the north shore of YBI, adjacent to Clipper Cove, a part of the Bay (Figure 1). Site YF3 primarily comprises a rocky tidal mixing zone (TMZ) area with a steep vegetated slope at the base of a retaining wall. As shown on Figures 2 and 3, Site YF3 also includes a paved road, North Gate Road, located above the narrow shoreline (Tetra Tech 2003).

Site YF3 is the location of two former piers used for marine vessel oil transfer, refueling activities, and garbage disposal. It included former Building 214 (heating plant), which contained a 10,000-gallon aboveground storage tank (AST) identified as AST 214 (Figures 4 and 5), which was reported to be used for "diesel fuel" (Tetra Tech 2003). Building 213, at the southeastern end of Site YF3, was used as a library, recreation building, storage area, and most recently as a fire station (Environmental Resources Management-West, Inc. [ERM-West] 1995) (Figure 2). Former Building 245 (earlier identified as 144) was used by the Navy as a trash and laundry facility (Navy 1996). Portions of former fuel lines F01 and F03 within this site appear to have been connected at one time to former AST 214, Former fuel line F03 was also associated with Building 213 and a former 550-gallon AST (AST 213), which was reported to be used for "diesel" (Tetra Tech 2003; ERM-West 1995).

Previous Investigations of Site YF3

Previous field investigations of the nature and extent of petroleum hydrocarbon contamination in saturated zone soil and groundwater (possibly originating from leaks in fuel lines F01 and F03 and ASTs 213 and 214) have been summarized in previous reports (Tetra Tech 2003; CH2M Hill Kleinfelder Joint Venture [KCH] 2013). Although the area of contamination around former AST 214 is within the TMZ, previous reports referred to all samples collected at the site, regardless of whether they were terrestrial soil or sediment from the TMZ, as "soil". The 2003 Corrective Action Plan (CAP) recommended additional sampling to better define the extent of

contamination (Tetra Tech 2003). The Final Field Activity Report (FAR) summarized the field activities and results of March 2012 sampling, and recommended a SLERA to determine if Site YF3 is a low-risk fuel site and a good candidate for closure, or whether additional investigation and possible corrective action must be considered (KCH 2013).

Evaluation of LNAPL Potential at Site YF3

A quantitative assessment of potential presence of LNAPL was conducted to support the SLERA. The evaluation included several supporting lines of evidence, including geologic, hydrogeologic, and marine influences; data regarding total petroleum hydrocarbons (TPH) in soil; and general LNAPL fate and transport mechanisms within shallow subsurface and TMZ environments. Based on site conditions and detections of TPH (TPH-diesel, TPH-gasoline, and TPH-motor oil), the areal and vertical extents of petroleum hydrocarbon contamination appear to be very limited. Several lines of evidence indicate low potential for presence of LNAPL at the site, and even less potential for migration of any LNAPL that may be present.

Identification of Chemicals of Potential Ecological Concern

Data used to conduct the SLERA included (1) reported concentrations of chemicals in shallow sediment (0 to 2 feet below ground surface [bgs]), as this is the sediment to which ecological receptors are most likely exposed; and (2) all groundwater data acquired at Site YF3. The data are primarily discussed and interpreted as derived from "sediment" rather than "soil" in the SLERA because the area of contamination around former AST 214 is within the TMZ rather than terrestrial habitat. All detected chemicals were retained as COPECs except for: TPH and volatile organic compounds (VOC) 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 have been established and little toxicity data are available; however, polycyclic aromatic hydrocarbons (PAH), 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.

Ecological Conceptual Site Model

The ecological CSM (Figure 8) is a framework for relating ecological receptors to contaminated media. The CSM includes the following components:

- Stressors – Chemical stressors in sediment and groundwater at Site YF3 were identified as COPECs for evaluation in this SLERA based on data acquired during previous investigations.
- Fate and Transport of Chemicals – Chemical concentrations in sediment may affect benthic invertebrates, birds, and mammals. Chemicals in groundwater may impact aquatic life if they migrate to a point of exposure in the Bay.
- Exposure Pathways and Routes – Via sediment and groundwater at the site, a chemical may travel from the source to an ecological receptor.

- Assessment and Measurement Endpoints – Assessment endpoints are environmental characteristics that, if significantly impaired, would indicate need for action by risk managers. Assessment endpoints were selected based on trophic levels expected to be present and potentially impacted by Site YF3, and include protection of (1) aquatic life, (2) benthic invertebrates, (3) invertivorous birds, (4) carnivorous birds, and (5) omnivorous mammals. Measurement endpoints correlate directly with one of the defined assessment endpoints, and are based on mechanisms of toxicity presented in the available literature.

Outcome of Exposure Pathway Evaluation (Step 1)

Potentially complete exposure pathways exist for transport of chemicals from sediment to ecological receptors onshore, and from groundwater to aquatic life at the point of exposure in the Bay. Therefore, potential toxicity to ecological receptors was assessed in Step 2 of the SLERA.

TIER 1 SLERA STEP 2: EXPOSURE ESTIMATION AND RISK CALCULATION

Aquatic life (organisms that live in the water column) was assumed exposed to the maximum concentration of each COPEC detected in groundwater at the site. These concentrations of COPECs were compared to toxicity-based surface water screening criteria for protection of aquatic life.

For benthic invertebrates (living in or on the bottom sediments of a water body), maximum concentrations of chemicals at each site were compared to toxicity-based benchmarks for benthic invertebrates (effects range-low [ER-L] and effects range-median [ER-M]) (Long and Morgan 1991; Long and others 1995; Long, Field, and MacDonald 1998).

The evaluation of risk to birds and mammals was based on selected assessment and measurement endpoints. Food chain models (FCM) were used to assess exposures of birds and mammals to chemicals ingested in food or incidentally during other activities (Pascoe, Blanchett, and Linder 1996). Potential reproductive or physiological effects were evaluated by comparing estimated daily doses with literature-derived toxicity reference values (TRV).

Outcome of the Risk Estimation (Step 2)

The SLERA indicated that maximum concentrations of several COPECs at Site YF3 pose potential risks to aquatic life, benthic invertebrates, and birds based on the conservative assumptions of the SLERA. These COPECs are further evaluated in the Step 3a risk refinement. The following is a list, for each assessment endpoint, of COPECs identified by exceedances of hazard quotients (HQ), and default COPECs so designated because of lack of established benchmarks or TRVs.

Tier 1 SLERA Results Summary

Assessment Endpoint	COPECs Based on HQs > 1.0	Default COPECs Based on Lack of Benchmark or TRV
Aquatic Life	Carbon Disulfide, TPH-diesel	NA
Benthic Invertebrates	Total HMW PAHs. Total LMW PAHs, Total PAHs	TPH-diesel, TPH-gasoline, TPH-motor oil, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbezene, 2-Butanone, 4-Isopropyltoluene, Acetone, Bromomethane, Carbon Disulfide, Chloromethane, Ethylbenzene, Isopropylbenzene, M-and P-Xylene, Methylene Chloride, N-Butylbenzene, O-Xylene, Propylbenzene, Sec-Butyl Benzene, Toluene
Birds	NA	Total HMW PAHs, Total LMW PAHs
Mammals	NA	NA

Notes:

COPEC	Chemical of potential ecological concern	NA	Not applicable
HMW	High molecular weight	PAH	Polycyclic aromatic hydrocarbon
HQ	Hazard quotient	TPH	Total petroleum hydrocarbons
LMW	Low molecular weight	TRV	Toxicity reference value

TIER 2 BERA STEP 3a RISK REFINEMENT

To identify COPECs that may require remedial action or further evaluation in a more comprehensive 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 indicate limited potential for exposure of ecological receptors to chemicals in sediment at concentrations that would cause adverse effects. None of the COPECs detected at the site are recommended for further evaluation.

LOW THREAT CLOSURE CRITERIA SUMMARY

Site YF3 exhibits characteristics very similar to those of UST sites. Low-threat closure criteria for UST sites are used to identify and close sites generally considered to "present a low threat to human health, safety and the environment" (State Water Board 2012). Site YF3 meets many of the low-threat closure criteria. In this report, the Navy presents comparisons of site characteristics with criteria for low-threat closure to support site closure decisions.

CONCLUSIONS AND RECOMMENDATIONS

Multiple lines of evidence indicate low potential for LNAPL to occur at Site YF3, that any LNAPL present would be at residual LNAPL saturation levels, and that any residual LNAPL present would not be mobile or migrating. Although no chemicals of concern for ecological receptors were identified in the SLERA and the Step 3a risk refinement conducted with the available site data, comments received on the draft report suggest there are data gaps that must be addressed with further characterization. Therefore, further characterization and evaluation of ecological risk in a BERA are recommended for Site YF3. Due to the lack of human exposure pathways, the site poses no risk to human health. There is limited site access because of the site

topography and tidal inundation, and no occupied structures are currently present or planned for construction (Treasure Island Development Authority 2011). The additional data gathered to further characterize and evaluate ecological risk at the site will also be used to further evaluate the site as a candidate for low-threat closure based on an analysis of the State Water Board low-threat closure criteria (State Water Board 2012). The Navy will coordinate with the regulatory agencies in planning for the additional data collection.

1.0 INTRODUCTION

This report presents the methodology and results of the screening-level ecological risk assessment (SLERA) and Step 3a risk refinement and an analysis of the site according to "Low-Threat Underground Storage Tank Closure Policy," criteria for site closure (State Water Resources Control Board [State Water Board] 2012). Site YF3 on Yerba Buena Island (YBI), is part of former Naval Station Treasure Island (NAVSTA TI) in San Francisco, California (Figure 1). Site YF3 was designated as a petroleum site to be addressed under California underground storage tank (UST) regulations (Title 23 of the California Code of Regulations, Article 11, 2720) (Tetra Tech EM Inc. [Tetra Tech] 2003). The SLERA and Step 3a risk refinement were performed to assess potential risks to ecological receptors associated with exposure to chemicals of potential ecological concern (COPEC). Although the site has been evaluated in previous reports, no ecological risk assessment (ERA) had been performed (Tetra Tech 2003; CH2M Hill Kleinfelder Joint Venture [KCH] 2013).

1.1 PURPOSE OF REPORT

The primary purpose of this report is to present the methodology and results of an ERA (SLERA and Step 3a risk refinement) and an analysis of the site according to the State Water Board criteria for closure as laid out by the "Low-Threat Underground Storage Tank Closure Policy" (State Water Board 2012). Although the suspected sources of contamination at Site YF3 are a former 10,000-gallon aboveground storage tank (AST) and associated former fuel lines, a comparison to the applicable low-threat UST closure criteria is provided for consideration by decision-makers and other stakeholders. Additionally addressed are concerns expressed about the nature and extent of contamination by the regulatory agencies in their reviews of the Field Activity Report (FAR) (KCH 2013). The purpose of the ERA was to evaluate whether COPECs at Site YF3 pose unacceptable risk to aquatic receptors, benthic invertebrates, and upper-trophic-level species. Representative bird and mammal species evaluated included the Spotted sandpiper (*Actitis macularius*), Great Blue Heron (*Ardea herodias*), and Raccoon (*Procyon lotor*).

1.2 ECOLOGICAL RISK ASSESSMENT APPROACH

A SLERA uses conservative assumptions and available scientific literature to evaluate potential risk to ecological receptors according to an approach consistent with Steps 1 and 2 of the eight-step process described in U.S. Environmental Protection Agency (EPA) guidance (EPA 1997, 1998; 1999a, 1999b, 2000). This approach also follows the Tier 1 approach presented in Department of the Navy (Navy) guidance for conducting ERAs (Navy 1999, 2004), and California Department of Toxic Substances Control (DTSC) guidance (DTSC 1996a, 1996b). The first two components of the DTSC process (scoping assessment and Phase I predictive assessment) are consistent with the EPA and Navy approaches. Substantive elements of the guidance provided by all three agencies were considered in the development of this SLERA. The SLERA methodology was presented to the regulatory agencies during the January 2014 Base Cleanup Team meeting to obtain agency feedback prior to writing the report

(Navy 2014). The materials presented in the meeting and the responses to regulatory agency comments on the methodology are provided in Appendix A.

A SLERA includes four primary phases: (1) problem formulation, (2) estimates of exposure, (3) evaluation of ecological effects, and (4) risk characterization. An ecological conceptual site model (CSM) is developed during the problem formulation phase to describe exposure pathways at the site, which guides selection of assessment and measurement endpoints. In the exposure assessment, conservative exposure parameters for representative receptors are identified based on information obtained from published literature and knowledge of the site. Contaminant exposure levels that represent conservative thresholds for adverse ecological effects are identified from the literature during the ecological effects evaluation. Finally, potential risks to selected assessment endpoints associated with the site are conservatively estimated during the risk characterization phase.

Per Navy guidance, the primary objective of the two steps of a Tier 1 SLERA (Navy 1999, 2004) include:

- Step 1 – identify complete exposure pathways between chemicals and selected ecological receptors at the site.
- Step 2 – characterize risks using screening ecotoxicity estimates and conservative exposure assumptions for those chemicals for which complete pathways are identified.

Each step uses existing data and conservative assumptions regarding contaminant exposure.

A scientific management decision point follows Step 2 of the SLERA. In accordance with EPA and Navy guidance (EPA 1997, 2001; Navy 1999), risk managers decide whether information gathered about preliminary risks associated with exposures is:

- Adequate to conclude that ecological risks are negligible and no additional investigation or remediation is necessary;
- Inadequate to make a decision; therefore, risk managers should request a site-specific baseline ecological risk assessment (BERA) to refine the risk estimate and reduce uncertainty associated with the SLERA; or
- Adequate to indicate potential for adverse ecological effects; therefore, risk managers should either evaluate remedial alternatives or consider a site-specific BERA to refine the risk estimate and reduce the uncertainty associated with the SLERA.

EPA guidance on conducting ERAs recommends re-evaluation of the list of COPECs during the problem formulation step of the BERA to account for site-specific and regional conditions (EPA 2001). In addition, Navy guidance (1999) specifies that an intermediate refinement step

(Step 3a risk refinement) may be conducted if the SLERA indicates unacceptable or uncertain risk. If the data evaluated in Steps 1 and 2 indicate risk to receptors at the site, the Navy will initiate the risk refinement step (Step 3a) of the BERA.

The initial step of the Tier 2 process, Step 3a risk refinement, refines the SLERA and considers less conservative and more realistic site-specific exposure assumptions in the risk calculations (EPA 1997). Refining the list of COPECs for further investigation in a BERA includes incorporating information regarding frequency and magnitudes of chemical detections, background concentrations of metals, dietary considerations, bioavailability, and additional considerations, as appropriate. The decision criteria for the SLERA should be revisited after completion of the Step 3a risk refinement (Navy 1999).

1.3 LOW THREAT CLOSURE COMPARISON APPROACH

A suspected source of petroleum contamination at the site is a former 10,000-gallon AST which was reported to be used for "diesel fuel" (Tetra Tech 2003), that appears to have been connected at one time to portions of two former fuel lines (F01 and F03), also regarded as possible sources of the contamination (Figure 2). The AST and the former fuel lines have been removed or closed in place.

While the AST was originally above ground and has since been removed, Site YF3 exhibits characteristics very similar to those of UST sites. Site YF3 fulfills many of the criteria for low-threat closure as presented by the "Plan for Implementation of Low-Threat Underground Storage Tank Closure Policy and Additional Program Improvements" (State Water Board 2012). That plan outlined the criteria for closing an UST sites considered to "present a low threat to human health, safety and the environment" (State Water Board 2012). Sites must satisfy both general and media-specific criteria in order to qualify for low-threat UST closure.

The general criteria for low threat closure include:

1. The unauthorized release is within the service area of a public water system.
2. The unauthorized release consists only of petroleum.
3. The unauthorized ("primary") release from the UST system has been stopped.
4. Free product has been removed to the maximum extent practicable.
5. A CSM that assesses the nature, extent, and mobility of the release has been developed.
6. Secondary source has been removed to the extent practicable.
7. Soil or groundwater has been tested for methyl tert-butyl ether (MTBE), and results reported in accordance with Health and Safety Code section 25296.15.

8. Nuisance as defined by Water Code section 13050 does not exist at the site (State Water Board 2012).

The media-specific criteria consist of the acceptable exposure criteria for the most common drivers of health risks, which are: groundwater, vapor intrusion (VI) to indoor air, and direct contact and outdoor air exposure (State Water Board 2012). To satisfy the criteria for groundwater, "the contaminant plume that exceeds water quality objectives must be stable or decreasing in areal extent and meet additional characteristics of one of the five classes of sites". If a site includes, or in the future could include, occupied structures, then site-specific conditions must satisfy all characteristics and criteria regarding petroleum VI to indoor air, direct contact, and outdoor air exposure outlined in State Water Board (2012).

Determination of whether a site meets the general and media-specific criteria for low-threat closure must be made by the regulatory agency responsible for issuing the closure letter (State Water Board 2012).

1.4 ORGANIZATION OF REPORT

The remainder of this report is organized as follows:

- Section 2.0 presents the problem formulation and exposure pathway evaluation for the SLERA.
- Section 3.0 presents the exposure estimation and risk characterization of the SLERA.
- Section 4.0 presents the Step 3a risk refinement (whether a Step 3a risk refinement is needed depends on results of the SLERA).
- Section 5.0 summarizes comparisons of appropriate data and information to the low threat closure criteria for Site YF3.
- Section 6.0 presents conclusions and offers recommendations for the site based on the SLERA, Step 3a risk refinement, and other lines of evidence.
- Section 7.0 includes all references.
- Figures and tables follow the reference section.

The following appendices include information supplemental to this SLERA and Step 3a risk refinement:

- Appendix A presents the scoping meeting materials and responses to agency comments.

- Appendix B contains the ecological checklist for the site.
- Appendix C describes selection of groundwater screening criteria for protection of aquatic life.
- Appendix D includes the food-chain model (FCM) dose and hazard quotient (HQ) calculations for the SLERA, and Step 3a risk refinement.
- Appendix E presents the analytical data used in this report.
- Appendix F presents the responses to regulatory agency comments on the draft report.
- Attachment 1 includes historical aerial photographs.

2.0 TIER 1 SLERA STEP 1: PROBLEM FORMULATIONS AND EXPOSURE PATHWAY EVALUATION

Primary goals of the problem formulation phase are to develop an ecological CSM and to identify the following:

- Environmental setting and chemicals known or suspected 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.
- Assessment and measurement endpoints to focus the assessment.

These bulleted items are discussed in more detail in the following subsections.

2.1 FACILITY AND SITE BACKGROUND

NAVSTA TI is located in San Francisco Bay (Bay), midway between San Francisco and Oakland, California. NAVSTA TI consists of two contiguous islands: (1) Treasure Island (TI), a 397-acre manmade island constructed in 1936 and 1937 of materials dredged from the Bay; and (2) YBI, a 160-acre natural island (Tetra Tech 2003; Seifel Consulting Inc. 2011). TI was constructed to be the site of the Golden Gate International Exposition in 1939 and 1940, and subsequently the City of San Francisco's commercial airport. In response to the Navy's request in 1941, the City of San Francisco leased and subsequently transferred NAVSTA TI to the Navy in exchange for government-owned land south of San Francisco, where San Francisco International Airport was eventually built (Tetra Tech 2003).

Military activity on YBI dates back to 1866, when the U.S. Government took possession of the island for defensive fortifications. The U.S. 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 station processed Pacific-bound and homecoming personnel, and housed training schools for Navy personnel (Tetra Tech 2003).

NAVSTA TI was an active, fully operational naval facility until 1997, with its official mission 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 the site of Navy family housing. In 1993, NAVSTA TI was designated for closure under the Defense Base Closure and Realignment Act of 1990. The base was closed on September 30, 1997, and is being transferred 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 the Bay. As shown on Figure 2, 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 tidal mixing zone (TMZ) and a small zone of shallow soil located inland of the TMZ below the retaining wall (Tetra Tech 2003) (Figure 3). A steep, thin zone of brush consisting of the Northern Coast Scrub habitat and eucalyptus trees (Conger Moss Guiard [CMG], Environmental Science Associates [ESA], and Wood Biological Consulting [WBC] 2009) is present along the margin between the base of the bluff and the TMZ. The TMZ 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 (heating plant) that dated back to 1945, and housed a 10,000-gallon diesel AST (AST 214) (Figures 4 and 5). Both the building and the AST were demolished and removed during the 1980s (Tetra Tech 2003).

Building 213, located just 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) (Figure 2). A former 550-gallon AST (AST 213) associated with the building was reported to be used for “diesel” (Tetra Tech 2003; ERM-West 1995). In addition, Building 245 (formerly 144) was used by the Navy as a trash and laundry facility; it was demolished no later than 1970 (Navy 1996).

Suspected and confirmed portions of both former fuel lines F01 and F03 within this site appear to have been connected at one time to former AST 214. Former fuel line F03 was also associated with Building 213 and former AST 213 (Tetra Tech 2003; ERM-West 1995). Between June 1997 and April 1998, approximately 220 linear feet of line F03 was removed from the eastern end of Site YF3 (KCH 2013).

2.2 ENVIRONMENTAL SETTING

It is believed that YBI was uplifted by faulting along a branch of the Hayward Fault approximately 1 million years ago. 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. YBI's climate is strongly controlled by marine influences, including frequent nightly fog (which can persist all day during the summer) and strong prevailing winds from the northwest through the Golden Gate. The island also supports many microclimates that influence assemblages of plant species (CMG, ESA, and WBC 2009).

These vegetation assemblages include a pygmy oak stand supported by thin soils over rocky substrate on the warm, wind-swept part of YBI; and taller oaks, toyons, and fern grottoes above Clipper Cove, which are sheltered from prevailing winds and receive fog drip from the surrounding eucalyptus trees (CMG, ESA, and WBC 2009). Stands of willows at the base of sandy slopes are supported by groundwater and act similar to "mangroves," dipping into the salt water. Rocky outcrops on western exposures support coastal scrub species (CMG, ESA, and WBC 2009). Site YF3 vegetation and wildlife communities are described in more detail in Section 2.2.3.

2.2.1 Geology

Three geologic units are present at YBI, two of which are present at Site YF3: (1) Landslide Debris and Fill, an artificial fill consisting of gravelly sand with silt, and (2) the underlying Franciscan Assemblage, consisting of bedrock. The Landslide Debris and Fill is the youngest geologic unit at YBI and results from downslope movement of unstable clayey, silty sand. The fill is present along the eastern shoreline (Tetra Tech 2003). The Franciscan Assemblage is interbedded sandstone and shale that forms the bedrock, which unconformably underlies the landslide debris, fill, and colluvium of YBI. The YBI Franciscan assemblage consists of shale and sandstone outcrops that trend to the southeast, northwest, and dipping northeast (Dames and Moore 1988; Tetra Tech 2003).

Several of the Site YF3 borings were drilled within the TMZ during low tides. Figures 6 and 7 present oblique views along the shoreline showing the near-vertical slope of the land, several site features, and the shallow geology at the site. At YF3, bedrock was encountered at 10 feet bgs in boring YF3HP021 (advanced within the footprint of former AST 214), at 7 feet bgs in boring YF3HP019 (near the Bay), and at a shallower 3 feet bgs in boring YF3HP022 (farther inland, 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 (Blum 1993 and Phillips and others 1992, as cited in Tetra Tech 2003). 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. 1997; Tetra Tech 2003).

Groundwater at Site YF3 was encountered in the gravelly sand in borings YF3HP018, YF3HP019, and YF3HP021 at depths ranging from 6 to 8 feet bgs (Tetra Tech 2003). Currently, no permanent monitoring wells are present at the site, but based on topography, groundwater is assumed to flow toward the Bay (Tetra Tech 2003). Tidal mixing at Site YF3 exerts an influence, but has not been quantified. A 72-hour tidal influence study conducted on TI showed that fluctuations in the groundwater level ranged from 1.81 feet within 30 feet of the Bay to 0.12 feet at inland locations 250 feet from the bay (Navy 1997; PRC Environmental Management, Inc. 1995a). Based on this information, changes in groundwater elevation at the YF3 site would be expected to be of a similar amplitude (less than 2 feet).

2.2.3 Ecology

The terrestrial vegetation on YBI consists of approximately 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). YBI has undergone extensive human habitation and disturbance, starting in 1866 when the U.S. Government took possession of YBI for defensive fortifications (Tetra Tech 2003). In addition, 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). While YBI has retained some areas of undeveloped habitat, these are of modest size and support a relatively limited group of fauna (CMG, ESA, and WBC 2009).

YBI is in the Bay, the largest estuary on the West Coast, and hundreds of thousands of birds of 281 species migrate over or near the island. At least 70 percent of these birds spend some time each year in the Bay, and reports of previous studies list the 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*) roost on the Bay Bridge and presumably use the island and surrounding waters for foraging (CMG, ESA, and WBC 2009).

As for mammals, YBI supports two small terrestrial mammal species: Botta's pocket gopher (*Thomomys bottae*), and the California ground squirrel (*Otospermophilus beecheyi*). In addition, calls from Mexican free-tailed bats (*Tadarida brasiliensis*) have been detected, and there is a year-round "haul-out" for harbor seals (*Phoca vitulina*). As for invertebrates and herpetofauna, recent 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. 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).

No special-status plants and no known breeding grounds for special-status wildlife have been documented on YBI (CMG, ESA, and WBC 2009). Plant species identified during a 2013 site visit 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*) (Appendix B). YBI provides extensive, highly diverse intertidal and offshore habitat and an assortment of ecological niches and environments (CMG, ESA, and WBC 2009). Site YF3 encompasses a rocky intertidal area and a steep vegetated slope consisting of the Northern Coast Scrub habitat and eucalyptus trees (Figure 3; Appendix B). Some documented eelgrass habitat is present within Clipper Cove (Merkel and Associates Inc. 2010). A completed ecological checklist for Site YF3 based on a literature review and site visit in 2013 is in Appendix B.

2.3 PREVIOUS INVESTIGATIONS

Previous field investigations at Site YF3 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 in 1997 and 1998 (Cal, Inc. 1998; Tetra Tech and Jonas and Associates 1999)
- Focused site characterization activities in 2000 (Tetra Tech and LFR 2000)
- Focused sampling of soil and groundwater in the area of former fuel lines and 10,000-gallon AST in 2012 (KCH 2013)

The primary objective of these investigations was to assess the nature and extent of petroleum hydrocarbon contamination in saturated zone soil and groundwater possibly resulting from leaks in fuel lines F01 and F03 and ASTs 213 and 214 (Tetra Tech 2003; KCH 2013). Although the area of contamination around former AST 214 is within the TMZ, previous reports referred to all samples collected at the site, regardless of whether they were terrestrial soil or sediment from the TMZ, as “soil”. Therefore, the summary of previous reports below and the light non-aqueous phase liquid (LNAPL) evaluation in Section 2.4 use the term “soil”.

2.3.1 Corrective Action Plan, Inactive Fuel Lines

The 2003 Corrective Action Plan (CAP) summarized field investigations from 1994-2003 to provide information on the nature and extent of petroleum contamination at the 14 inactive fuel line sites throughout NAVSTA TI (Tetra Tech 2003). The CAP also indicated whether

corrective action would be needed at each of those sites and, if so, provided evaluations of several corrective action alternatives (Tetra Tech 2003). The CAP's primary objective 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. Presence of "free product" was reported below 9 feet below ground surface (bgs) in boring YF3HP021 (Figure 5), and further investigation was recommended (Tetra Tech 2003). Based on data from investigations at the site to date, the term "free product" appears to have been used (as common at that time) to describe visible presence of residual sorbed, partially sorbed, or mobile but non-migrating petroleum contamination—not to designate confirmed, measurable quantities of migrating mobile, non-aqueous phase liquid (NAPL). This assumed meaning of the term is supported by results of a quantitative analysis performed using site analytical data to determine LNAPL saturation and recovery (Section 2.4).

In the shallow soil (0 to 6 feet bgs), total petroleum hydrocarbons (TPH) as gasoline range organics (TPH-gasoline) and diesel range organics (TPH-diesel) were detected at concentrations lower than both residential and non-residential screening criteria. TPH motor oil range organics (TPH-motor oil) were detected at concentrations lower than both residential and non-residential screening criteria in all but one shallow soil sample (from 1 to 1.5 feet bgs at YF3HP021), which had been collected within the former footprint of AST 214 (Tetra Tech 2003). The nonresidential 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-gasoline was detected in four of seven deep soil (6 to 10 feet bgs) samples, and TPH-diesel and TPH-motor oil were detected in all deep soil samples analyzed for TPH. One soil sample was analyzed for metals, but no concentrations exceeded ambient concentrations or screening criteria (Tetra Tech 2003). In addition, two soil samples were analyzed for semivolatile organic compounds (SVOC); however, no polycyclic aromatic compounds (PAH) were detected (Tetra Tech 2003).

One groundwater sample was analyzed for petroleum hydrocarbons, and TPH-diesel was the only analyte detected. No groundwater samples were analyzed for SVOCs or metals (Tetra Tech 2003).

The CAP (Tetra Tech 2003) offered the following recommendations:

- To further evaluate current presence of hydrocarbon contamination, advance a soil boring at location YF3HP021 where "free product" (as described above) was reported; if this contamination is not detected, collect a groundwater sample.
- Collect soil samples at both shallow and deeper depths down to bedrock, and analyze for purgeable TPH, extractable TPH, VOCs, and PAHs.
- Advance two to four additional borings at locations downslope of the former AST 214 location to evaluate 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 FAR summarized field activities and results of the March 2012 investigation to provide information useful for further evaluation of 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 the approved work plan and sampling and analysis plan, which stated that "The findings of soil and groundwater sampling will be used to determine if a recommendation for further action or no further actionNFA is applicable" for Site YF3 (KCH 2011). TPH concentrations reported in soil at KCHYF3-1 (Figure 5; KCH 2013) were lower than previously reported concentrations at YF3HP021 (Tetra Tech 2003). Concentrations of TPH-diesel and TPH-motor oil in soil samples collected at 2 and 5 feet bgs exceeded preliminary remediation criteria (PRC) developed for TI (Tetra Tech 2001) for ecological receptors (PRC ECO). One sample collected at 2 feet bgs (KCHYF3-3) also exceeded PRC ECO levels for TPH-gasoline. In addition, fluorene and phenanthrene were reported at concentrations at or exceeding respective nonresidential human health risk soil levels in one 5-foot-bgs soil sample (KCHYF3-3); no ecological criteria had been established for PAHs (KCH 2013). The human health screening criteria used in the FAR were nonresidential human health risk (HHR) PRCs developed for TI (Tetra Tech 2001). The project action limit (PAL) for all TPH constituents was 100 milligrams per kilogram (mg/kg) in soil, lower than the PRC ECO and PRC HHR levels (KCH 2011).

Groundwater sampling found that TPH-diesel and TPH-motor oil exceeded PRC ECO levels at three locations: KCHYF3-1, KCHYF3-2, and KCHYF3-4 (Figure 5). In soil samples, several PAHs and TPH-gasoline, TPH-diesel, and TPH-motor oil exceeded the PALs that had been established in the Sampling and Analysis Plan. Other PAHs and TPH-diesel and TPH-motor oil also exceeded PALs in groundwater samples (KCH 2013). A sheen of fuel was observed in the temporary wells; however, measurable "free product" in the water column was not detected (KCH 2013). The FAR recommended this SLERA to determine if Site YF3 is a low-risk fuel site and a good candidate for closure, or whether additional investigation and possible corrective action need to be considered (KCH 2013).

2.4 EVALUATION OF LIGHT NON-AQUEOUS PHASE LIQUID POTENTIAL AT SITE YF3

The potential presence of LNAPL was evaluated at the site, based on observations during previous field investigations and historical presence of ASTs and associated piping. Samples have been collected in and around the former potential source areas, typically at and downgradient of the former location of AST 214. In previous investigations, visible evidence of contamination was observed during soil sampling at one location (YF3HP021) (Tetra Tech 2003). A sheen was reported in five temporary wells during more recent groundwater sampling activities (KCH 2013). Based on site conditions and detections of TPH at the site, potential areal and vertical extents of impact appear to be very limited.

Petroleum products stored and transferred at Site YF3 are 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 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 [API] 2001).

This section assesses potential for presence of LNAPL, potential for migration of LNAPL, and associated risks. Several lines of evidence to support the evaluation are presented below, including: (1) geologic, hydrogeologic, and marine influences; (2) TPH soil data; and (3) LNAPL fate and transport mechanisms generally known from industry knowledge and academic research.

2.4.1 Geologic, Hydrogeologic, and Marine Influences

As indicated in Section 2.2.1, the former sources of hydrocarbon contamination were located along the tidally influenced beach area in the northern portion of the island. Boring logs for the site indicate that the overburden deposits in this area are composed of sands with varying percentages of silt and gravel. Gravelly soils have also been occasionally identified at the sample depth intervals. Although no site-specific testing has occurred at Site YF3, based on identified materials, hydraulic conductivity of the soils is likely on the order of 0.001 centimeters per second (Freeze and Cherry 1979).

The groundwater bearing zone at this location appears to be unconfined with no indications of confining influences from finer-grained geologic units. The magnitude of the hydraulic gradient is relatively low, which is consistent with similar sites within coastal groundwater discharge areas. Because tides fluctuate within the range of 2 to 6 feet at YBI (National Oceanic and Atmospheric Administration [NOAA] 2014), potential for substantial historical pore volume flushing is high given the site's location within the TMZ.

2.4.2 TPH Soil Data Analysis

Thirty-nine soil samples have been collected within 0 to 10 feet bgs and analyzed for TPH via EPA Method 8015M (Appendix E). There are fewer than 39 total samples for each analyte in the table below because in one of the samples only TPH-gasoline was measured, while in three other samples TPH-gasoline was not measured at all; hence there are only 36 samples analyzed for TPH-gasoline, and 38 for both TPH-diesel and TPH-motor oil. The analyses have consisted of speciation of carbon ranges or "fractions" for TPH-gasoline, TPH-diesel, and TPH-motor oil. In a similar number of analyses, TPH-gasoline was reported about half as frequently as the other fractions.

Total Petroleum Hydrocarbon Results in Soil and Sediment for Site YF3

TPH Fraction	Detection Frequency	Mean Concentration (mg/kg)	95 UCL* (mg/kg)	Maximum Concentration (mg/kg)
TPH-gasoline	16/38	34.9	217	450
TPH-diesel	35/36	1,590	6,010	10,000**
TPH-motor oil	31/38	1,220	2,570	10,000

Notes:

* One-sided 95 percent upper confidence limit (95 UCL) of the mean.

** Detected at two locations (YF3HP019 and YF3HP02).

mg/kg Milligrams per kilogram

TPH Total petroleum hydrocarbons

The specific carbon ranges for each analysis are assumed not to overlap and are likely to include C5-C12 for TPH-gasoline, C13-C22 for TPH-diesel, and C23-C44 for TPH-motor oil. (Note: these ranges vary on a laboratory-specific basis, and therefore are presented as a reference.) Statistical summaries for soil (0 to 2 feet, 0 to 5 feet, and 0 to 10 feet bgs) and groundwater data are presented in Tables 1 through 4. The greater frequency and magnitude of detections of middle and heavy range fractions (TPH-diesel and TPH-motor oil) 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.

Regarding previous observations of "free product" and a sheen in 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 will not enter a well and are retained in the soil by capillary pressure and interfacial tension.

- Mobile – LNAPL concentrations are above residual saturation levels, so LNAPL can 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 plume 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 plume extent.

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 International [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 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 TMZ 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

Although overlap of the TPH fractions is likely, which would result in overestimation of a TPH "total," the calculations generate conservative LNAPL saturation percentages. To be additionally conservative, all values not measured (i.e., not resulting from analyses) were assumed to be 100 mg/kg, and "less than" values were considered equal to their respective detection limits.

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:

- Fuel oil density = 0.87 (conservatively assumed to be No. 2 fuel oil, which has a carbon range similar to diesel fuel) (API 2004)

- Soil bulk density = 1.69 g/cm^3 (sands and gravelly sands, calculated based on estimated rock density of 2.8 g/cm^3 and a porosity of 0.4)

- Total soil porosity = 0.43 (sands and gravelly sands) (API 2004)

Table 5 lists the compiled original data from the sampling events that have been used to estimate the residual LNAPL saturation. Table 6 lists the same data; however, the non-numerical values (values listed as less than the detection limit) are replaced by surrogate assumed values, and calculated percent LNAPL saturations are listed. Based on uniformly applied assumptions, the greater the TPH concentrations, the greater the residual LNAPL saturation.

To evaluate potential for observation of mobile LNAPL in a hypothetical monitoring well, or for residual LNAPL to remain sorbed to soil 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.

As shown in Table 6 and described below, residual LNAPL saturation values equal to or greater than the calculated water residual saturation value of 6.5 percent were calculated for only two samples at YF3. 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 (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 TMZ 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. However, 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 TMZ, lack of

significant quantity of residual LNAPL, salt water intrusion mixing, and absence of a LNAPL hydraulic head.

2.4.3 Residual LNAPL Fate and Transport Mechanisms

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 TMZ 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.

Several lines of evidence indicate low potential for LNAPL to occur at the site and even less chance that any residual LNAPL present would be migrating. 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	• Typically, the C 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. • 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 saturation is within the range of likely residual water saturations and does not exceed the range's higher end value.
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 TMZ has removed the mobile fraction of LNAPL. • 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.

2.5 ECOLOGICAL CONCEPTUAL SITE MODEL

The ecological CSM (illustrated on Figure 8) indicates exposure pathways to be evaluated in the SLERA, 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.

2.5.1 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. Samples collected at Site YF3 were analyzed for TPH, PAHs, volatile organic compounds (VOC), SVOCs, and metals. The suspected sources of contamination were the former AST and fuel lines; however, no spill was reported. Had the tank or pipeline leaked under pressure, a substantial amount of contamination could have remained at the site; however, the most recent data indicate no presence of free product (measurable quantity of migrating, mobile NAPL) at the site, and no sheen or odor was detected at the sediment surface during a 2013 site walk (Appendix B).

2.5.2 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, chemicals in the bodies of mobile receptors such as migrating birds and far-ranging predators 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 SLERA focuses on chemicals in the environment that are bioavailable or potentially bioavailable to receptors.

2.5.3 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, groundwater, air, and food chain transfer.

Potential exposure pathways for ecological receptors at the site are shown on Figure 8. Sediment and groundwater were considered the most important exposure media at Site YF3. Chemicals in sediment may ingested or transferred via the food chain to ecological receptors, while chemicals in groundwater may enter Clipper Cove and the Bay, where aquatic receptors could be exposed. Based on a literature review and site visit (Appendix B), ecological exposure to chemicals at the site is relatively low because receptors are limited within the cobbled shoreline and contamination is found at greater depths in sediment than most receptors would reach.

Exposure routes, or the point of entry of a chemical into a receptor, may include inhalation, 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 omnivores and carnivores. 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 was considered the predominant exposure pathway for birds and mammals. Birds and mammals 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 and mammals. The dose assessment for higher-trophic-level receptors such as birds and mammals assumed that ingestion of contaminated prey and sediment was the dominant exposure route and that the contributions of other exposure routes were negligible (Suter 1993). Bioaccumulation factors (BAF) were used to estimate the chemical burden in prey tissues for each of the chemicals based on site sediment concentrations. BAFs describe bioaccumulation in terms of the ratio between the concentration of a substance in an organism caused by chemical uptake and the concentration in the surrounding environment. Maximum sediment-to-biota bioaccumulation models for invertebrates and fish from the Navy BERA for Pearl Harbor (Earth Tech, Inc. 2006) were used to estimate the concentration in prey. In addition, concentrations of PAHs detected in invertebrate and fish tissue collected along the southern shore of Clipper Cove beach during the Offshore Operable Unit (OU) Remedial Investigation (RI) (Tetra Tech 2001) were used in parallel with bioaccumulation factors. BAFs used in this SLERA are discussed in more detail in Section 3.3.1.

2.5.4 Assessment and Measurement Endpoints

EPA defines assessment endpoints as “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 impaired, would indicate 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 the site and a characteristic of the entity to protect, such as reproductive success or production per unit area.

The focus during this assessment was on endpoints 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 receptors 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 was considered an ecological value to be protected.

- **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 was considered an ecological value to be protected.

- **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 was considered an ecological value to be protected.

- **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 was considered an ecological value to be protected.

- **Protection and maintenance of omnivorous mammals typical to the area.** Omnivorous mammals provide a major source of food for upper-trophic-level organisms. Adverse effects on these secondary consumers could reduce the amount of food available to higher-trophic-level organisms. Therefore, maintenance of omnivorous mammals was considered an ecological value to be protected.

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 literature on mechanisms of toxicity.

Each measurement endpoint was selected based on the species or communities present or potentially present at Site YF3, adequacy of information regarding the specific endpoint based on literature research, and ability of the endpoint to suggest information about the related assessment endpoint.

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 groundwater with toxicity-based screening levels for the protection of aquatic life.** Chemical concentrations in groundwater were compared to screening criteria for the protection of aquatic life (Appendix C; Section 3.1). Potential risk to aquatic receptors was indicated where concentrations of COPECs in site groundwater exceeded the screening criteria.

- **For benthic invertebrates, comparison of concentrations of chemicals in soil with toxicity-based benchmarks for benthic invertebrates.** Chemical concentrations in sediment were compared with 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 and others 1995; Long, Field, and MacDonald 1998). The ER-L represents the lower 10th percentile of the effects data. Potential risk to benthic invertebrates was indicated where concentrations of COPECs in site sediment exceeded the ER-L (Section 3.2).

- **For birds and mammals, reproductive or physiological effects were evaluated using the HQ approach.** Potential reproductive or physiological effects were evaluated using literature-derived toxicity reference values (TRV) (Section 3.3). Chemicals without TRVs were evaluated qualitatively in Step 3a. Conservative daily doses were modeled based on chemical concentrations at the site and information on natural history for birds and mammals. HQs were developed by dividing the estimated daily dose for each chemical by the high and low TRVs.

The following receptors were selected 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.

- The raccoon (*Procyon lotor*) was selected to represent omnivorous mammals because it is one of the few mammals known to occupy the island (CMG, ESA, and WBC 2009) and the only resident mammal that might forage in the area of contamination at Site YF3. No other omnivorous or carnivorous mammals are known residents of YBI or are expected to forage significantly within the shoreline area of Site YF3.

Additional information on the rationale for selecting the assessment and measurement endpoints for the SLERA is provided in Appendix A.

2.6 SELECTION OF DATA SET AND CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN

Summary statistics were calculated for each detected analyte, and included detection frequency, arithmetic mean, minimum and maximum reported values, and 95 percent upper confidence limit on the arithmetic mean (95 UCL). In some cases, the limited number of samples or detections precluded the calculation of a 95 UCL. Summary statistics for available sediment and groundwater data are provided in Tables 1 through 4, and are described below. Selection of COPECs in sediment and groundwater to be evaluated in the SLERA are also described below. Appendix E presents the analytical data for Site YF3.

In addition to statistical analyses, a 3-dimensional visualization and analysis (3DVA) of the available data was performed to evaluate the analytical data 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 interpolating the data using C Tech Development Corporation's Mining Visualization System software.

The 3DVA was based on the following five primary data sets: (1) total TPH-diesel analytical soil data, (2) TPH-diesel analytical groundwater data, (3) geologic information gathered during the drilling operations, (4) topographic and bathymetric data, and (5) historical site features including ASTs, sewer utilities, buildings, and pipelines. Figures 4 through 7 and Figures 9 through 12 were generated from the 3DVA.

2.6.1 Statistical Analyses

Exposure point concentrations (EPC) in sediment and groundwater were calculated using ProUCL 5.0 software (EPA 2013). The data sets were processed as follows prior to calculating EPCs:

- Sediment was separated into 0- to 2-foot, 0- to 5-foot, and 0- to 10-foot depth ranges. The 0- to 2-foot depth interval was used to estimate risk to ecological receptors, as they are not likely to be exposed to deeper sediment; however the deeper 0- to 5- and 0- to 10-foot depth intervals were also assessed to provide additional information relevant to the low threat closure criteria (Section 5.0).

- Nondetect results that exceeded the highest detected value for each COPEC in each data set were removed.

- For summed COPECs (total low molecular weight [LMW] PAH, total high molecular weight [HMW] PAH, and total PAH), nondetected results that had a value of zero were removed. The PAHs included in the total calculations are listed below in Section 2.6.2.

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

For COPCs with six or more detected values in a data set, the 95 UCL recommended by ProUCL 5.0 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 5.0 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.

Tables 1 through 4 list the EPCs for sediment and groundwater. The tables include the distribution, detection frequency, number of censored results, range of detection limits, range of detected data, location of the maximum detected concentration (and depth for soil), mean of the data set, 95 UCL, 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.

2.6.2 Sediment

Data for shallow sediment (0 to 2 feet bgs) were used to conduct the SLERA, as this is the sediment 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. The data are discussed as derived from sediment rather than from soil throughout this report because the area of contamination around former AST 214 is within the TMZ. All chemicals detected were retained as COPECs.

VOCs were evaluated as COPECs for benthic invertebrates, which may have direct contact with VOCs in sediment and sediment porewater. However, because VOCs are generally not considered highly toxic to wildlife, rapidly volatilize when exposed to air, and do not tend to bioaccumulate, they were not evaluated for birds and mammals.

TPH was considered a COPEC for invertebrates, as some invertebrate toxicity studies and screening levels are available for consideration. However, no TRVs have been established for birds or mammals, and little toxicity data are available, so TPH constituents were not evaluated as COPECs for birds and mammals; 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.

2.6.3 Groundwater

Grab groundwater samples were collected from multiple borings at Site YF3 (no monitoring wells are present at the site), and were analyzed for TPH, VOCs, and SVOCs; all detected compounds were considered COPECs for aquatic life. Results from field duplicates collected in 2012 are presented in Appendix E, but are not included in statistical summaries; the data were not presented in the FAR (KCH 2013).

2.7 OUTCOME OF EXPOSURE PATHWAY EVALUATION (STEP 1)

There are potentially complete exposure pathways from chemicals in sediment to ecological receptors onshore and from groundwater to aquatic life at the point of exposure in the Bay. Therefore, potential toxicity to ecological receptors from exposure to chemicals in sediment and groundwater at Site YF3 was assessed in a Tier 1 SLERA.

3.0 TIER 1 SLERA STEP 2: EXPOSURE ESTIMATION AND RISK CALCULATION

Risks posed to aquatic life, benthic invertebrates, birds, and mammals from exposure to COPECS at Site YF3 were evaluated as described in the following sections.

3.1 ASSESSMENT OF RISK 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 groundwater if the groundwater reaches Clipper Cove. Exposure estimates for aquatic receptors were respective maximum concentrations of COPECs in groundwater, which were compared to surface water quality criteria for protection of aquatic life to identify chemicals that pose a potentially unacceptable risk to aquatic life, as described below. Selection of the groundwater screening criteria is described in Appendix C.

Chemicals that posed potential risk to aquatic life were identified based on comparisons of concentrations in groundwater to the screening criteria. HQs for aquatic life, which represent the ratio of the maximum groundwater concentration to the screening value, are listed in Table 7. Chemicals with HQs exceeding 1 are considered COPECs for aquatic life, indicating potential risk to receptors at the point of exposure adjacent to the site in Clipper Cove. Below is a list of the COPECs for aquatic life at Site YF3:

Hazard Quotients Greater than 1.0 for Aquatic Life

Chemical	Hazard Quotient
Carbon Disulfide	6.4
Total LMW PAHs	3.0
Total PAHs	3.5
TPH-Diesel	27.1
TPH-Motor Oil	3.9

3.2 ASSESSMENT OF RISK TO BENTHIC INVERTEBRATES

Benthic invertebrates are exposed to chemicals when they come into contact with or ingest contaminated sediment. Additional exposure can occur if chemicals are released from sediment into pore water or surface water. Chemical accumulation or toxicity occurs only after exposure. Benthic invertebrates are less mobile than other receptors, and thus have more direct exposure to

sediment. Benthic invertebrates are often used as environmental indicators because they are an integral part of the ecosystem and impacts to the benthic community can indicate impaired site conditions and habitat quality, such as contamination at toxic levels (EPA 1989). The SLERA considered exposure to benthic invertebrates to occur via direct contact with contaminated sediment. Ingestion of sediment is included in the direct contact pathway.

Some benthic invertebrates, such as deposit-feeders and detritivores, directly ingest sediment. Digestive processes for these organisms may allow uptake of some metals and organic contaminants bound to sediments (Campbell and Tessier 1989; Luoma and others 1992). Many deposit-feeding organisms selectively ingest certain particle sizes; taxa that ingest small particles may be more exposed to chemicals in sediment. Aquatic invertebrates respire large volumes of water, which may allow for uptake of soluble contaminants across gills and other specialized membranes or the integuments of the organisms (Hawker 1990).

Biological factors that affect exposure include feeding mode, selectivity in diet, position in the food chain, foraging depth, organism size, assimilation efficiency, and detoxifying mechanisms (Connell 1990; Fisher 1995). Variability in exposure also results from mobility of organisms; some invertebrates are relatively immobile after a planktonic larval phase, but others remain highly mobile throughout their lives. Complete exposure pathways for benthic invertebrates in offshore sediments therefore include dermal contact with sediment, surface water, or pore water; and dietary exposure to sediment, detritus, and prey (Hawker 1990; Luoma and Jenne 1976).

Bioavailability of inorganic chemicals depends on sediment characteristics such as hydrogen ion concentration (pH), oxidation state, and organic content and composition. Bioavailability was assumed equivalent to that of each study referenced to derive the toxicity benchmarks used in this SLERA. Exposure estimates for benthic invertebrates used the maximum concentration of each COPEC detected in sediment from 0 to 2 feet bgs at Site YF3.

Exposure estimates for COPECs were compared with ER-L values (Long and others 1995) to identify chemicals that pose a potentially unacceptable risk to demersal fish and benthic invertebrates. Table 8 compares chemical concentrations with ER-Ls. ER-L values (Long and others 1995) are based on chemical and biological effects data from a wide variety of studies on invertebrates in marine and estuarine sediments, including the NOAA database. The ER-L represents the lower 10th percentile of the effects data. Concentrations below the ER-L represent levels at which direct adverse biological effects to invertebrates are rarely expected.

An HQ approach was used to evaluate risks to benthic invertebrates. HQs were calculated using the following formula:

$$BenthicInvertebrate\ HQ = \frac{Concentration}{Invertebrate\ Benchmark} = \frac{(mg/kg)}{(mg/kg)}$$

Based on the HQ approach, a potential risk to benthic invertebrates exists if an HQ for a chemical based on the maximum concentration exceeds 1.0.

Selection of COPECs for benthic invertebrates that require additional evaluation in the Tier 2 Step 3a risk refinement involved a quantitative evaluation of maximum concentrations compared with ER-Ls. All chemicals with HQs exceeding 1.0 were identified as posing potential risk and retained for evaluation in Step 3a of the BERA. If no benchmarks were available for a preliminary COPEC, the chemical was automatically identified as posing potential risk and was retained for further evaluation in Step 3a of the BERA. Results of comparisons of the maximum concentrations to ER-Ls are presented in Table 8.

Benthic invertebrate COPECs with HQs exceeding 1.0 (based on the ER-L) and COPECs without ER-L values were retained for further evaluation in Step 3a; those chemicals are listed as follows:

HQ > 1.0 Based on ER-L (HQ)	No ER-L Available
LMW PAHs, HMW PAHs, Total PAHs	TPH (diesel, gasoline, and motor oil range), 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-butanone, 4-isopropyltoluene, acetone, bromomethane, carbon disulfide, chloromethane, ethylbenzene, isopropylbenzene, m- and p-xylene, methylene chloride, n-butylbenzene, o-xylene, propylbenzene, sec-butylbenzene, and toluene

COPECs without benchmarks are discussed in more detail in Section 4.4.

3.3 ASSESSMENT OF RISK TO BIRDS AND MAMMALS

The evaluation of risk to birds and mammals is based on the selected assessment and measurement endpoints identified in Section 2.5.4. FCMs are used to assess exposure of bird and mammals to COPECs in their diet (for example, evaluation of exposure through the ingestion pathway). These models are conceptually simple and focus on ecological receptors of concern. FCMs are one 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).

The following sections describe the model used to estimate ingested doses of site COPECs for birds and mammals using site-specific chemical concentrations in sediment and estimated concentrations in prey.

3.3.1 Exposure to Birds and Mammals

This section describes the models used to estimate ingested doses of COPECs for higher-level birds and mammals using estimated prey concentrations obtained from the literature.

Quantitative Evaluation of Risk Using a Food Chain Model

FCMs for birds and mammals 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 (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. Results from sediment samples collected within 0 to 2 feet bgs were used in the FCMs to estimate doses to birds and mammals. The dataset is described in more detail in Section 2.6. The parameters used in estimating total daily doses to birds and mammals are provided in Tables 9 through 11 for the representative receptors selected in Section 2.5.4.

Maximum daily doses were estimated for each COPEC and representative receptor if adequate data were available. These doses were then compared with high and low TRVs to estimate potential adverse biological effects on the receptor. The risk to each representative species was characterized using an HQ approach based on this comparison. Appendix D provides the FCMs for the representative receptors.

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 (kilograms per day [kg/day])
C_{prey}	=	Concentration in dry weight of COPEC in prey (mg/kg)
IR_{soil}	=	Ingestion rate of sediment (kg/day)
C_{soil}	=	Concentration in dry weight of COPEC in sediment (mg/kg)
SUF	=	Site use factor (unitless)
BW	=	Adult body weight (kilogram)

SLERA risk estimates ensure that the assessment does not indicate little or no risk when a risk actually exists; therefore, conservative assumptions were used in this analysis in the absence of site- or species-specific data. Exposure was 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

Sediment → Invertebrates (Mollusks and Crustaceans) → Raccoon

Bioaccumulation Factors and Tissue Concentrations

Ideally, sediment-to-tissue bioaccumulation factors would be based on recent COPEC measurements in collocated samples of sediment and desired tissue types of concern (in this case, benthic invertebrates, mollusks, crabs, and fish) from Site YF3, but these data are not available. However, tissue residue data from samples collected along the nearby southern shore of Clipper Cove beach as part of the Offshore OU RI (Tetra Tech 2001) were available for HMW and LMW PAHs. Although not collected specifically to assess risk at Site YF3, these tissue concentrations were used in parallel with BAFs developed as part of another Navy risk assessment (Earth Tech, Inc. 2006) to provide a more thorough estimate of potential risk to birds and mammals. As a result, two estimated daily doses were calculated for HMW PAHs and LMW PAHs: in one calculation, the prey tissue concentrations were assumed to be equal to those collected along the beach as part of the Offshore OU RI, and in the other the prey tissue was calculated by multiplying the site sediment concentration by the BAF from Earth Tech Inc. 2006.

The BAFs used to estimate sediment-based bioaccumulation for COPECs in invertebrates (benthic and macro) and fish at Site YF3 were developed for benthic invertebrates and demersal fish for the Navy BERA for Pearl Harbor (Earth Tech, Inc. 2006). The Pearl Harbor BAF values (1) represent the most complete set of values for the aquatic receptor types of interest, (2) were developed for a marine ecosystem where COPECs are sequestered in sediment, and (3) contain data regarding relevant COPECs (PAHs). Evaluations of tissue-to-sediment relationships for Pearl Harbor used COPEC measurements in collocated samples of sediments and wild-caught tissue samples. Tissue sampling included separate measurements for two types of benthic invertebrates (burrowing shrimp and the blue-clawed stone crab) and two types of demersal fish (tilapia and bandtail goatfish). The Pearl Harbor BAFs are tissue-dry-weight to sediment-dry-weight ratios.

Tissue concentrations from the Offshore OU RI and the BAF values from the Pearl Harbor BERA are summarized in Table 12.

3.3.2 Toxicological Effects on Birds and Mammals and Interpretation of Hazard Quotient

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

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

where:

HQ	=	Hazard quotient (unitless)
Dose	=	COPEC-, receptor-, and site-specific daily dose estimate (mg/kg-day)
TRV	=	COPEC- and receptor-specific toxicity reference value (mg/kg-day)

Because of the 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).

3.3.3 TRVs

TRVs used in the FCMs were from the Navy-Biological Technical Advisory Group working group technical memorandum (Navy 1998). Each TRV represents a critical exposure level from a toxicological study and is 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 a mid-range effects level for a COPEC, where the endpoint of toxicity was ecologically relevant. The COPEC-specific low and high TRVs used in the FCM are listed in the FCM tables in Appendix D. TRVs were derived separately for birds and mammals using available toxicological literature.

3.3.4 HQ Approach

Average ingested doses were calculated for representative receptors using average values for exposure parameters such as body weight and ingestion rate. 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:

Hazard Quotient 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.

Table 13 summarizes the FCM HQ results for each representative receptor by COPEC. Complete dose calculations are in Appendix D.

3.3.5 COPECs Evaluated Qualitatively

HQs cannot be calculated without a TRV for a given COPEC; COPECs without TRVs are retained by default for further evaluation in the Step 3a risk refinement. Because TRVs for total HMW and total LMW PAHs were unavailable for birds, a dose was calculated for comparison to literature-reported doses associated with effect or no-effect levels in the Step 3a risk refinement.

The qualitative evaluation of HMW and LMW PAHs for birds is presented in Section 4.4. Best professional judgment was used in interpreting literature data. Uncertainties associated with this approach are discussed in Section 4.6.

3.3.6 Evaluation of Potential Risk to Birds and Mammals

The evaluation of risk to birds and mammals focused on selected assessment endpoints identified in Section 2.5.4. Risks to representative birds (spotted sandpiper and great blue heron) and mammals (raccoon) were evaluated using an FCM, based on an HQ approach.

3.3.7 Results of the Food Chain Model for Birds

An estimated daily dose of each COPEC was calculated for the spotted sandpiper and great blue heron based on life history and foraging habits. As specified in both Navy (1999) and EPA (1997) guidance for SLERAs, all estimated doses were calculated using the maximum site-specific concentrations in soil. Calculations are presented in their entirety in Appendix D. As noted above in Section 3.3.5, no TRVs were available for birds, so HQs could not be calculated. Because HQs could not be calculated, potential risks to the spotted sandpiper and the great blue heron from total HMW PAHs and total LMW PAHs are further evaluated in Step 3a (see Section 4.4).

3.3.8 Results of the Food Chain Model for Mammals

An estimated daily dose for each COPEC was calculated for the raccoon based on life history and foraging habits. As specified in both Navy (1999) and EPA (1997) guidance for conducting SLERAs, all estimated doses were calculated using the maximum site-specific concentrations in soil.

Estimated daily doses of detected chemicals were compared to low and high TRVs, if available, by calculating an HQ. Calculations are presented in their entirety in Appendix D. No HQs exceeded 1.0 for the raccoon. A complete list of HQs for the raccoon is in Table 11. Because the estimated doses for the raccoon did not exceed the low TRVs, no COPECs pose an unacceptable risk to mammals at Site YF3.

3.4 TIER 1 UNCERTAINTY ANALYSIS

Uncertainty plays an important role in risk-based decision-making and is therefore incorporated explicitly into the risk characterization process. Identifying known sources of uncertainty is a critical component of a SLERA because of conservative default assumptions already incorporated; 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. Many assumptions in the SLERA process are conservative and result in overestimates of site-specific parameters; however, these assumptions are important to ensure that no COPEC is eliminated that poses an adverse ecological risk at a site. The following subsections discuss major uncertainties and conservative assumptions used in this SLERA.

3.4.1 Analytical Data

Limited data acquired at the site were used to evaluate conditions of the whole site; all concentrations measured are therefore only estimates of concentrations that may occur at the site (with associated error). Complete analytical data available for Site YF3 are in Appendix E. Uncertainty in the sample dataset includes use of the dataset to represent the entire site.

Estimates of COPEC concentrations in media were based on results from samples collected within known or suspected contaminated areas at the site, but were used to characterize conditions throughout the site. This method creates bias in the data toward the more affected areas at the site, and is likely to overestimate COPEC concentrations used to characterize conditions throughout the site.

Data used to characterize risk to all receptors except aquatic life at Site YF3 included results from surface (0 to 2 foot bgs) sediment samples; groundwater data were used to assess risk to aquatic life. The data had been acquired during previous investigations to assess contamination at the site, not specifically for this SLERA. However, the intent of the SLERA was to use available data, and the available data were considered adequate to characterize potential ecological risks at the site.

3.4.2 Identification of COPECs

Key uncertainties associated with identifying COPECs are associated with sampling data used to identify COPECs. These uncertainties involve errors in chemical analysis, sample size sufficiency, and laboratory reporting limits. Systematic or random errors in the chemical analysis may yield erroneous data. These errors can result in an underestimate of risk because

data may be viewed as nondetected or estimated as a result of laboratory errors or assumptions in the chemical analysis. This error could also result in fewer detected results or estimated results from specific samples or analyses.

Lack of sufficient samples to characterize the site can result in an underestimate or overestimate of risk because calculated risks for an exposure area may be based on very few samples, which may or may not be representative of the area at large.

In addition, elevated laboratory reporting limits for some chemicals can result in an underestimate of risk. Chemicals that not detected throughout a data set are not evaluated in the ERA. If the reporting limit for a chemical that is never detected throughout a data set exceeds toxicity-based concentration, the chemical may be present at the site at concentrations associated with adverse ecological effects.

3.4.3 Use of Screening Values

The comparison of site-specific maximum concentrations to generic screening values such as ER-Ls and 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. In addition, as discussed in previous sections, a number of COPECs could not be evaluated because screening values were not available.

Existing data are not sufficient to develop applicable TPH toxicity values for use in an ERA. 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 (2011) has identified soil screening levels of specific petroleum products for wildlife, including screening levels of gasoline range organics (1,000 to 5,000 mg/kg) and diesel range organics (2,000 to 6,000 mg/kg), which may also be used as cleanup levels. However, there are few supporting toxicological studies.

3.4.4 Uncertainties Associated With the Food Chain Model

The following discussion highlights uncertainties associated with the FCM used to evaluate risk to birds and mammals in Section 3.3. The overall effect of these uncertainties and conservative assumptions cannot be quantitatively calculated without site-specific information.

3.4.4.1 Tissue Residue and Data Bioaccumulation Factors

Site-specific tissue residue data from samples collected as part of the Offshore OU RI (Tetra Tech 2001) along the southern shore of Clipper Cove beach were available for both HMW and LMW PAHs. The tissue samples were collected to support the ERA for the offshore OU, as described in Section 3.3.1. Although not collected specifically to assess risk at Site YF3, the tissue data were used in parallel with BAFs to provide a more thorough estimate of potential risk to birds and mammals (Table 12).

Due to the uncertainty associated with the limited tissue data available (Section 3.3.1), prey concentrations were also estimated based on BAFs and other parameters. This approach is generally associated with much more uncertainty than is the approach based on site-specific prey tissue concentrations. The estimates of prey concentrations may be either overestimated or underestimated because conditions at the site are likely different from those reflected in the BAFs and tissue concentrations.

3.4.4.2 Site Use Factors

The SLERA assumed that all receptors live and forage within the two areas at all times (in other words, the site use factor [SUF] = 1). This assumption is certainly not true for receptors such as the great blue heron, which forages over large areas and is not likely to be consistently exposed to the maximum concentrations of COPECs at Site YF3. Therefore, the actual amount of sediment or prey ingested from the site would likely be much less than the values used in the risk calculations. Consequently, the SUFs may result in an overestimate of risk.

3.4.4.3 Dietary Composition

The diet of the great blue heron was assumed to consist of 25 percent invertebrates and 75 percent fish, and the diet of the spotted sandpiper was assumed to consist of 100 percent invertebrates. The diet of the raccoon was assumed to consist of 100 percent invertebrates, broken down into 50 percent mollusks and 50 percent crustaceans. These estimates of dietary composition may result in an overestimate or underestimate of risk because of the varied diets of the receptors.

3.4.4.4 Bioavailability

All COPECs were assumed bioavailable in sediment at the site. The bioavailability of each chemical in a receptor's diet was assumed equivalent to that of the chemical and exposure route used to derive the TRV. Depending on the COPEC and receptor, however, bioavailability may be significantly different. Consideration of bioavailability and bioaccumulation potential of chemicals is important with regard to understanding risk implications and potential ecotoxicological effects of total concentrations of chemicals detected in soils. The assumptions made in the SLERA may result in an underestimate or overestimate of risk.

3.4.4.5 Body Weight and Ingestion Rates

Ranges of reported body weights and ingestion rates for wildlife vary significantly in the literature (Beyer, Connor, and Gerould 1994; Nagy 2001; EPA 1993, 1999a; Pascoe, Blanchet, and Linder 1996; Dunning 1993). These values may not reflect the true attributes of these receptors at the site. The risk may be either overestimated or underestimated, depending on the difference between actual values and literature values.

3.4.4.6 Development of TRVs

TRVs used in risk calculations were derived from literature studies. These studies were not conducted on the specific receptors used in this assessment. The effect of this uncertainty cannot be estimated; it could result in either an overestimate or underestimate of risk.

3.4.4.7 Interspecies Extrapolation

Use of assessment endpoint species as surrogates for other related or ecologically similar taxa is supported by current guidance (EPA 1992a, 1992b); however, this type of analysis does not account for differences among taxa. In addition, uncertainty results when assessments of risk are applied to whole communities based on detailed assessments of risk to relatively few taxa. Use of endpoint species as surrogates may result in an overestimate or underestimate of risk.

3.4.4.8 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, focus 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.

3.4.4.9 Use of Maximum Detected Concentration as Exposure Point Concentration

The maximum concentration of each COPEC was used to estimate exposures and to ensure protectiveness. Thus, concentrations within the area of greatest contamination were used to characterize conditions throughout the site. However, the maximum concentration is likely to overestimate COPEC concentrations used to characterize conditions throughout the site. For example, TPH-diesel concentrations in sediment and groundwater are depicted on Figures 9 through 12, and demonstrate that concentrations are greatest within the area of former AST 214.

3.5 OUTCOME OF THE RISK ESTIMATION (STEP 2)

Despite the sources of uncertainty described in Section 3.4, adequate information was available to evaluate potential risk to receptors. As earlier sections have suggested, certain COPECs were

detected at concentrations that exceed benchmark values or levels that result in potential toxicity to representative receptors. Thus, concentrations of COPECs may pose a potential risk to aquatic life, benthic invertebrates, and birds.

According to Navy guidance (1999), an intermediate refinement step may be conducted (Step 3a) if the SLERA indicates unacceptable or uncertain risk. Step 3a reevaluates the conservative exposure assumptions of the SLERA to estimate potential risks. If this reevaluation supports an acceptable risk determination, no further evaluation of risk is required. If the reevaluation does not support an acceptable risk determination, the risk evaluation proceeds to a more complete BERA or an action such as a remedial alternative at the site.

The following is a list, for each assessment endpoint, of COPECs identified by exceedances of HQs, and default COPECs designated because of lack of established benchmarks or TRVs:

Assessment Endpoint	COPECs Based on HQs > 1.0	Default COPECs Based on Lack of Benchmark or TRV
Aquatic Life	Carbon Disulfide, Total LMW PAHs, Total PAHs, TPH-diesel, TPH-motor oil	Not applicable (NA)
Benthic Invertebrates	Total HMW PAHs, Total LMW PAHs, Total PAHs	TPH-diesel, TPH-gasoline, TPH-motor oil, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbezene, 2-Butanone, 4-Isopropyltoluene, Acetone, Bromomethane, Carbon Disulfide, Chloromethane, Ethylbenzene, Isopropylbenzene, M-and P-Xylene, Methylene Chloride, N-Butylbenzene, O-Xylene, Propylbenzene, Sec-Butylbenzene, Toluene
Birds	NA	Total HMW PAHs, Total LMW PAHs
Mammals	NA	NA

Notes:

COPEC	Chemical of potential ecological concern	NA	Not applicable
HMW	High molecular weight	PAH	Polycyclic aromatic hydrocarbon
HQ	Hazard quotient	TPH	Total petroleum hydrocarbons
LMW	Low molecular weight	TRV	Toxicity reference value

In summary, the SLERA indicates that maximum concentrations of several COPECs at Site YF3 pose potential risks to aquatic life, benthic invertebrates, and birds based on the conservative assumptions of the SLERA. These COPECs are further evaluated in the refinement process in Section 4.0.

4.0 TIER 2 BERA STEP 3A: RISK REFINEMENT

COPECs identified as risk drivers, potential risks, and COPECs by default in the SLERA were reconsidered under Step 3a using less conservative and more realistic site-specific assumptions. Specific variables assessed include the following:

1. A comparison to ambient concentrations in Bay sediments occurred to exclude from further evaluation COPECs at concentrations not significantly greater than background levels.

2. Spatial variations in the EPC were evaluated quantitatively using the lesser of the maximum concentration and 95 UCL, where applicable.

3. Estimated daily doses for vertebrates were recalculated using site-specific information and less conservative receptor-specific assumptions. Doses were calculated using the same methodology as was presented in Sections 3.1, 3.2, 3.3.3, and 3.3.8. However, alternative values for select parameters (for example, using an average rather than minimum body weight) were used in Step 3a.

4. The magnitude of exposure for vertebrate COPECs was evaluated by assessing estimated daily doses, background concentrations, the spatial distribution, and the receptor SUF.

5. COPECs with no benthic invertebrate benchmarks were evaluated qualitatively using alternative benchmarks or other data from the literature. COPECs without avian TRVs were evaluated by comparing estimated doses with literature-reported doses associated with effect or no effect levels. The chemical properties and toxicological effects of COPECs were also evaluated. Best professional judgment was used in interpreting literature data when information on a COPEC was limited.

The following sections discuss use of revised EPCs and parameters used in the Step 3a risk refinement.

4.1 BACKGROUND COMPARISON

Ambient concentrations of COPECs in Bay sediment were considered (San Francisco Regional Water Quality Control Board [Water Board] 1998) to ensure that COPECs at ambient levels were not further evaluated. Ambient concentrations were available for total HMW PAHs (0.256 mg/kg) and total LMW PAHs (0.379 mg/kg); these ambient values are for sediments with less than 40 percent fines, selected because the site sediment consists of a sandy rather than silty substrate (Figure 7). Site concentrations of total HMW PAHs and total LMW PAHs exceed the ambient concentration, so no COPECs were eliminated from further evaluation.

4.2 REFINED EXPOSURE ASSUMPTIONS

The refined EPCs in sediment for benthic invertebrates were compared to benchmark values, as well as to alternative benchmark values, if available. Doses were recalculated for birds based on the EPC for sediment, an average rather than minimum body weight, and a more realistic SUF; the maximum concentration in soil was used as a default in the FCM in cases where the limited number of samples or detections precluded calculation of a 95 UCL. Refined SUFs were calculated by dividing the site area (1.35 acres) by the foraging range of the receptors to yield a more realistic prediction of the receptors' use of the sites and resulting

exposure to COPECs. If the calculation yielded a SUF greater than 1.0, as it did for the spotted sandpiper, the default value of 1.0 was used. The refined parameters used in the Step 3a risk refinement to estimate total daily doses to birds are listed in Tables 9 through 11.

4.3 REFINEMENT OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR AQUATIC LIFE

The SLERA identified carbon disulfide, TPH-diesel and TPH-motor oil as COPECs that pose a potential risk to aquatic receptors. A focused refined assessment of the ecological risks posed to aquatic life in the Bay is presented below.

Carbon Disulfide

Carbon disulfide was identified as a COPEC because the maximum concentration (5.9 micrograms per liter [µg/L]) was greater than the screening criterion of 0.92 µg/L (Table 14). The refined HQ is 6.4 (the same as the Step 2 HQ because a 95 UCL could not be calculated). The arithmetic mean detected concentration (3 µg/L) compared with the criterion results in an HQ of 3.2. Although the concentration in groundwater exceeds the screening criterion for surface water, the risk to aquatic receptors is likely overestimated because exposure to aquatic receptors occurs only when the groundwater enters the Bay (the concentration detected in groundwater is not equal to the concentration to which aquatic receptors are actually exposed in the water column). Based on its expected half-life of less than 3 hours in surface water (EPA 1994) due to volatilization, carbon disulfide in groundwater at Site YF3 is not considered to pose unacceptable risk to aquatic life.

Total LMW PAHs and Total PAHs

Total LMW PAHs and total PAHs were identified as COPECs because the maximum concentrations (44.7 and 52.1 µg/L, respectively) exceed the screening value for PAHs and result in HQs of 3.0 and 3.5. However, only one of the five detections of total LMW PAHs and two of the detections of total PAHs exceeded the criterion. Although the maximum concentrations in groundwater exceed the screening criterion for surface water, the risk to aquatic receptors is likely overestimated because exposure to aquatic receptors occurs only when the groundwater enters the Bay. The 2012 samples were collected within the 5 to 10 feet interval of each boring based on mesh screen interval length (KCH 2013), and the 2000 samples were collected from a depth of approximately 6 to 8 feet (Tetra Tech 2003; Tetra Tech and LFR 2000). Based on the range of concentrations in the available data and an overestimate of site-wide risk based on use of the maximum concentration, total LMW PAHs and total PAHs in groundwater at Site YF3 are unlikely to pose unacceptable risk to aquatic life in the Bay.

TPH-Diesel

TPH-diesel was identified as a COPEC because the maximum concentration (38,000 µg/L) was greater than the TPH screening criterion of 1,400 µg/ L, developed in 1998 for screening out sites at NAVSTA TI that would not pose any ecological risk (Table 14) (Tetra Tech 2001).

The mean detected concentration (15,060 µg/L) also exceeds the criterion and results in an HQ of 10.8. Although the concentration in groundwater exceeds the screening criterion for surface water, the risk to aquatic receptors is likely overestimated because no 95 UCL could be calculated, and the exposure to aquatic receptors occurs only when the groundwater enters the Bay. A more recent study of TPH toxicity in the aquatic environment noted that the C_{13}-C_{18} and C_{19}-C_{36} fractions, which would include the diesel fraction most prevalent at Site YF3, were unlikely to be toxic because the mean concentration lethal to 50 percent of the test population (LC_{50}) exceeded the mean aqueous solubility (Battelle 2007); in other words, the solubility of the petroleum hydrocarbons is such that not enough would enter into solution to reach expected toxic levels.

An analysis of the composition of the weathered petroleum hydrocarbons at Site YF3 has not been conducted. However, because of weathering of the hydrocarbons in the sediment, their toxicity likely has been reduced since the time of original release to the environment, and the lighter, more toxic compounds are the likeliest to have decreased in concentration over time (AST 214 was removed in the 1980s).

Furthermore, persistence of residual TPH in sediment and groundwater at YF3 over several decades indicates that residual LNAPL is no longer migrating to surface water and contributing hydrocarbons to the Bay, for reasons noted in Section 2.4. Concentrations of TPH-diesel that exceed the criteria are limited in area, representing no more than a 150-foot length of the shoreline based on the sampling conducted, which was mostly biased toward the area of former AST 214 (Figures 10 through 12). Based on the available data indicating a limited area at which the point of exposure to the Bay would be impacted, and an overestimate of site-wide risk based on use of the maximum concentration, TPH-diesel in groundwater at Site YF3 is unlikely to pose unacceptable risk to aquatic life in the Bay.

TPH-Motor Oil

TPH-motor oil, detected in two of six samples, was identified as a COPEC because the maximum concentration (5,500 µg/L) exceeded the TPH screening criterion of 1,400 µg/L, developed in 1998 for screening out sites that would not pose any ecological risk (Table 14) (Tetra Tech 2001). The other detected concentration (130 µg/L) did not exceed the criterion. Although the maximum detected concentration in groundwater exceeds the screening criterion for surface water, the risk to aquatic receptors is likely overestimated because no 95 UCL could be calculated, and the exposure to aquatic receptors occurs only when the groundwater enters the Bay. A more recent study of TPH toxicity in the aquatic environment noted that the C_{19}-C_{36} fraction, which includes the motor oil fraction, is unlikely to be toxic because the mean LC_{50} exceeded the mean aqueous solubility (Battelle 2007); in other words, the solubility of the petroleum hydrocarbons is such that not enough would enter into solution to reach expected toxic levels. As discussed in Section 2.4, petroleum hydrocarbons from residual LNAPL have limited remaining potential for migration to the Bay at Site YF3. Based on available toxicity data and only one detected concentration at Site YF3 exceeding the criterion, TPH-motor oil in groundwater is not considered to pose unacceptable risk to aquatic life.

4.4 REFINEMENT OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR BENTHIC INVERTEBRATES

Step 2 of the SLERA identified PAHs (total HMW, total LMW, and total PAHs) as COPECs that pose a potential risk to benthic invertebrates at Site YF3. COPECs without ER-Ls include TPH (diesel, gasoline, and motor oil ranges), 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-butanone, 4-isopropyltoluene, acetone, bromomethane, carbon disulfide, chloromethane, ethylbenzene, isopropylbenzene, m- and p-xylene, methylene chloride, n-butylbenzene, o-xylene, propylbenzene, sec-butylbenzene and toluene. A focused refined assessment of the ecological risks to benthic invertebrates for each COPEC is presented below.

Polycyclic Aromatic Hydrocarbons (Total HMW PAHs, Total LMW PAHs, and Total PAHs)

Maximum detected concentrations of total HMW PAHs (3.8 mg/kg), LMW PAHs (3.0 mg/kg), and total PAHs (4.6 mg/kg) exceeded their respective ER-Ls of 1.7, 0.55, and 4.02 mg/kg. However, when these concentrations were compared to their respective ER-Ms, the resulting HQs were 0.4, 0.9, and 0.1 (see Table 15). The risk to benthic invertebrates is overestimated because no 95 UCL could be calculated for use in the risk refinement based on the limited number of samples. Based on the low HQs resulting from comparisons of ER-Ms to maximum detected concentrations, PAHs do not pose unacceptable risk to benthic invertebrates at Site YF3.

1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, 4-Isopropyltoluene, Chloromethane, N-Butylbenzene, Propylbenzene, Sec-Butylbenzene

No ER-Ls or alternative benchmarks were available for the following VOCs: 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 4-isopropyltoluene, chloromethane, n-butylbenzene, propylbenzene, and sec-butylbenzene. However, all were detected at low concentrations (ranging from 0.058 to 0.4 mg/kg) in just one of five samples, except for chloromethane and sec-butylbenzene, which were detected in two of five samples. Based on the limited detections at low concentrations, and the tendency of these VOCs to volatilize and not accumulate in the environment or tissues, they are not considered to pose unacceptable risk to benthic invertebrates, and thus are not recommended for further evaluation.

2-Butanone, Ethylbenzene, Isopropylbenzene, M- and P-Xylene, O-Xylene, Toluene

No ER-L values were available for comparison in Step 2, so alternative benchmarks from multiple sources were used to evaluate risk from 2-butanone, 4-isopropyltoluene, ethylbenzene, isopropylbenzene, m- and p-xylene, o-xylene, and toluene in Step 3a. EPA Region 3 Marine Sediment Benchmarks were used for ethylbenzene and toluene; freshwater sediment benchmark was used for isopropylbenzene (EPA 2013). Dutch Target Levels for Sediment were used for m- and p-xylene, and o-xylene (Verbruggen, Posthumus, and van Wezel 2001 as cited in Buchman 2008). An Oak Ridge National Laboratory (ORNL) secondary chronic value was used for 2-butanone (Jones, Suter, and Hull 1997) (Table 15). The concentrations detected at the site were well below their respective alternative benchmarks, with HQs ranging from 0.002 to 0.3.

Therefore, no further evaluation of risk to benthic invertebrates is recommended for butanone, ethylbenzene, isopropylbenzene, m- and p-xylene, o-xylene, and toluene.

TPH-Diesel, TPH-Gasoline, and TPH-Motor Oil

No ER-Ls were available for TPH fractions. Alternative benchmarks used in the Step 3a risk refinement were a Point of Compliance Concentration for fuel oil and diesel developed for the Presidio (used for TPH-diesel) (IT Corporation 1997) and Washington State Sediment Cleanup Levels for TPH-gasoline and TPH-motor oil (a minor adverse-effect level) (no marine value was available for gasoline, and motor oil range organics, so the freshwater value was used) (Washington State Department of Ecology 2011).

The TPH-diesel EPC (1,408 mg/kg) exceeded its alternative benchmark of 144 mg/kg, resulting in an HQ of 9.8 (Table 15). The benchmark is based on the mean concentration lethal to 25 percent of the test population (LC_{25}) of amphipods exposed to sediment from the Presidio of San Francisco (IT Corporation 1997). In comparison, the Washington State Sediment Cleanup Level for TPH-diesel is 510 mg/kg. The benchmarks of 144 mg/kg and 510 mg/kg were exceeded by 12 and 8 of the 15 detected concentrations, respectively. Only 3 of 10 samples collected from 0 to 1.5 feet bgs contained TPH-diesel at levels exceeding the Washington State Sediment Cleanup Level, and both of the samples collected from 0 to 0.5 feet bgs had TPH-diesel concentrations less than the Washington State Sediment Cleanup Level. Benthic invertebrates are expected to inhabit the shallower sediment, where concentrations are lower. Because the areal extent of surface contamination at Site YF3 is limited and concentrations at the depth of most likely exposure are relatively low. TPH-diesel is not considered to pose unacceptable risk to benthic invertebrates and is not recommended for further evaluation.

Concentrations of TPH-gasoline and TPH-motor oil did not exceed their benchmark of 1,400 mg/kg, with HQs of 0.1 and 0.3, respectively (Table 15). Based on the low HQs calculated using the maximum detected concentration, TPH-gasoline and TPH-motor oil do not pose unacceptable risk to benthic invertebrates at Site YF3 and are not recommended for further evaluation.

Acetone

Acetone is found naturally in the environment (in plants, trees, volcanic gases, and forest fires), and is produced in a number of industries. It evaporates readily into the air and mixes well with water. People and animals breathe out acetone produced from natural breakdown of body fat. Acetone is used as a solvent, and is released during its manufacture and use, in exhaust from automobiles, tobacco smoke, and from landfills (Agency for Toxic Substances and Disease Registry [ATSDR] 1997).

No ER-L was available for acetone. The EPA Region 5 Sediment Benchmark of 0.0099 mg/kg (EPA 2003 as cited in ORNL Risk Assessment Information System [RAIS] 2014) was used for comparison in the Step 3a risk refinement, which resulted in an HQ of 40.4 based on the maximum detected concentration at Site YF3 of 0.4 mg/kg (Table 15). The EPA Region 5

sediment screening level was derived using an equilibrium partitioning (EqP) equation and Region 5 water screening level for acetone (1,700 µg/L), and was not based on toxicity data for acetone. The water screening level used for this SLERA is 1,500 µg/L, and the maximum detected concentration of acetone in groundwater at Site YF3 is well below that at 54 µg/L. Based on limited toxicological information and lack of a toxicity-based benchmark, and low detected concentrations in water and sediment, acetone is not considered to pose unacceptable risk to benthic invertebrates at Site YF3.

Bromomethane

Bromomethane, also known as methyl bromide, is a colorless gas without much smell. Some bromomethane is formed in the ocean, likely by algae or kelp. However, most is manufactured as a pesticide, and some is used in the manufacture of other chemicals. Bromomethane breaks down into other chemicals in the environment. In underground water, bromomethane usually has a half-life about 1 month (ATSDR 1992).

No ER-L was available for bromomethane. The EPA Region 5 Sediment Benchmark of 0.00137 mg/kg (EPA 2003 as cited in ORNL RAIS 2014) was used for comparison in the Step 3a risk refinement, which resulted in an HQ of 27.7 based on the only detected concentration at Site YF3 of 0.038 mg/kg (Table 15). The EPA Region 5 sediment screening level was derived using an EqP equation and Region 5 water screening level (16 µg/L), and was not based on toxicity data for bromomethane. Bromomethane was not detected in groundwater at Site YF3. Based on limited toxicological information and lack of a toxicity-based benchmark, and low detected concentration in sediment, bromomethane is not considered to pose unacceptable risk to benthic invertebrates at Site YF3.

Carbon Disulfide

Carbon disulfide is released by chemical and manufacturing industries, as well as oil and gas processing. Nearly all releases, both anthropogenic and natural, are to air. Carbon disulfide is also produced naturally by soil and sediment microorganisms, vegetation, forest and grass fires, and volcanoes. It is thought that somewhere between 40 percent and 80 percent of releases stem from natural or biogenic activity. Carbon disulfide is rapidly metabolized and therefore does not bioconcentrate or biomagnify, and is unlikely to causes adverse effects on populations of aquatic or terrestrial organisms (World Health Organization [WHO] 2002).

No ER-L was available for carbon disulfide. The EPA Region 5 Sediment Benchmark of 0.0239 mg/kg (EPA 2003 as cited in ORNL RAIS 2014) was used for comparison in the Step 3a risk refinement, which resulted in an HQ of 2.8 based on the maximum detected concentration at Site YF3 of 0.068 mg/kg (Table 15). The EPA Region 5 sediment screening level was derived using an EqP equation and Region 5 water screening level for carbon disulfide (15 µg/L), and was not based on toxicity data for carbon disulfide. The water screening level used for this SLERA was 0.92 µg/L, and the maximum detected concentration of carbon disulfide in groundwater at Site YF3 was 5.9 µg/L. Based on limited toxicological information and lack of a

toxicity-based benchmark, and low detected concentrations in water and sediment, carbon disulfide is not considered to pose unacceptable risk to benthic invertebrates at Site YF3.

Methylene Chloride

Methylene chloride is used as a solvent, and nearly all releases to the environment are from its use by various industries and home use of paint removers and aerosol products (WHO 1996). No ER-L was available for methylene chloride. The EPA Region 5 Sediment Benchmark of 0.159 mg/kg (EPA 2003 as cited in ORNL RAIS 2014) was used for comparison in the Step 3a risk refinement, which resulted in an HQ of 4.9 based on the maximum detected concentration at Site YF3 of 0.8 mg/kg (Table 15). The EPA Region 5 sediment screening level was derived using an EqP equation and Region 5 water screening level for methylene chloride (940 µg/L), and was not based on toxicity data for methylene chloride. Methylene chloride was not detected in groundwater at Site YF3. Based on limited toxicological information and lack of a toxicity-based benchmark, and low detected concentrations in sediment, methylene chloride is not considered to pose unacceptable risk to benthic invertebrates at Site YF3.

4.5 REFINEMENT OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN FOR BIRDS

After Step 2 of the SLERA, total HMW PAHs and total LMW PAHs were identified as COPECs by default because no avian TRVs have been established. No COPECs for mammals were identified after the Step 2 SLERA (Table 16). A focused, refined assessment of ecological risk to birds is presented below.

Polycyclic Aromatic Hydrocarbons (Total HMW PAHs, Total LMW PAHs)

Total HMW PAHs

No avian TRVs were available for HMW PAHs, so these were considered COPECs for birds by default.

Potential risks to birds from concentrations of HMW PAHs are likewise discussed as a group because of the lack of information on the effects of individual PAHs on birds. The following is a summary of the range of refined doses for HMW PAHs in Appendix D, as modeled for the spotted sandpiper and great blue heron at Site YF3:

Receptor	HMW PAH Refined Doses (based on a BAF and a collected tissue concentration, respectively) (mg/kg-day)
Spotted sandpiper	0.079 and 0.37
Great blue heron	0.003 and 0.001

The following is a list of effects of HMW PAHs on birds based on toxicity studies and associated doses:

Study	Dose to Test Species (mg/kg-day)	Effect Type
Bond and others 1981	0.10	No effects
Trust and others 1994 (as cited in EPA 2007)	2.0	No effects
Trust and others 1994 (as cited in EPA 2007)	20.0	Lowest observed adverse effect level
Penn and Snyder 1988	40.0	Increase in arterio-sclerotic plaques

The studies listed above indicate that adverse effects are not likely to result from the doses of HMW PAHs modeled for birds at Site YF3. In addition, a study of weathered oil from the *Exxon Valdez* spill in Alaska indicated minimal adverse effects on mallard chicks at relatively high concentrations of weathered oil, with an estimated LD_{50} (does lethal to half of the test population) of 5,000 mg of weathered oil per kilogram body weight, and no adverse effects from direct application of weathered oil to eggshells (Stubblefield 1995a, 1995b). Therefore, HMW PAHs do not pose unacceptable risks to invertivorous or carnivorous birds at Site YF3.

Total LMW PAHs

Few studies have been published on the effects of LMW PAHs on birds. However, no mortality or visible signs of toxicity were reported in a study of mallards fed for 7 months a diet that contained a concentration of PAHs at 4,000 mg/kg (mostly the LMW PAHs naphthalenes, naphthene, and phenanthrene). Still, blood flow to the liver rose 30 percent and liver weight increased by 25 percent (Patton and Dieter 1980, as cited in Eisler 1987). In a study of juvenile bobwhites, no effects were observed at a dose of 1,653 mg/kg/day (EPA 2007). Estimated doses for the spotted sandpiper were 2.09 (based on literature BAF) and 0.14 mg/kg-day (based on tissue concentration). Estimated doses for the great blue heron were 0.05 (based on literature BAF) and 0.0005 mg/kg-day (based on tissue concentration). Birds rapidly metabolize PAHs, so bioaccumulation is expected to be minimal (EPA 2007). In addition, as noted above, minimal adverse effects on mallard chicks were observed at relatively high concentrations of weathered oil, with an estimated LD_{50} of 5,000 mg of weathered oil per kilogram body weight, and no adverse effects from direct application of weathered oil to eggshells (Stubblefield 1995a, 1995b). Based on the estimated daily doses, the assumed maximum of 9 mg/kg in the birds' prey, and the available toxicity data, HMW PAHs are unlikely to pose unacceptable risks to invertivorous or carnivorous birds at Site YF3.

4.6 TIER 2 UNCERTAINTY ANALYSIS

The following discussion highlights additional uncertainties associated with the Step 3a risk refinement used to evaluate risk to ecological receptors in Section 4.0. The overall effect of

these uncertainties and conservative assumptions cannot be quantified without additional site-specific information.

4.6.1 Tissue Residue Data and Bioaccumulation Factors

Tissue residue data from the Offshore OU RI (Tetra Tech 2001) were available for LMW and HMW PAHs, and were used in parallel with BAFs to calculate estimated daily doses in the SLERA and Step 3a risk refinement. The estimates of prey concentrations may be either overestimated or underestimated, as discussed in Section 3.4.4.1.

4.6.2 Site Use Factors

The Step 3a risk refinement 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 for Site YF3) by the foraging range of the receptors to yield a more realistic prediction of the receptors' use of the sites and resulting exposure to COPECs. 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 sediment or prey ingested from the site may be greater or less than the values used in the risk calculations. Consequently, the SUFs may result in an underestimate or overestimate of risk.

4.6.3 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 of each COPEC was used to estimate site-wide exposures and to ensure protectiveness. In some cases, the limited number of samples or detections precluded the calculation of a 95 UCL. The refined EPC may underestimate or overestimate COPEC concentrations used to characterize conditions throughout the site.

4.7 Summary and Conclusions of the Step 3a Risk Refinement

COPECs identified as posing potential risk in Step 2 were reconsidered based on site-specific information and refined EPCs to identify COPECs that may require remedial action or further evaluation in a more comprehensive BERA. There is inherent uncertainty in the risk assessment because of limited data from the site, use of literature-based reference values, use of BAFs and historical tissue concentrations, and assumptions made for the necessary calculations of risk.

Assessment of risk from petroleum hydrocarbons is particularly challenging due to the lack of uniformity in analytical and toxicological data, and a dearth of relevant studies on vertebrate exposures to contaminated sediment. The greatest levels of TPH at Site YF3 are at 2 feet and 7 feet bgs. At these depths, ecological receptors are unlikely to be exposed. Benthic

invertebrates would be nearer to the sediment surface. Likelihood of exposure of ecological receptors to TPH in sediment at Site YF3 is low.

Many assumptions in the SLERA process were conservative and may have resulted in overestimates of site-specific parameters, leading to biases toward an overestimation of risk. Elements of the SLERA exposure model that resulted in overestimate of risk included use of maximum COPEC concentrations to represent site conditions, the assumption of 100 percent bioavailability of COPECs to receptors, and the assumption that each receptor is feeding exclusively in the habitat area where they are modeled. Based on the results of Step 3a, potential for exposure of ecological receptors to chemicals in sediment at concentrations that would cause adverse effects is limited. None of the COPECs detected at the site is recommended for further evaluation.

5.0 LOW THREAT CLOSURE CRITERIA COMPARISON SUMMARY

As described in Section 1.3, Site YF3 exhibits characteristics very similar to those of UST sites. Table 17 presents a comparison with the criteria for low-threat closure, including the rationale for each "Yes", "No", or "NA" designation (State Water Board 2012). The table is based on the State Water Board's policy and checklist, and includes general and media-specific criteria. Table 18 compares site chemical concentrations with those in Table 1 of the low threat UST case closure policy, to support the evaluation of groundwater criteria in Table 17.

The low-threat closure criteria for UST sites are used to identify and close sites generally considered to "present a low threat to human health, safety and the environment" (State Water Board 2012). Sites must satisfy both general and media-specific criteria, identified in Section 1.3, in order to qualify for low-threat UST closure.

Key points noted in Table 17 regarding how Site YF3 meets the closure criteria include, but are not limited to, the following:

- General Criteria
  - Release consists solely of petroleum
  - No current source or ongoing release
  - No free product
  - CSM has been developed
  - No MTBE detected
  - No nuisance as defined by Water Code section 13050
- Media-Specific Criteria
  - Groundwater:
    - Contamination is stable
    - Poses a low threat to human health and the environment

- VI to Indoor Air:
    - Site is no longer active
    - No existing or anticipated buildings
    - No complete exposure pathway
- Direct Contact and Outdoor Air Exposure:
    - Concentrations of petroleum constituents on site are well below those associated with significant risk to human health
    - No complete exposure pathway

The determination of whether a site meets the general and media-specific criteria for low-threat closure must be made by the regulatory agency responsible for issuing the closure letter (Water Board 2012). The Navy has provided the comparison with the criteria for low-threat closure in this report to support site closure decisions.

6.0 OVERALL SITE YF3 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this report is to: (1) present the methodology and results of the site ERA (SLERA and Step 3a risk refinement); and (2) present an analysis of the site according to the State Water Board criteria for closure prescribed by the "Low-Threat Underground Storage Tank Closure Policy" (State Water Board 2012). Both the SLERA and low-threat closure analysis were conducted to facilitate site closure decisions for Site YF3.

The purpose of the site ERA was to evaluate whether concentrations of COPECs at Site YF3 site result in unacceptable risks to ecological receptors (aquatic life, benthic invertebrates, birds, and mammals), and to support future site decisions. Although, no chemicals of concern for ecological receptors were identified in the SLERA and the Step 3a risk refinement conducted with the available site data, comments received on the draft report (Appendix F) indicate there are data gaps that must be addressed with further characterization. Therefore, further characterization and evaluation of ecological risk in a BERA is recommended for Site YF3.

Site YF3 was designated as a petroleum site to be addressed under California UST regulations (Title 23 of the California Code of Regulations, Article 11, 2720) (Tetra Tech 2003). As discussed in Section 2.4, several lines of evidence indicate low potential for LNAPL to occur at Site YF3, that any LNAPL present would be at residual LNAPL saturation levels, and that any residual LNAPL present would not be mobile or migrating. Given the limited extent and degraded state of the petroleum hydrocarbons at the site, the site may pose no unacceptable ecological risk, but additional characterization must be conducted to support the ecological risk evaluation. Due to the absence of human exposure pathways, the site poses no risk to human health. The additional data gathered to further characterize and evaluate ecological risk at the site will also be used to further evaluate whether the site is a candidate for low-threat closure based on an analysis of the State Water Board low-threat closure criteria (State Water Board 2012). The Navy will coordinate with the regulatory agencies in planning for the additional data collection.

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FIGURES

Notes:
Aerial imagery courtesy of Geomatic Technologies Group, June 2012.

SLERA Screening-Level Ecological Risk Assessment

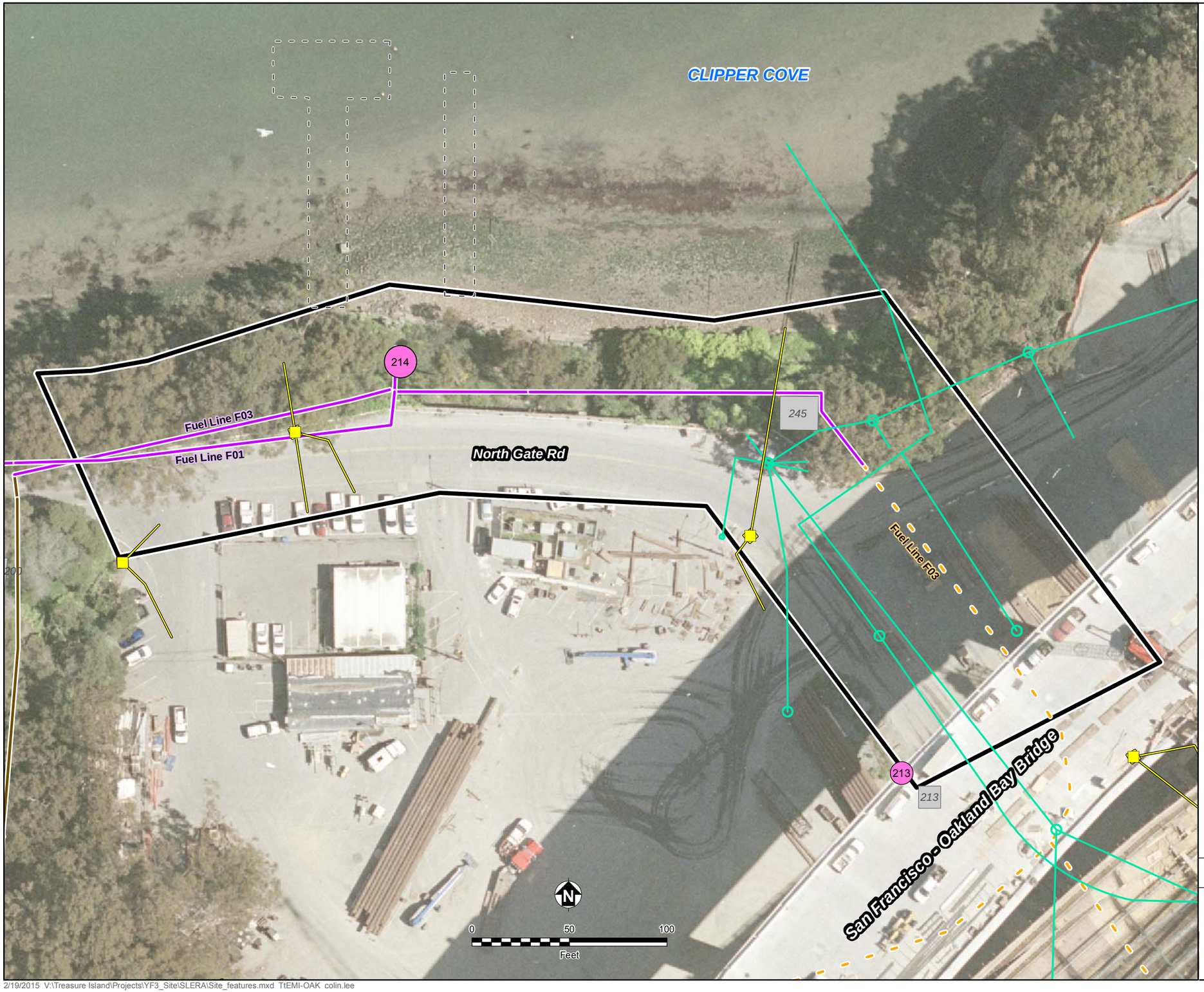
TriEco A Joint Venture

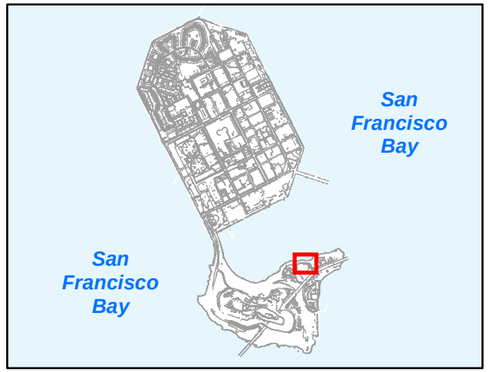
Naval Station Treasure Island
Department of the Navy, BRAC PMO West, San Diego, CA

FIGURE 1
SITE LOCATION

Site YF3 SLERA

4/22/2014 V:\Treasure Island\Projects\YF3_Site\SLERA\Site_Location.mxd TtEMI-OAK colin.lee





Former AST

Storm Line and Catch Basin

Sanitary Line and Manhole

Closed-In-Place Fuel Line

Un-located Portions of Former Fuel Lines

Former Fuel Line

Building

Former Pier

YF3 Site Boundary

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

AST Aboveground Storage Tank
SLERA Screening-Level Ecological Risk Assessment

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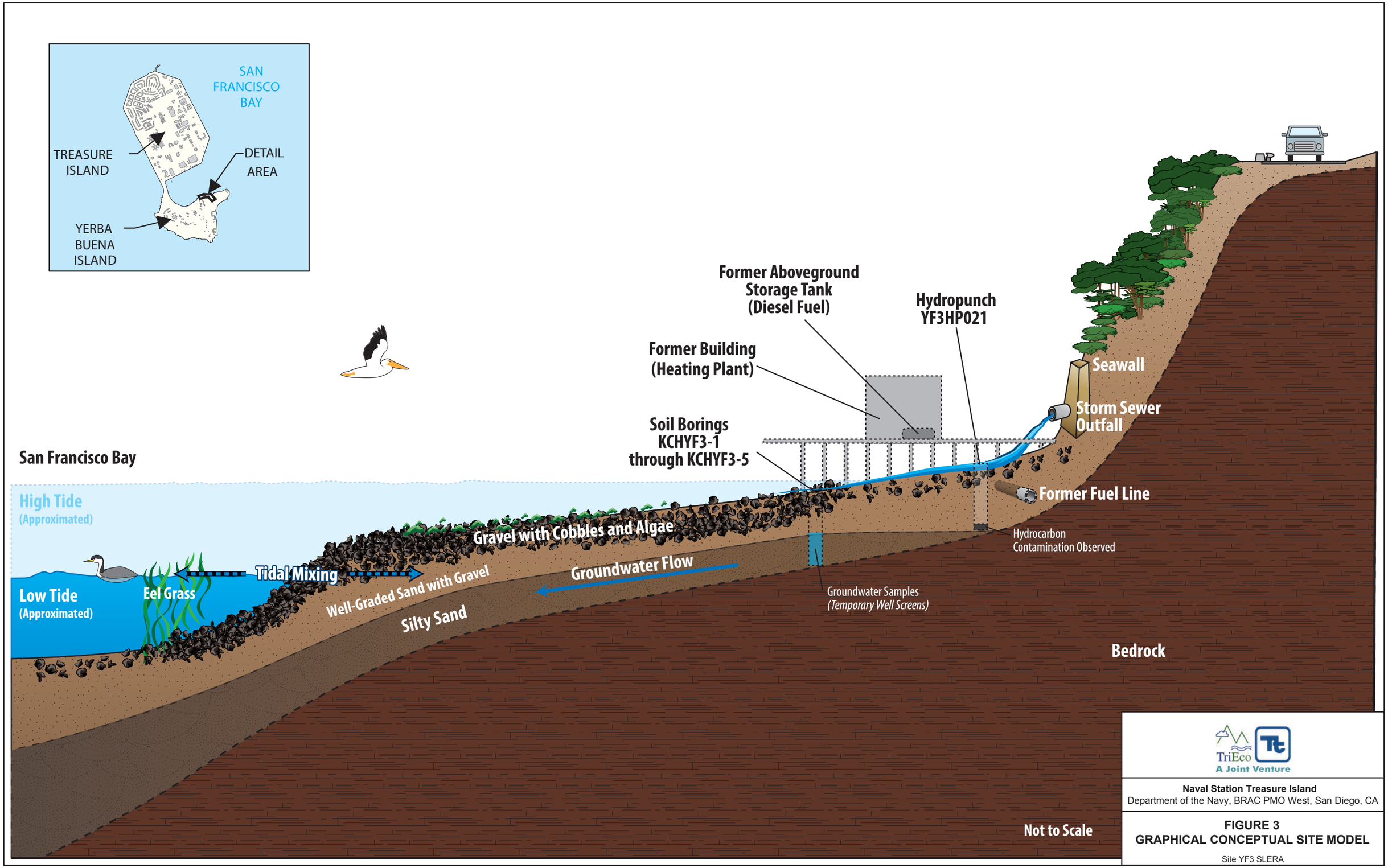
Naval Station Treasure Island

Department of the Navy, BRAC PMO West, San Diego, CA

FIGURE 2
SITE LAYOUT

Site YF3 SLERA

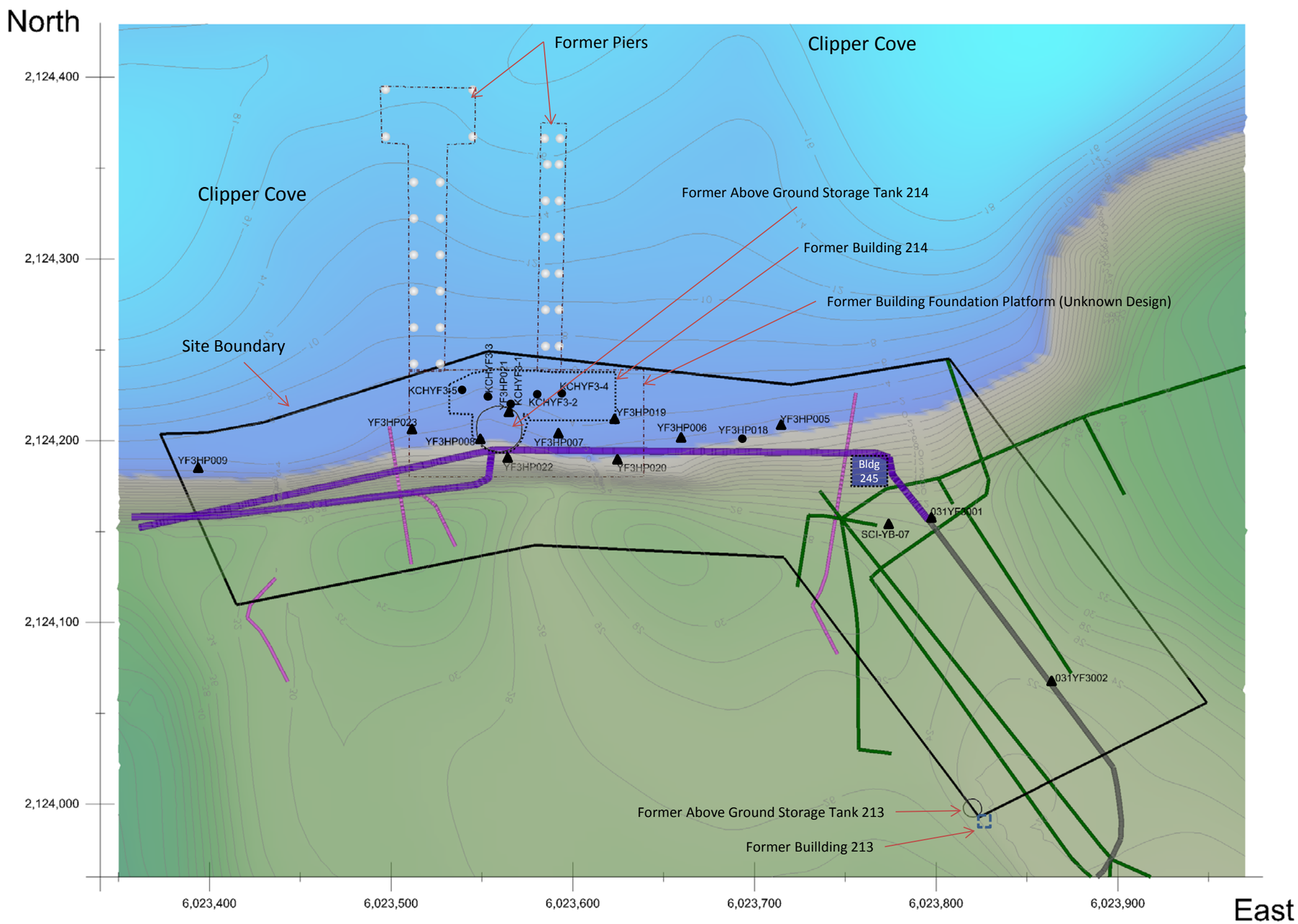
2/19/2015 V:\Treasure Island\Projects\YF3_Site\SLERA\Site_features.mxd TtEMI-OAK colin.lee

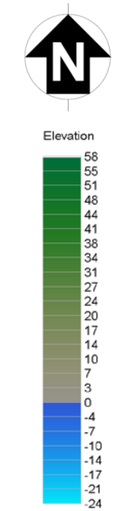


Naval Station Treasure Island
Department of the Navy, BRAC PMO West, San Diego, CA

FIGURE 3
GRAPHICAL CONCEPTUAL SITE MODEL

Site YF3 SLERA





Site Boundary

10 — Iso-Elevation Contour Line (2 ft. Intervals)

KCHYF3-4 — Groundwater Sampling Location

YF3HP005 — Soil Sampling Location

Storm Sewer

Closed In-Place Fuel Line

Sanitary Sewer

Un-located Portions of Former Fuel Lines

Notes:

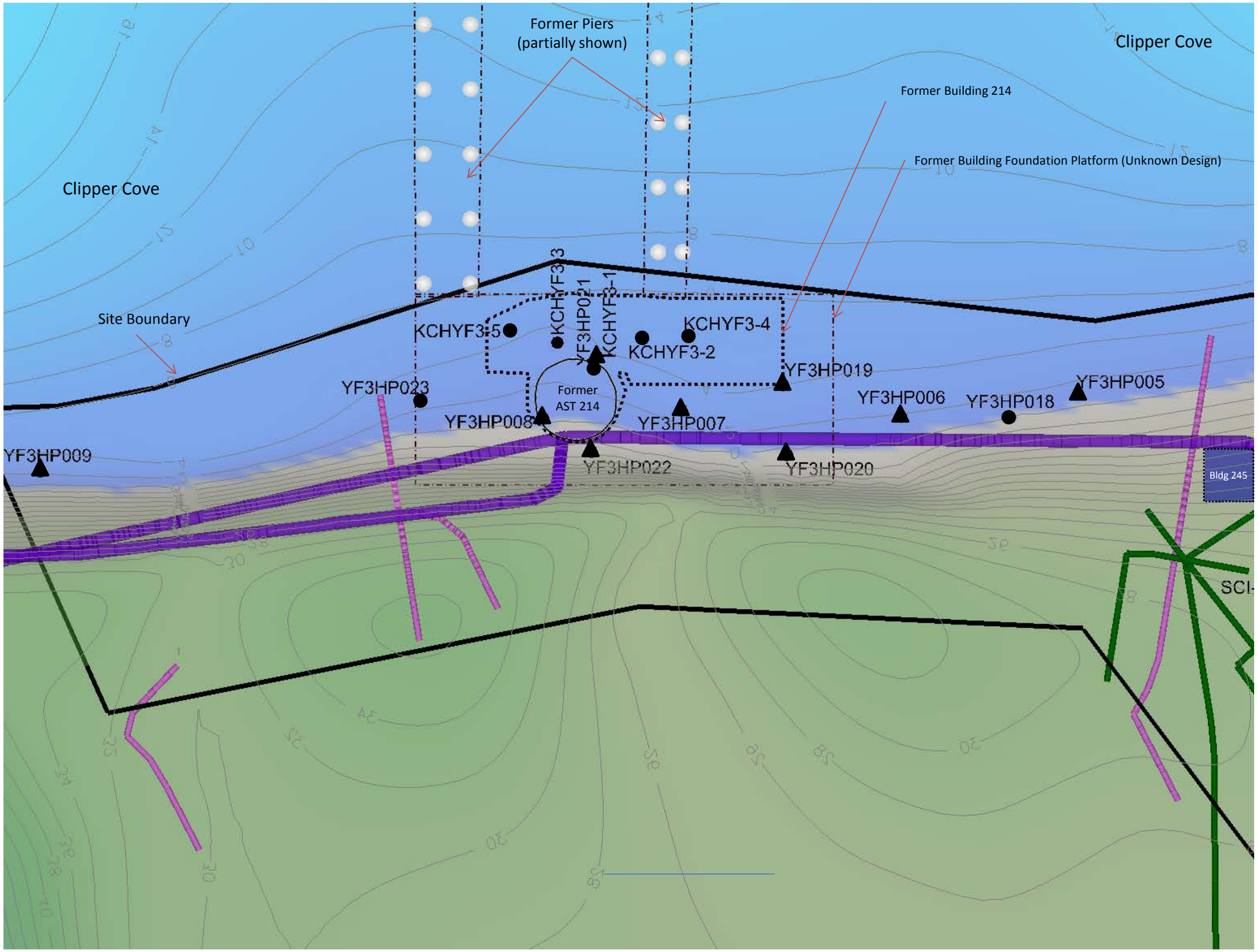
1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. Piers and supports are estimated locations and configurations

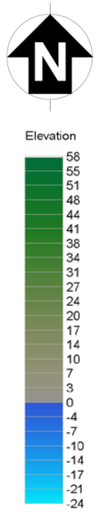
0 15 30 60 120
Feet

TriEco
A Joint Venture

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

FIGURE 4
SITE FEATURES





Site Boundary

10 — Iso-Elevation Contour Line (2 ft. Intervals)

KCHYF3-4 — Groundwater Sampling Location

YF3HP005 — Soil Sampling Location

Storm Sewer

Closed In-Place Fuel Line

Sanitary Sewer

Un-located Portions of Former Fuel Lines

Notes:

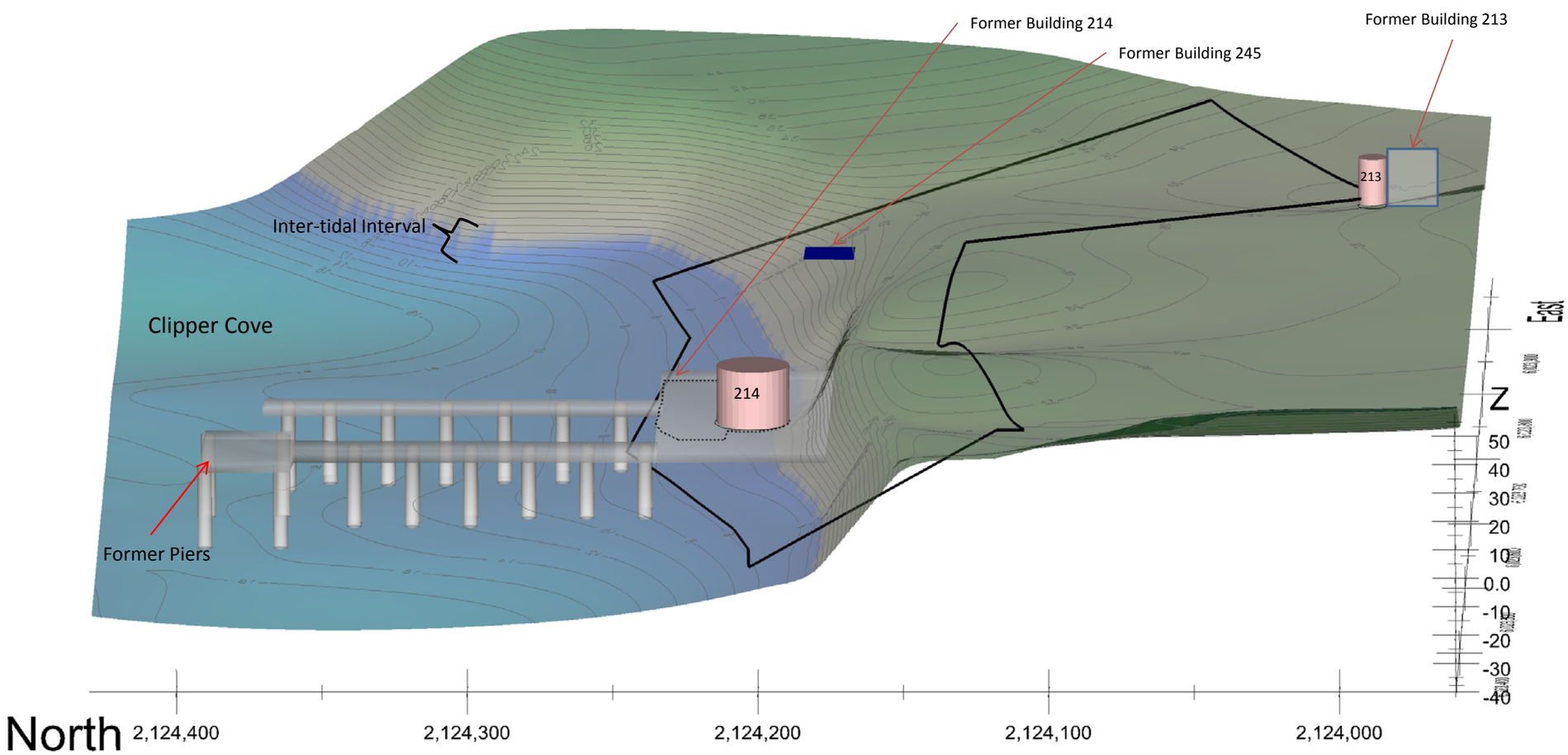
1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. Piers and supports are estimated locations and configurations

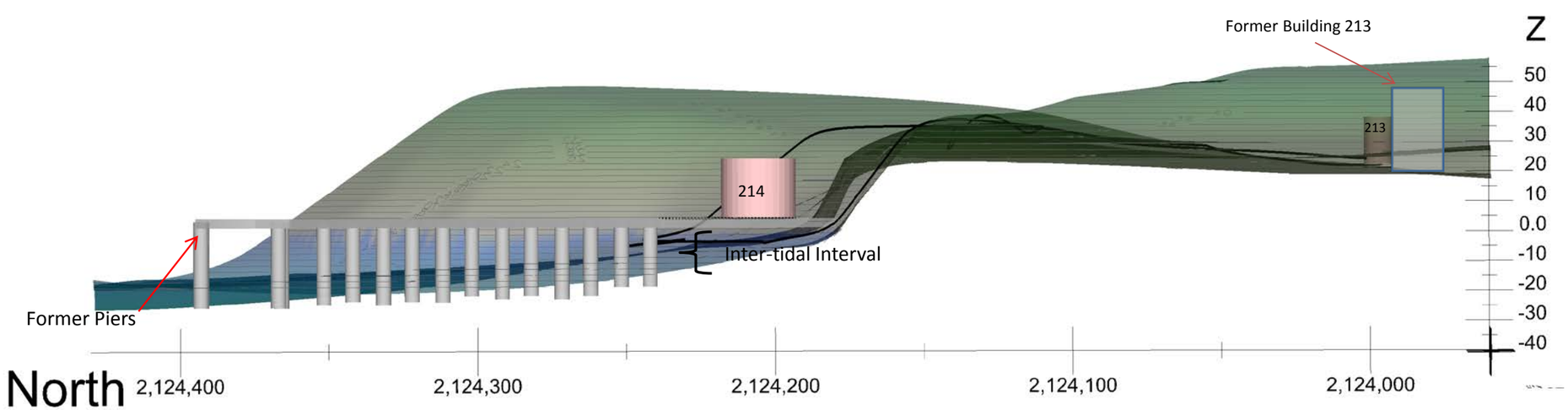
0 7.5 15 30 60
Feet

TriEco
A Joint Venture

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

FIGURE 5
SITE FEATURES (Shoreline Focus)





Elevation
58
55
51
48
44
41
38
34
31
27
24
20
17
14
10
7
3
0
-4
-7
-10
-14
-17
-21
-24

Site Boundary

10 Iso-Elevation Contour Line (2 ft. Intervals)

Former Above Ground Storage Tank

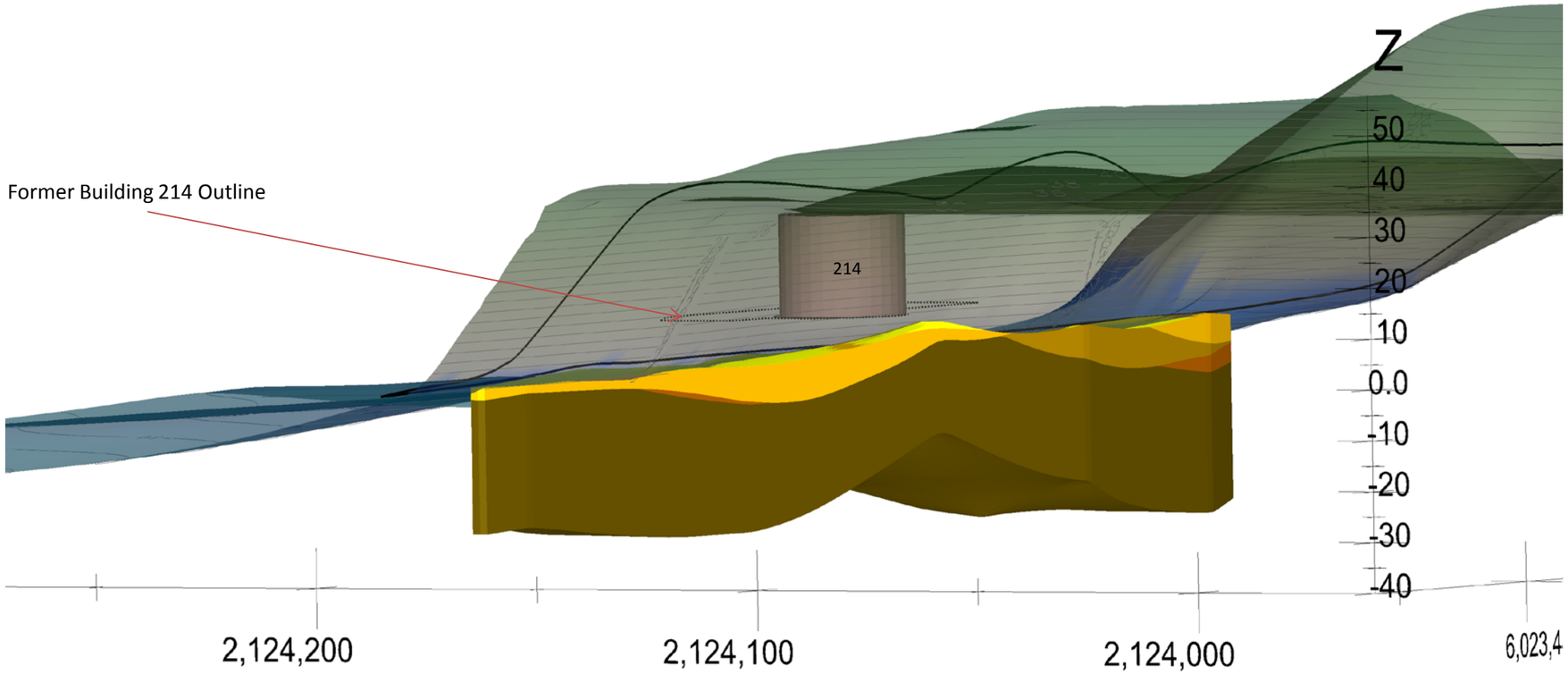
Notes:
1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. Piers and supports are estimated locations and configurations
3. Vertical exaggeration is 1:1

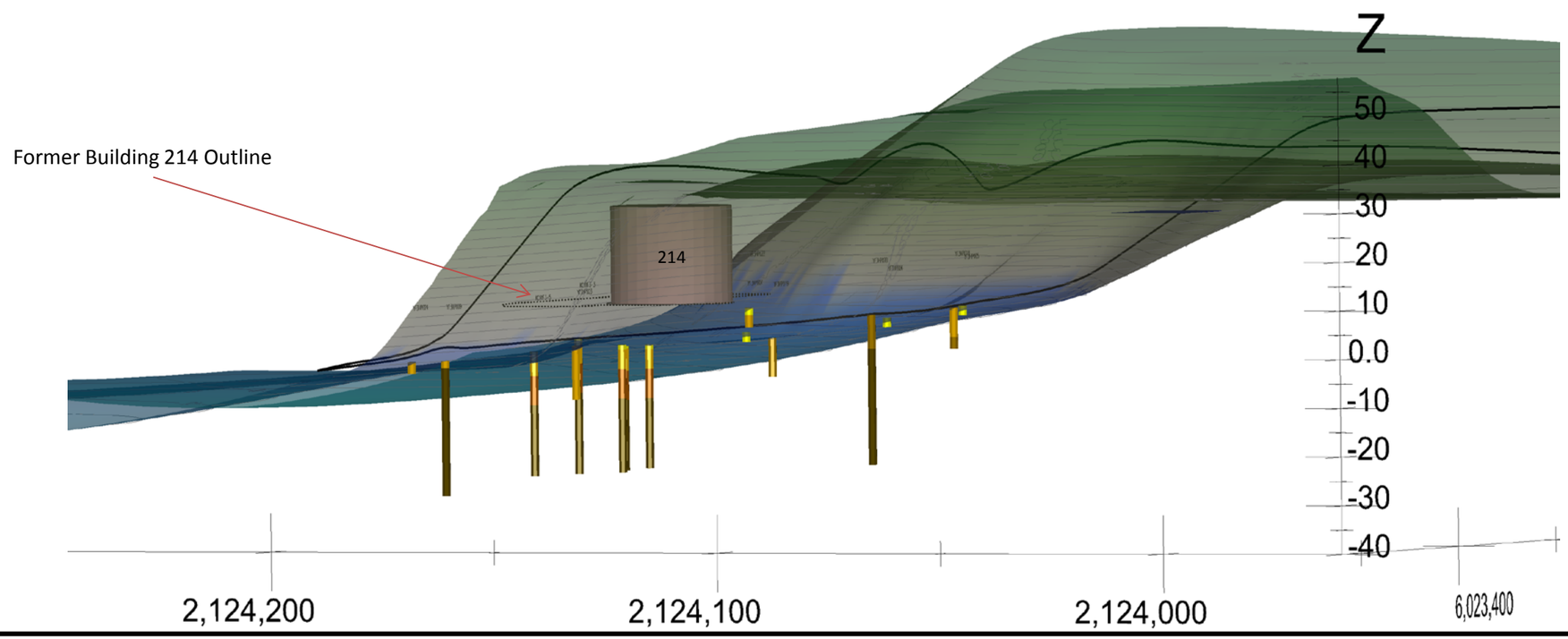
Scale Bar Not Applicable For Oblique View

TriEco A Joint Venture

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

FIGURE 6
SITE PHYSIOGRAPHY – OBLIQUE VIEWS TO EAST





N

Elevation

58
55
51
48
44
41
38
34
31
27
24
20
17
14
10
7
3
0
-4
-7
-10
-14
-17
-21
-24

Lithology

- Sand
- Cobbles
- Gravelly, Silty Sand
- Silty, Sandy Gravel
- Silty Sand
- Bedrock

10 — Iso-Elevation Contour Line (2 ft. Intervals)

Former Above Ground Storage Tank

Notes:

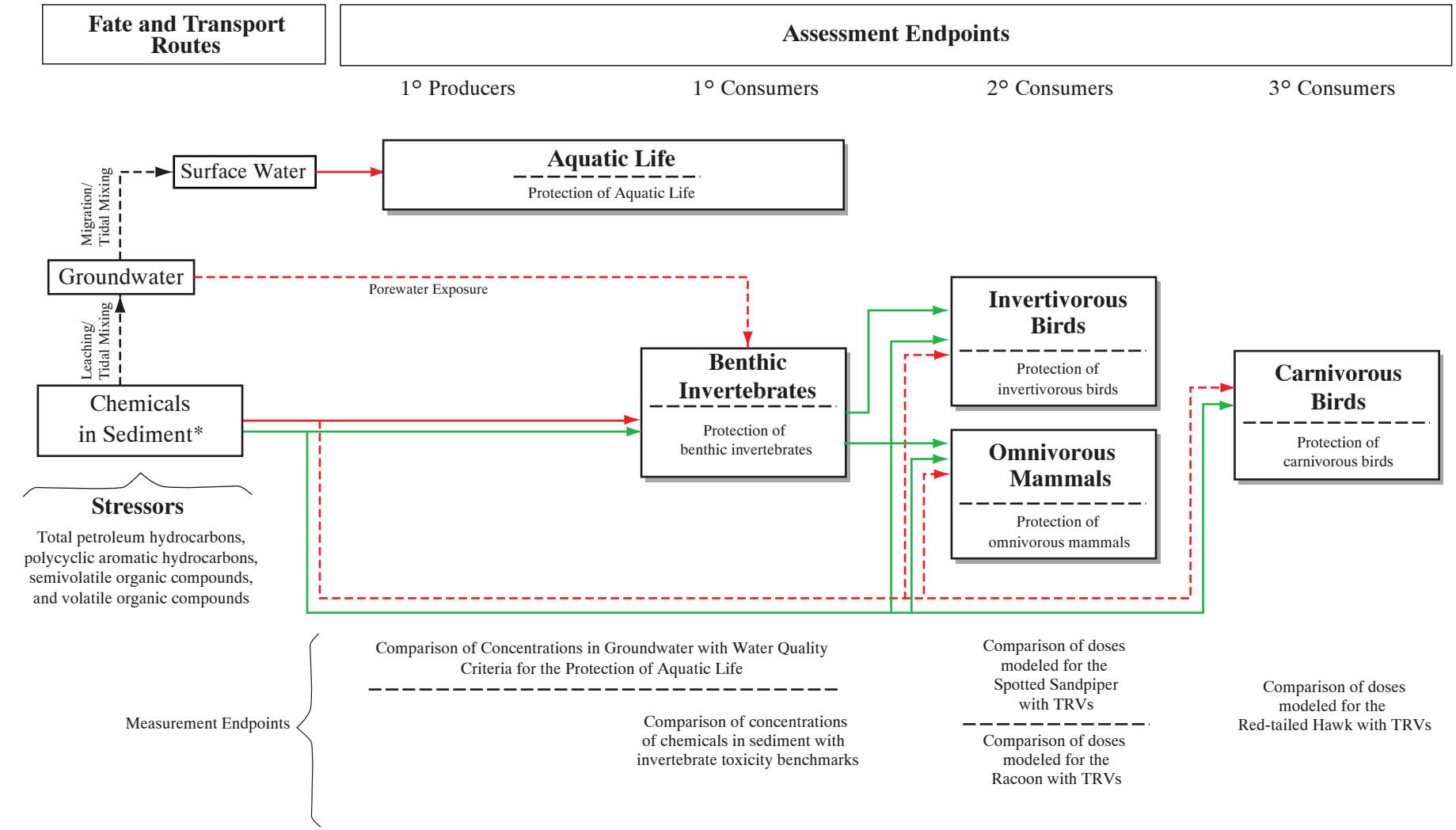
1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. Vertical exaggeration is 1:1

Scale Bar Not Applicable For Oblique View

TriEco
A Joint Venture

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

FIGURE 7
SITE GEOLOGY - OBLIQUE VIEW TO NORTHEAST



Legend

- Ingestion exposure pathway
- Direct contact exposure pathway
- Transport route
- (All colors) Minor transport routes and exposure pathway
- Major transport routes and exposure pathway
- TRV Toxicity Reference Value

*All receptors are exposed to surface sediment (0 to 2 feet below ground surface).

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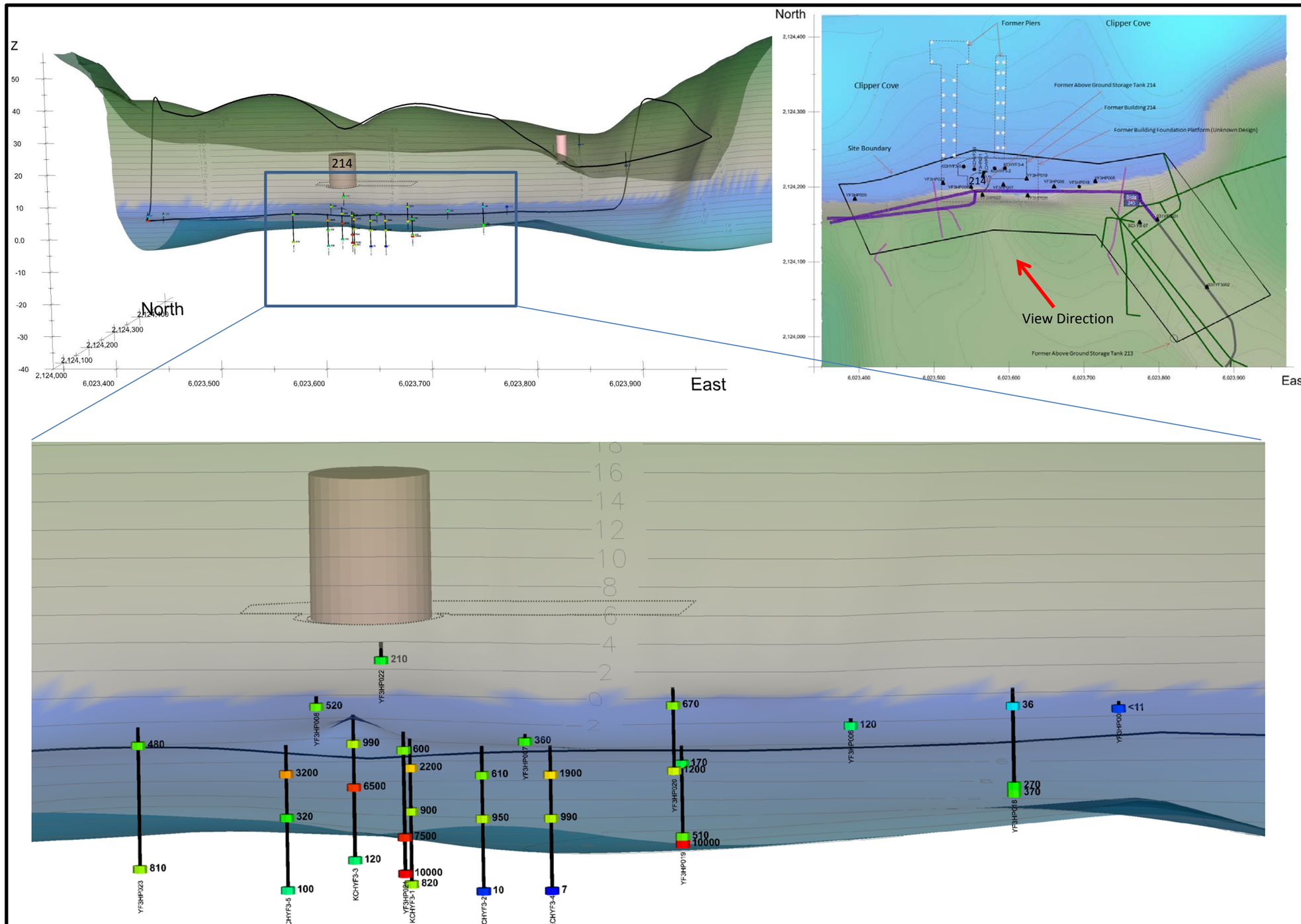
Naval Station Treasure Island
Department of the Navy, BRAC PMO West, San Diego, CA

FIGURE 8
ECOLOGICAL CONCEPTUAL SITE MODEL

Site YF3 SLERA



Notes:

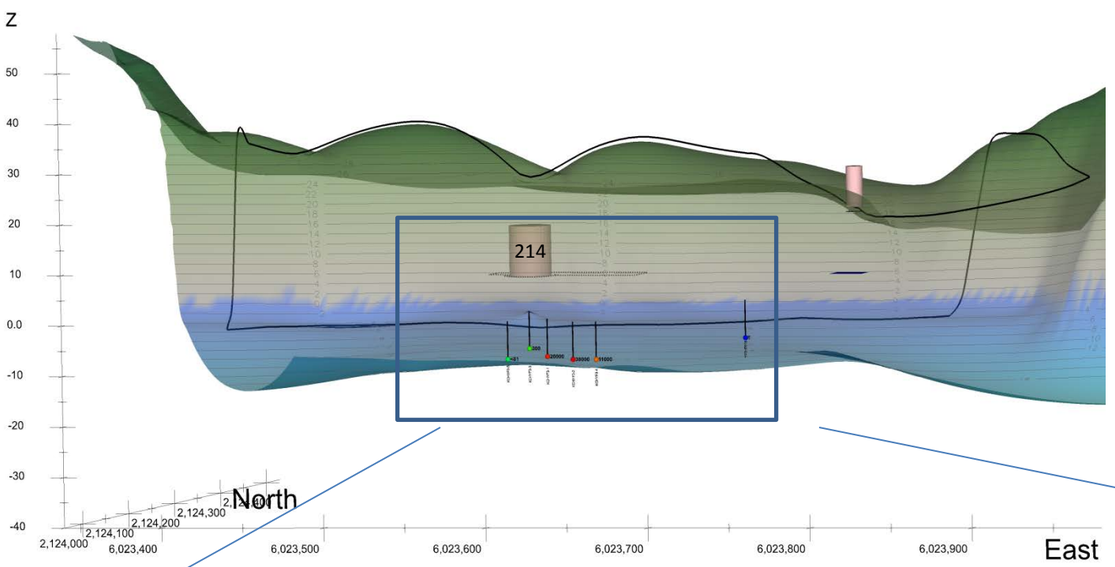
1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. Vertical exaggeration is 3:1

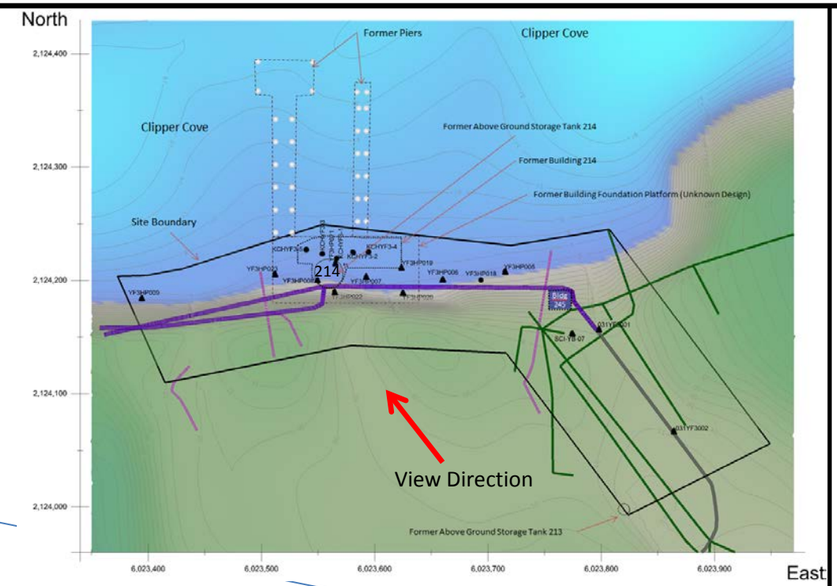
Scale Bar Not Applicable For Oblique View

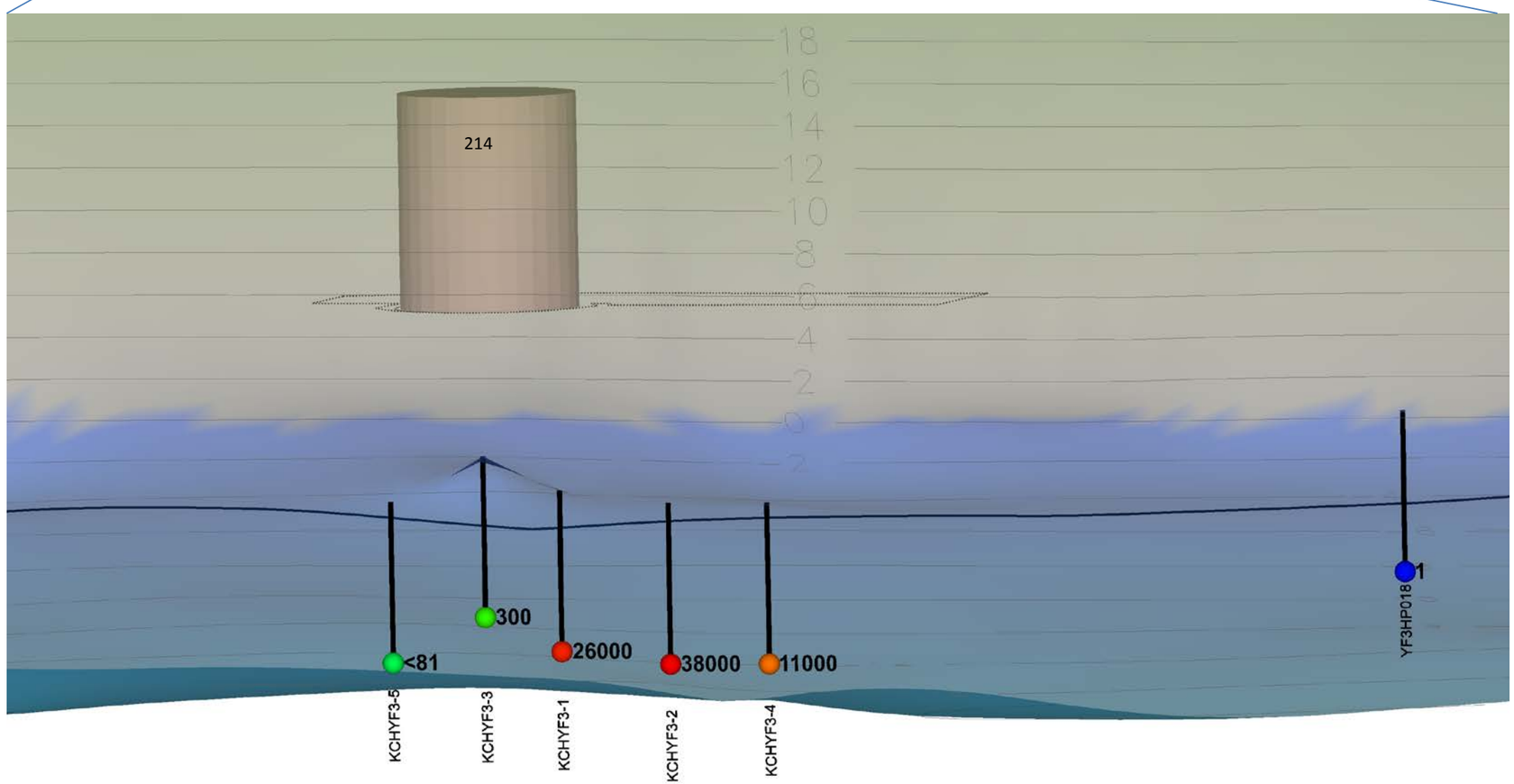
TriEco
A Joint Venture

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

FIGURE 9
TPH-DIESEL IN SEDIMENT







Elevation

58
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51
48
44
41
38
34
31
27
24
20
17
14
10
7
3
0
-4
-7
-10
-14
-17
-21
-24

TPH-diesel in Groundwater (Spheres)

300
KCHYF3-3

30,000 ug/L
10,000 ug/L
3,000 ug/L
1,000 ug/L
300 ug/L
100 ug/L
30 ug/L
10 ug/L
3 ug/L
1 ug/L

10 — Iso-Elevation Contour Line (2 ft. Intervals)

Site Boundary

Former Above Ground Storage Tank

Former Building 214 Outline

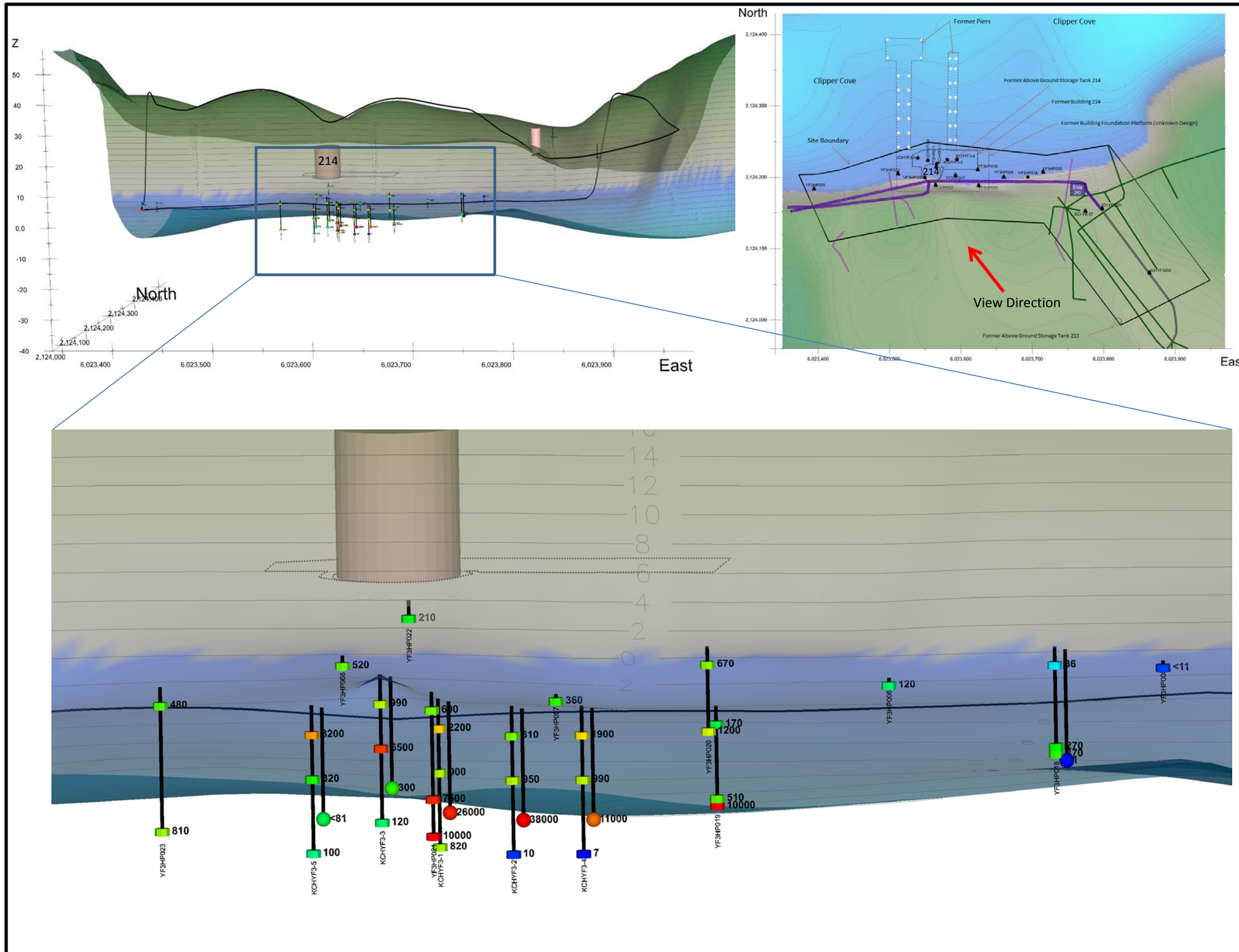
Notes:
1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. Vertical exaggeration is 3:1

Scale Bar Not Applicable For Oblique View

TriEco
A Joint Venture

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

FIGURE 10
TPH-DIESEL IN GROUNDWATER



Notes:

1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. Vertical exaggeration is 3:1

Scale Bar Not Applicable For Oblique View

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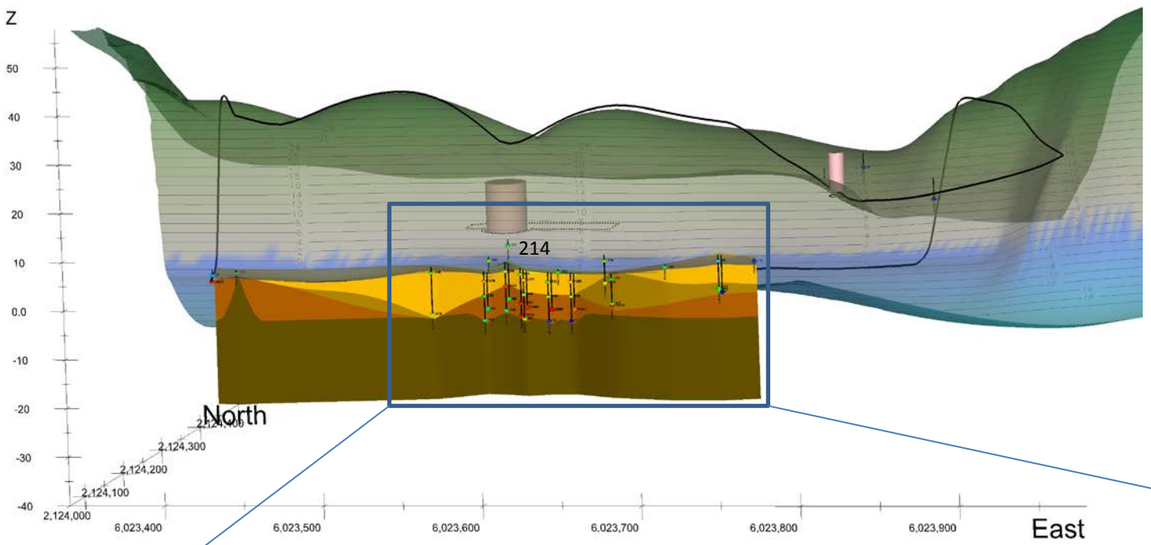
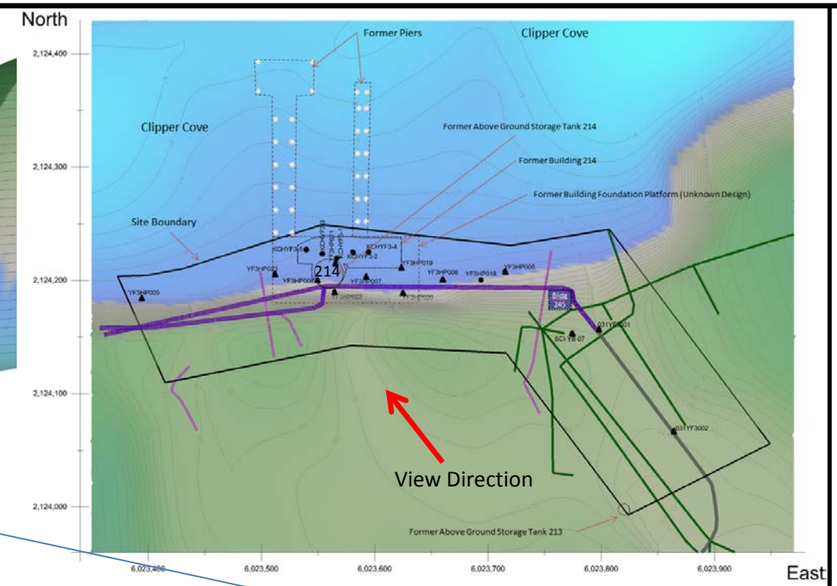
A Joint Venture

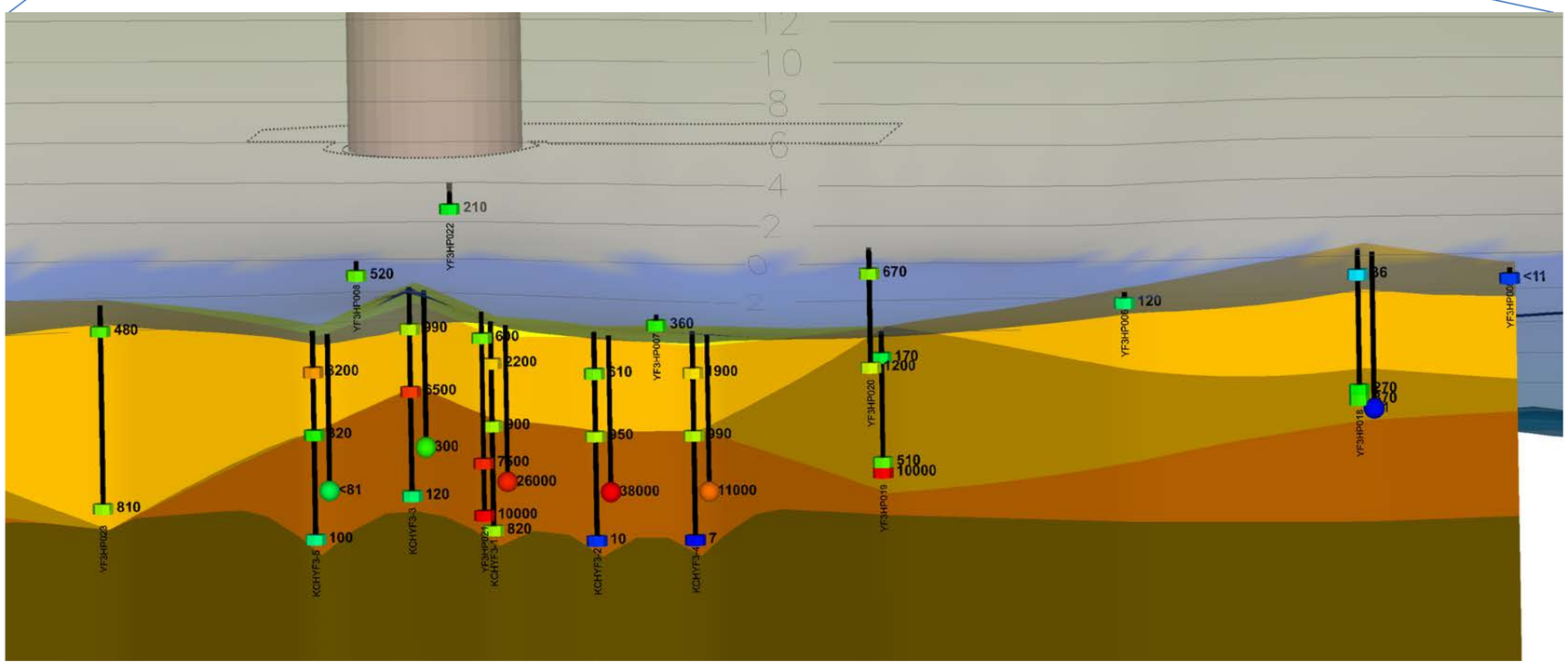
Naval Station Treasure Island
Department of the Navy, BRAC PMO West, San Diego, CA

FIGURE 11
TPH-DIESEL IN SEDIMENT AND GROUNDWATER

214 214







Elevation

58
55
51
48
44
41
38
34
31
27
24
20
17
14
10
7
3
0
-4
-7
-10
-14
-17
-21
-24

Lithology

- Sand
- Cobbles
- Gravelly, Silty Sand
- Silty, Sandy Gravel
- Silty Sand
- Bedrock

TPH-diesel in Groundwater (Spheres)

300 KCHYF3-3

30,000 ug/L
10,000 ug/L
3,000 ug/L
1,000 ug/L
300 ug/L
100 ug/L
30 ug/L
10 ug/L
3 ug/L
1 ug/L

TPH-diesel in Sediment (Cylinders)

100 KCHYF3-3

10,000 mg/Kg
1,000 mg/Kg
100 mg/Kg
10 mg/Kg
1 mg/Kg
0.1 mg/Kg
0.01 mg/Kg
0.001 mg/Kg

10 Iso-Elevation Contour Line (2 ft. Intervals)

Site Boundary

Former Above Ground Storage Tank

Former Building 214 Outline

Notes:

1. Coordinate System: NAD 1983 California State Plane Zone 3, US Survey feet
2. Vertical exaggeration is 3:1

Scale Bar Not Applicable For Oblique View

TriEco
A Joint Venture

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

FIGURE 12
TPH-DIESEL IN SEDIMENT AND GROUNDWATER WITH GEOLOGIC CROSS-SECTION

TABLES

TABLE 1: SUMMARY STATISTICS FOR SEDIMENT (0 TO 2 FEET BGS)

Site YF3 Screening-Level Ecological Risk Assessment, 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	2-METHYLNAPHTHALENE	--	3 / 5	0	2.00E-03	2.00E-03	1.50E-02	3.50E-01	KCHYF3-5	2 - 2	--	--	(1)	3.50E-01
	ACENAPHTHENE	--	1 / 5	0	2.20E-03	2.60E-03	1.60E-01	1.60E-01	KCHYF3-5	2 - 2	--	--	(1)	1.60E-01
	ACENAPHTHYLENE	--	2 / 5	0	2.00E-03	2.40E-03	5.20E-02	1.10E-01	KCHYF3-5	2 - 2	--	--	(1)	1.10E-01
	ANTHRACENE	--	2 / 5	0	1.80E-03	2.00E-03	2.70E-01	2.90E-01	KCHYF3-1	2 - 2	--	--	(1)	2.90E-01
	BENZO(A)ANTHRACENE	--	4 / 5	0	2.00E-03	2.00E-03	1.60E-02	3.80E-01	KCHYF3-1	2 - 2	--	--	(1)	3.80E-01
	BENZO(A)PYRENE	--	5 / 5	0	--	--	1.50E-02	3.00E-01	KCHYF3-1	2 - 2	--	--	(1)	3.00E-01
	BENZO(B)FLUORANTHENE	--	5 / 5	0	--	--	2.40E-02 J	3.70E-01 J	KCHYF3-1	2 - 2	--	--	(1)	3.70E-01
	BENZO(G,H,I)PERYLENE	--	5 / 5	0	--	--	1.20E-02	1.70E-01	KCHYF3-1	2 - 2	--	--	(1)	1.70E-01
	BENZO(K)FLUORANTHENE	--	5 / 5	0	--	--	2.90E-02 J	4.50E-01 J	KCHYF3-1	2 - 2	--	--	(1)	4.50E-01
	CHRYSENE	--	4 / 5	0	1.80E-03	1.80E-03	2.60E-02	5.20E-01	KCHYF3-1	2 - 2	--	--	(1)	5.20E-01
	DIBENZ(A,H)ANTHRACENE	--	4 / 5	0	2.00E-03	2.00E-03	4.60E-03 J	7.80E-02	KCHYF3-1	2 - 2	--	--	(1)	7.80E-02
	FLUORANTHENE	--	4 / 5	0	2.60E-03	2.60E-03	3.40E-02	4.30E-01	KCHYF3-1	2 - 2	--	--	(1)	4.30E-01
	FLUORENE	--	2 / 5	0	2.20E-03	2.60E-03	2.80E-02	4.50E-01	KCHYF3-5	2 - 2	--	--	(1)	4.50E-01
	INDENO(1,2,3-CD)PYRENE	--	5 / 5	0	--	--	1.00E-02	2.00E-01	KCHYF3-1	2 - 2	--	--	(1)	2.00E-01
	NAPHTHALENE	--	5 / 5	0	--	--	2.30E-03 J	1.00E-01	KCHYF3-5	2 - 2	--	--	(1)	1.00E-01
	PHENANTHRENE	--	3 / 5	0	2.40E-03	2.80E-03	3.20E-02	1.20E+00	KCHYF3-5	2 - 2	--	--	(1)	1.20E+00
	PYRENE	--	5 / 5	0	--	--	9.50E-02	8.60E-01	KCHYF3-1	2 - 2	--	--	(1)	8.60E-01
	TOTAL HMW PAH	--	5 / 5	0	--	--	2.66E-01	3.76E+00	KCHYF3-1	2 - 2	--	--	(1)	3.76E+00
	TOTAL LMW PAH	--	5 / 5	0	--	--	2.30E-03	2.96E+00	KCHYF3-5	2 - 2	--	--	(1)	2.96E+00
	TOTAL PAH	--	5 / 5	0	--	--	3.96E-01	4.64E+00	KCHYF3-5	2 - 2	--	--	(1)	4.64E+00
TPH	DIESEL RANGE ORGANICS	G	16 / 17	0	1.10E+01	1.10E+01	2.70E+01 H	3.20E+03	KCHYF3-5	2 - 2	7.22E+02	1.34E+03	(5)	1.34E+03
	GASOLINE RANGE ORGANICS	LN	6 / 17	0	2.10E-01	8.80E-01	5.50E-01 H	4.40E+02 J	KCHYF3-3	2 - 2	2.70E+01	3.00E+02	(8)	3.00E+02
	MOTOR OIL RANGE ORGANICS	N	14 / 17	0	5.70E+01	4.60E+02	1.00E+02 M	2.20E+03	KCHYF3-5	2 - 2	9.37E+02	1.26E+03	(3)	1.26E+03
VOC	1,2,4-TRIMETHYLBENZENE	--	1 / 5	1	2.00E-02	2.40E-02	1.00E-01	1.00E-01	KCHYF3-5	2 - 2	--	--	(1)	1.00E-01
	1,3,5-TRIMETHYLBENZENE	--	1 / 5	1	1.30E-02	1.54E-02	3.80E-02 J	3.80E-02 J	KCHYF3-5	2 - 2	--	--	(1)	3.80E-02
	2-BUTANONE	--	2 / 5	0	6.60E-02	7.80E-02	4.50E-01 J	1.70E+00 J	KCHYF3-3	2 - 2	--	--	(1)	1.70E+00
	4-ISOPROPYLTOLUENE	--	1 / 5	1	1.30E-02	1.54E-02	4.40E-02 J	4.40E-02 J	KCHYF3-5	2 - 2	--	--	(1)	4.40E-02
	ACETONE	--	3 / 5	1	3.20E-01	3.20E-01	1.80E-01 J	4.00E-01 J	KCHYF3-1	2 - 2	--	--	(1)	4.00E-01
	BROMOMETHANE	--	1 / 5	1	2.60E-02	3.00E-02	3.80E-02 J	3.80E-02 J	KCHYF3-1	2 - 2	--	--	(1)	3.80E-02
	CARBON DISULFIDE	--	2 / 5	1	2.20E-02	2.60E-02	4.00E-02 J	6.80E-02	KCHYF3-1	2 - 2	--	--	(1)	6.80E-02
	CHLOROMETHANE	--	2 / 5	3	--	--	1.90E-02 J	2.40E-02 J	KCHYF3-2	2 - 2	--	--	(1)	2.40E-02
	ETHYLBENZENE	--	1 / 5	4	--	--	2.40E-02 J	2.40E-02 J	KCHYF3-5	2 - 2	--	--	(1)	2.40E-02
	ISOPROPYLBENZENE	--	1 / 5	1	1.74E-02	2.00E-02	2.60E-02 J	2.60E-02 J	KCHYF3-5	2 - 2	--	--	(1)	2.60E-02
	M- AND P-XYLENE	--	1 / 5	2	4.40E-02	4.40E-02	4.50E-02 J	4.50E-02 J	KCHYF3-5	2 - 2	--	--	(1)	4.50E-02
	METHYLENE CHLORIDE	--	2 / 5	0	3.80E-02	3.80E-02	3.70E-02 J	7.80E-01 J	KCHYF3-3	2 - 2	--	--	(1)	7.80E-01
	N-BUTYLBENZENE	--	1 / 5	1	1.64E-02	1.94E-02	1.00E-01	1.00E-01	KCHYF3-5	2 - 2	--	--	(1)	1.00E-01
	O-XYLENE	--	1 / 5	3	2.00E-02	2.00E-02	2.10E-02 J	2.10E-02 J	KCHYF3-5	2 - 2	--	--	(1)	2.10E-02
	PROPYLBENZENE	--	1 / 5	1	2.20E-02	2.80E-02	4.70E-02 J	4.70E-02 J	KCHYF3-5	2 - 2	--	--	(1)	4.70E-02
	SEC-BUTYLBENZENE	--	2 / 5	0	1.30E-02	1.54E-02	5.80E-02	4.30E-01 J	KCHYF3-3	2 - 2	--	--	(1)	4.30E-01
	TOLUENE	--	1 / 5	4	--	--	1.20E-02 J	1.20E-02 J	KCHYF3-5	2 - 2	--	--	(1)	1.20E-02

TABLE 1: SUMMARY STATISTICS FOR SEDIMENT (0 TO 2 FEET BGS)

Site YF3 Screening-Level Ecological Risk Assessment, 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
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

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 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 2: SUMMARY STATISTICS FOR SEDIMENT (0 TO 5 FEET BGS)

Site YF3 Screening-Level Ecological Risk Assessment, 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						
Metals	BARIUM	--	1 / 1	0	--	--	3.30E+01 J	3.30E+01 J	SCI-YB-07	3.5 - 4	--	--	(1)	3.30E+01
	BERYLLIUM	--	1 / 1	0	--	--	1.30E-01 J	1.30E-01 J	SCI-YB-07	3.5 - 4	--	--	(1)	1.30E-01
	CADMIUM	--	1 / 1	0	--	--	1.30E-01 J	1.30E-01 J	SCI-YB-07	3.5 - 4	--	--	(1)	1.30E-01
	CHROMIUM	--	1 / 1	0	--	--	7.40E+00 J	7.40E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	7.40E+00
	COBALT	--	1 / 1	0	--	--	1.80E+00 J	1.80E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	1.80E+00
	COPPER	--	1 / 1	0	--	--	2.60E+00 J	2.60E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	2.60E+00
	LEAD	--	1 / 1	0	--	--	1.50E+00 J	1.50E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	1.50E+00
	NICKEL	--	1 / 1	0	--	--	3.10E+00 J	3.10E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	3.10E+00
	ZINC	--	1 / 1	0	--	--	5.60E+00 J	5.60E+00 J	SCI-YB-07	2 - 2	--	--	(1)	5.60E+00
PAH	2-METHYLNAPHTHALENE	NP	6 / 12	0	2.00E-03	3.50E-01	1.10E-02	3.50E-01	KCHYF3-5	5 - 5	3.79E-02	9.49E-02	(9)	9.49E-02
	ACENAPHTHENE	--	2 / 12	0	2.20E-03	3.50E-01	1.60E-01	6.70E-01	KCHYF3-3	5 - 5	--	--	(1)	6.70E-01
	ACENAPHTHYLENE	--	4 / 12	0	2.00E-03	3.50E-01	3.00E-02	3.90E-01	KCHYF3-3	5 - 5	--	--	(1)	3.90E-01
	ANTHRACENE	--	4 / 12	0	1.80E-03	3.50E-01	4.10E-02	7.60E-01	KCHYF3-3	2 - 2	--	--	(1)	7.60E-01
	BENZO(A)ANTHRACENE	N	8 / 12	0	2.00E-03	3.50E-01	1.60E-02	3.80E-01	KCHYF3-1	2 - 2	8.44E-02	1.46E-01	(3)	1.46E-01
	BENZO(A)PYRENE	G	10 / 12	2	--	--	1.50E-02	3.00E-01	KCHYF3-1	2 - 2	8.51E-02	1.69E-01	(4)	1.69E-01
	BENZO(B)FLUORANTHENE	G	10 / 12	0	3.40E-01	3.50E-01	2.40E-02 J	3.70E-01 J	KCHYF3-1	2 - 2	1.08E-01	1.87E-01	(5)	1.87E-01
	BENZO(G,H,I)PERYLENE	N	10 / 12	2	--	--	1.20E-02	1.70E-01	KCHYF3-1	2 - 2	5.80E-02	8.70E-02	(2)	8.70E-02
	BENZO(K)FLUORANTHENE	G	10 / 12	0	3.40E-01	3.50E-01	2.90E-02 J	4.50E-01 J	KCHYF3-1	2 - 2	1.29E-01	2.26E-01	(5)	2.26E-01
	CHRYSENE	N	8 / 12	0	1.80E-03	3.50E-01	2.60E-02	5.20E-01	KCHYF3-1	2 - 2	1.48E-01	2.44E-01	(3)	2.44E-01
	DIBENZ(A,H)ANTHRACENE	G	7 / 12	2	2.00E-03	2.00E-03	4.60E-03 J	7.80E-02	KCHYF3-1	5 - 5	1.86E-01	4.62E-02	(5)	4.62E-02
	FLUORANTHENE	N	8 / 12	0	2.60E-03	3.50E-01	3.40E-02	5.10E-01	KCHYF3-3	5 - 5	1.46E-01	2.39E-01	(3)	2.39E-01
	FLUORENE	--	4 / 12	0	2.20E-03	3.50E-01	1.40E-02	2.90E+00	KCHYF3-3	2 - 2	--	--	(1)	2.90E+00
	INDENO(1,2,3-CD)PYRENE	G	10 / 12	2	--	--	1.00E-02	2.00E-01	KCHYF3-1	2 - 2	5.83E-02	1.11E-01	(4)	1.11E-01
	NAPHTHALENE	G	10 / 12	2	--	--	2.30E-03 J	1.00E-01	KCHYF3-5	5 - 5	2.93E-02	7.03E-02	(4)	7.03E-02
	PHENANTHRENE	--	5 / 12	0	2.40E-03	3.50E-01	3.20E-02	3.30E+00	KCHYF3-3	2 - 2	--	--	(1)	3.30E+00
	PYRENE	LN	10 / 12	0	3.40E-01	3.50E-01	9.50E-02	8.60E-01	KCHYF3-1	2 - 2	2.98E-01	6.11E-01	(6)	6.11E-01
	TOTAL HMW PAH	G	10 / 12	0	--	--	2.66E-01	3.76E+00	KCHYF3-1	5 - 5	1.20E+00	2.33E+00	(4)	2.33E+00
	TOTAL LMW PAH	G	10 / 12	0	--	--	2.30E-03	8.10E+00	KCHYF3-3	5 - 5	1.36E+00	7.21E+00	(4)	7.21E+00
	TOTAL PAH	G	10 / 12	0	--	--	3.96E-01	1.08E+01	KCHYF3-3	2.5 - 3	2.56E+00	6.19E+00	(4)	6.19E+00
TPH	DIESEL RANGE ORGANICS	G	22 / 25	0	1.00E+01	1.10E+01	2.70E+01 H	6.80E+03 DH	YF3HP024	2.5 - 3	1.15E+03	2.18E+03	(5)	2.18E+03
	GASOLINE RANGE ORGANICS	LN	9 / 24	0	2.10E-01	1.00E+00	5.50E-01 H	4.40E+02 J	KCHYF3-3	2 - 2	2.25E+01	2.13E+02	(8)	2.13E+02
	MOTOR OIL RANGE ORGANICS	N	20 / 25	0	1.00E+01	4.60E+02	1.00E+02 M	3.10E+03 LM	YF3HP024	2.5 - 3	9.70E+02	1.39E+03	(3)	1.39E+03

TABLE 2: SUMMARY STATISTICS FOR SEDIMENT (0 TO 5 FEET BGS)

Site YF3 Screening-Level Ecological Risk Assessment, 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						
VOC	1,2,4-TRIMETHYLBENZENE	--	1 / 10	1	2.00E-02	2.40E-02	1.00E-01	1.00E-01	KCHYF3-5	2 - 2	--	--	(1)	1.00E-01
	1,3,5-TRIMETHYLBENZENE	--	1 / 10	1	1.26E-02	1.54E-02	3.80E-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
	4-ISOPROPYLTOLUENE	--	1 / 10	1	1.26E-02	1.54E-02	4.40E-02 J	4.40E-02 J	KCHYF3-5	5 - 5	--	--	(1)	4.40E-02
	ACETONE	N	6 / 10	1	3.00E-01	3.20E-01	1.80E-01 J	4.20E-01 J	KCHYF3-1	2 - 2	2.62E-01	3.22E-01	(3)	3.22E-01
	BROMOMETHANE	--	4 / 10	1	2.60E-02	3.00E-02	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	2.60E-02	2.10E-02 J	6.80E-02	KCHYF3-1	5 - 5	3.07E-02	4.06E-02	(3)	4.06E-02
	CHLOROMETHANE	N	6 / 10	4	--	--	1.80E-02 J	2.90E-02 J	KCHYF3-5	2 - 2	2.25E-02	2.58E-02	(2)	2.58E-02
	ETHYLBENZENE	--	1 / 10	7	2.40E-02	2.40E-02	2.40E-02 J	2.40E-02 J	KCHYF3-5	2 - 2	--	--	(1)	2.40E-02
	ISOPROPYLBENZENE	--	1 / 10	1	1.70E-02	2.00E-02	2.60E-02 J	2.60E-02 J	KCHYF3-5	2 - 2	--	--	(1)	2.60E-02
	M- AND P-XYLENE	--	1 / 10	2	4.20E-02	4.40E-02	4.50E-02 J	4.50E-02 J	KCHYF3-5	2 - 2	--	--	(1)	4.50E-02
	METHYLENE CHLORIDE	LN	6 / 10	0	3.80E-02	3.80E-02	2.10E-02 J	7.80E-01 J	KCHYF3-3	2 - 2	1.08E-01	5.93E-01	(7)	5.93E-01
	N-BUTYLBENZENE	--	1 / 10	1	1.58E-02	1.94E-02	1.00E-01	1.00E-01	KCHYF3-5	2 - 2	--	--	(1)	1.00E-01
	O-XYLENE	--	1 / 10	4	2.00E-02	2.00E-02	2.10E-02 J	2.10E-02 J	KCHYF3-5	2 - 2	--	--	(1)	2.10E-02
	PROPYLBENZENE	--	1 / 10	1	2.20E-02	2.80E-02	4.70E-02 J	4.70E-02 J	KCHYF3-5	2 - 2	--	--	(1)	4.70E-02
	SEC-BUTYLBENZENE	--	2 / 10	0	1.26E-02	1.54E-02	5.80E-02	4.30E-01 J	KCHYF3-3	2 - 2	--	--	(1)	4.30E-01
	TOLUENE	--	1 / 10	9	--	--	1.20E-02 J	1.20E-02 J	KCHYF3-5	2 - 2	--	--	(1)	1.20E-02

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
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

TABLE 2: SUMMARY STATISTICS FOR SEDIMENT (0 TO 5 FEET BGS)

Site YF3 Screening-Level Ecological Risk Assessment, 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						

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

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 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 3: SUMMARY STATISTICS FOR SEDIMENT (0 TO 10 FEET BGS)

Site YF3 Screening-Level Ecological Risk Assessment, 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						
Metals	BARIUM	--	1 / 1	0	--	--	3.30E+01 J	3.30E+01 J	SCI-YB-07	9.5 - 10	--	--	(1)	3.30E+01
	BERYLLIUM	--	1 / 1	0	--	--	1.30E-01 J	1.30E-01 J	SCI-YB-07	3.5 - 4	--	--	(1)	1.30E-01
	CADMIUM	--	1 / 1	0	--	--	1.30E-01 J	1.30E-01 J	SCI-YB-07	3.5 - 4	--	--	(1)	1.30E-01
	CHROMIUM	--	1 / 1	0	--	--	7.40E+00 J	7.40E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	7.40E+00
	COBALT	--	1 / 1	0	--	--	1.80E+00 J	1.80E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	1.80E+00
	COPPER	--	1 / 1	0	--	--	2.60E+00 J	2.60E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	2.60E+00
	LEAD	--	1 / 1	0	--	--	1.50E+00 J	1.50E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	1.50E+00
	NICKEL	--	1 / 1	0	--	--	3.10E+00 J	3.10E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	3.10E+00
	ZINC	--	1 / 1	0	--	--	5.60E+00 J	5.60E+00 J	SCI-YB-07	3.5 - 4	--	--	(1)	5.60E+00
PAH	2-METHYLNAPHTHALENE	NP	11 / 17	0	2.00E-03	3.50E-01	5.50E-03 J	5.70E-01 J	KCHYF3-1	10 - 10	6.19E-02	4.42E-01	(8)	4.42E-01
	ACENAPHTHENE	N	7 / 17	0	2.20E-03	3.50E-01	1.70E-03 J	6.70E-01	KCHYF3-3	5 - 5	6.32E-02	1.37E-01	(3)	1.37E-01
	ACENAPHTHYLENE	G	9 / 17	0	2.00E-03	3.50E-01	1.60E-03 J	3.90E-01	KCHYF3-3	5 - 5	4.96E-02	1.41E-01	(5)	1.41E-01
	ANTHRACENE	N	9 / 17	0	1.80E-03	3.50E-01	4.00E-03 J	7.60E-01	KCHYF3-3	5 - 5	1.26E-01	2.12E-01	(3)	2.12E-01
	BENZO(A)ANTHRACENE	N	13 / 17	0	2.00E-03	3.50E-01	4.40E-03 J	3.80E-01	KCHYF3-1	2 - 2	1.04E-01	1.52E-01	(3)	1.52E-01
	BENZO(A)PYRENE	G	15 / 17	2	--	--	4.00E-03 J	3.00E-01	KCHYF3-1	2 - 2	9.93E-02	1.71E-01	(4)	1.71E-01
	BENZO(B)FLUORANTHENE	N	15 / 17	0	3.40E-01	3.50E-01	5.00E-03 J	3.70E-01 J	KCHYF3-1	2 - 2	1.20E-01	1.65E-01	(3)	1.65E-01
	BENZO(G,H,I)PERYLENE	N	15 / 17	2	--	--	2.60E-03 J	1.70E-01	KCHYF3-1	2 - 2	6.02E-02	8.17E-02	(2)	8.17E-02
	BENZO(K)FLUORANTHENE	N	15 / 17	0	3.40E-01	3.50E-01	6.10E-03 J	4.50E-01 J	KCHYF3-1	2 - 2	1.46E-01	2.00E-01	(3)	2.00E-01
	CHRYSENE	N	13 / 17	0	1.80E-03	3.50E-01	4.00E-03 J	5.20E-01	KCHYF3-1	2 - 2	1.46E-01	2.12E-01	(3)	2.12E-01
	DIBENZ(A,H)ANTHRACENE	N	11 / 17	2	2.00E-03	2.00E-03	4.60E-03 J	7.80E-02	KCHYF3-1	2 - 2	1.73E-02	2.64E-02	(3)	2.64E-02
	FLUORANTHENE	N	13 / 17	0	2.60E-03	3.50E-01	6.90E-03	5.20E-01	KCHYF3-2	10 - 10	1.81E-01	2.61E-01	(3)	2.61E-01
	FLUORENE	G	9 / 17	0	2.20E-03	3.50E-01	3.40E-03 J	2.90E+00	KCHYF3-3	5 - 5	2.40E-01	1.51E+00	(5)	1.51E+00
	INDENO(1,2,3-CD)PYRENE	G	15 / 17	2	--	--	2.60E-03 J	2.00E-01	KCHYF3-1	2 - 2	6.23E-02	1.03E-01	(4)	1.03E-01
	NAPHTHALENE	G	15 / 17	2	--	--	2.30E-03 J	1.00E-01	KCHYF3-5	2 - 2	2.73E-02	5.00E-02	(4)	5.00E-02
	PHENANTHRENE	G	10 / 17	0	2.40E-03	3.50E-01	9.00E-03	3.30E+00	KCHYF3-3	5 - 5	3.90E-01	1.26E+00	(5)	1.26E+00
	PYRENE	N	15 / 17	0	3.40E-01	3.50E-01	1.10E-02	8.60E-01	KCHYF3-1	2 - 2	3.18E-01	4.22E-01	(3)	4.22E-01
	TOTAL HMW PAH	N	15 / 17	0	0.00E+00	0.00E+00	4.66E-02	3.76E+00	KCHYF3-1	2 - 2	1.30E+00	1.80E+00	(3)	1.80E+00
	TOTAL LMW PAH	G	15 / 17	0	0.00E+00	0.00E+00	2.30E-03	8.10E+00	KCHYF3-3	5 - 5	1.18E+00	3.37E+00	(5)	3.37E+00
	TOTAL PAH	N	15 / 17	0	0.00E+00	0.00E+00	7.52E-02	1.08E+01	KCHYF3-3	5 - 5	2.47E+00	3.72E+00	(3)	3.72E+00
TPH	DIESEL RANGE ORGANICS	LN	35 / 38	0	1.00E+01	1.10E+01	7.40E+00	1.00E+04 D	YF3HP019, YF3HP021	6.5 - 7, 9.5 - 10	1.59E+03	6.01E+03	(8)	6.01E+03
	GASOLINE RANGE ORGANICS	NP	16 / 36	0	1.90E-01	1.00E+00	5.50E-01 H	4.50E+02 H	YF3HP021	9.5 - 10	3.49E+01	2.17E+02	(8)	2.17E+02
	MOTOR OIL RANGE ORGANICS	G	31 / 38	0	1.00E+01	4.60E+02	1.50E+01 J	1.00E+04 LM	YF3HP019	6.5 - 7	1.22E+03	2.57E+03	(6)	2.57E+03

TABLE 3: SUMMARY STATISTICS FOR SEDIMENT (0 TO 10 FEET BGS)

Site YF3 Screening-Level Ecological Risk Assessment, 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						
VOC	1,2,4-TRIMETHYLBENZENE	--	1 / 15	1	1.00E+01	4.60E+02	1.00E-01	1.00E-01	KCHYF3-5	2 - 2	--	--	(1)	1.00E-01
	1,3,5-TRIMETHYLBENZENE	--	1 / 15	1	2.00E-02	4.60E-02	3.80E-02 J	3.80E-02 J	KCHYF3-5	2 - 2	--	--	(1)	3.80E-02
	2-BUTANONE	--	4 / 15	0	1.26E-02	3.00E-02	1.50E-01 J	1.70E+00 J	KCHYF3-3	2 - 2	--	--	(1)	1.70E+00
	4-ISOPROPYLTOLUENE	--	1 / 15	1	6.40E-02	1.46E-01	4.40E-02 J	4.40E-02 J	KCHYF3-5	2 - 2	--	--	(1)	4.40E-02
	ACETONE	N	7 / 15	2	1.26E-02	3.00E-02	1.80E-01 J	4.20E-01 J	KCHYF3-1	5 - 5	2.54E-01	2.96E-01	(3)	2.96E-01
	BROMOMETHANE	--	4 / 15	2	3.00E-01	3.40E-01	1.90E-02 J	3.80E-02 J	KCHYF3-1	2 - 2	--	--	(1)	3.80E-02
	CARBON DISULFIDE	N	7 / 15	1	2.60E-02	3.00E-02	1.50E-02 J	6.80E-02	KCHYF3-1	2 - 2	2.58E-02	3.32E-02	(3)	3.32E-02
	CHLOROMETHANE	N	8 / 15	7	2.20E-02	4.80E-02	1.80E-02 J	2.90E-02 J	KCHYF3-5	5 - 5	2.20E-02	2.44E-02	(2)	2.44E-02
	ETHYLBENZENE	--	1 / 15	12	--	--	2.40E-02 J	2.40E-02 J	KCHYF3-5	2 - 2	--	--	(1)	2.40E-02
	ISOPROPYLBENZENE	--	3 / 15	1	2.40E-02	2.40E-02	1.60E-02 J	6.50E-02 J	KCHYF3-1	10 - 10	--	--	(1)	6.50E-02
	M- AND P-XYLENE	--	1 / 15	7	1.70E-02	2.00E-02	4.50E-02 J	4.50E-02 J	KCHYF3-5	2 - 2	--	--	(1)	4.50E-02
	METHYLENE CHLORIDE	LN	10 / 15	0	4.20E-02	4.40E-02	2.10E-02 J	7.80E-01 J	KCHYF3-3	2 - 2	9.03E-02	4.06E-01	(7)	4.06E-01
	N-BUTYLBENZENE	--	2 / 15	1	3.80E-02	4.40E-02	1.00E-01 J	1.20E-01 J	KCHYF3-1	10 - 10	--	--	(1)	1.20E-01
	O-XYLENE	--	1 / 15	9	1.58E-02	1.94E-02	2.10E-02 J	2.10E-02 J	KCHYF3-5	2 - 2	--	--	(1)	2.10E-02
	PROPYLBENZENE	--	3 / 15	1	2.00E-02	2.00E-02	2.10E-02 J	8.50E-02 J	KCHYF3-1	10 - 10	--	--	(1)	8.50E-02
	SEC-BUTYLBENZENE	--	4 / 15	0	2.20E-02	2.80E-02	2.60E-02 J	4.30E-01 J	KCHYF3-3	2 - 2	--	--	(1)	4.30E-01
	TOLUENE	--	1 / 15	14	1.26E-02	1.54E-02	1.20E-02 J	1.20E-02 J	KCHYF3-5	2 - 2	--	--	(1)	1.20E-02

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
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

TABLE 3: SUMMARY STATISTICS FOR SEDIMENT (0 TO 10 FEET BGS)

Site YF3 Screening-Level Ecological Risk Assessment, 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						

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

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 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 4: SUMMARY STATISTICS FOR GROUNDWATER

Site YF3 Screening-Level Ecological Risk Assessment, 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	2-METHYLNAPHTHALENE	--	1 / 5	0	1.20E-01	1.20E-01	2.20E+00 J	2.20E+00 J	KCHYF3-1	--	--	(1)	2.20E+00
	ACENAPHTHENE	--	5 / 5	0	--	--	1.10E-01 J	3.80E+00	KCHYF3-2	--	--	(1)	3.80E+00
	ACENAPHTHYLENE	--	4 / 5	0	1.20E-01	1.20E-01	2.40E-01	2.70E+00	KCHYF3-2	--	--	(1)	2.70E+00
	ANTHRACENE	--	4 / 5	0	1.00E-01	1.00E-01	1.30E-01 J	1.80E+00	KCHYF3-2	--	--	(1)	1.80E+00
	BENZO(A)ANTHRACENE	--	3 / 5	0	1.40E-01	1.40E-01	1.90E-01 J	5.80E-01	KCHYF3-2	--	--	(1)	5.80E-01
	BENZO(A)PYRENE	--	1 / 5	0	1.20E-01	1.20E-01	2.60E-01	2.60E-01	KCHYF3-2	--	--	(1)	2.60E-01
	BENZO(B)FLUORANTHENE	--	3 / 5	0	1.20E-01	1.20E-01	1.00E-01 J	4.10E-01 J	KCHYF3-2	--	--	(1)	4.10E-01
	BENZO(G,H,I)PERYLENE	--	1 / 5	0	1.60E-01	1.60E-01	1.90E-01 J	1.90E-01 J	KCHYF3-2	--	--	(1)	1.90E-01
	BENZO(K)FLUORANTHENE	--	3 / 5	0	1.40E-01	1.40E-01	1.20E-01 J	5.00E-01 J	KCHYF3-2	--	--	(1)	5.00E-01
	CHRYSENE	--	3 / 5	0	1.00E-01	1.00E-01	3.10E-01 J	1.50E+00	KCHYF3-2	--	--	(1)	1.50E+00
	FLUORANTHENE	--	3 / 5	0	1.60E-01	1.60E-01	2.90E-01	1.10E+00	KCHYF3-2	--	--	(1)	1.10E+00
	FLUORENE	--	5 / 5	0	--	--	3.80E-01 J	1.40E+01	KCHYF3-2	--	--	(1)	1.40E+01
	INDENO(1,2,3-CD)PYRENE	--	1 / 5	0	1.40E-01	1.40E-01	2.20E-01	2.20E-01	KCHYF3-2	--	--	(1)	2.20E-01
	NAPHTHALENE	--	4 / 5	0	1.00E-01	1.00E-01	1.40E-01 J	1.20E+00	KCHYF3-2	--	--	(1)	1.20E+00
	PHENANTHRENE	--	5 / 5	0	--	--	1.80E-01 J	1.70E+01	KCHYF3-2	--	--	(1)	1.70E+01
	PYRENE	--	3 / 5	0	1.60E-01	1.60E-01	6.10E-01	2.60E+00	KCHYF3-2	--	--	(1)	2.60E+00
	TOTAL HMW PAH	--	3 / 5	0	--	--	1.62E+00	7.36E+00	KCHYF3-2	--	--	(1)	7.36E+00
	TOTAL LMW PAH	--	5 / 5	0	--	--	6.70E-01	4.47E+01	KCHYF3-2	--	--	(1)	4.47E+01
	TOTAL PAH	--	5 / 5	0	--	--	6.70E-01	5.21E+01	KCHYF3-2	--	--	(1)	5.21E+01
TPH	DIESEL RANGE ORGANICS	--	5 / 6	0	8.08E+01	8.08E+01	3.00E+02	3.80E+04	KCHYF3-2	--	--	(1)	3.80E+04
	GASOLINE RANGE ORGANICS	--	2 / 6	0	1.72E+01	5.00E+01	9.20E+00 J	1.50E+02 J	KCHYF3-1	--	--	(1)	1.50E+02
	MOTOR OIL RANGE ORGANICS	--	2 / 6	2	2.12E+02	2.12E+02	1.30E+02 J	5.50E+03	KCHYF3-4	--	--	(1)	5.50E+03
VOC	2-BUTANONE	--	4 / 5	0	1.20E+00	1.20E+00	8.60E-01 J	3.20E+00 J	KCHYF3-2	--	--	(1)	3.20E+00
	4-METHYL-2-PENTANONE	--	1 / 5	4	--	--	2.00E+00 J	2.00E+00 J	KCHYF3-5	--	--	(1)	2.00E+00
	ACETONE	--	5 / 5	0	--	--	1.70E+01 J	5.30E+01 J	KCHYF3-5	--	--	(1)	5.30E+01
	BENZENE	--	5 / 5	0	--	--	1.60E-01 J	2.40E-01 J	KCHYF3-3	--	--	(1)	2.40E-01
	CARBON DISULFIDE	--	5 / 5	0	--	--	6.80E-01 J	5.90E+00	KCHYF3-2	--	--	(1)	5.90E+00
	ETHYLBENZENE	--	1 / 5	4	--	--	2.90E-01 J	2.90E-01 J	KCHYF3-3	--	--	(1)	2.90E-01
	ISOPROPYLBENZENE	--	4 / 5	0	3.20E-01	3.20E-01	2.20E-01 J	1.80E+00 J	KCHYF3-1	--	--	(1)	1.80E+00
	N-BUTYLBENZENE	--	3 / 5	0	3.00E-01	3.00E-01	3.00E-01 J	7.80E-01 J	KCHYF3-1	--	--	(1)	7.80E-01
	O-XYLENE	--	1 / 5	4	--	--	2.00E-01 J	2.00E-01 J	KCHYF3-1	--	--	(1)	2.00E-01
	PROPYLBENZENE	--	3 / 5	0	4.20E-01	4.20E-01	8.30E-01 J	1.60E+00 J	KCHYF3-1	--	--	(1)	1.60E+00
	SEC-BUTYLBENZENE	--	3 / 5	0	2.40E-01	2.40E-01	5.20E-01 J	1.20E+00 J	KCHYF3-1	--	--	(1)	1.20E+00
	TERT-BUTYLBENZENE	--	1 / 5	4	--	--	1.70E-01 J	1.70E-01 J	KCHYF3-1	--	--	(1)	1.70E-01

TABLE 4: SUMMARY STATISTICS FOR GROUNDWATER

Site YF3 Screening-Level Ecological Risk Assessment, 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
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

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 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 5: TOTAL PETROLEUM HYDROCARBON DATA USED TO ESTIMATE LNAPL SATURATION AND MOBILITY

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Top Depth (feet)	Sample Bottom Depth (feet)	TPH-diesel (mg/kg)	TPH-gasoline (mg/kg)	TPH-motor oil (mg/kg)	Sample Location	Sample Identification Number
2.83	3.33	11	nm	11	031YF3001	031YF3001
4.08	4.58	10	nm	< 10	031YF3001	031YF3002
2.00	2.00	2,200	3.2	2,100	KCHYF3-1	KCHYF3-1-2
5.00	5.00	900	1.6	1,200	KCHYF3-1	KCHYF3-1-5
10.00	10.00	820	33	< 420	KCHYF3-1	KCHYF3-1-10
2.00	2.00	610	3.9	430	KCHYF3-2	KCHYF3-2-2
5.00	5.00	950	< 0.76	640	KCHYF3-2	KCHYF3-2-5
10.00	10.00	10	< 0.84	15	KCHYF3-2	KCHYF3-2-10
2.00	2.00	990	440	550	KCHYF3-3	KCHYF3-3-2
5.00	5.00	6,500	1.1	2,800	KCHYF3-3	KCHYF3-3-5
10.00	10.00	120	5.5	67	KCHYF3-3	KCHYF3-3-10
2.00	2.00	1,900	< 0.88	< 460	KCHYF3-4	KCHYF3-4-2
5.00	5.00	990	< 0.74	650	KCHYF3-4	KCHYF3-4-5
10.00	10.00	7.4	< 0.78	< 16	KCHYF3-4	KCHYF3-4-10
2.00	2.00	3,200	6.6	2,200	KCHYF3-5	KCHYF3-5-2
5.00	5.00	320	< 0.72	< 360	KCHYF3-5	KCHYF3-5-5
10.00	10.00	100	1.8	70	KCHYF3-5	KCHYF3-5-10
nm	nm	nm	1	nm	SCI-YB-07	SCI-YB-07
0.50	0.50	< 11	< 0.23	< 57	YF3HP005	262YF3211
0.50	0.50	120	2.6	520	YF3HP006	262YF3212
0.50	0.50	360	< 0.27	1,200	YF3HP007	262YF3213
0.70	0.70	520	0.55	1,900	YF3HP008	262YF3214
0.4	0.6	170	< 0.33	520	YF3HP009	262YF3215
1.00	1.50	36	< 0.22	160	YF3HP018	262YF3413
6.50	7.00	270	< 0.19	190	YF3HP018	262YF3414
7.00	7.50	370	nm	96	YF3HP018	262YF3415
1.00	1.50	170	< 0.21	420	YF3HP019	262YF3418
6.00	6.50	510	< 0.25	1,500	YF3HP019	262YF3419
6.50	7.00	10,000	1.3	10,000	YF3HP019	262YF3420
1.00	1.50	670	< 0.21	1,000	YF3HP020	262YF3423
5.50	6.00	1,200	2.7	470	YF3HP020	262YF3424

TABLE 5: TOTAL PETROLEUM HYDROCARBON DATA USED TO ESTIMATE LNAPL SATURATION AND MOBILITY

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Top Depth (feet)	Sample Bottom Depth (feet)	TPH-diesel (mg/kg)	TPH-gasoline (mg/kg)	TPH-motor oil (mg/kg)	Sample Location	Sample Identification Number
1.00	1.50	600	< 0.22	2,000	YF3HP021	262YF3428
7.00	7.50	7,500	220	5,800	YF3HP021	262YF3429
9.50	10.00	10,000	450	890	YF3HP021	262YF3430
1.00	1.50	210	< 0.24	730	YF3HP022	262YF3433
1.00	1.50	480	< 0.23	1,800	YF3HP023	262YF3438
9.50	10.00	810	< 0.25	3,100	YF3HP023	262YF3439
1.00	1.50	27	< 0.26	100	YF3HP024	262YF3443
2.50	3.00	6,800	77	3,100	YF3HP024	262YF3444

Notes:

1. Non-detect values are shown as less than "<" the detection limit. The detection limit was used in calculations of percent LNAPL saturation.

<	less than
LNAPL	Light non-aqueous phase liquid
mg/kg	Milligram per kilogram
nm	Not measured/not analyzed
TPH	Total petroleum hydrocarbons

TABLE 6: CALCULATION OF TOTAL PERCENT LNAPL SATURATION AND ESTIMATES OF LNAPL MOBILITY AT SITE YF3

Site YF3 Screening-Level 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
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
YF3HP024	262YF3443	27	0.26	100	127	1.68	0.87	40%	0.1%	6.5%	Residual
YF3HP024	262YF3444	6,800	77	3,100	9,977	1.68	0.87	40%	4.8%	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.

%	Percent
g/cm3	Gram per cubic centimeter
LNAPL	Light non-aqueous phase liquid
mg/kg	Milligram per kilogram
N	Porosity
TPH	Total petroleum hydrocarbons

Table 7: Comparison of Concentrations in Groundwater with Aquatic Screening Criteria (Step 2)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC[a]	Maximum Detected Concentration (µg/L)	Screening Criteria for the Protection of Aquatic Life (µg/L)[b]	Hazard Quotient (Maximum Concentration/ Screening Criteria)[c]
2-Methylnaphthalene	2.2	30	0.07
2-Butanone	3.2	14,000	0.0002
4-Methyl-2-Pentanone	2	170	0.01
Acenaphthene	3.8	710	0.005
Acenaphthylene	2.7	30	0.09
Acetone	53	1,500	0.04
Anthracene	1.8	30	0.06
Benzene	0.24	700	0.0003
Benzo(a)anthracene	0.58	30	0.02
Benzo(a)pyrene	0.26	30	0.009
Benzo(b)fluoranthene	0.41	30	0.01
Benzo(g,h,i)perylene	0.19	30	0.006
Benzo(k)fluoranthene	0.5	30	0.02
Chrysene	1.5	30	0.05
Carbon Disulfide	5.9	0.92	**6.4**
Ethylbenzene	0.29	43	0.007
Fluoranthene	1.1	16	0.07
Fluorene	14	30	0.47
Indeno(1,2,3-cd)pyrene	0.22	30	0.007
Isopropylbenzene	1.8	43	0.04
N-Butylbenzene	0.78	43	0.02
Naphthalene	1.2	235	0.005
O-Xylene	0.2	100	0.002
Phenanthrene	17	30	0.57
Propylbenzene	1.6	43	0.04
Pyrene	2.6	30	0.09
Sec-Butylbenzene	1.2	43	0.03
Tert-Butylbenzene	0.17	43	0.004
Total HMW PAH	7.4	15	0.49
Total LMW PAH	44.7	15	**3.0**
Total PAH	52.1	15	**3.5**
TPH-Diesel	38,000	1,400	**27.1**
TPH-Gasoline	150	1,400	0.11
TPH-Motor Oil	5,500	1,400	**3.9**

Notes:

µg/L	Micrograms per liter
COPEC	Chemical of potential ecological concern
HMW	High molecular weight
LMW	Low molecular weight
PAH	Polycyclic aromatic hydrocarbon
TPH	Total petroleum hydrocarbon

Footnotes:

a	All detected chemicals were considered COPECs.
b	The screening criteria were selected based on a tiered approach, as described in Appendix C (Water Board 1995, 2011, 2013a, 2013b; DTSC 2006; EPA 2000, 2001, 2013; Tetra Tech EM Inc. 2001; Suter and Tsao 1996).
c	**Bold** values indicate a hazard quotient greater than 1.

Table 7: Comparison of Concentrations in Groundwater with Aquatic Screening Criteria (Step 2)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

References:

Department of Toxic Substances Control (DTSC). 2006. "Ecological Screening Soil and Aquatic Values for Naval Station Treasure Island." [Site 201210-18Pca 18040 H:28]. March 15.

San Francisco Bay Regional Water Quality Control Board (Water Board). 2013a. "San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan)." June 29.

Water Board. 2013b. "Environmental Screening Levels." December. http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/esl.shtml

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Water Board. 1995. "San Francisco Bay Basin Plan." San Francisco Bay Region. June 21.

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

TABLE 8: COMPARISON OF COPEC CONCENTRATIONS IN SEDIMENT (0 to 2 FEET BGS) WITH TOXICITY BENCHMARKS TO ASSESS RISK TO BENTHIC INVERTEBRATES (STEP 2)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC	Maximum Concentration (mg/kg)	ER-L (mg/kg) [a]	Hazard Quotient (Maximum Detected Concentration/ER-L)[b]	ER-M (mg/kg) [a]	Hazard Quotient (Maximum Detected Concentration/ER-M)[b]
Total HMW PAH	3.8	1.7	**2.2**	9.6	0.4
Total LMW PAH	3.0	0.552	**5.4**	3.16	0.9
Total PAH	4.6	4.022	**1.2**	44.792	0.1

Notes:

a ER-L and ER-M values are from Long and others 1995. No ER-L or ER-M values were available for TPH-diesel, TPH-gasoline, TPH-motor oil, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-butanone, 4-isopropyltoluene, acetone, bromomethane, carbon disulfide, chloromethane, ethylbenzene, isopropylbenzene, m and p-xylene, methylene chloride, n-butylbenzene, o-xylene, propylbenzene, sec-butylbenzene and toluene. Chemicals without benchmarks are evaluated in the Step 3a risk refinement.

b Bold values indicate a hazard quotient greater than 1.

bgs	below ground surface	LMW	Low molecular weight
COPEC	Chemical of potential ecological concern	mg/kg	Milligram per kilogram
ER-L	Effects Range-Low	NA	Not available
ER-M	Effects Range-Median	PAH	Polycyclic aromatic hydrocarbon
HMW	High molecular weight	TPH	Total petroleum hydrocarbon

References:

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. “Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments.” Environmental Management. Volume 19. Number 1. Pages 81-97.

Table 9: Dose Parameters for the Spotted Sandpiper (*Actitis macularius*)
Site YF3 Screening-Level Ecological Risk Assessment
Naval Station Treasure Island, San Francisco, California

Parameter	ERA Step	Value	Units	Reference/Notes
Ingestion Rate$_{food}$	2	0.0085	kg/day	Calculated with body weight of 37.9 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).
	3a	0.0093		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$_{invertebrates}$	2	0.0085	kg/day	Based on 100 percent of food ingestion rate.
	3a	0.0093		
Ingestion Rate$_{sediment}$	2	0.00154	kg/day	18 percent total ingestion rate based on the western sandpiper (Beyer and others 1994).
	3a	0.00168		
Sediment Concentrations	2	Maximum Concentration	mg/kg	To be determined based on existing data for sediment collected from the site (0 to 2 feet bgs).
	3a	95 UCL Concentration		
Diet Composition[a]	2 and 3a	100%	Invertebrate tissue	Prey is assumed to be 100 invertebrates. This receptor is representative of invertivorous birds.
Foraging Range	2 and 3a	0.62	acre	Based on territory size reported by Maxson and Oring 1980, as cited in EPA 1993.
Site Use Factor	2	1	unitless	Based on conservative estimate of 100 percent site use per EPA SLERA guidance (1997).
	3a	1		Based on the site area (1.35 acres) divided by the foraging range.
Body Weight	2	0.0379	kg	Based on minimum mean male body weight (Johnson 1970, as cited in EPA 1993).
	3a	0.0425		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
bgs Below ground surface
BW Body weight
EPA U.S. Environmental Protection Agency
kg Kilogram
kg/day Kilogram per day
mg/kg Milligram per kilogram
SLERA Screening level ecological risk assessment

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.

EPA. 1997. "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final." Environmental Response Team. Edison, New Jersey.

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 10: Dose Parameters for the Great Blue Heron (*Ardea herodias*)
Site YF3 Screening-Level Ecological Risk Assessment
Naval Station Treasure Island, San Francisco, California

Parameter	ERA Step	Value	Units	Reference/Notes
Ingestion Rate$_{food}$	2	0.128	kg/day	Calculated with body weight of 2,300 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).
	3a	0.132		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$_{fish}$	2	0.096	kg/day	Based on 75 percent of food ingestion rate.
	3a	0.099		
Ingestion Rate$_{invertebrates}$	2	0.032	kg/day	Based on 25 percent of food ingestion rate.
	3a	0.033		
Ingestion Rate$_{sediment}$	2	0.0035	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).
	3a	0.0036		
Sediment Concentrations	2	Maximum Concentration	mg/kg	To be determined based on existing data for sediment collected from the site (0 to 2 feet bgs).
	3a	95 UCL Concentration		
Diet Composition[a]	2 and 3a	75%	Fish tissue	Prey is assumed to be 75 percent fish and 25 percent invertebrates (crustaceans and benthic invertebrates). This receptor is representative of carnivorous birds.
		25%	Invertebrate tissue	
Foraging Range	2 and 3a	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	2	1	unitless	Based on conservative estimate of 100 percent site use per EPA SLERA guidance (1997).
	3a	0.065		Based on the site area (1.35 acres) divided by the foraging range.
Body Weight	2	2.30	kg	Mean body weight of both sexes (Butler 1992)
	3a	2.39		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
bgs Below ground surface
BW Body weight
EPA U.S. Environmental Protection Agency
kg Kilogram
kg/day Kilogram per day
mg/kg Milligram per kilogram
SLERA Screening level ecological risk assessment

Sources:

Butler, R.W. 1992. The Birds of North America. A. Poole, P. Stettenheim, and F. Gill, editors. The Acadamy of Natural Science, Philadelphia, PA.

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. "Estimates of Soil Ingestion by Wildlife." *Journal of Wildlife Management.*

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

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

EPA. 1997. "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final." Environmental Response Team. Edison, New Jersey.

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 11: Dose Parameters for the Raccoon (*Procyon lotor*)
Site YF3 Screening-Level Ecological Risk Assessment
Naval Station Treasure Island, San Francisco, California

Parameter	ERA Step	Value	Units	Reference/Notes
Ingestion Rate$_{food}$	2	0.141	kg/day	Calculated with body weight of 4,310 grams using the equation for the food requirement for intake of dry matter for Carnivora (food ingestion rate = (0.102[BW(grams)]^0.864]/1000) (Nagy 2001).
	3a	0.180		Calculated with body weight of 5,740 grams using the equation for the food requirement for intake of dry matter for Carnivora (food ingestion rate = (0.102[BW(grams)]^0.864]/1000) (Nagy 2001).
Ingestion Rate $_{mollusks}$	2	0.0704	kg/day	Based on conservative assumption of 50 percent of food ingestion rate.
	3a	0.0902		
Ingestion Rate $_{crustaceans}$	2	0.0704	kg/day	Based on conservative assumption of 50 percent of food ingestion rate.
	3a	0.0902		
Ingestion Rate$_{sediment}$	2	0.0132	kg/day	9.4 percent of food ingestion rate (Beyer and others 1994).
	3a	0.0170		
Sediment Concentrations	2	Maximum Concentration	mg/kg	To be determined based on existing data for sediment collected from the site (0 to 2 feet bgs).
	3a	95 UCL Concentration		
Diet Composition[a]	2 and 3a	50%	Mollusk tissue	Food will consist of 100 percent invertebrate tissue (50 percent mollusks and 50 percent crustaceans) as a conservative estimate, based on the prey items available at the site. The raccoon is a representative species for omnivorous mammals.
		50%	Crustacean tissue	
Foraging Range	2 and 3a	96	acre	Based on mean female home range on coastal island (EPA 1993).
Site Use Factor	2	1	unitless	Based on conservative estimate of 100 percent site use per EPA SLERA guidance (1997).
	3a	0.014		Based on the site area (1.35 acres) divided by the foraging range.
Body Weight	2	4.31	kg	Based on minimum mean male body weight (Johnson 1970, as cited in EPA 1993).
	3a	5.74		Based on median of mean adult male body weights (EPA 1993).

Notes:

a The raccoon is a highly opportunistic feeder (Zeiner 1990).

95UCL One-sided 95 percent upper confidence limit of the mean
BW Body weight
EPA U.S. Environmental Protection Agency
kg Kilogram
kg/day Kilogram per day
mg/kg Milligram per kilogram
SLERA Screening level ecological risk assessment

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.

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TABLE 12: BIOACCUMULATION FACTORS AND TISSUE CONCENTRATIONS USED IN THE FOOD CHAIN MODELS

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

	Literature BAFs for Invertebrates and Fish (Earth Tech, Inc. 2006)		Tissue Concentrations from Samples Collected in the Area of Site YF3 (Tetra Tech EM, Inc. 2001)		
COPEC	**Invertebrate (Maximum for Composite Macroinfauna and Blue-Clawed Stone Crab)**	**Fish (Maximum for Tilapia and Bandtail Goatfish)**	**Crab**	**Fish**	**Clam**
Total LMW PAHs	3.04	5.32	0.0131	0.0583	0.111
Total HMW PAHs	0.779	0.0333	ND	ND	1.018

Notes:

Values are reported as milligram per kilogram dry weight.

The BAFs and site-collected tissue concentrations were used in parallel in the food chain models to calculate two different estimated daily doses for each COPEC and receptor. The tissue concentrations in the clam sample were used in the food chain model to represent site-collected invertebrate tissue for the spotted sandpiper and great blue heron. The clam and crab tissue concentrations were used to represent site-collected mollusk and crustacean concentrations, respectively, for the raccoon.

BAF Bioaccumulation factor
COPEC Chemical of potential ecological concern
HMW High molecular weight
LMW Low molecular weight
ND Not detected
PAH Polycyclic aromatic hydrocarbon

Reference:

Earth Tech, Inc. 2006. "Final Revised Step 7 Baseline Ecological Risk Assessment, Pearl Harbor Sediment Remedial Investigation, Pearl Harbor, Hawaii. Pearl Harbor, Hawaii: Pacific Division, Naval Facilities Engineering Command." October.

Tetra Tech EM Inc. 2001. "Final Remedial Investigation, Offshore Sediments Operable Unit, Naval Station Treasure Island, San Francisco, California". December 28.

TABLE 13: BIRD AND MAMMAL HAZARD QUOTIENTS (STEP 2)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC	Spotted Sandpiper (Invertivorous Bird)	Great Blue Heron (Omnivorous Bird)	Raccoon (Omnivorous Mammal)
TOTAL HMW PAHS	**(Calculated with Literature BAF)**		
Dose/High TRV	No TRV	No TRV	3.27E-03
Dose/Low TRV	No TRV	No TRV	8.18E-02
TOTAL HMW PAHS	**(Calculated with Tissue Concentration)**		
Dose/High TRV	No TRV	No TRV	8.59E-04
Dose/Low TRV	No TRV	No TRV	2.15E-02
TOTAL LMW PAHS	**(Calculated with Literature BAF)**		
Dose/High TRV	No TRV	No TRV	2.02E-03
Dose/Low TRV	No TRV	No TRV	6.06E-03
TOTAL LMW PAHS	**(Calculated with Tissue Concentration)**		
Dose/High TRV	No TRV	No TRV	6.35E-05
Dose/Low TRV	No TRV	No TRV	1.90E-04

Notes: **Bold** values indicate hazard quotient greater than 1.

BAF Bioaccumulation factor
COPEC Chemical of potential ecological concern
HMW High molecular weight
LMW Low molecular weight
PAH Polycyclic aromatic hydrocarbon
TRV Toxicity reference value

Table 14: Comparison of Concentrations in Groundwater with Aquatic Screening Criteria (Step 3a)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC[a]	Exposure Point Concentration (µg/L)	Screening Criteria for the Protection of Aquatic Life (µg/L)[b]	Hazard Quotient (Exposure Point Concentration/ Screening Criteria)[c]
Carbon Disulfide	5.9	0.92	**6.4**
Total LMW PAH	44.7	15	**3.0**
Total PAH	52.1	15	**3.5**
TPH-Diesel	38,000	1,400	**27.1**
TPH-Motor Oil	5,500	1,400	**3.9**

Notes:

µg/L	Micrograms per liter
COPEC	Chemical of potential ecological concern
LMW	Low molecular weight
PAH	Polycyclic aromatic hydrocarbon
TPH	Total petroleum hydrocarbon

Footnotes:

a	The refined exposure point concentration is the lesser of the 95 UCL (where applicable) and maximum concentration.
b	The screening criteria were selected based on a tiered approach, as described in Appendix B (Water Board 1995, 2011, 2013a, 2013b; DTSC 2006; EPA 2000, 2001, 2013; Tetra Tech EM Inc. 2001; Suter and Tsao 1996).
c	**Bold** values indicate a hazard quotient greater than 1.

References:

Department of Toxic Substances Control (DTSC). 2006. "Ecological Screening Soil and Aquatic Values for Naval Station Treasure Island." [Site 201210-18Pca 18040 H:28]. March 15.

San Francisco Bay Regional Water Quality Control Board (Water Board). 2013a. "San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan)." June 29.

Water Board. 2013b. "Environmental Screening Levels." December. http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/esl.shtml

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U.S. Environmental Protection Agency (EPA). 2000. "Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California." 40 CFR Part 131, RIN 2040-AC44. May 18.

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

TABLE 15: COMPARISON OF COPEC CONCENTRATIONS IN SEDIMENT (0 to 2 FEET BGS) WITH TOXICITY BENCHMARKS TO ASSESS RISK TO BENTHIC INVERTEBRATES (STEP 3A)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC	Refined EPC[a] (mg/kg)	ER-L (mg/kg) [b]	Hazard Quotient (Refined EPC/ER-L)[c]	ER-M (mg/kg) [b]	Hazard Quotient (Refined EPC/ER-M)[c]	Alternative Benchmark (mg/kg) [d]	Hazard Quotient (Refined EPC/Alternative Benchmark)[c]
Total HMW PAH	3.8	1.7	**2.2**	9.6	0.4	NA	NA
Total LMW PAH	3.0	0.6	**5**	3.16	0.9	NA	NA
Total PAH	4.6	4.0	**1.2**	44.792	0.1	NA	NA
TPH-Diesel	1,408	NA	NA	NA	NA	144	**9.8**
TPH-Gasoline	318	NA	NA	NA	NA	4,400	0.1
TPH-Motor Oil	1,310	NA	NA	NA	NA	4,400	0.3
1,2,4-Trimethylbenzene	0.1	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.04	NA	NA	NA	NA	NA	NA
2-Butanone	1.7	NA	NA	NA	NA	270	0.006
4-Isopropyltoluene	0.04	NA	NA	NA	NA	NA	NA
Acetone	0.4	NA	NA	NA	NA	0.0099	**40.4**
Bromomethane	0.04	NA	NA	NA	NA	0.00137	**27.7**
Carbon Disulfide	0.1	NA	NA	NA	NA	0.0239	**2.8**
Chloromethane	0.02	NA	NA	NA	NA	NA	NA
Ethylbenzene	0.02	NA	NA	NA	NA	0.305	0.1
Isopropylbenzene	0.03	NA	NA	NA	NA	0.086	0.3
M- and P-xylene	0.05	NA	NA	NA	NA	110	0.0004
Methylene Chloride	0.8	NA	NA	NA	NA	0.159	**4.9**
N-Butylbenzene	0.1	NA	NA	NA	NA	NA	NA
O-Xylene	0.02	NA	NA	NA	NA	89	0.0002
Propylbenzene	0.05	NA	NA	NA	NA	NA	NA
Sec-Butylbenzene	0.4	NA	NA	NA	NA	NA	NA
Toluene	0.01	NA	NA	NA	NA	1.09	0.01

Notes:

a The refined EPC is the lesser of the 95 UCL (where applicable) and maximum concentration.

b ER-L and ER-M values are from Long and others 1995.

c Bold values indicate a hazard quotient greater than 1.

d Alternative benchmarks are from multiple sources: Point of Compliance Concentration for fuel oil and diesel developed for the Presidio (diesel range organics) (IT Corporation 1997), Washington State Sediment Cleanup Levels (a minor adverse-effect level) (no marine value was available for diesel, gasoline, and motor oil range organics so the freshwater value was used) (Washington State Department of Ecology 2013), EPA Region 5 Sediment Benchmarks (acetone, bromomethane, carbon disulfide, and methylene chloride) (EPA 2003 as cited in ORNL RAIS 2014), EPA Region 3 Marine Sediment Benchmark (ethylbenzene and toluene; freshwater sediment benchmark was used for isopropylbenzene) (EPA 2013), Dutch Target Levels for Sediment (m-and p-xylene, and o-xylene) (Verbruggen, Posthumus, and van Wezel 2001 as cited in Buchman 2008), and an ORNL secondary chronic value (2-butanone) (Jones, Suter, and Hull 1997).

95UCL	95 percent upper confidence limit of the mean	HMW	High molecular weight
bgs	below ground surface	LMW	Low molecular weight
COPEC	Chemical of potential ecological concern	mg/kg	Milligrams per kilogram
EPA	U.S. Environmental Protection Agency	NA	Not available
EPC	Exposure point concentration	ORNL	Oak Ridge National Laboratory
ER-L	Effects Range-Low	PAH	Polycyclic aromatic hydrovarbon
ER-M	Effects Range-Median	RAIS	Risk Assessment Information System

TABLE 15: COMPARISON OF COPEC CONCENTRATIONS IN SEDIMENT (0 to 2 FEET BGS) WITH TOXICITY BENCHMARKS TO ASSESS RISK TO BENTHIC INVERTEBRATES (STEP 3A)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

References:

Buchman, M.F. 2008. NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration. 34 pages.

IT Corporation. 1997. Report of Petroleum Hydrocarbon Bioassay and Point-of-Compliance Concentration Determinations, Saltwater Ecological Protection Zone, Presidio of San Francisco, California. December.

Jones, D. S., G.W. Suter, and R.N. Hull. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision. ES/ER-TM-95/R4. November. Available online: http://www.esd.ornl.gov/programs/ecorisk/documents/tm95r4.pdf

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. “Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments.” Environmental Management. Volume 19. Number 1. Pages 81-97.

Oak Ridge National Laboratory Risk Assessment Information System. 2014. Online: http://rais.ornl.gov/. Accessed March 6.

EPA. 2013. Region 3 Marine Screening Benchmarks. Available online: http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/marine/screenbench.htm Updated September 25.

Washington State Department of Ecology. 2013. "Sediment Management Standards, Chapter 173-204 WAC". Publication No. 13-09-055. Revised February 2013, Effective Septamber 2013. Available online: https://fortress.wa.gov/ecy/publications/publications/1309055.pdf

TABLE 16: SUMMARY OF HAZARD QUOTIENTS (STEP 3a)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC	Spotted Sandpiper (Invertivorous Bird)	Great Blue Heron (Omnivorous Bird)	Raccoon (Omnivorous Mammal)
TOTAL HMW PAHS	**(Calculated with Literature BAF)**		
Dose/High TRV	No TRV	No TRV	--
Dose/Low TRV	No TRV	No TRV	--
TOTAL HMW PAHS	**(Calculated with Tissue Concentration)**		
Dose/High TRV	No TRV	No TRV	--
Dose/Low TRV	No TRV	No TRV	--
TOTAL LMW PAHS	**(Calculated with Literature BAF)**		
Dose/High TRV	No TRV	No TRV	--
Dose/Low TRV	No TRV	No TRV	--
TOTAL LMW PAHS	**(Calculated with Tissue Concentration)**		
Dose/High TRV	No TRV	No TRV	--
Dose/Low TRV	No TRV	No TRV	--

Notes: **Bold** values indicate hazard quotient greater than 1.

--	HQ less than 1 for both high and low TRV
BAF	Bioaccumulation factor
COPEC	Chemical of potential ecological concern
HMW	High molecular weight
LMW	Low molecular weight
PAH	Polycyclic aromatic hydrocarbon
TRV	Toxicity reference value

Table 17: Low Threat Closure Criteria Comparison for Site YF3

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Criteria	Criterion Met (Yes/No/NA)?	Supporting Notes
General Criteria (that must be satisfied by all candidate sites):		
a. The unauthorized release located within the service area of a public water system?	Yes	The San Francisco Public Utilities Commission provides water service to Yerba Buena Island.
b. The unauthorized release consists only of petroleum.	Yes	Former fuel lines and storage tanks are the suspected sources of site contamination (Tetra Tech Inc. 2003, KCH 2013). Sampling and analysis of soil and groundwater indicate residual concentrations of petroleum-related constituents.
c. The unauthorized ("primary") release from the UST system been stopped.	Yes	The site is no longer in use, and potential sources of contamination have been removed or closed in place.
d. Free product has been removed to the maximum extent practicable.	NA	Although a sheen was observed in temporary wells during recent sampling, measureable free product was not observed (KCH 2013). Although the 2003 Corrective Action Plan previously indicated that "free product" was observed (Tetra Tech Inc. 2003), that term appears to have been used, as was common at that time, to describe the visible presence of sorbed petroleum contamination versus the confirmation of mobile, non-aqueous phase liquid (NAPL). An assessment of the potential for presence of light non-aqueous phase liquid (LNAPL), potential for migration of LNAPL, and associated risks based on several lines of evidence, including: (1) geologic, hydrogeologic, and marine influences; (2) TPH soil data; and (3) LNAPL fate and transport mechanisms generally known from industry knowledge and academic research. The evaluation indicated that 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 tidal mixing zone (TMZ), lack of significant quantity of residual LNAPL, salt water intrusion mixing, and absence of a LNAPL hydraulic head.
e. A conceptual site model that assesses the nature, extent, and mobility of the release has been developed.	Yes	The conceptual site model, including a description of site characteristics, contaminated media, and potential migration is described in the main text of this report, building upon what has been presented in previous reports (Tetra Tech Inc. 2003, KCH 2013).
f. Secondary source has been removed to the extent practicable.	Yes	Site physical constraints at the base of a bluff and within a tidal zone with significant elevation and incursion during flood tides make removal of what limited residual contamination that remains technically and fiscally impracticable. Due to the limited access to the site, a barge must be used to bring equipment to the site and to remove it from the site after several hours when the area is inindated by the incoming tide. In addition, there have been previous landslides along the shore of YBI in the 1980s (Tetra Tech 2003), and excavation of contamination below the beach surface may threaten the stability of surrounding soils.
g. Soil or groundwater has been tested for MTBE and results reported in accordance with Health and Safety Code Section 25296.15.	Yes	Fifteen soil samples and six groundwater samples analyses were conducted for MTBE, and all results were non-detect (KCH 2013).
h. Nuisance as defined by Water Code section 13050 does not exist at the site.	Yes	Contamination at the site does not meet the nuisance criteria because it does not meet the following requirements (a nuisance must meet all three): (1) Is injurious to health, or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property, (2) Affects at the same time an entire community or neighborhood, or any considerable number of persons, although the extent of the annoyance or damage inflicted upon individuals may be unequal, and (3) Occurs during, or as a result of, the treatment or disposal of wastes.
Are there unique site attributes or site-specific conditions that demonstrably increase the risk associated with residual petroleum constituents?	NA	Due to the limited areal extent of residual contamination, and expectation of little or no future development at the site due to significant topographic and tidal constraints, there is little to no current or future anticipated exposure to human and ecological receptors. However, the area of contamination lies within the TMZ, and that there could potentially be a risk posed to ecological receptors in the bay if the contaminated sediments at depth were disturbed in the future.

Table 17: Low Threat Closure Criteria Comparison for Site YF3

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Criteria	Criterion Met (Yes/No/NA)?	Supporting Notes
Media-Specific Criteria (sites must satisfy all three of these):		
1. *Groundwater : To satisfy the media-specific criteria for groundwater, the contaminant plume that exceeds water quality objectives must be stable or decreasing in areal extent, and meet all of the additional characteristics of one of the five classes of sites:*		
a. If designated for beneficial use, the contaminant plume that exceeds water quality objectives must be stable or decreasing in areal extent.	Yes	Contamination appears to be stable and limited in ability to spread vertically and laterally by site geology.
b. Does the contaminant plume that exceeds water quality objectives meet all of the additional characteristics of one of the five classes of sites? If YES, identify applicable class: (1) a. The contaminant plume that exeeds water quality objectives is less than 100 feet in length. b. There is no free product. c. The nearest existing water supply well or surface water body is greater than 250 feet from the defined plume boundary. (2) a. The contaminant plume that exeeds water quality objectives is less than 250 feet in length. b. There is no free product. c. The nearest existing water supply well or surface water body is greater than 1,000 feet from the defined plume boundary. d. The dissolved concentration of benzene is less than 3,000 micrograms per liter (µg/L), and the dissolved concentration of MTBE is less than 1,000 µg/L. (3) a. The contaminant plume that exeeds water quality objectives is less than 250 feet in length. b. Free product has been removed to the maximum extent practicable, may still be present below the site where the release originated, but does not extend off-site. c. The plume has been stable or decreasing for a minimum of five years. d. The nearest existing water supply well or surface water body is greater than 1,000 feet from the defined plume boundary. e. The property owner is willing to accept a land use restriction if the regulatory agency requires a land use restriction as a condition of closure. (4) a. The contaminant plume that exeeds water quality objectives is less than 1,000 feet in length. b. There is no free product. c. The nearest existing water supply well or surface water body is greater than 1,000 feet from the defined plume boundary. d. The dissolved concentration of benzene is less than 1,000 micrograms per liter (µg/L), and the dissolved concentration of MTBE is less than 1,000 µg/L. (5) a. The regulatory agency determines, based on an analysis of site-specific conditions that under current and reasonably anticipated near-term future scenarios, the contaminant plume poses a low threat to human health and safety and to the environment and water quality objectives will be acheived within a	NA	The site does not meet the criteria for Classes 1 through 4 because the significantly linear and shallow zone of groundwater is not a drinking water resource, and as the area is located within the tidal mixing zone, there is no buffer zone between the groundwater contamination and the nearest surface water body (i.e., the bay). The site may be considered Class 5, however, since site-specific conditions under current and reasonably anticipated future scenarios pose a low threat to human health and safety and to the environment. In addition, because the hydrocarbons have not been migrating or changing greatly over time, it is anticipated that water quality objectives will be achieved within a reasonable time frame.
c. For sites with releases that have not affected groundwater, do mobile constituents (leachate, vapors, or light non-aqueous phase liquids) contain sufficient mobile constituents to cause groundwater to exceed the groundwater criteria?	NA	As noted above, petroleum hydrocarbons have been detected in groundwater samples. However, as noted in Section 2.4 of the report, migration is expected to be minimal.
2. *Petroleum Vapor Intrusion to Indoor Air : The criteria a through c below apply to sites where the release originated and impacted or potentially impacted parcels when: (1) existing buildings are occupied or may be reasonably expected to be occupied inthe future, or (2) buildings for human occupancy are reasonably expected to be cpnstructed in the future. Although there are no current or future plans to occupy any buildings at Site YF3, these criteria were considered below. A site is considered low-threat for vapor intrusion to indoor air if site-specific conditions satisfy all of the characteristics of one of the three classes of sites (a through c) or if the exception for active commercial fueling facilities applies.*		
Is the site an active commercial petroleum fueling facility?	No	The site is no longer active; all former structures and potential sources of contamination have been removed. Any future construction of inhabitable buildings in the area of contamination is unlikely, as the impacted area is within the tidal zone. The most likely structures, if any, to be erected would be piers or other structures that are not built directly upon the ground surface.
a. Site-specific conditions at the release site satisfy all of the applicable characteristics and criteria of scenarios 1 through 3 as applicable, or all of the characteristics and criteria of scenario 4; or	NA	There are no existing or anticipated buildings in the area of contamination (TIDA 2011).
b. A site-specific risk assessment for the vapor intrusion pathway is conducted and demonstrates that human health is protected to the satisfaction of the regulatory agency; or	NA	There are no complete human health exposure pathways at the site, nor is there anticipated to be future development at the site given its location within the tidal zone. There is limited site access due to the site topography and tidal inundation, and no occupied structures currently present or planned for construction (TIDA 2011).
c. As a result of controlling exposure through the use of mitigation measures or through the use of institutional or engineering controls, the regulatory agency determines that petroleum vapors migrating from soil or groundwater will have no significant risk of adversely affecting human health.	NA	There are no institutional or engineering controls in place, or anticipated to be emplaced, since there is no exposure and risk to humans, nor any structures present.

Table 17: Low Threat Closure Criteria Comparison for Site YF3

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Criteria	Criterion Met (Yes/No/NA)?	Supporting Notes
Media-Specific Criteria (sites must satisfy all three of these):		
3. *Direct Contact and Outdoor Air Exposure : The site is considered low-threat for direct contact and outdoor air exposure if site-specific conditions satisfy one of the three classes of sites (a through c).*		
a. Maximum concentrations of petroleum constituents in soil are less than or equal to those listed in Table 1 for the specified depth below ground surface (bgs). The concentration limits for 0 to 5 feet bgs protect from ingestion of soil, dermal contact with soil, and inhalationof volatile emissions and inhalation from particulate emissions. The 5 to 10 feet bgs concentration limits protect from inhalation of volatile soil emissions. Both the 0 to 5 feet bgs concentration limits and the 5 to 10 feet bgs concentration limits for the appropriate site classifiction (Residential or Commericla/Industrial) shall be satisfied. In additin, if exposure to construction workers or utility trench workers are reasonably anticipated, the concentration lmits for Utility Workers shall also be satisfied; or	Yes	Concentrations of benzene, ethylbenzene and naphthalene are well below the concentrations listed in Table 1 of the policy (See Table 18). Although waste oil or Bunker C fuel was released at the site, the toxicity equivalent (TEQ) for benzo(a)pyrene calculated for comparison is lower than the values listed in Table 1 of the policy.
b. Maximum concentrations of petroleum constituents in soil are less than levels that a site specific risk assessment demonstrates will have no significant risk of adversely affecting human health; or	Yes	Although site soil concentrations have been found to exceed screening values, there are no complete human health exposure pathways. Therefore, there is no risk posed to human health.
c. As a result of controlling exposure through the use of mitigation measures or through the use of institutional or engineering controls, the regulatory agency determines that the concentrations of petroleum constituents in soil will have no significant risk of adversely affecting human health.	NA	There are no institutional or engineering controls in place, or anticipated to be emplaced, since there is no exposure and risk posed to humans.

Notes:

LNAPL= Light non-aqueous phase liquid
MTBE = Methyl-tert-butyl-ether
NAPL = Non-aqueous phase liquid
NA = Not applicable
TEQ = Toxicicity Equivalent
TMZ = Tidal mixing zone
UST = Underground storage tank

References:

KCH. 2013. "Final Field Activity Report for Additional Soil and Groundwater Sampling at Area YF3 and Artifact 1. Yerba Buena Island, San Francisco, CA." March.
Tetra Tech, Inc. 2003. "Corrective Action Plan, Inactive Fuel Lines at Naval Station Treasure Island, San Francisco, CA." December.
Treasure Island Development Authority (TIDA). 2011. Treasure Island and Yerba Buena Island Design for Development. June 28.

Table 18: Comparison of Site Data with Chemical Concentrations in Table 1 of Low Threat UST Case Closure Policy

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Chemical	Concentrations in Soil that Will Have no Significant Risk of Adversely Affecting Human Health (mg/kg)[a]					Maximum Detected Site Concentration 0-5 feet bgs	Maximum Detected Site Concentration 0-10 feet bgs
	Residential		Commercial /Industrial		Utility Worker		
	0 to 5 feet bgs	0 to 10 feet bgs	0 to 5 feet bgs	0 to 10 feet bgs	0 to 10 feet bgs		
Benzene	1.9	2.8	8.2	12	14	ND	ND
Ethylbenzene	21	32	89	134	314	0.02	0.02
Naphthalene	9.7	9.7	45	45	219	0.1	0.1
PAH[b]	0.63	NA	0.68	NA	4.5	0.5	0.5

Notes:

a = Concentrations for each chemical are from Table 1 of the Water Board's Low Threat UST Case Closure Policy (State Water Resources Control Board 2012)

b = Based on the seven carcinogenic PAHs as benzo(a)pyrene toxicity equivalent (TEQ) [BaPe]. Sampling and analysis for PAH is only necessary where soil is affected by either waste oil or Bunker C fuel. Although waste oil and Bunker C fuel are not a concern at Site YF3, the PAH concentrations as BaPe have been calculated for comparison.

bgs = below ground surface

mg/kg = milligrams per kilogram

NA = Not applicable

ND= Not detected

PAH = Polycyclic aromatic hydrocarbon

References:

KCH. 2013. Final Field Activity Report for Additional Soil and Groundwater Sampling at Area YF3 and Artifact 1. Yerba Buena Island, San Francisco, CA. March.

State Water Resources Control Board. 2012. "*Low-Threat Underground Storage Tank Case Closure Policy.* " November 6.

APPENDIX A
SCOPING MEETING MATERIALS AND RESPONSES TO COMMENTS ON THE SCREENING-LEVEL RISK ASSESSMENT METHODOLOGY

Naval Facilities Engineering Command

ACTIVITY NAME

Scoping Discussion
Site YF3 Screening-Level Ecological Risk Assessment (SLERA)

Former Naval Station Treasure Island

BRAC Cleanup Team (BCT) Meeting

Louie Cardinale, Remedial Project Manager

Katie Henry, TriEco-Tt Project Manager

1/15/2014

Overview

The objective of this presentation is to present the proposed methodology to develop the SLERA. The following handouts will be used as references:

- **Handout 1: 2-D Graphical Conceptual Site Model and Site Photos**
- **Handout 2: Navy Ecological Risk Assessment Tiered Approach**
- **Handout 3: Selection of Assessment Endpoints**
- **Handout 4: Assessment and Measurement Endpoints**
- **Handout 5: Hierarchy of Benchmarks, Toxicity Reference Values, and Bioaccumulation Factors**
- **Handout 6: Dose Parameters for Representative Receptors**

Review Handouts

Refer to Handouts 1-6 (PDF format) for discussion

Next Steps

- **Provide Comments/Questions by January 29, 2014.**
- **The BCT to Resolve Outstanding Issues and Concur on Methodology by February 12, 2014.**
- **Draft SLERA - submitted on June 18, 2014.**

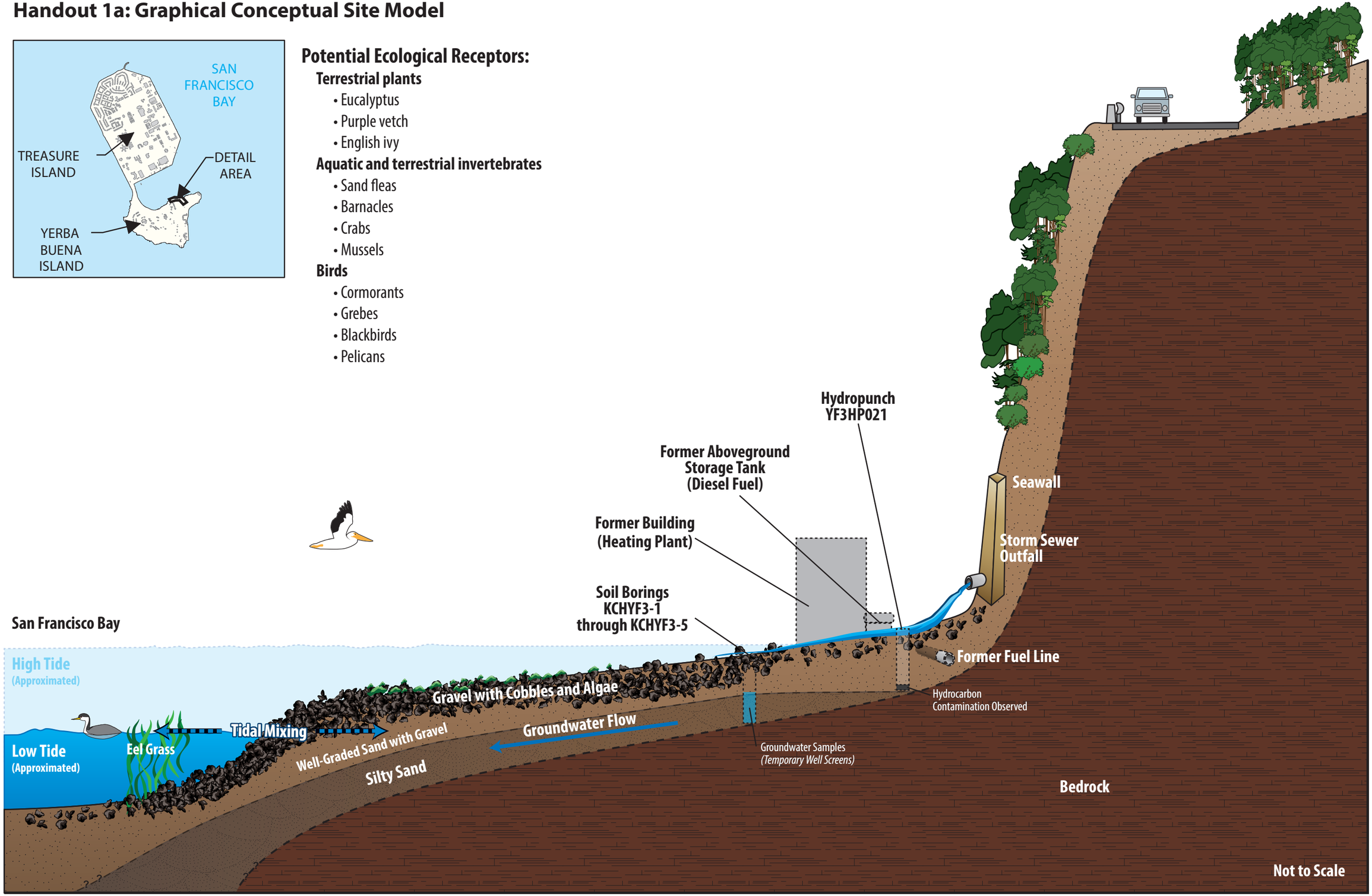
Handout 1a: Graphical Conceptual Site Model

Potential Ecological Receptors:

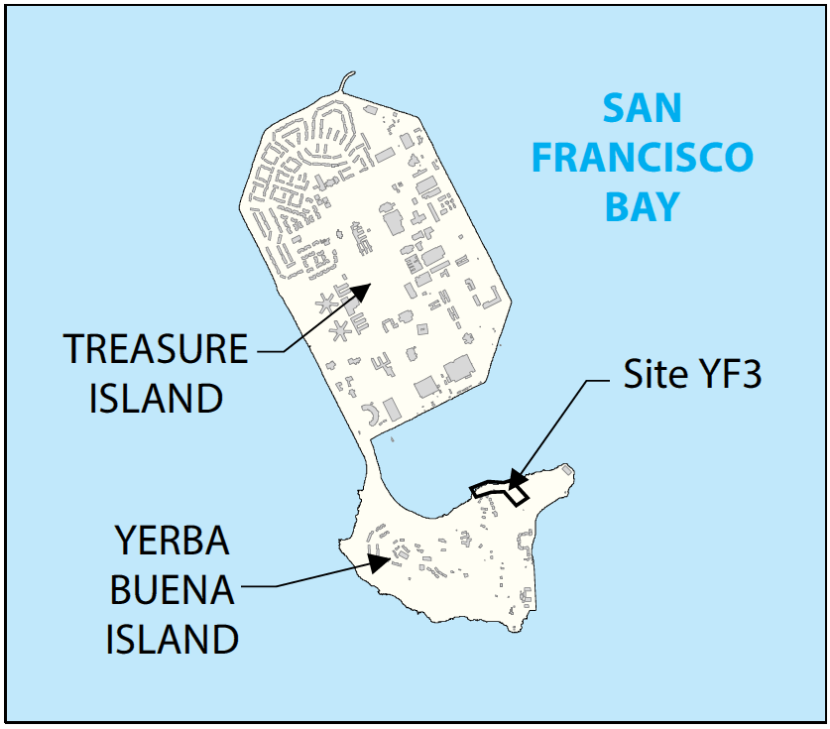
Terrestrial plants
- Eucalyptus
- Purple vetch
- English ivy

Aquatic and terrestrial invertebrates
- Sand fleas
- Barnacles
- Crabs
- Mussels

Birds
- Cormorants
- Grebes
- Blackbirds
- Pelicans



Handout 1b. Site Photos and Maps



1. Site Location Map

2. View of site – facing south

3. Wider view of site – facing south/southwest

4. View of site from tide line upslope (English Ivy and Eucalyptus dominant) - facing south

5. Vegetation above tideline on slope
(Canary Island Marguerite, dried fennel, toyon bush, and french broom

6. Intertidal zone, green and red algae, rubble and debris - facing north

7. Eastern edge of site (close) - facing east (close)

8. Eastern edge of site (wide)- facing east

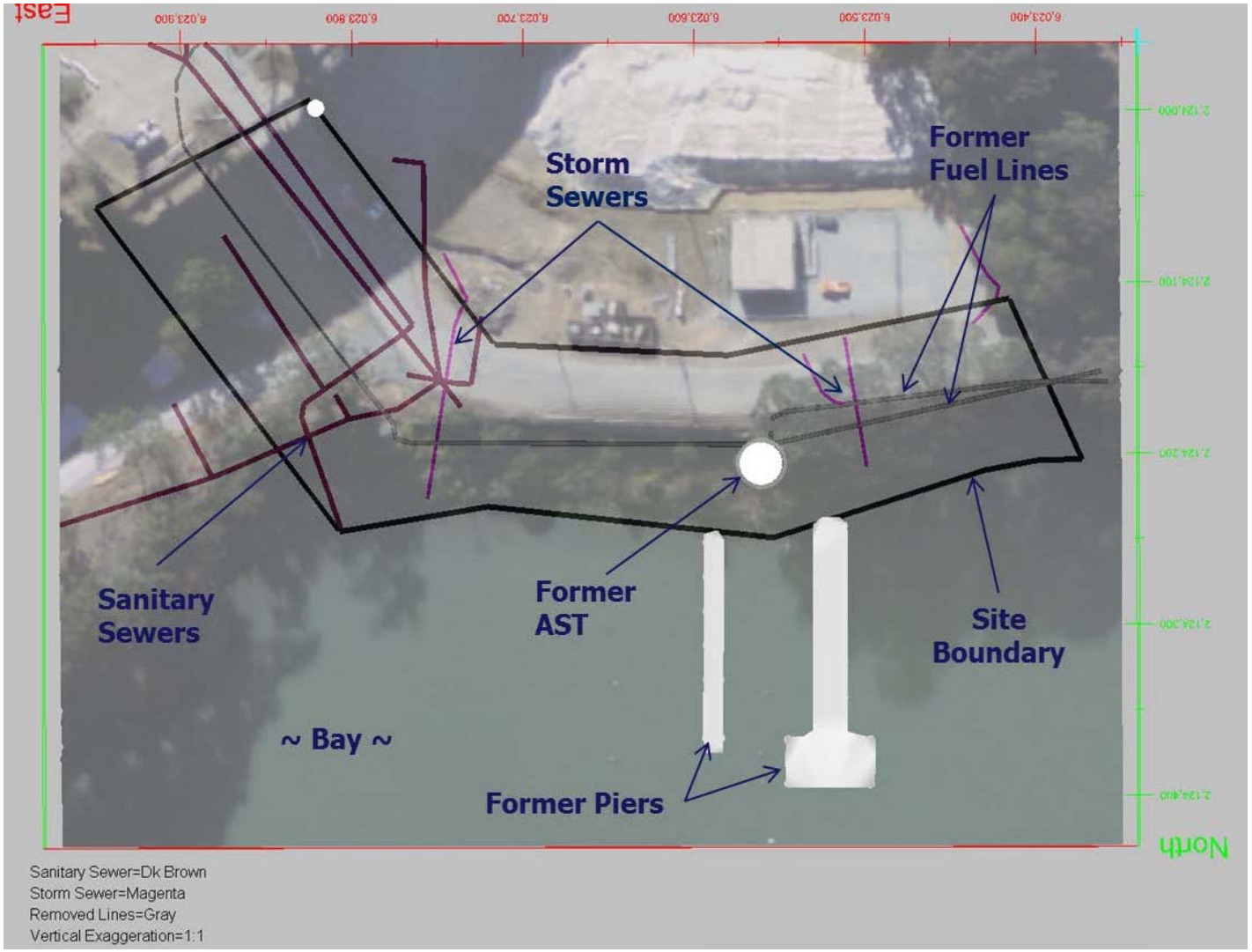
9. Debris line on eastern edge of site– facing east/southeast

10. Western edge of site, concrete remains visible – facing west/southwest

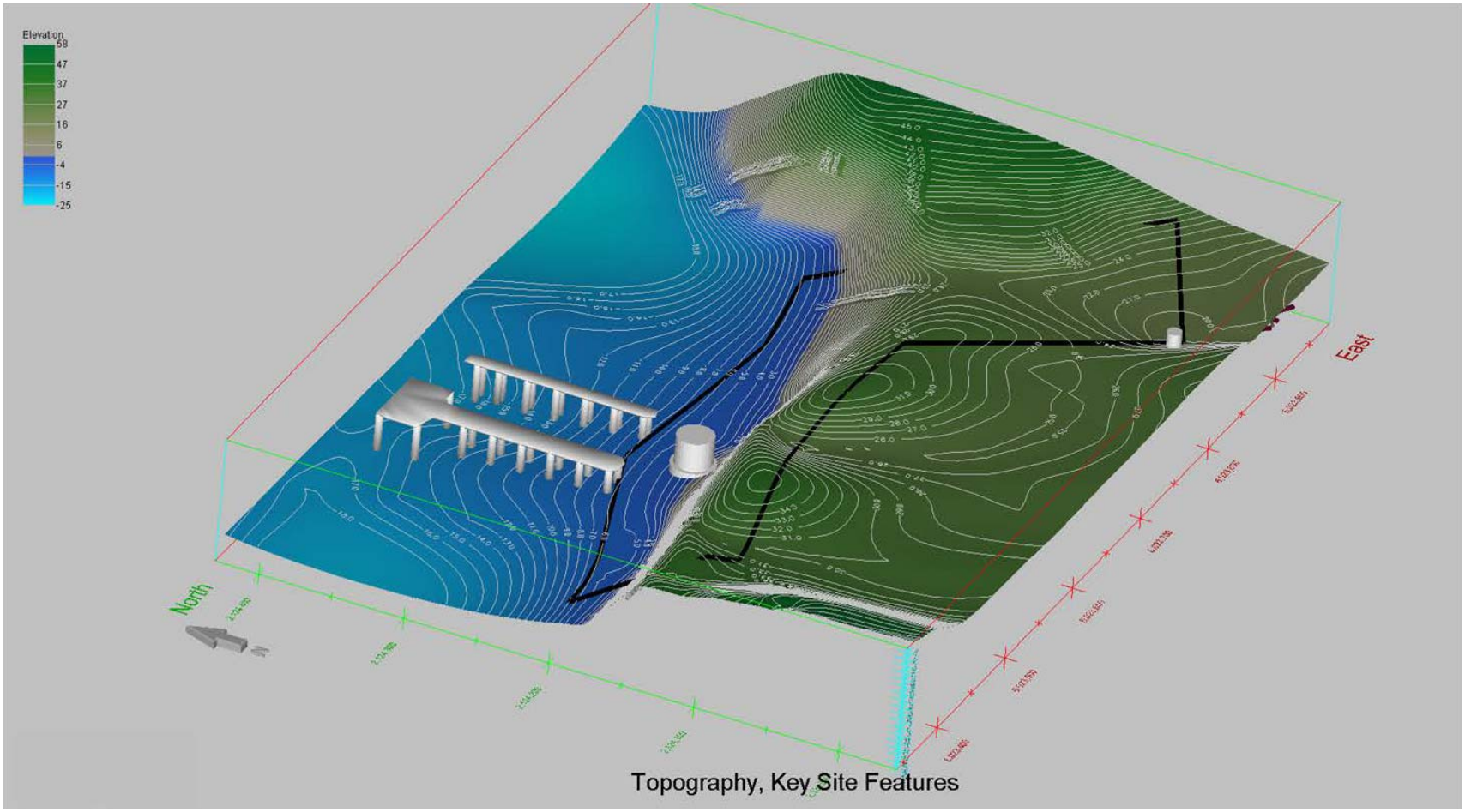
11. Western edge of site, concrete remains visible – facing west

12. View from Road downslope (courtesy of Navy RPM Danielle Janda)

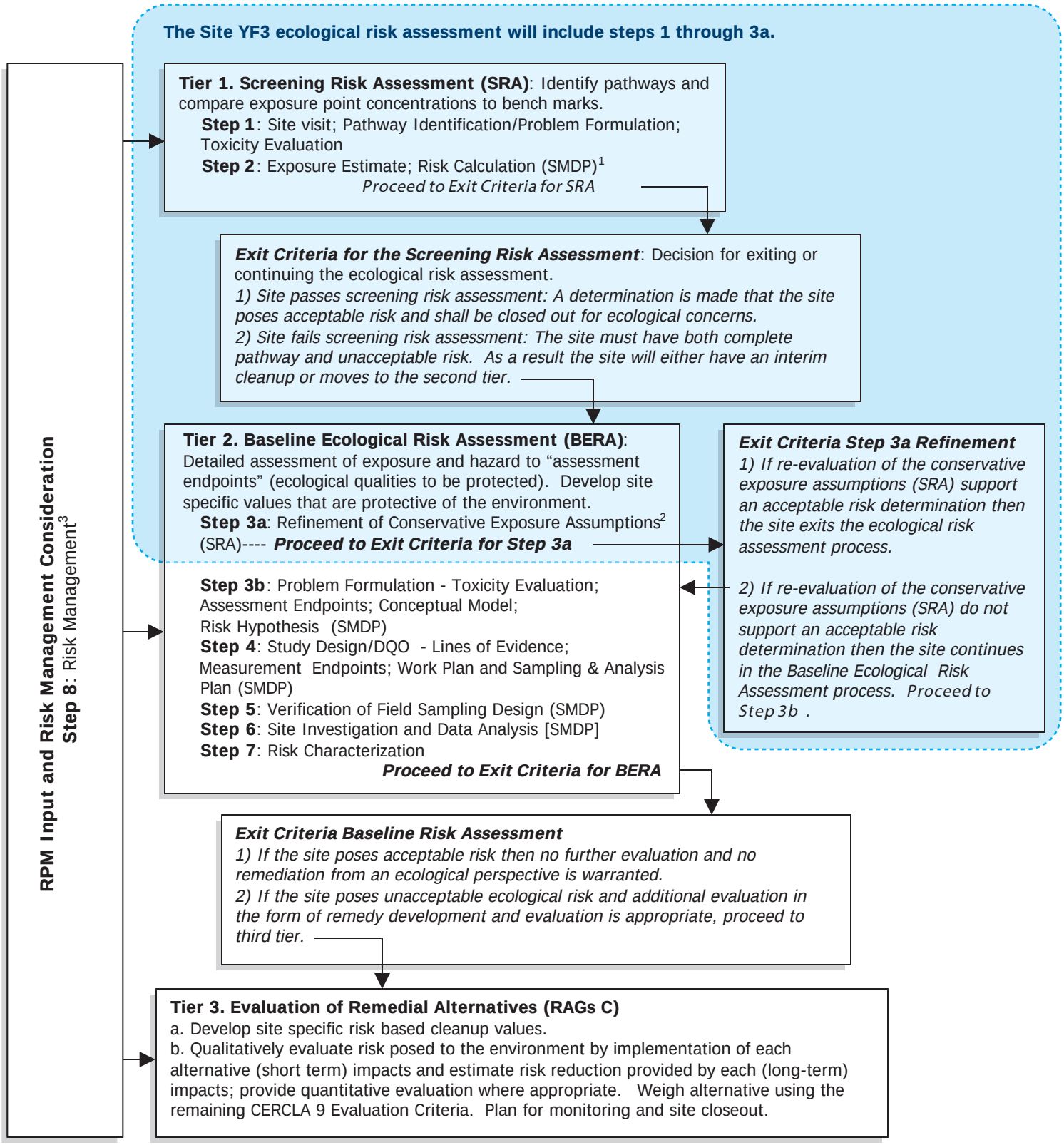
13. View of drill rig during 2012 sampling event (courtesy of Navy RPM Danielle Janda)



14. Overlay of Aerial Photo with Site Features



15. 3-D Site Topography and Bathymetry



Handout 2. Navy Ecological Risk Assessment Tiered Approach

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) Risk Management is incorporated throughout the tiered approach.

Handout 3. Selection of Assessment Endpoints

Screening-Level Ecological Risk Assessment for Site YF3, Former Naval Station Treasure Island, San Francisco, California

	Potential Ecological Receptor Group	Preliminary Assessment Endpoint	Retained for YF3 SLERA?	Rationale
1	Aquatic Life	Protection of aquatic life	Yes	Aquatic organisms may be exposed to chemicals if impacted groundwater reaches surface water in Clipper Cove.
2	Benthic Invertebrates	Protection of benthic invertebrates	Yes	Benthic invertebrates may be exposed to chemicals in tidal zone soils.
3	Terrestrial Plants	Protection of terrestrial plants	No	The area of contamination lies within the tidal zone, which does not support terrestrial plant growth; therefore, plants are not exposed to chemicals in sediment.
4	Terrestrial Invertebrates	Protection of soil invertebrates	No	The area of contamination lies within the tidal zone, which does not support soil invertebrates (e.g., earthworms); therefore, soil invertebrates are not exposed to chemicals in soil.
5	Herbivorous Birds	Protection of herbivorous birds	No	The area of contamination does not support terrestrial plants. Therefore, there is no exposure of herbivorous birds to chemicals in soil.
6	Invertivorous Birds	Protection of invertivorous birds	Yes	Birds like the spotted sandpiper may forage for invertebrates along the shoreline and may be exposed to chemicals in sediment via the food chain and/or by incidental ingestion of sediment.
7	Carnivorous Birds	Protection of carnivorous birds	Yes	Birds like the great blue heron may forage along the shoreline for fish and invertebrates and may be exposed to chemicals in sediment via the food chain and/or by incidental ingestion of sediment.
8	Omnivorous Mammals	Protection of omnivorous mammals	Yes	Raccoons are opportunistic feeders known to occur on YBI that may forage in the tidal zone and may be exposed to chemicals in sediment via the food chain and/or by incidental ingestion of sediment.

Handout 4. Assessment and Measurement Endpoints

Screening-Level Ecological Risk Assessment for Site YF3, Former Naval Station Treasure Island, San Francisco, California

Receptors	Assessment Endpoints	Risk Questions	Representative Species	Measurement Endpoints
Aquatic Life	Protection of aquatic life	Are COPECs in groundwater adversely affecting aquatic receptors?	Not Applicable*	Comparison of groundwater concentrations with water quality benchmarks
Benthic Invertebrates	Protection of benthic invertebrates	Are COPECs in sediment adversely affecting benthic invertebrates?	Not Applicable*	Comparison of sediment concentrations (0 to 2 feet bgs) with toxicity-based benchmarks
Invertivorous Birds	Protection of invertivorous birds	Are COPECs in sediment adversely affecting invertivorous birds?	Spotted sandpiper (*Actitis macularius*)	Food chain model dose calculations using shallow sediment concentrations (0 to 2 feet bgs) followed by a comparison with TRVs
Carnivorous Birds	Protection of carnivorous birds	Are COPECs in sediment adversely affecting carnivorous birds?	Great Blue Heron (*Ardea herodias*)	Food chain model dose calculations using shallow sediment concentrations (0 to 2 feet bgs) followed by a comparison with TRVs
Omnivorous Mammals	Protection of omnivorous mammals	Are COPECs in sediment adversely affecting omnivorous mammals?	Raccoon (*Procyon lotor*)	Food chain model dose calculations using shallow sediment concentrations (0 to 2 feet bgs) followed by a comparison with TRVs

Notes:

* There are no representative species for aquatic life or benthic invertebrates. The risk to these groups will be evaluated using toxicity benchmarks derived from studies of a range of species to estimate risk to each group as a whole.

bgs Below ground surface

COPEC Chemical of potential ecological concern

TRV Toxicity reference value

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HANDOUT 5.
PROPOSED HIERARCHY OF BENCHMARKS, TOXICITY REFERENCE VALUES, AND BIOACCUMULATION FACTORS FOR THE ECOLOGICAL RISK ASSESSMENT OF SITE YF3, YERBA BUENA ISLAND, SAN FRANCISCO, CALIFORNIA

Direct Contact Screening Benchmarks[1]

Aquatic Life (Groundwater):

1. Groundwater Screening Criteria Developed Using a Tiered Approach (the same approach has been used in previous reports, including the Site 12 Remedial Investigation [TriEco-Tt 2012])
2. Water Board Environmental Screening Level (ESL) (Water Board 2013)
3. Qualitative evaluation (with literature values [in Step 3a risk refinement[2] only])

Benthic Invertebrates (Tidal Zone Sediment):

1. Effects range-low [ER-L] and effects range-median [ER-M] (Long and Morgan 1991; Long and others 1995; Long and MacDonald 1998)
2. Qualitative evaluation (with literature values [in Step 3a risk refinement[2] only; after screening against San Francisco Bay Ambient Values (Water Board 1998)])

Toxicity Reference Values (TRV)[3]

Bird and Mammal TRVs:

1. Biological Technical Assistance Group (BTAG) TRVs (Department of the Navy 1998; Department of Toxic Substances Control [DTSC] 2009)
2. Oak Ridge National Laboratory (ORNL) TRVs (Sample and others 1996)
3. Ecological Soil Screening Level (Eco-SSL) (U.S. Environmental Protection Agency [EPA] 2013)
4. Qualitative evaluation (with literature values [in Step 3a risk refinement[2] only])

Bioaccumulation Factors (BAF)[3]

Note: Concentrations from invertebrate and fish tissue collected within and around the site during the Offshore Operable Unit Remedial Investigation (available for PAHs) (Tetra Tech 2001) will be used to model doses in parallel with literature-based bioaccumulation factors.

Invertebrates:

1. Maximum sediment-to-invertebrate tissue bioaccumulation factors (BAF) from the Navy baseline ecological risk assessment for Pearl Harbor (Earth Tech 2006)
2. Default BAF = 1.0

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Demersal Fish (Live and Feed Near Seabed):

1. Sediment-to-fish tissue bioaccumulation factors (BAF) from the Navy baseline ecological risk assessment for Pearl Harbor (Earth Tech 2006)
2. Default BAF = 1.0

Notes

1. The screening benchmarks will be compared with reported site chemical concentrations to calculate a hazard quotient (HQ), as shown below:

   HQ (unitless) = Concentration/Benchmark

   where:

   Concentration = Reported concentration (µg/L in groundwater; mg/kg in sediment)

   A HQ greater than 1.0 indicates a potential risk.

2. Chemicals identified as posing potential risks in the Tier 1 SLERA and those that do not have benchmarks or TRVs will be reevaluated in the Step 3a risk refinement. The purposes of Step 3a are to eliminate from further consideration those chemicals that were retained because very conservative exposure scenarios were used, and to consider site-specific conditions. Assumptions used in Step 3a (EPA 2001) are more realistic and less conservative than those used in the Tier 1 SLERA. Chemicals with no benchmarks or TRVs will be evaluated qualitatively using alternative benchmarks or other data from the literature.

3. Estimated daily doses for birds and mammals will be compared with TRVs to calculate HQs, which will be interpreted as described below the example dose calculation. BAFs are used to estimate the concentration to each receptor.

   <u>Example Dose calculation for the Spotted Sandpiper</u>:

   Dose (mg/kg-day) = (SUF) [(Cinvertebrates)(IR) + (Csediment)(IR)]/BW

   where:

SUF	=	Site use factor, assumed to be 1.0 in SLERA
Csediment	=	Concentration of COPEC in sediment (mg/kg)
Cinvertebrate	=	(Csediment)(invertebrate BAF) (unitless)
IR	=	Ingestion rate (kilogram per day)
BW	=	Body weight of receptor species (kilogram)

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Hazard quotients are interpreted as follows:

HQ = Dose or Air Concentration/TRV	Low TRV	High TRV	Between Low and High TRV
Average 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 the average receptor. However, the magnitude of the potential risk is uncertain.

Note: Use of the term “significant” does not reflect statistical significance.

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DRAFT

Handout 6a. Dose Parameters for the Spotted Sandpiper (*Actitis macularius*)

Screening-Level Ecological Risk Assessment

Site YF3, Former Naval Station Treasure Island, San Francisco, California

Parameter	ERA Step	Value	Units	Reference/Notes
Ingestion Rate$_{food}$	2	0.0085	kg/day	Calculated with body weight of 37.9 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).
	3a	0.0093		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$_{invertebrate}$	2	0.009	kg/day	Based on 100 percent of food ingestion rate.
	3a	0.009		
Ingestion Rate$_{sediment}$	2	0.0015	kg/day	18 percent total ingestion rate based on the western sandpiper (Beyer and others 1994).
	3a	0.0017		
Sediment Concentrations	2	Maximum Concentration	mg/kg	To be determined based on existing data for sediment collected from the site (0 to 2 feet bgs).
	3a	95 UCL Concentration		
Diet Composition[a]	2 and 3a	100%	Invertebrate tissue	Prey is assumed to be 100 invertebrates. This receptor is representative of invertivorous birds.
Foraging Range	2 and 3a	0.62	acre	Based on territory size reported by Maxson and Oring 1980, as cited in EPA 1993.
Site Use Factor	2	1	unitless	Based on conservative estimate of 100 percent site use per EPA SLERA guidance (1997).
	3a	1		Since the site area (1.35 acres) is greater than the foraging range, the site use factor is 1.0.
Body Weight	2	0.0379	kg	Based on average adult weight of males (EPA 1993).
	3a	0.0425		Based on average adult weights of both sexes (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
bgs	Below ground surface
BW	Body weight
EPA	U.S. Environmental Protection Agency
kg	Kilogram
kg/day	Kilogram per day
mg/kg	Milligram per kilogram
SLERA	Screening level ecological risk assessment

Sources:

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Handout 6b: Dose Parameters for the Great Blue Heron (*Ardea herodias*)

Screening-Level Ecological Risk Assessment
Site YF3, Former Naval Station Treasure Island, San Francisco, California

Parameter	ERA Step	Value	Units	Reference/Notes
Ingestion Rate$_{food}$	2	0.128	kg/day	Calculated with body weight of 2,300 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).
	3a	0.132		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$_{fish}$	2	0.096	kg/day	Based on 75 percent of the food ingestion rate.
	3a	0.099		
Ingestion Rate$_{invertebrates}$	2	0.032	kg/day	Based on 25 percent of the food ingestion rate.
	3a	0.033		
Ingestion Rate$_{sediment}$	2	0.0035	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).
	3a	0.0036		
Sediment Concentrations	2	Maximum Concentration	mg/kg	To be determined based on existing data for sediment collected from the site (0 to 2 feet bgs).
	3a	95 UCL Concentration		
Diet Composition[a]	2 and 3a	75%	Fish tissue	Prey is assumed to be 75 percent fish and 25 percent invertebrates. This receptor is representative of carnivorous birds.
		25%	Invertebrate tissue	
Foraging Range	2 and 3a	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	2	1	unitless	Based on conservative estimate of 100 percent site use per EPA SLERA guidance (1997).
	3a	0.065		Based on the site area (1.35 acres) divided by the foraging range.
Body Weight	2	2.30	kg	Mean body weight of both sexes (Butler 1992)
	3a	2.39		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
bgs	Below ground surface
EPA	U.S. Environmental Protection Agency
kg	Kilogram
kg/day	Kilogram per day
mg/kg	Milligram per kilogram
SLERA	Screening level ecological risk assessment

Sources:

Butler, R.W. 1992. The Birds of North America. A. Poole, P. Stettenheim, and F. Gill, editors. The Acadamy of Natural Science, Philadelphia, PA.

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Handout 6c: Dose Parameters for the Raccoon (*Procyon lotor*)

Screening-Level Ecological Risk Assessment

Site YF3, Former Naval Station Treasure Island, San Francisco, California

Parameter	ERA Step	Value	Units	Reference/Notes
Ingestion Rate $_{food}$	2	0.141	kg/day	Calculated with body weight of 4,310 grams using the equation for the food requirement for intake of dry matter for Carnivora (food ingestion rate = [0.102[BW]^0.864]/1000) (Nagy 2001).
	3a	0.180		Calculated with body weight of 5,740 grams using the equation for the food requirement for intake of dry matter for Carnivora (food ingestion rate = [0.102[BW]^0.864]/1000) (Nagy 2001).
Ingestion Rate $_{mollusks}$	2	0.0704	kg/day	Based on conservative assumption of 50 percent of food ingestion rate.
	3a	0.0902		
Ingestion Rate $_{crustaceans}$	2	0.0704	kg/day	Based on conservative assumption of 50 percent of food ingestion rate.
	3a	0.0902		
Ingestion Rate $_{sediment}$	2	0.0132	kg/day	9.4 percent of food ingestion rate (Beyer and others 1994).
	3a	0.0170		
Sediment Concentrations	2	Maximum Concentration	mg/kg	To be determined based on existing data for sediment collected from the site (0 to 2 feet bgs).
	3a	95 UCL Concentration		
Diet Composition[a]	2 and 3a	50%	Mollusk tissue	Food will consist of 100 percent invertebrate tissue (50 percent mollusks and 50 percent crustaceans) as a conservative estimate, based on the prey items available at the site. The raccoon is a representative species for omnivorous mammals.
		50%	Crustacean tissue	
Foraging Range	2 and 3a	96	acre	Based on mean female home range on coastal island (EPA 1993).
Site Use Factor	2	1	unitless	Based on conservative estimate of 100 percent site use per EPA SLERA guidance (1997).
	3a	0.014		Based on the site area (1.35 acres) divided by the foraging range.
Body Weight	2	4.31	kg	Based on minimum mean male body weight (Johnson 1970, as cited in EPA 1993).
	3a	5.74		Based on median of mean adult male body weights (EPA 1993).

Notes:

a The raccoon is a highly opportunistic feeder (Zeiner 1990).

95UCL One-sided 95 percent upper confidence limit of the mean
BW Body weight
EPA U.S. Environmental Protection Agency
kg Kilogram
kg/day Kilogram per day
mg/kg Milligram per kilogram
SLERA Screening level ecological risk assessment

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.

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RESPONSE TO COMMENTS
ON THE YF3 SLERA SCOPING MATERIALS
YERBA BUENA ISLAND, SAN FRANCISCO, CALIFORNIA
(March 12, 2014)

Comment from Ms. Myriam Zech, Project Manager
California Regional Water Quality Control Board (Water Board), Region 2 Comments
Dated: February 13, 2014

COMMENTS	RESPONSES
General Comment 1: In the draft SLERA, in order to fully evaluate the nature and extent of the subsurface petroleum impacts to soil and groundwater, please provide the following information: 1) Vertical cross section(s) as necessary to show the subsurface lithology, potential migration pathways, sample/boring/well locations, fuel lines and other potential sources, and the contaminant concentrations and known/inferred presence of free product. Contaminants should include PAHs and TOC. 2) A map at scale sufficient to evaluate the actual distances between the sample locations and nearby receptors (i.e., the Bay). This map should include all fuel pipelines and other fuel leak sources, and all sample/boring/well locations so that we're able to determine how far the sampling points are from the 220 linear feet of former Fuel Line F03 that was removed, and how far they are from the shore.	**Response:** The Navy will include figures in the report showing the lithology, potential migration pathways, locations of samples and potential sources of contamination, sample locations and results, and other aspects of the site conceptual model. The scale will be such that distances between the potential sources and borings can be evaluated. The report will also include additional information about the sources of data used to generate the figures. The presence of free product was not confirmed during focused sampling in 2012 (KCH 2013). Although the 2003 Corrective Action Plan previously indicated that "free product" was observed (Tetra Tech Inc. [Tetra Tech] 2003), that term appears to have been used, as was common at that time, to describe the visible presence of sorbed petroleum contamination versus the confirmation of mobile, non-aqueous phase liquid (NAPL). Samples collected in 2012 were analyzed for total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), and volatile organic compounds (VOC) (KCH 2013). However, none of the Site YF3 samples were analyzed for total organic carbon (TOC), therefore TOC data cannot be presented (Tetra Tech 2003, KCH 2013).

Comments from Darrel Lauren, Ph.D, Staff Toxicologist
Ecological Risk Assessment Section (ERAS), Human and Ecological Risk Office (HERO)
Comments Dated: February 13, 2014

COMMENTS	RESPONSES
General Comment 1: a. Please show the downgradient sample locations on Figure 14. b. Can you discuss whether AST 214 was surrounded by seawater, or under water, at any one time?	**Response:** a. The report will include a figure showing the site features and all sample locations. b. It appears in the attached undated map that former Aboveground Storage Tank (AST) 214, part of former Building 214, was most likely erected on a flat foundation at an elevation between the tideline and the roadway, adjacent to the slope of the island and connected to the walkway of the piers that reached into Clipper Cove. While the Navy cannot provide the details of the building's elevation, placement of such a structure within the tidal range would be unlikely. Therefore, the assumption is that the AST was not underwater at any time.
General Comment 2: Handout 2, Footnote 2. What do you expect the detection frequency to be?	**Response:** In the Step 3a risk refinement, chemicals of potential ecological concern (COPECs) for which risk will be indicated in the screening level ecological risk assessment (SLERA) will be further evaluated based on additional lines of evidence such as background, bioavailability, and detection frequency. The detection frequency will vary for each COPEC. For example, within the 0- to 2-foot depth interval, detection frequencies of TPH range from 37.5 percent (gasoline range) to 93.75 percent (motor oil range).

Comments from Darrel Lauren, Ph.D, Staff Toxicologist
Ecological Risk Assessment Section (ERAS), Human and Ecological Risk Office (HERO)
Comments Dated: February 13, 2014

COMMENTS	RESPONSES
General Comment 3: Handout 4: a. Please include mink, a mammalian carnivore with a high metabolic rate, not the raccoon. b. Are there any worthwhile avian toxicity reference values for PAHs (or TPH)?	**Response:** a. The Navy has not proposed to evaluate the mink because it is unlikely to occur on Yerba Buena Island based on the island's location and relatively poor foraging value. The mink's preferred foraging habitat consists of rivers, streams, marshes, lakes, ponds, and some coastal areas (Zeiner 1990). As noted in the habitat management plan, few mammal species occur on the island, and only the opportunistic raccoon would be expected to feed on prey at the site; the extent to which the raccoon would actually forage at the site is unknown (Conger Moss Guiard, ESA, and Wood Biological Consulting 2009). Because there have been sightings of raccoons foraging on the island, sometimes in tide pools, the Navy has included the raccoon as a receptor in the SLERA to provide a conservative estimate of risk (Conger Moss Guiard, ESA, and Wood Biological Consulting 2009). b. No accepted toxicity reference values (TRVs) exist but there are studies of avian exposure to PAHs, which will be discussed in the report.

Comments from Darrel Lauren, Ph.D, Staff Toxicologist
Ecological Risk Assessment Section (ERAS), Human and Ecological Risk Office (HERO)
Comments Dated: February 13, 2014

COMMENTS	RESPONSES
General Comment 4: Handout 5: a. Sediment SQUirT values such as ER-Ls and ER-Ms are only accepted by ERAS for initial screening; If PAHs are detected, ERAS may require equilibrium partitioning (EqP) and/or tissue residue analyses. b. When you collect PAH data, please collect TOC data as well, as TPH will not provide adequate toxicity information. TOC is used to calculate equilibrium partitioning of PAHs so you can tell what is bioavailable to cause toxicity. c. Please note that default BAFs of 1 cannot be assumed until the chemistry data is reported. In addition, high molecular weight PAHs may accumulate to higher levels in marine invertebrates.	**Response:** a. The SLERA and Step 3a risk refinement will use existing data collected during previous investigations (Tetra Tech 2003, KCH 2013). b. The data that will be used in the SLERA were collected during previous investigations, and the samples were not analyzed for TOC (Tetra Tech 2003, KCH 2013). Therefore, TOC data are not available. c. The default of 1 is to be used for the calculations only if there is no literature value. The uncertainty associated with the use of the literature and default BAFs, as well as the previously reported tissue concentrations, will be discussed in the report.

REFERENCES

Conger Moss Guiard, ESA, and Wood Biological Consulting. 2009. Draft Yerba Buena Island Habitat Management Plan. Prepared for Treasure Island Community Development. December.

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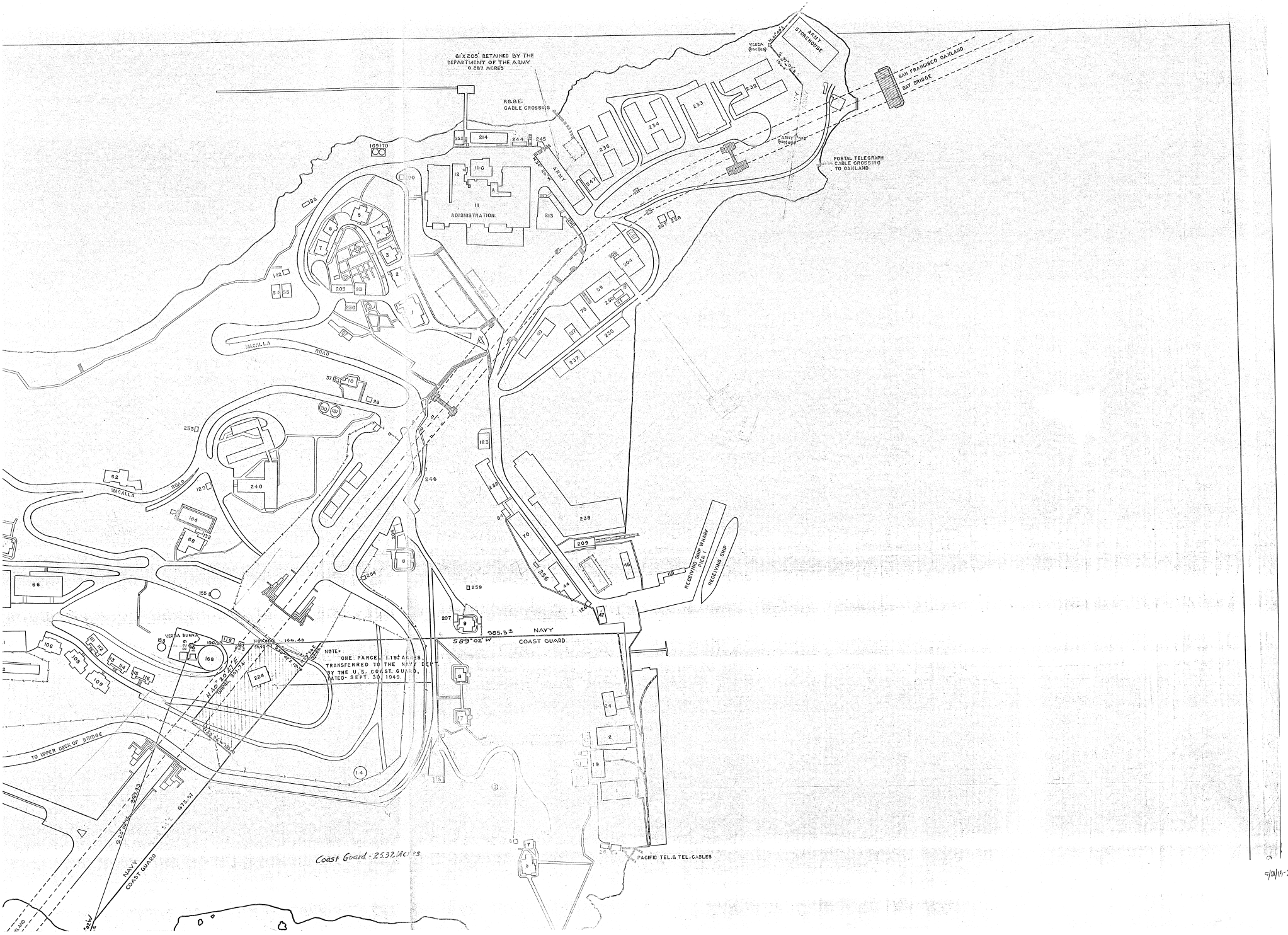
Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White. 1990. California's Wildlife: Volume III, Mammals. CWHR System. State of California, the Resource Agency, CDFG. Sacramento, California.


61'X205' RETAINED BY THE DEPARTMENT OF THE ARMY 0.287 ACRES
P.G.&E. CABLE CROSSING
ARMY STOREHOUSE
SAN FRANCISCO OAKLAND BAY BRIDGE
POSTAL TELEGRAPH CABLE CROSSING TO OAKLAND
ADMINISTRATION
MAGNOLIA ROAD
RECEIVING SHIP WHARF
RECEIVING SHIP
NOTE: ONE PARCEL 1.19± ACRES TRANSFERRED TO THE NAVY DEPT BY THE U.S. COAST GUARD, DATED SEPT. 30, 1949.
NAVY
COAST GUARD
TO UPPER DECK OF BRIDGE
PACIFIC TEL.& TEL. CABLES
Coast Guard - 2532 Acres

5/21/15-2

Comment from Ms. Myriam Zech, Project Manager
California Regional Water Quality Control Board (Water Board), Region 2
Dated: April 29, 2014

COMMENTS	RESPONSES
General Comment 1: Our preference remains that the mink be used for evaluation of toxicity to mammals. The extent of the contamination found at YF3 warrants more conservative assumptions, and we believe that using a carnivore will provide a more conservative risk estimate than using an omnivore such as the raccoon. The American mink is indigenous to the Bay Area. Mr. Lauren notes that YBI is a typical habitat for mink (in agreement with your response that one of the mink's preferred foraging habitats is coastal areas), and that Martinez is home to a growing mink population. Considering the proximity of Martinez to YBI, and considering that the American mink can swim 3 hours straight, it is unreasonable, in the absence of adequate field investigations, to discard the possibility of a mink population living at YBI.	**Response:** The raccoon, which does occur on the island (Conger Moss Guiard, Environmental Science Associates, and Wood Biological Consulting 2009), is considered an appropriate representative mammalian receptor for the site. Mink generally do not travel far from their den sites; however, they are known to travel farther to disperse, forage, or find a mate, and have been found to travel up to 7.5 miles in a single night (Whitaker and Hamilton 1998, as cited in Weston Solutions, Inc.). While it is possible that a male or dispersing juvenile might visit YBI to forage occasionally while roaming, Site YF3 would represent a minimal portion of its foraging range. The narrow, sandy, cobbled beach of Site YF3 is not likely to provide a substantial amount of food or serve as a den site, as it is more than 2 miles of open water away from more suitable habitat along the Bay shoreline. Mink are unlikely to live permanently or spend a substantial amount of time foraging on YBI when there is more suitable riparian and wetland habitat in places like Martinez (about 30 miles away as the mink swims), where prey is more abundant and the water is more shallow, warm, and calm. An evaluation of risk to the mink at Site YF3 would not necessarily be more conservative than the evaluation already conducted for the raccoon. Given the available prey that could be exposed to contamination at the site, the estimated daily dose to the raccoon has been modeled on a diet of mollusks and crustaceans, the same as would be assumed for the mink. If mink live on Yerba Buena Island (YBI), they might eat more fish than the raccoon, with the fish having a greater concentration of low-molecular weight (LMW) polycyclic aromatic hydrocarbons (PAH) than mollusks or crustaceans. However, if the raccoon were modeled with a 100 percent fish diet, there would be no significant increase in the hazard quotients (HQ); the low toxicity reference value (TRV) would still not be exceeded, and there would thus be no effect on the risk assessment conclusions.

Comment from Ms. Myriam Zech, Project Manager
California Regional Water Quality Control Board (Water Board), Region 2
Dated: April 29, 2014

COMMENTS	RESPONSES
	Based on the lack of evidence for substantial or even incidental use of the site by mink, and the similar dietary estimates already modeled for the raccoon, an evaluation of the mink as a representative receptor is not warranted for Site YF3.
General Comment 2: The March 2013 *Field Activity Report (FAR) for Additional Soil and Groundwater Sampling at Area YF3 and Artifact 1* documents the observation of a petroleum sheen, for example: • "Free product was not of measureable thickness in the five groundwater sampling points; however, a sheen was observed [at all five sampling locations]." (FAR, p. 2-5). • For both soil and groundwater samples, "in many cases, it was necessary to adjust laboratory quantitation limits to dilute samples because of site conditions, sheen, staining, or strong hydrocarbon odors observed during field activities." (FAR, *3.2.1 Area YF3 – Soil* and *3.2.2 Area YF3 – Groundwater*, p. 3-2.) Similar observations were also documented in previous field investigation reports. These frequent observations point to a likelihood that high concentrations of aliphatic hydrocarbons and possibly PAHs exist in pore water and sediment. Yet pore-water and sediment have not been characterized for the presence of these contaminants. Therefore, please explain how risks to benthic invertebrates potentially exposed to aliphatic hydrocarbons and PAHs in pore-water and sediment will be evaluated.	**Response:** The sheen observed in wells was likely caused by disturbance of the soil matrix during sampling. The draft screening-level ecological risk assessment (SLERA) report includes an evaluation of the potential presence and potential for migration of light non-aqueous phase liquid (LNAPL) at the site based on analytical results for total petroleum hydrocarbons (TPH)-gasoline, TPH-diesel, and TPH-motor oil (Section 2.4). Only one sample (location YF3HP019, 6.5- to 7.0-foot depth) was calculated to have the potential for LNAPL at levels exceeding residual water saturation, where LNAPL could enter an assumed monitoring well. However, given the negligible groundwater gradient, constant tidal fluctuations, and absence of a LNAPL hydraulic head, the potential for migration is small, and the potential for recoverability even less. The evaluation of risk to benthic invertebrates was conducted by comparing concentrations of PAHs in site sediment with effects range-low (ER-L) and effects range-median (ER-M) values (Long and Morgan 1991; Long and others 1995; Long and MacDonald 1998) based on multiple sediment toxicity studies; ER-L and ER-M values were not available for TPH and volatile organic compounds, which were evaluated in the Step 3a risk refinement. Pore-water sampling and testing are not routinely performed as part of site investigations, and are generally not conducted unless the results of a SLERA indicate that a baseline ecological risk assessment (BERA) is warranted. In this case, the site data indicates the highest concentrations of TPH at Site YF3 present at 2 feet and 7 feet below the surface, where ecological receptors, including benthic

Comment from Ms. Myriam Zech, Project Manager
California Regional Water Quality Control Board (Water Board), Region 2
Dated: April 29, 2014

COMMENTS	RESPONSES
	invertebrates, are unlikely to be exposed. The results of the SLERA and Step 3a refinement indicate the potential for exposure of ecological receptors at Site YF3 to chemicals at concentrations that would cause adverse effects is limited and none of the chemicals of potential ecological concern (COPECs) detected at the site is recommended for further evaluation.
General Comment 3: As the Navy points out in the RTCs, none of the YF3 samples were analyzed for TOC in the last monitoring event, and no TOC data is currently available for this location. According to the 2012 *Final Work Plan for Additional Soil and Groundwater Sampling, Inactive Fuel Line Site YF3 and Artifact 1*", the goals of the soil and groundwater sampling at Area YF3 were "to further assess soil and groundwater contamination associated with former fuel lines and former aboveground storage tanks in Area YF3, to assess if the waters of San Francisco Bay are impacted." (p. 1-1.) At the time, the need for a SLERA had not been determined or anticipated. After the results from the March 2012 sampling event were analyzed, however, the recommendations which the Navy developed and outlined in the FAR were as follow: "Based on the conclusions presented herein, and the site setting within the tidal zone, it is recommended that the Navy proceed with a screening-level ecological risk assessment to determine if Area YF3 is a good candidate for potential closure, possibly as a low-risk fuel site (RWQCB, 1996), or if additional investigation and possible corrective action need to be considered." (FAR, p. 4-1) We strongly recommend that pore-water and sediment samples be collected and analyzed for TPH, the 34 PAHs recommended by U.S.	**Response:** The work plan clearly stated that that "The findings of soil and groundwater sampling will be used to evaluate whether further action or NFA [no further action] is required at the Site" (CH2MHill Kleinfelder Joint Venture (KCH) 2012). To assess whether Site YF3 was affecting the Bay, concentrations of chemicals detected at Site YF3 were compared with both human health and ecological screening values. The SLERA was required because ecological screening criteria were exceeded and further assessment was needed to determine the path forward for the site. As noted in the response to comment 2, bioassays are typically planned and conducted as part of a BERA based on the results of a SLERA; the results of a SLERA are used to focus additional sampling on the media and receptors of concern. The Navy uses a screening value of 1,400 microgram per liter (µg/L) in the SLERA for comparison with site groundwater concentrations of TPH. The Navy also notes that much of the contamination is found at depths beyond the shallow depths where the benthic community is likely present. The comment regarding bioassays is noted.

Comment from Ms. Myriam Zech, Project Manager
California Regional Water Quality Control Board (Water Board), Region 2
Dated: April 29, 2014

COMMENTS	RESPONSES
EPA's Ecological Monitoring and Assessment Program (EMAP), and metals. If sediment data only are collected, then total organic carbon should also be collected to provide a more accurate site-specific estimate of equilibrium partitioning with pore-water, which can then be compared to screening levels based on water quality criteria. Has the Navy considered application of the 1400 ug/L TPH groundwater screening level to assess ecological risk at YF3? Finally, Dr. Lauren suggests that the most reliable way to evaluate the impact of aliphatics to the benthic community in the pore space is to conduct chronic (28-day) bioassays, or pore water bioassays (sea urchin embryos, mussel larvae, etc.).	
General Comment 4: Does the Navy plan to remove the following debris located at YF3: • portions of old pipelines; • concrete pieces and concrete foundations; • remnants of ASTs 169 and 170; • other debris located at YF3?	**Response:** The Navy does not plan to remove inert material such as construction debris, building foundations, or former infrastructure. Existing laws, regulations, and policies applicable to the Navy Base Realignment and Closure (BRAC) program expressly prohibit the Navy from undertaking improvements to excess or surplus property set to be transferred out of federal possession, unless the improvements are necessary to protect human health, the environment, or public safety (Department of the Navy and Unites States Marine Corps 2006; Department of Defense 2012). The term "improvements" is broadly defined to include activities such as demolition, infrastructure removal, or site clearing. Aboveground storage tanks 169 and 170 are both closed-in-place and require no further action, as noted in the Site Management Plan (TriEco-Tt 2013).

REFERENCES

CH2MHill Kleinfelder Joint Venture (KCH). 2012. Final Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan), Additional Soil and Groundwater Sampling, Inactive Fuel Line Site YF3 and Artifact 1. Yerba Buena Island, San Francisco, CA. February.

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Department of the Navy and Unites States Marine Corps. 2006. Department of the Navy Environmental Restoration Program Manual. August.

Long, E.R. and L.G. Morgan. 1991. "The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program." NOAA Technical Memorandum NOS OMA 52. August.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." *Environmental Management*. Volume 19. Number 1. Pages 81 through 97.

Long, E.R., L.J. Field, and D.D. MacDonald. 1998. "Predicting toxicity in marine sediments with numerical sediment quality guidelines." *Environ Toxicol Chem*. Volume 17. Pages 714-727.

TriEco-Tt. 2013. Final Site Management Plan. December 20.

Weston Solutions, Inc. 2003. Ecological Risk Assessment for General Electric (GE)/Housatronic River Site, Rest of River. Prepared for U.S. Army Corps of Engineers and U.S. Environmental Protection Agency. July.

APPENDIX B
ECOLOGICAL CHECKLIST

CHECKLIST FOR ECOLOGICAL ASSESSMENT – YF3

INTRODUCTION

This checklist has been adopted from the Checklist for Ecological Risk Assessment/Sampling provided in the U.S. Environmental Protection Agency's (EPA) "Ecological Risk Assessment Guidance for Superfund" (EPA 1997). The checklist has been adapted for use during site visits as a tool to gather information about the facility property and surrounding areas to support the screening-level ecological risk assessment (SLERA) process. Specifically, the checklist helps compile information on the physical and biological aspects of the site. The data include the site environmental setting, use of the site, releases at the site, contaminant fate and transport mechanisms, and the area's habitats, receptors and exposure pathways. The completed checklist can then be used to construct the conceptual site model (CSM) for the site. The checklist and CSM serve as the basis for the SLERA.

In general, the checklist is designed for applicability to all sites; however, there may be unusual circumstances which require professional judgment in order to determine the need for further ecological evaluation (e.g., cave-dwelling receptors). In addition, some of the questions in the checklist may not be relevant to all sites. Some facilities may have large amounts of data available regarding contaminant concentrations and hydrogeologic conditions at the site, while others may have only limited data. In either case, the questions on the checklist should be addressed as completely as possible with the information available.

Habitats and receptors, which may be present at the site, can be identified by direct or indirect[1] observations and by contacting local and regional natural resource agencies. Habitat types may be determined by reviewing land use and land cover maps (LULC), which are available via the Internet at http://www.nationalatlas.gov/mapit.html. Since receptors are often present at a site even when they are not observed, it should be assumed they are present where viable habitat is present.

[1] Examples of indirect observations that indicate the presence of receptors include: tracks, feathers, burrows or scat.

INSTRUCTIONS FOR COMPLETING THE CHECKLIST

The checklist consists of four sections: Site Location, Site Characterization, Habitat Evaluation and Exposure Pathway Evaluation. Answers to the checklist should reflect existing conditions and should not consider future remedial actions at the site. Completion of the checklist should provide sufficient information for the preparation of a CSM and SLERA and allow for the identification of any data gaps.

Section I - Site Location provides general site information, identifies the facility being evaluated and gives specific location information. Site maps and diagrams, which should be attached to the completed report, are an important part of this section. The following elements should be clearly illustrated: (1) the location and boundaries of the site relative to the surrounding area, (2) any buildings, structures or important features of the facility or site, and (3) all ecological areas or habitats identified during completion of the checklist. It is possible that several maps will be needed to clearly and adequately illustrate the required elements. Although topographical information should be illustrated on at least one map, it is not required for every map. Simplified diagrams (preferably to scale) of the site and surrounding areas will usually suffice.

Section II - Site Characterization is intended to provide additional temporal and contextual information about the site. It may have an impact on determining whether a certain area should be characterized as ecologically viable habitat or contains receptors. Answers to the questions in Section II will help the reviewer develop a broader and more complete evaluation of the ecological aspects of a site.

Section III - Habitat Evaluation provides information regarding the physical and biological characteristics of the different habitat types present at or in the locality of the site. The applicable portions of Section III of the checklist should be completed for each individual habitat identified. For example, the questions in Section III.C of the checklist should be answered for each wetland area identified at or in the locality of the site. The individual areas must be identified on a map or maps.

Section IV- Exposure Pathway Evaluation is used to determine if contaminants at the site have the potential to impact habitat identified in Section III. An exposure pathway is the course a chemical or physical agent takes from a source to an exposed organism. Each exposure pathway includes a source (or release from a source), an environmental transport mechanism, an exposure point and an exposure route. A complete exposure pathway is one in which each of these components, as well as a receptor to be exposed, are present. Essentially, this section addresses the fate and transport of contaminants that are known or suspected to have been released at the site. In the rare cases where a potentially complete exposure pathway does not exist, additional ecological evaluation is usually not warranted.

Potential transport pathways addressed in this checklist include migration of contaminants via air dispersion, leaching into groundwater, soil erosion/runoff and groundwater discharge to surface water.

CHECKLIST FOR ECOLOGICAL ASSESSMENTS/SAMPLING

I. SITE LOCATION

1. Site Name YF3
   Location Yerba Buena Island
   County San Francisco City San Francisco State CA

2. Latitudue 37.814021 Longitude -122.362916

Attach site maps, including a topographical map, a diagram which illustrates the layout of the facility (e.g., site boundaries, structures, etc.), and maps showing all habitat areas identified in Section III of the checklist. Also, include maps which illustrate known and suspected release areas, sampling locations and any other important features, if available.

II. SITE CHARACTERIZATION

1. Indicate the approximate area of the site (i.e., acres or sq. ft.) 1.35 acres

2. Is this the first site visit? ☒ Yes ☐ No
   If no, attach trip report of previous site visit(s), if available.

   Dates of previous site visit(s) _____

3. Are aerial or other site photographs available? ☒ Yes ☐ No

   If yes, please attach any available photo(s) to the site map to the report. See Attachment 1: Site photos and maps

4. Provide an approximate breakdown of the land uses on the site:

	% Heavy Industrial		% Light Industrial		% Urban
	% Residential		% Rural		% Recreational[a]
	% Agricultural[b]		% Undisturbed	100	% Other[c]

[a]For recreational areas, please describe the use of the area (e.g., park, playing field, golf course, etc).

[b]For agricultural areas, please list the crops and/or livestock which are present.

[c]For areas designated as "other," please describe the use of the area.
About 35 percent of the site area consists of North Gate Road, and the rest is a steep vegetated natural area.

Checklist for Ecological Assessments/Sampling (Continued)

5. Provide an approximate breakdown of the land uses in the area surrounding the site. Indicate the radius (in miles) of the area described: 0.5 miles

5	% Heavy Industrial	5	% Light Industrial	5	% Urban
5	% Residential		% Rural	75	% Recreational[a]
	% Agricultural[b]	5	% Undisturbed		% Other[c]

[a]For recreational areas, please describe the use of the area (e.g., park, playing field, golf course, etc).
San Francisco Bay used for commerce and recreation; recreational use of marina at Clipper Cove on Treasure Island

[b]For agricultural areas, please list the crops and/or livestock which are present.

[c]For areas designated as "other," please describe the use of the area.

6. Has any movement of soil taken place at the site? ☒ Yes ☐ No

If yes, indicate the likely source of the disturbance, (e.g., erosion, agricultural, mining, industrial activities, removals, etc.) degree of disturbance, and estimate when these events occurred.
Two former above ground storage tanks and a former building were removed, and a removal action was conducted to address potential contamination from inactive fuel lines at the site.
Landslides have occurred in the past, which obscured the location of a former pipeline.

7. Do any sensitive environmental areas exist within 50 feet of or within one-half mile of the site, (e.g. Federal and State parks, National and State monuments, wetlands)? *Remember, flood plains and wetlands are not always obvious; do not answer "no" without confirming information. See Table 1 for a list of contacts.*
Yes. The site is adjacent to San Francisco Bay, and there is eelgrass habitat along the shoreline.

Please provide the source(s) of information used to identify these sensitive areas, and indicate their general location on the site map.
National Wetlands Inventory map (http://www.fws.gov/wetlands/Wetlands-Mapper.html) and CalTrans biological mitigation reports (http://www.biomitigation.org/bio_overview/).

Checklist for Ecological Assessments/Sampling (Continued)

8. What type of facility is located at the site?

☐ Chemical ☐ Manufacturing ☐ Mixing
☐ Waste Disposal ☒ Other (specify) Former refueling and pipeline site

9. Identify the contaminants of potential concern (COPCs) at the site. If known, include the maximum contaminant levels. Please indicate the source of data cited (e.g., RFI, confirmatory sampling, etc).
Petroleum hydrocarbons, semivolatile organic compounds (including polycyclic aromatic Hydrocarbons [PAH]), and metals have all been detected. The main concerns are petroleum hydrocarbons and PAHs; petroleum hydrocarbons were detected at maximum concentrations of 10,000 mg/kg as both diesel and as motor oil in soils form 6.5 to 7 feet below the ground surface. Total HMW and LMW PAHs were detected at a maximum of 3.76 and 8.1 mg/kg, at depths of 2 and 5 feet below the surface, respectively.

10. Check any potential routes of off-site migration of contaminants observed at the site:

☐ Swales ☐ Depressions ☐ Drainage Ditches
☒ Runoff ☒ Windblown Particulates ☐ Vehicular Traffic
☐ Other (specify):

11. Indicate the approximate depth to groundwater (in feet below ground surface [(bgs)].
6-8 feet bgs; based on locations YF3HP018, YF3HP019, and YF3HP021

12. Indicate the direction of groundwater flow (e.g., north, southeast, etc.)
Assumed to flow toward the Bay

13. Is the direction of surface runoff apparent from site observations? ☒ Yes ☐ No

If yes, to which of the following does the surface runoff discharge? Indicate all that apply.

☒ Surface water ☐ Groundwater ☐ Sewer
☐ Collection Impoundment

14. Is there a navigable water body or tributary to a navigable water body? A water body is a natural feature such as a lake, pond, bay, river or creek. ☐ Yes ☒ No

15. Is there a water body anywhere on or in the vicinity of the site? If yes, also complete Section III.B.1: Aquatic Habitat Checklist—Non-Flowing Systems and/or Section III.B.2: Aquatic Habitat Checklist—Flowing Systems.

☒ Yes (approx. distance adjacent to site) ☐ No

Checklist for Ecological Assessments/Sampling (Continued)

16. Is there evidence of flooding? ☒ Yes ☐ No
Wetlands and flood plains are not always obvious. Do not answer "no" without confirming information. If yes, complete Section III.C: Wetland Habitat Checklist.

17. If a field guide was used to aid any of the identifications, please provide a reference. Also, estimate the time spent identifying fauna. (Use a blank sheet if additional space is needed for text.)
Sawyer, J.O., Keeler Wolf, T., Evens J.M. 2009. " A Manual of California Vegetation". Second Edition. California Native Plant Society.

18. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site? ☒ Yes ☐ No

If yes, you are required to verify this information with the U.S. Fish and Wildlife Service or other appropriate agencies (see Table 1 for a list of contacts). If species' identities are known, please list them next.
See Attachment 2: April 4, 2013 Site Visit Observations

19. Record weather conditions at the site at the time of the site visit when information for completion of this checklist was prepared:

DATE	04/04/13
Temperature (°C/°F):	62°F
Wind (direction/speed):	0-10 mph
Cloud Cover:	Cloudy/overcast
Normal daily high temperature (°C/°F):	64°F
Precipitation (rain, snow):	Light, intermittent drizzle

20. Describe reasonable and likely future land and/or water use(s) at the site.
Site is likely to remain as it is, and include a roadway and natural open space for the vegetated slope adjacent to Clipper Cove/SF Bay.

21. Describe the historical uses of the site. Include information on chemical releases that may have occurred as a result of previous land uses. For each chemical release, provide information on the form of the chemical released (i.e., solid, liquid, vapor) and the known or suspected causes or mechanism of the release (i.e., spills, leaks, material disposal, dumping, explosion, etc.).
The site includes two former piers used for oil transfer and refueling, as well as garbage disposal activities. A small (550 gallon) above ground storage tank (AST) holding diesel has been removed from the site. A former heating plant (Bldg 214) and 10,000 gallon AST that held diesel fuel were also present. The plant and storage tank were removed in the 1980s. Fuel lines had at one time been connected to Bldg 214. ASTs 213 and 214, and former fuel lines F01 and F03, are the potential sources of petroleum contamination at YF3.

Checklist for Ecological Assessments/Sampling (Continued)

22. Identify the media (e.g., soil [surface or subsurface], surface water, air, groundwater) which are known or suspected to contain COCs.
Shallow (0-2 feet bgs) and deeper sediment (2 to 10 feet bgs), and groundwater.

SUMMARY OF OBSERVATIONS AND SITE SETTING

Include information on significant source areas and migration pathways that are likely to constitute complete exposure pathways.
The site habitat consists of a rocky intertidal area and steep vegetated slope. Migration to the contaminants that reach the Bay. There is limited potential exposure to contaminants for terrestrial plants (they seem to be thriving and are not near the source area). However, benthic invertebrates, as well as birds and mammals (potential food chain exposure) may be exposed to contaminated sediment.

Checklist Completed by	Katie Henry
Affiliation	Tetra Tech, Inc.
Author Assisted by	Rebecca Johnson
Date	04/04/13

III. HABITAT EVALUATION

This section describes any terrestrial, aquatic, wetland, and miscellaneous habitat types found at the site. Sensitive environments and receptors are also described in subsection III.D. If any specific ecosystem or plant community is found within one of the habitat types, it should be noted in the checklist within the appropriate habitat section.

III.A TERRESTRIAL HABITAT CHECKLIST

This section describes any wooded, scrub, open field, and other terrestrial habitats found at the site.

III.A.1 Wooded

Are any wooded areas on or within 50 feet of the site? ☒ Yes ☐ No

If yes, indicate the wooded area on the attached site map and answer the following questions. If more than one wooded area is present on or within 50 feet of the site, make additional copies of the following questions and fill out for each individual wooded area. Distinguish between wooded areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.A.2: Shrub/Scrub

Wooded Area Questions

☒ On-site ☐ Off-site

Name or Designation: Eucalyptus woodland

1. Estimate the approximate size of the wooded area (15 % of site)

   Please identify what information was used to determine the wooded area of the site (e.g., direct observation, photos, etc).
   Direct observation, photos, and comparison to site figures.

2. Indicate the dominant type of vegetation in the wooded area. Provide photographs, if available.

   ☐ Evergreen
   ☒ Deciduous
   ☐ Mixed
   Dominant plant species, if known: Eucalyptus trees

3. Estimate the vegetation density of the wooded area.

   ☒ Dense (i.e., greater than 75% vegetation)
   ☐ Moderate (i.e., 25% to 75% vegetation)
   ☐ Sparse (i.e., less than 25% vegetation)

4. Indicate the predominant size of the trees at the site. Use diameter at breast height.

   ☐ 0-6 inches
   ☒ 6-12 inches
   ☐ >12 inches
   ☐ No single size range is predominant

5. Specify type of understory present, if known. Provide a photograph, if available.

III.A.2 Shrub/Scrub

Are any shrub/scrub areas on within 50 feet of the site? ☒ Yes ☐ No

If yes, indicate the shrub/scrub area on the attached site map and answer the following questions. If more than one shrub/scrub area is present on or within 50 feet of the site, make additional copies of the following questions and fill out for each individual shrub/scrub area. Distinguish between shrub/scrub areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.A.3: Open Field

Shrub/Scrub Area Questions

☒ On-site ☐ Off-site

Name or Designation: Northern Coastal Scrub

1. Estimate the approximate size of the shrub/scrub area (30 % of site).
   Please identify what information was used to determine the shrub/scrub area of the site (e.g., direct observation, photos, etc).
   Direct observation, photos, and comparison to site figures.

2. Indicate the dominant type of shrub/scrub vegetation present, if known.
   Fennel (*Foeniculum vulgare*) is dominant in flatter dryer areas, but other species do well on the wetter portions of the slope.

3. Estimate the vegetation density of the shrub/scrub area.

   ☒ Dense (i.e., greater than 75% vegetation)
   ☐ Moderate (i.e., 25% to 75% vegetation)
   ☐ Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the scrub/shrub vegetation.

   ☒ 0-2 feet
   ☐ 2-5 feet
   ☐ >5 feet

5. Specify type of understory present, if known. Provide a photograph, if available.

III.A.3 Open Field

Are any open field areas on or within 50 feet of the site? ☐ Yes ☒ No

If yes, indicate the open field area on the attached site map and answer the following questions. If more than one open field area is present on or within 50 feet of the site, make additional copies of the following questions and fill out for each individual open field area. Distinguish between open field areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.A.4: Miscellaneous

III.A.4 Miscellaneous

Are other types of terrestrial habitats present at the site, other than woods, scrub/shrub and open field? ☒ Yes ☐ No

If yes, indicate the area on the attached site map and answer the following questions. If more than one of these areas are present on or within 50 feet of the site, make additional copies of the following questions and fill out for each individual area. Distinguish between areas by using names or other designations. Clearly identify each area on the site map.

If no, proceed to Section III.B: Aquatic Habitats.

Miscellaneous Area Questions

☒ On-site ☐ Off-site

Name or Designation: North Gate Road and Parking Area

1. Provide a description of the terrestrial miscellaneous habitat and identify the area on the site map.
   Paved area consisting of roadway, parking, and staging areas.

2. Estimate the approximate size of the area (50 % of site).

3. What observations, if any, were made at the site regarding the presence and/or absence of insects, birds, mammals, etc.?
   No animals were observed within the miscellaneous area. Other species observed during the site visit are listed in Attachment 2.

4. Review the questions in Section I to determine if any additional habitat checklists should be completed for this site.

III.B AQUATIC HABITATS

Aquatic systems are often associated with wetland habitats. Please refer to Section III.C, Wetland Habitat Checklist.

III.B.1 Non-Flowing Systems

Are any non-flowing aquatic features (such as ponds or lakes) located at or within 50 feet of the site? ☐ Yes ☒ No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the non-flowing aquatic features. If more than one non-flowing aquatic feature is present on or within 50 feet of the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations. Clearly identify each area on the site map.

If no, proceed to Section III.B.2: Flowing Systems

III.B.2 Flowing Systems

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section III.C, Wetland Habitat Checklist.

Are any flowing watercourses (such as streams or rivers) located at or within 50 feet of the site? ☒ Yes ☐ No

If yes, indicate the watercourse on the attached site map and answer the following questions regarding the flowing system. If more than one flowing system is present on or within 50 feet of the site, make additional copies of the following questions and complete one set for each individual aquatic feature. Distinguish between flowing systems by using names or other designation. Clearly identify each area on the site map

If no, proceed to Section III.C: Wetlands Habitats.

Flowing Aquatic Systems Questions

☐ On-site ☒ Off-site

Name or Designation: San Francisco Bay

1. Indicate the type of flowing aquatic feature present.

☐ River
☐ Stream/Creek/Brook
☐ Intermittent stream
☐ Artificially created (ditch, etc.)
☐ Channeling
☒ Other (specify) Bay

2. For natural systems, are there any indicators of physical alteration (e.g., channeling, debris, etc.)? ☒ Yes ☐ No

If yes, please describe the indicators observed.
The Bay has been altered by infill (including man-made Treasure Island) and shipping channels.

3. Indicate the general composition of the bottom substrate.

☐	Bedrock	☐	Sand (course)	☐	Concrete
☐	Boulder (>10 in.)	☐	Silt (fine)	☐	Debris
☐	Cobble (2.5 - 10 in.)	☐	Clay (slick)	☐	Detritus
☐	Gravel (0.1 – 2.5 in.)	☐	Muck (fine/black)	☐	Marl (Shells)
☒	Other (please specify):		Bay Mud, varies throughout the Bay		

4. Describe the condition of the bank (e.g., height, slope, extent of vegetative cover).
Steep, densely vegetated slope

5. Is the system influenced by tides? ☒ Yes ☐ No

What information was used to make this determination?
The Bay is influenced by the Pacific Ocean, with high and low tides at various times throughout the Bay.

6. Is the flow intermittent? ☐ Yes ☒ No

If yes, please note the information used to make this determination.

7. Is there a discharge from the site to the water body? ☒ Yes ☐ No

If yes, describe the origin of each discharge and its migration path.
Runoff from site will run downslope into the Bay

8. Indicate the discharge point of the water body. Specify name of the discharge, if known.
Pacific Ocean

9. Identify any field measurements and observations of water quality that were made. Provide the measurement and the units of measure in the appropriate space below:

NA

10. Describe observed color and area of coloration.
Blue-green, opaque throughout

11. Is any aquatic vegetation present? ☒ Yes ☐ No

If yes, please identify the type of vegetation present, if known.

☐ Emergent ☒ Submergent (Eelgrass) ☐ Floating

12. Mark the flowing watercourse on the attached site map. See Attachment 1: Site photos and maps

What observations were made at the water body regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc?
No organisms were observed in the water. See Attachment 2 for a description of flora and fauna observed during the site visit.

III.C WETLAND HABITATS

Are any wetland[2] areas such as marshes or swamps on or within 50 feet of the site?
☒ Yes ☐ No

If yes, indicate the wetland area on the attached site map and answer the following questions regarding the wetland area. If more than one wetland area is present on or within 50 feet of the site, make additional copies of the following questions and fill out one for each individual wetland area. Distinguish between wetland areas by using names or other designations (such as location). Clearly identify each area on the site map. Also, obtain and attach a National Wetlands Inventory Map (or maps) to illustrate each wetland area.

The San Francisco Bay is considered deepwater marine wetland habitat (National Wetlands Inventory).

Identify the sources of the observations and information (e.g., National Wetland Inventory, Federal or State Agency, USGS topographic maps) used to make the determination whether or not wetland areas are present.

The National Wetlands Inventory and San Francisco Bay's recent 2013 inclusion as a wetland of importance under the Ramsar Convention international treaty (http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0__).

If no wetland areas are present, proceed to Section III.D: Sensitive Environments and Receptors.

[2] Wetlands are defined in 40 CFR §232.2 as " Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Examples of typical wetlands plants include: cattails, cordgrass, willows and cypress trees. National wetland inventory maps may be available at http:\\nwi.fws.gov. Additional information on wetland delineation criteria is also available from the Army Corps of Engineers.

Wetland Area Questions

☐ On-site ☒ Off-site

Name or Designation: San Francisco Bay

1. Indicate the approximate area of the wetland (acres or ft.^{2}) 340,000 acres

2. Identify the type(s) of vegetation present in the wetland.

   ☒ Submergent (i.e., underwater) vegetation
   ☐ Emergent (i.e., rooted in the water, but rising above it) vegetation
   ☐ Floating vegetation
   ☐ Scrub/shrub
   ☐ Wooded
   ☐ Other (please describe): _____

3. Provide a general description of the vegetation present in and around the wetland (height, color, etc). Provide a photograph of the known or suspected wetlands, if available.
   In the area near YF3, eelgrass beds have been documented. The shoreline habitat of the Bay varies, as there are interspersed harbors , tidal wetlands, and shoreline developments throughout the area.

4. Estimate the vegetation density of the wetland area.

   ☐ Dense (i.e., greater than 75% vegetation)
   ☐ Moderate (i.e., 25% to 75% vegetation)
   ☒ Sparse (i.e., less than 25% vegetation)

5. Is standing water present? ☐ Yes ☒ No

   If yes, is the water primarily: ☐ Fresh ☐ Brackish

6. Identify any field measurements and observations of water quality that were made. Provide the measurement and the units of measure in the appropriate space below:

   NA

7. Describe observed color and area of coloration.
   Blue-green, opaque throughout

8. If known, indicate the source of the water in the wetland.

- ☒ Stream/River/Creek/Lake/Pond
- ☐ Flooding
- ☐ Groundwater
- ☐ Surface runoff

9. Is there a discharge from the site to the wetland? ☒ Yes ☐ No

If yes, please describe:
Runoff and groundwater are assumed to flow from the site to the Bay.

10. Is there a discharge from the wetland? ☒ Yes ☐ No

If yes, to what water body is discharge released?

- ☒ Marine (Name: Pacific Ocean)
- ☐ Surface stream/River (Name: _____)
- ☐ Lake/Pond (Name: _____)
- ☐ Groundwater
- ☐ Not sure

11. Does the area show evidence of flooding? ☒ Yes (high tide and storms) ☐ No

If yes, indicate which of the following are present (mark all that apply).

- ☒ Standing water
- ☒ Water-saturated soils
- ☐ Water marks
- ☐ Buttressing
- ☒ Debris lines
- ☐ Mud cracks
- ☐ Other (Please describe): _____

12. If a soil sample was collected, describe the appearance of the soil in the wetland area. Circle or write in the best response. No soil was collected.

13. Mark the observed wetland area(s) on the attached site map. See Attachment 1

III.D SENSITIVE ENVIRONMENTS AND RECEPTORS

1. Do any other potentially sensitive environmental areas[3] exist within 50 feet of or within one-half mile of the site? If yes, list these areas and provide the source(s) of information used to identify sensitive areas. *Do not answer "no" without confirmation from the U.S. Fish and Wildlife Service and other appropriate agencies. See Table 1 for a list of contacts.*
   The Central SF Bay was listed as impaired for a number of chemicals in the 2002 CWA Section 305(d) Report, including mercury, selenium, pesticides, PCBs, and dioxins. Clipper Cove's mudflats and eelgrass beds are described as a sensitive and protected area in the Federal Register [November 25, 2005 (Volume 70, Number 226)] that serves as an important fish spawning, rearing, and foraging habitat.

2. Are any areas on or near (i.e., within one-half mile) the site owned or used by local tribes? If yes, describe. No.

3. Does the site serve or potentially serve as a habitat, foraging area or refuge by rare, threatened, endangered, candidate and/or proposed species (plants or animals), or any otherwise protected species? If yes, identify species. *This information should be obtained from the U.S. Fish and Wildlife Service and other appropriate agencies. See Table 1 for a list of contacts.*
   Yes. The site could potentially serve as a foraging or refuge area for the peregrine falcon (*Falco peregrinus*), which has been known to nest at the Bay Bridge.

4. Is the site potentially used as a breeding, roosting or feeding area by migratory bird species? If yes, identify which species.
   Yes, the site may be used for foraging or roosting by many passerine birds, as well as raptors, including the peregrine falcon as noted above.

5. Is the site used by any ecologically[4], recreationally or commercially important species? If yes, explain.
   The site does have algae, crustaceans, and plants that may be a food source for other Species (See Attachment 1).

[3] Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young and overwintering. Refer to Table 2 at the end of this document for examples of sensitive environments.

[4] Ecologically important species include populations of species which provide a critical (i.e., not replaceable) food resource for higher organisms. These species' functions would not be replaced by more tolerant species or perform a critical ecological function (such as organic matter decomposition) and will not be replaced by other species. Ecologically important species include pest and opportunistic species that populate an area if they serve as a food source for other species, but do not include domesticated animals (e.g., pets and livestock) or plants/animals whose existence is maintained by continuous human interventions (e.g., fish hatcheries, agricultural crops, etc).

IV. EXPOSURE PATHWAY EVALUATION

1. Do existing data provide sufficient information on the nature, rate and extent of contamination at the site?

☐ Yes
☐ No
☒ Uncertain

Please provide an explanation for your answer.
Existing data characterize the area around suspected sources, which are the former AST and inactive fuel lines.

2. Do existing data provide sufficient information on the nature, rate and extent of contamination in offsite affected areas?

☐ Yes
☐ No
☒ Uncertain
☐ No offsite contamination

Please provide an explanation for your answer.
The YF3 Area is not suspected to have resulted in offsite contamination on land, and the CERCLA sites surrounding the YF3 Area have been investigated and closed. However, it is possible that contaminants in have migrated to the Bay.

3. Do existing data address potential migration pathways of contaminants at the site?

☒ Yes
☐ No
☐ Uncertain

Please provide an explanation for your answer.
Migration is influenced by the presence of bedrock tidal zone mixing, as the site is adjacent to the Bay.

4. Do existing data address potential migration pathways of contaminants in offsite affected areas?

☐ Yes
☐ No
☒ Uncertain
☐ No offsite contamination

Please provide an explanation for your answer.
As noted above here is no offsite contaminated area on the island. The source of contamination at the site has been removed and there remains some residual contamination near the former source that may have migrated to the Bay.

5. Are there visible indications of stressed habitats or receptors on or near (i.e., within one-half mile) the site that may be the result of a chemical release? If yes, explain. Attach photographs if available
No.

6 Is the location of the contamination such that receptors might be reasonably expected to come into contact with it? For soil, this means contamination in the soil 0 to 1 foot below ground surface (bgs). If yes, explain.
No, the contamination is below the surface (sediment samples start at 2 feet bgs), and not readily accessible to receptors.

7. Are receptors located in or using habitats where chemicals exist in air, soil, sediment or surface water? If yes, explain.
Yes, there are some ecological receptors at the site; however, there is little exposure to the contaminated sediment and groundwater.

8. Could chemicals reach receptors via groundwater? Can chemicals leach or dissolve to groundwater? Are chemicals mobile in groundwater? Does groundwater discharge into receptor habitats? If yes, explain.
Contamination in groundwater may mix with water in the Bay, where receptors would be exposed.

9. Could chemicals reach receptors through runoff or erosion? Answer the following questions.

What is the approximate distance from the contaminated area to the nearest watercourse? A watercourse is an open path or channel, natural or man-made, that may carry water, including runoff, to or from the site.

- [x] 0 feet (i.e., contamination has reached a watercourse)
- [ ] 1-10 feet
- [ ] 11-20 feet
- [ ] 21-50 feet
- [ ] 51-100 feet
- [ ] 101-200 feet
- [ ] > 200 feet
- [ ] > 500 feet
- [ ] > 1000 feet

What is the slope of the ground in the contaminated area?

☒ 0-10%
☐ 10-30%
☐ > 30%

What is the approximate amount of ground and canopy vegetative cover in the contaminated area?

☒ < 25%
☐ 25-75%
☐ > 75%

Is there visible evidence of erosion (e.g., a rill or gully) in or near the contaminated area?

☒ Yes
☐ No
☐ Do not know

Do any structures, pavement or natural drainage features direct run-on flow (i.e., surface flows originating upstream or uphill from the area of concern) into the contaminated area?

☒ Yes (Site includes steep hillside, and is subject to runoff)
☐ No
☐ Do not know

10. Could chemicals reach receptors through the dispersion of contaminants in air (e.g., volatilization, vapors, fugitive dust)? If yes, explain.
No.

11. Could chemicals reach receptors through migration of non-aqueous phase liquids (NAPLs)? Is a NAPL present at the site that might be migrating towards receptors or habitats? Could NAPL discharge contact receptors or their habitat?
Potentially. In previous sampling, some NAPL (petroleum compound) was found at the site.

TABLE 1
SENSITIVE ENVIRONMENT CONTACTS

CONTACT	TELEPHONE #	SENSITIVE ENVIRONMENT
California State Parks	(800) 777-0369 (916) 653-6995	State Parks Designated State Natural Areas State Seashore, Lakeshore, and River Recreational Areas National and State Historical Sites
CA Department of Fish and Wildlife	(916) 445-0411	Rare species (state and federal Threatened and Endangered) Sensitive Aquatic Habitat Areas Important to Maintenance of Unique Natural Communities Terrestrial Areas Utilized for Breeding by Large or Dense Aggregations of Animals National or State Wildlife Refuges Species within River, Lake or Coastal Tidal Waters State Lands Designated for Wildlife or Game Management
National Park Service Public Affairs Office:	(415) 623-2100 Internet: www.nps.gov/rivers	National Seashore, Lakeshore and River Recreational Areas National Parks or Monuments Federal Designated Wild & Scenic Rivers
US Forest Service	(707) 562-8737	Designated and Proposed Federal Wilderness and Natural Areas National Preserves and Forests Federal Land Designated for the protection of natural ecosystems.
State Water Resources Control Board	(916) 341-5250 *Ask for Clean Water Act 305b report*	Critical Areas Identified Under the Clean Lakes Program State-Designated Areas for Protection or Maintenance of Aquatic Life
California Department of Forestry and Fire Protection	(916)653-5123	State Preserves and Forests
NOAA	(301) 713-3145	Marine Sanctuaries
California Coastal Commission	(415) 904-5200 FAX (415) 904-5400	Areas Identified Under Coastal Protection Legislation Coastal Barriers or Units of a Coastal Barrier Resources System
US Army Corps of Engineers	(202) 528-4285 (415) 977-8600	Wetlands

TABLE 2
EXAMPLES OF SENSITIVE ENVIRONMENTS

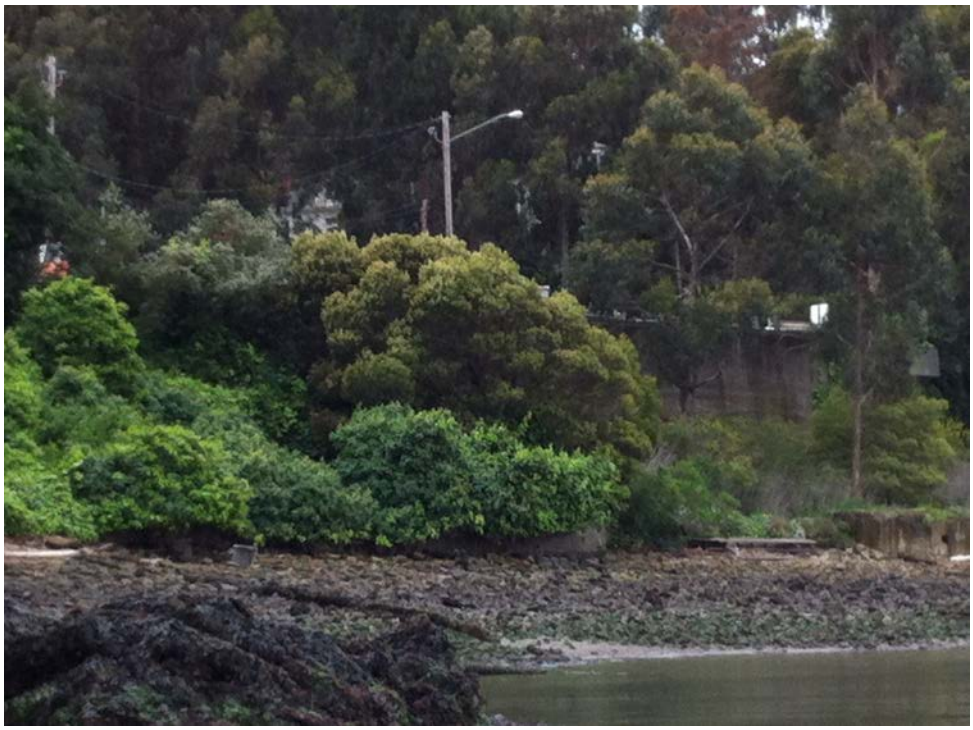
- National Parks and National Monuments
- Designated or Administratively Proposed Federal Wilderness Areas
- National Preserves
- National or State Wildlife Refuges
- National Lakeshore Recreational Areas
- Federal land designated for protection of natural ecosystems
- State land designated for wildlife or game management
- State designated Natural Areas
- Federal or state designated Scenic or Wild River

  All areas that provide or could potentially provide critical habitat[1] for state and federally listed Threatened or Endangered Species, those species that are currently petitioned for listing, and species designated by other agencies as sensitive or species of concern.
- Marine Sanctuary
- Areas identified under the Coastal Zone Management Act
- Sensitive areas identified under the National Estuary Program or Near Coastal Waters Program
- Critical areas identified under the Clean Lakes Program
- National Seashore Recreational Area
- Habitat known to be used by Federal designated or proposed endangered or threatened species
- Unit of Coastal Barrier Resources System
- Coastal Barrier (undeveloped)
- Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters
- Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which the fish spend extended periods of time
- Terrestrial areas utilized for breeding by large or dense aggregations of animals
- National river reach designated as Recreational
- Habitat known to be used by state designated endangered or threatened species
- Habitat known to be used by species under review as to its Federal endangered or threatened status
- Coastal Barrier (partially developed)
- Particular areas, relatively small in size, important to maintenance of unique biotic communities
- State-designated areas for protection or maintenance of aquatic life
- Wetlands

[1] Critical habitats are defined by the Endangered Species Act (50 CFR §424.02(d)) as:

1) Specific areas within the geographical area currently occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection, and
2) Specific areas outside the geographical area occupied by a species at the time it is listed upon a determination by the Secretary [of Interior] that such areas are essential for the conservation of the species.

Attachment 1
Site Photos and Maps



1. View of site – facing south

2. Wider view of site – facing south/southwest

3. View of site from tide line upslope (English Ivy and Eucalyptus dominant)- facing south

4. Vegetation above tideline on slope (Canary Island Marguerite, dried fennel, toyon bush, and french broom)

5. Intertidal zone, green and red algae, rubble and debris - facing north

6. Eastern edge of site (close) - facing east (close)

7. Eastern edge of site (wide)- facing east

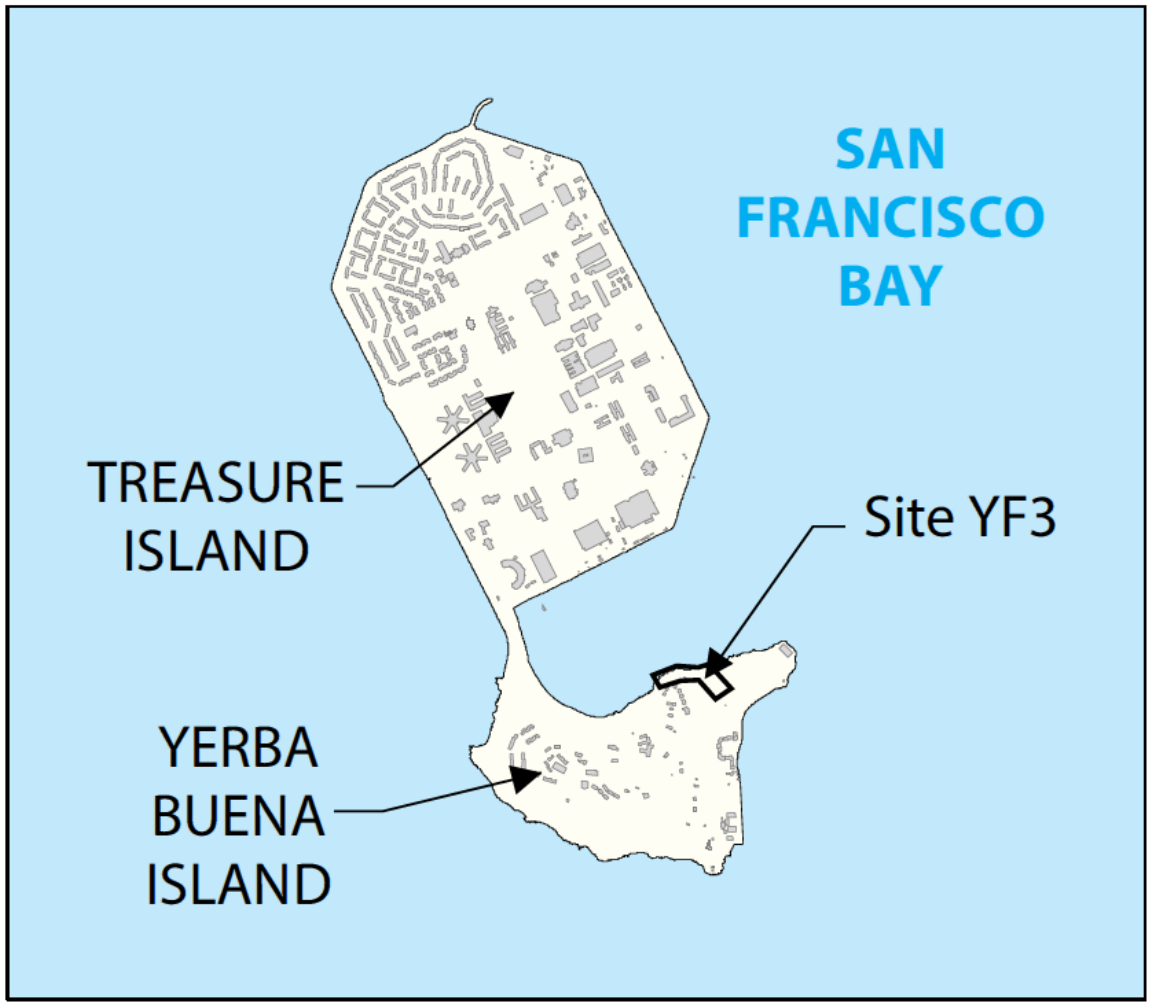
8. Debris line on eastern edge of site– facing east/southeast

9. Western edge of site, concrete remains visible – facing west/southwest

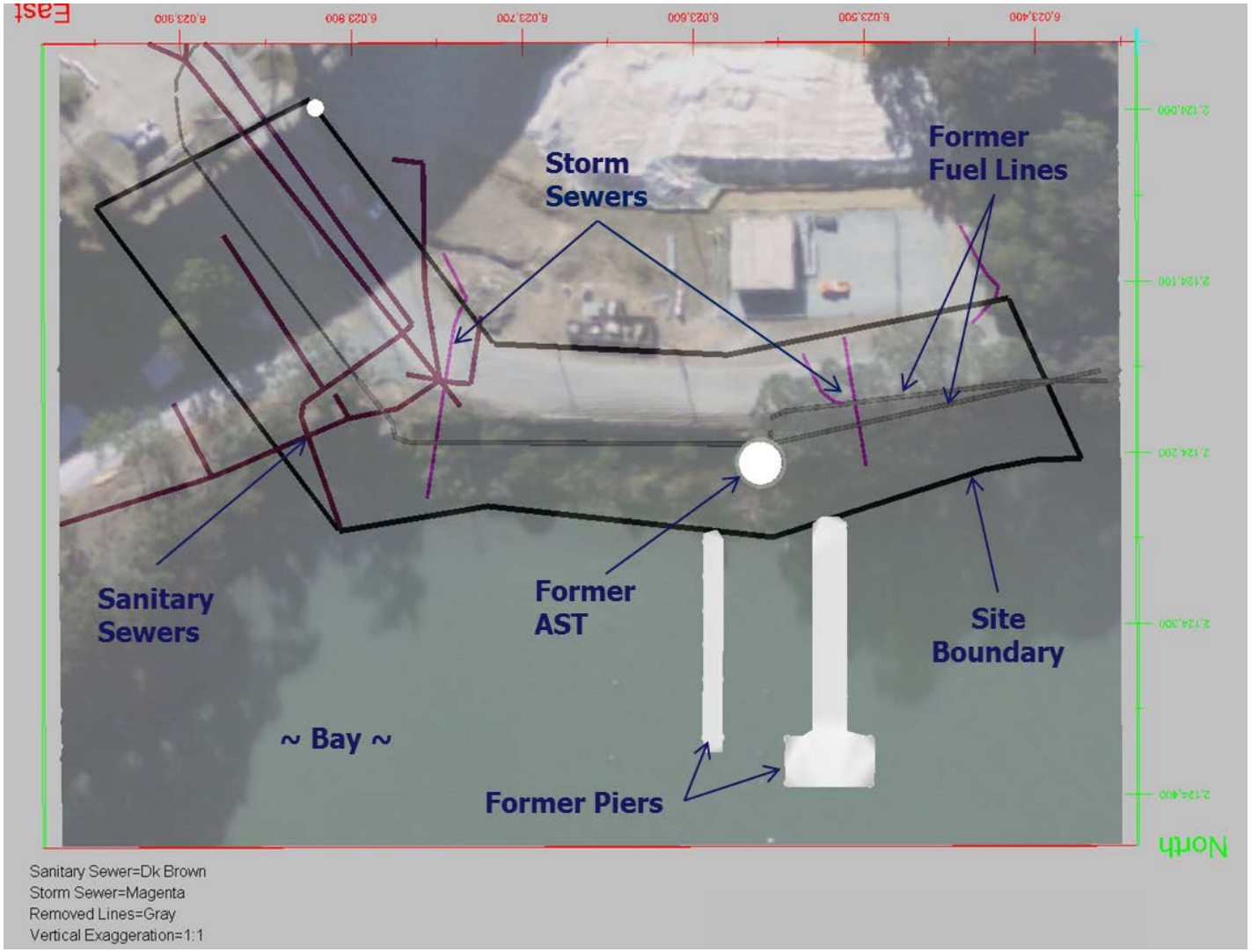
10. Western edge of site, concrete remains visible – facing west

11. View from Road downslope (courtesy of Navy RPM Danielle Janda)

12. View of drill rig during 2012 sampling event (courtesy of Navy RPM Danielle Janda)



13. Site Location Map



14. Overlay of Aerial Photo with Site Features

Attachment 2
Observations of April 4, 2013 Site Visit

Observations of April 4, 2013 Site Visit

Conditions During Visit: Low tide, Overcast, Raining off and on throughout the day

General Habitat: Rocky Tide Pools, little sand in area of contamination

Species Observed within the Tidal Zone:

- Algae present throughout the tidal zone
- Green and Red Algae in intertidal zone
    - Possible Green Algae species - *Ulva californica*
    - Possible Red Algae species - *Rhodymenia pacifica*
- No evidence of eel grass
- Mussels barnacles observed throughout the tidal zone
- Some dead crustaceans- various small crabs

Species Observed Onshore:

Birds

- Cormorant- unknown species; one seen flying away from site and another in the water; did not appear to be nesting on site

Aquatic and Terrestrial Invertebrates

- Sand fleas
- Shellfish and crustaceans at high tides

Plants observed above the shoreline on the slope coming down from the road:

1. Fennel (*Foeniculum vulgare*) - currently too wet for it, but it is evident it was dominant in the flatter dryer areas, undergrowth coming back
2. Eucalyptus - overstory
3. Canary Island Marguerite (*Argyranthemum foeniculaceum*)
4. English Ivy with berries (*Hedera helix*)
5. Purple Vetch (*Vicia benghalensis* L.; *Vicia atropurpurea*)
6. French broom (*Genista monspessulana*)
7. Toyon bush (*Heteromeles arbutifolia*)
8. White flower- bell shaped- no leaf (uknown species)

APPENDIX C
GROUNDWATER SCREENING CRITERIA

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C-1 Groundwater Screening Criteria Tiers

C-2 Groundwater Screening Criteria

C1.0 INTRODUCTION

This appendix contains a detailed summary of the groundwater screening criteria used for the Site YF3 screening-level ecological risk assessment (SLERA). The site is on Yerba Buena Island and is part of Naval Station Treasure Island (NAVSTA TI). The groundwater screening criteria are based on potential exposure of aquatic organisms that live along the shoreline of Yerba Buena Island to contaminants in groundwater at Site YF3.

C2.0 SCREENING CRITERIA SELECTION METHODOLOGY

The groundwater screening criteria for detected chemicals at Site YF3 were compiled through comprehensive reviews of published regulatory standards, goals, and guidance, including those established by the California Regional Water Quality Control Board (Water Board) in "A Compilation of Water Quality Goals" (Water Board 2011) and in the Basin Plan and "Environmental Screening Levels Look Up Tables" (Water Board 2013a, 2013b); the U.S. Environmental Protection Agency (EPA) in the National Recommended Water Quality Criteria (EPA 2013); and other sources, as appropriate (Tetra Tech EM Inc. [Tetra Tech] 2001; Suter and Tsao 1996). The types of screening criteria (Department of the Navy [Navy] 2000) and methodology for selecting screening criteria used in this appendix are identical to those used previously in groundwater status reports and the remedial investigation for Site 12 at NAVSTA TI (Tetra Tech 2002, 2003a, 2003b, 2003c; Sullivan Consulting Group and Tetra Tech 2004; SulTech 2005; TriEco-Tt 2012).

Individual toxicity criteria were selected for screening under the NAVSTA TI groundwater monitoring program using a methodology that sorts and selects criteria according to the applicability and quality of data. First, the criteria identified were sorted by applicability and quality of data into one of four tiers (Table C-1). Toxicity criteria for chronic exposure were identified as most applicable for the exposure scenario at NAVSTA TI and as more protective (lower concentration values) than short-duration acute or instantaneous exposure toxicity criteria (higher concentration values). As a result, applicable toxicity criteria for chronic exposure were assigned to the first tier of applicability. Where more than one applicable toxicity value was available in the same tier, the most protective (lowest) value was selected for screening.

An acute value was selected as a second-tier criterion if no first-tier exposure toxicity criterion was available for a specific analyte. Each acute criterion was made more protective and thus conservative to make acute criteria more appropriate for use in chronic exposure scenarios. An uncertainty factor of 10 was applied to extrapolate from an acute lowest-observed-effect-level (LOEL) to a chronic LOEL. The California Department of Toxic Substances Control (DTSC) recommended this methodology in a memorandum dated March 15, 2006 (DTSC 2006).

Additionally, toxicity criteria were evaluated for applicability and compared in terms of regulatory status and quality of the scientific data. For example, promulgated federal or state regulatory toxicity standards and recommended criteria were used in this compendium, whereas unique research values (such as are presented by individual authors, industry research groups, or academic research groups where study methodology and data quality are unknown) were not used. In addition, published EPA LOEL criteria were included as third-tier criteria for screening in cases where no first- or second-tier criteria were available. Finally, a Water Board

environmental screening level (for 2-methylnaphthalene, 2-butanone, 4-methyl-2-pentanone, acetone, and o-xylene; Water Board 2013), a NAVSTA TI-derived value (for total petroleum hydrocarbons; Tetra Tech 2001), and a secondary chronic value (for carbon disulfide; Suter and Tsao 1996) were used where no first- through third-tier criteria were available for specific analytes of concern.

C3.0 RESULTS

Table C-2 presents the results of the screening criteria selection process. Values shaded in the far right-hand column of Table C-2 were selected as the screening criteria for analytes of concern in the SLERA. The most protective (lowest) value was selected for the screening where more than one applicable toxicity value was available in the same tier. Using the tiered methodology detailed above, the most protective second-tier criterion was selected when no first-tier criterion was identified, and so on. Two dashes (--) indicate that no criterion was available for the analyte of concern.

C4.0 REFERENCES

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San Francisco Bay Regional Water Quality Control Board (Water Board). 2011. "A Compilation of Water Quality Goals." Prepared by Jon B. Marshack, Central Valley Region. April.

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U.S. Environmental Protection Agency (EPA). 2013. "National Recommended Water Quality Criteria." Available on-line: http://www.epa.gov/ost/criteria/wqctable/

TABLES

TABLE C-1: GROUNDWATER SCREENING CRITERIA TIERS

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Criteria Tier	San Francisco Bay Region Water Quality Control Plan (Basin Plan) [a]	California Toxic Rule [b]	National Ambient Water Quality Criteria [c]
First Tier Chronic criteria	Chronic criteria	Chronic criteria	Recommended chronic criteria Chronic LOEL criteria
Second tier Acute criteria Apply an uncertainty factor of 10 to extrapolate from an acute LOEL to a chronic LOEL [d]	Acute criteria	Acute criteria	Acute recommended criteria Acute LOEL criteria
Third tier Other LOEL criteria	Not applicable	Not applicable	Other LOEL criteria
Fourth tier Other criteria	2-methylnaphthalene[e], 2-butanone[e], 4-methyl-2-pentanone[e], acetone[e], and o-xylene[e], carbon disulfide[f], and total petroleum hydrocarbons [g]		

Notes:

a San Francisco Bay Regional Water Quality Control Board (Water Board). 2013a. "San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan)." June 29.

b U.S. Environmental Protection Agency (EPA). 2000. "Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California." 40 Code of Federal Regulations Part 131, RIN 2040-AC44. May 18.

c U.S. Environmental Protection Agency (EPA). 2013. "National Recommended Water Quality Criteria." available online: http://www.epa.gov/ost/criteria/wqctable/

d Department of Toxic Substances Control (DTSC). 2006. "Ecological Screening Soil and Aquatic Values for Naval Station Treasure Island." [Site 201210-18 Pca 18040 H:28]. March 15.

e Water Board. 2013b. "Environmental Screening Levels." December. Available online: http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/esl.shtml

f Suter, G.W. II, and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. ES/ER/TM-96/R2. Available online: http://rais.ornl.gov/documents/tm96r2.pdf

g Tetra Tech EM Inc. (Tetra Tech). 2001. "Final Preliminary Remediation Criteria for Petroleum Constituents. Technical Memorandum. Naval Station Treasure Island. San Francisco California." November 13.

LOEL Lowest-observable-effect level

Table C-2: GROUNDWATER SCREENING CRITERIA

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Detected Analyte	Pseudonym	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) Saltwater Aquatic Life						National Ambient Water Quality Criteria (AWQC) for Protection of Saltwater Aquatic Life[g] (µg/L) Lowest Observed Effect Level (LOEL)						Other Criteria (footnotes indicate source) (µg/L)		Selected Toxicity Screening Criteria (µg/L)
				Chronic[e]		Acute[e]		Instantaneous Maximum		Chronic[e]		Acute[e]				Chronic[f]		Acute[g]				Other[h]				
		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	
2-Methylnaphthalene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30	l	30
2-Butanone	Methyl Ethyl Ketone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14000	m	14,000
4-Methyl-2-Pentanone	Methyl Isobutyl Ketone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	170	m	170
Acenaphthene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	710	--	970	--	--	--	500	(38)	--	--	710
Acenaphthylene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Acetone		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1500	m	1,500
Anthracene		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Benzene		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5,100	--	--	--	700	(83)	--	--	700
Benzo(a)anthracene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Benzo(a)pyrene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Benzo(b)fluoranthene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Benzo(g,h,i)perylene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Benzo(k)fluoranthene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Chrysene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Carbon Disulfide		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.92	p	0.92
Ethylbenzene		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	430	86	43	o	--	--	--	--	43
Fluoranthene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16	--	40	--	--	--	--	--	--	--	16
Fluorene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Indeno(1,2,3-cd)pyrene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Isopropylbenzene	Cumene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	430	86	43	o	--	--	--	--	43
N-Butylbenzene		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	430	86	43	o	--	--	--	--	43
Naphthalene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,350	470	235	--	--	--	--	--	235
O-Xylene		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100	n	100
Phenanthrene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Propylbenzene		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	430	86	43	o	--	--	--	--	43
Pyrene		15	b	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	300	60	30	(52)	--	--	--	--	30
Sec-Butylbenzene		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	430	86	43	o	--	--	--	--	43
Tert-Butylbenzene		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	430	86	43	o	--	--	--	--	43
TPH-Diesel	Diesel range organics; Diesel Fuel;	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,400	j	1,400
TPH-Gasoline	Gasoline range organics; Gasoline	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,400	j	1,400
TPH-Motor Oil	Motor oil range organics; Motor Oil	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,400	j	1,400

Notes: Footnotes and references are detailed below.

µg/L Microgram per liter
-- No criterion available
NAVSTA TI Naval Station Treasure Island
TPH Total petroleum hydrocarbon

Table C-2: GROUNDWATER SCREENING CRITERIA

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Footnotes:

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 Control Plan." June 29.
b	From Water Board "Basin Plan" 24-Hour Average (Acute) (retained from 1995 value; not recommended in Water Board 2011 or Water Board 2013b)
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 chronic 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 exceedence. 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
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 Constiuents. 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).
m	Basis: USDOE FW Chronic PRG, Value: Lowest Marine Aquatic Habitat Goal. From "Table F-4a. Summary of Selected Aquatic Habitat Goals" (Water Board 2013b).
n	Basis: 5% acute SW LC 50, Value: Lowest Marine Aquatic Habitat Goal. From "Table F-4a. Summary of Selected Aquatic Habitat Goals" (Water Board 2013b).
o	Values for ethylbenzene from EPA National "AWQC Lowest Observed Effect Level (Acute)" (Water Board 2011). Ethylbenzene was used as a surrogate for isopropylbenzene, N-Butylbenzene, N-Propylbenzene, Sec-Butylbenzene and N-Propylbenzene.
p	Secondary chronic value from Suter and Tsao1996.

The following numbered footnotes are derived from "A Compilation of Water Quality Goals" (Water Board 2011). These footnotes directly correlate with the source document.

38	Toxicity to algae occurs.
52	For polycyclic aromatic hydrocarbons
83	Adverse effects on a fish species exposed for 168 days

References:

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Water Board. 2011. "A Compilation of Water Quality Goals." Prepared by Jon B. Marshack, Central Valley Region. April.

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Suter, G.W. II, and Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. ES/ER/TM-96/R2. Available online: http://rais.ornl.gov/documents/tm96r2.pdf

Tetra Tech EM Inc. 2001. "Final Preliminary Remediation Criteria for Petroleum Constiuents. Technical Memorandum. Naval Station Treasure Island. San Francisco California." November 13.

U.S. Environmental Protection Agency (EPA). 2000. "Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California." 40 CFR Part 131, RIN 2040-AC44. May 18.

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

APPENDIX D
DOSE CALCULATIONS AND HAZARD QUOTIENTS FOR BIRDS AND MAMMALS

Table D-1: SPOTTED SANDPIPER DOSE CALCULATIONS AND HAZARD QUOTIENTS (STEP 2)
Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC	Total Prey Ingestion Rate[1] (kg/day)	Benthic Invertebrate Ingestion Rate[2] (kg/day)	Benthic Invertebrate BAF[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]	Source of TRV
TOTAL HMW PAHS	**(Calculated with Literature BAF)**													
Dose/High TRV	8.54E-03	8.54E-03	7.79E-01	2.93E+00	2.50E-02	1.54E-03	3.76E+00	5.78E-03	1.00E+00	3.79E-02	8.12E-01	No TRV	No TRV	NA
Dose/Low TRV	8.54E-03	8.54E-03	7.79E-01	2.93E+00	2.50E-02	1.54E-03	3.76E+00	5.78E-03	1.00E+00	3.79E-02	8.12E-01	No TRV	No TRV	NA
TOTAL HMW PAHS	**(Calculated with Tissue Concentration)**													
Dose/High TRV	8.54E-03	8.54E-03	NA	1.02E+00	8.70E-03	1.54E-03	3.76E+00	5.78E-03	1.00E+00	3.79E-02	3.82E-01	No TRV	No TRV	NA
Dose/Low TRV	8.54E-03	8.54E-03	NA	1.02E+00	8.70E-03	1.54E-03	3.76E+00	5.78E-03	1.00E+00	3.79E-02	3.82E-01	No TRV	No TRV	NA
TOTAL LMW PAHS	**(Calculated with Literature BAF)**													
Dose/High TRV	8.54E-03	8.54E-03	3.04E+00	9.00E+00	7.69E-02	1.54E-03	2.96E+00	4.55E-03	1.00E+00	3.79E-02	2.15E+00	No TRV	No TRV	NA
Dose/Low TRV	8.54E-03	8.54E-03	3.04E+00	9.00E+00	7.69E-02	1.54E-03	2.96E+00	4.55E-03	1.00E+00	3.79E-02	2.15E+00	No TRV	No TRV	NA
TOTAL LMW PAHS	**(Calculated with Tissue Concentration)**													
Dose/High TRV	8.54E-03	8.54E-03	NA	1.11E-01	9.48E-04	1.54E-03	2.96E+00	4.55E-03	1.00E+00	3.79E-02	1.45E-01	No TRV	No TRV	NA
Dose/Low TRV	8.54E-03	8.54E-03	NA	1.11E-01	9.48E-04	1.54E-03	2.96E+00	4.55E-03	1.00E+00	3.79E-02	1.45E-01	No TRV	No TRV	NA

Notes are presented after Table D-3.

Table D-2: GREAT BLUE HERON DOSE CALCULATIONS AND HAZARD QUOTIENTS (STEP 2)
Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC	Total Prey Ingestion Rate[1] (kg/day)	Fish Ingestion Rate[2] (kg/day)	Fish BAF[3] (unitless)	Fish Concentration[4] (mg/kg)	Fish Daily Dose[5] (mg/day)	Invertebrate Ingestion Rate[2] (kg/day)	Invertebrate BAF[3] (unitless)	Invertebrate Concentration[4] (mg/kg)	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]	Source of TRV
TOTAL HMW PAHS	**(Calculated with Literature BAFs)**																	
Dose/High TRV	1.28E-01	9.61E-02	3.33E-02	1.25E-01	1.20E-02	3.20E-02	7.79E-01	2.93E+00	9.38E-02	3.46E-03	3.76E+00	1.30E-02	1.00E+00	2.30E+00	5.16E-02	No TRV	No TRV	NA
Dose/Low TRV	1.28E-01	9.61E-02	3.33E-02	1.25E-01	1.20E-02	3.20E-02	7.79E-01	2.93E+00	9.38E-02	3.46E-03	3.76E+00	1.30E-02	1.00E+00	2.30E+00	5.16E-02	No TRV	No TRV	NA
TOTAL HMW PAHS	**(Calculated with Tissue Concentrations)**																	
Dose/High TRV	1.28E-01	9.61E-02	NA	0.00E+00	0.00E+00	3.20E-02	NA	1.02E+00	3.26E-02	3.46E-03	3.76E+00	1.30E-02	1.00E+00	2.30E+00	1.98E-02	No TRV	No TRV	NA
Dose/Low TRV	1.28E-01	9.61E-02	NA	0.00E+00	0.00E+00	3.20E-02	NA	1.02E+00	3.26E-02	3.46E-03	3.76E+00	1.30E-02	1.00E+00	2.30E+00	1.98E-02	No TRV	No TRV	NA
TOTAL LMW PAHS	**(Calculated with Literature BAFs)**																	
Dose/High TRV	1.28E-01	9.61E-02	5.32E+00	1.57E+01	1.51E+00	3.20E-02	3.04E+00	9.00E+00	2.88E-01	3.46E-03	2.96E+00	1.02E-02	1.00E+00	2.30E+00	7.88E-01	No TRV	No TRV	NA
Dose/Low TRV	1.28E-01	9.61E-02	5.32E+00	1.57E+01	1.51E+00	3.20E-02	3.04E+00	9.00E+00	2.88E-01	3.46E-03	2.96E+00	1.02E-02	1.00E+00	2.30E+00	7.88E-01	No TRV	No TRV	NA
TOTAL LMW PAHS	**(Calculated with Tissue Concentrations)**																	
Dose/High TRV	1.28E-01	9.61E-02	NA	5.83E-02	5.60E-03	3.20E-02	NA	1.11E-01	3.56E-03	3.46E-03	2.96E+00	1.02E-02	1.00E+00	2.30E+00	8.43E-03	No TRV	No TRV	NA
Dose/Low TRV	1.28E-01	9.61E-02	NA	5.83E-02	5.60E-03	3.20E-02	NA	1.11E-01	3.56E-03	3.46E-03	2.96E+00	1.02E-02	1.00E+00	2.30E+00	8.43E-03	No TRV	No TRV	NA

Notes are presented after Table D-3.

Table D-3: RACCOON DOSE CALCULATIONS AND HAZARD QUOTIENTS (STEP 2)
Screening-Level Ecological Risk Assessment, Site YF3, Former Naval Station Treasure Island, San Francisco, California

COPEC	Total Prey Ingestion Rate[1] (kg/day)	Mollusk Ingestion Rate[2] (kg/day)	Mollusk BAF[3] (unitless)	Mollusk Concentration[4] (mg/kg)	Mollusk Daily Dose[5] (mg/day)	Crustacean Ingestion Rate[2] (kg/day)	Crustacean BAF[3,6] (unitless)	Crustacean Concentration[4] (mg/kg)	Crustacean 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]	Source of TRV
TOTAL HMW PAHS	**(Calculated with Literature BAFs)**																	
Dose/High TRV	1.41E-01	7.04E-02	7.79E-01	2.93E+00	2.06E-01	7.04E-02	7.79E-01	2.93E+00	2.06E-01	1.32E-02	3.76E+00	4.98E-02	1.00E+00	4.31E+00	1.07E-01	3.28E+01	3.27E-03	Calculated
Dose/Low TRV	1.41E-01	7.04E-02	7.79E-01	2.93E+00	2.06E-01	7.04E-02	7.79E-01	2.93E+00	2.06E-01	1.32E-02	3.76E+00	4.98E-02	1.00E+00	4.31E+00	1.07E-01	1.31E+00	8.18E-02	Navy 1998
TOTAL HMW PAHS	**(Calculated with Tissue Concentrations)**																	
Dose/High TRV	1.41E-01	7.04E-02	NA	1.02E+00	7.17E-02	7.04E-02	NA	0.00E+00	0.00E+00	1.32E-02	3.76E+00	4.98E-02	1.00E+00	4.31E+00	2.82E-02	3.28E+01	8.59E-04	Calculated
Dose/Low TRV	1.41E-01	7.04E-02	NA	1.02E+00	7.17E-02	7.04E-02	NA	0.00E+00	0.00E+00	1.32E-02	3.76E+00	4.98E-02	1.00E+00	4.31E+00	2.82E-02	1.31E+00	2.15E-02	Navy 1998
TOTAL LMW PAHS	**(Calculated with Literature BAFs)**																	
Dose/High TRV	1.41E-01	7.04E-02	3.04E+00	9.00E+00	6.34E-01	7.04E-02	3.04E+00	9.00E+00	6.34E-01	1.32E-02	2.96E+00	3.92E-02	1.00E+00	4.31E+00	3.03E-01	1.50E+02	2.02E-03	Navy 1998
Dose/Low TRV	1.41E-01	7.04E-02	3.04E+00	9.00E+00	6.34E-01	7.04E-02	3.04E+00	9.00E+00	6.34E-01	1.32E-02	2.96E+00	3.92E-02	1.00E+00	4.31E+00	3.03E-01	5.00E+01	6.06E-03	Navy 1998
TOTAL LMW PAHS	**(Calculated with Tissue Concentrations)**																	
Dose/High TRV	1.41E-01	7.04E-02	NA	1.31E-02	9.24E-04	7.04E-02	NA	1.31E-02	9.24E-04	1.32E-02	2.96E+00	3.92E-02	1.00E+00	4.31E+00	9.52E-03	1.50E+02	6.35E-05	Navy 1998
Dose/Low TRV	1.41E-01	7.04E-02	NA	1.31E-02	9.24E-04	7.04E-02	NA	1.31E-02	9.24E-04	1.32E-02	2.96E+00	3.92E-02	1.00E+00	4.31E+00	9.52E-03	5.00E+01	1.90E-04	Navy 1998

Notes are presented after Table D-3.

NOTES FOR FOOD-CHAIN MODEL TABLES D-1 THROUGH D-3 (STEP 2)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

1	See Tables 9 through 11 for total prey ingestion rate calculation.
2	See Tables 9 through 11 for benthic invertebrate, mollusk, crab, and fish ingestion rates.
3	Sources of literature BAFs and field-collected tissue concentrations are described in Table 12. The iterature BAFs and site-collected tissue concentrations were used in parallel in the food chain models to calculate two different estimated daily doses for each COPEC and receptor. The tissue concentrations in the clam sample were used in the food chain model to represent site-collected invertebrate tissue for the spotted sandpiper and great blue heron. The clam and crab tissue concentrations were used to represent site-collected mollusk and crustacean concentrations, respectively, for the raccoon.
4	The benthic invertebrate, mollusk, crab, and fish concentrations were calculated by multiplying the maximum sediment concentration by the respective BAF, or were based on site-collected tissue concentrations, as described in Table 12.
5	The benthic invertebrate, mollusk, crab, and fish daily doses were calculated by multiplying the respective ingestion rate (see note 2) by the respective tissue concentration (see note 4).
6	See Tables 9 through 11 for sediment ingestion rate.
7	The maximum site-collected surface sediment concentration (0 to 2 feet below sediment surface) was used for all receptors.
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 Tables 9 through 11 for source of body weight.
10	Total daily dose is calculated using the following equation: total daily dose = ([benthic invertebrate daily dose (if applicable) + fish daily dose (if applicable) + mollusk daily dose [if applicable] + crustacean daily dose [if applicable] + sediment daily dose]*SUF)/receptor species body weight.
11	The derivation of TRVs are described in Navy (1998). Chemicals without TRVs will be evaluated qualitatively in Step 3a. The mammal TRVs for napthalene and benzo(a)pyrene were used as surrogates for total LMW PAH and total HMW PAHs, respectively.
12	HQs were calculated using the following equation: HQ = total daily dose/TRV.
BAF	Bioaccumulation 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
NA	Not applicable
Navy	Department of the Navy
PAH	Polycyclic aromatic hydrocarbons
SUF	Site use factor
TRV	Toxicity reference value

Reference: Navy. 1998. "Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California, Interim Final." Prepared by Naval Facilities Engineering Command, Engineering Field Activity West (EFA West). San Bruno, California.

Table D-4: SPOTTED SANDPIPER DOSE CALCULATIONS AND HAZARD QUOTIENTS (STEP 3a)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC	Total Prey Ingestion Rate[1] (kg/day)	Benthic Invertebrate Ingestion Rate[2] (kg/day)	Benthic Invertebrate BAF[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]	Source of TRV
TOTAL HMW PAHS	**(Calculated with Literature BAF)**													
Dose/High TRV	9.33E-03	9.33E-03	7.79E-01	2.93E+00	2.73E-02	1.68E-03	3.76E+00	6.31E-03	1.00E+00	4.25E-02	7.91E-01	No TRV	No TRV	NA
Dose/Low TRV	9.33E-03	9.33E-03	7.79E-01	2.93E+00	2.73E-02	1.68E-03	3.76E+00	6.31E-03	1.00E+00	4.25E-02	7.91E-01	No TRV	No TRV	NA
TOTAL HMW PAHS	**(Calculated with Tissue Concentration)**													
Dose/High TRV	9.33E-03	9.33E-03	NA	1.02E+00	9.50E-03	1.68E-03	3.76E+00	6.31E-03	1.00E+00	4.25E-02	3.72E-01	No TRV	No TRV	NA
Dose/Low TRV	9.33E-03	9.33E-03	NA	1.02E+00	9.50E-03	1.68E-03	3.76E+00	6.31E-03	1.00E+00	4.25E-02	3.72E-01	No TRV	No TRV	NA
TOTAL LMW PAHS	**(Calculated with Literature BAF)**													
Dose/High TRV	9.33E-03	9.33E-03	3.04E+00	9.00E+00	8.40E-02	1.68E-03	2.96E+00	4.97E-03	1.00E+00	4.25E-02	2.09E+00	No TRV	No TRV	NA
Dose/Low TRV	9.33E-03	9.33E-03	3.04E+00	9.00E+00	8.40E-02	1.68E-03	2.96E+00	4.97E-03	1.00E+00	4.25E-02	2.09E+00	No TRV	No TRV	NA
TOTAL LMW PAHS	**(Calculated with Tissue Concentration)**													
Dose/High TRV	9.33E-03	9.33E-03	NA	1.11E-01	1.04E-03	1.68E-03	2.96E+00	4.97E-03	1.00E+00	4.25E-02	1.41E-01	No TRV	No TRV	NA
Dose/Low TRV	9.33E-03	9.33E-03	NA	1.11E-01	1.04E-03	1.68E-03	2.96E+00	4.97E-03	1.00E+00	4.25E-02	1.41E-01	No TRV	No TRV	NA

Notes are presented after Table D-5.

Table D-5: GREAT BLUE HERON DOSE CALCULATIONS AND HAZARD QUOTIENTS (STEP 3a)
Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

COPEC	Total Prey Ingestion Rate[1] (kg/day)	Fish Ingestion Rate[2] (kg/day)	Fish BAF[3] (unitless)	Fish Concentration[4] (mg/kg)	Fish Daily Dose[5] (mg/day)	Invertebrate Ingestion Rate[2] (kg/day)	Invertebrate BAF[3] (unitless)	Invertebrate Concentration[4] (mg/kg)	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]	Source of TRV
TOTAL HMW PAHS	**(Calculated with Literature BAFs)**																	
Dose/High TRV	1.32E-01	9.86E-02	3.33E-02	1.25E-01	1.23E-02	3.29E-02	7.79E-01	2.93E+00	9.63E-02	3.55E-03	3.76E+00	1.33E-02	6.51E-02	2.39E+00	3.32E-03	No TRV	No TRV	NA
Dose/Low TRV	1.32E-01	9.86E-02	3.33E-02	1.25E-01	1.23E-02	3.29E-02	7.79E-01	2.93E+00	9.63E-02	3.55E-03	3.76E+00	1.33E-02	6.51E-02	2.39E+00	3.32E-03	No TRV	No TRV	NA
TOTAL HMW PAHS	**(Calculated with Tissue Concentrations)**																	
Dose/High TRV	1.32E-01	9.86E-02	NA	0.00E+00	0.00E+00	3.29E-02	NA	1.02E+00	3.35E-02	3.55E-03	3.76E+00	1.33E-02	6.51E-02	2.39E+00	1.27E-03	No TRV	No TRV	NA
Dose/Low TRV	1.32E-01	9.86E-02	NA	0.00E+00	0.00E+00	3.29E-02	NA	1.02E+00	3.35E-02	3.55E-03	3.76E+00	1.33E-02	6.51E-02	2.39E+00	1.27E-03	No TRV	No TRV	NA
TOTAL LMW PAHS	**(Calculated with Literature BAFs)**																	
Dose/High TRV	1.32E-01	9.86E-02	5.32E+00	1.57E+01	1.55E+00	3.29E-02	3.04E+00	9.00E+00	2.96E-01	3.55E-03	2.96E+00	1.05E-02	6.51E-02	2.39E+00	5.06E-02	No TRV	No TRV	NA
Dose/Low TRV	1.32E-01	9.86E-02	5.32E+00	1.57E+01	1.55E+00	3.29E-02	3.04E+00	9.00E+00	2.96E-01	3.55E-03	2.96E+00	1.05E-02	6.51E-02	2.39E+00	5.06E-02	No TRV	No TRV	NA
TOTAL LMW PAHS	**(Calculated with Tissue Concentrations)**																	
Dose/High TRV	1.32E-01	9.86E-02	NA	5.83E-02	5.75E-03	3.29E-02	NA	1.11E-01	3.65E-03	3.55E-03	2.96E+00	1.05E-02	6.51E-02	2.39E+00	5.42E-04	No TRV	No TRV	NA
Dose/Low TRV	1.32E-01	9.86E-02	NA	5.83E-02	5.75E-03	3.29E-02	NA	1.11E-01	3.65E-03	3.55E-03	2.96E+00	1.05E-02	6.51E-02	2.39E+00	5.42E-04	No TRV	No TRV	NA

Notes are presented after Table D-5.

NOTES FOR FOOD-CHAIN MODEL TABLES D-4 AND D-5 (STEP 3a)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

1	See Tables 9 through 11 for total prey ingestion rate calculation.
2	See Tables 9 through 11 for benthic invertebrate and fish ingestion rates.
3	Sources of literature BAFs and field-collected tissue concentrations are described in Table 12. The iterature BAFs and site-collected tissue concentrations were used in parallel in the food chain models to calculate two different estimated daily doses for each COPEC and receptor. The tissue concentrations in the clam sample were used in the food chain model to represent site-collected invertebrate tissue for the spotted sandpiper and great blue heron.
4	The benthic invertebrate and fish concentrations were calculated by multiplying the maximum sediment concentration by the respective BAF, or were based on site-collected tissue concentrations, as described in Table 12.
5	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).
6	See Tables 9 through 11 for sediment ingestion rate.
7	The maximum site-collected surface sediment concentration (0 to 2 feet below sediment surface) was used for all receptors because a 95 UCL could not be calculated.
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 Tables 9 through 11 for source of body weight.
10	Total daily dose is calculated using the following equation: total daily dose = ([benthic invertebrate daily dose (if applicable) + fish daily dose (if applicable) + sediment daily dose]*SUF)/receptor species body weight.
11	The derivation of TRVs are described in Navy (1998). Chemicals without TRVs are evaluated qualitatively in Step 3a.
12	HQs were calculated using the following equation: HQ = total daily dose/TRV.
95UCL	95 percent upper confidence limit of the mean
BAF	Bioaccumulation 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
NA	Not applicable
Navy	Department of the Navy
PAH	Polycyclic aromatic hydrocarbons
SUF	Site use factor
TRV	Toxicity reference value

Reference: Navy. 1998. "Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California, Interim Final." Prepared by Naval Facilities Engineering Command, Engineering Field Activity West (EFA West). San Bruno, California.

APPENDIX E
ANALYTICAL DATA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	031YF3001	031YF3002	KCHYF3-1	KCHYF3-1	KCHYF3-1	KCHYF3-2	KCHYF3-2
Sample ID	031YF3001	031YF3002	KCHYF3-1-2	KCHYF3-1-5	KCHYF3-1-10	KCHYF3-2-2	KCHYF3-2-10
Sample Date	07/23/1997	07/23/1997	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	2.83 - 3.33	4.08 - 4.58	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	10.00 - 10.00
Volatile Organic Compounds (mg/kg)							
1,1,1,2-TETRACHLOROETHANE	NA	NA	0.0144 U	0.0142 U	0.032 U	0.0142 U	0.0162 U
1,1,1-TRICHLOROETHANE	NA	NA	0.0156 U	0.0154 U	0.034 U	0.0152 U	0.0174 U
1,1,2,2-TETRACHLOROETHANE	NA	NA	0.03 U	0.03 U	0.066 U	0.03 U	0.034 U
1,1,2-TRICHLOROETHANE	NA	NA	0.022 U	0.022 U	0.048 U	0.022 U	0.024 U
1,1-DICHLOROETHANE	NA	NA	0.022 U	0.02 U	0.046 UJ	0.02 U	0.024 U
1,1-DICHLOROETHENE	NA	NA	0.034 U	0.032 U	0.074 U	0.032 U	0.038 U
1,1-DICHLOROPROPENE	NA	NA	0.022 U	0.022 U	0.048 U	0.022 U	0.024 U
1,2,3-TRICHLOROBENZENE	NA	NA	0.032 U	0.032 U	0.07 U	0.032 U	0.036 U
1,2,3-TRICHLOROPROPANE	NA	NA	0.044 U	0.042 U	0.096 UJ	0.042 U	0.048 U
1,2,4-TRICHLOROBENZENE	NA	NA	0.024 U	0.022 U	0.052 U	0.022 U	0.026 U
1,2,4-TRIMETHYLBENZENE	NA	NA	0.022 U	0.02 U	0.046 U	0.02 U	0.024 U
1,2-DIBROMO-3-CHLOROPROPANE	NA	NA	0.084 U	0.084 U	0.186 U	0.082 U	0.094 U
1,2-DIBROMOETHANE	NA	NA	0.022 U	0.022 U	0.048 U	0.022 U	0.024 U
1,2-DICHLOROBENZENE	NA	NA	0.019 U	0.0186 U	0.042 UJ	0.0186 U	0.022 U
1,2-DICHLOROETHANE	NA	NA	0.0156 U	0.0154 U	0.034 U	0.0152 U	0.0174 U
1,2-DICHLOROPROPANE	NA	NA	0.019 U	0.0186 U	0.042 U	0.0186 U	0.022 U
1,3,5-TRIMETHYLBENZENE	NA	NA	0.0134 U	0.0132 U	0.03 U	0.013 U	0.0148 U
1,3-DICHLOROBENZENE	NA	NA	0.0122 U	0.012 U	0.026 U	0.012 U	0.0136 U
1,3-DICHLOROPROPANE	NA	NA	0.019 U	0.0186 U	0.042 UJ	0.0186 U	0.022 U
1,4-DICHLOROBENZENE	NA	NA	0.022 U	0.02 U	0.046 U	0.02 U	0.024 U
2,2-DICHLOROPROPANE	NA	NA	0.024 U	0.024 U	0.054 U	0.024 U	0.028 U
2-BUTANONE	NA	NA	0.45 J	0.47 J	0.146 U	0.066 U	0.074 U
2-CHLOROTOLUENE	NA	NA	0.0156 U	0.0154 U	0.034 U	0.0152 U	0.0174 U
2-HEXANONE	NA	NA	0.102 U	0.1 U	0.22 U	0.1 U	0.114 U
4-CHLOROTOLUENE	NA	NA	0.0144 U	0.0142 U	0.032 UJ	0.0142 U	0.0162 U
4-METHYL-2-PENTANONE	NA	NA	0.22 U	0.2 U	0.46 U	0.2 U	0.24 U
ACETONE	NA	NA	0.4 J	0.42 J	0.68 U	0.2 J	0.34 U
BENZENE	NA	NA	0.0178 U	0.0176 U	0.04 U	0.0174 U	0.0198 U
BROMOBENZENE	NA	NA	0.0178 U	0.0176 U	0.04 U	0.0174 U	0.0198 U
BROMOCHLOROMETHANE	NA	NA	0.0168 U	0.0164 U	0.036 U	0.0164 U	0.0186 U
BROMODICHLOROMETHANE	NA	NA	0.0156 U	0.0154 U	0.034 U	0.0152 U	0.0174 U
BROMOFORM	NA	NA	0.0156 U	0.0154 U	0.034 U	0.0152 U	0.0174 U
BROMOMETHANE	NA	NA	0.038 J	0.028 J	0.058 U	0.026 U	0.03 U
CARBON DISULFIDE	NA	NA	0.068	0.031 J	0.048 U	0.022 U	0.024 U
CARBON TETRACHLORIDE	NA	NA	0.0112 U	0.011 U	0.024 U	0.0108 U	0.0124 U

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	031YF3001	031YF3002	KCHYF3-1	KCHYF3-1	KCHYF3-1	KCHYF3-2	KCHYF3-2
Sample ID	031YF3001	031YF3002	KCHYF3-1-2	KCHYF3-1-5	KCHYF3-1-10	KCHYF3-2-2	KCHYF3-2-10
Sample Date	07/23/1997	07/23/1997	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	2.83 - 3.33	4.08 - 4.58	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	10.00 - 10.00
Volatile Organic Compounds (mg/kg)							
CHLOROBENZENE	NA	NA	0.024 U	0.022 U	0.052 UJ	0.022 U	0.026 U
CHLOROETHANE	NA	NA	0.024 U	0.022 U	0.052 UJ	0.022 U	0.026 U
CHLOROFORM	NA	NA	0.0178 U	0.0176 U	0.04 U	0.0174 U	0.0198 U
CHLOROMETHANE	NA	NA	0.034 U	0.034 U	0.076 U	0.024 J	0.038 U
CIS-1,2-DICHLOROETHENE	NA	NA	0.0178 U	0.0176 U	0.04 U	0.0174 U	0.0198 U
CIS-1,3-DICHLOROPROPENE	NA	NA	0.0168 U	0.0164 U	0.036 U	0.0164 U	0.0186 U
DIBROMOCHLOROMETHANE	NA	NA	0.022 U	0.02 U	0.046 U	0.02 U	0.024 U
DIBROMOMETHANE	NA	NA	0.022 U	0.022 U	0.048 UJ	0.022 U	0.024 U
ETHYLBENZENE	NA	NA	0.026 U	0.026 U	0.056 U	0.026 U	0.028 U
FREON 11	NA	NA	0.026 U	0.026 U	0.058 U	0.026 U	0.03 U
FREON 12	NA	NA	0.022 U	0.02 U	0.046 U	0.02 U	0.024 U
HEXACHLOROBUTADIENE	NA	NA	0.022 U	0.02 U	0.046 U	0.02 U	0.024 U
ISOPROPYLBENZENE	NA	NA	0.0178 U	0.0176 U	0.065 J	0.0174 U	0.0198 U
M,P-XYLENES	NA	NA	0.044 U	0.044 U	0.098 UJ	0.044 U	0.05 U
METHYL-TERT-BUTYL ETHER	NA	NA	0.022 U	0.02 U	0.046 U	0.02 U	0.024 U
METHYLENE CHLORIDE	NA	NA	0.038 U	0.038 U	0.11 J	0.038 U	0.044 U
N-BUTYLBENZENE	NA	NA	0.0168 U	0.0164 U	0.12	0.0164 U	0.0186 U
N-PROPYLBENZENE	NA	NA	0.024 U	0.022 U	0.085 J	0.022 U	0.026 U
NAPHTHALENE	NA	NA	0.04 U	0.04 U	0.088 U	0.04 U	0.044 U
O-XYLENE	NA	NA	0.022 U	0.02 U	0.046 U	0.02 U	0.024 U
PARA-ISOPROPYL TOLUENE	NA	NA	0.0134 U	0.0132 U	0.03 U	0.013 U	0.0148 U
SEC-BUTYLBENZENE	NA	NA	0.0134 U	0.0132 U	0.13	0.013 U	0.0148 U
STYRENE	NA	NA	0.028 U	0.028 U	0.062 U	0.028 U	0.03 U
TERT-BUTYLBENZENE	NA	NA	0.0144 U	0.0142 U	0.032 U	0.0142 U	0.0162 U
TETRACHLOROETHENE	NA	NA	0.0168 U	0.0164 U	0.036 U	0.0164 U	0.0186 U
TOLUENE	NA	NA	0.019 U	0.0186 U	0.042 U	0.0186 U	0.022 U
TRANS-1,2-DICHLOROETHENE	NA	NA	0.022 U	0.02 U	0.046 U	0.02 U	0.024 U
TRANS-1,3-DICHLOROPROPENE	NA	NA	0.02 U	0.0196 U	0.044 U	0.0196 U	0.022 U
TRICHLOROETHENE	NA	NA	0.0178 U	0.0176 U	0.04 U	0.0174 U	0.0198 U
VINYL CHLORIDE	NA	NA	0.026 U	0.026 U	0.056 U	0.026 U	0.028 U
Petroleum Hydrocarbons (mg/kg)							
Diesel/Motor Oil Range (extractables)							
DIESEL RANGE ORGANICS	11 UJ a	10 U	2,200	900	820	610	10
MOTOR OIL RANGE ORGANICS	11 UJ a	10 U	2,100	1,200	420 U	430 J	15 J

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	031YF3001	031YF3002	KCHYF3-1	KCHYF3-1	KCHYF3-1	KCHYF3-2	KCHYF3-2
Sample ID	031YF3001	031YF3002	KCHYF3-1-2	KCHYF3-1-5	KCHYF3-1-10	KCHYF3-2-2	KCHYF3-2-10
Sample Date	07/23/1997	07/23/1997	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	2.83 - 3.33	4.08 - 4.58	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	10.00 - 10.00
Petroleum Hydrocarbons (mg/kg)							
Gasoline Range (purgeables)							
GASOLINE RANGE ORGANICS	NA	NA	3.2 J	1.6	33 J	3.9	0.84 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4-TRICHLOROBENZENE	0.35 U	0.34 U	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	0.17 U	0.16 U	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	0.17 U	0.16 U	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	0.17 U	0.16 U	NA	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	0.35 U	0.34 U	NA	NA	NA	NA	NA
2,4,5-TRICHLOROPHENOL	0.88 U	0.85 U	NA	NA	NA	NA	NA
2,4,6-TRICHLOROPHENOL	0.35 U	0.34 U	NA	NA	NA	NA	NA
2,4-DICHLOROPHENOL	0.35 U	0.34 U	NA	NA	NA	NA	NA
2,4-DIMETHYLPHENOL	0.35 U	0.34 U	NA	NA	NA	NA	NA
2,4-DINITROPHENOL	0.88 U	0.85 U	NA	NA	NA	NA	NA
2,4-DINITROTOLUENE	0.35 U	0.34 U	NA	NA	NA	NA	NA
2,6-DINITROTOLUENE	0.35 U	0.34 U	NA	NA	NA	NA	NA
2-CHLORONAPHTHALENE	0.35 U	0.34 U	NA	NA	NA	NA	NA
2-CHLOROPHENOL	0.35 U	0.34 U	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	0.35 U	0.34 U	0.002 U	0.002 U	0.57 J	0.002 U	0.0062
2-METHYLPHENOL	0.35 U	0.34 U	NA	NA	NA	NA	NA
2-NITROANILINE	0.88 U	0.85 U	NA	NA	NA	NA	NA
2-NITROPHENOL	0.35 U	0.34 U	NA	NA	NA	NA	NA
3,3'-DICHLOROBENZIDINE	0.35 UJ c	0.34 UJ c	NA	NA	NA	NA	NA
3-NITROANILINE	0.88 UJ c	0.85 UJ c	NA	NA	NA	NA	NA
4,6-DINITRO-2-METHYLPHENOL	0.88 UJ c	0.85 UJ c	NA	NA	NA	NA	NA
4-BROMOPHENYL-PHENYLETHER	0.35 U	0.34 U	NA	NA	NA	NA	NA
4-CHLORO-3-METHYLPHENOL	0.35 U	0.34 U	NA	NA	NA	NA	NA
4-CHLOROANILINE	0.35 U	0.34 U	NA	NA	NA	NA	NA
4-CHLOROPHENYL-PHENYLETHER	0.35 U	0.34 U	NA	NA	NA	NA	NA
4-METHYLPHENOL	0.35 U	0.34 U	NA	NA	NA	NA	NA
4-NITROANILINE	0.88 U	0.85 U	NA	NA	NA	NA	NA
4-NITROPHENOL	0.88 U	0.85 U	NA	NA	NA	NA	NA
ACENAPHTHENE	0.35 U	0.34 U	0.0022 U	0.0022 U	0.15	0.0022 U	0.0033 J
ACENAPHTHYLENE	0.35 U	0.34 U	0.052	0.002 U	0.11	0.002 U	0.022
ANTHRACENE	0.35 U	0.34 U	0.29	0.0018 U	0.14 J	0.0018 U	0.17
BENZO(A)ANTHRACENE	0.35 U	0.34 U	0.38	0.052	0.096 J	0.002 U	0.24

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	031YF3001	031YF3002	KCHYF3-1	KCHYF3-1	KCHYF3-1	KCHYF3-2	KCHYF3-2
Sample ID	031YF3001	031YF3002	KCHYF3-1-2	KCHYF3-1-5	KCHYF3-1-10	KCHYF3-2-2	KCHYF3-2-10
Sample Date	07/23/1997	07/23/1997	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	2.83 - 3.33	4.08 - 4.58	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	10.00 - 10.00
Semivolatile Organic Compounds (mg/kg)							
BENZO(A)PYRENE	0.35 U	0.34 U	0.3	0.029	0.08	0.04	0.23
BENZO(B)FLUORANTHENE	0.35 U	0.34 U	0.37 J	0.048 J	0.096 J	0.055 J	0.25 J
BENZO(G,H,I)PERYLENE	0.35 U	0.34 U	0.17	0.02	0.047	0.029	0.12
BENZO(K)FLUORANTHENE	0.35 U	0.34 U	0.45 J	0.057 J	0.12 J	0.067 J	0.31 J
BIS(2-CHLOROETHOXY)METHANE	0.35 U	0.34 U	NA	NA	NA	NA	NA
BIS(2-CHLOROETHYL)ETHER	0.35 U	0.34 U	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	0.14 U	0.13 U	NA	NA	NA	NA	NA
BUTYLBENZYLPHTHALATE	0.35 U	0.34 U	NA	NA	NA	NA	NA
CARBAZOLE	0.35 U	0.34 U	NA	NA	NA	NA	NA
CHRYSENE	0.35 U	0.34 U	0.52	0.13	0.17 J	0.0018 U	0.2
DI-N-BUTYLPHTHALATE	0.35 U	0.34 U	NA	NA	NA	NA	NA
DI-N-OCTYLPHTHALATE	0.35 U	0.34 U	NA	NA	NA	NA	NA
DIBENZ(A,H)ANTHRACENE	0.35 U	0.34 U	0.078	0.002 U	0.014	0.011	0.021
DIBENZOFURAN	0.35 U	0.34 U	NA	NA	NA	NA	NA
DIETHYLPHTHALATE	0.35 U	0.34 U	NA	NA	NA	NA	NA
DIMETHYLPHTHALATE	0.35 U	0.34 U	NA	NA	NA	NA	NA
FLUORANTHENE	0.35 U	0.34 U	0.43	0.098	0.16	0.0026 U	0.52
FLUORENE	0.35 U	0.34 U	0.0022 U	0.0022 U	0.47 J	0.0022 U	0.026
HEXACHLOROBENZENE	0.35 U	0.34 U	NA	NA	NA	NA	NA
HEXACHLOROBUTADIENE	0.35 U	0.34 U	NA	NA	NA	NA	NA
HEXACHLOROCYCLOPENTADIENE	0.35 UJ c	0.34 UJ c	NA	NA	NA	NA	NA
HEXACHLOROETHANE	0.35 U	0.34 U	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	0.35 U	0.34 U	0.2	0.028	0.052 J	0.032	0.12
ISOPHORONE	0.35 U	0.34 U	NA	NA	NA	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	0.35 U	0.34 U	NA	NA	NA	NA	NA
N-NITROSODIPHENYLAMINE (1)	0.35 U	0.34 U	NA	NA	NA	NA	NA
NAPHTHALENE	0.35 U	0.34 U	0.04	0.0039 J	0.074 J	0.0023 J	0.013
NITROBENZENE	0.35 U	0.34 U	NA	NA	NA	NA	NA
PENTACHLOROPHENOL	0.88 U	0.85 U	NA	NA	NA	NA	NA
PHENANTHRENE	0.35 U	0.34 U	0.22	0.0024 U	0.71	0.0024 U	0.38
PHENOL	0.35 U	0.34 U	NA	NA	NA	NA	NA
PYRENE	0.35 U	0.34 U	0.86	0.16	0.33 J	0.16	0.6
Metals (mg/kg)							
ANTIMONY	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	**031YF3001**	**031YF3002**	**KCHYF3-1**	**KCHYF3-1**	**KCHYF3-1**	**KCHYF3-2**	**KCHYF3-2**
Sample ID	031YF3001	031YF3002	KCHYF3-1-2	KCHYF3-1-5	KCHYF3-1-10	KCHYF3-2-2	KCHYF3-2-10
Sample Date	07/23/1997	07/23/1997	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	2.83 - 3.33	4.08 - 4.58	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	10.00 - 10.00
Metals (mg/kg)							
ARSENIC	NA	NA	NA	NA	NA	NA	NA
BARIUM	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA	NA	NA	NA
CADMIUM	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA
COBALT	NA	NA	NA	NA	NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	NA
MOLYBDENUM	NA	NA	NA	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA	NA	NA	NA
SILVER	NA	NA	NA	NA	NA	NA	NA
THALLIUM	NA	NA	NA	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA	NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	NA
TRPH							
TRPH (mg/kg)	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-2	KCHYF3-3	KCHYF3-3	KCHYF3-3	KCHYF3-4	KCHYF3-4	KCHYF3-4
Sample ID	KCHYF3-2-5	KCHYF3-3-2	KCHYF3-3-5	KCHYF3-3-10	KCHYF3-4-2	KCHYF3-4-5	KCHYF3-4-10
Sample Date	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	5.00 - 5.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00
Volatile Organic Compounds (mg/kg)							
1,1,1,2-TETRACHLOROETHANE	0.0144 U	0.28 U	0.0142 U	0.0152 U	0.0168 U	0.0142 U	0.0148 U
1,1,1-TRICHLOROETHANE	0.0156 U	0.3 U	0.0152 U	0.0164 U	0.018 U	0.0154 U	0.016 U
1,1,2,2-TETRACHLOROETHANE	0.03 U	0.6 U	0.03 U	0.032 U	0.034 U	0.03 U	0.03 U
1,1,2-TRICHLOROETHANE	0.022 U	0.44 U	0.022 U	0.024 U	0.026 U	0.022 U	0.022 U
1,1-DICHLOROETHANE	0.022 U	0.42 U	0.02 U	0.022 U	0.024 U	0.02 U	0.022 U
1,1-DICHLOROETHENE	0.034 U	0.66 U	0.032 U	0.036 U	0.038 U	0.032 U	0.034 U
1,1-DICHLOROPROPENE	0.022 U	0.44 U	0.022 U	0.024 U	0.026 U	0.022 U	0.022 U
1,2,3-TRICHLOROBENZENE	0.032 U	0.64 U	0.032 U	0.034 U	0.038 U	0.032 U	0.032 U
1,2,3-TRICHLOROPROPANE	0.044 U	0.86 U	0.042 U	0.046 U	0.05 U	0.042 U	0.044 U
1,2,4-TRICHLOROBENZENE	0.024 U	0.46 U	0.022 U	0.024 U	0.028 U	0.022 U	0.024 U
1,2,4-TRIMETHYLBENZENE	0.022 U	0.42 U	0.02 U	0.022 U	0.024 U	0.02 U	0.022 U
1,2-DIBROMO-3-CHLOROPROPANE	0.084 U	1.66 U	0.082 U	0.09 U	0.098 U	0.084 U	0.086 U
1,2-DIBROMOETHANE	0.022 U	0.44 U	0.022 U	0.024 U	0.026 U	0.022 U	0.022 U
1,2-DICHLOROBENZENE	0.0188 U	0.38 U	0.0184 U	0.02 U	0.022 U	0.0186 U	0.0194 U
1,2-DICHLOROETHANE	0.0156 U	0.3 U	0.0152 U	0.0164 U	0.018 U	0.0154 U	0.016 U
1,2-DICHLOROPROPANE	0.0188 U	0.38 U	0.0184 U	0.02 U	0.022 U	0.0186 U	0.0194 U
1,3,5-TRIMETHYLBENZENE	0.0134 U	0.26 U	0.013 U	0.014 U	0.0154 U	0.0132 U	0.0136 U
1,3-DICHLOROBENZENE	0.0122 U	0.24 U	0.012 U	0.0128 U	0.0142 U	0.012 U	0.0126 U
1,3-DICHLOROPROPANE	0.0188 U	0.38 U	0.0184 U	0.02 U	0.022 U	0.0186 U	0.0194 U
1,4-DICHLOROBENZENE	0.022 U	0.42 U	0.02 U	0.022 U	0.024 U	0.02 U	0.022 U
2,2-DICHLOROPROPANE	0.024 U	0.48 U	0.024 U	0.026 U	0.028 U	0.024 U	0.026 U
2-BUTANONE	0.066 U	1.7 J	0.15 J	0.07 U	0.078 U	0.066 U	0.068 U
2-CHLOROTOLUENE	0.0156 U	0.3 U	0.0152 U	0.0164 U	0.018 U	0.0154 U	0.016 U
2-HEXANONE	0.102 U	2 U	0.1 U	0.108 U	0.118 U	0.1 U	0.104 U
4-CHLOROTOLUENE	0.0144 U	0.28 U	0.0142 U	0.0152 U	0.0168 U	0.0142 U	0.0148 U
4-METHYL-2-PENTANONE	0.22 U	4.2 U	0.2 U	0.22 U	0.24 U	0.2 U	0.22 U
ACETONE	0.32 U	6.2 U	0.26 J	0.32 U	0.18 J	0.24 J	0.32 U
BENZENE	0.0178 U	0.36 U	0.0174 U	0.0188 U	0.02 U	0.0174 U	0.0182 U
BROMOBENZENE	0.0178 U	0.36 U	0.0174 U	0.0188 U	0.02 U	0.0174 U	0.0182 U
BROMOCHLOROMETHANE	0.0166 U	0.32 U	0.0162 U	0.0176 U	0.0194 U	0.0164 U	0.017 U
BROMODICHLOROMETHANE	0.0156 U	0.3 U	0.0152 U	0.0164 U	0.018 U	0.0154 U	0.016 U
BROMOFORM	0.0156 U	0.3 U	0.0152 U	0.0164 U	0.018 U	0.0154 U	0.016 U
BROMOMETHANE	0.026 U	0.52 U	0.027 J	0.028 U	0.03 U	0.026 U	0.028 U
CARBON DISULFIDE	0.021 J	0.44 U	0.031 J	0.015 J	0.026 U	0.022 U	0.022 U
CARBON TETRACHLORIDE	0.0112 U	0.22 U	0.0108 U	0.0118 U	0.0128 U	0.011 U	0.0114 U

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-2	KCHYF3-3	KCHYF3-3	KCHYF3-3	KCHYF3-4	KCHYF3-4	KCHYF3-4
Sample ID	KCHYF3-2-5	KCHYF3-3-2	KCHYF3-3-5	KCHYF3-3-10	KCHYF3-4-2	KCHYF3-4-5	KCHYF3-4-10
Sample Date	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	5.00 - 5.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00
Volatile Organic Compounds (mg/kg)							
CHLOROBENZENE	0.024 U	0.46 U	0.022 U	0.024 U	0.028 U	0.022 U	0.024 U
CHLOROETHANE	0.024 U	0.46 U	0.022 U	0.024 U	0.028 U	0.022 U	0.024 U
CHLOROFORM	0.0178 U	0.36 U	0.0174 U	0.0188 U	0.02 U	0.0174 U	0.0182 U
CHLOROMETHANE	0.018 J	0.68 U	0.024 J	0.021 J	0.04 U	0.021 J	0.02 J
CIS-1,2-DICHLOROETHENE	0.0178 U	0.36 U	0.0174 U	0.0188 U	0.02 U	0.0174 U	0.0182 U
CIS-1,3-DICHLOROPROPENE	0.0166 U	0.32 U	0.0162 U	0.0176 U	0.0194 U	0.0164 U	0.017 U
DIBROMOCHLOROMETHANE	0.022 U	0.42 U	0.02 U	0.022 U	0.024 U	0.02 U	0.022 U
DIBROMOMETHANE	0.022 U	0.44 U	0.022 U	0.024 U	0.026 U	0.022 U	0.022 U
ETHYLBENZENE	0.026 U	0.5 U	0.024 U	0.026 U	0.03 U	0.026 U	0.026 U
FREON 11	0.026 U	0.52 U	0.026 U	0.028 U	0.03 U	0.026 U	0.028 U
FREON 12	0.022 U	0.42 U	0.02 U	0.022 U	0.024 U	0.02 U	0.022 U
HEXACHLOROBUTADIENE	0.022 U	0.42 U	0.02 U	0.022 U	0.024 U	0.02 U	0.022 U
ISOPROPYLBENZENE	0.0178 U	0.36 U	0.0174 U	0.016 J	0.02 U	0.0174 U	0.0182 U
M,P-XYLENES	0.044 U	0.88 U	0.044 U	0.046 U	0.052 U	0.044 U	0.046 U
METHYL-TERT-BUTYL ETHER	0.022 U	0.42 U	0.02 U	0.022 U	0.024 U	0.02 U	0.022 U
METHYLENE CHLORIDE	0.021 J	0.78 J	0.046 J	0.024 J	0.037 J	0.06 J	0.063 J
N-BUTYLBENZENE	0.0166 U	0.32 U	0.0162 U	0.0176 U	0.0194 U	0.0164 U	0.017 U
N-PROPYLBENZENE	0.024 U	0.46 U	0.022 U	0.021 J	0.028 U	0.022 U	0.024 U
NAPHTHALENE	0.04 U	1.6	0.04 U	0.042 U	0.046 U	0.04 U	0.04 U
O-XYLENE	0.022 U	0.42 U	0.02 U	0.022 U	0.024 U	0.02 U	0.022 U
PARA-ISOPROPYL TOLUENE	0.0134 U	0.26 U	0.013 U	0.014 U	0.0154 U	0.0132 U	0.0136 U
SEC-BUTYLBENZENE	0.0134 U	0.43 J	0.013 U	0.026 J	0.0154 U	0.0132 U	0.0136 U
STYRENE	0.028 U	0.54 U	0.028 U	0.03 U	0.032 U	0.028 U	0.028 U
TERT-BUTYLBENZENE	0.0144 U	0.28 U	0.0142 U	0.0152 U	0.0168 U	0.0142 U	0.0148 U
TETRACHLOROETHENE	0.0166 U	0.32 U	0.0162 U	0.0176 U	0.0194 U	0.0164 U	0.017 U
TOLUENE	0.0188 U	0.38 U	0.0184 U	0.02 U	0.022 U	0.0186 U	0.0194 U
TRANS-1,2-DICHLOROETHENE	0.022 U	0.42 U	0.02 U	0.022 U	0.024 U	0.02 U	0.022 U
TRANS-1,3-DICHLOROPROPENE	0.02 U	0.4 U	0.0196 U	0.022 U	0.024 U	0.0196 U	0.02 U
TRICHLOROETHENE	0.0178 U	0.36 U	0.0174 U	0.0188 U	0.02 U	0.0174 U	0.0182 U
VINYL CHLORIDE	0.026 U	0.5 U	0.024 U	0.026 U	0.03 U	0.026 U	0.026 U
Petroleum Hydrocarbons (mg/kg)							
Diesel/Motor Oil Range (extractables)							
DIESEL RANGE ORGANICS	950	990	6,500	120	1,900	990	7.4
MOTOR OIL RANGE ORGANICS	640	550	2,800	67	460 U	650	16 U

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-2	KCHYF3-3	KCHYF3-3	KCHYF3-3	KCHYF3-4	KCHYF3-4	KCHYF3-4
Sample ID	KCHYF3-2-5	KCHYF3-3-2	KCHYF3-3-5	KCHYF3-3-10	KCHYF3-4-2	KCHYF3-4-5	KCHYF3-4-10
Sample Date	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	5.00 - 5.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00
Petroleum Hydrocarbons (mg/kg)							
Gasoline Range (purgeables)							
GASOLINE RANGE ORGANICS	0.76 U	440 J	1.1	5.5	0.88 U	0.74 U	0.78 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4-TRICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	NA	NA	NA	NA	NA	NA	NA
2,4,5-TRICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4,6-TRICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DIMETHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DINITROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DINITROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2,6-DINITROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2-CHLORONAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
2-CHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	0.011	0.015	0.0098 U	0.0084	0.023	0.017	0.0055 J
2-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
2-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
2-NITROPHENOL	NA	NA	NA	NA	NA	NA	NA
3,3'-DICHLOROBENZIDINE	NA	NA	NA	NA	NA	NA	NA
3-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
4,6-DINITRO-2-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-BROMOPHENYL-PHENYLETHER	NA	NA	NA	NA	NA	NA	NA
4-CHLORO-3-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-CHLOROANILINE	NA	NA	NA	NA	NA	NA	NA
4-CHLOROPHENYL-PHENYLETHER	NA	NA	NA	NA	NA	NA	NA
4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
4-NITROPHENOL	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE	0.0022 U	0.0022 U	0.67	0.02	0.0026 U	0.0022 U	0.0017 J
ACENAPHTHYLENE	0.002 U	0.002 U	0.39	0.022	0.0024 U	0.002 U	0.0016 J
ANTHRACENE	0.0018 U	0.0018 U	0.76	0.083	0.002 U	0.0018 U	0.004 J
BENZO(A)ANTHRACENE	0.002 U	0.016	0.18	0.11	0.028	0.018	0.0044 J

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-2	KCHYF3-3	KCHYF3-3	KCHYF3-3	KCHYF3-4	KCHYF3-4	KCHYF3-4
Sample ID	KCHYF3-2-5	KCHYF3-3-2	KCHYF3-3-5	KCHYF3-3-10	KCHYF3-4-2	KCHYF3-4-5	KCHYF3-4-10
Sample Date	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	5.00 - 5.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00
Semivolatile Organic Compounds (mg/kg)							
BENZO(A)PYRENE	0.056	0.015	0.18	0.095	0.058	0.03	0.004 J
BENZO(B)FLUORANTHENE	0.073 J	0.024 J	0.22 J	0.11 J	0.076 J	0.051 J	0.005 J
BENZO(G,H,I)PERYLENE	0.04	0.012	0.12	0.054	0.068	0.026	0.0026 J
BENZO(K)FLUORANTHENE	0.088 J	0.029 J	0.26 J	0.13 J	0.091 J	0.062 J	0.0061 J
BIS(2-CHLOROETHOXY)METHANE	NA	NA	NA	NA	NA	NA	NA
BIS(2-CHLOROETHYL)ETHER	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA	NA
BUTYLBENZYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
CARBAZOLE	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	0.0018 U	0.026	0.32	0.094	0.077	0.062	0.004 J
DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DIBENZ(A,H)ANTHRACENE	0.015	0.0046 J	0.039	0.01	0.017	0.002 U	0.002 U
DIBENZOFURAN	NA	NA	NA	NA	NA	NA	NA
DIETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DIMETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
FLUORANTHENE	0.0026 U	0.034	0.51	0.19	0.08	0.044	0.0069
FLUORENE	0.0022 U	0.028	2.9	0.094	0.0026 U	0.0022 U	0.0034 J
HEXACHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROBUTADIENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROCYCLOPENTADIENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	0.037	0.01	0.11	0.057	0.055	0.021	0.0026 J
ISOPHORONE	NA	NA	NA	NA	NA	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	NA	NA	NA	NA	NA	NA	NA
N-NITROSODIPHENYLAMINE (1)	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	0.0055 J	0.017	0.076	0.015	0.021	0.013	0.0034 J
NITROBENZENE	NA	NA	NA	NA	NA	NA	NA
PENTACHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
PHENANTHRENE	0.0024 U	0.032	3.3	0.21	0.0028 U	0.0024 U	0.009
PHENOL	NA	NA	NA	NA	NA	NA	NA
PYRENE	0.19	0.095	0.73	0.25	0.23	0.17	0.011
Metals (mg/kg)							
ANTIMONY	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	**KCHYF3-2**	**KCHYF3-3**	**KCHYF3-3**	**KCHYF3-3**	**KCHYF3-4**	**KCHYF3-4**	**KCHYF3-4**
Sample ID	KCHYF3-2-5	KCHYF3-3-2	KCHYF3-3-5	KCHYF3-3-10	KCHYF3-4-2	KCHYF3-4-5	KCHYF3-4-10
Sample Date	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Sample Depth (bgs)	5.00 - 5.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00
Metals (mg/kg)							
ARSENIC	NA	NA	NA	NA	NA	NA	NA
BARIUM	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA	NA	NA	NA
CADMIUM	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA
COBALT	NA	NA	NA	NA	NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	NA
MOLYBDENUM	NA	NA	NA	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA	NA	NA	NA
SILVER	NA	NA	NA	NA	NA	NA	NA
THALLIUM	NA	NA	NA	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA	NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	NA
TRPH							
TRPH (mg/kg)	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-5	KCHYF3-5	KCHYF3-5	SCI-YB-07	YF3HP005	YF3HP006	YF3HP007
Sample ID	KCHYF3-5-2	KCHYF3-5-5	KCHYF3-5-10	SCI-YB-07	262YF3211	262YF3212	262YF3213
Sample Date	03/14/2012	03/14/2012	03/14/2012	11/11/1994	03/16/2000	03/16/2000	03/16/2000
Sample Depth (bgs)	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	3.50 - 4.00	0.50 - 0.50	0.50 - 0.50	0.50 - 0.50
Volatile Organic Compounds (mg/kg)							
1,1,1,2-TETRACHLOROETHANE	0.0144 U	0.0138 U	0.0158 U	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE	0.0156 U	0.0148 U	0.017 U	NA	NA	NA	NA
1,1,2,2-TETRACHLOROETHANE	0.03 U	0.028 U	0.032 U	NA	NA	NA	NA
1,1,2-TRICHLOROETHANE	0.022 U	0.022 U	0.024 U	NA	NA	NA	NA
1,1-DICHLOROETHANE	0.022 U	0.02 U	0.024 U	NA	NA	NA	NA
1,1-DICHLOROETHENE	0.034 U	0.032 U	0.036 U	NA	NA	NA	NA
1,1-DICHLOROPROPENE	0.022 U	0.022 U	0.024 U	NA	NA	NA	NA
1,2,3-TRICHLOROBENZENE	0.032 U	0.03 U	0.036 U	NA	NA	NA	NA
1,2,3-TRICHLOROPROPANE	0.044 U	0.042 U	0.048 U	NA	NA	NA	NA
1,2,4-TRICHLOROBENZENE	0.024 U	0.022 U	0.026 U	NA	NA	NA	NA
1,2,4-TRIMETHYLBENZENE	0.1	0.02 U	0.024 U	NA	NA	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	0.084 U	0.08 U	0.092 U	NA	NA	NA	NA
1,2-DIBROMOETHANE	0.022 U	0.022 U	0.024 U	NA	NA	NA	NA
1,2-DICHLOROBENZENE	0.0188 U	0.018 U	0.02 U	NA	NA	NA	NA
1,2-DICHLOROETHANE	0.0156 U	0.0148 U	0.017 U	NA	NA	NA	NA
1,2-DICHLOROPROPANE	0.0188 U	0.018 U	0.02 U	NA	NA	NA	NA
1,3,5-TRIMETHYLBENZENE	0.038 J	0.0126 U	0.0146 U	NA	NA	NA	NA
1,3-DICHLOROBENZENE	0.0122 U	0.0116 U	0.0134 U	NA	NA	NA	NA
1,3-DICHLOROPROPANE	0.0188 U	0.018 U	0.02 U	NA	NA	NA	NA
1,4-DICHLOROBENZENE	0.022 U	0.02 U	0.024 U	NA	NA	NA	NA
2,2-DICHLOROPROPANE	0.024 U	0.024 U	0.026 U	NA	NA	NA	NA
2-BUTANONE	0.066 U	0.064 U	0.072 U	NA	NA	NA	NA
2-CHLOROTOLUENE	0.0156 U	0.0148 U	0.017 U	NA	NA	NA	NA
2-HEXANONE	0.102 U	0.098 U	0.112 U	NA	NA	NA	NA
4-CHLOROTOLUENE	0.0144 U	0.0138 U	0.0158 U	NA	NA	NA	NA
4-METHYL-2-PENTANONE	0.22 U	0.2 U	0.24 U	NA	NA	NA	NA
ACETONE	0.32 U	0.3 U	0.25 J	NA	NA	NA	NA
BENZENE	0.0178 U	0.017 U	0.0194 U	NA	NA	NA	NA
BROMOBENZENE	0.0178 U	0.017 U	0.0194 U	NA	NA	NA	NA
BROMOCHLOROMETHANE	0.0166 U	0.0158 U	0.0182 U	NA	NA	NA	NA
BROMODICHLOROMETHANE	0.0156 U	0.0148 U	0.017 U	NA	NA	NA	NA
BROMOFORM	0.0156 U	0.0148 U	0.017 U	NA	NA	NA	NA
BROMOMETHANE	0.026 U	0.019 J	0.03 U	NA	NA	NA	NA
CARBON DISULFIDE	0.04 J	0.022 J	0.024 U	NA	NA	NA	NA
CARBON TETRACHLORIDE	0.0112 U	0.0106 U	0.0122 U	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-5	KCHYF3-5	KCHYF3-5	SCI-YB-07	YF3HP005	YF3HP006	YF3HP007
Sample ID	KCHYF3-5-2	KCHYF3-5-5	KCHYF3-5-10	SCI-YB-07	262YF3211	262YF3212	262YF3213
Sample Date	03/14/2012	03/14/2012	03/14/2012	11/11/1994	03/16/2000	03/16/2000	03/16/2000
Sample Depth (bgs)	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	3.50 - 4.00	0.50 - 0.50	0.50 - 0.50	0.50 - 0.50
Volatile Organic Compounds (mg/kg)							
CHLOROBENZENE	0.024 U	0.022 U	0.026 U	NA	NA	NA	NA
CHLOROETHANE	0.024 U	0.022 U	0.026 U	NA	NA	NA	NA
CHLOROFORM	0.0178 U	0.017 U	0.0194 U	NA	NA	NA	NA
CHLOROMETHANE	0.019 J	0.029 J	0.038 U	NA	NA	NA	NA
CIS-1,2-DICHLOROETHENE	0.0178 U	0.017 U	0.0194 U	NA	NA	NA	NA
CIS-1,3-DICHLOROPROPENE	0.0166 U	0.0158 U	0.0182 U	NA	NA	NA	NA
DIBROMOCHLOROMETHANE	0.022 U	0.02 U	0.024 U	NA	NA	NA	NA
DIBROMOMETHANE	0.022 U	0.022 U	0.024 U	NA	NA	NA	NA
ETHYLBENZENE	0.024 J	0.024 U	0.028 U	NA	NA	NA	NA
FREON 11	0.026 U	0.026 U	0.03 U	NA	NA	NA	NA
FREON 12	0.022 U	0.02 U	0.024 U	NA	NA	NA	NA
HEXACHLOROBUTADIENE	0.022 U	0.02 U	0.024 U	NA	NA	NA	NA
ISOPROPYLBENZENE	0.026 J	0.017 U	0.0194 U	NA	NA	NA	NA
M,P-XYLENES	0.045 J	0.042 U	0.048 U	NA	NA	NA	NA
METHYL-TERT-BUTYL ETHER	0.022 U	0.02 U	0.024 U	NA	NA	NA	NA
METHYLENE CHLORIDE	0.038 U	0.023 J	0.059 J	NA	NA	NA	NA
N-BUTYLBENZENE	0.1	0.0158 U	0.0182 U	NA	NA	NA	NA
N-PROPYLBENZENE	0.047 J	0.022 U	0.026 U	NA	NA	NA	NA
NAPHTHALENE	0.32	0.038 U	0.044 U	NA	NA	NA	NA
O-XYLENE	0.021 J	0.02 U	0.024 U	NA	NA	NA	NA
PARA-ISOPROPYL TOLUENE	0.044 J	0.0126 U	0.0146 U	NA	NA	NA	NA
SEC-BUTYLBENZENE	0.058	0.0126 U	0.0146 U	NA	NA	NA	NA
STYRENE	0.028 U	0.026 U	0.03 U	NA	NA	NA	NA
TERT-BUTYLBENZENE	0.0144 U	0.0138 U	0.0158 U	NA	NA	NA	NA
TETRACHLOROETHENE	0.0166 U	0.0158 U	0.0182 U	NA	NA	NA	NA
TOLUENE	0.012 J	0.018 U	0.02 U	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	0.022 U	0.02 U	0.024 U	NA	NA	NA	NA
TRANS-1,3-DICHLOROPROPENE	0.02 U	0.019 U	0.022 U	NA	NA	NA	NA
TRICHLOROETHENE	0.0178 U	0.017 U	0.0194 U	NA	NA	NA	NA
VINYL CHLORIDE	0.026 U	0.024 U	0.028 U	NA	NA	NA	NA
Petroleum Hydrocarbons (mg/kg)							
Diesel/Motor Oil Range (extractables)							
DIESEL RANGE ORGANICS	3,200	320	100 J	NA	11 U	120 H	360 H
MOTOR OIL RANGE ORGANICS	2,200	360 U	70 J	NA	57 U	520 LM	1,200 LM

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-5	KCHYF3-5	KCHYF3-5	SCI-YB-07	YF3HP005	YF3HP006	YF3HP007
Sample ID	KCHYF3-5-2	KCHYF3-5-5	KCHYF3-5-10	SCI-YB-07	262YF3211	262YF3212	262YF3213
Sample Date	03/14/2012	03/14/2012	03/14/2012	11/11/1994	03/16/2000	03/16/2000	03/16/2000
Sample Depth (bgs)	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	3.50 - 4.00	0.50 - 0.50	0.50 - 0.50	0.50 - 0.50
Petroleum Hydrocarbons (mg/kg)							
Gasoline Range (purgeables)							
GASOLINE RANGE ORGANICS	6.6	0.72 U	1.8	1 UJ	0.23 U	2.6 H	0.27 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4-TRICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	NA	NA	NA	NA	NA	NA	NA
2,4,5-TRICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4,6-TRICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DIMETHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DINITROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DINITROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2,6-DINITROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2-CHLORONAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
2-CHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	0.35	0.012	0.0063	NA	NA	NA	NA
2-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
2-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
2-NITROPHENOL	NA	NA	NA	NA	NA	NA	NA
3,3'-DICHLOROBENZIDINE	NA	NA	NA	NA	NA	NA	NA
3-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
4,6-DINITRO-2-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-BROMOPHENYL-PHENYLETHER	NA	NA	NA	NA	NA	NA	NA
4-CHLORO-3-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-CHLOROANILINE	NA	NA	NA	NA	NA	NA	NA
4-CHLOROPHENYL-PHENYLETHER	NA	NA	NA	NA	NA	NA	NA
4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
4-NITROPHENOL	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE	0.16	0.0022 U	0.0052 J	NA	NA	NA	NA
ACENAPHTHYLENE	0.11	0.03	0.039	NA	NA	NA	NA
ANTHRACENE	0.27	0.041	0.2	NA	NA	NA	NA
BENZO(A)ANTHRACENE	0.16	0.06	0.24	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-5	KCHYF3-5	KCHYF3-5	SCI-YB-07	YF3HP005	YF3HP006	YF3HP007
Sample ID	KCHYF3-5-2	KCHYF3-5-5	KCHYF3-5-10	SCI-YB-07	262YF3211	262YF3212	262YF3213
Sample Date	03/14/2012	03/14/2012	03/14/2012	11/11/1994	03/16/2000	03/16/2000	03/16/2000
Sample Depth (bgs)	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	3.50 - 4.00	0.50 - 0.50	0.50 - 0.50	0.50 - 0.50
Semivolatile Organic Compounds (mg/kg)							
BENZO(A)PYRENE	0.078	0.065	0.23	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	0.13 J	0.08 J	0.25 J	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	0.052	0.043	0.1	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	0.15 J	0.097 J	0.31 J	NA	NA	NA	NA
BIS(2-CHLOROETHOXY)METHANE	NA	NA	NA	NA	NA	NA	NA
BIS(2-CHLOROETHYL)ETHER	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA	NA
BUTYLBENZYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
CARBAZOLE	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	0.4	0.062	0.2	NA	NA	NA	NA
DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DIBENZ(A,H)ANTHRACENE	0.002 U	0.015	0.027	NA	NA	NA	NA
DIBENZOFURAN	NA	NA	NA	NA	NA	NA	NA
DIETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DIMETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
FLUORANTHENE	0.26	0.13	0.43	NA	NA	NA	NA
FLUORENE	0.45	0.014	0.039	NA	NA	NA	NA
HEXACHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROBUTADIENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROCYCLOPENTADIENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	0.051	0.039	0.12	NA	NA	NA	NA
ISOPHORONE	NA	NA	NA	NA	NA	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	NA	NA	NA	NA	NA	NA	NA
N-NITROSODIPHENYLAMINE (1)	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	0.1	0.014	0.012	NA	NA	NA	NA
NITROBENZENE	NA	NA	NA	NA	NA	NA	NA
PENTACHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
PHENANTHRENE	1.2	0.066	0.38	NA	NA	NA	NA
PHENOL	NA	NA	NA	NA	NA	NA	NA
PYRENE	0.4	0.23	0.62	NA	NA	NA	NA
Metals (mg/kg)							
ANTIMONY	NA	NA	NA	1 UJ	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-5	KCHYF3-5	KCHYF3-5	SCI-YB-07	YF3HP005	YF3HP006	YF3HP007
Sample ID	KCHYF3-5-2	KCHYF3-5-5	KCHYF3-5-10	SCI-YB-07	262YF3211	262YF3212	262YF3213
Sample Date	03/14/2012	03/14/2012	03/14/2012	11/11/1994	03/16/2000	03/16/2000	03/16/2000
Sample Depth (bgs)	2.00 - 2.00	5.00 - 5.00	10.00 - 10.00	3.50 - 4.00	0.50 - 0.50	0.50 - 0.50	0.50 - 0.50
Metals (mg/kg)							
ARSENIC	NA	NA	NA	0.25 UJ	NA	NA	NA
BARIUM	NA	NA	NA	33 J	NA	NA	NA
BERYLLIUM	NA	NA	NA	0.13 J	NA	NA	NA
CADMIUM	NA	NA	NA	0.13 J	NA	NA	NA
CHROMIUM	NA	NA	NA	7.4 J	NA	NA	NA
COBALT	NA	NA	NA	1.8 J	NA	NA	NA
COPPER	NA	NA	NA	2.6 J	NA	NA	NA
LEAD	NA	NA	NA	1.5 J	NA	NA	NA
MERCURY	NA	NA	NA	0.05 UJ	NA	NA	NA
MOLYBDENUM	NA	NA	NA	0.25 UJ	NA	NA	NA
NICKEL	NA	NA	NA	3.1 J	NA	NA	NA
SELENIUM	NA	NA	NA	0.5 UJ	NA	NA	NA
SILVER	NA	NA	NA	0.25 UJ	NA	NA	NA
THALLIUM	NA	NA	NA	2 UJ	NA	NA	NA
VANADIUM	NA	NA	NA	6 UJ	NA	NA	NA
ZINC	NA	NA	NA	5.6 J	NA	NA	NA
TRPH							
TRPH (mg/kg)	NA	NA	NA	10 UJ	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP008	YF3HP009	YF3HP018	YF3HP018	YF3HP018	YF3HP019	YF3HP019
Sample ID	262YF3214	262YF3215	262YF3413	262YF3414	262YF3415	262YF3418	262YF3419
Sample Date	03/16/2000	03/16/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000
Sample Depth (bgs)	0.70 - 0.70	0.50 - 0.50	1.00 - 1.50	6.50 - 7.00	7.00 - 7.50	1.00 - 1.50	6.00 - 6.50
Volatile Organic Compounds (mg/kg)							
1,1,1,2-TETRACHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-TETRACHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1,2-TRICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1-DICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
1,1-DICHLOROPROPENE	NA	NA	NA	NA	NA	NA	NA
1,2,3-TRICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2,3-TRICHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
1,2,4-TRICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2,4-TRIMETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
1,2-DIBROMOETHANE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
1,3,5-TRIMETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,3-DICHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
2,2-DICHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
2-BUTANONE	NA	NA	NA	NA	NA	NA	NA
2-CHLOROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2-HEXANONE	NA	NA	NA	NA	NA	NA	NA
4-CHLOROTOLUENE	NA	NA	NA	NA	NA	NA	NA
4-METHYL-2-PENTANONE	NA	NA	NA	NA	NA	NA	NA
ACETONE	NA	NA	NA	NA	NA	NA	NA
BENZENE	NA	NA	NA	NA	NA	NA	NA
BROMOBENZENE	NA	NA	NA	NA	NA	NA	NA
BROMOCHLOROMETHANE	NA	NA	NA	NA	NA	NA	NA
BROMODICHLOROMETHANE	NA	NA	NA	NA	NA	NA	NA
BROMOFORM	NA	NA	NA	NA	NA	NA	NA
BROMOMETHANE	NA	NA	NA	NA	NA	NA	NA
CARBON DISULFIDE	NA	NA	NA	NA	NA	NA	NA
CARBON TETRACHLORIDE	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP008	YF3HP009	YF3HP018	YF3HP018	YF3HP018	YF3HP019	YF3HP019
Sample ID	262YF3214	262YF3215	262YF3413	262YF3414	262YF3415	262YF3418	262YF3419
Sample Date	03/16/2000	03/16/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000
Sample Depth (bgs)	0.70 - 0.70	0.50 - 0.50	1.00 - 1.50	6.50 - 7.00	7.00 - 7.50	1.00 - 1.50	6.00 - 6.50
Volatile Organic Compounds (mg/kg)							
CHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
CHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
CHLOROFORM	NA	NA	NA	NA	NA	NA	NA
CHLOROMETHANE	NA	NA	NA	NA	NA	NA	NA
CIS-1,2-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
CIS-1,3-DICHLOROPROPENE	NA	NA	NA	NA	NA	NA	NA
DIBROMOCHLOROMETHANE	NA	NA	NA	NA	NA	NA	NA
DIBROMOMETHANE	NA	NA	NA	NA	NA	NA	NA
ETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA
FREON 11	NA	NA	NA	NA	NA	NA	NA
FREON 12	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROBUTADIENE	NA	NA	NA	NA	NA	NA	NA
ISOPROPYLBENZENE	NA	NA	NA	NA	NA	NA	NA
M,P-XYLENES	NA	NA	NA	NA	NA	NA	NA
METHYL-TERT-BUTYL ETHER	NA	NA	NA	NA	NA	NA	NA
METHYLENE CHLORIDE	NA	NA	NA	NA	NA	NA	NA
N-BUTYLBENZENE	NA	NA	NA	NA	NA	NA	NA
N-PROPYLBENZENE	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
O-XYLENE	NA	NA	NA	NA	NA	NA	NA
PARA-ISOPROPYL TOLUENE	NA	NA	NA	NA	NA	NA	NA
SEC-BUTYLBENZENE	NA	NA	NA	NA	NA	NA	NA
STYRENE	NA	NA	NA	NA	NA	NA	NA
TERT-BUTYLBENZENE	NA	NA	NA	NA	NA	NA	NA
TETRACHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
TOLUENE	NA	NA	NA	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
TRANS-1,3-DICHLOROPROPENE	NA	NA	NA	NA	NA	NA	NA
TRICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
VINYL CHLORIDE	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons (mg/kg)							
Diesel/Motor Oil Range (extractables)							
DIESEL RANGE ORGANICS	520 H	170 H	36 H	270 HD	370 D	170 H	510 H
MOTOR OIL RANGE ORGANICS	1,900 M	520 M	160 H	190 L	96 L	420 M	1,500 M

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP008	YF3HP009	YF3HP018	YF3HP018	YF3HP018	YF3HP019	YF3HP019
Sample ID	262YF3214	262YF3215	262YF3413	262YF3414	262YF3415	262YF3418	262YF3419
Sample Date	03/16/2000	03/16/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000
Sample Depth (bgs)	0.70 - 0.70	0.50 - 0.50	1.00 - 1.50	6.50 - 7.00	7.00 - 7.50	1.00 - 1.50	6.00 - 6.50
Petroleum Hydrocarbons (mg/kg)							
Gasoline Range (purgeables)							
GASOLINE RANGE ORGANICS	0.55 H	0.33 U	0.22 U	0.19 U	NA	0.21 U	0.25 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4-TRICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	NA	NA	NA	NA	NA	NA	NA
2,4,5-TRICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4,6-TRICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DIMETHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DINITROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DINITROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2,6-DINITROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2-CHLORONAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
2-CHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
2-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
2-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
2-NITROPHENOL	NA	NA	NA	NA	NA	NA	NA
3,3'-DICHLOROBENZIDINE	NA	NA	NA	NA	NA	NA	NA
3-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
4,6-DINITRO-2-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-BROMOPHENYL-PHENYLETHER	NA	NA	NA	NA	NA	NA	NA
4-CHLORO-3-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-CHLOROANILINE	NA	NA	NA	NA	NA	NA	NA
4-CHLOROPHENYL-PHENYLETHER	NA	NA	NA	NA	NA	NA	NA
4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
4-NITROPHENOL	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	NA
ANTHRACENE	NA	NA	NA	NA	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP008	YF3HP009	YF3HP018	YF3HP018	YF3HP018	YF3HP019	YF3HP019
Sample ID	262YF3214	262YF3215	262YF3413	262YF3414	262YF3415	262YF3418	262YF3419
Sample Date	03/16/2000	03/16/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000
Sample Depth (bgs)	0.70 - 0.70	0.50 - 0.50	1.00 - 1.50	6.50 - 7.00	7.00 - 7.50	1.00 - 1.50	6.00 - 6.50
Semivolatile Organic Compounds (mg/kg)							
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA
BIS(2-CHLOROETHOXY)METHANE	NA	NA	NA	NA	NA	NA	NA
BIS(2-CHLOROETHYL)ETHER	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA	NA
BUTYLBENZYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
CARBAZOLE	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	NA	NA	NA	NA	NA	NA	NA
DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DIBENZ(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA
DIBENZOFURAN	NA	NA	NA	NA	NA	NA	NA
DIETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DIMETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA
FLUORENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROBUTADIENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROCYCLOPENTADIENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA
ISOPHORONE	NA	NA	NA	NA	NA	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	NA	NA	NA	NA	NA	NA	NA
N-NITROSODIPHENYLAMINE (1)	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
NITROBENZENE	NA	NA	NA	NA	NA	NA	NA
PENTACHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
PHENANTHRENE	NA	NA	NA	NA	NA	NA	NA
PHENOL	NA	NA	NA	NA	NA	NA	NA
PYRENE	NA	NA	NA	NA	NA	NA	NA
Metals (mg/kg)							
ANTIMONY	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP008	YF3HP009	YF3HP018	YF3HP018	YF3HP018	YF3HP019	YF3HP019
Sample ID	262YF3214	262YF3215	262YF3413	262YF3414	262YF3415	262YF3418	262YF3419
Sample Date	03/16/2000	03/16/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000
Sample Depth (bgs)	0.70 - 0.70	0.50 - 0.50	1.00 - 1.50	6.50 - 7.00	7.00 - 7.50	1.00 - 1.50	6.00 - 6.50
Metals (mg/kg)							
ARSENIC	NA	NA	NA	NA	NA	NA	NA
BARIUM	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA	NA	NA	NA
CADMIUM	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA
COBALT	NA	NA	NA	NA	NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	NA
MOLYBDENUM	NA	NA	NA	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA	NA	NA	NA
SILVER	NA	NA	NA	NA	NA	NA	NA
THALLIUM	NA	NA	NA	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA	NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	NA
TRPH							
TRPH (mg/kg)	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP019	YF3HP020	YF3HP020	YF3HP021	YF3HP021	YF3HP021	YF3HP022
Sample ID	262YF3420	262YF3423	262YF3424	262YF3428	262YF3429	262YF3430	262YF3433
Sample Date	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/27/2000
Sample Depth (bgs)	6.50 - 7.00	1.00 - 1.50	5.50 - 6.00	1.00 - 1.50	7.00 - 7.50	9.50 - 10.00	1.00 - 1.50
Volatile Organic Compounds (mg/kg)							
1,1,1,2-TETRACHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-TETRACHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1,2-TRICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1-DICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,1-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
1,1-DICHLOROPROPENE	NA	NA	NA	NA	NA	NA	NA
1,2,3-TRICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2,3-TRICHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
1,2,4-TRICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2,4-TRIMETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
1,2-DIBROMOETHANE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
1,3,5-TRIMETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,3-DICHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
2,2-DICHLOROPROPANE	NA	NA	NA	NA	NA	NA	NA
2-BUTANONE	NA	NA	NA	NA	NA	NA	NA
2-CHLOROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2-HEXANONE	NA	NA	NA	NA	NA	NA	NA
4-CHLOROTOLUENE	NA	NA	NA	NA	NA	NA	NA
4-METHYL-2-PENTANONE	NA	NA	NA	NA	NA	NA	NA
ACETONE	NA	NA	NA	NA	NA	NA	NA
BENZENE	NA	NA	NA	NA	NA	NA	NA
BROMOBENZENE	NA	NA	NA	NA	NA	NA	NA
BROMOCHLOROMETHANE	NA	NA	NA	NA	NA	NA	NA
BROMODICHLOROMETHANE	NA	NA	NA	NA	NA	NA	NA
BROMOFORM	NA	NA	NA	NA	NA	NA	NA
BROMOMETHANE	NA	NA	NA	NA	NA	NA	NA
CARBON DISULFIDE	NA	NA	NA	NA	NA	NA	NA
CARBON TETRACHLORIDE	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP019	YF3HP020	YF3HP020	YF3HP021	YF3HP021	YF3HP021	YF3HP022
Sample ID	262YF3420	262YF3423	262YF3424	262YF3428	262YF3429	262YF3430	262YF3433
Sample Date	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/27/2000
Sample Depth (bgs)	6.50 - 7.00	1.00 - 1.50	5.50 - 6.00	1.00 - 1.50	7.00 - 7.50	9.50 - 10.00	1.00 - 1.50
Volatile Organic Compounds (mg/kg)							
CHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
CHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
CHLOROFORM	NA	NA	NA	NA	NA	NA	NA
CHLOROMETHANE	NA	NA	NA	NA	NA	NA	NA
CIS-1,2-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
CIS-1,3-DICHLOROPROPENE	NA	NA	NA	NA	NA	NA	NA
DIBROMOCHLOROMETHANE	NA	NA	NA	NA	NA	NA	NA
DIBROMOMETHANE	NA	NA	NA	NA	NA	NA	NA
ETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA
FREON 11	NA	NA	NA	NA	NA	NA	NA
FREON 12	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROBUTADIENE	NA	NA	NA	NA	NA	NA	NA
ISOPROPYLBENZENE	NA	NA	NA	NA	NA	NA	NA
M,P-XYLENES	NA	NA	NA	NA	NA	NA	NA
METHYL-TERT-BUTYL ETHER	NA	NA	NA	NA	NA	NA	NA
METHYLENE CHLORIDE	NA	NA	NA	NA	NA	NA	NA
N-BUTYLBENZENE	NA	NA	NA	NA	NA	NA	NA
N-PROPYLBENZENE	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
O-XYLENE	NA	NA	NA	NA	NA	NA	NA
PARA-ISOPROPYL TOLUENE	NA	NA	NA	NA	NA	NA	NA
SEC-BUTYLBENZENE	NA	NA	NA	NA	NA	NA	NA
STYRENE	NA	NA	NA	NA	NA	NA	NA
TERT-BUTYLBENZENE	NA	NA	NA	NA	NA	NA	NA
TETRACHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
TOLUENE	NA	NA	NA	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
TRANS-1,3-DICHLOROPROPENE	NA	NA	NA	NA	NA	NA	NA
TRICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA
VINYL CHLORIDE	NA	NA	NA	NA	NA	NA	NA
Petroleum Hydrocarbons (mg/kg)							
Diesel/Motor Oil Range (extractables)							
DIESEL RANGE ORGANICS	10,000 H	670 H	1,200 D	600 H	7,500 HD	10,000 D	210 H
MOTOR OIL RANGE ORGANICS	10,000 LM	1,000 LM	470 L	2,000 M	5,800 LM	890 L	730 HM

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP019	YF3HP020	YF3HP020	YF3HP021	YF3HP021	YF3HP021	YF3HP022
Sample ID	262YF3420	262YF3423	262YF3424	262YF3428	262YF3429	262YF3430	262YF3433
Sample Date	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/27/2000
Sample Depth (bgs)	6.50 - 7.00	1.00 - 1.50	5.50 - 6.00	1.00 - 1.50	7.00 - 7.50	9.50 - 10.00	1.00 - 1.50
Petroleum Hydrocarbons (mg/kg)							
Gasoline Range (purgeables)							
GASOLINE RANGE ORGANICS	1.3 H	0.21 U	2.7 H	0.22 U	220 H	450 H	0.24 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4-TRICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	NA	NA	NA	NA	NA	NA	NA
2,4,5-TRICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4,6-TRICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DICHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DIMETHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DINITROPHENOL	NA	NA	NA	NA	NA	NA	NA
2,4-DINITROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2,6-DINITROTOLUENE	NA	NA	NA	NA	NA	NA	NA
2-CHLORONAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
2-CHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
2-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
2-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
2-NITROPHENOL	NA	NA	NA	NA	NA	NA	NA
3,3'-DICHLOROBENZIDINE	NA	NA	NA	NA	NA	NA	NA
3-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
4,6-DINITRO-2-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-BROMOPHENYL-PHENYLETHER	NA	NA	NA	NA	NA	NA	NA
4-CHLORO-3-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-CHLOROANILINE	NA	NA	NA	NA	NA	NA	NA
4-CHLOROPHENYL-PHENYLETHER	NA	NA	NA	NA	NA	NA	NA
4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA
4-NITROANILINE	NA	NA	NA	NA	NA	NA	NA
4-NITROPHENOL	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	NA
ANTHRACENE	NA	NA	NA	NA	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP019	YF3HP020	YF3HP020	YF3HP021	YF3HP021	YF3HP021	YF3HP022
Sample ID	262YF3420	262YF3423	262YF3424	262YF3428	262YF3429	262YF3430	262YF3433
Sample Date	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/27/2000
Sample Depth (bgs)	6.50 - 7.00	1.00 - 1.50	5.50 - 6.00	1.00 - 1.50	7.00 - 7.50	9.50 - 10.00	1.00 - 1.50
Semivolatile Organic Compounds (mg/kg)							
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA
BIS(2-CHLOROETHOXY)METHANE	NA	NA	NA	NA	NA	NA	NA
BIS(2-CHLOROETHYL)ETHER	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA	NA
BUTYLBENZYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
CARBAZOLE	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	NA	NA	NA	NA	NA	NA	NA
DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DIBENZ(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA
DIBENZOFURAN	NA	NA	NA	NA	NA	NA	NA
DIETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
DIMETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA
FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA
FLUORENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROBUTADIENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROCYCLOPENTADIENE	NA	NA	NA	NA	NA	NA	NA
HEXACHLOROETHANE	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA
ISOPHORONE	NA	NA	NA	NA	NA	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	NA	NA	NA	NA	NA	NA	NA
N-NITROSODIPHENYLAMINE (1)	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA
NITROBENZENE	NA	NA	NA	NA	NA	NA	NA
PENTACHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA
PHENANTHRENE	NA	NA	NA	NA	NA	NA	NA
PHENOL	NA	NA	NA	NA	NA	NA	NA
PYRENE	NA	NA	NA	NA	NA	NA	NA
Metals (mg/kg)							
ANTIMONY	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP019	YF3HP020	YF3HP020	YF3HP021	YF3HP021	YF3HP021	YF3HP022
Sample ID	262YF3420	262YF3423	262YF3424	262YF3428	262YF3429	262YF3430	262YF3433
Sample Date	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/26/2000	06/27/2000
Sample Depth (bgs)	6.50 - 7.00	1.00 - 1.50	5.50 - 6.00	1.00 - 1.50	7.00 - 7.50	9.50 - 10.00	1.00 - 1.50
Metals (mg/kg)							
ARSENIC	NA	NA	NA	NA	NA	NA	NA
BARIUM	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA	NA	NA	NA
CADMIUM	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA	NA	NA	NA
COBALT	NA	NA	NA	NA	NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	NA
LEAD	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	NA
MOLYBDENUM	NA	NA	NA	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA	NA	NA	NA
SILVER	NA	NA	NA	NA	NA	NA	NA
THALLIUM	NA	NA	NA	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA	NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	NA
TRPH							
TRPH (mg/kg)	NA	NA	NA	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP023	YF3HP023	YF3HP024	YF3HP024
Sample ID	262YF3438	262YF3439	262YF3443	262YF3444
Sample Date	06/27/2000	06/27/2000	06/27/2000	06/27/2000
Sample Depth (bgs)	1.00 - 1.50	9.50 - 10.00	1.00 - 1.50	2.50 - 3.00
Volatile Organic Compounds (mg/kg)				
1,1,1,2-TETRACHLOROETHANE	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE	NA	NA	NA	NA
1,1,2,2-TETRACHLOROETHANE	NA	NA	NA	NA
1,1,2-TRICHLOROETHANE	NA	NA	NA	NA
1,1-DICHLOROETHANE	NA	NA	NA	NA
1,1-DICHLOROETHENE	NA	NA	NA	NA
1,1-DICHLOROPROPENE	NA	NA	NA	NA
1,2,3-TRICHLOROBENZENE	NA	NA	NA	NA
1,2,3-TRICHLOROPROPANE	NA	NA	NA	NA
1,2,4-TRICHLOROBENZENE	NA	NA	NA	NA
1,2,4-TRIMETHYLBENZENE	NA	NA	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	NA	NA	NA	NA
1,2-DIBROMOETHANE	NA	NA	NA	NA
1,2-DICHLOROBENZENE	NA	NA	NA	NA
1,2-DICHLOROETHANE	NA	NA	NA	NA
1,2-DICHLOROPROPANE	NA	NA	NA	NA
1,3,5-TRIMETHYLBENZENE	NA	NA	NA	NA
1,3-DICHLOROBENZENE	NA	NA	NA	NA
1,3-DICHLOROPROPANE	NA	NA	NA	NA
1,4-DICHLOROBENZENE	NA	NA	NA	NA
2,2-DICHLOROPROPANE	NA	NA	NA	NA
2-BUTANONE	NA	NA	NA	NA
2-CHLOROTOLUENE	NA	NA	NA	NA
2-HEXANONE	NA	NA	NA	NA
4-CHLOROTOLUENE	NA	NA	NA	NA
4-METHYL-2-PENTANONE	NA	NA	NA	NA
ACETONE	NA	NA	NA	NA
BENZENE	NA	NA	NA	NA
BROMOBENZENE	NA	NA	NA	NA
BROMOCHLOROMETHANE	NA	NA	NA	NA
BROMODICHLOROMETHANE	NA	NA	NA	NA
BROMOFORM	NA	NA	NA	NA
BROMOMETHANE	NA	NA	NA	NA
CARBON DISULFIDE	NA	NA	NA	NA
CARBON TETRACHLORIDE	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP023	YF3HP023	YF3HP024	YF3HP024
Sample ID	262YF3438	262YF3439	262YF3443	262YF3444
Sample Date	06/27/2000	06/27/2000	06/27/2000	06/27/2000
Sample Depth (bgs)	1.00 - 1.50	9.50 - 10.00	1.00 - 1.50	2.50 - 3.00
Volatile Organic Compounds (mg/kg)				
CHLOROBENZENE	NA	NA	NA	NA
CHLOROETHANE	NA	NA	NA	NA
CHLOROFORM	NA	NA	NA	NA
CHLOROMETHANE	NA	NA	NA	NA
CIS-1,2-DICHLOROETHENE	NA	NA	NA	NA
CIS-1,3-DICHLOROPROPENE	NA	NA	NA	NA
DIBROMOCHLOROMETHANE	NA	NA	NA	NA
DIBROMOMETHANE	NA	NA	NA	NA
ETHYLBENZENE	NA	NA	NA	NA
FREON 11	NA	NA	NA	NA
FREON 12	NA	NA	NA	NA
HEXACHLOROBUTADIENE	NA	NA	NA	NA
ISOPROPYLBENZENE	NA	NA	NA	NA
M,P-XYLENES	NA	NA	NA	NA
METHYL-TERT-BUTYL ETHER	NA	NA	NA	NA
METHYLENE CHLORIDE	NA	NA	NA	NA
N-BUTYLBENZENE	NA	NA	NA	NA
N-PROPYLBENZENE	NA	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA
O-XYLENE	NA	NA	NA	NA
PARA-ISOPROPYL TOLUENE	NA	NA	NA	NA
SEC-BUTYLBENZENE	NA	NA	NA	NA
STYRENE	NA	NA	NA	NA
TERT-BUTYLBENZENE	NA	NA	NA	NA
TETRACHLOROETHENE	NA	NA	NA	NA
TOLUENE	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	NA	NA	NA	NA
TRANS-1,3-DICHLOROPROPENE	NA	NA	NA	NA
TRICHLOROETHENE	NA	NA	NA	NA
VINYL CHLORIDE	NA	NA	NA	NA
Petroleum Hydrocarbons (mg/kg)				
Diesel/Motor Oil Range (extractables)				
DIESEL RANGE ORGANICS	480 H	810 H	27 H	6,800 DH
MOTOR OIL RANGE ORGANICS	1,800 M	3,100 M	100 M	3,100 LM

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP023	YF3HP023	YF3HP024	YF3HP024
Sample ID	262YF3438	262YF3439	262YF3443	262YF3444
Sample Date	06/27/2000	06/27/2000	06/27/2000	06/27/2000
Sample Depth (bgs)	1.00 - 1.50	9.50 - 10.00	1.00 - 1.50	2.50 - 3.00
Petroleum Hydrocarbons (mg/kg)				
Gasoline Range (purgeables)				
GASOLINE RANGE ORGANICS	0.23 U	0.25 U	0.26 U	77 H
Semivolatile Organic Compounds (mg/kg)				
1,2,4-TRICHLOROBENZENE	NA	NA	NA	NA
1,2-DICHLOROBENZENE	NA	NA	NA	NA
1,3-DICHLOROBENZENE	NA	NA	NA	NA
1,4-DICHLOROBENZENE	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)	NA	NA	NA	NA
2,4,5-TRICHLOROPHENOL	NA	NA	NA	NA
2,4,6-TRICHLOROPHENOL	NA	NA	NA	NA
2,4-DICHLOROPHENOL	NA	NA	NA	NA
2,4-DIMETHYLPHENOL	NA	NA	NA	NA
2,4-DINITROPHENOL	NA	NA	NA	NA
2,4-DINITROTOLUENE	NA	NA	NA	NA
2,6-DINITROTOLUENE	NA	NA	NA	NA
2-CHLORONAPHTHALENE	NA	NA	NA	NA
2-CHLOROPHENOL	NA	NA	NA	NA
2-METHYLNAPHTHALENE	NA	NA	NA	NA
2-METHYLPHENOL	NA	NA	NA	NA
2-NITROANILINE	NA	NA	NA	NA
2-NITROPHENOL	NA	NA	NA	NA
3,3'-DICHLOROBENZIDINE	NA	NA	NA	NA
3-NITROANILINE	NA	NA	NA	NA
4,6-DINITRO-2-METHYLPHENOL	NA	NA	NA	NA
4-BROMOPHENYL-PHENYLETHER	NA	NA	NA	NA
4-CHLORO-3-METHYLPHENOL	NA	NA	NA	NA
4-CHLOROANILINE	NA	NA	NA	NA
4-CHLOROPHENYL-PHENYLETHER	NA	NA	NA	NA
4-METHYLPHENOL	NA	NA	NA	NA
4-NITROANILINE	NA	NA	NA	NA
4-NITROPHENOL	NA	NA	NA	NA
ACENAPHTHENE	NA	NA	NA	NA
ACENAPHTHYLENE	NA	NA	NA	NA
ANTHRACENE	NA	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP023	YF3HP023	YF3HP024	YF3HP024
Sample ID	262YF3438	262YF3439	262YF3443	262YF3444
Sample Date	06/27/2000	06/27/2000	06/27/2000	06/27/2000
Sample Depth (bgs)	1.00 - 1.50	9.50 - 10.00	1.00 - 1.50	2.50 - 3.00
Semivolatile Organic Compounds (mg/kg)				
BENZO(A)PYRENE	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA
BIS(2-CHLOROETHOXY)METHANE	NA	NA	NA	NA
BIS(2-CHLOROETHYL)ETHER	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA
BUTYLBENZYLPHTHALATE	NA	NA	NA	NA
CARBAZOLE	NA	NA	NA	NA
CHRYSENE	NA	NA	NA	NA
DI-N-BUTYLPHTHALATE	NA	NA	NA	NA
DI-N-OCTYLPHTHALATE	NA	NA	NA	NA
DIBENZ(A,H)ANTHRACENE	NA	NA	NA	NA
DIBENZOFURAN	NA	NA	NA	NA
DIETHYLPHTHALATE	NA	NA	NA	NA
DIMETHYLPHTHALATE	NA	NA	NA	NA
FLUORANTHENE	NA	NA	NA	NA
FLUORENE	NA	NA	NA	NA
HEXACHLOROBENZENE	NA	NA	NA	NA
HEXACHLOROBUTADIENE	NA	NA	NA	NA
HEXACHLOROCYCLOPENTADIENE	NA	NA	NA	NA
HEXACHLOROETHANE	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA
ISOPHORONE	NA	NA	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	NA	NA	NA	NA
N-NITROSODIPHENYLAMINE (1)	NA	NA	NA	NA
NAPHTHALENE	NA	NA	NA	NA
NITROBENZENE	NA	NA	NA	NA
PENTACHLOROPHENOL	NA	NA	NA	NA
PHENANTHRENE	NA	NA	NA	NA
PHENOL	NA	NA	NA	NA
PYRENE	NA	NA	NA	NA
Metals (mg/kg)				
ANTIMONY	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP023	YF3HP023	YF3HP024	YF3HP024
Sample ID	262YF3438	262YF3439	262YF3443	262YF3444
Sample Date	06/27/2000	06/27/2000	06/27/2000	06/27/2000
Sample Depth (bgs)	1.00 - 1.50	9.50 - 10.00	1.00 - 1.50	2.50 - 3.00
Metals (mg/kg)				
ARSENIC	NA	NA	NA	NA
BARIUM	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA
CADMIUM	NA	NA	NA	NA
CHROMIUM	NA	NA	NA	NA
COBALT	NA	NA	NA	NA
COPPER	NA	NA	NA	NA
LEAD	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA
MOLYBDENUM	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA
SILVER	NA	NA	NA	NA
THALLIUM	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA
ZINC	NA	NA	NA	NA
TRPH				
TRPH (mg/kg)	NA	NA	NA	NA

TABLE E-1: SOIL/SEDIMENT ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Notes:

a	Surrogate recovery problem
bgs	Below ground surface
c	Calibration criteria exceedance
D	Chromatographic pattern resembles diesel
H	Chromatographic pattern is in the heavier hydrocarbon end of the analyte's range in the standard
ID	Identification
J	Estimated value
L	Chromatographic pattern is in the lighter hydrocarbon end of the analyte's range in the standard
M	Chromatographic pattern resembles motor oil
mg/kg	Milligram per kilogram
NA	Not analyzed
NAVSTA	Naval Station
TRPH	Total recoverable petroleum hydrocarbons
U	Nondetected

TABLE E-2: GROUNDWATER ANALYTICAL RESULTS FOR SITE YF3

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-1	KCHYF3-2	KCHYF3-2 (dup)	KCHYF3-3	KCHYF3-4	KCHYF3-5 (dup)	KCHYF3-5
Sample ID	KCHYF3-1	KCHYF3-2	KCHYF3-6	KCHYF3-3	KCHYF3-4	KCHYF3-0	KCHYF3-5
Sample Date	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Volatile Organic Compounds (µg/L)							
1,1,1,2-TETRACHLOROETHANE	0.26 UJ	0.26 U	0.26 U	0.26 U	0.26 UJ	NA	0.26 UJ
1,1,1-TRICHLOROETHANE	0.28 U	0.28 U	0.28 U	0.28 U	0.28 UJ	NA	0.28 UJ
1,1,2,2-TETRACHLOROETHANE	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	NA	0.2 UJ
1,1,2-TRICHLOROETHANE	0.4 U	0.4 U	0.4 U	0.4 U	0.4 UJ	NA	0.4 UJ
1,1-DICHLOROETHANE	0.38 U	0.38 U	0.38 U	0.38 U	0.38 UJ	NA	0.38 UJ
1,1-DICHLOROETHENE	0.6 UJ	0.6 U	0.6 U	0.6 U	0.6 UJ	NA	0.6 UJ
1,1-DICHLOROPROPENE	0.4 UJ	0.4 U	0.4 U	0.4 U	0.4 UJ	NA	0.4 UJ
1,2,3-TRICHLOROBENZENE	0.58 UJ	0.58 U	0.58 U	0.58 U	0.58 UJ	NA	0.58 UJ
1,2,3-TRICHLOROPROPANE	0.78 U	0.78 U	0.78 U	0.78 U	0.78 UJ	NA	0.78 UJ
1,2,4-TRICHLOROBENZENE	0.42 UJ	0.42 U	0.42 U	0.42 U	0.42 UJ	NA	0.42 UJ
1,2,4-TRIMETHYLBENZENE	0.38 UJ	0.38 U	0.38 U	0.38 U	0.38 UJ	NA	0.38 UJ
1,2-DIBROMO-3-CHLOROPROPANE	1.52 U	1.52 U	1.52 U	1.52 U	1.52 UJ	NA	1.52 UJ
1,2-DIBROMOETHANE	0.4 U	0.4 U	0.4 U	0.4 U	0.4 UJ	NA	0.4 UJ
1,2-DICHLOROBENZENE	0.34 UJ	0.34 U	0.34 U	0.34 U	0.34 UJ	NA	0.34 UJ
1,2-DICHLOROETHANE	0.28 U	0.28 U	0.28 U	0.28 U	0.28 UJ	NA	0.28 UJ
1,2-DICHLOROPROPANE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 UJ	NA	0.34 UJ
1,3,5-TRIMETHYLBENZENE	0.24 UJ	0.24 U	0.24 U	0.24 U	0.24 UJ	NA	0.24 UJ
1,3-DICHLOROBENZENE	0.22 UJ	0.22 U	0.22 U	0.22 U	0.22 UJ	NA	0.22 UJ
1,3-DICHLOROPROPANE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 UJ	NA	0.34 UJ
1,4-DICHLOROBENZENE	0.38 UJ	0.38 U	0.38 U	0.38 U	0.38 UJ	NA	0.38 UJ
2,2-DICHLOROPROPANE	0.44 U	0.44 U	0.44 U	0.44 U	0.44 UJ	NA	0.44 UJ
2-BUTANONE	2.9 J	3.2 J	3.4 J	2.7 J	0.86 J	NA	1.2 UJ
2-CHLOROTOLUENE	0.28 UJ	0.28 U	0.28 U	0.28 U	0.28 UJ	NA	0.28 UJ
2-HEXANONE	1.84 U	1.84 U	1.84 U	1.84 U	1.84 UJ	NA	1.84 UJ
4-CHLOROTOLUENE	0.26 UJ	0.26 U	0.26 U	0.26 U	0.26 UJ	NA	0.26 UJ
4-METHYL-2-PENTANONE	3.8 U	3.8 U	3.8 U	3.8 U	3.8 UJ	NA	2 J
ACETONE	20 J	24	27	21	17 J	NA	53 J
BENZENE	0.2 J	0.21 J	0.2 J	0.24 J	0.2 J	NA	0.16 J
BROMOBENZENE	0.32 UJ	0.32 U	0.32 U	0.32 U	0.32 UJ	NA	0.32 UJ
BROMOCHLOROMETHANE	0.3 U	0.3 U	0.3 U	0.3 U	0.3 UJ	NA	0.3 UJ
BROMODICHLOROMETHANE	0.28 U	0.28 U	0.28 U	0.28 U	0.28 UJ	NA	0.28 UJ
BROMOFORM	0.28 U	0.28 U	0.28 U	0.28 U	0.28 UJ	NA	0.28 UJ
BROMOMETHANE	0.48 U	0.48 U	0.48 U	0.48 U	0.48 UJ	NA	0.48 UJ
CARBON DISULFIDE	5 J	5.9	5.7	1.8	1.4 J	NA	0.68 J
CARBON TETRACHLORIDE	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 UJ	NA	0.2 UJ

TABLE E-2: GROUNDWATER ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-1	KCHYF3-2	KCHYF3-2 (dup)	KCHYF3-3	KCHYF3-4	KCHYF3-5 (dup)	KCHYF3-5
Sample ID	KCHYF3-1	KCHYF3-2	KCHYF3-6	KCHYF3-3	KCHYF3-4	KCHYF3-0	KCHYF3-5
Sample Date	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Volatile Organic Compounds (µg/L)							
CHLOROBENZENE	0.42 UJ	0.42 U	0.42 U	0.42 U	0.42 UJ	NA	0.42 UJ
CHLOROETHANE	0.42 U	0.42 U	0.42 U	0.42 U	0.42 UJ	NA	0.42 UJ
CHLOROFORM	0.14 U	0.14 U	0.14 U	0.14 U	0.14 UJ	NA	0.14 UJ
CHLOROMETHANE	0.84 U	0.84 U	0.84 U	0.84 U	0.84 UJ	NA	0.84 UJ
CIS-1,2-DICHLOROETHENE	0.32 U	0.32 U	0.32 U	0.32 U	0.32 UJ	NA	0.32 UJ
CIS-1,3-DICHLOROPROPENE	0.3 U	0.3 U	0.3 U	0.3 U	0.3 UJ	NA	0.3 UJ
DIBROMOCHLOROMETHANE	0.38 U	0.38 U	0.38 U	0.38 U	0.38 UJ	NA	0.38 UJ
DIBROMOMETHANE	0.4 U	0.4 U	0.4 U	0.4 U	0.4 UJ	NA	0.4 UJ
ETHYLBENZENE	0.46 UJ	0.46 U	0.46 U	0.29 J	0.46 UJ	NA	0.46 UJ
FREON 11	0.48 UJ	0.48 U	0.48 U	0.48 U	0.48 UJ	NA	0.48 UJ
FREON 12	0.38 U	0.38 U	0.38 U	0.38 U	0.38 UJ	NA	0.38 UJ
HEXACHLOROBUTADIENE	0.38 UJ	0.38 U	0.38 U	0.38 U	0.38 UJ	NA	0.38 UJ
ISOPROPYLBENZENE	1.8 J	1	0.99 J	1.2	0.22 J	NA	0.32 UJ
M,P-XYLENES	0.38 UJ	0.38 U	0.38 U	0.38 U	0.38 UJ	NA	0.38 UJ
METHYL-TERT-BUTYL ETHER	0.52 U	0.52 U	0.52 U	0.52 U	0.52 UJ	NA	0.52 UJ
METHYLENE CHLORIDE	0.7 U	0.7 U	0.7 U	0.7 U	0.7 UJ	NA	0.7 UJ
N-BUTYLBENZENE	0.78 J	0.43 J	0.36 J	0.3 J	0.3 UJ	NA	0.3 UJ
N-PROPYLBENZENE	1.6 J	0.83 J	0.77 J	1	0.42 UJ	NA	0.42 UJ
NAPHTHALENE	0.72 UJ	4.2	3.6	0.72 U	0.72 UJ	NA	0.72 UJ
O-XYLENE	0.2 J	0.38 U	0.38 U	0.38 U	0.38 UJ	NA	0.38 UJ
PARA-ISOPROPYL TOLUENE	0.24 UJ	0.24 U	0.24 U	0.24 U	0.24 UJ	NA	0.24 UJ
SEC-BUTYLBENZENE	1.2 J	0.67 J	0.6 J	0.52 J	0.24 UJ	NA	0.24 UJ
STYRENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 UJ
TERT-BUTYLBENZENE	0.17 J	0.26 UJ	0.14 J	0.26 U	0.26 UJ	NA	0.26 UJ
TETRACHLOROETHENE	0.48 UJ	0.48 U	0.48 U	0.48 U	0.48 UJ	NA	0.48 UJ
TOLUENE	0.34 UJ	0.34 U	0.34 U	0.34 U	0.34 UJ	NA	0.34 UJ
TRANS-1,2-DICHLOROETHENE	0.38 UJ	0.38 U	0.38 U	0.38 U	0.38 UJ	NA	0.38 UJ
TRANS-1,3-DICHLOROPROPENE	0.36 U	0.36 U	0.36 U	0.36 U	0.36 UJ	NA	0.36 UJ
TRICHLOROETHENE	0.32 UJ	0.32 U	0.32 U	0.32 U	0.32 UJ	NA	0.32 UJ
VINYL CHLORIDE	0.46 U	0.46 U	0.46 U	0.46 U	0.46 UJ	NA	0.46 UJ
Petroleum Hydrocarbons (mg/L)							
Diesel/Motor Oil Range (extractables) - SG							
DIESEL RANGE ORGANICS	NA	NA	NA	NA	NA	NA	NA
MOTOR OIL RANGE ORGANICS	NA	NA	NA	NA	NA	NA	NA

TABLE E-2: GROUNDWATER ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	KCHYF3-1	KCHYF3-2	KCHYF3-2 (dup)	KCHYF3-3	KCHYF3-4	KCHYF3-5 (dup)	KCHYF3-5
Sample ID	KCHYF3-1	KCHYF3-2	KCHYF3-6	KCHYF3-3	KCHYF3-4	KCHYF3-0	KCHYF3-5
Sample Date	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012	03/14/2012
Petroleum Hydrocarbons (mg/L)							
Diesel/Motor Oil Range (extractables)							
DIESEL RANGE ORGANICS	26	38	NA	0.3	11	0.0808 U	0.0808 U
MOTOR OIL RANGE ORGANICS	10.6 U	10.6 U	NA	0.13 J	5.5	0.212 U	0.212 U
Gasoline Range (purgeables)							
GASOLINE RANGE ORGANICS	0.15 J	0.0172 U	0.022 J	0.0092 J	0.0172 U	NA	0.0172 U
Semivolatile Organic Compounds (µg/L)							
2-METHYLNAPHTHALENE	2.2 J	0.12 U	NA	0.12 U	0.12 U	0.12 U	0.12 U
ACENAPHTHENE	1.2	3.8	NA	0.85	2	0.12 U	0.11 J
ACENAPHTHYLENE	0.58 J	2.7	NA	0.24	1	0.12 U	0.12 U
ANTHRACENE	0.37	1.8	NA	0.13 J	0.69	0.1 U	0.1 U
BENZO(A)ANTHRACENE	0.19 J	0.58	NA	0.14 U	0.57	0.14 U	0.14 U
BENZO(A)PYRENE	0.12 U	0.26	NA	0.12 U	0.12 U	0.12 U	0.12 U
BENZO(B)FLUORANTHENE	0.1 J	0.41 J	NA	0.12 U	0.1 J	0.12 U	0.12 U
BENZO(G,H,I)PERYLENE	0.16 U	0.19 J	NA	0.16 U	0.16 U	0.16 U	0.16 U
BENZO(K)FLUORANTHENE	0.12 J	0.5 J	NA	0.14 U	0.12 J	0.14 U	0.14 U
CHRYSENE	0.31 J	1.5	NA	0.1 U	0.65	0.1 U	0.1 U
DIBENZ(A,H)ANTHRACENE	0.1 U	0.1 U	NA	0.1 U	0.1 U	0.1 U	0.1 U
FLUORANTHENE	0.29	1.1	NA	0.16 U	0.33	0.16 U	0.16 U
FLUORENE	3.6 J	14	NA	3.3	4.4	0.22 J	0.38 J
INDENO(1,2,3-CD)PYRENE	0.14 U	0.22	NA	0.14 U	0.14 U	0.14 U	0.14 U
NAPHTHALENE	0.27 J	1.2	NA	0.14 J	0.32	0.1 U	0.1 U
PHENANTHRENE	4.2 J	17	NA	1.3	5.1	0.075 J	0.18 J
PYRENE	0.61	2.6	NA	0.16 U	0.69	0.16 U	0.16 U

TABLE E-2: GROUNDWATER ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP018
Sample ID	262YF3417
Sample Date	06/26/2000
Volatile Organic Compounds (µg/L)	
1,1,1,2-TETRACHLOROETHANE	NA
1,1,1-TRICHLOROETHANE	NA
1,1,2,2-TETRACHLOROETHANE	NA
1,1,2-TRICHLOROETHANE	NA
1,1-DICHLOROETHANE	NA
1,1-DICHLOROETHENE	NA
1,1-DICHLOROPROPENE	NA
1,2,3-TRICHLOROBENZENE	NA
1,2,3-TRICHLOROPROPANE	NA
1,2,4-TRICHLOROBENZENE	NA
1,2,4-TRIMETHYLBENZENE	NA
1,2-DIBROMO-3-CHLOROPROPANE	NA
1,2-DIBROMOETHANE	NA
1,2-DICHLOROBENZENE	NA
1,2-DICHLOROETHANE	NA
1,2-DICHLOROPROPANE	NA
1,3,5-TRIMETHYLBENZENE	NA
1,3-DICHLOROBENZENE	NA
1,3-DICHLOROPROPANE	NA
1,4-DICHLOROBENZENE	NA
2,2-DICHLOROPROPANE	NA
2-BUTANONE	NA
2-CHLOROTOLUENE	NA
2-HEXANONE	NA
4-CHLOROTOLUENE	NA
4-METHYL-2-PENTANONE	NA
ACETONE	NA
BENZENE	NA
BROMOBENZENE	NA
BROMOCHLOROMETHANE	NA
BROMODICHLOROMETHANE	NA
BROMOFORM	NA
BROMOMETHANE	NA
CARBON DISULFIDE	NA
CARBON TETRACHLORIDE	NA

TABLE E-2: GROUNDWATER ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP018
Sample ID	262YF3417
Sample Date	06/26/2000
Volatile Organic Compounds (µg/L)	
CHLOROBENZENE	NA
CHLOROETHANE	NA
CHLOROFORM	NA
CHLOROMETHANE	NA
CIS-1,2-DICHLOROETHENE	NA
CIS-1,3-DICHLOROPROPENE	NA
DIBROMOCHLOROMETHANE	NA
DIBROMOMETHANE	NA
ETHYLBENZENE	NA
FREON 11	NA
FREON 12	NA
HEXACHLOROBUTADIENE	NA
ISOPROPYLBENZENE	NA
M,P-XYLENES	NA
METHYL-TERT-BUTYL ETHER	NA
METHYLENE CHLORIDE	NA
N-BUTYLBENZENE	NA
N-PROPYLBENZENE	NA
NAPHTHALENE	NA
O-XYLENE	NA
PARA-ISOPROPYL TOLUENE	NA
SEC-BUTYLBENZENE	NA
STYRENE	NA
TERT-BUTYLBENZENE	NA
TETRACHLOROETHENE	NA
TOLUENE	NA
TRANS-1,2-DICHLOROETHENE	NA
TRANS-1,3-DICHLOROPROPENE	NA
TRICHLOROETHENE	NA
VINYL CHLORIDE	NA
Petroleum Hydrocarbons (mg/L)	
Diesel/Motor Oil Range (extractables) - SG	
DIESEL RANGE ORGANICS	0.96 D
MOTOR OIL RANGE ORGANICS	0.3 U

TABLE E-2: GROUNDWATER ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Sample Location ID	YF3HP018
Sample ID	262YF3417
Sample Date	06/26/2000
Petroleum Hydrocarbons (mg/L)	
Diesel/Motor Oil Range (extractables)	
DIESEL RANGE ORGANICS	NA
MOTOR OIL RANGE ORGANICS	NA
Gasoline Range (purgeables)	
GASOLINE RANGE ORGANICS	0.05 U
Semivolatile Organic Compounds (µg/L)	
2-METHYLNAPHTHALENE	NA
ACENAPHTHENE	NA
ACENAPHTHYLENE	NA
ANTHRACENE	NA
BENZO(A)ANTHRACENE	NA
BENZO(A)PYRENE	NA
BENZO(B)FLUORANTHENE	NA
BENZO(G,H,I)PERYLENE	NA
BENZO(K)FLUORANTHENE	NA
CHRYSENE	NA
DIBENZ(A,H)ANTHRACENE	NA
FLUORANTHENE	NA
FLUORENE	NA
INDENO(1,2,3-CD)PYRENE	NA
NAPHTHALENE	NA
PHENANTHRENE	NA
PYRENE	NA

TABLE E-2: GROUNDWATER ANALYTICAL RESULTS FOR SITE YF3 (Continued)

Site YF3 Screening-Level Ecological Risk Assessment, Naval Station Treasure Island, San Francisco, California

Notes:

All 2012 samples were collected within the 5 to 10 feet interval of each boring, based on mesh screen interval length (CH2M Hill Kleinfelder Joint Venture [KCH] 2013), 2000 samples were collected from a depth of approximately 6 to 8 feet (Tetra Tech EM Inc. [Tetra Tech] 2003; Tetra Tech and LFR 2000).

D	Chromatographic pattern resembles diesel
dup	Duplicate sample
ID	Identification
J	Estimated value
Mg/L	Milligram per liter
NA	Not analyzed
NAVSTA	Naval Station
SG	Silica gel
U	Nondetected
µg/L	Microgram per liter

Source:

KCH. 2013. Final Field Activity Report for Additional Soil and Groundwater Sampling at Area YF3 and Artifact 1. Yerba Buena Island, San Francisco, CA. March.

Tetra Tech. 2003. “Corrective Action Plan Inactive Fuel Lines at Naval Station Treasure Island, San Francisco, CA.” December.

Tetra Tech and LFR. 2000. “Remedial Investigation Work Plan, Inactive Fuel Pipeline Sites, Naval Station Treasure Island, San Francisco, California.” January 31.

APPENDIX F
RESPONSES TO COMMENTS ON THE DRAFT SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT AND LOW-THREAT CLOSURE EVALUATION FOR SITE YF3

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Myriam Zech, RWQCB PM

Date of Comments: September 15, 2014

No.	Section / Page	Comment	Response
General Comments			
1.		Use of the Low-Threat UST Case Closure Policy. Although the Policy was designed for petroleum releases from USTs, we find that the framework is appropriate for evaluating this AST and pipeline release site. Nevertheless, we consider that the site and release location (straddling the Bay) constitutes a unique site attribute that requires a more site-specific analysis of conditions, but that this can still be accomplished using the Policy as a framework.	Comment noted.
2.		Policy Criterion e (A conceptual site model that assesses the nature, extent, and mobility of the release has been developed). The extent of contamination in sediment and groundwater has not been adequately defined, and the CSM is incomplete (see Specific Comment #6b for detailed information regarding the lack of adequate definition). Therefore, please submit a work plan by November 7, 2014 for additional investigation. The work plan should include sediment porewater testing since the site straddles the Bay. Future TPH testing should be performed both with and without silica gel cleanup because the polar degradation compounds of petroleum hydrocarbons (polars) are not non-toxic (see Section 8.4 of the December 2013 ESL User's Guide: Derivation and Application of Environmental Screening Levels – Interim Final). A petroleum fingerprint analysis should be performed on one or more samples of petroleum contaminated sediment and porewater to better understand the extent of weathering and degradation of petroleum hydrocarbons to potentially toxic breakdown products. Also, ecological toxicity testing should be included to refine the site-specific ecological evaluation for site YF3. Moreover, San Francisco Bay shall not be used to treat contamination through oxidation or dilution.	The Navy agrees to propose further characterization of the nature and extent of contamination at the site and the potential ecological risks posed by the site. As discussed with the Regional Water Quality Control Board (Water Board) during a call on September 29, 2014, the Navy's response is predicated on the timing of securing additional funding in the context of the change in federal fiscal year and related funding allocations process. In the meantime, the Navy will coordinate with the regulatory agencies to determine an appropriate approach to resolve the apparent data gaps identified by the Water Board, and update the conclusions of the screening-level ecological risk assessment (SLERA).

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Myriam Zech, RWQCB PM

Date of Comments: September 15, 2014

No.	Section / Page	Comment	Response
General Comments (Continued)			
3.		Policy Criterion f (Secondary Source Removed to the Extent Practicable). In Table 17, the SLERA states "Site physical constraints at the base of a bluff and within a tidal zone with significant elevation and incursion during flood tides make removal of what limited residual contamination that remains technically and fiscally impracticable. Due to the limited access to the site, a barge must be used to bring equipment to the site and to remove it from the site after several hours when the area is inundated by the incoming tide. In addition, there have been previous landslides along the shore of YBI in the 1980s (Tetra Tech 2003), and excavation of contamination below the beach surface may threaten the stability of surrounding soils." The conclusion that removal of the secondary source is impractical is inadequate. Discharges at or near the shoreline are one of our agency's most significant water quality concerns. Typical shoreline work is logistically challenging (requires specialized equipment, coordination with the tides and limited working hours) and is costly. While landslides are a concern for a removal action, they also were a concern when the facility was constructed in the 1940s and demolished during the 1980s. Therefore, please submit a corrective action or interim remedial action work plan by December 5, 2014 for addressing the secondary source. Note that there is nothing that prevents the Navy from proposing alternate technologies to treat or contain the secondary source instead of, or in addition to, removal. Lastly, any secondary source left in place for any reason will trigger the need to consider institutional controls (e.g., covenant and/or management plan).	Please see the response to Water Board general comment 2. Once additional characterization has been conducted, the Navy will evaluate whether there is a need for measures to contain or remove any contamination.
Specific Comments			
1.	**Section 2.4.2 (TPH Soil Data Analysis), Table of TPH Results, p. 12**	The table title should include "soil or sediment" for clarity.	The table title will be changed to "Total Petroleum Hydrocarbon Results in Soil and Sediment for Site YF3."

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Myriam Zech, RWQCB PM

Date of Comments: September 15, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
2.	**Section 2.5.4 (Assessment and Measurement Endpoints), second bullet on p. 20**	The concentrations detected in sediment samples collected within 3 feet of the surface should be compared against the surface sediment criterion of 144 mg/kg for TPHd and fuel oil based on amphipod toxicity testing performed at the Presidio (citation provided in footnote on p. 2).	The Navy requests the Water Board provide a copy of the cited document so that the 144 milligrams per kilogram (mg/kg) value may be considered for use in the SLERA.
3.	**Section 3.1 (Assessment of Risk to Aquatic Life), table on p. 24**	The hazard quotients for the maximum detected groundwater concentrations are: TPHd (27.1) and TPHmo (3.9). The TPHd hazard quotient is an order of magnitude higher than the risk management range that we would consider acceptable.	Comment noted.
4.	**Section 4.3 (Refinement of Chemicals of Potential Ecological Concern for Aquatic Life), TPH –Diesel, p 36**	Address the following: 4a. Total TPH Criterion for Groundwater – The Total TPH screening criterion for discharge to the Bay is 1,400 µg/L, not 1,400 µg/kg. 4b. Argument Dismissing the Total TPH Criterion for Groundwater and the Groundwater Data – The SLERA argues for dismissing or ignoring the Total TPH Criterion for groundwater using information presented in Sediment Toxicity of Petroleum Hydrocarbon Fractions (Battelle 2007). This report presented information regarding the toxicity of the C13-C18 fraction (diesel range) and the C19-C32 fraction (motor oil range), and the relative solubility of those fractions: "the solubility of the petroleum hydrocarbons is such that not enough would enter into solution to reach expected toxic levels." We do not agree with the conclusions presented in this report for the following reasons: • The Total TPH Criterion for groundwater was developed based on ecological toxicity tests performed at nearby Treasure Island, which coincidentally evaluated the polars because no silica gel cleanup was performed. Limited research has been performed on the toxicity of the polars at petroleum release sites, but data available indicate the polars (also defined as oxygen-containing hydrocarbon derivatives) are not non-toxic. Oxygen-containing breakdown products have been shown to mediate toxic effects attributed to specific hydrocarbons. Moreover, the polars are significantly more soluble than the parent petroleum hydrocarbons (e.g., MTBE is an oxygen-containing hydrocarbon derivative or polar). Based on our review of the Sediment Toxicity of Petroleum Hydrocarbon Fractions report, the polars were not considered. • Site-specific grab groundwater data has been collected at YF3, and those results significantly exceed the criterion. Additional data (sediment porewater) is necessary to complete the CSM (see General Comment #2). We see no reason to ignore the site data at this time.	4a. Comment noted. 4b. Please see the response to Water Board general comment 2.

Comments by: Myriam Zech, RWQCB PM

Date of Comments: September 15, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
4. (con't)		• Nature of the Petroleum Hydrocarbons – The text also states "An analysis of the composition of the weathered petroleum hydrocarbons at Site YF3 has not been conducted. However, because of weathering of the hydrocarbons in the sediment, their toxicity likely has been reduced since the time of original release to the environment, and the lighter, more toxic compounds are the likeliest to have decreased in concentration over time (AST 214 was removed in the 1980s)." Appropriate petroleum fingerprint testing and site-specific ecological toxicity testing should be performed (see General Comment #2) to support this type of statement. Given the large concentrations of the 2012 grab groundwater samples, it appears that there is little or no attenuation taking place, nearly 30 years after the facility was demolished and the primary source removed. Extend the preceding comments to the section regarding TPH-Motor Oil.	
5.	**Section 4.4 (Refinement of Chemicals of Potential Ecological Concern for Benthic Invertebrates – TPH-Diesel, TPH-Gasoline, and TPH-Motor Oil), p. 38**	This section will need to be revised pending completion of the CSM. We do not support the conclusion at this time. Extend this comment to Section 4.7.	Comment noted. Please see the response to Water Board general comment 2.
6.	**Table 17 (Low Threat Closure Criteria Comparison for Site YF3)**	We recommend that the table list the criteria exactly as stated in the Policy and that the Navy consider moving this evaluation into the text rather than a table. In addition, address the following: 6a. General Criterion d (Free product has been removed to the maximum extent practicable) – The table should include a brief summary of the residual saturation evaluation regarding mobile LNAPL presented in Section 2.4.	The Navy will review and update the table as needed to ensure the criteria are listed consistent with the policy. The Navy prefers not to move the evaluation into the main text in the SLERA, but will present it in the main text of a future report (such as a baseline risk assessment and low-threat closure evaluation). 6a. A brief summary of the light nonaqueous phase liquid (LNAPL) evaluation presented in Section 2.4 will be added to the comparison regarding whether free product has been removed to the maximum extent practicable, as modified per the suggested changes in the response to Treasure Island Development Authority (TIDA) general comment 10 below.

Comments by: Myriam Zech, RWQCB PM

Date of Comments: September 15, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
6. (con't)		6b. General Criterion e (A conceptual site model that assesses the nature, extent, and mobility of the release has been developed) – The extent of contamination in sediment and groundwater has not been adequately defined. Section 2.4 of the SLERA states "Based on site conditions and detections of TPH at the site, potential areal and vertical extents of impact appear to be very limited." However, based on our review, this statement is not justified. For example, the extent of sediment contamination is not defined at these locations: • KCHYF3-5 (5,407 mg/kg total TPH) – extent not defined to the north and west. • YF3HP021 (11,340 mg/kg total TPH) – extent not defined to the north. • YF3HP019 (20,000 mg/kg total TPH) – extent not defined to the north and east. The extent of groundwater contamination similarly is not defined: • KCHYF3-1 (26,000 µg/L total TPH) – extent not defined to the north. • KCHYF3-2 (38,000 µg/L total TPH) – extent not defined to the north. • KCHYF3-4 (11,000 µg/L total TPH) – extent not defined to the north, east, or south. The discussion regarding the extent of contamination should be supported by maps with data and isoconcentration contours to clearly illustrate extent. While the cross sections with data in the SLERA are useful in illustrating vertical extent, they only depict the lateral extent along those particular section lines. Furthermore, only the TPHd results are presented.	6b. Please see the response to Water Board general comment 2. No new figures will be created for the SLERA.
		6c. General Criterion f (Secondary source has been removed to the extent practicable) – The secondary source has not been adequately addressed. See General Comment #3.	6c. Please refer to Water Board general comment 2. As noted in response to Water Board general comment 4, the Navy will evaluate whether there is a need for measures to contain or remove the contamination after further characterization.

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
6. (con't)		6d. General Criterion h (Nuisance as defined by Water Code section 13050 does not exist at the site) – Provide justification for concluding that there is no nuisance. The table simply states that contamination at the site does not meet the nuisance criteria, without any supporting justification. 6e. Are there unique site attributes or site-specific conditions that demonstrably increase the risk associated with residual petroleum constituents? – The site location (straddling the bay) is a unique attribute. The release (into the intertidal sediments) does not meet any of the surface water setback distances in the Policy Groundwater-Specific Criteria. The lack of adequate setback distance means there is little or no ability for soil or sediments to attenuate dissolved contamination. 6f. Is the contaminant plume that exceeds water quality objectives stable or decreasing in areal extent? The table states "Contamination is stable and limited in ability to spread vertically and laterally by site geology." Provide technical justification for stating that the groundwater contamination is stable and that the contamination is limited in ability to spread vertically and laterally by site geology. Regarding the former, we are unaware that sufficient groundwater monitoring over time has been performed to establish trends or demonstrate the areal extent to be decreasing. Given the large concentrations of the 2012 grab groundwater samples, it appears that there is little or no attenuation taking place, nearly 30 years after the facility was demolished and the primary source removed. Regarding the latter (site geology), clarify whether "contamination" refers specifically to LNAPL or dissolved contamination and provide justification for the statement.	6d. The text will be revised to explain why Site YF3 does not meet the definition of a nuisance under Water Code section 13050. 6e. Comment noted. The Navy will revise Table 17 to indicate that the area of contamination lies within the tidal mixing zone (TMZ), and that there is a potential risk posed to receptors in the bay if the contaminated sediments at depth were disturbed in the future. 6f. It is acknowledged that the current data set is limited for providing confirming technical justification for all aspects of current site conditions. See response to Water Board general comment 2. The beach environment is not conducive to use of conventional monitoring wells for groundwater monitoring; thus, options are constrained for technologies to collect temporal groundwater data that will yield repeatable equivalent results and quality. As described in Section 2.4 of the report, current data suggest that there is limited potential for migration of any residual LNAPL, that it is effectively confined to the subsurface and, therefore, is not an ongoing source of dissolved phase contamination to the Bay. In addition, polycyclic aromatic hydrocarbons (PAH) are not present in groundwater at concentrations above surface water screening criteria (Table 7), indicating the dissolved hydrocarbons are not likely to be a concern. If further characterization supports the hypothesis that the dissolved contamination is limited and the residual LNAPL is not mobile, there may be no need for a buffer zone for attenuation as is defined in Classes 1 through 4 (which require either 250 or 1,000 feet of distance from a water body to conform to the class definitions, depending on the length of the area of contamination).

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Myriam Zech, RWQCB PM

Date of Comments: September 15, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
6. (con't)		6g. Does the contaminant plume that exceeds water quality objectives meet all of the additional characteristics of one of the five classes of sites? The table correctly concludes that the site does not meet any of the first four classes of groundwater sites and then states that it may meet Class 5 (site-specific analysis). However, based on our review, the CSM needs to be completed (see General Comment #2) before a conclusion that the site meets Class 5 can be made. The site-specific analysis must provide a credible basis for concluding that water quality objectives will be met within a reasonable amount of time.	6g. Please see the responses to Water Board general comment 2 and specific comment 6f. The Navy will coordinate with the Water Board to ensure a determination of whether the site meets the Class 5 definition can be made.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Darrel Lauren, Ph.D., DTSC

Date of Comments: August 12, 2014

No.	Section / Page	Comment	Response
General Comments			
1.		The absence of surface sediment samples and TOC levels makes interpretation of the data provided uncertain. Because the Navy only collected data on 17 PAHs in ground water and 18 in sediment, risk was estimated using the factor of 11.5 (EPA 2003) to calculate the effect of the 34 PAHs recommended by NOAA. Because the Navy did not collect TOC data, ERAS assumed 1%, as indicated by data from USGS reports in the Treasure Island area. Using equilibrium partitioning ERAS calculated unacceptable risk to benthos at the 5 foot level of sediments at station 3-3 and in sediment pore water at Station 3-2. Risk to benthic invertebrates cannot be calculated due to the absence of surface sediment bulk and pore water samples.	Please see the response to Water Board general comment 2.
2.		Evaluation of the available PAH data shows that the source of these PAHs is petrogenic rather than pyrogenic. Both sediment and pore water have a unique profile in that the highest PAH concentrations are for fluorene and phenanthrene, although other low molecular weight PAHs are also elevated into the mg/kg and mg/L range, particularly at station 3-3. The relatively high concentrations of LMW PAHs at the 5 foot depth are likely to be a continuing source of these compounds to the surface sediments as shown by the Z foot samples.	Please see the response to Water Board specific comment 6f regarding the potential for migration of contamination at depth.
3.		The EPA Ambient Water Quality Criterion for phenanthrene is 4.6 µg/L while the sediment pore water concentration is 17 µg/L at Station 3-2. The British Columbia Ambient Water Criterion for fluorine is 12 µg/L while the sediment pore water concentration is 14 µg/L at Station 3-2.	Comment noted.
Specific Comments			
1.	**Page ES-3, paragraph 2**	Wildlife, such as ground squirrels, may be exposed to VOCs via inhalation while in their burrows.	The contaminated area of the site is in the TMZ and the shoreline is inundated regularly by the tide (up to 6 feet increase between low and high tides [www.tidesandcurrents.noaa.gov]), so no burrowing mammals are present.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Darrel Lauren, Ph.D., DTSC

Date of Comments: August 12, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
2.	**Page ES-, paragraph 3**	ER-Ls and ER-Ms are scientifically invalid measures of toxicity. See EPA (2003) and below.	Screening benchmarks such as the effects range-low (ER-L) and effects range-median (ER-M) values are acceptable for use in the SLERA. However, the Navy may use the suggested U.S. Environmental Protection Agency (EPA) benchmarks in a future assessment.
3.	**Page 7, paragraph 2**	The failure to measure PAHs in ground water is a data gap for site characterization.	Section 2.3.1 (formerly 2.2.1)summarizes only the Corrective Action Plan (CAP). PAHs were measured in 5 groundwater samples collected in 2012 to fill that data gap (see Section 2.3.2 and Table 4).
4.	**Page 8, paragraph 1**	Toxicity data is available for soil invertebrates and plants exposed to PAHs. See Sverdrup et al. (2002, 2003). Water quality criteria exist for many PAHs.	There is no exposure to terrestrial plants and invertebrates, which is why they are not reflected in the assessment and measurement endpoints (see Appendix A). Water quality criteria for PAHs were compared with site data in Appendix C, as summarized in Section 3.1 and Table 7; no PAHs exceeded the screening criteria.
5.	**Page 11, paragraph 1**	Even if there is no dissolved phase for the sheen found in sediment samples, the presence of sheen must be assumed to be either toxic to benthic invertebrates, or destructive of their habitat. This can only be ascertained by bioassays.	Please see the response to the California Department of Toxic Substances Control (DTSC) specific comment 8 regarding the appearance of a sheen. The Navy acknowledges the value of bioassays, but they are not required to conduct a SLERA. It is not scientifically valid to assume toxicity, or lack thereof, based on the presence or absence of a visible sheen in water samples, particularly those collected deeper than the surface sediments where benthic invertebrates may be present. As a result, screening values are used in the SLERA, as presented in Sections 3.1 and 3.2.
6.	**Page 11, paragraph 5**	While pore water flushing may be high, the presence of low molecular weight (LMW) PAHs in both sediment and groundwater samples show a continuing source to the shallowest samples collected.	Please see the response to Water Board specific comment 6f.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Darrel Lauren, Ph.D., DTSC

Date of Comments: August 12, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
7.	**Page 14, paragraph 2**	It is not clear what is meant by an "assumed monitoring well". Please clarify.	The text will be revised to read *"hypothetical monitoring well,"* and to clarify that the model is for presumed behavior in a well, if one were to be installed, based on uniformly applied assumptions, as described in the previous paragraph.
8.	**Page 16, bullet 3, column 3**	Please explain how disturbance of the soil resulted in the appearance of 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 and release very small quantities of LNAPL or dissolved hydrocarbon compounds that are capable of producing a visible sheen on the groundwater.
9.	**Page 17, paragraph 2**	While the fate, transport, and toxicity of chemicals in sediments may be "complicated", uncertainty can be eliminated by measuring toxicity and/or uptake, or analysis of field-collected organisms.	Comment noted. The intent of this text is merely to highlight the complexity of the processes that control fate and transport in the environment. As noted in response to Water Board general comment 2, the Navy will coordinate with the regulatory agencies to determine an appropriate approach to resolve data gaps.
10.	**Page 18, paragraph 1**	Without understanding the bioavailability in Pearl Harbor relative to the Site, it is not valid to extrapolate from one site to another. TOC data is required to estimate the bioavailability of PAHs in sediments or measured pore water data.	Comment noted. Please see the response to Water Board general comment 2.
11.	**Page 22, bullet 1**	ERAS found no data for analyses of the alkylated PAHs listed except 2-methylnaphthalene.	Comment noted.
12.	**Page 24, text table**	TPH is a useless measurement for ecological risk prediction.	Total petroleum hydrocarbons (TPH) are not as useful as constituent analysis (such as PAHs) because the mixtures are unique and correlation to toxicological data is limited; however, some ecological soil screening levels have been developed, as noted in Section 3.4.3. Please see the response to Water Board general comment 2.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Darrel Lauren, Ph.D., DTSC

Date of Comments: August 12, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
13.	**Page 24, paragraph 3**	See Comment 2, above.	Please see the response to DTSC specific comment 2.
14.	**Page 25, text table**	See Comment 2, above.	Please see the response to DTSC specific comment 2.
15.	**Page 29, paragraph 1**	TRVs for birds and mammals exposed to PAH mixtures are available in Stubblefield et al. (1995a, 1995b).	The toxicity test results in Stubblefield and others (1995a, 1995b) will not be used as toxicity references values (TRV), but will be considered in the Step 3a risk refinement for birds and mammals.
16.	**Page 37, paragraph 3**	See Comment 2, above. Please explain why the 95% UCL could not be calculated.	In some cases, the limited number of samples or detections precluded the calculation of a 95 percent upper confidence limit (95 UCL).
17.	**Page 37, paragraph 4**	No effect concentrations can be easily calculated for these hydrocarbons using EPA (2008) equilibrium partitioning. Please report the detection limits for these and other hydrocarbons analyzed.	Please see the response to Water Board general comment 2. The Navy will consider using equilibrium partitioning in a future evaluation, but will not revise the SLERA. Detection limits vary for the various hydrocarbons listed in paragraph 4 and are shown for non-detections in Appendix E.
18.	**Page 38, Paragraph 1**	Please use EPA (2008) equilibrium partitioning to estimate no effect concentrations for these VOCs.	As noted in response to DTSC specific comment 17, the Navy will consider using the equilibrium partitioning approach in the future, but will not revise the SLERA.
19.	**Pages 41 and 42**	The toxicity of individual PAHs should be summed for wildlife as well as benthic invertebrates.	PAHs were evaluated as total high molecular weight (HMW) and total low molecular weight (LMW) PAHs for both invertebrates and wildlife. This approach is appropriately conservative because it assumes all compounds have the same toxic effects as the most toxic compound, for which the TRV have been developed. Although it would be ideal to use a toxicity equivalence factor (TEF) approach in assessing risk, similar to that used to assess risk from dioxins and dioxin-like compounds, the limitations of the existing toxicological literature do not allow for such an analysis (EPA 2007).

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Darrel Lauren, Ph.D., DTSC

Date of Comments: August 12, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
20.	**Page 41, paragraph 4**	Sediment to biota uptake factors must be based on site-specific sediment, TOC, and organisms.	In a SLERA, bioaccumulation factors do not have to be based on site-specific data; and site-specific data are rarely available for a SLERA. Please see the response to Water Board general comment 2. Additional characterization is anticipated to help resolve the data gaps posed by the DTSC's comment regarding site-specific uptake.
21.	**Page 43, bullets 2 and 11**	The presence of LMW PAHs in 2 foot sediment samples and pore water show that there is a continuing source of contamination to the benthic community and the bay. It is possible there is an exposure to burrowing animals, but this was not evaluated. However, the risk associated with such exposure is likely *de minimis*.	Please see the response to Water Board general comment 2. Additional characterization is anticipated to help resolve the data gaps posed by the DTSC's comment regarding the benthic community. The contaminated area of the site is located in the TMZ and the shoreline is inundated regularly by the tide (up to 6 feet increase between low and high tides [www.tidesandcurrents.noaa.gov]); therefore, no burrowing mammals are present.
22.	**Figure 8**	Please include the pore water to biota exposure pathway.	Figure 8 will be revised to include exposure to benthic invertebrates through pore water.
23.	**Figures**	Please provide depth-specific ground water and sediment plume concentration kriged figures for PAHs.	The linearity of the sampling locations for the groundwater grab sample data prevent the ability to krige them. The sampling depths are also approximate. Sediment data, having been collected at multiple depths, could be kriged, but only in a 2-dimensional vertical plane.
24.	**Tables**	Please add Sum HMW PAH, LMW PAH and total PAH to all tables. Where data are marked "U", please add the MDL or the MDL range in a footnote.	The concentrations of HMW PAH, LMW PAH, and total PAH in groundwater will be added to Table 7. The concentrations are currently presented in Tables 1 through 4, along with the data for individual PAHs, and in the comparison with sediment benchmarks in Table 8.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Darrel Lauren, Ph.D., DTSC

Date of Comments: August 12, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
25.	**Table E-2**	Please report the depth for ground water samples.	Only approximate depths can be provided for the grab groundwater samples. A note will be added to Table E-2 to indicate that the 2012 samples were collected within the 5 to 10 feet interval of the borings, based on mesh screen interval length (KCH 2013) and the depth of groundwater collected in 2000 was approximately 6 to 8 feet (Tetra Tech 2003; Tetra Tech and LFR 2000).
Conclusions			
		Considerable uncertainty remains concerning the level of exposure of ecological receptors at this site. Using equilibrium partitioning ERAS calculated unacceptable risk to benthos at the 5 foot level of sediments at station 3-3 and in sediment pore water at Station 3-2. This uncertainty should be eliminated by sampling surface sediment and/or indwelling benthic invertebrates from the intertidal zone.	Please see the response to Water Board general comment 2.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Langan Treadwell Rollo, TIDA

Date of Comments: August 15, 2014

No.	Section / Page	Comment	Response
General Comments			
1.	**Section 2.1, Facility and Site Background, page 6**	Section 2.1 identifies a former 550-gallon above ground storage tank (AST), AST 213, which was reportedly used for 'diesel'. The subsequent section (Section 2.2) describes a previous geophysical investigation conducted to locate a suspected underground storage tank (UST), UST 213, in 1995; however, only the location of UST 213 is identified on Figure 2. Please add the location of AST 213 on Figure 2 or clarify in the text whether Building 213 is the location of a former UST or a former AST.	Both the text and Figure 2 will be revised to clarify that former Aboveground Storage Tank (AST) 213 was associated with Building 213, located just outside the boundary of the site.
2.	**Section 2.2.1, Corrective Action Plan, Inactive Fuel Lines, page 7, 2nd paragraph**	Section 2.2.1 indicates that detected concentrations of TPH were compared to residential and "non-residential" screening criteria. Please add the screening criteria regulatory reference (e.g. DTSC, USEPA) and clarify the definition of "non-residential" (i.e. commercial or industrial).	The text of Section 2.3.1 (formerly 2.2.1) will be revised to explain that the nonresidential criteria used to screen TPH concentrations in the CAP were originally developed for the Presidio of San Francisco to be protective of recreational use and protective of a park maintenance worker and groundskeeper (Montgomery Watson 1996).
3.	**Section 2.2.1 Corrective Action Plan, Inactive Fuel Lines, page 7**	One surface soil TPH-oil exceedance, four deep soil TPH-gasoline exceedances, and one TPH-diesel groundwater detection were described in the CAP in Section 2.2.1. Please identify the sample locations of these exceedances and detection on Figure 5.	The text of Section 2.3.1 (formerly 2.2.1) will identify the samples exceeding the screening criteria in the 2003 CAP (Tetra Tech 2003). No changes will be made to Figure 5 because those results are not based on the criteria or the complete data set used in the current evaluation.
4.	**Section 2.2.2, Field Activities Report, page 8**	This section identifies the March 2012 soil samples that exceeded TPH ecological screening criteria (PRC ECO). Fluorene and phenanthrene were also reported at concentrations that exceeded human health screening criteria. Please describe the relevant human health screening criteria for TPH and identify any soil samples in exceedance of the human health criteria.	The text of Section 2.3.2 (formerly 2.2.2) will be revised to briefly describe the human health screening criteria used in the field activities report (KCH 2013).
5.	**Section 2.2.2, Field Activities Report, page 8**	PAHs, TPH-diesel, and TPH-motor oil exceeded PALs established in the Sampling Analysis Plan. Please consider defining the TPH PALs within Section 2.2.2 and/or including the Sampling Analysis Plan as an Appendix to this report.	The text will be revised in Section 2.3.2 (formerly 2.2.2) to note that the project action limit for all TPH constituents was 100 mg/kg in soil and will reference the sampling and analysis plan (SAP) (KCH 2011).

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Langan Treadwell Rollo, TIDA

Date of Comments: August 15, 2014

No.	Section / Page	Comment	Response
General Comments (Continued)			
6.	**Section 2.2.2, Field Activities Report, page 8**	Samples have not been collected within or around the former location of the piers used for oil transfer and refueling activities. While no release has been recorded or reported, this area represents an exposure area that may potentially have impacts by historical activities. Please consider additional sampling in the former location of the piers and incorporating these results into the SLERA.	Had significant, non-transitory, release of petroleum product occurred at the location of the pier, it would have initially impacted surface water at the water surface, and assuming it migrated shoreward, resulted in contamination of the surficial sediments of the beach within the highly active TMZ. Based on all reports and substantive evidence available, however, there have been no known or suspected releases from oil transfer and refueling at the piers of a scale that would have sustained impact to suggest the need to sample in the area near the old piers.
7.	**Section 2.2.2, Field Activities Report, page 8**	Sample KCHYF3-3 had a detected TPH concentration of 6,500 mg/kg at the 5 foot interval; however, there were no step out samples to delineate this impact. While 5 feet bgs is outside of the bioactive zone, the impacts seen at this depth could potentially correlate with impacts within the biological active zone further out from shoreline both in the TMZ and deeper bay areas. Please consider additional sampling at the point of groundwater discharge and incorporating these results into the SLERA.	Please see the response to Water Board general comment 2.
8.	**Section 2.3.2, Hydrogeology, page 9**	Please consider including a description of the estimated tidal influence on groundwater elevation at the site.	The following text will be added to Section 2.2.2 (formerly 2.3.2): *"A 72-hour tidal influence study conducted on Treasure Island showed that fluctuations in the groundwater level ranged from 1.81 feet within 30 feet of the bay to 0.12 feet at inland locations 250 feet from the bay (Navy 1997; PRC 1995a). Based on this information, changes in groundwater elevation at the YF3 site would be expected to be of a similar amplitude (less than 2 feet)."*
9.	**Section 2.4.2, TPH Soil Data Analysis, page 11**	Please consider identifying the 38 sample locations identified in this section on a figure and include a reference to the Table 5 and Appendix E in this section.	There are 39 samples, collected at various depths from the sampling locations already identified on Figures 4, 9, 11, and 12. A reference to Appendix E will be added to Section 2.4.2.

No.	Section / Page	Comment	Response
General Comments (Continued)			
10.	**Section 2.4.2, TPH Soil Data Analysis, page 13-14**	Section 2.4.2 describes the residual LNAPL and water saturations calculations from TPH data. Please clarify that the calculated residual water saturation was 6.5% in the third paragraph on page 14. Additionally, please add the following clarifying statement, "Samples with calculated residual LNAPL saturations that exceeded the calculated water saturation of 6.5% were considered 'potentially mobile' (as indicated in Table 6)."	The first sentence of the third paragraph on page 14 will be replaced by the following sentence, *"As shown in Table 6, only two samples at YF3 were calculated to have Residual LNAPL saturation values equal to or greater than the calculated water residual saturation value of 6.5 percent. "* The first sentence in the fourth paragraph on page 14 is incorrectly located and will be moved to its correct location as the fourth bullet of the third paragraph. In addition, text in the fourth paragraph that compares samples to 7 to 11 percent saturation, based on the standard deviations of input parameters, will be revised as follows to clarify that the calculated residual water saturation in the paragraph is 6.5 percent and to include conclusions about the results relative to LNAPL mobility: "*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, only two of 29 samples have calculated values that indicate potential LNAPL mobility as related to the hypothetical monitoring well. However, 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 TMZ, lack of significant quantity of residual LNAPL, salt water intrusion mixing, and absence of a LNAPL hydraulic head,.*"

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Langan Treadwell Rollo, TIDA

Date of Comments: August 15, 2014

No.	Section / Page	Comment	Response
General Comments (Continued)			
10. (con't)	**Section 2.4.2, TPH Soil Data Analysis, page 13-14 (con't)**		It is further noted that mobile LNAPL does not indicate an unstable plume. Mobility refers to pore fluid level (micro-scale behavior). Stability is relative to plume migration and expansion of the plume footprint (macro-scale behavior).
11.	**Section 2.5.4, Assessment and Measurement Endpoints, page 20**	Please consider including a reference to Table 8 in the second bullet point on page 20.	A reference to Section 3.2, which presents the assessment of risk to benthic invertebrates, where Table 8 is introduced, will be added to Section 2.5.4.
12.	**Section 2.6.1, Statistical Analyses, page 21**	The second bullet point on page 21 indicates that nondetect results that exceeded the highest detected value for each COPEC in each data set were removed. According to the USEPA ProUCL Version 5.0 User Guide, it is not recommended to exclude nondetect values from statistical analyses. Please consider revising the EPC analyses to include all nondetect values. Additionally, please note in this section the number of samples (or percentage of samples) with MDLs or RDLs that exceeded the highest COPEC detection.	Comment noted. Censored results that exceeded the maximum detected concentration for each chemical were excluded from all analyses. As discussed in Helsel (2005), these high censored results provide no useful information for calculating the one-sided 95UCL, so their exclusion has no effect on estimates derived using the censored methods currently recommended in EPA guidance (EPA 2009). No changes will be made to the tables in the SLERA.
13.	**Section 2.6.2, Sediment, page 22**	The SLERA states that sediments from 0 to 2 feet bgs represent the sediment to which ecological receptors are most likely exposed. However, the biological active zone is typically defined as 0 to 1 ft bgs for estuarine and marine habitats (according to the USEPA and Interstate Technology & Regulatory Council). According to this definition, only five sediment soil samples have been collected within the biological active zone within the TMZ. Please consider conducting additional sampling of sediments within the 0 to 1 ft bgs interval and incorporating these results into the SLERA.	Please see the response to Water Board general comment 2.

Comments by: Langan Treadwell Rollo, TIDA

Date of Comments: August 15, 2014

No.	Section / Page	Comment	Response
General Comments (Continued)			
14.	**Section 3.5, Outcome of the Risk Estimation, page 34**	Metals were not screened in as COPECs in the table on page 34; however, metals have not been sampled for in the biologically active zone. While metals concentrations were below ambient levels at two deep sample locations, these samples cannot be used to account for site activities that would have impacted the surface samples relevant to the SLERA. Please consider additional sampling for metals in the biologically active zone and incorporating these results into the SLERA.	There are no reported site activities suspected of releasing metals to Site YF3 to warrant additional sampling for metals. The offshore remedial investigation (Tetra Tech 2001) evaluated metals and no unacceptable risk was identified, with the exception of lead shot at IR Site 27 (Former Clipper Cove Skeet Range), which has been addressed with a remedial action.
15.	**Section 4.3, Refinement of Chemicals of Potential Ecological Concern for Aquatic Life, Carbon Disulfide, page 36**	Please clarify the following statement regarding the risk of exposure to carbon disulfide: "…the risk to aquatic receptors is likely overestimated because exposure to aquatic receptors occurs only when the groundwater enters the Bay". Additionally, this paragraph states that the HQ for carbon disulfide is 3.2, however the HQ is listed as 6.4 in Table 14, please clarify this discrepancy.	The risk assessment conservatively assumes that all constituents migrate from groundwater to surface water. The text will be revised to explain that, the concentration detected in groundwater is not equal to the concentration to which aquatic receptors are actually exposed in the bay. This statement is based on the slow migration of groundwater and dilution, retardation, and chemical transformation in the TMZ before and dilution at the point of exposure. Therefore, the risk is overestimated by comparing site groundwater concentrations with surface water quality criteria. The text will be revised for clarity to note that the refined hazard quotient (HQ) is 6.4 (the same as the Step 2 HQ because a 95 UCL could not be calculated), and that if the arithmetic mean concentration is used for comparison, the HQ is 3.2.
16.	**Section 4.3, Refinement of Chemicals of Potential Ecological Concern for Aquatic Life, TPH-Motor Oil, page 36**	TPH-motor oil was identified as a COPEC because the maximum detected concentration exceeded the screening criteria and its HQ was greater than one. Please include TPH-motor oil in the list of COPECs located in Section 3.5, Outcome of the Risk Estimation (Step 2), page 34.	TPH-motor oil will be added to the list of COPECs in Section 3.5.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Langan Treadwell Rollo, TIDA

Date of Comments: August 15, 2014

No.	Section / Page	Comment	Response
General Comments (Continued)			
17.	**Section 4.5, Refinement of Chemicals of Potential Ecological Concern for Birds, page 40**	Total HMW PAHs and LMW PAHs were identified as COPECs by default because avian TRVs have been established. However, TRVs for individual PAHs have been published. Instead of only addressing these PAHs qualitatively, please consider addressing these COPECs individually in the food chain models.	There are no Biological Technical Advisory Group (BTAG)-recommended avian TRVs for PAHs (DTSC 2009), so no change will be made to the SLERA.
18.	**Table 17, Low Threat Closure criteria Comparison for Site YF3, page 3**	Table 17 states that there are no complete human health exposure pathways, therefore there is no risk posed to human health by petroleum constituents. Please explain the reasoning and basis supporting the statement and please consider a reference to TIDA's 2011 Design for Development Plan, which indicates the site would remain shoreline with limited access.	The table will be revised to better explain the nature of the site, including the very limited access and lack of structures currently present or planned for construction, and will reference TIDA's 2011 Design for Development Plan (TIDA 2011).
Minor Comments			
19.	**Executive Summary, Ecological Conceptual Site Model, page ES-3**	Please consider referencing the ecological CSM figure number (Figure 3 and/or Figure 8) in the first sentence of this section.	References to Figures 3 and 8 will be added to the executive summary.
20.	**Executive Summary, Ecological Conceptual Site Model, page ES-3**	Please consider including a description of benthic invertebrates and explain their regulatory background and significance.	Additional text will be added to page ES-4 under "Tier 1 SLERA Step 2; Exposure Estimation and Risk Calculation" to describe benthic invertebrates, and to more clearly distinguish the evaluation of risk to benthic invertebrates from that of risk to aquatic life. Benthic invertebrates and their significance in the risk assessment will be described in greater detail in Sections 2.5.4 and 3.2.
21.	**Section 2.3, Environmental Setting, page 8**	Section 2.3 describes the environmental setting, geology, hydrogeology, and ecology of the site. Please consider reorganizing this section such that it appears prior to Section 2.2, Previous Investigations.	The Navy will reorganize the presentation of information in Sections 2.2 and 2.3 as requested.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Langan Treadwell Rollo, TIDA

Date of Comments: August 15, 2014

No.	Section / Page	Comment	Response
Minor Comments (Continued)			
22.	**Section 5.0, Low Threat Closure Criteria Comparison Summary, page 43**	Please consider revising the third paragraph sentence to state: "Key points noted in Table 17 regarding how Site YF3 meets the closure criteria include, but are not limited to, the following:".	The text will be revised as suggested.
23.	**Appendix E, Soil/Sediment/ Groundwater Analytical Results for Site YF3**	Please consider providing Appendix E on larger (11x17 inch) paper so that all data for a particular chemical can be read on the same page.	It is not possible to present a complete data set for multiple samples on 11 by 17 inch paper without reducing the font to illegibility.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Dale Smith, RAB

Date of Comments: August 25, 2014

No.	Section / Page	Comment	Response
Specific Comments			
1.		This document is so riddled with efforts to minimize risk, that it begs rejection. The project manager must have been taking his cue from Alameda, where if the sampling area is large enough, contamination can be reduced to zero, cf. Site 34.	The report presents a site-specific evaluation of a limited area of contamination. Please see the responses to other comments for additional clarification.
2.		I find it difficult to justify no remediation if a sheen is produced by sampling. The sheen suggests that the contamination is in areas larger than ganglia, usually associated with very small paths, such as those made by plant roots.	Please see the responses to DTSC specific comments 5 and 8. In addition, no plant material was noted in soil samples. No live, root-bearing vegetation is known to be present at depth within the beach sediments.
3.		The use of naval toxicity reference values is completely inappropriate as the navy consistently uses much lower standards in order to avoid adequate clean up. It's like having the fox guard the henhouse.	The toxicity reference values used in the report were developed and have been used in conjunction with approval of the regulatory agencies. Please see the responses to Water Board specific comment 2 and DTSC specific comments 2 and 17 regarding the potential use of alternate benchmarks.
4.		It appears in an effort to avoid cleaning up to safe levels for ecological receptors, the consultant hired is not a professional botanist or zoologist. The investigator couldn't identify a bromus species, a cormorant species or a lily species. This is pretty basic knowledge expected of a UCB Natural Resources or Sonoma State major.	The site visit was done to characterize the habitat in general terms and to identify potentially complete exposure pathways and receptor groups, and not to develop an inventory of species at the site. Terrestrial plants are not receptors of concern, for the reasons indicated in Handout 3 of Appendix A.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Dale Smith, RAB

Date of Comments: August 25, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
5.		The animals selected for the risk assessment are laughable. Almost none are appropriate. The fish species used is the tilapia, found in fresh water in Africa. If mink can't be used because they reside primarily in fresh water, why is it appropriate to use a non-native, highly invasive fresh water fish from another continent (the goatfish is a tropical reef species)? Why not use flounder and ray? Both reside in the Bay Area and rest on bottom sediment; the flounder even nestles into the sediment to avoid detection. The spotted sandpiper is not a common bird in the Bay Area. The Christmas Bird Count counted 37; whereas over 1400 avocets were recorded. The avocet is a year-round resident, breeding here, and it loves sand fleas. Although it is larger, it and its fledglings would be more likely impacted by petroleum contamination if exposed. Selecting the raccoon for the terrestrial species is again misguided. The animal is an opportunistic feeder that has become accustomed to coexisting with humans*. The animals on Treasure Island and Yerba Buena Island are more inclined to check out the dumpster behind the pizza shop than hunt for grubs (that wouldn't be found in contaminated soil anyway) and nuts and berries. The great blue heron is obliquely referenced as carnivorous. However, I doubt it could ever eat a raccoon. A more appropriate terrestrial receptor would be the ground squirrel, that is eaten by great blues as juveniles when small enough to fit down the gullet. Additionally, it burrows four to six feet below ground surface and would hit those pesky little ganglia. They preen and would ingest the petroleum and being of small weight (two pounds, not thirty) would be more impacted by the contact. If the navy wanted a large terrestrial megafauna to remove all possibility of risk, why not use a cow? They're local and even bigger. * Nature: Raccoon Nation, KQED, Wednesday August 20, 2014	The risk assessment does not evaluate risk to fish specifically, but to aquatic life. The rationale for use of tilapia-based bioaccumulation values is described in Section 3.3.1. The spotted sandpiper was selected to represent invertivorous birds that forage in the sediment along the shoreline, and is more likely to forage at Site YF3 than the avocet because of the sandy and rough nature of the shoreline substrate. The sandpiper has a greater amount of incidental ingestion of sediment while foraging than the American avocet because of differences in feeding behavior. The greater ingestion of sediment makes the evaluation of risk more conservative. There is abundant relevant life history information available for modeling exposure to the sandpiper, which is considered representative of other shorebird species with similar foraging behavior. The raccoon was selected because it is one of very few resident mammals on the island and the only one that might actually forage at Site YF3 given the intertidal nature of the site (Conger Moss Guiard, ESA, and Wood Biological Consulting 2009). It is included as a conservative measure. The great blue heron is not assumed to eat mammals in the risk assessment, but solely animal tissue that includes fish and macroinvertebrates, which meets the definition of carnivore. The ground squirrel, or any other burrowing receptor, is an inappropriate receptor for Site YF3, as noted in response to DTSC specific comment 1, because the site is regularly inundated by the tide. There are no cows or forage for cows on Yerba Buena Island.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Dale Smith, RAB

Date of Comments: August 25, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
6.		Most of the Hazard Quotients (HQ) are above 1, ranging from 40.4 down to 2.8, yet remediation is not required. In many documents and early trainings at Treasure Island if a HQ is above 1 remediation must take place. Again, by manipulating the data the document states that no clean up is needed to lower these levels. If the ground squirrel, flounder and ray were use, the HQs would be even higher.	The hazard quotient as a measure of potential effects is one aspect of the risk assessment, and an HQ greater than 1 does not necessarily indicate remedial action is necessary. The data have not been manipulated for the purpose of "reducing" risk, but has been evaluated in light of site conditions. As noted in response to Water Board general comment 2, additional samples will be collected to better define the nature and extent of contamination, and the potential for ecological risk in a baseline risk assessment. The risk calculations will be done with additional site-specific data to reduce the uncertainty associated with the current risk assessment. Please see the response to DTSC specific comment 1 and Dale Smith specific comment 5 regarding representative ecological receptors.
7.		In the section Refinement of Chemicals of Potential Ecological Concern measurements switch from µg/kg to mg/kg. This masks the enormity of the volume of contamination to all but the regulators.	The typo on page 36, where µg/kg is inadvertently used in place of µg/L, will be corrected; otherwise, the units µg/L (for water) and mg/kg (for soil) are used consistently in the text and will not be changed. These units of concentration are standard in the presentation of sample results.
8.		On page 35 the text states that "total HMW PAHs is (.0256mg/kg) and HMW PAHs is (0.0379mg/kg)". How can there be two different values? Note how the use of milligrams changes the perceived contamination level.	There is a typo on page 35, and the text should read "total HMW PAHs (0.256 mg/kg) and LMW PAHs is (0.379mg/kg)." The abbreviation "mg/kg" is used correctly and consistently both internally and with other reports of soil and sediment concentrations.

Response to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, July 2014

Comments by: Dale Smith, RAB

Date of Comments: August 25, 2014

No.	Section / Page	Comment	Response
Specific Comments (Continued)			
9.		Overall, this document does not satisfy the requirements of a thorough investigation of screening risks and their remediation. There is an astounding effort made to refute the data starting with using lower clean up exposures to inappropriate choice of species to "refining" the values to reach no further action. The analysis needs to be redone to really address ecological receptors and the impact of the contamination on them. It most definitely looks like an attempt to walk away from leaving a lovely little shore clean and inviting to future guests to the conference center or the Torpedo Building if it should be repurposed.	Risk refinement is an important part of the ecological risk assessment (ERA) process (Navy 1999, 2004). The Tier 1 SLERA corresponds to Steps 1 and 2 of the EPA guidance (EPA 1997, 2001), and sites identified in Tier 1 as posing potential unacceptable risks proceed to a Tier 2 baseline ecological risk assessment (BERA), which corresponds to Steps 3 to 7 of the EPA guidance. The initial step of the Tier 2 BERA includes refining conservative exposure assumptions employed in Tier 1 and recalculating risk estimates. This refinement step is referred to as Step 3a (Navy 2004). No buildings are currently present on or affected by the site.

Response to Comments on the Responses to Comments on the Draft Screening-Level Ecological Risk Assessment and Low-Threat Closure Evaluation for Site YF3, Naval Station Treasure Island, San Francisco, California, December 19, 2014

Comments by: Myriam Zech, RWQCB PM

Date of Comments: February 9, 2015

No.	Section / Page	Comment	Response
General Comments			
1.		Response to General Comment #2 – If the Navy has difficulty securing funding for the further investigation and evaluation, please let us know in a timely fashion so that we may keep our management informed.	Comment noted. The Navy will continue to work with the Water Board to plan for additional characterization of Site YF3.
2.		Response to Specific Comment #2 – A pdf of the Presidio document was emailed on February 2, 2015.	The Navy received the document and has incorporated the surface sediment criterion into the final report.
3.		Response to Specific Comment #6f, Paragraphs 2 and 3 – Water Board staff agrees that, based on the existing data and area of the release investigated, the LNAPL appears to be residual (i.e., not migrating or mobile). However, we do not agree that the draft SLERA supports a conclusion that the petroleum is not dissolving and discharging to the Bay through tidal action or other means. Water Board staff considers that such a conclusion would require additional supporting data to adequately address the level of uncertainty.	Comment noted. The Navy looks forward to working with the Water Board to plan for additional characterization of Site YF3.
4.		Furthermore, PAHs are not a suitable surrogate for evaluating the dissolution of a petroleum secondary source (i.e., LNAPL, LNAPL residual). This is simply because PAHs are relatively insoluble. However, the solubility of the petroleum degradation products (including PAH degradation products) is greater than the parent compounds and can result in greater exposure.	Comment noted. The Navy did not intend to imply that PAHs are considered a surrogate for evaluating dissolution of LNAPL, and looks forward to working in coordination with the Water Board to conduct additional characterization to support the evaluation of Site YF3.

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ATTACHMENT 1
HISTORICAL AERIAL PHOTOGRAPHS

Naval Station Treasure Island

Department of the Navy, BRAC PMO West, San Diego, CA

YF3 SITE BOUNDARY
MAY 27, 1931 AERIAL PHOTOGRAPH

Site YF3 SLERA

Naval Station Treasure Island

Department of the Navy, BRAC PMO West, San Diego, CA

YF3 SITE BOUNDARY
1942 AERIAL PHOTOGRAPH

Site YF3 SLERA

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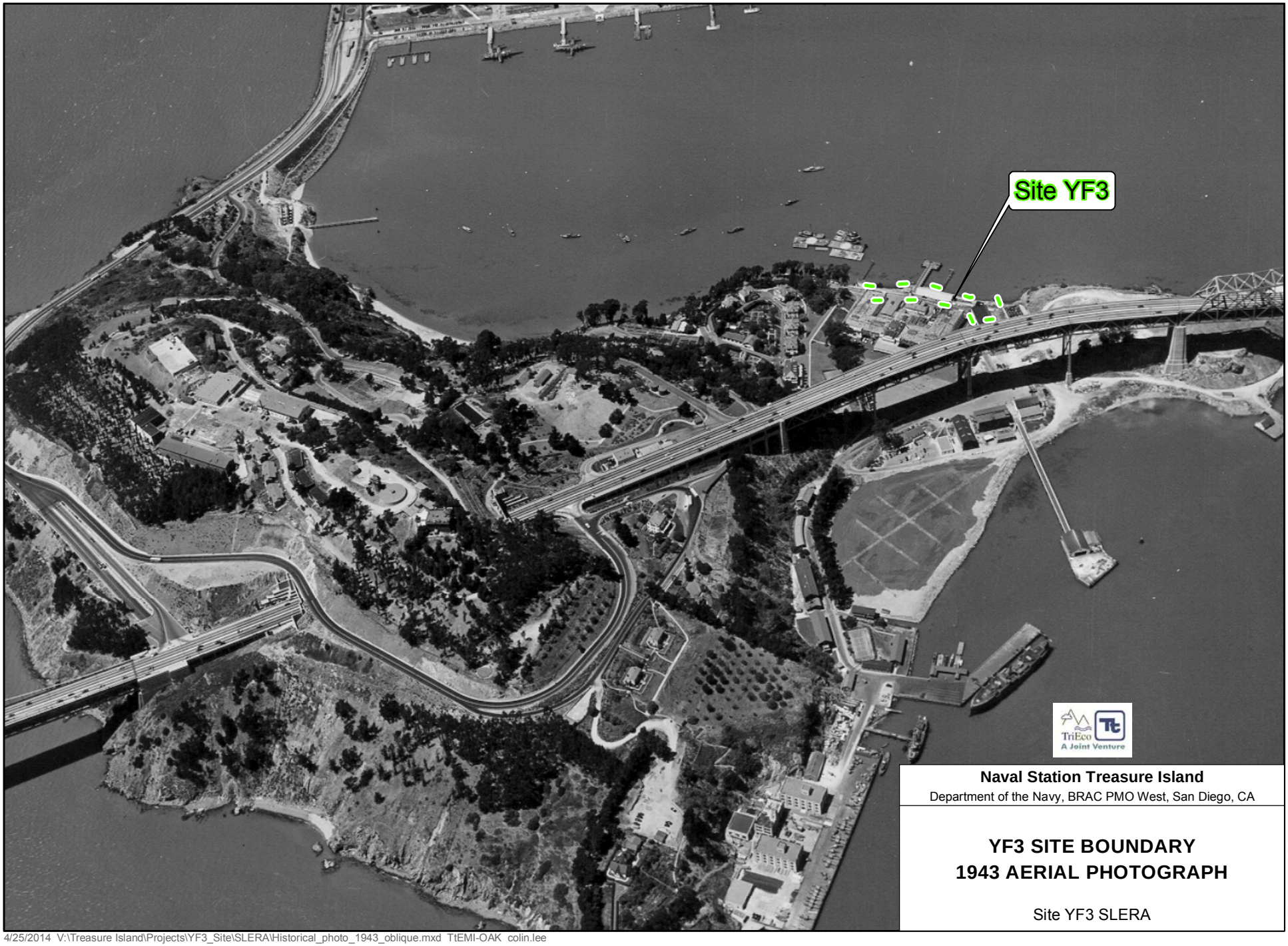

Naval Station Treasure Island

Department of the Navy, BRAC PMO West, San Diego, CA

YF3 SITE BOUNDARY
1943 AERIAL PHOTOGRAPH

Site YF3 SLERA

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