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Final

Remedial Investigation/Feasibility Study Report for Parcel E-2

Hunters Point Shipyard
San Francisco, California

Volume I of III

May 2011

Prepared for:
Base Realignment and Closure
Program Management Office West
San Diego, California 92108

Prepared by:
Engineering/Remediation Resources Group, Inc.
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Prepared under:
Naval Facilities Engineering Command Southwest
Contract Number N68711-05-C-6011
DCN: ERRG-6011-0000-0004

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Dear BCT members:

Enclosure (1) is the Final Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard, San Francisco, California, May 5, 2011.

If you should you have any concerns with this matter, please contact Lara Urizar at (619) 532-0960 or me at (619) 532-0913.

Sincerely,

KEITH FORMAN
BRAC Environmental Coordinator
By direction of the Director

Enclosure: 1. Final Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard, San Francisco, California, May 5, 2011.

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This public summary represents information presented in the document listed below. Neither the document nor the public summary has been reviewed by the regulatory agencies.

Public Summary: **Final Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard, San Francisco, California, May 2011**

The Department of the Navy (Navy) has prepared a combined Remedial Investigation (RI)/Feasibility Study (FS) Report for the contiguous area consisting of the closed industrial landfill (referred to as the "Parcel E-2 Landfill") and the surrounding areas that contain isolated or non-contiguous pockets of buried solid waste at Parcel E-2, Hunters Point Shipyard in San Francisco, California. This RI/FS Report summarizes and evaluates the nature and extent of contamination using all available data, including information from removal actions that have removed potential contamination sources at Parcel E-2. The data were used to update risk assessments for humans and wildlife at Parcel E-2. The results from the nature and extent evaluation and risk assessments were used to identify remedial action objectives, and to develop remedial alternatives consistent with U.S. Environmental Protection Agency (EPA) RI/FS guidance for landfills.

Based on the nature and extent evaluation and the risk assessment results, the following media and affected areas pose potential threats to humans and wildlife and are analyzed in the FS: (1) solid waste and soil in the Parcel E-2 Landfill; (2) landfill gas; (3) soil and isolated solid waste in the surrounding areas; (4) groundwater in the A-aquifer and B-aquifer; (5) surface water runoff; and (6) shoreline sediment. Consistent with EPA RI/FS guidance and the National Oil and Hazardous Substances Pollution Contingency Plan, the Navy evaluated a focused set of remedial alternatives for Parcel E-2 that included (1) no action; (2) excavate and dispose of solid waste, soil, and sediment; (3) contain solid waste, soil, and sediment with hot spot removal; and (4) contain solid waste, soil, sediment, and groundwater with hot spot removal. Alternatives 2, 3, 4, and 5 also include monitoring of contaminated media (such as groundwater) and institutional controls that would be implemented across the entire parcel to prevent exposure to contaminated soil and groundwater.

Information Repositories: A complete copy of the "Final Remedial Investigation/Feasibility Study Report for Parcel E-2," dated May 2011, is available to community members at:

San Francisco Main Library
100 Larkin Street
Government Information Center, 5th Floor
San Francisco, CA 94102
Phone: (415) 557-4500

Hunters Point Shipyard Office Trailer
690 Hudson Street
San Francisco, CA 94124

The report is also available to community members on request to the Department of the Navy. For more information about environmental investigation and cleanup at Hunters Point Shipyard, contact Keith Forman, BRAC Environmental Coordinator for the Navy, at:

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Final

Remedial Investigation/Feasibility Study Report for Parcel E-2
Hunters Point Shipyard, San Francisco, California
May 2011

Contract No.: N68711-05-C-6011
DCN: ERRG-6011-0000-0004

Submitted by:
Engineering/Remediation Resources Group, Inc. and Shaw Environmental, Inc.

Signature	May 5, 2011
Doug Bielskis, P.E.	Date
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Signature	May 5, 2011
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CERTIFICATION

This document was prepared under the direction and supervision of a qualified Professional Engineer

Doug Bielskis, P.E.
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Acronyms and Abbreviations

§	Section
µg/L	micrograms per liter
AFA	AFA Construction Group
AFCEE	Air Force Center for Environmental Excellence
ARAR	applicable or relevant and appropriate requirement
ARIC	area requiring institutional controls
ATSDR	Agency for Toxic Substances and Disease Registry
ATT	Aqua Terra Technologies
BAAQMD	Bay Area Air Quality Management District
Basin Plan	Comprehensive Water Quality Control Plan for the San Francisco Bay Basin
Bay	San Francisco Bay
BCDC	San Francisco Bay Conservation and Development Commission
BCT	Base Realignment and Closure Cleanup Team
BERA	baseline ecological risk assessment
BGMP	Basewide Groundwater Monitoring Program
bgs	below ground surface
BHC	benzene hexachloride
BMPs	best management practices
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, and xylenes
Cal/EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CCSF	City and County of San Francisco
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIWMB	California Integrated Waste Management Board
cm/sec	centimeters per second
COCs	chemicals of concern
COECs	chemicals of ecological concern
COPCs	chemicals of potential concern
COPECs	chemicals of potential ecological concern

cpm	counts per minute
CPT	cone penetrometer test
CSC	California species of special concern
CTR	California Toxics Rule
DCA	dichloroethane
DCB	dichlorobenzene
DCE	dichloroethene
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DHS	Department of Health Services
DNAPL	dense nonaqueous-phase liquid
DoD	U.S. Department of Defense
DQO	data quality objective
DTSC	Department of Toxic Substance Control
EE/CA	engineering evaluation/cost analysis
EEC	Eagle Environmental Construction
ELCRs	excess lifetime cancer risks
EMCON	EMCON Associates
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
ER-M	effects range-median
ERRG	Engineering/Remediation Resources Group, Inc.
ESAP	environmental sampling and analysis plan
ESL	environmental screening level
FFA	Federal Facilities Agreement
FS	Feasibility Study
FSP	field sampling plan
GAC	granular activated carbon
GCL	geosynthetic clay liner
GDGI	groundwater data gaps investigation
GES	groundwater extraction system
GMP	gas monitoring probe

gpd	gallons per day
GRA	general response action
GRI	Geosynthetic Research Institute
HELP-3	Hydrogeologic Evaluation of Landfill Performance, Version 3
HDPE	high-density polyethylene
HGAL	Hunters Point groundwater ambient levels
HHRA	human health risk assessment
HI	hazard index
HLA	Harding Lawson Associates
HPALs	Hunters Point ambient levels
HPS	Hunters Point Shipyard
HQs	hazard quotients
HRA	Historical Radiological Assessment
IAS	Initial Assessment Study
IDW	investigation-derived waste
IPCC	Intergovernmental Panel on Climate Change
IR	Installation Restoration
IT	International Technology Corporation
ITSI	Innovative Technical Solutions, Inc
Kleinfelder	Kleinfelder, Inc.
LEL	lower explosive limit
LFR	Levine-Fricke-Recon
LLRW	low-level radioactive waste
LNAPL	light nonaqueous-phase liquid
LRLs	laboratory reporting limits
LUC	land use control
MACTEC	MACTEC Engineering and Consulting
MARRS	MARRS Services, Inc.
MCLs	maximum contaminant levels
MD	munitions debris
MDAS	material documented as safe
MDLs	method detection limits
mg/kg	milligrams per kilogram
mg/L	milligrams per liter

MOA	Memorandum of Agreement
MPE	maximum probable earthquake
MPPEH	material potential presenting an explosive hazard
msl	mean sea level
NACIP	Navy Assessment and Control of Installation Pollutants
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
Navy	Department of the Navy
NAWQC	National Ambient Water Quality Criteria
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDGIs	nonstandard data gaps investigations
NEESA	Naval Energy and Environmental Support Activity
NMOC	nonmethane organic compound
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRDL	Naval Radiological Defense Laboratory
NTCRA	non-time-critical removal action
O&M	operation and maintenance
OMP	Operation and Maintenance Plan
PAHs	polycyclic aromatic hydrocarbons
PAMP	perimeter air monitoring program
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
PeCDF	pentachlorodibenzofuran
PMO	Program Management Office
ppm	parts per million
ppmv	parts per million by volume
PQL	practical quantitation limit
PRB	permeable reactive barrier
PRC	PRC Environmental Management
PRG	preliminary remediation goal

PSC	protective soil concentration
PV	present value
PVC	polyvinyl chloride
QAPP	quality assurance project plan
QCSR	quality control summary report
R&D	research and development
RAOs	remedial action objectives
RASO	Radiological Affairs Support Office
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI	Remedial Investigation
RIEC	remedial investigation evaluation criteria
RME	reasonable maximum exposure
RMP	Risk Management Plan
ROCs	radionuclides of concern
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SCRS	surface confirmation radiation survey
SDGI	standard data gap investigation
SFDA	San Francisco District Attorney
SFRA	San Francisco Redevelopment Agency
Shaw	Shaw Environmental, Inc.
SLERA	screening-level ecological risk assessment
SPT	standard penetration test
SSF	site specific factors
SVOCs	semivolatile organic compounds
SWAQAT	Solid Waste Air Quality Assessment Test
SWDMP	Stormwater Discharge Management Plan
SWRCB	State Water Resources Control Board
TCA	trichloroethane
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCE	trichloroethene

TCRA	time-critical removal action
TDS	total dissolved solids
TEQ	toxicity equivalent quotient
TIZ	tidal influenced zone
TMZ	tidal mixing zone
TOG	total oil and grease
TPH	total petroleum hydrocarbons
TPH-d	TPH as diesel
TPH-g	TPH as gasoline
TPH-mo	TPH as motor oil
Triple A	Triple A Machine Shop, Inc.
TRVs	toxicity reference values
TtECI	Tetra Tech EC, Inc.
TtEMI	Tetra Tech EM Inc.
TtFW	Tetra Tech FW, Inc.
U&A	Uribe and Associates, Inc.
UCL	upper confidence limit
UCSF	University of California, San Francisco
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance
VOCs	volatile organic compounds
WBZ	water-bearing zone
WMMP	wetlands mitigation and monitoring plan
WQOs	water quality objectives

Executive Summary

The Department of the Navy (Navy) has prepared this combined Remedial Investigation (RI)/Feasibility Study (FS) Report for the area consisting of the closed industrial landfill (hereafter identified as the "Parcel E-2 Landfill") and the surrounding areas that contain isolated or noncontiguous pockets of buried solid waste within Parcel E-2 at Hunters Point Shipyard (HPS) in San Francisco, California. This RI/FS Report is part of ongoing efforts by the Navy to address contamination at Parcel E-2 in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Title 42 United States Code [USC] Sections [§§] 9601-9675).

Because past shipyard operations left hazardous materials on site, HPS property was placed on the National Priorities List in 1989 as a Superfund site pursuant to CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986. In 1991, HPS was designated for closure pursuant to the Defense Base Closure and Realignment Act of 1990. Closure activities at HPS involve conducting environmental remediation and making the property available for nondefense use. As a management tool to accelerate site investigation, cleanup, and reuse, HPS was divided into parcels. Sites within each parcel are evaluated concurrently. In September 2004, the Navy divided Parcel E into two parcels (Parcels E and E-2) to facilitate closure of the Parcel E-2 Landfill and its adjacent areas.

This RI/FS Report summarizes and evaluates the nature and extent of contamination using all available data, including information from removal actions that have removed potential contamination sources at Parcel E-2. The data were used to update risk assessments for humans and wildlife at Parcel E-2. Results from the nature and extent evaluation and risk assessments were used to identify remedial action objectives (RAOs), and to develop remedial alternatives consistent with U.S. Environmental Protection Agency (EPA) RI/FS guidance for landfills (EPA, 1991a). Each remedial alternative was evaluated in accordance with criteria established in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Title 40 Code of Federal Regulations [CFR] Part 300). This RI/FS Report addresses CERCLA hazardous substances except for radionuclides. Radionuclides in soil and groundwater are evaluated in the radiological addendum to this RI/FS Report. Both chemical and radiological contaminants will then be addressed together in the proposed plan and the Record of Decision (ROD).

ES.1. SITE HISTORY AND PLANNED REUSE

Parcel E-2 consists of 47.4 acres of shoreline and lowland coast along the southwestern portion of HPS, and contains four distinct areas, which were designated to streamline the information presented in this RI/FS Report (Figure ES-1):

- The "Landfill Area," which comprises the entire Parcel E-2 Landfill and its immediate perimeter
- The "Panhandle Area," located west and southwest of the Landfill Area
- The "East Adjacent Area," located to the east of the Landfill Area
- The "Shoreline Area" located at the interface with San Francisco Bay

Based on the City and County of San Francisco's Redevelopment Plan for HPS, Parcel E-2 is designated for open space reuse except for a small area in the East Adjacent Area, which is designated as part of the "Shipyard South Multi-Use District." The potential land uses envisioned for the Shipyard South Multi-Use District include recreational, industrial, and residential (San Francisco Redevelopment Agency, 2010).

ES.1.1. Operational History

Parcel E-2 is part of an area created in the 1940s, 1950s, and 1960s by filling in the bay margin with various materials, including soil, crushed bedrock, dredged sediments, and debris. The overall composition of the fill material, on which the Parcel E-2 Landfill was created, is primarily sand and clay with intermixed construction debris (Tetra Tech EM Inc. [TtEMI], 2004f). Almost all of the land at HPS was created by filling activities conducted between the early 1940s and the late 1960s.

Between 1958 and 1974, the Navy created the Parcel E-2 Landfill by placing various shipyard wastes, including construction debris, municipal-type solid waste, and industrial waste (including sandblast waste, paint sludge, solvents, and waste oils) (Naval Energy and Environmental Support Activity [NEESA], 1984). As a result, the landfill has a heterogeneous composition and includes solid waste intermixed with soil fill. The physical extent of solid waste covers approximately 22 acres (TtEMI, 2004f). Shortly after landfill operations ceased in 1974, the Navy implemented several preliminary landfill closure measures, including placing a minimum of 2 feet of compacted, imported fill on top of the landfill.

Between 1976 and 1986, industrial operations conducted by a lessee of the property (Triple A Machine Shop, Inc.) allegedly resulted in the disposal of industrial debris, sandblast waste, oily industrial sand, and asphalt over an area of approximately 5 acres along the shoreline in Parcel E-2 and in a portion of the Landfill Area. The lessee also allegedly stored unlabeled, deteriorating, uncovered drums with their contents exposed to the elements in the southeast portion of Parcel E-2 (San Francisco District Attorney, 1986).

ES.1.2. Investigation Activities

Environmental investigations performed from 1984 to 1996 were evaluated in RI and FS reports for Parcel E, which encompassed the area later subdivided as Parcel E-2. During preparation of these reports, the Navy and regulatory agencies decided that additional data gaps investigations were needed to better define the nature and extent of chemicals in soil and groundwater at Parcel E-2, and to better evaluate site conditions in and around the Parcel E-2 Landfill. Previous environmental investigations at Parcel E-2 are listed below.

Environmental Investigation Activities at Parcel E-2	
▪ 1984	Initial Assessment Study
▪ 1987	Confirmation Study/Verification Step, Area Study for Asbestos-Containing Material and Organic and Inorganic Soil Contamination
▪ 1986–1988	Triple A Investigation, Remedial Action Order and RI/FS Scoping Document
▪ 1988–1989	Solid Waste Air Quality Assessment Test
▪ 1988–1992	Operable Unit I Remedial Investigation
▪ 1991–1992	Intertidal Sediment Study
▪ 1991 and 1993	Radiological Investigation (Phases I and II)
▪ 1994–1996	Ecological Risk Assessment (Phases 1A and 1B)
▪ 1995–1998	Parcel E Remedial Investigation and Feasibility Study
▪ 1999–2000	Ecological Risk Assessment Validation Study
▪ 2000–2002	Groundwater Data Gaps Investigations (Phases I, II, and III)
▪ 2001–2002	Landfill and Soil Data Gaps Investigations, Wetlands Delineation
▪ 2001–2003	Radiological Investigations, Phase V (and other interim investigations)
▪ 2002–2005	Shoreline Sediment Characterization
▪ 2007–2008	Parcel E-2 Groundwater Investigation

ES.1.3. Interim Removal Actions

The Navy has performed several interim removal actions at Parcel E-2 to minimize potential exposure of hazardous substances and to expedite the cleanup process. Removal actions conducted to date are listed below.

Removal Actions at Parcel E-2 (Figure ES-1)

- Groundwater Extraction System, 1997–1998: a groundwater containment and extraction system was installed at the southeast portion of Parcel E-2 to reduce the potential for release of landfill constituents into San Francisco Bay.
- Landfill Cap Construction, 2000–2001: a multilayer interim cap was constructed on a portion of the Parcel E-2 Landfill to prevent oxygen intrusion and extinguish smoldering subsurface areas following a brush fire.
- Landfill Gas Removal Action, 2002–2003: a landfill gas control and monitoring system was installed along the northern Parcel E-2 boundary to control gas migration from the landfill.
- Metal Slag Area Removal Action, 2005–2007: 8,200 cubic yards of contaminated soil and sediment, including 119 cubic yards of radiologically impacted soil and debris, was excavated and disposed of off site from this area in the southwest portion of Parcel E-2.
- Polychlorinated Biphenyl Hot Spot Area Removal Action, 2005–2007: 44,500 cubic yards of contaminated soil, including 611 cubic yards of radiologically impacted soil and debris, was excavated from this area and disposed of off site in the southeast portion of Parcel E-2.

ES.1.4. Ongoing Monitoring Programs

The Navy has implemented several environmental monitoring programs to satisfy regulatory requirements for Parcel E-2 until a final remedy is selected. The ongoing monitoring programs at Parcel E-2 are summarized below.

Ongoing Monitoring Programs Implemented at Parcel E-2

2003–Present	Stormwater Discharge Management Program
2003–Present	Landfill Cover Inspection and Maintenance Program
2004–Present	Basewide Groundwater Monitoring Program
2004–Present	Landfill Gas Control and Monitoring Program

ES.2. NATURE AND EXTENT OF CONTAMINATION

The nature and extent evaluation was performed for the following potentially contaminated media: (1) solid waste and soil in the Landfill Area; (2) landfill gas; (3) soil and isolated solid waste in the adjacent areas (Panhandle, East Adjacent, and Shoreline Areas); (4) groundwater; (5) surface water; and (6) shoreline sediment. Data were initially evaluated to identify chemicals whose presence may be attributed to the Navy's past site operations. The evaluation was then focused by comparing the site data against remedial investigation evaluation criteria (RIEC). The RIEC were selected based on regulatory criteria and are adequately conservative to show the extent of chemicals that may pose a risk to human health or the environment. As discussed on Page ES-1, this RI/FS Report addresses CERCLA hazardous

substances except for radionuclides. Radionuclides in soil and groundwater are evaluated in the radiological addendum to this RI/FS Report.

ES.2.1. Solid Waste and Soil in the Landfill Area

The contiguous solid waste in the Landfill Area is composed primarily of municipal-type waste and construction debris. The waste was observed in 28 soil borings, 18 monitoring wells, and 25 test pits extended within the Landfill Area. The solid waste includes wood, paper, plastic, metal, glass, asphalt, concrete, and bricks that are mixed with sand, clay, and gravel fill. Construction debris (such as asphalt, concrete, and brick) is typically inert and is not expected to generate leachate that would create potential risks to human health or the environment.

In addition to municipal-type waste and construction debris, historic information indicates that industrial wastes were also disposed of in or around the Landfill Area, including sandblast waste, radioluminescent devices, asbestos-containing debris, paint sludge, solvents, and waste oils (NEESA, 1984; Naval Sea Systems Command, 2004). The presence of some of these industrial wastes was confirmed during cleanup activities within the Polychlorinated Biphenyl (PCB) Hot Spot Area, which extended into a small portion the Landfill Area (Navy, 2005b through 2005f; Tetra Tech EC, Inc. [TtECI], 2007a). The characterization data suggest that the quantity of industrial waste within the Landfill Area is less than the quantity of municipal-type waste and construction debris.

The areal extent of solid waste covers approximately 22 acres, and the estimated volume of the solid waste is 473,000 cubic yards. Waste across the Landfill Area varies from less than 10 feet thick to greater than 25 feet thick (with an average of about 13 feet thick). In most areas of the Parcel E-2 Landfill, waste is in direct contact with groundwater.

The soil data set within the Landfill Area was derived from 333 soil samples collected from the intermittent soil fill mixed within the solid waste. Metals, semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), PCBs, pesticides, and petroleum hydrocarbons were detected at concentrations exceeding the RIEC in soil samples collected at the Landfill Area. Soil characterization data within the Landfill Area are used to assess the general extent of RIEC exceedances relative to the landfill waste volume. This assessment provides a basis for determining whether lesser quantities of hazardous wastes are present in the landfill as compared with municipal wastes, which is one evaluation factor outlined in EPA presumptive remedy guidance (provided in Appendix H of this report). Nearly all of the chemicals detected in Landfill Area soil at concentrations above RIECs were of a limited extent relative to the overall waste volume. These results indicate that lesser quantities of potentially hazardous industrial wastes are present in the landfill as compared with municipal-type waste and construction debris.

The nature and extent of solid waste and chemicals in soil within the Landfill Area is adequately characterized to evaluate a focused set of remedial alternatives in the FS. This determination is based in large part on EPA presumptive remedy guidance for CERCLA landfills (EPA, 1993a, 1993b, 1994, and 1996). Consistent with EPA guidance, characterization of the solid waste is not necessary or appropriate for selecting a response action for the Landfill Area.

ES.2.2. Landfill Gas

Landfill gas characterization, consisted of installation of temporary soil gas borings and 21 permanent gas monitoring probes (GMPs). It was determined that methane was present at concentrations exceeding 25 percent of the lower explosive limit (LEL), equivalent to 1.25 percent methane by volume, north of the Parcel E-2 Landfill (including property owned by the University of California San Francisco [UCSF]). Methane was not detected at concentrations exceeding 25 percent of the LEL in locations along Crisp Avenue (approximately 200 feet north of the landfill) or to the east, south, and west of the landfill. Nonmethane organic compounds (NMOCs) were detected in both the temporary soil gas borings and the permanent GMPs, with the highest concentrations immediately north of the landfill.

Upon completion of the landfill gas characterization, the Navy conducted a removal action to (1) remove landfill gas and reduce subsurface methane concentrations at the UCSF compound to below the LEL (5 percent methane by volume in air); and (2) control future migration of landfill gas to off-site areas. The removal action involved installation and operation of a gas control, extraction, and treatment system. Monitoring is performed on a regular basis and includes notification and response procedures if hazardous concentrations of landfill gas (either methane or NMOCs) are detected beyond the fence line of the landfill and beneath the UCSF compound. Data collected as part of the landfill gas characterization study, the removal action, and ongoing landfill gas monitoring have adequately defined the nature and extent of landfill gas at Parcel E-2. Additional studies are planned, in conjunction with the remedial design, to more thoroughly evaluate soil gas concentrations in the Panhandle Area and East Adjacent Area and to assess whether methane or NMOCs are present in the areas at concentrations that may be hazardous to human health.

ES.2.3. Soil and Isolated Solid Waste in the Panhandle and East Adjacent Areas

The nature and extent of solid waste in the Panhandle and East Adjacent Areas are distinct from the solid waste defined in the Landfill Area. Specifically, fill material in the Panhandle and East Adjacent Areas consists primarily of soil and rock with isolated solid waste locations that are not contiguous with solid waste in the Landfill Area. Solid waste within the Panhandle and East Adjacent Areas consists of a heterogeneous distribution of construction debris (primarily concrete, brick, wood, and asphalt) and isolated locations of industrial wastes (such as, sandblast waste, metal slag, radioluminescent devices, and oily waste). Industrial wastes have been encountered in the two Parcel E-2 areas where removal actions

were recently completed. Industrial wastes encountered within the Metal Slag Area (in the Panhandle Area) and the PCB Hot Spot Area (in the East Adjacent Area) were removed and disposed of off site; however, chemical concentrations in soil remain at both areas and warrant further analysis in the FS portion of this report.

The soil data set was derived from 754 soil samples (113 soil borings, 113 excavation grids within the PCB Hot Spot Area and Metal Slag Area, and 14 test pits) collected within the Panhandle and East Adjacent Areas. Metals, SVOCs, VOCs, pesticides, PCBs, dioxins and furans, and petroleum hydrocarbons were detected at concentrations exceeding RIECs in soil samples collected in the Panhandle and East Adjacent Areas. Soil contamination is more widely distributed in the Panhandle Area and the shallow zones (0 to 10 feet below ground surface [bgs]) of the East Adjacent Area. Soil contamination is less extensive within East Adjacent Area soil at depths greater than 10 feet bgs. This finding is attributed to the fact that deep soil within the East Adjacent Area consists of either natural sediments or fill material placed during expansion of the shipyard in the early 1940s.

The heterogeneous distribution of solid waste and soil contamination makes delineation of potential areas of concern problematic; however, past characterization efforts have provided sufficient data to evaluate potential risks to humans and wildlife at Parcel E-2 because past sampling locations have focused, to the extent practical, on the most likely contaminant sources (based on a comprehensive review of historic aerial photographs and any visual evidence of contamination).

ES.2.4. Groundwater

Groundwater contamination has been confirmed through sampling across Parcel E-2 in both the A-aquifer and uppermost B-aquifer. The lateral and vertical extent of chemicals in groundwater has been defined across most of Parcel E-2 through a series of investigations and the ongoing groundwater monitoring program. The extent of chemicals in groundwater, however, is not completely defined along the Parcel E-2 shoreline. In 2008, a focused data gaps investigation was performed along the Parcel E-2 shoreline, and results of the investigation helped to identify areas requiring further evaluation in the FS portion of this report. Primary potential migration pathways for contaminated groundwater include migration and discharge of A-aquifer groundwater into San Francisco Bay and wetlands and migration of A-aquifer groundwater (including the saturated waste layer) into the uppermost B-aquifer.

The primary groundwater analytical groups at Parcel E-2 include metals, SVOCs, VOCs, pesticides, PCBs, petroleum hydrocarbons, and anions (such as ammonia and cyanide). Groundwater sampling results indicate that the concentrations and extent of contamination in the uppermost B-aquifer are less than observed in the A-aquifer due to the hydrogeologic and geologic characteristics (presence of Bay Mud) across most of Parcel E-2. Overall, the number of detected chemicals and the magnitude of the concentrations detected in both aquifers have declined between 1990 and 2007.

ES.2.5. Surface Water

Potential exposure of wildlife to unacceptable chemical concentrations in surface water runoff is monitored in accordance with a Stormwater Discharge Management Program (MARRS Services, Inc. [MARRS] and MACTEC Engineering and Consulting [MACTEC], 2009b). Results to date indicate no incidents of noncompliance at Parcel E-2 except in isolated locations where best management practices (BMPs) require modification to better control erosion and sediment transport from neighboring properties (TtEMI, 2004d; AFA Construction Group and Eagle Environmental Construction [EEC], 2005a; EEC, 2006 and 2007; MARRS and MACTEC, 2008a, 2009a, and 2010). The ongoing maintenance of the interim cap and implementation of BMPs serves to minimize erosion from surface water runoff and potential exposure to wildlife. Continued management (through implementation of BMPs) and monitoring of surface water runoff should be evaluated as part of any remedial alternative that leaves contaminated soil in place.

ES.2.6. Shoreline Sediment

Potential risks to wildlife, specifically benthic invertebrates, birds, and mammals, exposed to intertidal sediments at Parcel E-2 were evaluated in a screening-level ecological risk assessment (SLERA) prepared in conjunction with the Shoreline Characterization Technical Memorandum (included as Appendix G in this RI/FS Report). Concentrations of chemicals in surface and subsurface sediment samples collected from the Shoreline Area were screened against toxicological benchmarks for invertebrates, birds, and mammals.

The shoreline SLERA concluded that concentrations of copper and lead in sediment along the Parcel E-2 shoreline are a potential source of contamination to Parcel F. In addition, benthic invertebrates, birds, and mammals are at risk from exposure to PCBs in surface sediments along the Parcel E-2 shoreline.

Source control measures are warranted along the Parcel E-2 shoreline, particularly in the Metal Slag Area of the Panhandle Area and the Landfill Area, to control potential releases of copper and lead to Parcel F. In addition, ecological risk to benthic invertebrates, birds, and mammals in the shoreline warrants the evaluation of remedial alternatives for intertidal sediments along the entire Parcel E-2 shoreline.

ES.3. RISK ASSESSMENTS

Potential risks to humans and wildlife were evaluated for the following contaminated media: (1) soil; (2) landfill gas; (3) groundwater; and (4) shoreline sediment. The human health risk assessment (HHRA) was performed in accordance with the protocols and procedures for conducting HHRAs at HPS established by the Base Realignment and Closure Cleanup Team. SLERAs for soil and sediment were performed in accordance with Navy policy and EPA guidance (Navy, 1999; EPA, 1997).

ES.3.1. Soil

Human Health Risk Assessment

The HHRA calculated cancer risks and noncancer hazards from exposure to chemicals of potential concern (COPCs) in soil for recreational users and construction workers. The recreational use evaluated in the HHRA is consistent with the planned open space reuse at Parcel E-2. As discussed in Section ES.1, land uses other than open space are incompatible with the landfill area, and institutional controls such as restrictive covenants will address this incompatibility. Both total and incremental risks were evaluated for exposure to soil at Parcel E-2. The total risk evaluation provides an estimate of the risks posed by all chemicals at the site, including those present at concentrations at or below Hunters Point ambient levels (HPALs). The incremental risk evaluation provides an estimate of risks posed by all chemicals at the site, except those that do not exceed HPALs. A risk characterization analysis, of both total and incremental risk, identified the following chemicals of concern (COCs) that contribute to cancer risks exceeding 1×10^{-6} or noncancer hazard indices exceeding 1.0:

Chemicals of Concern		
Construction Worker Exposure [a] to Subsurface Soil (0 to 10 feet bgs)	**Recreational User Exposure [b] to Surface Soil (0 to 2 feet bgs)**	
4,4-DDT	Antimony	Indeno(1,2,3-cd)pyrene
Antimony	Aroclor-1242	Lead
Aroclor-1016	Aroclor-1248	Total PCBs (non-dioxin)
Aroclor-1242	Aroclor-1254	
Aroclor-1248	Aroclor-1260	
Aroclor-1254	Arsenic	
Aroclor-1260	Benzo(a)anthracene	
Arsenic	Benzo(a)pyrene	
Benzo(a)anthracene	Benzo(b)fluoranthene	
Benzo(a)pyrene	Benzo(k)fluoranthene	
Benzo(b)fluoranthene	Dieldrin	
Benzo(k)fluoranthene	Heptachlor epoxide	

Notes: COCs for total risk and incremental risk are identical

a The construction worker exposure scenario is not associated with a specific planned reuse for Parcel E-2.

b COCs identified for this exposure scenario are based on the planned reuse for Parcel E-2 as open space.

DDT Dichlorodiphenyltrichloroethane

The highest cancer and noncancer risks were at grid cells where the western and southwestern sidewall of the PCB Hot Spot Area excavation is located. Risk in these grid cells was reduced slightly following the removal action; however, remaining chemical concentrations along the western and southwestern sidewall of the PCB Hot Spot Area excavation continue to drive risk.

Screening-Level Ecological Risk Assessment

The Navy implemented the following steps to update previous ecological assessments with recent data collected during the soil data gaps investigation and following removal actions at the Metal Slag Area and the PCB Hot Spot Area: (1) evaluated the new data set to validate the list of chemicals of potential ecological concern (COPECs) used in the previous baseline ecological risk assessment for terrestrial receptors; (2) identified additional chemicals as COPECs and calculated protective soil concentrations (PSCs) for these additional chemicals; and (3) updated the previous ecological assessments by performing a SLERA for onshore ecological receptors using the updated PSCs and surface soil data set. The onshore SLERA evaluated all soil data within the Landfill Area, Panhandle Area, and East Adjacent Area, including data collected within wetland areas. Concentrations of cadmium, copper, lead, manganese, mercury, nickel, vanadium, zinc, polycyclic aromatic hydrocarbons, total DDT, and total PCBs exceeded PSCs (adjusted by HPALs, as appropriate) and are chemicals of ecological concern (COECs) that pose a potential threat to birds and mammals exposed to soil in Parcel E-2.

ES.3.2. Landfill Gas

Human exposure to subsurface air emanating from the landfill (referred to as landfill gas) can pose a potential risk in two ways: (1) explosive conditions due to concentrations of methane at or above the LEL; and (2) inhalation of NMOCs that, above certain concentrations, have associated cancer and noncancer health effects. Evaluation of these potential risks was performed consistent with regulations outlined in Title 27 California Code of Regulations (CCR).

For the landfill gas characterization, the evaluation methodology for methane data involved comparing field and laboratory data collected from the monitoring network against the numeric 27 CCR limits. The evaluation methodology for NMOCs involved performing risk assessments on soil gas data using the Johnson and Ettinger vapor intrusion model (EPA, 2003a). Cancer risk calculations for GMPs along Crisp Avenue and within the UCSF compound were less than the NCP point of departure of 1×10^{-6}; therefore, soil gas along Crisp Avenue and within the UCSF compound does not pose an unacceptable risk to human health.

Based on evaluation of available data from January 2004 through June 2010, the gas control system is controlling the migration of hazardous levels of methane gas beyond the northern fence line of the Parcel E-2 Landfill. In January and February 2006, hazardous levels of methane were detected at the fence line of the landfill. The Navy promptly performed active extraction to control the migration of hazardous levels of methane beyond the fence line of the landfill. The potential exists for methane, if not properly controlled, to migrate beyond the Parcel E-2 Landfill boundary at concentrations that may be hazardous to human health. Therefore, continued monitoring and control (through either passive or active methods) of methane should be included as part of any remedial alternative that leaves solid wastes in place in the Landfill Area.

ES.3.3. Groundwater

Human Health Risk Assessment

For the evaluation of human exposure to groundwater, the HHRA used groundwater monitoring data from the 12 most recent sampling events (through October 2007) from all Parcel E-2 wells to develop a conservative exposure concentration for each potentially complete pathway (based on the 95 percent upper confidence limit). The HHRA evaluated B-aquifer groundwater for domestic use; the evaluation used both B-aquifer and A-aquifer data because of the potential for vertical hydraulic communication between the A- and B-aquifers in some areas at Parcel E-2. In addition, construction workers were also assumed to be exposed to groundwater in the A-aquifer during trenching activities. For groundwater exposures, risks are the same for the total risk and incremental risk evaluations because a comparison to ambient levels was not conducted for groundwater.

The primary risk drivers for the construction worker trench exposure scenario are SVOCs, primarily benzo(a)pyrene and dibenz(a,h)anthracene, which account for more than 95 percent of the total cancer risk exceeding 1×10^{-6}. However, benzo(a)pyrene and dibenz(a,h)anthracene have not been detected in Parcel E-2 groundwater since August 2002. In addition, the extent of most SVOCs in Parcel E-2 groundwater has been localized, with maximum concentrations detected at former well IR01MWI-3 in the PCB Hot Spot Area excavation.

The primary risk drivers for the domestic use of the groundwater exposure scenario are arsenic and PCBs, accounting for over 70 percent of the total cancer risk exceeding 1×10^{-6}. Another risk driver that contributes significantly to the total cancer risk is benzo(a)pyrene, which accounts for approximately 13 percent of the total cancer risk exceeding 1×10^{-6}. The risk evaluation also indicated that the primary noncancer risk drivers include metals (arsenic, iron, hexavalent chromium, and thallium), 4-nitrophenol, and PCBs, which account for over 85 percent of the noncancer risk exceeding a hazard index of 1.0.

Ecological Risk Assessment

A screening-level assessment of ecological risk to aquatic wildlife exposed to potentially contaminated groundwater at Parcel E-2 is provided in Appendix M. Chemical concentrations in groundwater were screened against the assigned aquatic evaluation criteria, mainly comprising saltwater aquatic criteria, to identify COPECs for surface water quality. Site-specific data for select COPECs were then evaluated against trigger levels, consistent with the methods used in recent FS reports at other HPS parcels, to further confirm if the COPECs needed to be addressed in remedial alternatives. Based on concentrations exceeding trigger levels (as adjusted based on HGALs), the following chemicals (or groups of chemicals) pose a potential threat to aquatic wildlife exposed to potentially contaminated groundwater at Parcel E-2:

- Copper
- Lead
- Zinc
- Un-ionized Ammonia
- Sulfide
- Cyanide
- PCBs (Total)
- Total petroleum hydrocarbons (TPH)

ES.4. REMEDIAL INVESTIGATION CONCLUSIONS

Parcel E-2 has been adequately characterized to support the development of a focused set of remedial alternatives. The conclusion that adequate data exist, despite the areas where chemicals in soil and groundwater are not completed delineated, is consistent with EPA RI/FS guidance. Specifically, EPA RI/FS guidance states that "the objective of the RI/FS process is not the unattainable goal of removing all uncertainty, but rather to gather information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site" (EPA, 1988a).

Based on the nature and extent evaluation, the identified exposure pathways based on the conceptual site model, and the risk assessment results, the following media and affected areas pose potential threats to human health and the environment and will undergo remedial option analysis in the FS: (1) solid waste and soil in the Landfill Area; (2) landfill gas; (3) soil and isolated solid waste in the Panhandle and East Adjacent Areas; (4) A-aquifer and B-aquifer groundwater; (5) surface water runoff; and (6) shoreline sediment.

ES.5. FEASIBILITY STUDY

The approach used to conduct the FS consisted of the following steps: develop remediation goals, develop RAOs, identify general response actions (GRAs), identify areas requiring remediation, and evaluate alternatives based on the nine NCP evaluation criteria. Each of these steps is discussed in the following paragraphs.

ES.5.1. Remediation Goals

Humans

Remediation goals for humans were derived for each COC identified in the risk assessments by comparing the highest concentrations of acceptable incremental risk with both the laboratory's reporting limit and the ambient level for the COC, if one was established. The greatest value from this comparison was selected as the remediation goal for that COC. For landfill gas, remediation goals were derived using the numeric 27 CCR limits for methane and by identifying screening levels for NMOCs that are considered protective of human health.

Wildlife

Remediation goals for wildlife were derived for COECs identified from the nature and extent evaluation and the risk assessments. For surface soil and shoreline sediment, remediation goals were derived using the corresponding PSCs (for soil) and effects range-median values (for shoreline sediment) developed as part of the risk assessment process. For surface water runoff, remediation goals were derived using promulgated criteria for saltwater aquatic life. Saltwater aquatic criteria were used in a screening-level evaluation of groundwater discharges; however, the identified chemicals in groundwater that may pose a risk to aquatic wildlife in San Francisco Bay are considered COPECs (that is, of chemicals of potential ecological concern) given the conservative nature of the risk analysis performed for that pathway. As such, groundwater remediation goals have not been developed for these COPECs. The remedial alternatives evaluate areas affected by these COPECs, the remediation technologies to be evaluated (include source removal, containment, and monitoring) are considered adequate to address the potential risk to aquatic wildlife in the bay.

In addition, remediation goals were established for TPH that are commingled with CERCLA-regulated chemicals. The TPH remediation goals were based on criteria established for Hunters Point petroleum program and were developed for protection of aquatic wildlife in the bay. The TPH criteria sum all TPH categories (gasoline-range, diesel-range, and motor-oil range). The total TPH groundwater criterion ranges from 1,400 to 20,000 micrograms per liter, depending on the distance from the shoreline (Shaw Environmental, Inc. [Shaw], 2007). The total TPH soil source criterion is 3,500 milligrams per kilogram, and is applied to potential soil sources between 0 and 10 feet bgs (Shaw, 2007).

ES.5.2. Remedial Action Objectives

RAOs for Parcel E are medium-specific goals that were developed to protect human health and the environment. Each RAO specifies: (1) the COCs; (2) the exposure route and receptor(s); and (3) an acceptable chemical concentration or range of concentrations for medium of concern. The following table summarizes the RAOs developed for Parcel E-2.

Media / Receptor	Remedial Action Objective
Waste, Soil, and Sediment / Humans	Prevent exposure to organic and inorganic chemicals at concentrations greater than remediation goals in (1) solid waste, soil, or sediment from 0 to 2 feet bgs by recreational users; or (2) solid waste, soil, or sediment from 0 to 10 feet bgs by construction workers.
Waste, Soil, and Sediment / Wildlife	Prevent exposure of wildlife to organic and inorganic chemicals in solid waste or soil at concentrations greater than remediation goals from 0 to 3 feet bgs throughout Parcel E-2.
	Prevent exposure of wildlife to organic and inorganic chemicals in intertidal sediment at concentrations greater than remediation goals from 0 to 2.5 feet bgs throughout the Shoreline Area.
Landfill Gas	Control methane concentrations to (1) 5 percent (by volume in air) or less at subsurface points of compliance; and (2) 1.25 percent (by volume in air) or less in on-site structures.
	Prevent exposure to NMOCs at concentrations (1) greater than 500 parts per million by volume (ppmv) at the subsurface points of compliance; and (2) greater than 5 ppmv above background levels in the breathing zone of on-site workers and visitors.
Groundwater / Humans	Prevent exposure to groundwater that may contain COCs at concentrations greater than remediation goals through the domestic use pathway.
	Prevent or minimize migration of B-aquifer groundwater that may contain COCs at concentrations greater than remediation goals beyond the compliance boundary.
	Prevent or minimize dermal contact to and vapor inhalation from A-aquifer groundwater containing COCs at concentrations greater than remediation goals by construction workers.
Groundwater / Wildlife	Prevent or minimize migration of COPECs to prevent discharge that would result in concentrations greater than the corresponding water quality criteria for aquatic wildlife.
	Prevent or minimize migration of A-aquifer and B-aquifer groundwater containing total TPH concentrations greater than the remediation goal (where commingled with CERCLA substances) into San Francisco Bay.
Surface Water / Wildlife	Prevent or minimize migration of surface water that may contain COECs at concentrations greater than water quality criteria for aquatic wildlife into San Francisco Bay.

ES.5.3. General Response Actions, Remedial Technologies, and Process Options

GRAs are responses or remedies intended to meet RAOs. The following GRAs were selected for Parcel E-2:

- No action—which is required by the NCP and is used as a baseline for comparison
- Institutional actions—includes institutional controls, engineering controls, and site monitoring
- Containment actions (with or without collection, treatment, and disposal)—includes technologies that isolate media to reduce or eliminate exposure to, and off-site migration of, surface and subsurface contaminants
- Removal actions—includes removal of contaminated media for treatment and disposal on or off site; exposure risk and migration potential are diminished by eliminating or reducing the contaminant source

The technologies and associated process options identified for each GRA were screened using three criteria: (1) effectiveness; (2) implementability; and (3) cost. Screening of the technologies and process options for each GRA is summarized in Figure ES-2. The Landfill Area meets all of the criteria specified in EPA guidance for application of the containment presumptive remedy. However, based on feedback from members of the local community, the Navy has agreed to fully evaluate excavation of the landfill as part of the FS to provide information to support the community's review of potential remedial alternatives for Parcel E-2. Therefore, removal by excavation and off-site disposal was retained as a potentially viable process option for the Landfill Area. For the Panhandle, East Adjacent, and Shoreline Areas, process options related to both containment and removal were retained for development of remedial alternatives.

Implementation of any containment or removal action that would alter existing site conditions will affect Parcel E-2 wetlands. Compliance with regulations for wetlands protection (in accordance with the Clean Water Act [§ 404] and the San Francisco Bay Plan [14 CCR, §§ 10110 through 11990]) will require that such effects be addressed through the established wetlands mitigation process. The following mitigation approaches have been identified: (1) wetlands banking; (2) wetlands restoration within HPS at areas not affected by COCs or COECs; and (3) wetlands restoration in the Panhandle Area of Parcel E-2.

ES.5.4. Development of Remedial Alternatives

The following remedial alternatives were developed for Parcel E-2 from the technologies and process options retained for each GRA:

- **Alternative 1 – No Action:** For this alternative, no remedial action would take place. Solid waste, soil, sediment, groundwater, and surface water would be left in place without any response actions (such as, institutional controls, monitoring, containment, removal, and treatment). The no action alternative is retained throughout the FS process as required by the NCP to provide a baseline for comparison with and evaluation of other alternatives.
- **Alternative 2 – Excavate and Dispose of Solid Waste, Soil, and Sediment (including monitoring, institutional controls, and unlined freshwater wetlands):** This alternative would involve excavation and off-site disposal of all solid waste, debris, and soil in the Landfill Area. Isolated solid waste locations, soil, and sediment in the adjacent areas (which consist of the Panhandle Area, East Adjacent Area, and Shoreline Area) would also be excavated and disposed of off site. The proposed excavation in the Panhandle Area, East Adjacent Area, and Shoreline Area would eliminate exposure to radioactive and nonradioactive contamination, in accordance with the exposure depths in the risk assessments, and would extend deeper in areas with known hot spots of nonradioactive chemicals. Groundwater monitoring would be included under this alternative to evaluate chemical concentrations in groundwater while the aquifers naturally recover. Additionally, groundwater monitoring would be used to confirm site conditions and to ensure that, over time, the potential exposure pathways would remain incomplete. This alternative would also include institutional controls (consisting of land use and activity restrictions) that would be implemented across the entire parcel to prevent exposure to COCs and COECs in soil and groundwater. Wetlands disturbed during excavation activities would be restored on top of the clean fill in the Panhandle Area.
- **Alternative 3 – Contain Solid Waste, Soil, and Sediment with Hot Spot Removal (including monitoring, institutional controls, and lined freshwater wetlands):** This alternative would involve (1) excavation and off-site disposal of all radiological surface anomalies and Tier 1 and Tier 2 hot spots in the Panhandle Area, East Adjacent Area, and Shoreline Area; and (2) excavation and on-site consolidation of soil in portions of the Panhandle Area planned for wetlands restoration (both tidal and freshwater) and sediment throughout the Shoreline Area. Excavation activities would be followed by containment of solid waste and soil in the Landfill, Panhandle, East Adjacent, and Shoreline Areas. The portions of the Landfill Area not already covered by the existing multilayer cap would be covered with a similarly designed multilayer cap. The isolated solid waste locations and soil in the East Adjacent Area, as well as portions of the Panhandle and Shoreline Areas not planned for tidal wetlands restoration, would be covered with a geosynthetic cap. The cap termination within the Shoreline Area would be protected with a shoreline protection system and, where the Landfill Area abuts the Shoreline Area, would also be underlain by a subsurface drainage system (in the event that groundwater monitoring results prompt extraction and treatment of leachate and contaminated groundwater). In addition, this alternative would include (1) construction of a groundwater diversion system (consisting of an upgradient slurry wall and subsurface drain) along the west side of the landfill to divert upgradient groundwater and reduce leachate generation; (2) installation, operation, and maintenance of an active landfill gas control system; (3) monitoring of landfill gas, stormwater, and groundwater; and (4) institutional controls (consisting of land use and activity restrictions) that would be implemented across the entire parcel to prevent exposure to COCs and COECs in soil, landfill gas, and groundwater. Also, freshwater wetlands disturbed during construction of the containment systems would be restored on top of the cap in the Panhandle Area, while tidal wetlands disturbed during construction would be restored without a cap.

- **Alternative 4 – Contain Solid Waste, Soil, Sediment, and Groundwater with Hot Spot Removal (including monitoring, institutional controls, and lined freshwater wetlands):** This alternative would have the same components as Alternative 3, but would include (1) excavation and off-site disposal of Tier 3, 4, and 5 hot spots (in addition to Tier 1 and 2 hot spots; (2) containment of contaminated groundwater with a slurry wall in the nearshore areas where landfill waste is within 100 feet of San Francisco Bay (referred to as the "nearshore slurry wall"); and (3) a contingency to extend the nearshore slurry wall south into the PCB Hot Spot Area. The need for this extension will be assessed in the remedial design using updated groundwater monitoring data from wells in and around the excavated portion of the PCB Hot Spot Area, which is being collected under the Basewide Groundwater Monitoring Program. The groundwater diversion system along the west side of the landfill, as proposed under Alternative 3, would minimize hydraulic head buildup behind the nearshore slurry wall.
- **Alternative 5 – Contain Solid Waste, Soil, Sediment, and Groundwater with Hot Spot Removal (including monitoring, institutional controls, and unlined freshwater wetlands):** This alternative would have the same components as Alternative 4, but would include restoration of freshwater wetlands without a liner. Alternative 5 was developed to evaluate the relative advantages of unlined freshwater wetlands compared with the lined freshwater wetlands proposed under Alternatives 3 and 4.

ES.5.5. Detailed Evaluation of Remedial Alternatives

Each remedial alternative was evaluated in comparison to the two threshold and five balancing evaluation criteria established in the NCP. The two modifying criteria, state and community acceptance, will be assessed in the ROD following comment on the RI/FS Report and the proposed plan. A comparative analysis was then conducted to evaluate the relative performance of the three remedial alternatives developed for Parcel E-2.

NCP EVALUATION CRITERIA

Threshold Criteria
- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements

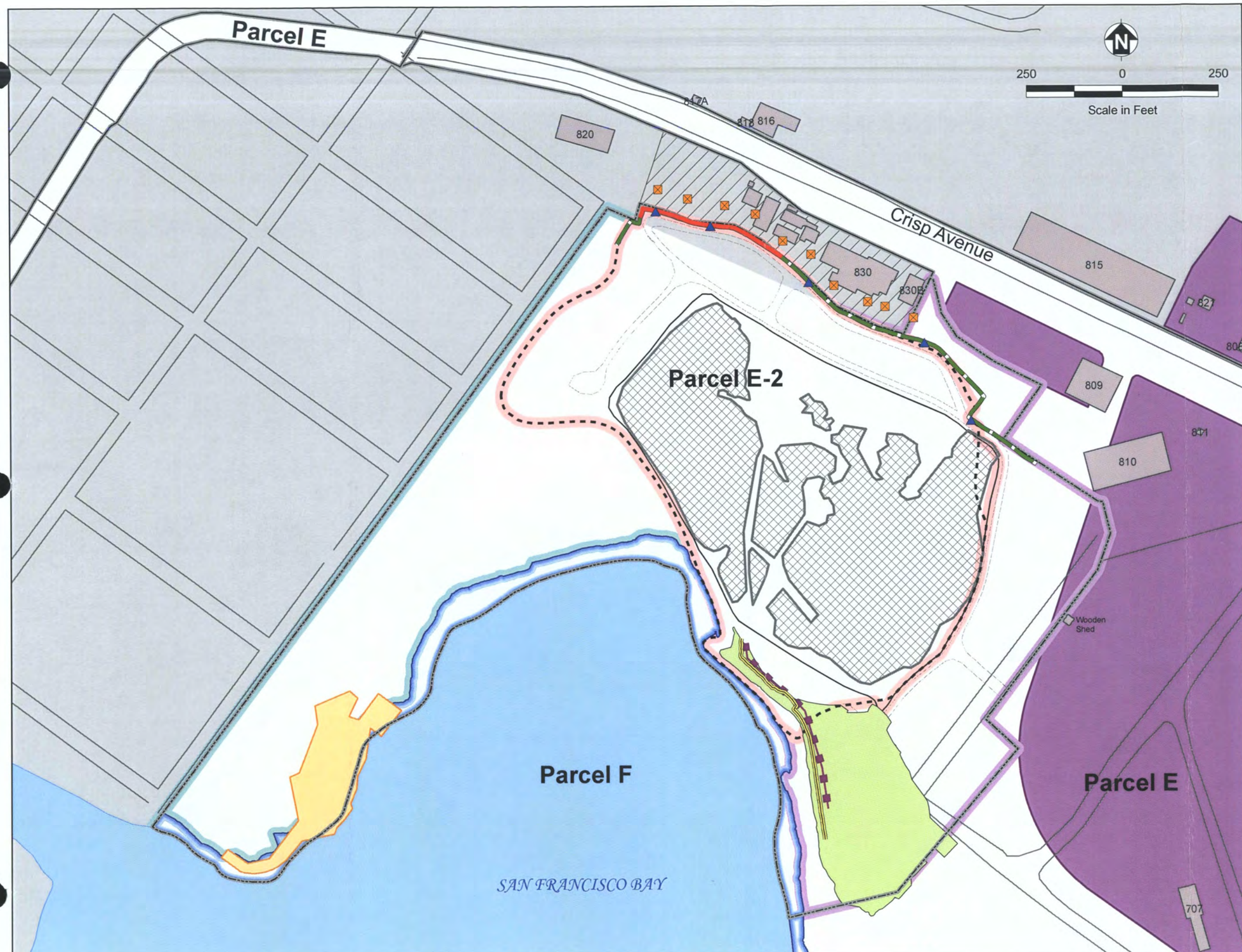
Balancing Criteria
- Long-term effectiveness and permanence
- Reduction of mobility, toxicity, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying Criteria
- State acceptance
- Community acceptance

ES.5.6. Comparative Analysis of Remedial Alternatives

Table ES-1 summarizes the comparative analysis; showing each alternative's rating under the three threshold criteria and five balancing criteria. The no action alternative (Alternative 1) would not be effective in protecting human health and the environment. Alternatives 2, 3, 4, and 5 would be effective remedial alternatives for Parcel E-2. Alternatives 3, 4, and 5 appear to be significantly more feasible, predictable, cost-effective, time-effective, and implementable remedies, when compared with Alternative 2. Alternatives 4 and 5 offer improved long-term effectiveness but have a higher cost relative to Alternative 3. The remedy for Parcel E-2 will be selected in the ROD following comment on the RI/FS Report and the proposed plan.

Figures



LEGEND

- Burn Area
- Parcel E-2 Boundary
- Parcel Boundary
- Estimate of Soild Waste Extent
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- Non-Navy Property
- UCSF Compound
- Building
- San Francisco Bay
- Road
- Gravel Road

Reuse Category

- Shipyard South Multi-Use District

Removal Actions

- Interim Landfill Cap
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]

Groundwater Extraction System

- Sheet-Pile Wall
- Extraction Trench

Interim Landfill Gas Control System

- Extraction Well
- Passive Vent
- HDPE Barrier Wall
- Grouted Section of HDPE Barrier Wall That Can Be Used For Extraction

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

HDPE = high density polyethylene
PCB = polychlorinated biphenyls
UCSF = University of California, San Francisco

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U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE ES-1

PARCEL E-2 LOCATIONS AND REMOVAL ACTION AREAS

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Site Features Map2.mxd

Medium	General Response Action	Remedial Technology	Process Options	Description	Comments	Effectiveness	Implementability	Cost	Retained for Analysis?
Solid Waste and Soil in Landfill, Panhandle, and East Adjacent Areas; Sediment in Shoreline Area	No Action	None	None	No additional action would be taken to address solid waste and soil in the Landfill Area, Panhandle Area or East Adjacent Area, or sediment in the Shoreline Area.	Required by the NCP and is used as a baseline against which other response actions are compared - would not meet RAOs.	Low	High	No Cost	Yes
	Institutional Actions	Institutional Controls	Legal Mechanisms (Restrictive Covenants, Negative Easements, Deed Notifications); Administrative Mechanisms (Land Use Plans, Soil and Groundwater Procedures and Policies, Construction Permitting, Public Notices and Educational Materials)	Legal and administrative mechanisms used in combination to enforce various land use restrictions such as: • Restrict the use of the parcel to open space • Require maintenance of control systems • Maintain the integrity of covers (or access restrictions where covers are not present) • Require development of a soil and groundwater management plan to be implemented during all intrusive site activities (such as, subsurface construction)	Institutional controls would be integral to and highly effective at maintaining the integrity of any final remedy, and are likely to be included as a part of any alternative that leaves landfill solid waste or other hazardous substances in place.	High	High	Low	Yes
		Engineering Controls (i.e., to limit and restrict access)	Signs (Warning and No Trespassing); Traffic Barriers and Perimeter Fencing	Engineering controls are physical mechanisms that serve to restrict access and potential exposure to contaminated media. Process options include warning and no trespassing signs, engineered barriers to vehicular traffic and perimeter fencing to reduce the potential for direct human contact with contaminated media.	Access restrictions conflict with future open space reuse; to be used during implementation of other remedial technologies.	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low	No (not effective as part of permanent remedy; conflicts with planned open space reuse)
		Site Monitoring	Short-Term Monitoring; Long-Term Monitoring	Short-term monitoring involves outdoor air monitoring during construction that may disturb contaminated solid waste, soil, or sediment. Long-term monitoring includes operation and maintenance of control systems (such as, inspection and maintenance of caps/covers).	Although monitoring alone would not achieve RAOs, short-term and long-term monitoring would be integral components in any remedial alternative implemented at Parcel E-2.	Low	High	Low	Yes
	Containment	Caps/Covers	Low-Permeability Soil Cap	The low-permeability soil cap system (Title 27 cover, prescriptive standard) includes a low-permeability soil layer (such as clay) at least 12 inches thick with a maximum permeability of $1x10^{-6}$ cm/sec or equal to the hydraulic conductivity of the base liner system.	Limited local sources of low-permeability soil; costly to purchase and import large volumes of suitable low-permeability soil.	High	Moderate-High	Moderate-High	Yes (for potential focused application at freshwater wetlands)
			Geosynthetic Cap	The geosynthetic cap system (Title 27 cover, engineered alternative) would include a 60-mil-thick HDPE geomembrane in place of the low-permeability soil layer (typical permeability is $1x10^{-13}$ cm/sec)	Highly effective and implementable with proper QA/QC, skilled labor, and appropriate supplies and equipment.	High	High	Moderate	Yes
			Multilayer Geosynthetic Cap	The multilayer geosynthetic cap system includes a composite low-permeability layer consisting of an HDPE geomembrane at least 60 mils thick over a GCL (typical permeability of GCL is $5x10^{-9}$ cm/sec)	Already installed over a portion of the waste area; highly effective and implementable with proper QA/QC, skilled labor, and appropriate supplies and equipment.	High	High	Moderate-High	Yes
			Evapotranspiration Cap	An evapotranspiration cap is typically a 4- to 6-foot-thick soil layer over a soil foundation layer; it acts to store moisture within the cap thickness, while minimizing infiltration, until the moisture is removed through vegetative uptake or evaporation.	Diminished effectiveness in temperate climates; ideal in arid or semi-arid climates; would require importation of a significant amount of cover soil and may encroach on neighboring property.	Moderate	Low	Moderate to High	No (not implementable given limited space and temperate climate)
		Shoreline Protection *	Armoring	Armoring includes seawalls, bulkheads, and protective revetments.	Armoring would protect the containment systems from erosion, and allow freshwater wetlands to be established in the Panhandle Area.	High	High	High	Yes
			Shoreline Stabilization	Shoreline stabilization includes man-made structures (such as nearshore breakwaters and reefs) or natural material (such as vegetation or sand fill) used to moderate the coastal sediment transport processes and reduce the local erosion rate.	Shoreline stabilization would be effective In areas planned for tidal wetlands restoration.	Moderate	High	Moderate to High	Yes
			Shoreline Nourishment	Shoreline nourishment can include berms, dunes, feeder beach, nearshore berm, dune stabilization, or structural stabilization.	Inadequate area for proper implementation; would not prevent erosion.	Low	Low	Moderate	No (not implementable within narrow Shoreline Area)
	Removal	Excavation	Excavation/Off-Site Disposal 1. Landfill Area 2. Soil in adjacent areas	Excavation and off-site disposal of all solid waste and contaminated soil in the Landfill Area, and contaminated soil/sediment in Panhandle, East Adjacent, and Shoreline Areas that may pose a risk to human health and the environment	Multiple issues associated with excavation and transport of such a large volume of landfill solid waste and soil.	Moderate-High	Low-Moderate	Very High	Yes (to support community review of potential remedies)
			Excavation/Off-Site Disposal 1. Hot spots in adjacent areas 2. Incidental LLRW	Excavation and off-site disposal of hot spots in Panhandle, East Adjacent, and Shoreline Areas (including LLRW encountered during hot spot excavation activities)	Primary hot spots consist of liquid and highly toxic wastes in the PCB Hot Spot shoreline; additional removal at other locations in the Panhandle and East Adjacent Areas to enhance performance of remedy.	High	High	Moderate to High	Yes
			Excavation/On-Site Consolidation of hot spots in adjacent areas (with off-site disposal of incidental LLRW)	Excavation of hot spots in Panhandle, East Adjacent, and Shoreline Areas with off-site disposal of LLRW and on-site consolidation of non-radiological hot spot material	Hot spots are not mobile, and planned leachate collection/treatment system is considered adequate but not as robust as off-site disposal facilities.	Moderate	Moderate	Moderate	No (potential issues with administrative implementability)
			Excavation/On-Site Consolidation of contaminated material in adjacent areas (with off-site disposal of incidental LLRW)	Excavation of solid waste and contaminated soil/sediment in Panhandle, East Adjacent, and Shoreline Areas, as needed to meet design requirements of a containment process option (for example, stable slopes along shoreline and altered topography to support wetlands restoration), with off-site disposal of LLRW and on-site consolidation of non-radiological material	Specific hot spot removal areas include surface soil in the Metal Slag Area, soil along the PCB Hot Spot shoreline, soil along the Landfill Area Shoreline, and soil from various inland locations in the Panhandle and East Adjacent Areas.	High	High	Moderate	Yes

Legend

- Retained for use in Remedial Alternatives
- Retained for possible future incorporation (based on future site data)
- Eliminated from consideration

Notes:

* Required in Shoreline Area

Acronyms defined on page 4

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

FIGURE ES-2
RESULTS OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS EVALUATION

Remedial Investigation/Feasibility Study for Parcel E-2

N:\Projects\2005 F 025-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\Graphics\ES-2 Remedial Technology Screening Table_0 0.vsd

Medium	General Response Action	Remedial Technology	Process Options	Description	Comments	Effectiveness	Implementability	Cost	Retained for Analysis?
Landfill Gas in Parcel E-2	No Action	None	None	No additional action would be taken to remove or treat landfill gas.	Required by the NCP and is used as a baseline against which other response actions are compared – would not meet RAOs.	Low	High	No Cost	Yes
	Institutional Actions	Institutional Controls	Legal Mechanisms (Restrictive Covenants, Negative Easements, Deed Notifications) Administrative Mechanisms (Land Use Plans, Soil and Groundwater Procedures and Policies, Construction Permitting, Public Notices and Educational Materials)	Legal and administrative mechanisms used in combination to enforce various land use restrictions such as: • Require maintenance of control systems • Ensure compliance with 27 CCR requirements for construction within 1,000 feet of a landfill, such as the requirement for gas control systems on any installed subsurface structures or other areas in which landfill gas may accumulate	Institutional controls would be integral to and highly effective at maintaining the integrity of any final remedy, and are likely to be included as a part of any alternative that leaves landfill solid waste or other hazardous substances in place.	High	High	Low	Yes
		Engineering Controls (i.e., to limit and restrict access)	Signs (Warning and No Trespassing) Traffic Barriers and Perimeter Fencing	Engineering controls are physical mechanisms that serve to restrict access and potential exposure to contaminated media. Process options include warning and no trespassing signs, engineered barriers to vehicular traffic and perimeter fencing to reduce the potential for direct human contact with contaminated media.	Access restrictions conflict with future open space reuse; to be used during implementation of other remedial technologies.	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low	No (not effective as part of permanent remedy; conflicts with planned open space reuse)
		Site Monitoring	Short-Term Monitoring Long-Term Monitoring	Short-term monitoring involves outdoor air monitoring during construction that may affect landfill gas migration. Long-term monitoring includes monitoring of gas monitoring probes, subsurface structures, and site structures; also includes operation and maintenance of gas control systems.	Although monitoring alone would not achieve RAOs, short-term and long-term monitoring would be integral components in any remedial alternative implemented at Parcel E-2.	Low	High	Low	Yes
	Containment	Landfill Gas Collection	Passive Venting	A passive system at Parcel E-2 would include a series of venting wells extending from below the historic low water table elevation through the cap and discharging to the atmosphere above the surface of the cap.	Diminished effectiveness at landfills with no bottom and sidewall liner system, or landfills with insufficient buffer space between the edge of waste and the compliance points; if NMOC treatment is required at the discharge points, the required treatment systems could restrict landfill gas venting, rendering venting less effective.	Moderate	High	Low	Yes
			Active Collection	Active landfill gas collection uses vacuum blowers to extract landfill gas through vertical extraction wells installed and plumbed together; gases are drawn to a central collection point to create an inward pressure gradient to prevent outward landfill gas migration.	More effective with geosynthetic caps in shallow landfills because geosynthetic materials offer a better barrier against vacuum short-circuiting to the surface.	High	High	Moderate	Yes
		Treatment (gas treatment and/or destruction) *	Adsorption (via GAC and Hydrosil®)	GAC	GAC would remove SVOCs and most VOCs; could be used with either passive or active collection systems.	Treatment units could restrict the airflow of passive venting systems, rendering them less effective.	High	High	Low (if NMOC concentrations are low) High (if NMOC concentrations are high, following capping of the entire landfill)	Yes
				Hydrosil® (permanganate-impregnated zeolite medium)	Hydrosil® would remove lighter VOCs such as vinyl chloride; could be used with either passive or active collection systems.				
			Destruction (via combustion)	Enclosed Flare	An enclosed flare would destroy landfill gas, including NMOCs and methane, through combustion; primary chemical byproducts from flares are carbon dioxide and nitrogen oxide compounds.	Operating conditions would reduce the possibility of dioxin formation by promoting the destruction of organics, operating at temperatures above those that would allow dioxin formation followed by rapid quenching, and extending the combustion residence time.	High	Moderate to High	Low to Moderate	Yes
				Open Flare	Eliminated from consideration due to poor system controls (relative to enclosed flares).		N/A	N/A	N/A	N/A
				Internal Combustion Engine	Eliminated from consideration because volume of gas generated by the Parcel E-2 Landfill is not anticipated to be sufficient to support the cost-effective implementation of internal combustion engines.		N/A	N/A	N/A	N/A
			Destruction (via non-combustion processes)	Energy Recovery	Energy recovery technologies, such as fuel cells, use landfill gas to produce energy directly.	Effectiveness of energy recovery and gas-to-product systems at Parcel E-2 is unknown because of the lack of information on gas concentration generation rates (assumed moderate to high, depending on implementability).	Likely Low (assumed moderate to high, if implementable at Parcel E-2)	Likely Low (site-specific conditions need to be better defined)	High	Yes
				Gas-to-Product	Gas-to-product conversion technologies focus on converting landfill gas into commercial products, such as compressed natural gas, methanol, purified carbon dioxide and methane, or liquefied natural gas.					

Legend

- Retained for use in Remedial Alternatives
- Retained for possible future incorporation (based on future site data)
- Eliminated from consideration

Notes:

* Additional data are needed to determine the type(s) of treatment required for landfill gas at Parcel E-2.

Acronyms defined on page 4

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FIGURE ES-2 (cont.)
RESULTS OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS EVALUATION

Remedial Investigation/Feasibility Study for Parcel E-2

N:\Projects\2005 F 025-049 Navy HPS E-2 RI-FSIN Maps&Drawings\Graphics\ES-2 Remedial Technology Screening Table_0.vsd

Medium	General Response Action	Remedial Technology	Process Options	Description	Comments	Effectiveness	Implementability	Cost	Retained for Analysis?
Groundwater in Parcel E-2	No Action	None	None	No action would be taken to remove, contain or treat groundwater; no institutional controls would be established to prevent exposure, and no monitoring would be required.	Required by the NCP and is used as a baseline against which other response actions are compared – would not meet RAOs.	Low	High	No Cost	Yes
	Institutional Actions	Institutional Controls	Legal Mechanisms (Restrictive Covenants, Negative Easements, Deed Notifications) Administrative Mechanisms (Land Use Plans, Soil and Groundwater Procedures and Policies, Construction Permitting, Public Notices and Educational Materials)	Legal and administrative mechanisms used in combination to enforce various land use restrictions such as: • Require development of a soil and groundwater management plan to be implemented during all intrusive site activities (such as subsurface construction • Restrict the use of groundwater within the Parcel E-2 boundaries • Prohibit the installation of wells that have the potential to affect the migration of contaminated groundwater within Parcel E-2.	Institutional controls would be integral to and highly effective at maintaining the integrity of any final remedy, and would be required to prevent exposure to groundwater within the Parcel E-2 boundaries.	High	High	Low	Yes
		Engineering Controls (i.e., to limit and restrict access)	Signs (Warning & No Trespassing) Traffic Barriers & Perimeter Fencing	Engineering controls are physical mechanisms that serve to restrict access and potential exposure to contaminated media. Process options include warning and no trespassing signs, engineered barriers to vehicular traffic and perimeter fencing to reduce the potential for direct human contact with contaminated media.	Access restrictions conflict with future open space reuse; to be used during implementation of other remedial technologies.	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low	No (not effective as part of permanent remedy; conflicts with planned open space reuse)
		Site Monitoring	Short-Term Monitoring Long-Term Monitoring	Short-term monitoring involves outdoor air monitoring during construction of groundwater control systems. Long-term monitoring includes groundwater monitoring and operation and maintenance of groundwater control systems.	Although monitoring alone would not achieve RAOs, short-term and long-term monitoring would be integral components in any remedial alternative implemented at Parcel E-2.	Low	High	Low	Yes
	Containment	Physical Barrier	Slurry Wall	Physical barrier would be installed to cut off and/or redirect groundwater flow.	Physical barrier may need to be complemented with hydraulic barrier to prevent excessive groundwater mounding.	Moderate to High	Moderate to High	Moderate to High	Yes
			Grout Curtain Vertical Geomembrane	Physical barrier would be installed to cut off and/or redirect groundwater flow.	Site-specific conditions limit the implementability of these options.	Moderate to High	Low to Moderate	Moderate to High	No (not implementable given site-specific conditions)
			Sheet-Pile Wall	Physical barrier would be installed to cut off and/or redirect groundwater flow.	Physical barrier may need to be complemented with a hydraulic barrier to prevent excessive groundwater mounding. Corrosion potential limits effectiveness and presence of large debris limits implementability.	Moderate	Moderate	Moderate to High	No (issues regarding effectiveness and implementability)
		Hydraulic Barrier	Flow Diversion Drain	Flow diversion drain coupled with a physical barrier would be installed on the upgradient side of the landfill to reduce groundwater flow through the waste. Drain would divert flow to reduce groundwater mounding behind the physical barrier.	Flow diversion drain is a passive technology requiring no operation, and minimal maintenance after installation.	Moderate to High	High	Low	Yes
			Extraction from Wells and Off-Site Discharge	System would extract groundwater through pumping wells to contain groundwater and achieve RAOs at compliance points; extracted groundwater could be discharged to the sanitary sewer system, treated and reinjected, or treated and discharged to the bay.	Groundwater modeling would be required to optimize extraction well placement and pumping rates, and to minimize the volume of water pumped from the Parcel E-2 aquifers; the required level of treatment would greatly influence cost.	Moderate to High	High	High	Yes
			Phytoremediation / Phytohydraulics	Phytohydraulics would use of plants to control rainfall infiltration and groundwater levels and movement; plants would remove water through evapotranspiration. In addition to hydraulic control, phytoremediation could potentially help reduce chemical concentrations in subsurface soil and groundwater.	Further studies would be required to identify plant species that could tolerate brackish groundwater, determine required planting area size and plant density. Space requirements may be incompatible with site conditions.	Moderate to High	Low	Low to Moderate	No (issues regarding implementability)
	Treatment	Reactive Barrier	Permeable Reactive Barrier	Permeable reactive barrier would be installed along the shoreline to breakdown contaminants in groundwater flowing off site.	Permeable reactive barrier is a passive technology that may require periodic reinjection of reagent to maintain effectiveness. Technology is unproven for treatment of landfill leachate in a tidal environment.	Undetermined in the short term; Low in the long term	Low	High	No (issues regarding effectiveness, implementability, and cost)

Legend

- Retained for use in Remedial Alternatives
- Retained for possible future incorporation (based on future site data)
- Eliminated from consideration

Notes:
Acronyms defined on page 4

ERRG Engineering/Remediation Resources Group, Inc.

Hunters Point Shipyard, San Francisco, California
Department of the Navy, BRAC PMO West, San Diego, California

FIGURE ES-2 (cont.)
RESULTS OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS EVALUATION
Remedial Investigation/Feasibility Study for Parcel E-2

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Medium	General Response Action	Remedial Technology	Process Options	Description	Comments	Effectiveness	Implementability	Cost	Retained for Analysis?
Surface Water in Parcel E-2	No Action	None	None	No action would be taken to monitor or manage stormwater runoff and groundwater discharges to wetlands and the Bay at Parcel E-2; no institutional controls would be established to prevent exposure to surface water.	Required by the NCP and is used as a baseline against which other response actions are compared – would not meet RAOs.	Low	High	No Cost	Yes
	Institutional Actions	Institutional Controls	Legal Mechanisms (Restrictive Covenants, Negative Easements, Deed Notifications) Administrative Mechanisms (Land Use Plans, Soil and Groundwater Procedures and Policies, Construction Permitting, Public Notices and Educational Materials)	Legal and administrative mechanisms used in combination to enforce various land use restrictions such as: • Restrict the use of the parcel to open space • Require maintenance of stormwater BMPs • Require development of a soil and groundwater management plan to be implemented during all intrusive site activities (such as, subsurface construction)	Institutional controls would be integral to and highly effective at maintaining the integrity of any final remedy, and are likely to be included as a part of any alternative that leaves landfill solid waste or other hazardous substances in place.	High	High	Low	Yes
		Engineering Controls (i.e., to limit and restrict access)	Signs (Warning and No Trespassing) Traffic Barriers and Perimeter Fencing	Engineering controls are physical mechanisms that serve to restrict access and potential exposure to contaminated media. Process options include warning and no trespassing signs, engineered barriers to vehicular traffic and perimeter fencing to reduce the potential for direct human contact with contaminated media.	Access restrictions conflict with future open space reuse; to be used during implementation of other remedial technologies.	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low (if used as part of a permanent remedy) High (if used during implementation of an active remediation technology)	Low	No (not effective as part of permanent remedy; conflicts with planned open space reuse)
		Site Monitoring	Short-Term Monitoring Long-Term Monitoring Stormwater BMPs	Short-term monitoring involves stormwater monitoring during construction. Long-term monitoring includes surface water monitoring and inspection and maintenance of stormwater BMPs. Monitoring of surface water is used to demonstrate compliance with RAOs designed to prevent unacceptable exposures to aquatic receptors in the bay.	Although monitoring alone would not achieve RAOs, a stormwater monitoring program, including stormwater BMPs, would be implemented in conjunction with an inspection and maintenance for any containment systems.	Low	High	Low	Yes

Legend

- Retained for use in Remedial Alternatives
- Retained for possible future incorporation (based on future site data)
- Eliminated from consideration

Acronyms

BMPs = best management practices
CCR = California Code of Regulations
cm/sec = centimeters per second
GAC = granular activated carbon
GCL = geosynthetic clay liner
GRA = general response action
HDPE = high-density polyethylene
LLRW = low-level radioactive waste
NCP = National Oil and Hazardous Substances Pollution Contingency Plan
NMOC = nonmethane organic compound
PCB = polychlorinated biphenyl
QA = quality assurance
QC = quality control
RAOs = remedial action objectives
RCRA = Resource Conservation and Recovery Act
SVOCs = semivolatile organic compounds
VOC = volatile organic compounds

ERRG Engineering/Remediation Resources Group, Inc.

Hunters Point Shipyard, San Francisco, California
Department of the Navy, BRAC PMO West, San Diego, California

FIGURE ES-2 (cont.)
RESULTS OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS EVALUATION
Remedial Investigation/Feasibility Study for Parcel E-2

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Tables

Table ES-1. Comparative Analysis of Parcel E-2 Remedial Alternatives

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard, San Francisco, California

ALTERNATIVES	Overall Protection of Human Health and the Environment [a]	Compliance with ARARs [a]	Long-Term Effectiveness and Permanence	Reduction of Mobility, Toxicity, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost ($ Million)	Overall Rating by Alternative
Alternative 1: No Action	No	No	○	○	●	●	$0	NA
Alternative 2: Excavate and Dispose of Solid Waste, Soil, and Sediment (including monitoring, ICs, and unlined freshwater wetlands)	Yes	Meets ARARs	●	◑	○	○	$351.5	○
Alternative 3: Contain Solid Waste, Soil, and Sediment with Hot Spot Removal (including monitoring, ICs, and lined freshwater wetlands)	Yes	Meets ARARs	◑	◑	◕	◑	$77.7 (A) $78.4 (B)	◑
Alternative 4: Contain Solid Waste, Soil, Sediment and Groundwater with Hot Spot Removal (including monitoring, ICs, and lined freshwater wetlands)	Yes	Meets ARARs	◕	◑	◕	◑	$85.4 (A) $86.6 (B)	◕
Alternative 5: Contain Solid Waste, Soil, Sediment and Groundwater with Hot Spot Removal (including monitoring, ICs, and unlined freshwater wetlands)	Yes	Meets ARARs	◕	◑	◕	◕	$85.5 (A) $86.7 (B)	◕

Legend:

○ Low

◑ Moderate

◕ Moderate to High

● High

Notes:

a Overall protection of human health and the environment and compliance with ARARs are threshold criteria and alternatives are judged as either meeting or not meeting the criteria.

ARARs applicable or relevant and appropriate requirements

ICs institutional controls

NA not acceptable

ERRG

Section 1. Introduction

This report presents a combined Remedial Investigation (RI)/Feasibility Study (FS) for the contiguous area consisting of the closed industrial landfill (hereafter referred to as the "Parcel E-2 Landfill") and the surrounding adjacent areas that contain isolated or noncontiguous pockets of buried solid waste at Parcel E-2, Hunters Point Shipyard (HPS) in San Francisco, California (Figure 1-1). HPS was identified as a National Priorities List (NPL) site by the U.S. Environmental Protection Agency (EPA) in 1989. As a result, the Department of the Navy (Navy) is conducting investigations and response actions in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Title 42 United States Code [42 USC] Sections [§§] 9601-9675) at a number of sites at HPS where a release of a CERCLA hazardous substance has occurred. As a management tool to accelerate site investigation, cleanup, and reuse, HPS was divided into parcels, and sites within each parcel are evaluated concurrently.

HPS is currently divided into 10 parcels, as shown on Figure 1-1. In 1992, the Navy divided HPS into five contiguous parcels (A through E). In 1996, the Navy added a sixth parcel (Parcel F), which encompasses immediately adjacent areas of San Francisco Bay; Parcel F is referred to as the "offshore area." In September 2004, the Navy divided Parcel E into two parcels (Parcels E and E-2) to facilitate closure of the Parcel E-2 Landfill and its adjacent areas (Figure 1-2). In December 2004, the Navy transferred Parcel A to the San Francisco Redevelopment Agency (SFRA). In July 2008, the Navy subdivided Parcel D into four separate parcels (Parcels D-1, D-2, G, and UC-1), and separated the western edge of Parcel C to create Parcel UC-2; these changes were made to expedite the closure and transfer of these new parcels.

This RI/FS is part of ongoing efforts by the Navy to address contamination at HPS Parcel E-2 in accordance with CERCLA. The RI/FS is a mechanism for characterizing the nature and extent of site contamination and associated human health and ecological risks and evaluating potential remedial options to address those risks. As the lead response agency, the Navy has authority over evaluation of risk, selection of the remedial alternative, and overall public participation at HPS. The Navy is coordinating with the EPA Region 9, the Department of Toxic Substances Control (DTSC), and the San Francisco Bay Regional Water Quality Control Board (RWQCB) in accordance with a Federal Facility Agreement (FFA) that provides a procedural framework and schedule for the CERCLA cleanup process at HPS (Navy, EPA, DTSC, and RWQCB, 1991). The Navy, EPA, DTSC, and RWQCB representatives are collectively referred to as the Base Realignment and Closure (BRAC) Cleanup Team (BCT) for HPS.

Engineering/Remediation Resources Group, Inc. (ERRG) and Shaw Environmental, Inc. (Shaw) jointly produced this combined RI/FS Report for Parcel E-2, with support from Tetra Tech EM Inc. (TtEMI). Shaw was retained by the Navy to develop remedial alternatives 3, 4, and 5. TtEMI was subcontracted by ERRG to provide FS support and to perform the baseline human health risk assessment (HHRA).

1.1. PARCEL E-2 CERCLA PROGRESS

EPA guidance describes the CERCLA remedial process as a series of progressive steps for achieving cleanup and release of environmental issues at a site for future reuse (EPA, 1988a). The typical sequence includes a preliminary assessment and site inspection, RI, FS, proposed plan, public comment period, record of decision (ROD), remedial design (RD), remedial action, and post-construction reporting. Removal actions are also used at times to expedite the cleanup process.

1.1.1. Previous Investigations

The Navy previously completed parcel-wide RI and FS reports (TtEMI, Levine-Fricke-Recon [LFR], and Uribe & Associates [U&A], 1997; TtEMI, 1998) for Parcel E, which encompassed the area later subdivided as Parcel E-2. During preparation of the Parcel E RI and FS reports, the Navy and regulatory agencies identified additional tasks to support the RD for Parcel E, most of which were specific to the Parcel E-2 Landfill. These tasks included defining the nature and extent of landfill gas, refining the lateral extent of solid waste, evaluating liquefaction potential, and delineating wetlands areas adjacent to the landfill. In addition, the Navy and regulatory agencies decided that additional data for Parcel E were needed, including data from the area now referred to as Parcel E-2, to better define the nature and extent of chemicals in soil and groundwater.

Groundwater data gap investigations (GDGIs) were conducted in three phases, from July 2000 through October 2002, to better define the extent of groundwater contamination at Parcels C, D, and E (TtEMI, 2001a, 2002c, and 2004c). From 2007 to 2008, a focused GDGI was performed to evaluate chemical concentrations along the Parcel E-2 shoreline (CE2-Kleinfelder Joint Venture, 2009a). In addition, a soil and sediment data gaps investigation was conducted in 2002 to further delineate the nature and extent of soil and sediment contamination in Parcel E (TtEMI, 2005c), including areas within Parcel E-2. This soil and sediment data gap investigation was referred to as the "standard data gaps investigation" (SDGI), to differentiate it from a series of data gap investigations conducted in 2002 to evaluate various landfill and wetland characteristics at Parcel E-2 (TtEMI, 2002a). These landfill and wetland data gap investigations were referred to as "nonstandard data gaps investigations" (NDGIs), and included:

- A characterization of the nature and extent of landfill gas (TtEMI, 2003e; Appendix A to this report)
- An evaluation of the lateral extent of the solid waste within the Parcel E-2 Landfill (TtEMI, 2004f; Appendix B to this report)
- An evaluation of landfill liquefaction potential (TtEMI and Innovative Technical Solutions, Inc. [ITSI], 2004b; Appendix C to this report)
- A delineation and functions and values assessment of the wetland areas within and adjacent to the Parcel E-2 Landfill (TtEMI, 2003d; Appendix D to this report)

Parcel E-2 was evaluated as Installation Restoration (IR) Site 01/21 in the previous RI and FS reports and subsequent data gaps investigations; however, small portions of IR Sites 02 and 76 are located within Parcel E-2. In addition, numerous sampling locations from adjoining IR Sites 04, 12, 56, and 72 are located within Parcel E-2.

1.1.2. Ongoing Monitoring Programs

The Navy has implemented several environmental monitoring programs to satisfy regulatory requirements for Parcel E-2[1] until a final remedy is selected. In accordance with the monitoring requirements for waste disposal facilities (Title 27 California Code of Regulations [27 CCR], Chapter 2), the following monitoring programs have been established and are currently being conducted at Parcel E-2:

- Landfill gas control and monitoring program (TtEMI and ITSI, 2004c): Program includes operation and maintenance (O&M) of the gas control system and perimeter gas monitoring to document compliance with 27 CCR requirements for control of off-site gas migration.
- Basewide groundwater monitoring program (BGMP) (CE2-Kleinfelder Joint Venture, 2009c): Program involves regular monitoring of groundwater wells throughout Parcel E-2 for various chemicals specified in 27 CCR, including volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs), metals and other inorganic compounds, petroleum hydrocarbons, polychlorinated biphenyls (PCBs), and pesticides.
- Landfill cover integrity monitoring and maintenance program (TtEMI, 2003b): Program includes irrigation of the vegetative cover, periodic inspections of the interim cap, and necessary maintenance actions based on inspection results.
- Stormwater management and monitoring program (MARRS Services, Inc. [MARRS] and MACTEC Engineering and Consulting [MACTEC], 2009b): Program involves inspecting and maintaining best management practices (BMPs) currently in place to control erosion, and monitoring surface water runoff at discharge points.

[1] In September 2004, the Navy divided Parcel E into two parcels (E and E-2). Discussions within this report that reference documents published prior to September 2004 refer to the portion of Parcel E that became Parcel E-2.

These monitoring programs are discussed in more detail in Section 3.9. The landfill gas and groundwater data produced from these ongoing monitoring programs helped define the nature and extent of contamination at Parcel E-2 and are presented in Sections 4 and 5, along with data from previous investigations.

1.1.3. Removal Actions in Parcel E-2

The Navy also conducted several removal actions in Parcel E-2 after completion of the Parcel E RI and FS reports. These removal actions consisted of:

- Installation of a groundwater containment and extraction system to reduce the potential for release of landfill constituents into the San Francisco Bay (International Technology Corporation [IT], 1999)
- Installation of a multilayer interim cap on a portion of the Parcel E-2 Landfill to prevent oxygen intrusion and extinguish smoldering subsurface areas following a brush fire (TtEMI, 2005b; Appendix E to this report)
- Installation of a landfill gas control and monitoring system along the northern Parcel E-2 boundary to control gas migration from the landfill (TtEMI, 2004a; Appendix F to this report)
- Collection, characterization, and disposal of debris along the shoreline of Parcels E and E-2 (Tetra Tech FW, Inc. [TtFW], 2004c)

In 2006, the Navy completed removal actions to excavate and dispose of PCB-contaminated soil (referred to as a "hot spot") and a metal slag area at Parcel E-2 (Tetra Tech EC, Inc. [TtECI], 2007a and 2007b). The location of the removal actions are shown on Figure 1-3. As discussed in Section 3.8.8, the shoreline portion of the PCB Hot Spot Area was not excavated because of its proximity to San Francisco Bay. The FS portions of this report include an assessment of the removal of the remaining portions of the PCB Hot Spot Area.

1.1.4. Parcel E-2 RI/FS

This RI/FS Report was prepared to summarize and evaluate the current site conditions following the data gaps investigations and removal actions. The data gaps investigations and ongoing monitoring programs significantly expanded the set of environmental data at Parcel E-2, with more than 1,070 additional soil and groundwater samples being collected to date. In addition, removal actions have removed potential contamination sources in Parcel E-2. To address these changes, this RI/FS Report includes: (1) an update to the site characterization; (2) a revised HHRA and an evaluation of potential environmental effects on the San Francisco Bay; (3) updated remedial action objectives (RAOs); and (4) development and evaluation of revised remedial alternatives based on these updates.

This report addresses CERCLA hazardous substances except for radionuclides. Radionuclides in soil and groundwater are evaluated in the radiological addendum to this RI/FS Report. Both chemical and radiological contaminants will then be addressed together in the proposed plan and the ROD.

1.2. STUDY AREAS IN PARCEL E-2

Figure 1-2 shows the location of the four distinct but contiguous areas contained within Parcel E-2:

- The "Landfill Area," which comprises the entire Parcel E-2 Landfill and its immediate perimeter
- The "East Adjacent Area," located to the east of the Landfill Area
- The "Panhandle Area," located west and southwest of the Landfill Area
- The "Shoreline Area," located at the interface with San Francisco Bay

These four areas were defined for the RI/FS to facilitate referencing to each throughout the narrative, figures, and tables. Each study area is further described in Section 1.6.4.

Although part of Parcel E-2, the Shoreline Area is located in a narrow intertidal zone that is being evaluated in conjunction with Parcel F, the offshore area at HPS. This report briefly summarizes studies conducted in the Shoreline Area and discusses the tidal wetlands located in the Shoreline Area. The intertidal sediments were evaluated in the Shoreline Characterization Technical Memorandum that included a screening-level ecological risk assessment (SLERA) for the Parcels E and E-2 shoreline (SulTech, 2007; Appendix G to this report). The results of the shoreline SLERA were incorporated into the FS portion of this report. The remedial alternatives evaluated in this report are intended to control unacceptable exposures to humans and wildlife from contaminated soil, sediment, and groundwater, throughout Parcel E-2, including the Shoreline Area.

1.3. REPORT FRAMEWORK

In 2004, the Navy decided to conduct the RI/FS for Parcel E-2 separately from the other Parcel E sites to increase efficiency of the CERCLA process. Creation of Parcel E-2 to separate the Landfill, Panhandle, East Adjacent, and Shoreline Areas from the rest of Parcel E allows for a more streamlined remedy evaluation process that will help accelerate the final remedy for Parcel E-2. This report was prepared in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Title 40 of the *Code of Federal Regulations* [40 CFR], Part 300) and used the following guidance documents:

- "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA, 1988a)
- "Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites" (EPA, 1991a)
- "A Guide to Principal Threat and Low Level Threat Wastes" (EPA, 1991b)

- "Presumptive Remedy for CERCLA Municipal Landfill Sites" (EPA, 1993a; Appendix H to this report)
- "Presumptive Remedy: Policy and Procedures" (EPA, 1993b; Appendix H to this report)
- "Feasibility Study Analysis for CERCLA Municipal Landfill Sites" (EPA, 1994; Appendix H to this report)
- "Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills" (EPA, 1996; Appendix H to this report)
- "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (EPA, 2000b)

1.4. REPORT PURPOSE AND GOALS

As discussed in the NCP, the purpose of the RI/FS process is to assess site conditions and evaluate alternatives to the extent necessary to select a remedy, and the goal of the remedy selection process is to select remedies that (1) are protective of human health and the environment; (2) maintain this protection over time; and (3) minimize untreated waste (55 Federal Register 8846, March 8, 1990). For this report, the Navy followed separate remedy evaluation processes for the Landfill Area and the adjacent areas (Panhandle Area, East Adjacent Area, and Shoreline Area). Each evaluation process is discussed below.

1.4.1. Evaluation Process for Landfill Area

The EPA has developed a specialized RI/FS process for landfill sites (EPA, 1991a, 1993a, 1993b, 1994, and 1996) that, provided certain conditions are met, supports selection of a containment presumptive remedy. Use of the specialized process is intended to improve and accelerate the site characterization and remedy evaluation process and to ensure consistent evaluation of remedial alternatives at similar sites. This process is based on the rationale that the unique characteristics of landfills (such as the presence of extensive heterogeneous waste intervals) limit the selection of practicable remedial alternatives.

EPA's specialized RI/FS process includes an evaluation methodology specific to military landfills (EPA, 1996) that is applicable to the Landfill Area. The approach allows the process to focus on containment technologies for use in remedial alternative evaluations and allows for qualitative risk evaluations instead of more detailed quantitative evaluations, provided there is a clear need for remedial action based on exceedance of risk-based criterion established to protect human health and the environment or applicable or relevant and appropriate requirement (ARAR) criterion.

The containment presumptive remedy typically involves:

- A landfill cap
- Source area groundwater control and leachate control, if groundwater contamination is an issue

- Landfill gas control, if landfill gas is migrating beyond the site boundary above action levels
- Institutional controls to prevent any direct contact with contamination in waste material, groundwater, and landfill gas, if any of these are present

The containment presumptive remedy has typically been used for wastes that pose a relatively low long-term threat and where treatment is impracticable. An example is a large landfill (approximately 100,000 cubic yards or larger) with heterogeneous wastes impracticable for treatment (EPA, 1996).

The Parcel E-2 Landfill can be considered for application of the presumptive remedy because it is large (estimated volume of 473,000 cubic yards) and its contents are more similar to municipal landfills than to hazardous waste landfills. However, some members of the local community have expressed a strong desire for the Navy to thoroughly evaluate excavation of the landfill. The Navy has agreed to evaluate excavation of the landfill as part of this report to provide information to support the community's review of potential remedial alternatives for Parcel E-2.

EPA guidance for military landfills (EPA, 1996) advises that the presumptive remedy should not be used where excavation is considered; however, the Navy believes that, based on site-specific considerations, excavation should also be evaluated to address community concerns although this goes beyond the requirements of the presumptive remedy policy. This approach is consistent with EPA's directive titled "Presumptive Remedies: Policy and Procedures" (pp. 1-2, EPA 1993b), which states that "there may be unusual circumstances (such as, complex contaminant mixtures, soil conditions, or extraordinary State and community concerns) that may require the site manager to look beyond the presumptive remedies for additional (perhaps more innovative) technologies or remedial approaches." In addition, this approach was applied in the Remedial Action Plan and ROD prepared for the landfill within Investigation Area H1 at the former Mare Island Naval Shipyard (Weston Solutions, Inc, 2006).

1.4.2. Evaluation Process for Panhandle, East Adjacent, and Shoreline Areas

The areas adjacent to the Parcel E-2 Landfill (the Panhandle Area, East Adjacent Area, and Shoreline Area) contain waste deposits that, while similar in content to the Landfill Area, are intermittent and separated by other fill soil. This intermittence is largely because the areas adjacent to the Parcel E-2 Landfill were reclaimed from San Francisco Bay using a combination of fill soil and waste materials. The intermittent waste distribution in the Panhandle Area, East Adjacent Area, and Shoreline Area makes evaluation of these areas under the presumptive remedy guidance inappropriate. As a result, these areas require consideration more typical of a standard RI/FS (i.e., quantitative risk assessments and evaluation of remedial alternatives other than containment).

Although the containment presumptive remedy does not apply to the Panhandle Area, East Adjacent Area, and Shoreline Area, the Navy recognizes that site conditions at these areas and their proximity to the Landfill Area present opportunities to streamline the remedy evaluation process by focusing on

remediation technologies that can be closely aligned with actions at the Landfill Area. For example, sediment within the Shoreline Area will require removal during implementation of a containment remedy at the Landfill Area to provide a stable base for future shoreline protection features. Previous studies have determined that concentrations of copper and lead in Shoreline Area sediment are a potential source of contamination to San Francisco Bay. The contaminated sediment, once excavated from the Shoreline Area and screened to segregate any potential radiological materials, can be placed at an upland location in the Landfill Area prior to capping, thereby minimizing the risk to San Francisco Bay. This type of focused remedy evaluation process for the Panhandle Area, East Adjacent Area, and Shoreline Area is consistent with the streamlining approach outlined in pages 8704-8705 of the 1990 NCP Preamble (55 Federal Register 8704-8705, March 8, 1990) and in Section 4.1.3.1 of EPA's RI/FS guidance (EPA, 1988a).

1.4.3. Goal of Parcel E-2 RI/FS Report

The overall goal of this report is to integrate a presumptive remedy RI/FS for the Landfill Area with a standard RI/FS for the areas adjacent to the Landfill Area. To achieve this goal, the RI uses characterization data collected through March 2008, and presents quantitative risk assessments for soil and groundwater to (1) determine whether the containment presumption, as outlined in EPA guidance (EPA, 1993a, 1993b, and 1996) is appropriate for the Landfill Area; and (2) provide a strong basis for the RAOs established for contamination in the Panhandle Area, East Adjacent Area, and Shoreline Area. For the Landfill Area, the FS focuses on containment technologies (consistent with EPA RI/FS presumptive remedy guidance for landfills) and includes excavation and disposal technologies for comparison purposes. For the Panhandle Area, East Adjacent Area, and Shoreline Area, the FS focuses on (1) excavation and disposal technologies to address isolated areas that pose a significant risk to future site occupants and wildlife; and (2) containment technologies to address areas of more widespread but low-level contamination.

Based on this approach, the specific goals of the RI/FS are:

- Characterize the nature and extent of contamination in Parcel E-2 by compiling and evaluating data from previous investigations.
- Develop a conceptual site model that describes contaminant sources, transport routes, exposure pathways, and potential receptors.
- Conduct a quantitative risk assessment that uses the conceptual site model and data from previous investigations to identify areas that require remedial action to protect human health and the environment.
- Develop RAOs that specify the contaminants and media of interest, exposure pathways, and remediation goals.
- Develop general response actions (GRAs) for each medium that will satisfy the RAOs.

- Identify and screen remedial technologies and process options for each GRA to retain those that can be technically and cost-effectively implemented at Parcel E-2, with a focus on containment and excavation and disposal technologies.
- Develop focused remedial alternatives from the retained remedial technologies and process options, screen the alternatives against EPA criteria, and perform a comparative analysis of retained alternatives to identify those that most effectively meet the RAOs.

This RI/FS Report is meant to provide the necessary information to support an informed risk management decision on which remedy appears to be most appropriate for Parcel E-2. Following the RI/FS, a preferred alternative will be presented by the Navy in a proposed plan. Following public review and comment, a final remedy will be selected by the Navy and documented in a ROD.

1.5. REPORT ORGANIZATION

The primary report sections and appendices are summarized in Table 1-1. The RI sections of the report, which include an evaluation of the nature and extent of the contamination, development of a conceptual site model, and evaluations of human health and ecological risks, are provided in Sections 1 through 8. Sections 9 through 14 constitute the FS portion of the document and include development of RAOs, identification of ARARs, specification of GRAs, identification and screening of technologies and process options, and development and evaluation of remedial alternatives.

Appendices A through D include summary reports for previous phases of the NDGI. Appendices E and F present the closure reports for the interim landfill cap and the landfill gas control system, respectively. Appendix G presents the characterization information (including a SLERA) for the Shoreline Area. Appendix H includes EPA presumptive remedy guidance documents for incorporation into the CERCLA administrative record for Parcel E-2. Appendix I presents an evaluation of groundwater beneficial uses for the A- and B-aquifers at Parcel E-2. Appendix J summarizes analytical data and boring logs from previous Parcel E-2 investigations. Appendix K presents the HHRA. Appendix L presents the SLERA for the Landfill Area, Panhandle Area, and East Adjacent Area. Appendix M presents an evaluation of groundwater chemical migration to the aquatic environment offshore of Parcel E-2. Appendix N includes an ARARs analysis for the remedial alternatives. Appendix O provides a regulatory analysis of the Shoreline Area and the adjacent wetlands that may be affected by the proposed remedial alternatives. Appendix P includes three preliminary evaluations associated with the proposed containment alternatives (i.e., landfill cap infiltration, landfill gas generation, and groundwater modeling). Appendix Q evaluates slope stability for the proposed containment alternatives. Appendix R details the cost estimates for each remedial alternative. Appendix S presents the responses to regulatory agency comments on the Draft and Draft Final RI/FS Report for Parcel E-2.

1.6. SITE DESCRIPTION

This subsection presents a general description of the location, topography and site features, and climate of HPS. A brief description of Parcel E-2, including the Landfill Area and other adjacent areas (the Panhandle Area, East Adjacent Area, and Shoreline Area), is also provided. More specific descriptions of site features and physical characteristics (i.e., geology, hydrology, and ecology) of Parcel E-2 are provided in Section 2.

1.6.1. Location

HPS is located in southeast San Francisco on a peninsula that extends east into San Francisco Bay. Parcel E-2 consists of 47.4 acres of shoreline and lowland coast along the southwestern portion of HPS (Figure 1-1). Parcel E-2 is bounded by:

- Property owned by the University of California, San Francisco (UCSF) and a portion of Parcel E to the north
- The bay to the south
- Portions of Parcel E to the east
- Non-Navy off-base property to the west

The Landfill Area is located in Parcel E-2, with a small portion extending north onto the UCSF property, which is a formerly used defense site investigated during the Parcel E RI as IR Site 76 (TtEMI, LFR, and U&A, 1997). Although the Parcel E-2 Landfill extends slightly north beyond the property line, this small portion of land is not being used by UCSF. The Navy has negotiated an easement with UCSF to perform the necessary environmental restoration activities within this small portion of land. Figure 1-2 shows the small portion of the Landfill Area that extends onto UCSF property.

1.6.2. Topography and Site Features

The ground surface elevation at Parcel E-2 varies from approximately 30 feet above mean sea level (msl) in the northern portion of the parcel to a few feet above msl along the southwestern portion of the parcel. The Parcel E-2 Landfill is covered with either several feet of soil or a multilayer landfill cap composed of geosynthetic materials with a soil vegetative cover. Surface runoff from most of Parcel E-2 flows directly into the bay, but runoff in the northern portion of Parcel E-2 (including portions of the UCSF property) flows into catch basins, which discharge into the HPS storm sewer system and then the bay. Surface water runoff at point source discharge locations is monitored in accordance with the Stormwater Discharge Management Plan (SWDMP) (MARRS and MACTEC, 2009b).

Limited underground utilities are located in the northeastern portion of Parcel E-2 and include water and storm sewer lines. Historical records show that these utility lines may extend into the landfill waste; however, no subsurface utilities were encountered during construction of the gas control system, which

extended through an area where a water line was shown to exist on historic records. Figure 1-4 shows the surface topography, surface water discharge locations (including an underdrain channel that bisects the landfill cap), and underground utility lines present at Parcel E-2.

Seasonal vegetation is present in the Panhandle Area and East Adjacent Area, and portions of the Shoreline Area are covered with concrete riprap (TtEMI, LFR, and U&A, 1997). Saline emergent wetlands (approximately 2.38 acres) are located along the Parcel E-2 shoreline and extend into the Panhandle Area, Landfill Area, and East Adjacent Area. In addition, a 1.3-acre seasonally ponded area is located in the Panhandle Area of Parcel E-2 (TtEMI, 2003d). Wetland areas in Parcel E-2 are shown on Figure 1-4 and are discussed in Section 2.4.2.

No buildings are present in Parcel E-2. Table 1-2 lists buildings located within 1,000 feet of the Parcel E-2 Landfill, which, in accordance with the requirements of 27 CCR, are not being threatened by landfill gas migration based on the results of previous and ongoing gas monitoring (TtEMI, 2003e and 2004a; ITSI, 2004a through 2004g, 2005a through 2005n, 2006a through 2006g, 2006i through 2006m, 2007a through 2007c, 2007e through 2007g, 2008a through 2008c, 2008e, 2009a through 2009d, and 2010a through 2010c).

1.6.3. Climate

The climate in the HPS area is characterized by partly cloudy, cool summers with little precipitation and mostly clear, mild winters with moderate precipitation. Average temperatures typically vary between 50 and 60 degrees Fahrenheit, with an average humidity range of 70 to 75 percent.

The prevailing winds at HPS are out of the west, west-northwest, and west-southwest. Figure 1-5 shows a wind rose plot generated from wind data collected at the meteorological station at HPS over a 6-year period. Seasonal variations occur in wind strength and direction. Generally, wind at HPS is strongest in the mid- to late afternoon hours, when higher velocity wind tends to blow in from the Pacific Ocean. The average wind speed is approximately 8 miles per hour, although gusts may exceed 25 miles per hour (TtEMI, LFR, and U&A, 1997).

1.6.4. Study Areas

For the purposes of this report, Parcel E-2 comprises four distinct but contiguous areas, as described in Section 1.2. These areas are shown on Figure 1-2 and are described in the following subsections.

Parcel E-2 was created by filling in the bay margin with various materials, including native soil, rock, and sediments, as well as construction and industrial debris. Figures 1-6 through 1-11 are aerial photographs of Parcel E-2 that document the expansion of Parcel E-2 into the bay at various stages of filling history.

Specific observations from these aerial photographs are discussed below; however, the overall filling history is discussed in Section 1.7.2.

1.6.4.1. The Landfill Area

Between 1958 and 1974, the Navy created the Parcel E-2 Landfill by placing various shipyard wastes, including construction debris, municipal-type solid waste, and industrial waste (including sandblast waste, paint sludge, solvents, and waste oils) (Naval Energy and Environmental Support Activity [NEESA], 1984). As a result, the landfill has a heterogeneous composition and includes solid waste intermixed with soil fill. Intervals containing the solid waste are usually brown to black. In some areas, the waste can be sludge-like with an oily sheen. Historic records indicate that an oily waste area was located along the western perimeter of the Landfill Area (Navy, 1974) (Figure 1-8). The physical extent of solid waste covers approximately 22 acres (TtEMI, 2004f). Figure 1-10 shows the approximate extent of solid waste within the Landfill Area superimposed over an aerial photograph from 1975.

1.6.4.2. The East Adjacent Area

The East Adjacent Area extends from the Landfill Area to the eastern Parcel E-2 boundary, which abuts portions of Parcel E (IR Sites 02, 04, 12, 56, and 72). During previous investigations, the Navy concluded the East Adjacent Area contained isolated solid waste locations and soil contamination. The East Adjacent Area includes an area with PCB contamination that was addressed under an interim removal action; however, portions of the PCB-contaminated soil remain unexcavated (TtECI, 2007a). Parcel E-2 encompasses a small portion of IR Site 02 (known as the "Bay Fill Area"); the Parcel E-2 boundary was created so the initial PCB Hot Spot Area would be contained entirely within the Parcel E-2.

Aerial photographs from 1946 through 1969 (Figures 1-6 through 1-9) show that the Navy historically used the East Adjacent Area for storage of equipment and material. During the RI, these uses were distinguished from the industrial uses of the adjacent Parcel E IR sites, which are shown on Figure 1-9. Navy operations at these sites included a former scrap yard (IR Site 04); a former salvage yard (IR Site 12); a railroad yard and former lumber storage yard (IR Site 56); and a former paint and oil store house (IR Site 72). From 1976 to 1986, the adjacent Parcel E IR sites were also used by a private ship repair company, Triple A Machine Shop, Inc. (Triple A), for operations that reportedly included the disposal of hazardous substances and wastes at various locations (California Department of Health Services [DHS], 1988). Triple A sites within Parcel E-2 and the adjoining Parcel E IR sites are identified on Figure 1-11. The adjacent Parcel E IR sites are being evaluated under a separate RI report.

1.6.4.3. The Panhandle Area

The Panhandle Area is located west and southwest of the Landfill Area and has a relatively flat topography. A drainage channel is located along the western perimeter of Parcel E-2, and runs south into

the low-lying inland seasonal wetlands southwest of the Landfill Area. During previous investigations, the Navy concluded the Panhandle Area contains isolated solid waste locations and soil contamination. The Panhandle Area also contains areas of potential low-level radioactivity, including an experimental ship-shielding area (Figure 1-8) and a metal slag area (Figure 1-3). A removal action was conducted to remove the metal slag and prevent potential contaminant migration to San Francisco Bay (TtFW, 2005b). The radiological history at Parcel E-2 is discussed briefly in Section 1.7.3 and is presented in detail in Volume II of the Historical Radiological Assessment (HRA) (Naval Sea Systems Command [NAVSEA], 2004).

1.6.4.4. The Shoreline Area

The Shoreline Area is the intertidal zone that contains areas covered with concrete riprap and other exposed shoreline containing intertidal sediments and emergent saline wetlands. The inland boundary of the Shoreline Area is defined by the break in slope (in areas covered with concrete riprap) or presence of drift material (in beach and wetland areas). The outboard boundary of the Shoreline Area shown on Figure 1-3 was defined in the aerial photograph used to generate the HPS base map. The intertidal sediments present in the Shoreline Area were characterized during the RI and SDGI, and the results are summarized in a Shoreline Characterization Technical Memorandum (SulTech, 2007; see Appendix G). The metal slag area, discussed in the subsection above, also extends into the Shoreline Area.

1.7. SITE HISTORY

The site history described in this subsection is presented as a graphical timeline on Figure 1-12. The following subsections summarize the history of activities that led to contaminant releases at HPS and the subsequent cleanup efforts that have been conducted to reduce those releases.

1.7.1. General Site History

HPS was owned and operated as a commercial dry dock facility until 1939, when the Navy purchased the property from Bethlehem Steel. Upon entry of the U.S. into World War II in 1941, the Navy immediately began to expand HPS into a naval shipyard. The Navy began excavation of the hills surrounding the shipyard, using the resulting spoils to expand the shoreline into San Francisco Bay. Quays, docks, and support buildings were built on an expedited wartime schedule to support the shipyard's mission of fleet repair and maintenance (NAVSEA, 2004).

As shipyard operations expanded, the need for skilled workers grew. HPS, known then as San Francisco Naval Shipyard, established apprenticeship programs for most of the shipyard trades and recruited personnel from all over the U.S. to fill jobs created by the shipyard expansion. This influx of personnel greatly affected growth of the surrounding area (NAVSEA, 2004).

Immediately after the end of World War II, the Navy used the expansive berthing facilities at HPS for reserve fleet ships returning from the Pacific. By 1951, HPS shifted from operating as a general repair facility to specializing in submarine maintenance and repair. However, the Navy continued to operate Pacific Fleet carrier overhaul and ship maintenance repair facilities at HPS through the 1960s. Use of the shipyard began to decline steadily in the late 1960s and early 1970s, and the shipyard was disestablished as an active Naval facility in 1974 (NAVSEA, 2004).

From 1976 to 1986, the Navy leased 98 percent of HPS to Triple A. During this period, Triple A used dry docks, berths, machine shops, power plants, offices, and warehouses to repair commercial and naval vessels. During its occupancy, Triple A allegedly generated and disposed of hazardous substances and wastes at various locations throughout HPS, including Parcel E-2 (DHS, 1988).

The Navy resumed operation of the shipyard in 1986, when HPS was assigned as an annex to Naval Station Treasure Island. Shipyard operations were permanently terminated in 1989 (NAVSEA, 2004). In 1991, HPS was slated for closure under the Defense Base Closure and Realignment Act of 1990. Oversight of the base closure activities was performed by the Navy's Naval Facility Engineering Command (NAVFAC), Engineering Field Activity West, in San Bruno, California, until 2000, when oversight of HPS was transferred to NAVFAC Southwest, in San Diego, California. Ongoing base closure work at HPS is overseen by the Navy's BRAC Program Management Office (PMO) West, in San Diego, California.

The first environmental investigation at HPS was the 1984 Initial Assessment Study (IAS), conducted under the Navy Assessment and Control of Installation Pollutants (NACIP) program. The IAS consisted primarily of a records review and visual inspection of the site. The IAS recommended confirmation studies at numerous HPS sites, including the Parcel E-2 Landfill (NEESA, 1984). Following completion of the confirmation studies, a RI/FS process was developed for a number of HPS sites (including the Parcel E-2 Landfill) and RI field activities were initiated in 1988 (TtEMI, LFR, and U&A, 1997).

In 1989, HPS was placed on the NPL as a Superfund site pursuant to CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. HPS was designated as a "B" site by the Agency for Toxic Substances and Disease Registry (ATSDR) in 1991; this designation is for sites that pose no imminent threats to human health but have the potential to pose long-term threats to human health (ATSDR, 1991). In 1992, HPS was divided into five parcels (Parcels A through E) to aid in environmental investigation and cleanup activities. In 2004, Parcel E was divided into two parcels (Parcels E and E-2) to facilitate the closure of the Parcel E-2 Landfill and its adjacent areas.

1.7.2. Parcel E-2 History

Parcel E-2 is part of an area created in the 1940s, 1950s, and 1960s by filling in the bay margin with various materials, including soil, crushed bedrock, dredged sediments, and debris. The overall

composition of the fill material, on which the Parcel E-2 Landfill was created, is primarily sand and clay with intermixed construction debris (TtEMI, 2004f). Most land at HPS was created in the early 1940s; however, these filling activities only extended into the eastern edge of Parcel E-2, as evidenced in the 1946 aerial photograph (Figure 1-6). In 1955 (Figure 1-7), additional filling had occurred at the western boundary of Parcel E-2. By 1965 (Figure 1-8), most of Parcel E-2 had been filled and industrial activities throughout the parcel were evident. By 1969 (Figure 1-9), filling activities at Parcel E-2 were largely complete except for a channel that extended from near the bay to the northwestern corner of Parcel E-2. This channel was filled in by 1975, at which time the landfill was closed by placing and compacting a soil cover (Figure 1-10). Triple A's industrial operations at Parcel E-2 are evidenced in the 1985 aerial photograph (Figure 1-11).

During Triple A's occupancy of the site from 1976 to 1986, the company allegedly disposed of industrial debris, sandblast waste, oily industrial sand, and asphalt over an area of approximately 5 acres along the shoreline in Parcel E-2, Triple A Site 16 (Figure 1-11) (San Francisco District Attorney [SFDA], 1986). A portion of the Landfill Area was also included as part of Triple A Site 16 (TtEMI, LFR, and U&A, 1997). In addition, Triple A allegedly stored unlabeled, deteriorating, uncovered drums with their contents exposed to the elements in the southeast portion of Parcel E-2 known as Triple A Site 1 (Figure 1-11; SFDA, 1986).

Since landfill operations ceased, the Navy implemented several preliminary landfill closure measures (Navy, 1974), including:

- Installing a stormwater interceptor line to divert runoff from the hill area north of the Parcel E-2 Landfill to an outfall
- Attempting to construct a clay dike to minimize groundwater flow into the bay; the construction was terminated due to extensive large debris present within the landfill
- Placing a minimum of 2 feet of compacted, imported fill on top of the landfill
- Grading the entire site to facilitate stormwater drainage

The Parcel E-2 Landfill was initially identified as an area of potential concern during the IAS, which concluded that it was highly probable that chemicals from waste disposed of in the landfill had reached the groundwater and were migrating toward San Francisco Bay. This conclusion revealed a potential threat to the bay environment, and a confirmation study was recommended for the site (NEESA, 1984). As a result, the landfill was included in several subsequent investigations, eventually progressing to the RI stage as IR Site 01/21. The IR Site 01/21 boundary encompasses most of Parcel E-2; however, a small portion of IR Site 2 (Bay Fill Area) is included within Parcel E-2. Figure 1-13 shows the air, soil, soil gas, and groundwater locations where samples were collected during previous investigations at Parcel E-2. Figure 1-13 also shows the boundaries of IR Site 01/21 and various Triple A sites identified in Parcel E-2.

As discussed in Section 1.1.3, the Navy has performed several removal actions at Parcel E-2 to control potential releases of hazardous substances. These actions included construction of an interim landfill cap in response to an August 2000 brush fire at the Parcel E-2 Landfill. The landfill cap was constructed to inhibit oxygen migration into the waste to prevent more fires from occurring under the capped area (TtEMI, 2005b; provided as Appendix E to this report). The cap consists of a multilayer system of sub-base soil, high-density polyethylene (HDPE) membrane, synthetic drainage layer, and topsoil. The cap encompasses approximately 14.5 acres (Figure 1-10).

Table 1-3 summarizes environmental investigations and interim actions conducted at Parcel E-2 from 1984 to March 2008. These activities are discussed in more detail in Section 3.

1.7.3. Parcel E-2 Radiological History

A history of Navy radiological operations at HPS is provided in Volume II of the HRA (NAVSEA, 2004). The HRA concluded that low levels of radiological contamination exist within the confines of HPS. The review of previous radiological activities, cleanup actions, and release surveys identified no imminent threat or substantial risk to tenants or the environment of HPS or the local community (NAVSEA, 2004).

Historical radiological operations at Parcel E-2 included:

- Disposal of radioluminescent commodity items (such as dials, gauges, and deck markers)
- Potential disposal of wastes from decontamination of ships used in atomic weapons testing (i.e., sandblast waste)
- Potential disposal of building debris from demolition of radiologically impacted buildings used by the Naval Radiological Defense Laboratory (NRDL)
- Potential disposal of materials used in radiological experiments by NRDL
- Use of an Experimental Shielding Range – located in the Panhandle Area; the range was used for ship shielding experiments and included a fan-shaped, post-exposure reflection and refraction field, and two other support areas bordered on the west side by a soil berm (Figure 1-8)

Numerous investigations of potential radiological contamination have been performed throughout HPS, including Parcel E-2. The results of the radiological investigations at Parcel E-2 are discussed briefly in Section 3.6, and are presented in more detail in Volume II of the HRA. The HRA identified most of the land area within Parcel E-2 as radiologically impacted. These radiologically impacted sites are shown on Figure 1-14.

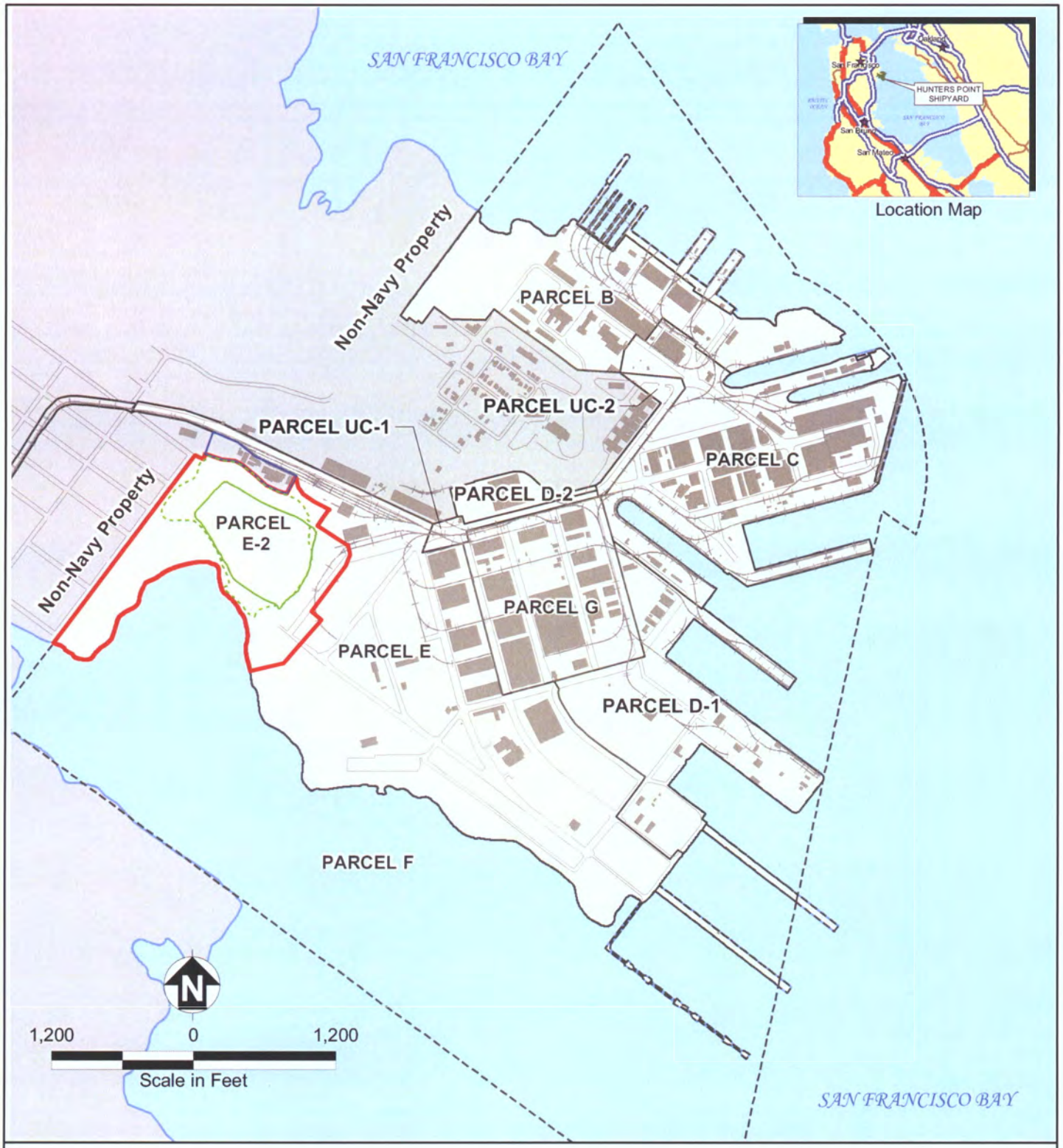
The results of radiological characterization performed to date are summarized in the radiological addendum to this RI/FS Report. Based on the potential radiological impacts at Parcel E-2, the remedial alternatives evaluated in this report include provisions for the proper screening, handling, and disposal of radiological materials.

1.8. FUTURE SITE REUSE

The data analysis, risk evaluations, and remedial alternatives presented in this RI/FS Report assume that the future reuse of Parcel E-2 will be open space. This assumption was developed in consultation with the City and County of San Francisco (CCSF) based on the 1997 "Hunters Point Shipyard Redevelopment Plan," and was documented in the previous versions of the RI/FS Report published in 2007 and 2009. Pursuant to the CCSF's 2010 amended "Hunters Point Shipyard Redevelopment Plan," a small area (about 0.42 acres) in the East Adjacent Area is part of the "Shipyard South Multi-Use District," and may be used for recreational, industrial, and residential purposes (SFRA, 2010). The proposed remedial alternatives will allow for potential residential use in this 0.42-acre area if it is demonstrated that soil contaminants do not exceed levels established elsewhere at HPS for residential reuse, or if any contaminants that exceed those established levels are addressed by the remedial alternatives.

Figure 1-15 shows the designated reuse of Parcel E-2 according to the SFRA Redevelopment Plan (SFRA, 2010).

Figures



- Parcel Boundary
- University of California, San Francisco Compound
- Non-Navy Property
- Parcel E-2 Boundary
- Parcel F Boundary
- Road
- Rail Line
- Building
- Estimate of Solid Waste Extent
- Interim Landfill Cap Extent

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FIGURE 1-1

SITE VICINITY MAP

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\B_originals\GIS\Projects\Landfill\Landfill_RI\Facility Location Map.mxd

Parcel E

Crisp Avenue

820

816

830

830B

815

809

810

Parcel E-2

Landfill Area

Panhandle Area

Shoreline Area

Parcel F

East Adjacent Area

Spear Avenue

Wooden Shed

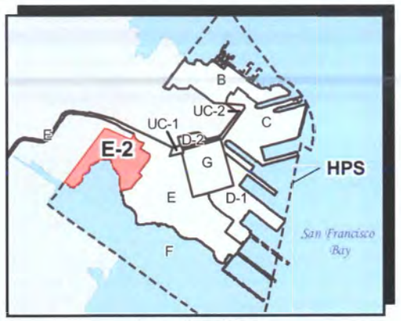
6th Avenue

Parcel E

J Street

707

SAN FRANCISCO BAY



Location Map

Legend

- Parcel Boundary
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- Estimate of Solid Waste Extent
- Interim Landfill Cap Extent
- Non-Navy Property
- UCSF Compound
- UCSF Property within Landfill Area*
- Building (with building number)
- Road
- Gravel Road

Notes:

*Remediation work in area to be performed under easement (granted by UCSF.)

UCSF = University of California, San Francisco

N

250 0 250

Scale in Feet

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FIGURE 1-2

LANDFILL/PARCEL E-2 LOCATIONS

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\B_originals\GIS\Projects\Landfill\Landfill_RI\Landfill-Parcel_E-2_Location.mxd

LEGEND

- Burn Area
- Parcel E-2 Boundary
- Parcel Boundary
- Estimate of Soild Waste Extent
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- Non-Navy Property
- UCSF Compound
- Building
- Road
- Gravel Road

Removal Actions

- Interim Landfill Cap
- Metal Slag Area (proposed boundary)
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (proposed boundary)
- PCB Hot Spot Area (2007 excavation limit)[a]

Groundwater Extraction System

- Sheet-Pile Wall
- Extraction Trench

Interim Landfill Gas Control System

- Extraction Well
- Passive Vent
- HDPE Barrier Wall
- Grouted Section of HDPE Barrier Wall That Can Be Used For Extraction

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

HDPE = high-density polyethylene
PCB = polychlorinated biphenyl
UCSF = University of California, San Francisco

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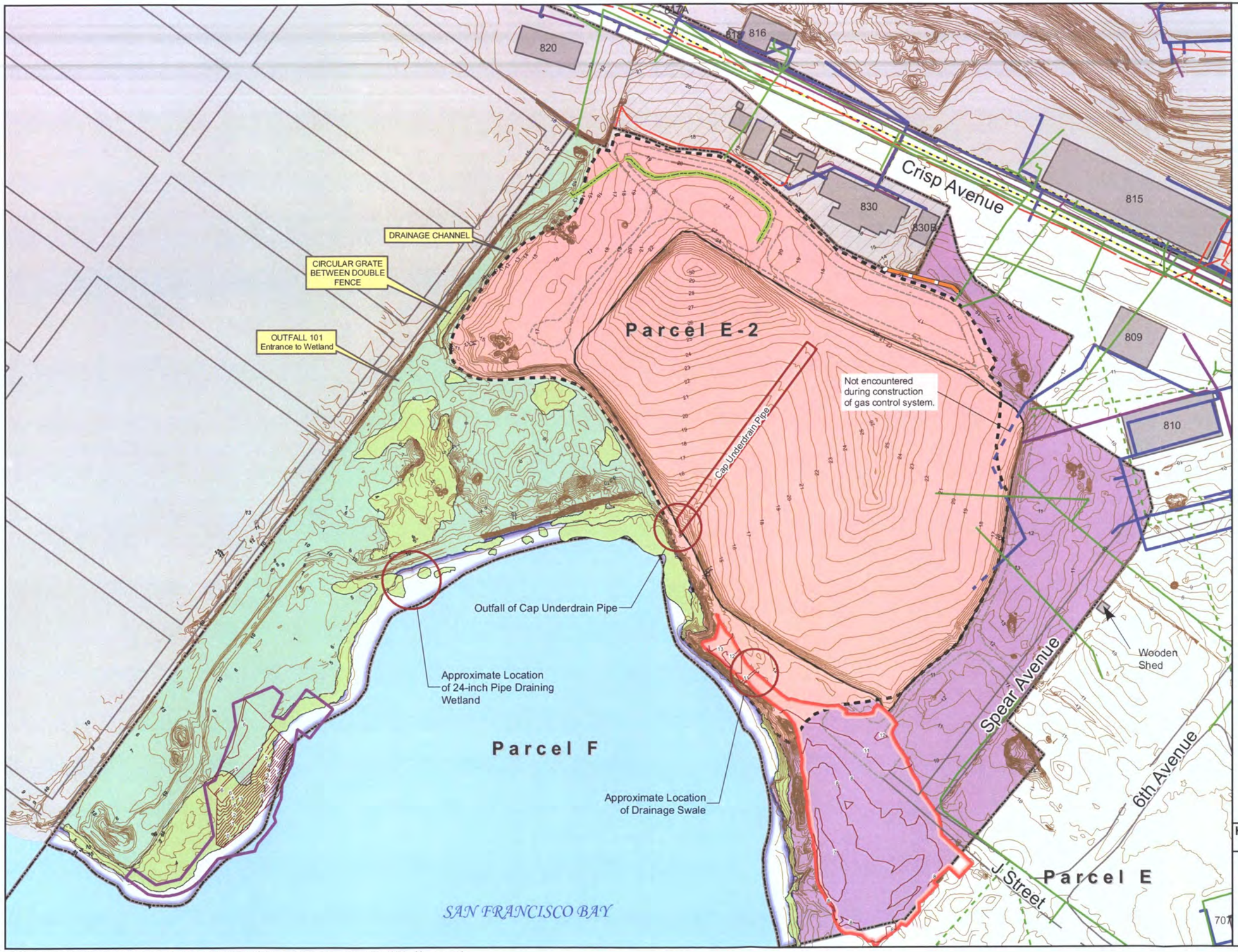
FIGURE 1-3

REMOVAL ACTION AREAS

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Site Features Map3.mxd



Legend

- Storm Line (Above Groundwater)
- Storm Line (Below Groundwater)
- Underground Drain Pipe
- Storm Water Drainage Channel
- Electric Line
- Water Line
- Natural Gas Line
- Sanitary Sewer Line (Above Groundwater)
- Ground Surface Elevation (1-foot interval)
- Parcel Boundary
- Estimate of Solid Waste Extent
- Interim Landfill Cap Extent
- Non-Navy Property
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- UCSF Compound
- Building
- Wetland Area
- Road
- Gravel Road

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

PCB = polychlorinated biphenyl
UCSF = University of California, San Francisco

N

250 0 250

Scale in Feet

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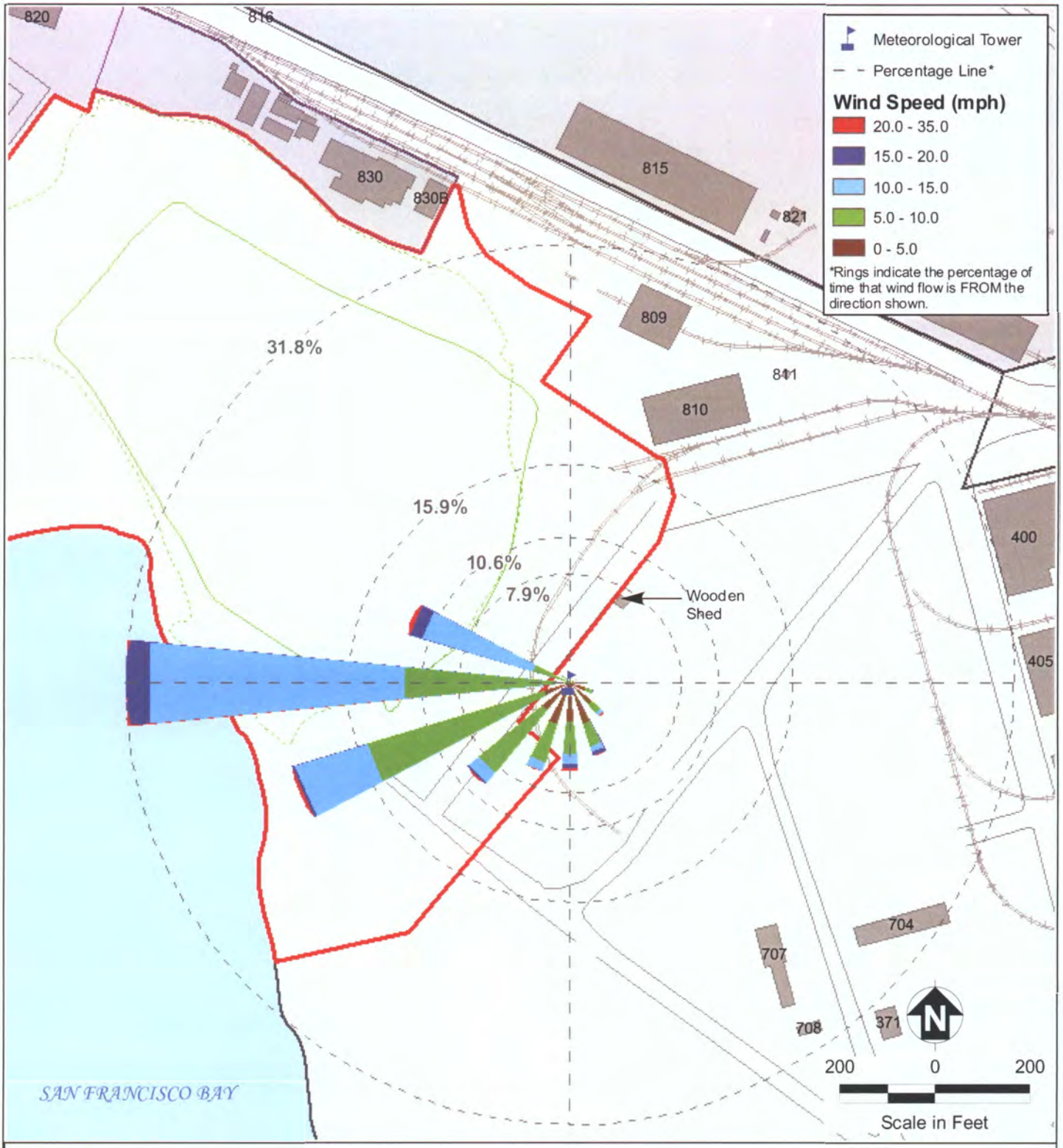
FIGURE 1-4

SURFACE TOPOGRAPHY AND SITE FEATURES

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\E-2_Utilities Map_rev.mxd



University of California, San Francisco Compound
Non-Navy Property
Parcel E-2 Boundary
Road
Rail Line
Building
Parcel F Boundary
Estimate of Solid Waste Extent
Interim Landfill Cap Extent

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FIGURE 1-5

WIND SPEED AND DIRECTION MAP

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\B_originals\GIS\Projects\Landfill\Landfill_RI\Windrose Map.mxd

Legend

Parcel E-2 Boundary

1935 Shoreline

N

500 0 500

Scale in Feet

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FIGURE 1-6

1946 AERIAL PHOTOGRAPH

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Aerial_Photos\1946_new.mxd

Legend

Parcel E-2 Boundary

1935 Shoreline

N

500 0 500

Scale in Feet

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FIGURE 1-7

1955 AERIAL PHOTOGRAPH

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Aerial_Photos\1955_new.mxd

Legend

- Parcel E-2 Boundary
- 1935 Shoreline
- Experimental Ship-Shielding Area
- Oily Waste Area

N

500 0 500

Scale in Feet

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FIGURE 1-8

1965 AERIAL PHOTOGRAPH

Remedial Investigation/Feasibility Study for Parcel E-2

\\con-fs01\projects\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Aerial_Photos\1965_new.mxd

Legend

- Parcel E-2 Boundary
- 1935 Shoreline
- Drainage Channel
- Installation Restoration Site

N

500 0 500

Scale in Feet

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FIGURE 1-9

1969 AERIAL PHOTOGRAPH WITH IR SITE BOUNDARIES

Remedial Investigation/Feasibility Study for Parcel E-2

\\con-fs01\projects\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Aerial_Photos\1969_newv_2.mxd

Legend

- Parcel E-2 Boundary
- 1935 Shoreline
- Estimated Extent of Waste

N

500 0 500

Scale in Feet

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FIGURE 1-10

1975 AERIAL PHOTOGRAPH

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Aerial_Photos\1975_new.mxd

Legend

- Parcel E-2 Boundary
- 1935 Shoreline
- Triple A Sites

N

500 0 500

Scale in Feet

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FIGURE 1-11

1985 AERIAL PHOTOGRAPH WITH TRIPLE A SITE BOUNDARIES

Remedial Investigation/Feasibility Study for Parcel E-2

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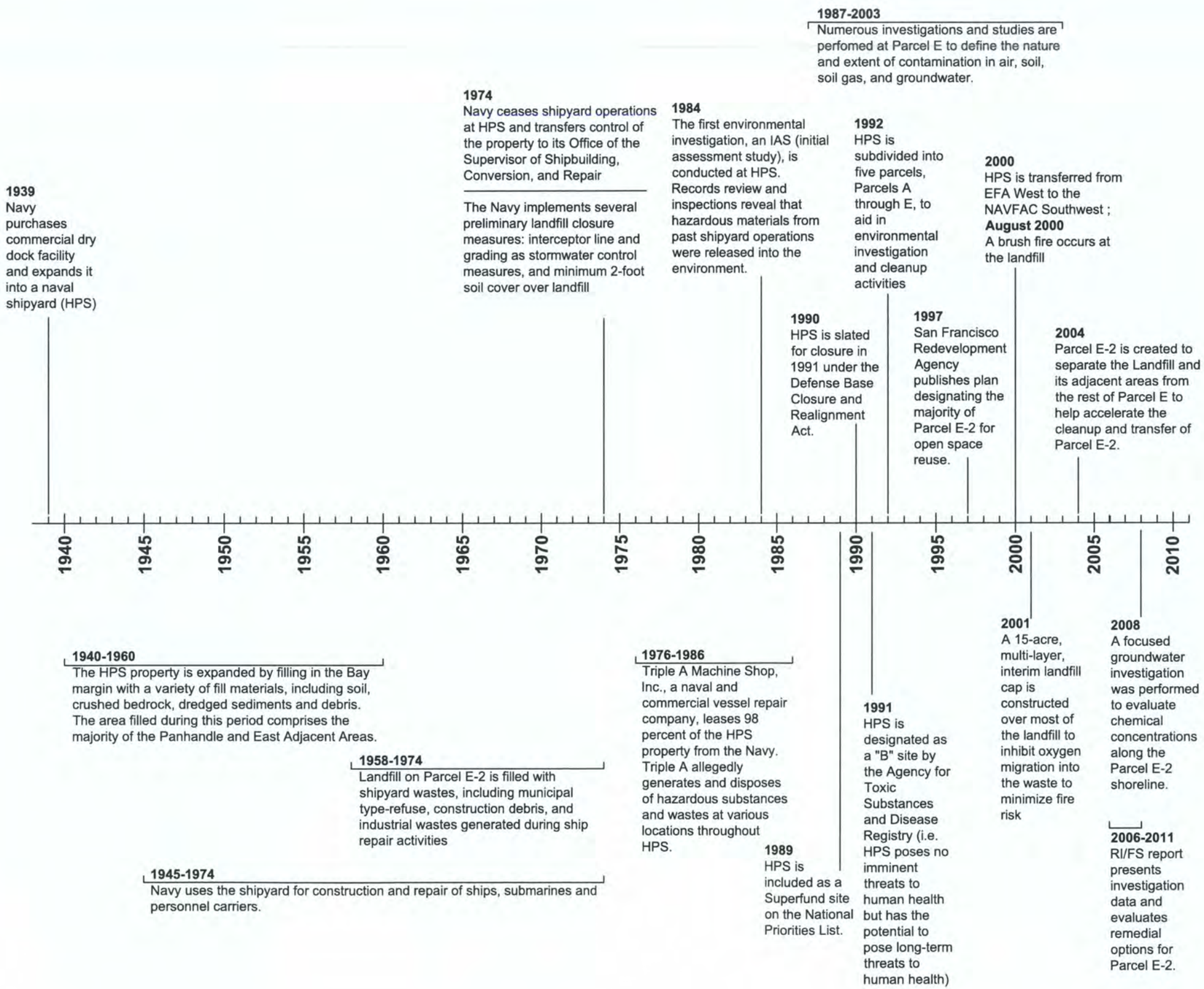

Navy = U.S. Department of the Navy

BRAC = Base Realignment and Closure

HPS = Hunters Point Shipyard

IAS = Initial Assesment Study

NAVFAC = Naval Facilities Engineering Command

EFA = Engineering Field Activity

PMO = Project Management Office

RI/FS = Remedial Investigation/Feasibility Study

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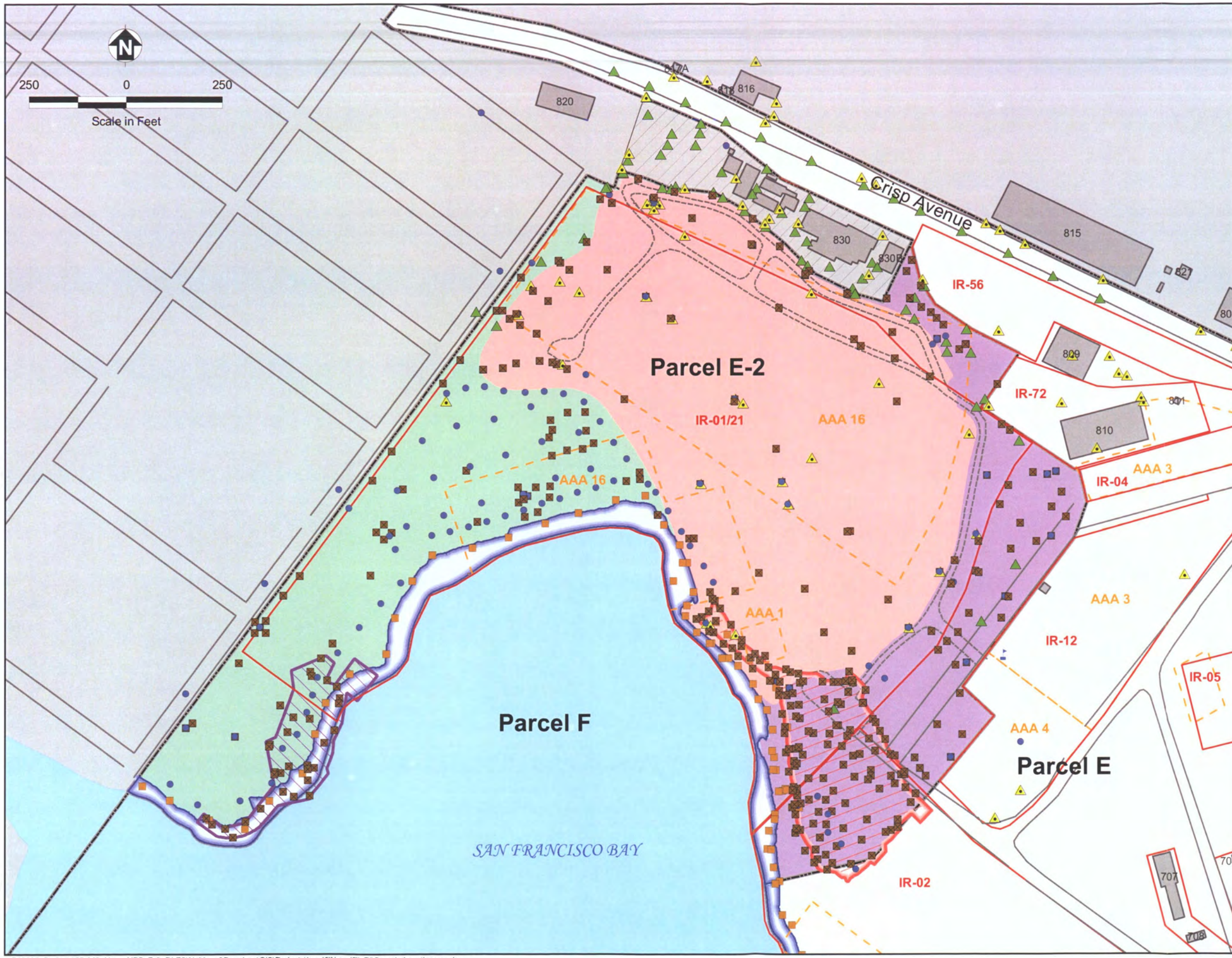
FIGURE 1-12
SITE HISTORY TIMELINE

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Section 3\1_1-HPS-timeline.dwg



Remedial Investigation, Data Gaps Investigations, and Removal Action Sampling Locations

- Soil Gas
- Ambient Air
- Groundwater
- Soil
- Shoreline Sediment
- Metereological Tower
- IR Site
- Triple A Site
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Parcel Boundary
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- Non-Navy Property
- Building
- Road
- Gravel Road

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

IR = installation restoration
PCB = polychlorinated biphenyl
UCSF = University of California, San Francisco

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FIGURE 1-13

SAMPLING LOCATIONS

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Sample Locations.mxd

Area Radiological Status

- Radiologically Impacted Site
- Impacted Storm Drain System (Above Groundwater)
- Impacted Storm Drain System (Below Groundwater)
- Impacted Sanitary Sewer System
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- Interim Landfill Cap Extent
- Experimental Ship-Shielding Area
- IR Site Boundary
- Parcel Boundary
- Non-Navy Property
- Building
- Demolished Building
- Road
- Rail Line

Notes:

Impacted sites are sites that have known radiological contamination or where site history indicates that radiological contamination may be present.

Impacted sites based on Historical Radiological Assessment (Naval Sea Systems Command, 2004).

For planning purposes, all storm drains and sanitary sewers should be considered impacted.

Storm drain and sanitary sewer line locations are based on data from the Navy's Caretaker Site Office and the Historical Radiological Assessment; locations will be verified in the field. Construction documentation for septic sewer lines does not exist. Potential septic sewer lines, if found to originate from radiologically impacted buildings near Parcel E-2 (Building 810), would be considered impacted.

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FIGURE 1-14

PARCEL E-2 RADIOLOGICALLY IMPACTED SITES

Remedial Investigation/Feasibility Study for Parcel E-2

N:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Radiological Status_Parcel E.mxd

Legend

- Estimate of Solid Waste Extent
- Shoreline Area
- Road
- Gravel Road
- Interim Landfill Cap Extent
- Non-Navy Property within Landfill Area*
- Parcel E-2 Boundary
- Other Parcel Boundary
- Building
- UCSF Compound
- San Francisco Bay
- Non-Navy Property

Reuse Category

- Shipyard South Multi-Use District
- Shoreline Open Space

Notes:

*Remediation work in area to be performed under easement (granted by UCSF.)

UCSF = University of California, San Francisco

N

250 0 250

Scale in Feet

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FIGURE 1-15

DESIGNATED REUSE ZONES AT PARCEL E-2

Remedial Investigation/Feasibility Study for Parcel E-2

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Tables

Table 1-1. RI/FS Organization Summary
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Section	Description
1. Introduction	Presents the CERCLA Progress and study areas at Parcel E-2; report framework, purpose, and goals; report organization; site description; site history; and planned reuse.
2. Site Description and Physical Characteristics	Describes the site features and geology, hydrogeology, hydrology, and ecology of Parcel E-2. Characteristics of the four study areas at Parcel E-2 are also described.
3. Remedial Investigation Activities and Removal Actions	Summarizes investigations and evaluations conducted at Parcel E-2 (including removal actions and ongoing monitoring).
4. Nature and Extent of Solid Waste, Landfill Gas, and Chemicals in Soil	Evaluates data collected during previous investigations conducted at Parcel E-2 (as discussed in Section 3 and subsections) to define the nature and extent of solid waste, landfill gas, and chemicals in soil. Information presented in this section could affect the remedial alternatives evaluated in the FS portion of this report.
5. Nature and Extent of Chemicals in Groundwater	Evaluates data collected during previous investigations conducted at Parcel E-2 (as discussed in Section 3 and subsections) to define the nature and extent of chemicals in groundwater. Information presented in this section could affect the remedial alternatives evaluated in the FS portion of this report.
6. Conceptual Site Model	Describes the Parcel E-2 contaminant sources, potentially affected media and migration pathways, and potential receptors.
7. Risk Assessment	Describes the baseline HHRA and SLERA conducted to quantify the potential risks to human health and wildlife from the Landfill Area, East Adjacent Area, and Panhandle Area.
8. Remedial Investigation Summary and Conclusions	Summarizes the results of the RI and the conclusions based on the RI data.
9. Remedial Action Objectives	Describes media, exposure routes, and human and ecological receptors to be addressed in the remedial alternatives and defines contaminant concentrations that are protective of receptors in Parcel E-2.
10. Potential Applicable or Relevant and Appropriate Requirements	Identifies potential chemical-, location-, and action-specific ARARs as required by CERCLA.
11. Identification and Screening of Technologies and Process Options	Describes the GRAs appropriate for Parcel E-2 and evaluates remedial technologies and processes that are applicable to Parcel E-2.
12. Development of Remedial Alternatives	Describes each alternative developed from the remedial technologies and process options retained after the evaluation in Section 10.
13. Detailed Analysis of Remedial Alternatives	Evaluates each remedial alternative against the nine criteria defined in EPA guidance (EPA, 1988a).
14. Comparative Analysis of Remedial Alternatives	Compares retained remedial alternatives to evaluate which alternative most effectively meets the RAOs.
15. References	Presents the documents, publications, and reports used to prepare this RI/FS Report.

Table 1-1. RI/FS Organization Summary *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Appendices	
A	Final Parcel E Nonstandard Data Gaps Investigation Landfill Gas Characterization (provided on compact disc only)
B	Final Parcel E Nonstandard Data Gaps Investigation Landfill Lateral Extent Evaluation (provided on compact disc only)
C	Final Parcel E Nonstandard Data Gaps Investigation Landfill Liquefaction Potential (provided on compact disc only)
D	Final Parcel E Nonstandard Data Gaps Investigation Wetlands Delineation and Function and Values Assessment Parcel B and E (provided on compact disc only)
E	Final Removal Action Landfill Cap Closeout Report (provided on compact disc only)
F	Removal Action Closeout Report, Landfill Gas Removal Action (provided on compact disc only)
G	Parcels E and E-2 Shoreline Characterization Technical Memorandum (provided on compact disc only)
H	EPA Presumptive Remedy Guidance (provided on compact disc only)
I	Groundwater Beneficial Use Evaluation
J	Analytical Results, Boring Logs, and Well Construction/Water Level Data (provided on compact disc only)
K	Baseline Human Health Risk Assessment
L	Screening-Level Ecological Risk Assessment for Onshore Areas
M	Evaluation of Groundwater Chemical Migration to the Aquatic Environment
N	Applicable or Relevant and Appropriate Requirements
O	Regulatory Analysis of Shoreline Area and Adjacent Wetlands
P	Preliminary Evaluations for Landfill Containment Systems
Q	Qualitative Slope Stability Evaluation
R	Detailed Cost Estimates and Assumptions
S	Responses to Regulatory Agency Comments on the Draft and Draft Final RI/FS Report for Parcel E-2

Notes:

ARARs applicable or relevant and appropriate requirements
CERCLA Comprehensive Environmental Response, Compensation and Liability Act
EPA U.S. Environmental Protection Agency
FS Feasibility Study
GRAs general response actions
HHRA human health risk assessment
RAOs remedial action objectives
RI Remedial Investigation
SLERA screening-level ecological risk assessment

Sources:

EPA. 1988a. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA." Office of Solid Waste and Emergency Response Directive 9355-3.01 and -02. EPA/540G-89/004. Available Online at: <http://epa.gov/superfund/policy/remedy/sfremedy/rifs/overview.htm>.

Table 1-2. Buildings Within 1,000 Feet of Parcel E-2 Landfill
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Building	IR Site	Parcel	Former Use	Current Use	Planned Reuse[a]	Approximate Distance from Landfill
400	IR-36 North	E	Storehouse	Vacant	Mixed Use	950 feet east
704	IR-36 West	E	Automotive repair shop	Vacant	Mixed Use	950 feet southeast
707	IR-39	E	NRDL animal colony	Vacant	Mixed Use	875 feet southeast
808	NA	Former A	Industrial Storehouse	Leased to Precision Transport	Mixed Use	700 feet northeast
809	IR-56	E	Lumber storehouse	Vacant	Mixed Use	250 feet northeast
810	IR-72	E	Paint and oil storehouse	Vacant	Mixed Use	250 feet northeast
811	IR-72	E	Diesel fueling station	Vacant	Mixed Use	575 feet northeast
815	IR-74	FUDS	NRDL main laboratory	Leased to Filesafe Company	NA[b]	325 feet northeast
816	NA	Former A	NRDL high-voltage accelerator laboratory	Vacant	Open Space	250 feet north
817A	NA	Former A	Sentry House	Vacant	Open Space	250 feet north
818	NA	Former A	Chlorination plant	Vacant	Open Space	250 feet north
820	IR-75	FUDS	NRDL cyclotron laboratory	Wood moulding shop	NA[b]	175 feet northwest
821	NA	Former A	X-ray shield facility	Vacant	Mixed Use	625 feet northeast
830	IR-76	FUDS	NRDL animal kennels	UCSF animal kennels	NA[c]	Less than 00 feet north
830B	IR-76	FUDS	UCSF animal kennels	UCSF animal kennels	NA[c]	Less than 100 feet north
831	IR-76	FUDS	NRDL animal kennels	UCSF animal kennels	NA[c]	Less than 100 feet north

Table 1-2. Buildings Within 1,000 Feet of Parcel E-2 Landfill *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Building	IR Site	Parcel	Former Use	Current Use	Planned Reuse[a]	Approximate Distance from Landfill
Shed	IR-12	E	Storage shed (unnamed)	Vacant	Mixed Use	250 feet east

Notes: Current and former Navy buildings are identified in the table above; additional structures are located within 1,000 feet of the western boundary of the Parcel E-2 landfill.

a Hunters Point Shipyard Redevelopment Plan (SFRA, 2010)

b FUDS property owned by Ted Lowpensky

c FUDS property owned by UCSF

FUDS formerly used defense site

IR Installation Restoration

NA not applicable

NRDL Naval Radiological Defense Laboratory

R&D research and development

SFRA San Francisco Redevelopment Agency

UCSF University of California, San Francisco

Source:

SFRA. 2010. "Hunters Point Shipyard Redevelopment Plan." August 3 (amendment to July 14, 1997, redevelopment plan).

Table 1-3. Summary of Previous Environmental Investigations and Remedial Activities in Parcel E-2
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Date(s)	Activity	Summary of Activities
1984	Initial Assessment Survey	The purpose of the IAS was to identify sites posing a potential threat to human health or the environment from contamination from past hazardous material operations. Records reviews and a visual inspection of the landfill (IAS Site 3, later renamed IR Site 01/21) were conducted. The IAS concluded that it was highly probable that chemicals from waste disposed of in the Parcel E-2 Landfill had reached groundwater and were migrating toward San Francisco Bay. This migration constituted a potential threat to the bay environment, and a confirmation study was recommended for the site (NEESA, 1984).
1987	Confirmation Study / Verification Step	The study was conducted in response to the IAS to verify the presence of hazardous waste contamination. Activities conducted in the area of the landfill included a geophysical survey, subsurface exploration using exploratory borings, and soil and groundwater sampling. The study concluded that soil at the Parcel E-2 Landfill contained a variety of VOCs and SVOCs that appeared to be associated with petroleum products and some chlorinated organic solvents. The report recommended further environmental investigations based on the detection of contaminants beyond the reported landfill boundaries (EMCON, 1987a).
1987	Area Study	The study was conducted throughout HPS to evaluate whether a release of hazardous substances to soil had occurred at construction sites outside the boundaries of previously identified investigation sites. The area study primarily concluded that soils within Study Area A, including Parcels E and E-2, contained naturally occurring asbestos derived from serpentine bedrock (EMCON, 1987b).
1988	Solid Waste Air Quality Assessment Test	The study included evaluation of meteorological conditions, ambient air quality, landfill gas compositions, surface gas emissions, and subsurface gas migration. The analysis of gases covered a wide range of organic chemicals, including VOCs and methane. Surface gas emissions were not detected during this investigation. The only chemicals detected were in ambient air and detected upwind from possible sources off site in the surrounding industrial areas. Methane was detected in isolated pockets at IR Site 01/21 and at the northern edge of the IR Site 01/21 boundary (near the UCSF compound but within the solid waste footprint) (HLA, 1989).
1986 to 1988	Triple A Investigation, Remedial Action Order and Remedial Investigation/ Feasibility Study Scoping Document	The Navy identified 19 sites that Triple A had allegedly used to store and dispose of hazardous and other wastes during its occupancy of the site. Two of these sites, Triple A Sites 1 and 16, are located within Parcel E-2 (SFDA, 1986). DHS issued a Remedial Action Order to the Navy and its tenant, Triple A (DHS, 1988). The Remedial Action Order listed numerous sites, including IR Site 01/21 and Triple A Sites 1 and 16. In response to the Remedial Action Order, the Navy completed a scoping document for the RI/FSs to be conducted at HPS. The scoping document grouped the sites into OUs and described the field investigations to be conducted under the RI (HLA, 1988).

Table 1-3. Summary of Previous Environmental Investigations and Remedial Activities in Parcel E-2 *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Date(s)	Activity	Summary of Activities
1988 – 1992	Operable Unit I Remedial Investigation	The Parcel E-2 Landfill progressed to the RI stage as IR Site 01/21 and was grouped (along with IR Sites 02 and 03 in Parcel E) into OU-I. The first phase of the OU-I RI (from 1988 to 1989) consisted of reconnaissance activities, including a geophysical survey and test pit excavation to delineate the extent of landfill waste, a soil gas survey to evaluate the presence of VOCs in soil and groundwater, and the installation of deep soil borings to define subsurface stratigraphy. Subsequent phases of the OU-I RI involved primary and contingency sampling of soil and groundwater performed from October 1990 to June 1992 (TtEMI, LFR, and U&A, 1997).
1991 to 1992	Intertidal Sediment Study	As part of the intertidal sediment study, sediment samples were collected in the intertidal zone of HPS, including along the Parcel E-2 shoreline, to evaluate if chemicals had migrated from Parcels E and E-2 to the bay (ATT, 1991). The ESAP whole sediment study measured concentrations of chemicals in sediments, stormwater, and bay water near stormwater outfalls and other potential source areas within the boundaries of HPS.
1991 and 1993	Radiological Investigations (Phases I and II)	The Phase I investigation was initiated to evaluate and confirm the nature and surficial extent of radium-bearing devices in several disposal areas at HPS, including Parcel E-2. Nine radioactive point source anomalies associated with radium-containing devices were observed in the southwestern and northeastern areas. The Phase II investigation was conducted to delineate the subsurface distribution of radium-containing devices at several locations, including Parcel E-2. No elevated gamma count rates were measured in the test pits or trenches installed within IR Site 01/21; however, test pits and trenches installed at IR Site 02, in close proximity to Parcel E-2, contained gamma-emitting anomalies associated with radium-containing devices and firebrick (NAVSEA, 2004).
1991 to 1995	Sandblast Waste Fixation	A field treatment demonstration was performed to determine if sandblast waste could be stabilized and recycled into asphalt (Battelle, 1989). Between 1991 and 1995, 4,665 tons of sandblast waste from throughout HPS was collected and consolidated in Parcel E-2. The waste was sent to an asphalt plant, where it was successfully reused in the manufacture of asphalt (Battelle, 1996).
1992, 1994, and 1996	Facility-wide Ambient Air Monitoring (Phases I, II, and III)	Ambient air sampling was conducted at select locations, including the Parcel E-2 Landfill. Low levels of VOCs and asbestos were detected at IR Site 01/21 during Phase I. During Phase II, air samples near a sandblast waste pile at IR Site 01/21 contained elevated concentrations of asbestos, metals, and PCBs. During Phase III, detected concentrations of asbestos, metals, and VOCs were similar to regional background concentrations, and concentrations of PCBs were two orders of magnitude lower than concentrations detected during Phase II. The Phase III study concluded that the removal of the sandblast waste pile in 1994 most likely contributed to the elevated concentrations of asbestos, metals, and PCBs detected during Phase II (TtEMI, LFR, and U&A, 1997).

Table 1-3. Summary of Previous Environmental Investigations and Remedial Activities in Parcel E-2 *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Date(s)	Activity	Summary of Activities
1994 to 1996	Phase 1A and 1B Ecological Risk Assessment	The Phase 1A ERA was a qualitative analysis that developed a preliminary characterization of HPS based on existing data, biotic surveys, and contaminant migration pathways and exposure routes. Both terrestrial and aquatic environments were considered in the Phase 1A ERA. Following the Phase 1A analysis, the quantitative Phase 1B ERA was performed to delineate potential gradients of contamination from onshore sources to offshore sediments, and to characterize the risk to aquatic wildlife (PRC, 1994, 1996c, and 1996d).
1995 to 1998	Parcel E Remedial Investigation and Feasibility Study	Following the 1992 decision to align the HPS IR sites into parcels, the RI at the landfill was completed in conjunction with other Parcel E IR sites, and involved additional field investigation performed from October 1995 to June 1996 (TtEMI, LFR, and U&A, 1997). In 1993, IR Site 01 was combined with IR Site 21. IR Site 21 was initially identified as a separate site during the RI/FS scoping process, but was later determined to be part of the landfill and thus was combined with IR Site 01. The Parcel E RI also included a baseline ERA and HHRA. During preparation of the Parcel E RI and FS reports in 1997 and 1998, the Navy and regulatory agencies identified additional tasks to support the remedial design for Parcel E. These tasks were performed as part of data gaps investigations from 2000 through 2003.
1996 to 1997	Storm Drain Sediment Removal Action	The Navy removed accumulated sediments from the storm drain system at HPS to reduce potential transport of contaminated sediments to the bay. The storm drain system at HPS consists of approximately 107,000 linear feet of piping, less than 1,000 feet of which are present in Parcel E-2. Most storm drain lines within Parcel E-2 were inaccessible during the removal action, except for a short section of storm drain (less than 200 feet) present southwest of Building 810 (IT, 1997).
1997 to 1998	Groundwater Extraction System and Containment Barrier	Previous investigations identified high PCB concentrations in groundwater in the southeast portion of Parcel E-2. To prevent the potential transport of PCBs to the bay, the Navy (1) constructed a 614-foot-long, sheet-pile wall between the landfill and the Bay and (2) installed a groundwater extraction system behind the sheet-pile wall to reduce groundwater mounding behind the wall (IT, 1999). These components are shown on Figure 1-3.
1999 to 2000	ERA Validation Study and Protective Soil Concentration Technical Memorandum	The validation study addressed some of the uncertainties associated with dose calculations (from the baseline ERA) and developed site-specific soil concentrations that would be protective of terrestrial receptors (referred to as PSCs). Based on the results of the validation study, cadmium, copper, lead, nickel, selenium, and zinc were determined to be of potential risk to wildlife and PSCs were derived for these chemicals (TtEMI and LFR, 2000a and 2000b).
2000 to 2001	Interim Landfill Cap Construction	In August 2000, a brush fire burned about 37 percent of the landfill surface area. An interim cap was constructed to extinguish the fire and prevent the occurrence of future fires under the capped areas (TtEMI, 2005b) (Appendix E of this RI/FS report). In addition, the cap reduces the potential for hazardous substances to leach from landfill waste by preventing stormwater from flowing through materials in the landfill. The cap encompasses about 14.5 acres (Figure 1-3). An extensive air monitoring program was performed during the cap construction to identify any conditions requiring corrective measures necessary to ensure that public health and the environment of the nearby community were not compromised by air emissions from the subsurface smoldering and landfill capping activities.

Table 1-3. Summary of Previous Environmental Investigations and Remedial Activities in Parcel E-2 *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Date(s)	Activity	Summary of Activities
July 2000 to October 2002	Groundwater Data Gaps Investigation	The GDGI was conducted in three phases between 2000 and 2002 to update previous assessments of groundwater conditions at HPS, supplement information gathered during the Parcel E RI, and better define the extent of groundwater contamination at HPS (TtEMI, 2001a and 2004c). Water level measurements and a tidal study were used to refine the Parcel E-2 hydrogeological conceptual model, and three rounds of groundwater monitoring were used to develop a basewide groundwater monitoring program and to refine the nature and extent evaluation presented in this RI/FS.
2001 to 2005	Radiological Investigations, Phase V (and other interim investigations)	As part of an interim 2001 investigation, a characterization survey of the Parcels E and E-2 shoreline was performed. Several areas were noted during the survey that exceeded background gamma radiation levels, most significantly the area known as the "metal reef" within Parcel E. The Phase V investigation was performed from 2002 to 2003 at the radiologically impacted sites within Parcel E-2. Several areas with elevated levels of radioactivity were reported. The Historical Radiological Assessment recommended further characterization, followed by remediation and a final status survey (NAVSEA, 2004).
October 2001 to November 2002	Nonstandard Data Gaps Investigation	An NDGI was conducted to collect supplemental information required to support the remedial design for Parcel E. Four separate investigations were conducted and are described below. ▪ Wetlands Delineation and Functions and Values Assessment (October 2001 to April 2002). The Navy conducted the wetland delineation and wetland functions and values assessment as part of the NDGI (TtEMI, 2003d) (Appendix D of this RI/FS Report). Two wetland areas were identified at Parcel E: (1) about 3.2 acres of tidal wetlands along the shoreline and (2) about 1.3 acres of inland seasonal freshwater wetland that partially overlaps with the Parcel E-2 Landfill. The functions and values assessment found that the value of these wetlands is low, and the most significant function of these wetlands to be seasonal wildlife use for wintering and migrating birds. ▪ Landfill Lateral Extent Evaluation (March to April 2002). The Navy evaluated the lateral extent of solid waste as part of the NDGI of Parcel E (TtEMI, 2004f) (Appendix B of this RI/FS Report). After a review of the existing information, test pits and soil borings were installed to determine the edge of physical waste. The lateral extent of landfill waste was found to encompass about 22 acres (Figure 1-2), and the vertical extent varies from 5 to 25 feet thick, with the bottom of waste being located between 12 and 30 feet bgs.

Table 1-3. Summary of Previous Environmental Investigations and Remedial Activities in Parcel E-2 *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Date(s)	Activity	Summary of Activities
October 2001 to November 2002	Nonstandard Data Gaps Investigation *(continued)*	▪ Landfill Liquefaction Potential (April 2002). The Navy evaluated the potential for soil liquefaction during an earthquake in areas surrounding the Parcel E-2 Landfill as part of the NDGI (TtEMI and ITSI, 2004b) (Appendix C of this RI/FS Report). The evaluation indicated that most of the cohesionless soil layers (66 to 67 percent) would not liquefy during the MPE. The evaluation determined that, for the remaining soil layers that could liquefy during the MPE, lateral movement of soil below the waste would be less than 4 to 5 feet. The evaluation also concluded that, if containment were selected as the final remediation measure, further analysis would be required on response of the landfill cap, overall stability of the landfill site, slope stability, and other closure features. ▪ Landfill Gas Characterization (April to November 2002). As part of the NDGI, the Navy conducted an evaluation to characterize and delineate landfill gas as part of the NDGI (TtEMI, 2003e) (Appendix A of this RI/FS Report). As part of the investigation, ambient air and soil gas surveys were conducted and GMP01 through GMP21 were installed and monitored on a weekly basis. Results from GMP monitoring indicated that methane, the main component of landfill gas, was present at levels that exceeded the LEL (5 percent by volume in air) in subsurface areas in the northern part of the landfill and aboveground at four areas on the UCSF compound. Trace concentrations of NMOCs were also detected in this area; however, a screening evaluation concluded that the detected levels of NMOCs did not pose an unacceptable risk to human health.
August 2002 to May 2003	Landfill Gas Time-Critical Removal Action	The Navy conducted a TCRA to remove combustible levels of methane on the UCSF compound. The landfill gas TCRA had the following goals: (1) to reduce methane levels on the UCSF compound to less than the LEL of 5 percent for methane and (2) to prevent future landfill gas migration onto the UCSF compound. The TCRA completed the following actions to achieve these goals: ▪ An active gas extraction system, consisting of 2 mobile extraction units, 10 extraction wells, and 5 GMPs on the UCSF compound was operated beginning in October 2002 to reduce methane levels. By January 20, 2003, the TCRA goals were met and gas extraction within the UCSF compound was discontinued. ▪ The Navy installed a landfill gas control system along the northern boundary of the landfill; the landfill gas control system consists of an HDPE barrier wall, gas collection trench, gas collection piping, and four gas vents. ▪ Removed NMOCs from the vented and extracted gas streams using mobile treatment systems within the UCSF compound and permanent treatment units attached to each of the four landfill gas control system vents; after goals within the UCSF compound were achieved, extraction within the UCSF compound was discontinued.

Table 1-3. Summary of Previous Environmental Investigations and Remedial Activities in Parcel E-2 *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Date(s)	Activity	Summary of Activities
August 2002 to May 2003	Landfill Gas Time-Critical Removal Action *(continued)*	▪ From January 29 to February 19, 2003, the gas extraction phase within the UCSF compound was followed by four rounds of weekly confirmation monitoring and then from February through May 2003, four rounds of monthly confirmation monitoring were conducted. These monitoring events showed that methane concentrations across the UCSF property remained below the methane LEL. ▪ In February 2003 and May 2003, two rounds of sampling were conducted to verify NMOC concentrations. Gas samples were collected from all GMPs within the UCSF compound and submitted for laboratory analyses. Sampling results confirmed that methane concentrations were less than 5 percent and NMOCs were below the action level of 5 ppmv above background. Based on the confirmation field monitoring and laboratory sample data, the landfill gas TCRA goals were successfully met (TtEMI, 2004a) (Appendix F of this RI/FS report).
September 2002 to February 2003	Standard Data Gaps Investigation	The Navy conducted the onshore SDGI to further define the nature and extent of chemicals in soil within the non-landfill areas. The Navy reviewed aerial photographs and logs from test pits, soil borings, monitoring wells, and GMPs from various investigations at Parcel E-2 to identify known and potential contaminant sources that required additional delineation. The results from the SDGI (TtEMI, 2005c) were also used to delineate the PCB Hot Spot, which was partially removed under an interim removal action. In addition to the onshore sampling, the SDGI characterized the nature and extent of chemicals in sediment within, or in close proximity to, the Shoreline Area. The intertidal sediments were evaluated in a Shoreline Characterization Technical Memorandum that included a SLERA for the Parcels E and E-2 shoreline (SulTech, 2005) (Appendix G to this report).
September 2003 to June 2004	Shoreline Cleanup	As part of a waste consolidation effort throughout HPS, hazardous and nonhazardous debris (consisting primarily of brick, metal scrap, concrete, and wood) along the Parcels E and E-2 shoreline (including portions of the Panhandle Area) was characterized and disposed of off site (TtFW, 2004c).
May 2003 to Present	Landfill Gas Monitoring and Control	Landfill gas is being monitored on a regular basis under the Interim Landfill Gas MCP (TtEMI and ITSI, 2004c) to verify that hazardous levels of landfill gas are not migrating beyond the fence line of the landfill and onto the UCSF compound. The landfill gas control system is operated using both passive venting and active extraction. During monitoring performed since January 2004, all concentrations of NMOCs were below action levels and regulatory requirements identified in the MCP. Methane concentrations have, in nearly all cases, remained below specified action levels; however, methane concentrations exceeding specified action levels were detected in occasionally. In these instances, the Navy notified the appropriate parties and implemented response measures to control methane at the fence line of the landfill.

Table 1-3. Summary of Previous Environmental Investigations and Remedial Activities in Parcel E-2 *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Date(s)	Activity	Summary of Activities
July 2003 to Present	Interim Cap Inspection and Maintenance	Inspection and maintenance of the interim landfill cap is performed in accordance with a site-specific operation and maintenance plan (TtEMI, 2003b). The irrigation system, along with other components of the interim cap, is inspected on a quarterly basis to ensure that it is functioning properly and providing adequate water to the vegetative cover. Inspection and mowing of the vegetative cover is performed twice per year.
July 2003 to Present	Storm Water Management and Monitoring	Stormwater discharge in Parcel E-2 is managed in accordance with a SWDMP that was originally published in 2003 (TtEMI, 2003c). The Parcel E-2 stormwater program involves quarterly visual observations of non-stormwater discharge, storm water sampling and analysis, monthly visual observations of stormwater discharge, and an annual comprehensive site compliance evaluation. Results to date indicate no incidents of noncompliance at Parcel E-2 except in isolated locations where BMPs require modification to better control erosion and sediment transport from neighboring properties. In 2007, the Parcel E-2 SWDMP was integrated with the basewide SWDMP to streamline the stormwater program (MARRS and MACTEC, 2007). The SWDMP is revised on an annual basis to reflect current site conditions, clarify or change the discharge locations, and update the list of BMPs (MARRS and MACTEC, 2009b).
June 2004 to Present	Basewide Groundwater Monitoring Program	The Navy monitors groundwater on a regular basis under the BGMP (TtEMI, 2004e). Since June 2004, the BGMP has been updated several times to optimize the monitoring network within Parcel E-2 and other HPS parcels (CE2-Kleinfelder Joint Venture, 2007c, 2007g, 2008b, 2008c, and 2009c). Analyses of samples from wells in and around the landfill are performed based on 27 CCR requirements. Additionally, four A-aquifer wells in southern end of the Panhandle Area are sampled to monitor chemicals previously detected at concentrations that may pose a potential risk to human health and the environment (CE2-Kleinfelder Joint Venture, 2009c).
June 2005 to May 2006	Metal Slag Area Removal Action	The TCRA at the Metal Slag Area was performed in conjunction with removal of the Metal Debris Reef in the southeast portion of Parcel E. The TCRA was designed to remove metal slag and debris containing low-level radiological material, as well as non-radiological chemical contamination incidental to the removal of both areas. A detailed description of this removal action is included in the Final Removal Action Completion Report (TtECI, 2007b).
June 2005 to September 2006	PCB Hot Spot Removal Action	The TCRA at the PCB Hot Spot was designed to remove PCB- and petroleum hydrocarbon-contaminated soil and debris, possibly containing low-level radiological material. The excavation involved the removal of soils that contained PCBs at concentrations greater than 1 mg/kg (from the surface to 3 feet bgs) and 100 mg/kg (deeper than 3 feet bgs), TPH at concentrations greater than 3,500 mg/kg, and radiological contaminants above the radiological removal action goals. The removal action goals also included removal of, to a practical extent, free-phase petroleum hydrocarbons. A detailed description of this removal action is included in the Final Removal Action Completion Report (TtECI, 2007a). The shoreline portion of the PCB Hot Spot was not excavated because of its proximity to San Francisco Bay; however, the Navy initiated a follow-on removal action in this area in March 2010; the follow-on removal action is scheduled for completion in 2011).

Table 1-3. Summary of Previous Environmental Investigations and Remedial Activities in Parcel E-2 *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Date(s)	Activity	Summary of Activities
September 2007 to June 2008	Groundwater Investigation	A focused groundwater investigation was performed to evaluate chemical concentrations (dissolved metals, PCBs, petroleum hydrocarbons, and ammonia) along the Parcel E-2 shoreline. Study areas included areas adjacent to the Parcel E-2 Landfill, the PCB Hot Spot, and Metal Slag Area (CE2-Kleinfelder Joint Venture, 2009a). The scope of the investigation was expanded to include supplemental sampling for specific radionuclides.

Notes:

27 CCR	Title 27 California Code of Regulations
ATT	Aqua Terra Technologies, Inc.
Battelle	Battelle Memorial Institute
BGMP	Basewide Groundwater Monitoring Program
BMPs	best management practices
bgs	below ground surface
DHS	Department of Health Services
EMCON	EMCON Associates, Inc.
ERA	ecological risk assessment
ESAP	Environmental Sampling and Analysis Plan
FS	Feasibility Study
GDGI	groundwater data gaps investigation
GMP	gas monitoring probe
HDPE	high-density polyethylene
HHRA	human health risk assessment
HLA	Harding Lawson Associates, Inc.
HPS	Hunters Point Shipyard
IAS	Initial Assessment Study
IR	Installation Restoration
IT	International Technology Corporation
ITSI	Innovative Technical Solutions, Inc.
LEL	lower explosive limit
LFR	Levine-Fricke-Recon
MCP	Monitoring and Control Plan
mg/kg	milligrams per kilogram
MPE	maximum probable earthquake
NAVSEA	Naval Sea Systems Command
Navy	Department of the Navy
NEESA	Naval Energy and Environmental Support Activity
NDGI	nonstandard data gaps investigation
NMOC	non-methane organic compound
OU	Operable Unit
PCBs	polychlorinated biphenyls
ppmv	parts per million by volume
PRC	PRC Environmental Management, Inc.
PSC	protective soil concentration
RI	Remedial Investigation
SDGI	standard data gaps investigation
SFDA	San Francisco District Attorney
SLERA	Screening level ecological risk assessment
SVOCs	semivolatile organic compounds
SWDMP	Stormwater Discharge Management Plan
TCRA	time-critical removal action
TPH	total petroleum hydrocarbons
Triple A	Triple A Machine Shop
TtECI	Tetra Tech EC, Inc.
TtEMI	Tetra Tech EM Inc.
TtFW	Tetra Tech Foster Wheeler, Inc.
U&A	Uribe and Associates, Inc.
UCSF	University of California, San Francisco
VOCs	volatile organic compounds

Section 2. Site Description and Physical Characteristics

This section describes the site characteristics associated with Parcel E-2, including the site features; geologic, hydrogeologic, and hydrologic conditions; and ecologic conditions, such as terrestrial, wetland, and intertidal habitats[2]. According to EPA guidance, characterization of a landfill's contents is not necessary or generally appropriate for selecting a response action for these sites when applying the presumptive remedy methodology for remedial alternatives evaluation (EPA, 1993a; Appendix H to this report). However, because Parcel E-2 is composed of a landfill, as well as adjacent areas (the Panhandle Area, East Adjacent Area, and Shoreline Area) containing noncontiguous waste deposits outside the primary landfill area, characterization data collected through March 2008 were used in the remedy evaluation process.

2.1. SITE FEATURES

Parcel E-2 encompasses approximately 47.4 acres at HPS. As described in Section 1, the parcel was divided into the following four areas:

- The "Landfill Area," which comprises the entire Parcel E-2 Landfill and its immediate perimeter
- The "Panhandle Area," located west and southwest of the Landfill Area
- The "East Adjacent Area," located to the east of the Landfill Area
- The "Shoreline Area," located at the interface with San Francisco Bay

The following subsections describe the surface features for each of the four areas listed above, including information about the types of solid waste believed to be present at each area. Numerous areas within Parcel E-2 are considered "radiologically impacted," which is discussed in further detail in Section 3.6.

2.1.1. Landfill Area

The 22-acre Landfill Area consists of two subareas: (1) a 14.5-acre interim landfill cap and (2) a 7.5-acre area that is covered with a 2-foot-thick soil layer. The interim cap, originally constructed to smother remnants of a waste layer fire that occurred in August 2000, consists of a multilayer system of sub-base soil, an HDPE membrane, a synthetic drainage layer, and topsoil (TtEMI, 2005b; Appendix E to this

[2] In September 2004, the Navy divided Parcel E into two parcels (E and E-2). Discussions within this report that reference documents published prior to September 2004 refer to the portion of Parcel E that became Parcel E-2.

report). The remaining 7.5 acres that were unaffected by the fire are covered by a 2-foot-thick soil layer that was placed in 1974 during a preliminary closure action.

Based on data from 26 soil borings, 12 monitoring wells, and 25 test pits extended within the Landfill Area, solid waste in the landfill is primarily municipal-type waste and construction debris. The solid waste includes wood, paper, plastic, metal, glass, asphalt, concrete, and bricks that are mixed with sand, clay, and gravel fill. Historic information indicates that industrial wastes, including sandblast waste, radioluminescent devices, asbestos-containing debris, paint sludge, solvents, and waste oils, were also disposed of in or around the Landfill Area (NEESA, 1984; NAVSEA, 2004). For simplicity, the debris and waste that make up the landfill are referred to as "solid waste" throughout the remainder of this report. The lateral and vertical extents of solid waste within the landfill were evaluated during previous investigations, as discussed in Section 3.2 of this RI/FS Report. The types of solid waste within the Landfill Area are discussed in more detail in Section 4.2.1.

The 14.5-acre interim landfill cap limits precipitation from percolating into portions of the solid waste, and the entire Landfill Area is sloped sufficiently for surface drainage that avoids ponding (drainage patterns are discussed in Section 2.3). The Navy performs inspection and maintenance of the interim landfill cap in accordance with a site-specific operation and maintenance (O&M) plan (TtEMI, 2003b).

In 2002, a landfill gas characterization study revealed that landfill gas had migrated north of the solid waste extent and onto the adjacent Navy and UCSF property. In response to this finding, a time-critical removal action (TCRA) was conducted to (1) reduce concentrations of subsurface methane north of the Parcel E-2 Landfill (under both Navy and UCSF property) to below 5 percent, and (2) prevent future landfill gas migration. The TCRA included installation and operation of a gas control, extraction, and treatment system; the TCRA is discussed in more detail in Section 3.8.5 of this RI/FS Report.

From 1997 to 1998, a 614-foot-long sheet-pile wall was constructed along the southern portion of the Landfill Area, to a depth ranging from 12 to 55 feet bgs, to reduce the potential for release of chemicals from the landfill into the bay. To reduce groundwater mounding behind the sheet-pile wall, a groundwater extraction system (GES) was installed at the same time to intercept, treat, and discharge groundwater to the municipal sewer system (IT, 1999); both features are shown on Figure 1-3 and are discussed in more detail in Section 3.8.3 of this RI/FS Report. These features targeted A-aquifer groundwater. The GES was deactivated in April 2005 to excavate contaminated soil adjacent to the sheet-pile wall and remains offline following implementation of the removal action in the PCB Hot Spot Area (TtFW, 2005a) (discussed in Section 3.8.8).

2.1.2. Panhandle Area

The Panhandle Area has a relatively flat topography and is covered by fill soil that contains noncontiguous pockets of solid waste. Waste at these locations is not contiguous with the Landfill Area and consists primarily of construction debris, with lesser quantities of industrial waste (discussed further in Section 4.3.1). The presence of isolated solid waste locations is largely because the Panhandle Area was reclaimed from the bay by filling using a combination of fill soil and waste materials (with larger proportions of fill soil as compared to the fill material within the Landfill Area). The interim landfill cap, that covers much of the Landfill Area, does not extend onto the Panhandle Area.

The Panhandle Area includes a drainage channel just outside the extent of landfill waste along the western perimeter of Parcel E-2 (see Figure 1-4). The drainage channel directs runoff south and discharges indirectly to the bay through low-lying seasonal wetlands southwest of the Parcel E-2 Landfill. The wetland areas are discussed in more detail in Section 2.4.2.

The Panhandle Area contains areas of potential low-level radioactivity, including a former experimental ship-shielding area and the metal slag area. The metal slag area, which is in the southern peninsula of the Panhandle Area and extends into the Shoreline Area, was excavated under an interim removal action (see Figure 1-3; TtECI, 2007b).

2.1.3. East Adjacent Area

Like the Panhandle Area, the East Adjacent Area has a relatively flat topography and includes solid waste locations intermixed with fill soil that are not contiguous with the Parcel E-2 Landfill. Waste at these locations is not contiguous with the Landfill Area and consists primarily of construction debris, with lesser quantities of industrial waste (discussed further in Section 4.4.1). The East Adjacent Area also includes an area containing potential low-level radioactive debris. The East Adjacent Area contains an area with PCB contamination, a portion of which was excavated under an interim removal action (see Figure 1-3; TtECI, 2007a). The sheet-pile wall and associated GES extends from the Landfill Area into the East Adjacent Area (Figure 1-3). The interim gas control system also extends into the East Adjacent Area.

2.1.4. Shoreline Area

The Shoreline Area is the intertidal zone that contains areas covered with concrete riprap and other exposed shoreline containing sediments and emergent saline wetlands. The intertidal sediments present in the Shoreline Area were characterized during the SDGI, and the results are summarized in the Shoreline Characterization Technical Memorandum (SulTech, 2007; Appendix G to this report). The metal slag area, discussed in the subsection above, also extends into the Shoreline Area and was previously excavated under an interim removal action (Figure 1-3; TtECI, 2007b).

2.2. GEOLOGY AND HYDROGEOLOGY

Numerous field investigations have been performed to characterize and define the geology and hydrogeology at HPS. This subsection discusses the geologic and hydrogeologic conditions at Parcel E-2 based on the information derived from those investigations. The geologic descriptions presented in this subsection are interpreted from lithologic cross sections presented in the Landfill Lateral Extent Evaluation Report (TtEMI, 2004f). Hydrogeologic descriptions related to hydrostratigraphy, groundwater flow patterns, hydraulic characteristics, tidal effects, and total dissolved solids (TDS) are also presented in this subsection and are based primarily on information included in the Parcel E Groundwater Summary Report prepared following the Phase III GDGI (TtEMI, 2004c). This subsection also summarizes the evaluation of potential beneficial uses of groundwater at Parcel E-2.

2.2.1. Geologic and Hydrogeologic Units

The peninsula forming HPS is within a northwest-trending belt of the Franciscan Complex bedrock known as the Hunters Point Shear zone. The natural geology at HPS consists of unconsolidated Holocene sediments of estuarine and alluvial origin (Quaternary age) deposited on an uneven, eroded bedrock surface composed primarily of serpentinite (Jurassic-Cretaceous age). Artificial fill was deposited extensively over the natural sediments and bedrock during expansion of the shipyard in the early 1940s. Six individual geologic units have been identified at HPS. In general, the stratigraphic sequence of these geologic units, from youngest (shallowest) to oldest (deepest), is as follows: (1) Artificial Fill; (2) Slope Debris and Ravine Fill; (3) Undifferentiated Upper Sand Deposits; (4) Bay Mud; (5) Undifferentiated Sedimentary Deposits; and (6) Franciscan Complex Bedrock (TtEMI, 2004c). Figure 2-1 shows the surficial geologic units present at HPS, including the various subdivisions within the Franciscan Complex Bedrock. With the exception of Slope Debris and Ravine Fill, all other geologic units are present at Parcel E-2.

The hydrostratigraphy of Parcel E-2 consists of four distinct units, including three water-bearing units and one aquitard. The shallowest water-bearing unit is referred to as the A-aquifer. The A-aquifer is essentially manmade and consists primarily of Artificial Fill material, but also includes Undifferentiated Upper Sand Deposits. The A-aquifer is separated from the deeper water-bearing unit, referred to as the B-aquifer, by the Bay Mud in most locations across HPS. The B-aquifer consists of Undifferentiated Sedimentary Deposits underlying the Bay Mud. The upper weathered portions of the Franciscan Complex bedrock that directly underlie permeable Artificial Fill, Undifferentiated Upper Sand, and Undifferentiated Sedimentary deposits are considered part of the overlying aquifer (TtEMI, 2004c). The portions of saturated bedrock that are not in direct contact with the A- or B-aquifers are hydrostratigraphically classified as the bedrock water-bearing zone (WBZ) (TtEMI, 2004c). Flow in the bedrock WBZ generally occurs in localized, discontinuous fractures located below the upper portions of

bedrock (TtEMI, LFR, and U&A, 1997). The relationships between the stratigraphic and hydrostratigraphic units at Parcel E-2 are presented below.

Stratigraphic Unit	Corresponding Hydrostratigraphic Unit
Artificial Fill (Qaf)	A-aquifer [a]
Undifferentiated Upper Sand Deposits (Quus)	A-aquifer [a]
Bay Mud (Qbm)	Aquitard [b]
Undifferentiated Sedimentary Deposits (Qu)	B-aquifer [c]
Franciscan Complex Bedrock (KJfm)	Bedrock WBZ [d]

Notes:

a Hydrostratigraphic unit comprises permeable portions of the Artificial Fill and Undifferentiated Upper Sand deposits, and includes weathered portions of the bedrock that directly underlie saturated Artificial Fill or Undifferentiated Upper Sand deposits and localized areas where Undifferentiated Upper Sand deposits are interbedded with Bay Mud deposits.

b Hydrostratigraphic unit also includes low-permeability Artificial Fill deposits.

c Unit comprises the permeable portions of the Undifferentiated Sedimentary deposits.

d Unit consists of portions of saturated bedrock that are not in direct contact with the A- or B-aquifers.

Numerous field investigations at Parcel E-2 have provided geologic information that was used to define the subsurface stratigraphy and depth to bedrock at Parcel E-2. Figure 2-2 is a map showing cross-section locations across Parcel E-2. Figures 2-3 through 2-8 are the geologic cross-section diagrams of the Landfill Area that were presented in the Landfill Lateral Extent Evaluation Report (TtEMI, 2004f). Figures 2-9, 2-10, and 2-11 are hydrogeologic cross-section diagrams that were originally presented in the Parcel E Groundwater Summary Report (TtEMI, 2004c). The hydrogeologic cross sections cover the Landfill Area, Panhandle Area, and East Adjacent Area, and depict the lithologic units and the relative permeabilities of these sediments to portray the hydrostratigraphy at Parcel E-2.

Because of the different purposes for each set of cross sections, the data set used to construct the hydrogeologic cross sections does not provide the same level of detail for the heterogeneous artificial fill as compared to the geologic cross sections. The geologic cross sections were originally prepared to depict the subsurface conditions in and immediately surrounding the landfill waste and, as such, focused on providing the greatest level of detail within the heterogeneous artificial fill. In contrast, the hydrogeologic cross sections were prepared to depict the overall hydrostratigraphy at Parcel E-2, with a focus on identifying permeable zones within the A- and B-aquifers.

An important geologic feature at Parcel E-2 is the bedrock surface that declines steeply from the northern portion to the southern portion of Parcel E-2 (cross section G-G', Figure 2-9). The bedrock within the Hunters Point Shear Zone has been subjected to intense tectonic activity resulting in a high degree of folding, faulting, and metamorphism. As a result, the top surface of the bedrock ranges from approximately 55 feet below ground surface (bgs) in the northern part of Parcel E-2 to greater than 280 feet bgs in the southern part of Parcel E-2. This is a decline of approximately 225 feet over the length

of the site, which corresponds to a horizontal distance of approximately 1,100 feet. Based on the bedrock depths reported above, overburden sediments and fill above the bedrock at Parcel E-2 vary from about 55 feet thick in the northeast portion of Parcel E-2 to greater than 280 feet thick in the southern portion. Figure 2-12 shows the bedrock surface elevations at and adjacent to Parcel E-2.

Another important geologic feature at Parcel E-2 is the distribution of the Bay Mud Aquitard. The Bay Mud is present over most of Parcel E-2, except in the northwest corner. In this location, saturated Artificial Fill material and Undifferentiated Upper Sand Deposits (the A-aquifer) directly overlie the Undifferentiated Sediments (the B-aquifer); as a result, the A- and B-aquifers are in hydraulic communication at this location. However, as discussed in Section 2.2.2.2, where the Bay Mud aquitard is present, potentiometric data indicate an upward flow potential between the A- and B-aquifers. Further, as shown in cross section G-G' (Figure 2-9), the presence of laterally continuous layers of silt and clay within the B-aquifer sediments serves to hydraulically isolate the uppermost portions of the B-aquifer (that are interconnected with the A-aquifer) from the lower portions of the B-aquifer. The Bay Mud Aquitard thickens away from upland areas in the northern portion of Parcel E-2, as shown on Figure 2-13.

As part of the subsurface investigations that were conducted to gather the geologic and hydrogeologic data for Parcel E-2, monitoring wells were installed across the parcel in the A-aquifer and uppermost B-aquifer zones, and the well identifications are designated by "A" and "B" suffixes, respectively. These well identifications are consistent with the hydrostratigraphic interpretations made on Figures 2-9, 2-10, and 2-11 (TtEMI, 2004c). The Navy is monitoring groundwater in the A-aquifer and uppermost B-aquifer under the BGMP. Groundwater monitoring has not been required in the lower B-aquifer zone because (1) the degree of contamination in the uppermost B-aquifer is much lower than that in the A-aquifer (see Section 5); (2) the uppermost portions of the B-aquifer (that are interconnected with the A-aquifer) are hydraulically isolated from the lower portions of the B-aquifer; and (3) there is an upward vertical flow potential from the uppermost B-aquifer to the A-aquifer (see Section 2.2.2.2). Groundwater monitoring has not been required in the Parcel E-2 bedrock WBZ because the bedrock is relatively deep (greater than 55 feet bgs in the northern portion of Parcel E-2 to greater than 200 feet bgs in the southeast portion of Parcel E-2). In addition, the potential for downward migration of contamination into the bedrock WBZ is low because site stratigraphy within the B-aquifer limits hydraulic communication between the uppermost B-aquifer zone and the lower B-aquifer zone.

The following subsections provide more detail on each of the geologic units at Parcel E-2 and their relationships to their corresponding hydrogeologic units.

2.2.1.1. Artificial Fill and Undifferentiated Upper Sand Deposits – The A-Aquifer

Cross-sections A-A' through J-J' (Figures 2-3 through 2-11) show varying thickness of heterogeneous Artificial Fill material at Parcel E-2 and adjacent portions of Parcel E and the UCSF compound. The Artificial Fill ranges from 17 feet thick at the southern and northern edges of the Parcel E-2 Landfill (cross sections A-A' and B-B') (Figures 2-3 and 2-4) to 34 feet thick in the eastern portion of the landfill (cross section E-E') (Figure 2-7). The fill material consists primarily of soil and construction debris used for land reclamation, as well as a range of solid waste, construction, and demolition debris deposited in the landfill. The soil portion of the fill varies in composition from fine-grained clay deposits to coarse gravel and larger boulders and has an irregular contact with the underlying units. The irregular contact may be attributed to both natural causes (such as former stream channels) and manmade causes (such as dredging or placement of heavier bedrock-derived fill and debris on softer Bay Mud and sand deposits).

Construction and demolition debris, consisting mainly of broken concrete, asphalt, and bricks used as riprap, is visible along the edge of the Landfill Area, where it meets the Shoreline Area. Much of this shoreline debris was removed in 2004 as part of shoreline cleanup (TtFW, 2004c). Ballast sand and fill soil are mixed with the construction debris in some areas (TtEMI, 2004f). In addition to construction and demolition debris, the landfill contains industrial wastes, sandblast waste, and domestic refuse.

Based on the geologic cross sections (Figures 2-3 through 2-8), the vertical extent of solid waste in the Parcel E-2 Landfill ranges from approximately 10 to 25 feet thick and has an overlying cover of 1 to 15 feet thick. The top elevation of solid waste in the landfill is estimated to vary between 2 to 18 feet above msl, and in most locations is present above the water table. The bottom of the solid waste in the landfill extends beneath the water table, and is estimated to vary in elevation between 3 feet above msl and 13 feet below msl (cross section D-D') (Figure 2-6). The extent of the contiguous solid waste in the landfill is described in detail in Section 4.2.2.

Cross sections B-B', D-D', and E-E' (Figures 2-4, 2-6, and 2-7) show a discontinuous, undifferentiated sand unit present beneath the Artificial Fill in the northern portion of Parcel E-2. This Undifferentiated Upper Sand unit consists mostly of fine sand with occasional silty and clayey sands with marine shells. It ranges from 0 to 14 feet thick and generally overlies the Undifferentiated Sediments unit or Bay Mud, but in localized areas is interbedded with the Bay Mud (TtEMI, 2003e and 2004c).

The A-aquifer primarily consists of the heterogeneous, unconsolidated Artificial Fill material, with portions of the Undifferentiated Upper Sand Deposits and localized areas of the Bay Mud interbedded with Undifferentiated Upper Sand deposits. Cross sections H-H' (Figure 2-10) and J-J' (Figure 2-11) show that the lateral continuity of the A-aquifer is disrupted by numerous low-permeability zones because of the heterogeneous nature of the Artificial Fill (TtEMI, 2004c). The A-aquifer directly overlies the B-aquifer in the northwest corner of Parcel E-2, where the Bay Mud aquitard is absent (Figures 2-9, 2-10,

and 2-13). Cross section C-C' (Figure 2-5) shows that, north of Parcel E-2, along Crisp Avenue, the A-aquifer lies directly on the bedrock and the weathered bedrock beneath the water table is considered to belong to the A-aquifer.

The A-aquifer is approximately 5 to 15 feet thick from north to south across Parcel E-2 and is generally unconfined (TtEMI, 2004c); however, semiconfined conditions exist in areas where fine-grained fill material overlies coarser-grained fill material or Undifferentiated Upper Sand deposits (cross sections H-H' and J-J') (Figures 2-10 and 2-11). Groundwater flow directions in the A-aquifer are discussed in Section 2.2.2.

2.2.1.2. Bay Mud – The Aquitard

Bay Mud is present across most of Parcel E-2 and consists of Holocene, estuarine, grayish-green sediments that are almost exclusively composed of silt and clay (TtEMI, 2004c). The aquitard has an irregular upper surface, as discussed in Section 2.2.1.1. The Bay Mud thickens to the south and is over 45 feet thick near the shoreline at the southern end of Parcel E-2 (TtEMI, 2003e). As Figure 2-13 shows, the Bay Mud is absent in the northwest corner of Parcel E-2 and thickens to greater than 10 feet across most of Parcel E-2 (to a maximum of 39 feet thick in the southeast portion of Parcel E-2). The Bay Mud acts as an aquitard between the A- and B-aquifers where it is sufficiently thick (typically 1 to 2 feet). Fine-grained fill material that underlies the A-aquifer may also act as an aquitard (TtEMI, 2004c).

As discussed in Section 2.2.1, the Bay Mud aquitard is absent in the northwest corner of Parcel E-2; as a result, the A- and B-aquifers are interconnected. However, the vertical flow potential is upward in this area, and the presence of laterally continuous layers of silt and clay within the B-aquifer sediments throughout Parcel E-2 serves to hydraulically isolate the uppermost portions of the B-aquifer (that are interconnected with the A-aquifer) from the lower portions of the B-aquifer.

2.2.1.3. Undifferentiated Sediments – The B-Aquifer

The Undifferentiated Sediments consist of interbedded clay, silt, and sand and are the oldest unconsolidated sedimentary unit in Parcel E-2. The Undifferentiated Sediments unconformably overlie the Franciscan Complex Bedrock, and range from 45 feet thick in the northern part of Parcel E-2 to over 235 feet thick in the southern portion of Parcel E-2 (TtEMI, 2003e). Cross sections G-G' and J-J' (Figures 2-9 and 2-11) show that the Undifferentiated Sediments consist of two to three relatively thick (approximately 30- to 40-foot), laterally continuous layers of sand and silty or clayey sand, which are separated by laterally continuous layers of silt or clay that range from 8 to 120 feet thick (TtEMI, 2004c).

The B-aquifer is present in the permeable portions of the Undifferentiated Sediments, which, as described above, consists of two to three permeable layers separated by thick silt or clay layers. The uppermost

B-aquifer is semiconfined and separated from the A-aquifer by an aquitard, except in the northwest corner of Parcel E-2 (TtEMI, 2004c).

2.2.1.4. Franciscan Complex Bedrock – The Bedrock Water-Bearing Zone

Bedrock in Parcel E-2 consists of the Franciscan Complex, with serpentinite as the most common component. Serpentine bedrock is often associated with metamorphic basalt called "greenstone," which has a distinctive green color. Pockets of greywacke sandstones occur in some areas (TtEMI, 2004c). Figure 2-12 shows where serpentinite bedrock outcrops north of Parcel E-2. From the northern part of Parcel E-2, the bedrock plunges to the west and south. The depth to bedrock ranges from approximately 55 feet bgs in the northern part of Parcel E-2 to greater than 280 feet bgs in the southern part of Parcel E-2.

As discussed in Section 2.2.1, the upper weathered portions of the bedrock that directly underlie A- or B-aquifer sediments are considered part of the overlying aquifer. The highly weathered bedrock has low hardness, and has been described as both crumbling easily to sand-sized grains and as having weathered to clay (TtEMI, LFR, and U&A 1997; TtEMI, 2004c). Borings logs for gas monitoring probes (GMPs) installed in the upper weathered bedrock underlying Crisp Avenue (located approximately 150 feet north of Parcel E-2) demonstrate this variability. The portions of saturated bedrock that are not in direct contact with the A- or B-aquifers are hydrostratigraphically classified as the bedrock WBZ (TtEMI, 2004c). Flow in the bedrock WBZ generally occurs in localized, discontinuous fractures located below the upper portions of bedrock (TtEMI, LFR, and U&A, 1997).

2.2.2. Groundwater Flow

Groundwater flow patterns in the A-aquifer are regularly evaluated by collecting water level measurements at monitoring wells installed throughout Parcel E-2 and generating groundwater elevation maps as part of the BGMP. Construction details for the Parcel E-2 monitoring wells are summarized in Appendix J3. Historic groundwater elevations are presented in Appendix J4. A-aquifer groundwater elevations are measured using a methodology designed to reduce the influence of tidal effects on the general definition of the potentiometric surface; the methodology is described in the sampling and analysis plan for the BGMP (CE2-Kleinfelder Joint Venture, 2009c). Additionally, groundwater flow patterns within the uppermost B-aquifer and tidal influenced zone (TIZ) of the A-aquifer have been evaluated during previous investigations at the parcel. The following subsections discuss the groundwater flow patterns of these aquifers, as well as groundwater recharge and discharge for the A-aquifer and uppermost B-aquifer.

2.2.2.1. Horizontal Groundwater Flow

Across most of Parcel E-2, groundwater in the A-aquifer flows south toward the bay; however, flow in the northeast portion of Parcel E-2 flows east toward a groundwater depression that is east of the landfill, near the boundary between Parcels G and E (CE2-Kleinfelder Joint Venture, 2007f, 2008a, and 2008d). This groundwater depression is most likely the residual effect of groundwater infiltrating damaged sanitary sewer lines during pumping at a nearby lift station. The sanitary sewer lift station, located at the former Parcel A, ceased operation in May 2007. The lateral extent of the groundwater depression had decreased from approximately 73 acres in May 2007 to less than 0.1 acre in March 2009 (CE2-Kleinfelder Joint Venture, 2009d). The potentiometric surfaces shown on Figures 2-14 and 2-15 (CE2-Kleinfelder Joint Venture, 2007f and 2008a) do not incorporate removal of tidal effects; however, past tidal studies have shown that the general geometry of the potentiometric surface within the TIZ can be accurately represented without filtering out tidal effects (TtEMI, 2004c). Section 2.2.4 presents a more thorough discussion of tidal effects.

Other buried utility lines located below the groundwater table may also act as preferential groundwater flow pathways. As shown on Figures 2-14 and 2-15, sections of the storm drain system in adjacent Parcel E are submerged below the groundwater table and appear to be affecting A-aquifer flow patterns south of Building 810. The Navy is in the process of removing the existing sanitary sewer and storm drain lines across HPS. The potentiometric surface of the A-aquifer continues to be monitored quarterly under the BGMP to track possible changes in flow patterns of the A-aquifer.

Groundwater elevations in the uppermost B-aquifer, as measured in August 2007, are presented on Figure 2-16 (CE2-Kleinfelder Joint Venture, 2008a). Based on the groundwater elevations in the limited number of wells shown on Figure 2-16, groundwater in the uppermost B-aquifer flows to the southeast across most of Parcel E-2. B-aquifer groundwater elevations are monitored under the BGMP on a quarterly basis (CE2-Kleinfelder Joint Venture, 2008a and 2008d).

2.2.2.2. Vertical Groundwater Flow Potential

Figure 2-17 illustrates vertical flow potential by presenting hydrographs for well pairs screened in the A-aquifer and uppermost B-aquifer. Based on available water level data from 2004 to 2008, the vertical component of groundwater flow potential between the A-aquifer and the uppermost B-aquifer is upward at these well pairs (Figure 2-17). The available data suggest that, in addition to the presence of the Bay Mud aquitard, potential downward migration of contaminated groundwater from the A- to B-aquifer is limited by the upward groundwater flow potential (from the B- to A-aquifer).

2.2.2.3. Groundwater Recharge and Discharge

Groundwater recharge to the A-aquifer at Parcel E-2 is affected by vertical and lateral infiltration from within Parcel E-2, as well as groundwater flow from land upgradient of Parcel E-2. Recharge may also be contributed by leaking utility lines. Higher groundwater levels exist during the rainy season. Groundwater elevations measured in Parcel E-2 wells in March 2007 were on average 0.9 foot higher than in August 2007. A-aquifer groundwater discharge over the northeast portion of Parcel E-2 is directed eastward across Parcel E toward a groundwater depression near the Parcel E and Parcel G boundary. As discussed in Section 2.2.2.1, deactivation of the sanitary sewer lift station has decreased the lateral extent of the groundwater depression from approximately 73 acres to 0.1 acre over a 21-month period (CE2-Kleinfelder Joint Venture, 2009d). The Navy continues to remove the existing sanitary sewer and storm drain lines across HPS, and the effect of this activity is being evaluated as part of the BGMP quarterly water level measurements. Groundwater near the Parcel E-2 shoreline discharges toward the bay.

The area hydraulically upgradient of Parcel E-2 is the primary source of recharge to the B-aquifer. This area consists of non-Navy industrial property to the west and northwest. The recharge source is groundwater flowing horizontally into the B-aquifer. The B-aquifer is hydraulically connected to and discharges to permeable zones underlying the bay.

2.2.2.4. Seasonal Groundwater Effects

Recent groundwater data for Parcel E-2 (four quarters from 2007 and the first quarter 2008) were evaluated as part of this RI/FS Report to assess seasonal effects in groundwater flow patterns or gradients (CE2-Kleinfelder Joint Venture, 2007f, 2008a, and 2008d). A-aquifer groundwater levels were highest in March 2007 (Figure 2-14), following the wet winter season, and lowest in August 2007, representing dry season conditions (Figure 2-15). Groundwater gradients measured across Parcel E-2 were somewhat lower in March 2007 (average of 0.014) than they were in August 2007 (average of 0.021). The overall direction of groundwater flow was consistent from season to season, with the primary seasonal difference being the somewhat shallower gradients across the landfill mass, with steeper gradients along the boundaries of the landfill area during the dry season (June and August) than during the wet season (March). Groundwater gradients are steepest on the south side of the landfill mass (toward the bay) and shallowest on the eastern side (toward Parcel E). Groundwater levels in the B-aquifer are slightly higher during the wet season as compared with the dry season (Figure 2-17); however, B-aquifer groundwater flow patterns and gradients do not appear to be significantly affected by the wet and dry seasons.

2.2.3. Hydraulic Characteristics

Constant rate aquifer tests were performed at various A- and B-aquifer wells during the Parcel E RI (TtEMI, LFR, and U&A, 1997). Additionally, slug tests were performed in Parcel E-2 during the Parcel E RI, and in conjunction with an evaluation of the groundwater extraction system (IT, 2001). Figure 2-18 shows the constant rate and slug test locations in Parcel E-2. Based on the slug test results shown in Table 2-1, hydraulic conductivity within the A-aquifer varies significantly across the site, ranging from 0.14 to 130 feet per day. The highly variable hydraulic conductivity is likely because slug tests were primarily conducted on wells screened within the heterogeneous artificial fill material.

In addition, existing data from constant-rate aquifer pumping tests (TtEMI, LFR, and U&A, 1997; TtEMI, 2004c) were evaluated. Because they occur over a longer time period, constant-rate tests stress a much larger volume of the water-bearing units than do slug tests; therefore, they represent a larger volume of the aquifer. Table 2-2 presents the results of constant rate aquifer tests performed at Parcel E-2; hydraulic conductivities using this method ranged from 3.4 to 1,440 feet per day.

For this project, hydraulic conductivity values estimated from constant-rate aquifer tests are considered most representative of site conditions. Hydraulic conductivity values obtained from the constant rate aquifer tests were used, in conjunction with the representative hydraulic gradient calculated using data from the June 2002 tidal study, to estimate A-aquifer groundwater flow velocities using the following equation:

$$V = Ki / \eta_e \qquad (2\text{-}1)$$

where:

v	=	Groundwater flow velocity (feet per day)
K	=	Hydraulic conductivity (feet per day)
i	=	Hydraulic gradient (dimensionless)
η_e	=	Effective porosity (dimensionless)

Using the range of hydraulic conductivity values from constant-rate aquifer tests of 3.4 to 1,440 feet per day (Table 2-2), a hydraulic gradient of 0.002 (Figure 3-12 of Parcel E Groundwater Summary Report; TtEMI, 2004c), and an assumed A-aquifer effective porosity of 0.25[3], the groundwater flow velocity in the A-aquifer ranges from 0.03 to 12 feet per day (TtEMI, 2004c). Using the same parameters, but substituting a hydraulic gradient of 0.014 (based on representative gradients measured in March 2007), the groundwater flow velocity in the A-aquifer ranges from 0.2 to 81 feet per day.

[3] Two soil samples were collected for effective porosity analysis during the drilling of IR03MW372A (TtEMI, 2004c). An effective porosity of 0.25 is considered "typical" of the A-aquifer (TtEMI, 2004c).

2.2.4. Tidal Effects

Tidal studies performed during the Parcel E RI and the Phase III GDGI have characterized the extent of the A-aquifer TIZ, which is defined as the area where the maximum tidal fluctuation exceeds 0.10 foot in the A-aquifer (TtEMI, 2004c). The A-aquifer TIZ in Parcel E-2 extends approximately 100 to 300 feet inland from the Bay. The data are insufficient to estimate the boundary of the uppermost B-aquifer TIZ, but B-aquifer well IR01MW17B (in the northwest corner of Parcel E-2 about 555 feet from the bay) exhibited stronger tidal responses than nearby A-aquifer well IR01MW16A. This stronger tidal response is expected in the semiconfined uppermost B-aquifer compared with the generally unconfined A-aquifer, because pressure changes in the aquifer associated with the tidal water level changes in the bay are more readily transmitted through confined aquifers than unconfined aquifers (TtEMI, 2004c).

Additional tidal influence parameters, including tidal efficiency and time lag, were quantified during the Phase III GDGI and are presented on Figure 2-19 (TtEMI, 2004c). Tidal efficiency was estimated using the following equation:

$$eff = h_w / h_o \qquad (2\text{-}2)$$

where:

eff	=	Tidal efficiency (dimensionless)
h_w	=	Difference between groundwater elevation in a monitoring well observed over a period in time, usually between subsequent low and high tides (feet)
h_o	=	Difference between water elevation in the bay observed over the same tidal cycle as h_w (feet)

Tidal efficiency ranges from 0.3 to 6 percent in A-aquifer wells in Parcel E-2. Tidal efficiency is generally higher near the bay and decreases with distance inland. This conclusion is generally supported by the observation of the maximum tidal efficiency at A-aquifer well IR01MWI-8 (located 70 feet from the bay) and the minimum tidal efficiency at A-aquifer well IR01MW16A (located 605 feet from the bay). However, A-aquifer tidal efficiency data from elsewhere at Parcel E-2 indicate no clear correlation between distance from the bay and tidal efficiency. Variations in tidal efficiency are most likely a result of the heterogeneous nature of the A-aquifer.

The Phase III GDGI tidal influence study also evaluated the potential for ruptured utility lines to affect the groundwater level response to the tide. The study did not reveal any potential preferential pathways within the A-aquifer TIZ at Parcel E-2. This finding is not surprising due to the low number of submerged utility lines present in Parcel E-2.

The Phase III GDGI also evaluated the extent of the tidal mixing zone (TMZ) in the A-aquifer. The TMZ is the portion of the A-aquifer within which the bay water flows in and out during a tidal cycle so that groundwater physically mixes with the bay water. The TMZ is not the same as the TIZ, which is defined by groundwater level (pressure) responses to tidal fluctuations in the bay. The tidal mixing study involved collection of specific conductance (a temperature-independent surrogate for salinity derived from continuous conductivity and temperature measurements) data over time from wells located in IR Site 02 and IR Site 15 at Parcel E. The study found that tidal mixing extended inland greater than 70 feet, but less than 335 feet from the bay. The extent of tidal mixing was greater than predicted using a simple hydraulic model, and could be attributed to a submerged storm drain line that possibly provided a direct connection to saline bay water (TtEMI, 2004c).

2.2.5. Total Dissolved Solids

TDS concentrations in groundwater are an important measure of groundwater quality and are a primary criterion in determining the beneficial uses of groundwater (Section 2.2.6). As presented in the Parcel E Groundwater Summary Report for the Phase III GDGI (TtEMI, 2004c), TDS concentrations typically exceed 3,000 milligrams per liter (mg/L) in the A-aquifer across most of Parcel E-2, and the highest TDS concentrations (greater than 10,000 mg/L) in the A-aquifer are encountered along the Parcel E-2 shoreline. In the southeast corner of Parcel E-2, an area where TDS concentrations are less than 3,000 mg/L is surrounded by TDS concentrations exceeding 3,000 mg/L. This area coincides with a large groundwater mound believed to be caused by leaking water lines in the south-central portion of the Parcel E shoreline (TtEMI, 2004c).

Limited TDS data are available for the uppermost B-aquifer across Parcel E-2. In June 2002, maximum B-aquifer TDS concentrations in Parcel E-2 ranged from 1,700 to 4,610 mg/L (TtEMI, 2004c).

Earlier definitions of the TIZ, such as those in the Parcel E RI Report (TtEMI, LFR, and U&A, 1997), included high TDS concentrations (greater than 10,000 mg/L) in groundwater. Inclusion of the TDS concentration in the TIZ definition appears to have given the impression that high TDS concentrations up to 400 feet inland from the bay are caused by tidal mixing. As discussed in Section 2.2.4, tidal mixing appears to occur at some inland locations and is believed to be attributable to preferential pathways such as ruptured and submerged storm drain lines. High TDS concentrations inland could also be the result of a wedge of saline water that normally lies beneath the freshwater portion of an aquifer that is near a body of seawater. A saline wedge does not move laterally hundreds of feet with the tide; it is a stable feature in equilibrium with the fresh water above (TtEMI, 2004c).

2.2.6. Groundwater Beneficial Reuse

According to the RWQCB Basin Plan, groundwater at Parcel E-2 has the following potential beneficial uses (RWQCB, 2007a):

- Agricultural water supply
- Industrial service and process water supply
- Municipal and domestic drinking water supply

Groundwater at Parcel E-2 is unlikely to be used for agricultural and industrial purposes due to generally high TDS, chloride, salinity, specific conductance, and hardness values in the A-aquifer and uppermost B-aquifer (see data in Appendix G of TtEMI, 2004c). According to the Basin Plan, site-by-site determinations of the freshwater replenishment beneficial use will be made. Freshwater replenishment has been determined to be a beneficial use of the groundwater at Parcel E-2; Appendix M evaluates the potential for chemicals in groundwater to pose a risk to aquatic life in the bay. Appendix I evaluates the beneficial uses of groundwater at Parcel E-2, with a specific focus on evaluating use of the A- and B-aquifers at Parcel E-2 as potential drinking water sources. The following subsections summarize the findings of this evaluation.

2.2.6.1. A-Aquifer Evaluation for Federal Criteria

Federal groundwater classification criteria identify three classes of groundwater (EPA, 1986). Class I groundwater is an irreplaceable source of drinking water or is ecologically vital. Class II groundwater is a current or potential source of drinking water that has other beneficial uses. Class III groundwater is not a potential source of drinking water and is of limited beneficial use. EPA considers groundwater to be Class I or Class II if the following criteria are met:

- The TDS concentration is less than 10,000 mg/L
- A minimum well yield of 150 gallons per day (gpd) or 0.104 gallon per minute is achievable

Transmissivities measured at Parcel E-2 during the RI (Table 2-2) suggest that the minimum well yield of 150 gpd would be met for the A-aquifer. Therefore, the classification of the A-aquifer relative to federal criteria focuses on measured TDS concentrations. Figure 2-20 presents the maximum historical TDS concentrations (from data collected through October 2002) detected in A-aquifer groundwater monitoring wells at Parcel E-2, along with contours for the federal TDS criteria. As shown on Figure 2-20, Class II groundwater exists throughout most of Parcel E-2 A-aquifer.

Appendix I evaluates various site-specific factors (SSF) to determine if conditions other than TDS concentrations affect the potential for Class II A-aquifer groundwater at Parcel E-2 to be used as a drinking water source. The NCP preamble allows for the application of SSFs to determine appropriate

remediation goals for Class I and II groundwater. As outlined in Appendix I, a range of other SSFs make use of A-aquifer groundwater for water supply extremely unlikely. Principal among these are:

- Insufficient aquifer thickness to provide adequate supply
- Depth to groundwater too shallow to support a sanitary seal and adequate screened interval
- Lack of historical and current precedents for use of HPS groundwater for public water supply
- Existence of local and state institutional controls that prohibit or severely restrict locations where new potable wells can be installed
- Poor quality of underlying B-aquifer relative to drinking water standards

Considering these factors together, the weight of evidence indicates that the Class II A-aquifer at Parcel E-2 is not a potential source of water for municipal or domestic water supply.

2.2.6.2. A-Aquifer Evaluation for State Criteria

Under State Water Resources Control Board (SWRCB) Resolution No. 88-63, all groundwater is considered potentially suitable for municipal or domestic supply unless at least one of the following conditions applies (SWRCB, 1988):

- The TDS concentration exceeds 3,000 mg/L and the groundwater is not reasonably expected by RWQCB to supply a public water system
- The groundwater is contaminated, either by natural processes or by human activity, to the degree that it cannot reasonably be treated for domestic use
- The water source does not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gpd

In response to a request by the Navy (2003), the RWQCB determined that the A-aquifer at HPS is not suitable or potentially suitable as a municipal or domestic water supply, and meets exemption criteria in SWRCB Resolution 88-63 and RWQCB Resolution 89-39 (RWQCB, 2003c). This determination is based on the following factors:

- TDS concentrations in A-aquifer groundwater exceed 3,000 mg/L
- Artificial fill composes most of the A-aquifer
- Naturally occurring dissolved metals concentrations have been estimated (Hunters Point groundwater ambient levels [HGAL]), and some of these metals concentrations exceed maximum contaminant levels (MCLs) for drinking water when the metal is at or below its HGAL
- There is no historical, present, or planned future use of groundwater at HPS
- Well construction requirements prohibit water supply wells in most parts of HPS
- Pumping would cause saltwater intrusion in areas where potable wells could conceivably be installed

2.2.6.3. B-Aquifer Evaluation

TDS data are available for the six wells installed in the uppermost B-aquifer in Parcel E-2, and maximum TDS concentrations in these wells ranged from 1,600 to 5,120 mg/L. Based on available TDS data, the B-aquifer at Parcel E-2 would be considered suitable as a potential drinking water source, and the evaluation of SSFs in Appendix I reveals that the B-aquifer in Parcel E-2 has moderate potential to be used as a drinking water source. Considering this conclusion and past agreements with the BCT on the HHRA, the groundwater ingestion pathway is included in the risk assessment for the B-aquifer. This assumption provides an additional layer of conservatism with respect to the protection of human health at Parcel E-2.

2.2.6.4. Bedrock Water-Bearing Zone Evaluation

As discussed in Section 2.2.1, groundwater monitoring has not been required in the Parcel E-2 bedrock WBZ because the bedrock is relatively deep (greater than 55 feet bgs in the northern portion of Parcel E-2 to greater than 200 feet bgs in the southeast portion of Parcel E-2). Therefore, no direct data are available to assess the water quality or yield of the bedrock WBZ underlying Parcel E-2 relative to federal and state criteria.

2.3. HYDROLOGY

Precipitation is the main source of surface water runoff at HPS. Surface water runoff at HPS is greatest in the winter months (November through April), when rainfall often exceeds 4 inches per month. Precipitation is less than 0.1 inch per month from June through September, resulting in minimal runoff. Precipitation data from an on-site meteorological station are shown on Figure 2-21. In addition to rainfall, the irrigation system for the interim landfill cap at Parcel E-2 is another potential source of surface water runoff. The irrigation system could potentially generate runoff if used excessively during dry months to maintain vegetation; however, the system is operated and maintained so that excessive watering does not occur (ITSI, 2006h, 2007d, 2008d, 2010d, and 2010e).

As discussed in Section 1.6.2, surface water runoff at the landfill is managed in accordance with the SWDMP (MARRS and MACTEC, 2009b), which complies with the General Permit of the National Pollutant Discharge Elimination System (NPDES), as administered by the SWRCB. Monitoring is performed in accordance with the SWDMP, and various BMPs described in the SWDMP are used to limit erosion or unwanted discharges from the site (MARRS and MACTEC, 2009b). Surface water drainage patterns at Parcel E-2 and engineered BMPs are shown on Figure 2-22 and described below.

In the western and northwestern portion of Parcel E-2, runoff is controlled by drainage channels constructed along the western perimeter of Parcel E-2. The channels direct runoff south and discharge indirectly to the bay through low-lying seasonal wetlands in the Panhandle Area southwest of the landfill.

Stormwater discharge is monitored at the point where the western perimeter channel discharges into the Panhandle Area (MARRS and MACTEC, 2009b).

In the northeastern portion of Parcel E-2 (and portions of the UCSF property), runoff is controlled by drainage channels that direct runoff into one of two catch basins (Figure 2-22). Stormwater then flows east through a 12-inch-diameter polyvinyl chloride (PVC) pipe and discharges into the HPS storm sewer system, which ultimately discharges into the bay. Stormwater discharge is monitored at both catch basins (MARRS and MACTEC, 2009b).

In the eastern portion of Parcel E-2 (including the eastern portion of the interim landfill cap), runoff flows south into a low-lying area south of the interim landfill cap (Figure 2-22). This area was excavated and revegetated following the removal action at the PCB Hot Spot Area (TtECI, 2007a), as discussed in Section 3.8.8. The vegetation helps limit sediment runoff. In addition, the drainage swale at the southeast portion of the landfill, which diverts runoff from the eastern portion of the cap to the bay, was restored following the removal action (Figure 2-22).

In the central portion of Parcel E-2, most runoff flows to a riprap-lined swale in the center of the interim landfill cap and then discharges into the bay at the southern edge of the interim cap. The drainage structures in Parcel E-2 are presently capable of handling runoff from the 100-year, 24-hour storm event (estimated at 4 inches). To limit erosion, vegetation and other BMPs (such as silt fences, hay bales, fiber rolls, gravel or sandbags, and berms) have been established at Parcel E-2. Surface water runoff from Parcel E-2 will be controlled and monitored in accordance with the existing SWDMP until implementation of the final remedy for Parcel E-2 (MARRS and MACTEC, 2009b).

2.4. ECOLOGY

The ecology of Parcel E includes terrestrial habitat, aquatic environments, and transitional wetlands. All of these ecological areas have been disturbed by human activities such as excavation, filling, and development (Harding Lawson Associates [HLA], 1991). Habitat data from the Phase 1A ecological risk assessment (ERA) were used with data from a resurvey of Parcels E and E-2 in February 1997. The field survey results delineated the terrestrial habitats (industrial, ruderal, and non-native annual grassland) and the wetland and intertidal habitats (TtEMI, LFR, and U&A, 1997). In 2001 and 2002, ecological surveys were performed in the wetland and intertidal habitats at Parcel E-2 (TtEMI, 2003d; SulTech, 2007, Appendix G to this report), and are discussed in Sections 2.4.2 and 2.4.3 below. In 2004, a biological assessment was performed to support the removal actions at the Metal Slag Area and PCB Hot Spot Area (TtFW, 2004a).

2.4.1. Terrestrial Habitat

The onshore environment at Parcels E and E-2 is significantly less developed than other areas at HPS and consists primarily of industrial and ruderal (disturbed) habitat. These habitats are typified by paved and fenced areas, abandoned lots, and other disturbed areas. Poorly developed soil horizons, low organic soil content, soil contamination, and shallow saline groundwater limit the composition and abundance of the terrestrial vegetation community (TtEMI, LFR, and U&A, 1997). Plant species present in Parcel E-2 are opportunistic weeds and herbaceous species adapted to arid conditions and poor soil quality (HLA, 1991). Although the onshore environment at Parcel E-2 supports few plant species, birds, mammals, and reptiles have been observed in this parcel. The habitat in Parcel E-2 provides food for granivorous, omnivorous, and scavenging birds observed at HPS (HLA, 1991). Burrows have been observed in Parcel E-2 and are suspected to have been created by small mammals (PRC Environmental Management, Inc. [PRC], 1994). The terrestrial habitats at Parcel E-2 are summarized in the following sections. Figure 2-23 presents the terrestrial ecological habitat at Parcel E-2.

2.4.1.1. Industrial Habitat

Industrial areas present within the East Adjacent Area consist of artificial structures, including paved areas (such as roadways, parking lots, and old foundations), packed earth, and other similar areas. Industrial areas may provide shelter for wildlife species but lack the vegetative component essential to support most wildlife. Common bird species such as barn swallows (*Hirundo rustica*), mourning doves (*Zenaida macroura*), song sparrows (*Melospiza melodia*), and barn owls (*Tyto alba*) are known to use abandoned industrial structures adjacent to Parcel E-2 for nesting. Raptors such as the red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*) may also use these areas to perch. Small mammals such as the house mouse (*Mus musculus*), deer mouse (*Peromyscus maniculatus*), and Norway rat (*Rattus norvegicus*) may shelter in abandoned structures adjacent to Parcel E-2. Although industrial structures may provide shelter, they do not provide a food source. Therefore, animals are expected to forage in other less disturbed habitat types in Parcel E-2 where food sources are present (TtEMI, LFR, and U&A, 1997).

2.4.1.2. Ruderal Habitat

The ruderal habitat present within the Panhandle Area and East Adjacent Area (and a small portion of the Landfill Area) consists of areas that have been "altered" and is typified by abandoned lots, eroding pavement, and other marginal zones. Most of the habitat is undeveloped and often cluttered with debris such as concrete, scrap iron, and other discarded materials. Ruderal areas are dominated by aggressive non-native plants. Common plant species found in the ruderal habitat at Parcel E-2 include a predominance of fennel (*Foeniculum vulgare*), black mustard (*Brassica nigra*), barley (*Hordeum murinum*), cultivated oat (*Avena sativa*), plantain (*Plantago sp.*), and perennial ryegrass (*Lolium perenne*) (TtFW, 2005b). In addition, native shrub species such as coyote brush (*Baccharis pilularis*) and non-

native ornamental tree species such as Peruvian pepper tree (*Schinus molle*) and green wattle (*Acacia decurrens*) occur in disturbed areas (TtEMI, LFR, and U&A, 1997).

The ruderal areas throughout Parcel E-2 provide habitat for a variety of bird species, including the mourning dove, rock dove (*Columba livia*), house finch (*Carpodacus mexicanus*), savannah sparrow (*Passerculus sandwichensis*), song sparrow, western meadowlark (*Sturnella neglecta*), and northern mockingbird (*Mimus polyglottos*). These bird species were observed during the February 1997 field survey. Birds of prey such as the red-tailed hawk and American kestrel were also observed at Parcel E-2 during the 1997 survey (TtEMI, LFR, and U&A, 1997).

Small mammals observed within the ruderal habitat include the black-tailed jackrabbit (*Lepus californicus*) and California ground squirrel (*Spermophilus beecheyi*). Other mammals that may occur within this habitat include the deer mouse, Botta's pocket gopher (*Thomomys bottae*), raccoon (*Procyon lotor*), and red fox (*Vulpes vulpes*). Ruderal habitat at Parcel E-2 may provide a home for the western fence lizard (*Sceloporus occidentalis*), gopher snake (*Pituophis melanoleucus*), and garter snake (*Thamnophis sirtalis*) (HLA, 1991; PRC, 1994). The bird, mammal, and reptile species noted above are a potential prey base for predatory birds observed over Parcel E-2, such as the red-tailed hawk and American kestrel.

2.4.1.3. Non-Native Annual Grassland Habitat

Non-native annual grasslands, present within the Landfill Area and Panhandle Area, are dominated by annual grass species such as ripgut brome, perennial ryegrass, wild oat *(Avena fatua*), and barley. Although these grasses may occur in the other habitat types, non-native annual grassland is characterized by approximately 100 percent grass coverage with little or no shrub component (TtEMI, LFR, and U&A, 1997).

The vegetative cover on the interim landfill cap and surrounding areas within the Landfill Area consists of Zorro annual fescue *(Vulpia myuros),* Blando brome *(Bromus hordeaceus),* Rose clover *(Trifolium hirtum),* Gulf annual ryegrass *(Lolium multiflorum),*and mixed California wildflowers (TtEMI, 2005b). The vegetative cover is inspected on a regular basis to ensure that proper vegetation growth prevents soil erosion and does not damage the geosynthetic membrane. Inspection for and removal of deep-rooted, invasive species is also performed on a regular basis (TtEMI, 2003b).

The herbaceous vegetation of grassland habitat provides refuge, as well as foraging and nesting habitat, for many wildlife species. Grassland habitats likely support fauna similar to ruderal areas, including bird species such as the meadowlark, song sparrow, red-tailed hawk, northern harrier (*Circus cyaneus*, a California species of special concern [CSC]), and the American kestrel. Additionally, the burrowing owl (*Athene cunicularia*), also a CSC, has been sighted in the past at HPS and may use grassland habitat at Parcel E-2 for nesting and foraging. Small mammals commonly found in grassland habitat include the

black-tailed jackrabbit, California ground squirrel, Botta's pocket gopher, and the deer mouse. Other mammals, such as the black-tailed deer (*Odocoileus hemionus*) and red fox, likely forage in the grassland habitat (TtEMI, LFR, and U&A, 1997).

2.4.2. Wetland Habitat

Wetlands studies performed at HPS, including Parcel E-2, are summarized in the Delineation and Functions and Values Assessment (TtEMI, 2003d; Appendix D to this report). This subsection summarizes information provided in that report.

In October 2001, the Navy delineated wetland areas in Parcels B, E, and E-2. Figure 2-23 presents the wetland habitat at Parcel E-2. The wetlands delineation was conducted using technical guidelines and methods described in the U.S. Army Corps of Engineers' (USACE) Wetland Delineation Manual (USACE, 1987b). The methodology consisted of visually observing soil, vegetation, and hydrology characteristics along a transect line perpendicular to site contours and across potential wetlands and uplands. Soil was characterized for each transect by digging 1-foot-diameter test pits and inspecting the upper 1.5 feet of soil for hydric soil indicators. Vegetation was characterized according to the "National List of Plant Species that Occur in Wetlands: 1996 National Summary" (U.S. Fish and Wildlife Service, 1996). Hydrology was assessed by observing wetland hydrologic indicators such as watermarks, drift lines, sediment deposits, and drainage patterns. The Delineation and Functions and Values Assessment was submitted to the USACE for review to ensure technical adequacy and compliance with all substantive requirements. The USACE responded on July 30, 2003, that it had no comments.

The two wetland areas identified at Parcel E-2 are summarized below.

Intertidal wetlands along the shoreline: Approximately 3.2 acres of intertidal and saline emergent wetlands along the Parcels E and E-2 shoreline were identified. Of the 3.2 acres, 2.38 acres are in Parcel E-2. The wetlands are bounded by a riprap wall and San Francisco Bay. The riprap wall ranges from 10 to 30 feet wide and 3 to 15 feet high. The ground surface in the intertidal wetlands areas slopes gently downward from the base of the riprap wall to the shore of the bay. Most of the intertidal wetlands are part of the Shoreline Area, the intertidal zone that is being evaluated in conjunction with Parcel F. A portion of the intertidal wetlands is collocated with the Parcel E-2 Landfill and will be affected by remedial activities.

An inland seasonal freshwater wetland in the Panhandle Area: A 1.3-acre seasonally ponded area was identified in the Panhandle Area of Parcel E-2. The wetland consists of a stormwater drainage ditch and a low-lying area where stormwater runoff ponds during the wet season. The wetland is bordered by the Landfill Area to the northeast, the Bayview/Hunters Point district to the west and northwest, and the riprap wall to the south. The wetland receives runoff from the north through a drainage ditch. During

storm events, some tidal influx may occur through a culvert in the south berm. The bay-side opening of the drainage culvert has a flap to prevent tidal inflow, but the flap has been rusted open for some time.

The following subsections generally describe the functions and values characteristics of the wetlands at Parcel E-2, as well as potential mitigation measures that could be implemented to mitigate damage caused to these wetlands as part of ongoing or future remedial actions.

2.4.2.1. Functions and Values of Wetland Areas

A functions and values assessment of the wetlands was conducted in December 2001, in conjunction with the wetlands delineation, and was followed by a confirmatory assessment in April 2002. The functions and values assessment followed the methods and guidance in USACE's wetland evaluation technique (USACE, 1987a).

The primary features of the *tidal wetlands* that contribute to the overall function of the system include the presence of known contaminants, vegetation cover, and location along the Pacific Flyway. The prime function of these wetlands consists of a low ability to retain sediments and toxicants and to produce nutrients. The tidal system and substrate type reduce the groundwater recharge and discharge ability of this wetland.

The features of the *seasonal freshwater wetland* that contribute to the overall function of the system include a stormwater ditch that drains to the wetland, a drainage culvert that drains the wetland, the watershed, infrequent tidal influences, presence of known contaminants, vegetative cover, and location along the Pacific Flyway. The prime functions of this wetland consist of the ability to retain sediments and toxicants and to produce nutrients. Because of the restricted outlet, export of nutrients is minimal. The combined estuarine and freshwater system and substrate type reduce the groundwater recharge and discharge ability of this wetland.

All wetlands identified at Parcel E-2 (tidal and seasonal freshwater) are situated along the Pacific Flyway; therefore, an abundance and diversity of wintering and migrating waterfowl species is a potentially significant feature; however, only red-winged blackbirds were observed to nest in the seasonal freshwater wetland. The diversity and abundance of aquatic organisms are moderate in the tidal wetlands and low in the seasonal freshwater wetland. This lack of aquatic organisms is presumably due to the toxicity of the soil and water in both types of wetlands and due to the seasonal nature of the freshwater wetland.

Both the tidal and seasonal freshwater wetlands identified at Parcel E-2 have no recreational value. Access to the wetlands is restricted because the site is located within a naval base. The wetlands are not unique and have no cultural value because they are manmade and situated on artificial fill.

In general, the most significant function of these wetlands is seasonal use for wintering and migrating wildlife. Because the wetlands are located on a known hazardous waste disposal site on manmade land, value in terms of social significance, effectiveness, and opportunity is low.

2.4.2.2. Presence of Special-Status Species

Species present in the Parcel E-2 wetland areas were assessed during the Phase 1A ERA (PRC, 1994) and a field survey conducted in 1997 in conjunction with the RI (TtEMI, LFR, and U&A, 1997). The only special-status species observed was the American peregrine falcon (*Falco peregrinus anatum*), which has been sighted feeding in the area (PRC, 1994). The American peregrine falcon is currently identified as a candidate for delisting from the state of California endangered and threatened species list; this species was delisted as a federal endangered species in 1999 (California Department of Fish and Game, 2008).

Non-special-status species observed in the wetland areas include plants (such as salt grass and sedge) and migratory shorebirds (such as the black turnstone [*Arenaria melanocephala*], killdeer [*Charadrius vociferous*], and willet [*Tringa semipalmata*]). During high tides, additional species may be present, including the osprey [*Pandion haliaetus*], great blue heron (*Ardea herodias*), great egret (*Ardea alba*), and belted kingfisher (*Megaceryle alcyon*). In addition, the Panhandle Area potentially contains raccoons, mallard ducks (*Anas plathyrhynchos*), California ground squirrels, and burrowing owls (PRC, 1994; TtEMI, LFR, and U&A, 1997). In 2004, the Navy conducted a bird survey of Parcels E and E-2 to identify potential special-status species in advance of several interim removal actions. The primary conclusion of that survey was that no suitable habitat exists at Parcels E or E-2 for any of the rail species (TtFW, 2004a). Protection of all plant and animal species in the Parcel E-2 wetland areas will be considered during the evaluation of potential remedies and during the RD. The RD will consider appropriate measures to protect the American peregrine falcon, which is the only special-status species identified at Parcel E-2.

2.4.2.3. Surface Water Drainage Effects to Seasonal Freshwater Wetlands

Seasonal freshwater wetlands in the Panhandle Area currently receive surface water runoff from the landfill cap area and function to remove suspended solids from the runoff before it enters San Francisco Bay. Parcel E-2 remediation may involve installation of a larger landfill cap, thereby resulting in additional surface water runoff from the cap to the wetlands. As stated above, the area of seasonal freshwater wetlands in the Panhandle Area can be enhanced to add new wetlands areas. Enhancing the wetland would serve two purposes: (1) the wetland would be capable of handling larger volumes of surface water runoff from any additional landfill cap area created as part of the Parcel E-2 remedy; and (2) it would compensate for wetlands lost during the removal actions occurring at other parts of Parcel E-2. Enlarging the seasonal freshwater wetlands in the Panhandle Area is discussed in the subsection below, as well as in Section 12.1.5.

2.4.2.4. Wetlands Restoration and Mitigation

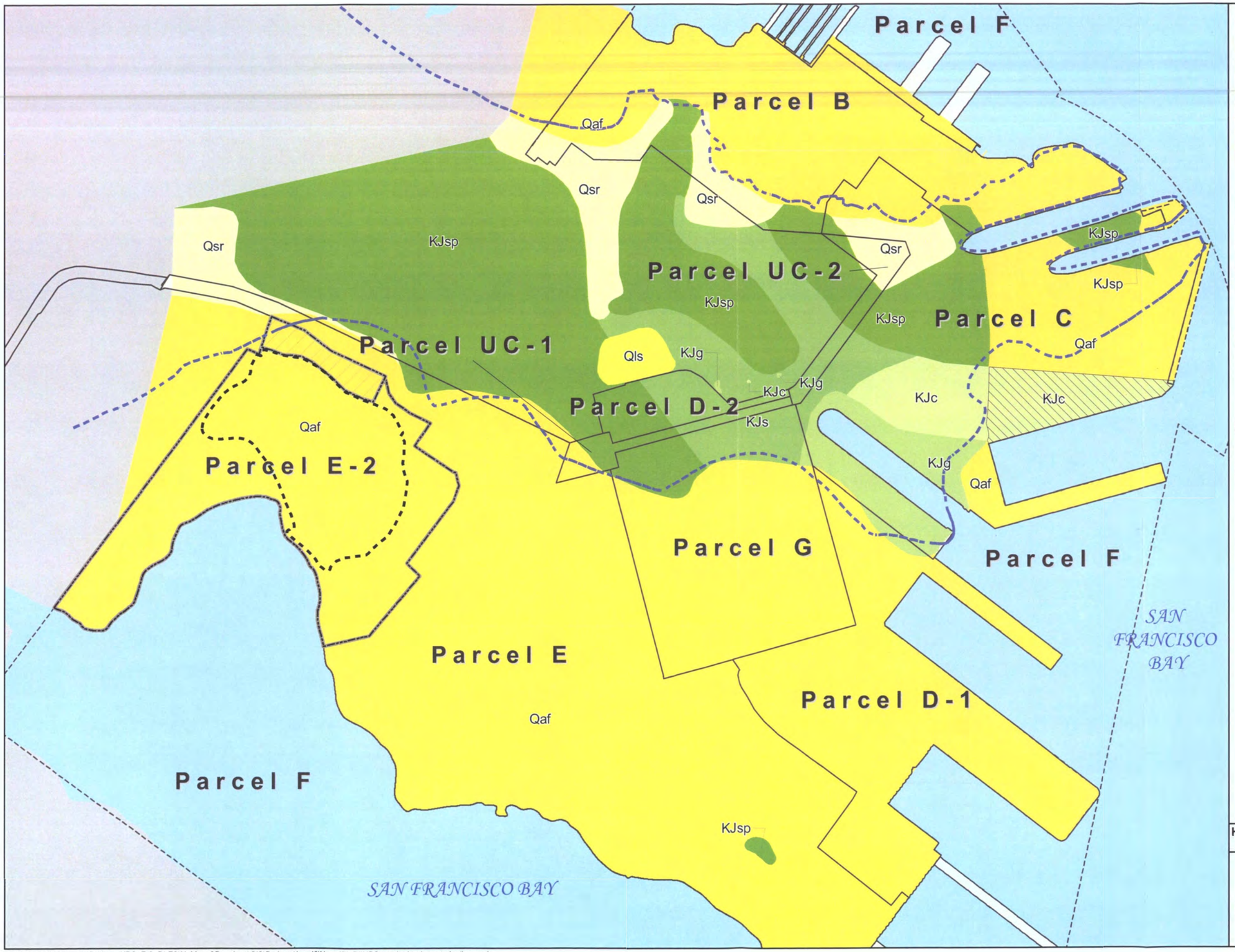
Because wetlands are collocated with the Landfill Area and other solid waste disposal areas at Parcel E-2, they will likely be disturbed or destroyed during ongoing and future (if any) remedial actions. The exact acreage of wetlands affected depends on the remedial alternative that is selected; specific acreages affected by remediation under each alternative are discussed in the FS portion of this report.

The Panhandle Area west of the Landfill Area was identified as a potential location where damage to wetlands could be mitigated. For every acre (or fraction thereof) of wetland destroyed in Parcel E-2, the Navy intends to use an area of non-wetland property of the same size in the Panhandle Area for creation of new wetlands. Current estimates indicated that enough non-wetland property is located within the Panhandle Area that the area can be used as a mitigation area to compensate (typically on a one-to-one basis) for the permanent destruction of wetland areas in other parcels at HPS, if necessary. Future development plans for the Panhandle Area will need to address potential incompatibilities between recreation and pedestrian facilities and wetland areas. Further details on wetland restoration and mitigation are provided in Sections 11.8 and 12.1.5.

2.4.3. Intertidal Habitat

Habitat within the Shoreline Area consists of intertidal and saline emergent wetlands, unvegetated shoreline areas, and riprap covered areas. Figure 2-23 presents the intertidal habitat at Parcel E-2. Riprap consists of large pieces of concrete, metal rebar, and wood to prevent erosion. Wetland habitats are discussed in Section 2.4.2. Plant and animal species identified in the intertidal Shoreline Area are discussed in Section 1.3.1 of the Shoreline Characterization Technical Memorandum (SulTech, 2007; Appendix G of this report), and include California ground squirrels and the house mouse.

Figures



Geologic Characterization

- KJc-Chert Interbedded with Shale
- KJg-Predominantly Greenstone Volcanic Rock
- KJs-Undifferentiated Sandstone and Shale
- KJsp-Serpentinite
- Qls-Landslide Debris Zone
- Qaf-Artificial Fill
- Qsr-Slope Debris and Ravine Fill
- Geologic Contact (TtEMI, 2001a)
- Parcel Boundary
- Parcel E-2 Boundary
- Estimate of Solid Waste Extent
- UCSF Compound
- Non-Navy Property
- San Francisco Bay
- 1935 Shoreline

Notes:
UCSF = University of California, San Francisco

Reference:

Bonilla, M.G. 1971. "Preliminary Geologic Map of the San Francisco South Quadrangle and Part of the Hunters Point Quadrangle." *U.S. Geological Survey Miscellaneous Field Studies Map.* MG-311. 1:24,000.

TtEMI. 2001a. "Parcel E Information Package Phase II Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California." August 10.

N

600 0 600

Scale in Feet

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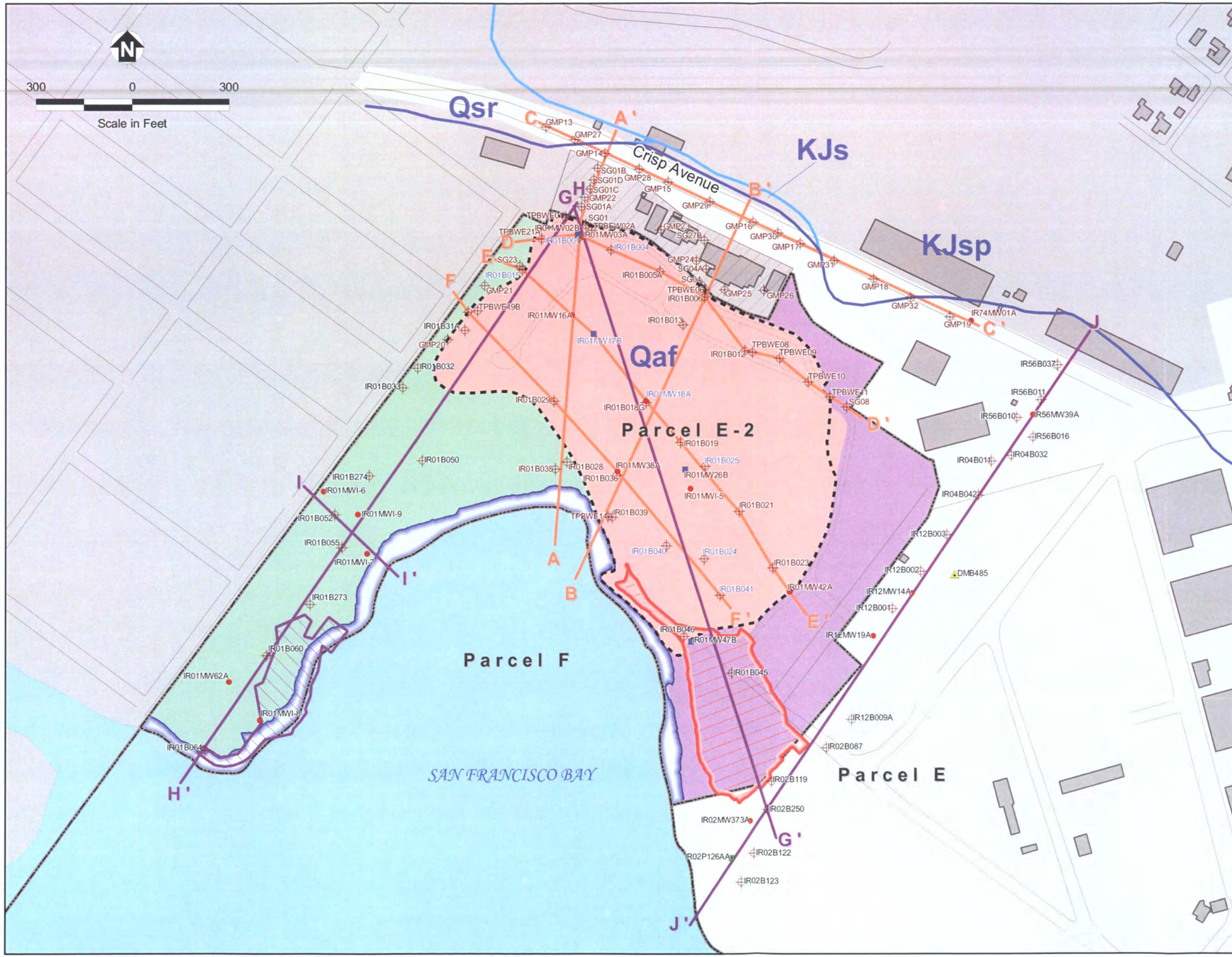
FIGURE 2-1

HUNTERS POINT SURFICIAL GEOLOGY

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\HPS_geologic_characterization.mxd



- Piezometer
- Historical Geotechnical Boring
- A-Aquifer Monitoring Well
- B-Aquifer Monitoring Well
- Boring Location
- Geologic Cross Section Location
- Hydrogeologic Cross Section Location
- Geologic Contact
- Bedrock-Artificial Fill Geologic Contact*
- Road
- Gravel Road
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Limit of Landfill Cap
- Estmate of Solid Waste Extent
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

KJs = Sandstone and Shale Bedrock
KJsp = Serpentinite Bedrock
Qaf = Artificial Fill
Qsr = Slope Debris and Ravine Fill
UCSF = University of California, San Francisco

Black Text = Borings used in Hydrogeologic Cross-Sections
Brown Text = Borings used in Geologic Cross-Sections
Blue Text = Borings used in both Geologic and Hydrogeologic Cross-Sections

References:

Bonilla, M.G. 1971. "Preliminary Geologic Map of the San Francisco South Quadrangle and Part of the Hunters Point Quadrangle."
U.S. Geological Survey Miscellaneous Field Studies Map. MG-311. 1:24,000.
*Geologic Conact based on Bonilla (1971)

TtEMI 2001a. "Parcel E Information Package Phase II Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California." August 10

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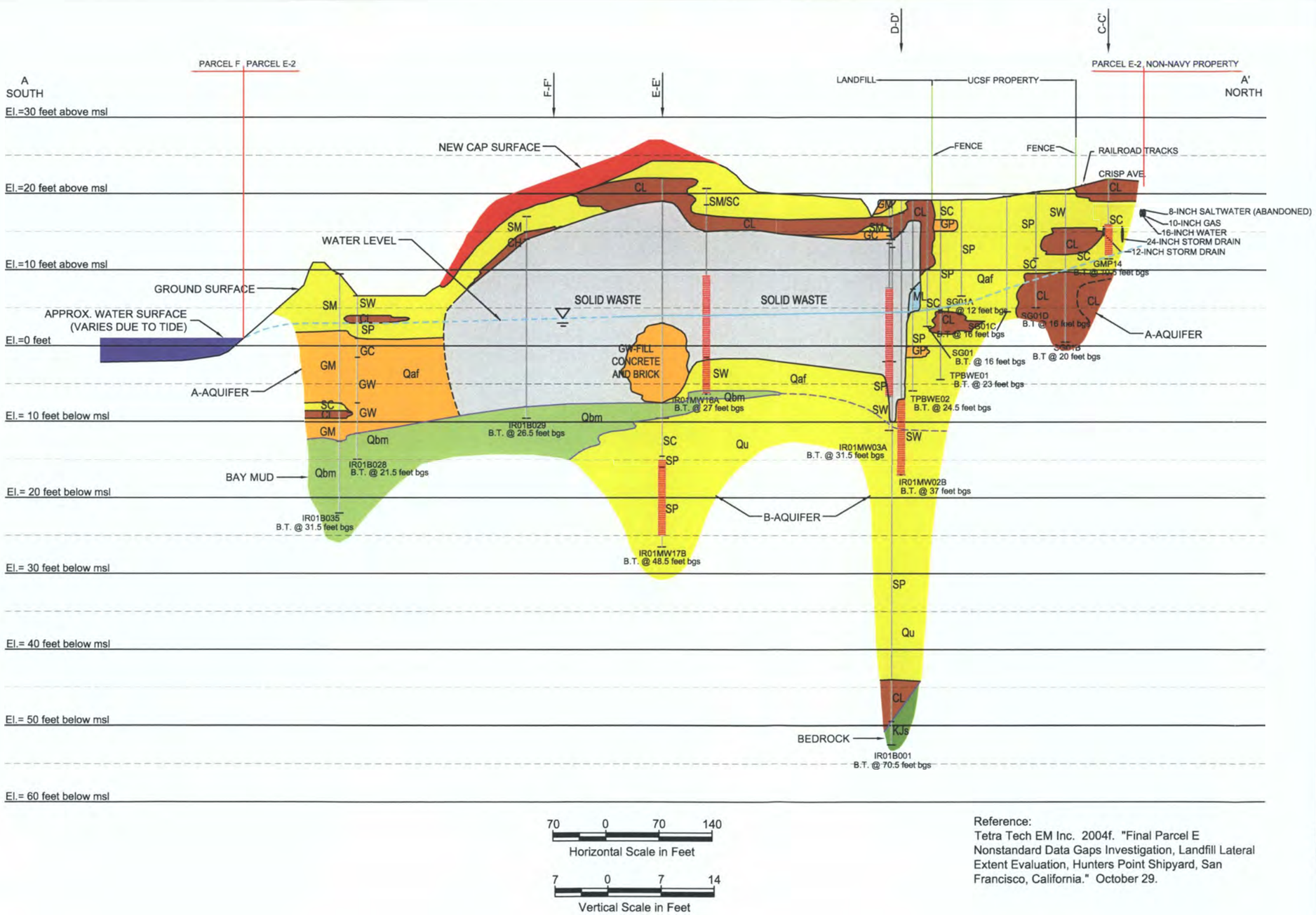
FIGURE 2-2

LOCATION OF PARCEL E-2 CROSS SECTIONS

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\GW_figures\Location of E-2 Cross Sections1.mxd



Reference:
Tetra Tech EM Inc. 2004f. "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Lateral Extent Evaluation, Hunters Point Shipyard, San Francisco, California." October 29.

Water Table Measurement on February 20, 2002; Water Level Shown is A-aquifer (dashed where inferred)

Lithologic or Waste Boundary (dashed where inferred)

Formation Boundary (dashed where inferred)

IR01B006 Boring Location (tic marks represent change in lithology)

IR01MW02B Screened Area

C-C' Intersection Location of Cross Sections

Cap

Sand

Clay

Silt

Gravel

Bay Mud (clay)

Solid Waste

Bedrock

Tidal Reference

Notes:

bgs	below ground surface
B.T.	borehole termination
CH	high-plasticity clay
CL	clay
El.	elevation
GC	clayey gravel
GM	silty gravel
GMP	gas monitoring probe
GP	poorly graded gravel
GW	well graded gravel
KJs	Sandstone and Bedrock
ML	silt
msl	mean sea level
Qaf	Artificial Fill
Qbm	Bay Mud (clay)
Qu	Undifferentiated Sediments
SC	clayey sand
SM	silty sand
SP	poorly graded sand
SW	well graded sand
UCSF	University of California, San Francisco

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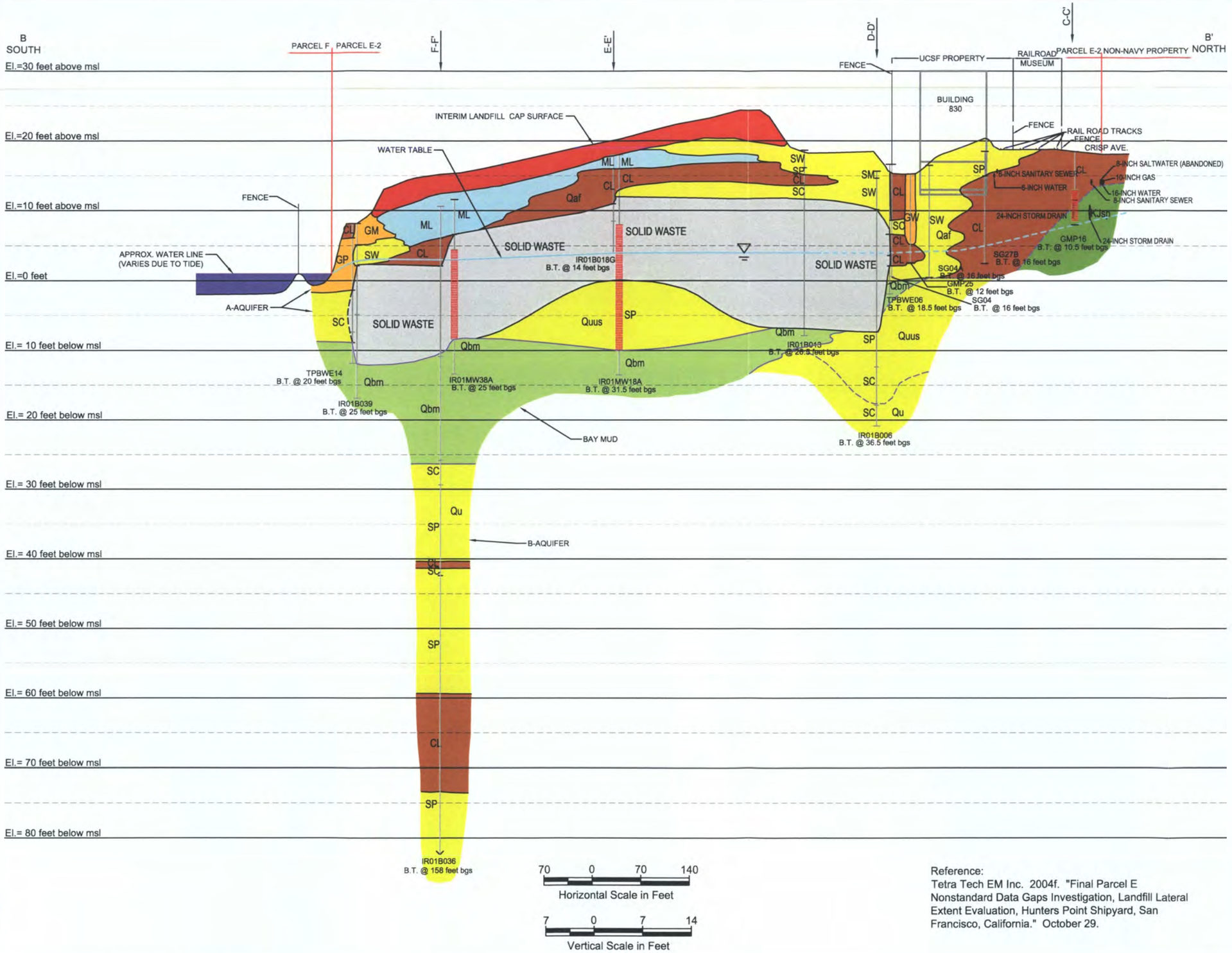
FIGURE 2-3

CROSS SECTION A-A'

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FSIN_Maps&Drawings\GIS\Projects\HPCross Sections\Figure 2-3.dwg



Reference:
Tetra Tech EM Inc. 2004f. "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Lateral Extent Evaluation, Hunters Point Shipyard, San Francisco, California." October 29.

Water Table Measurement on February 20, 2002; Water Level Shown is A-aquifer (dashed where inferred)

Lithologic or Waste Boundary (dashed where inferred)

Formation Boundary (dashed where inferred)

IR01B006 — Boring Location (tic marks represent change in lithology)

GMP16 — Screened Area

C-C' — Intersection Location of Cross Sections

- Cap
- Sand
- Clay
- Silt
- Gravel
- Bay Mud (clay)
- Solid Waste
- Bedrock
- Tidal Reference

Notes:

bgs	below ground surface
B.T.	borehole termination
CL	clay
El.	elevation
GM	silty gravel
GMP	gas monitoring probe
GP	poorly graded gravel
GW	well graded gravel
KJsp	Serpentine Bedrock
ML	silt
msl	mean sea level
Qaf	Artificial Fill
Qbm	Bay Mud (clay)
Qu	Undifferentiated Sediments
Quus	Undifferentiated Upper Sand Deposits
SC	clayey sand
SM	silty sand
SP	poorly graded sand
SW	well graded sand
UCSF	University of California, San Francisco

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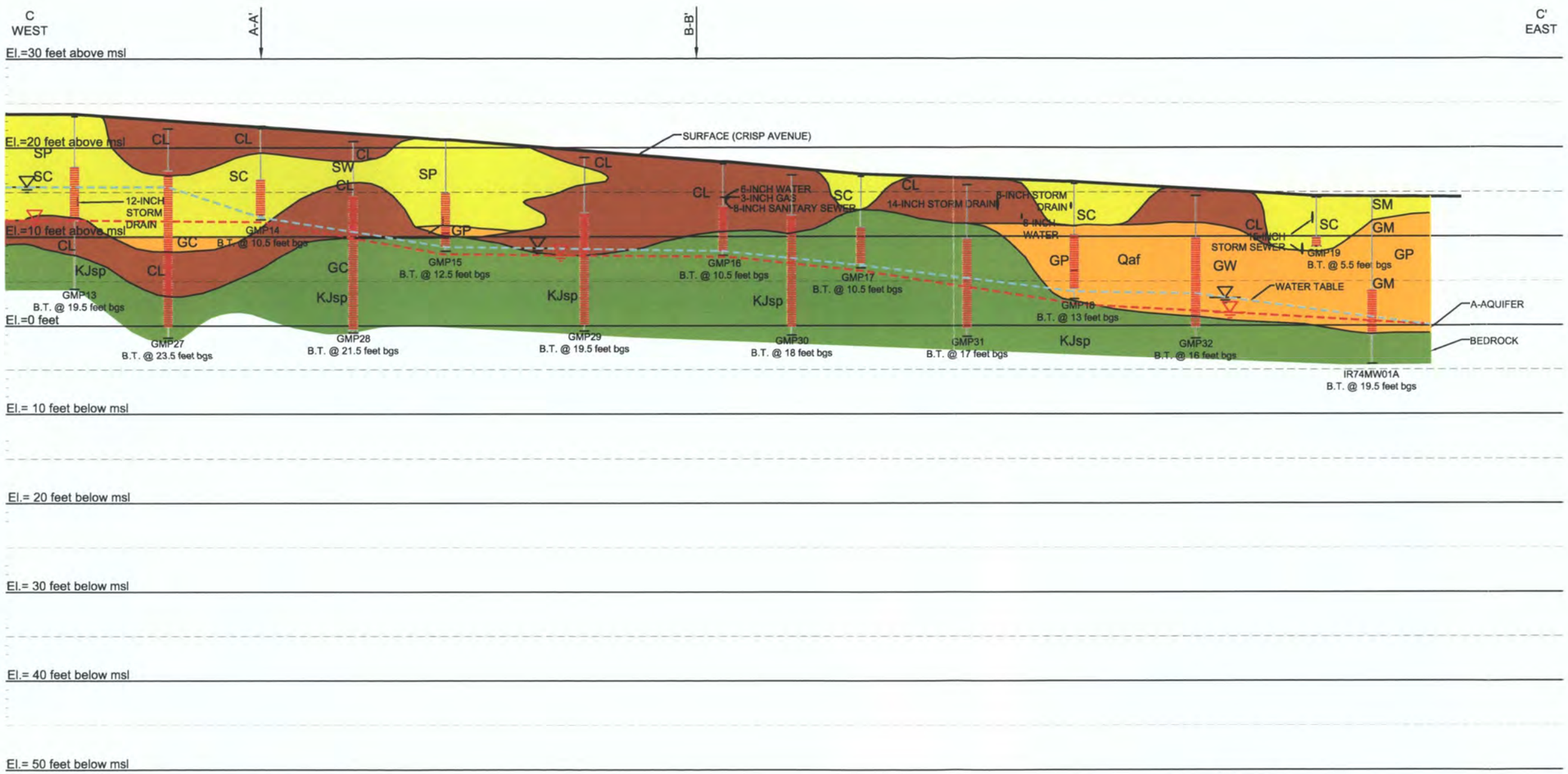
FIGURE 2-4

CROSS SECTION B-B'

Remedial Investigation/Feasibility Study for Parcel E-2



Water Table Measurements at GMPs on February 20, 2002; Water Level Shown is A-aquifer (dashed where inferred)

Water Table Represents the Estimated Low Groundwater Level Based on the Measurements at GMPs on May 31, 2002, that were adjusted approximately 2 feet downward to account for the maximum historic-level fluctuation (dashed where inferred)

Stormwater Sewer Utility Line

Lithologic or Waste Boundary (dashed where inferred)

Boring Location (tic marks represent change in lithology)

IR01B006

IR74MW01A Screened Area

A-A' Intersection Location of Cross Sections

Sand

Clay

Gravel

Bedrock

Notes:

bgs	below ground surface
B.T.	borehole termination
CL	clay
El.	elevation
GC	clayey gravel
GM	silty gravel
GMP	gas monitoring probe
GP	poorly graded gravel
GW	well graded gravel
KJsp	Serpentine Bedrock
msl	mean sea level
Qaf	Artificial Fill
SC	clayey sand
SM	silty sand
SP	poorly graded sand
SW	well graded sand

Reference:
Tetra Tech EM Inc. 2004f. "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Lateral Extent Evaluation, Hunters Point Shipyard, San Francisco, California." October 29.

70 0 70 140
Horizontal Scale in Feet

7 0 7 14
Vertical Scale in Feet

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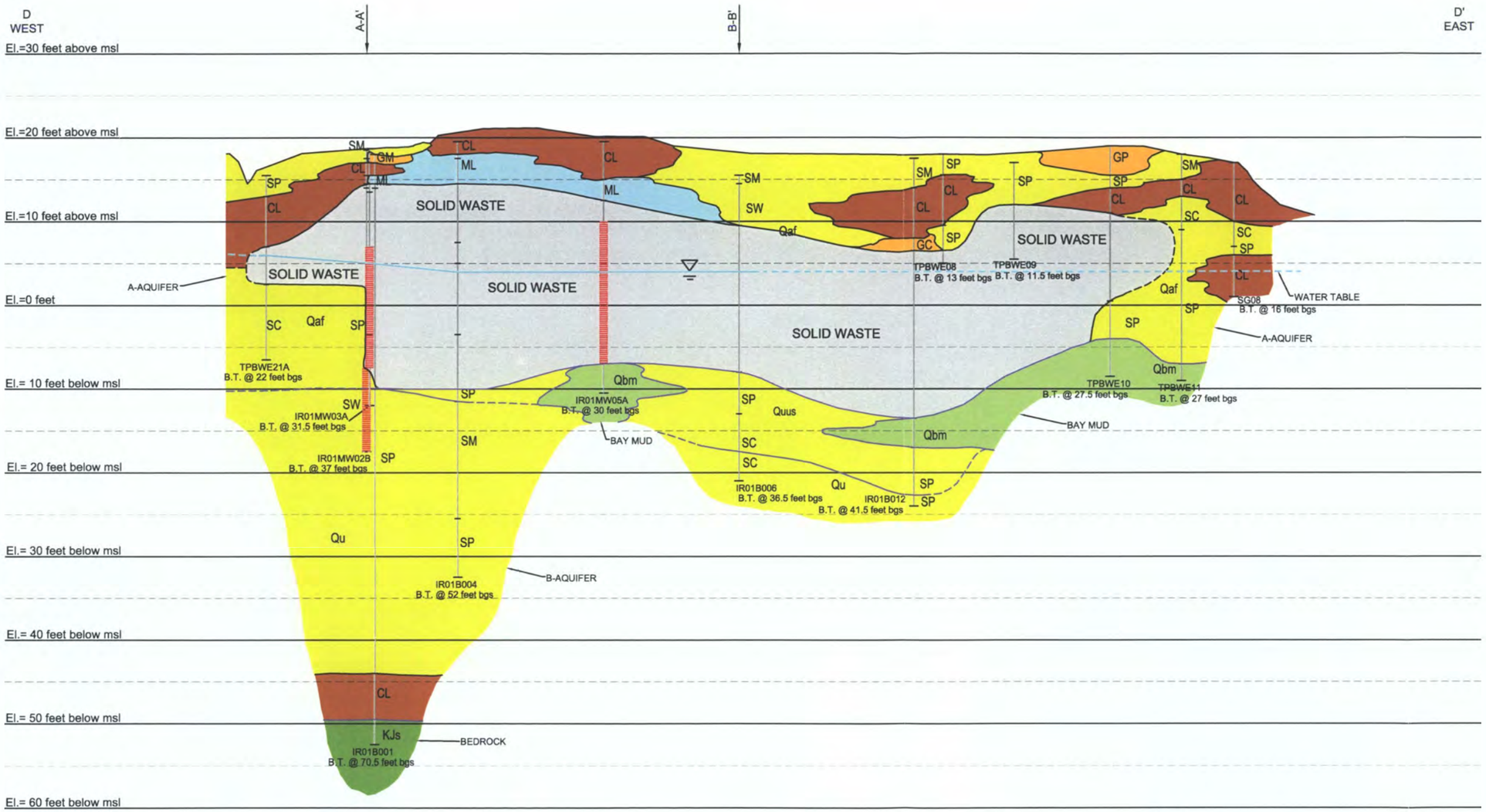
FIGURE 2-5

CROSS SECTION C-C'

Remedial Investigation/Feasibility Study for Parcel E-2

2006-10-05 P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\HP Cross Sections\Figure 2-5.dwg



Water Table Measurement on February 20, 2002; Water Level Shown is A-aquifer (dashed where inferred)

Lithologic or Waste Boundary (dashed where inferred)

Formation Boundary (dashed where inferred)

IR01B006 Boring Location (tic marks represent change in lithology)

IR01MW02B Screened Area

A-A' Intersection Location of Cross Sections

Sand

Clay

Silt

Gravel

Bay Mud (clay)

Solid Waste

Bedrock

Notes:

bgs	below ground surface
B.T.	borehole termination
CL	clay
El.	elevation
GC	clayey gravel
GM	silty gravel
GP	poorly graded gravel
KJs	Sandstone and Shale Bedrock
ML	silt
msl	mean sea level
Qaf	Artificial Fill
Qbm	Bay Mud (clay)
Qu	Undifferentiated Sediments
Quus	Undifferentiated Upper Sand Deposits
SC	clayey sand
SM	silty sand
SP	poorly graded sand
SW	well graded sand

70 0 70 140
Horizontal Scale in Feet

7 0 7 14
Vertical Scale in Feet

Reference:
Tetra Tech EM Inc. 2004f. "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Lateral Extent Evaluation, Hunters Point Shipyard, San Francisco, California." October 29.

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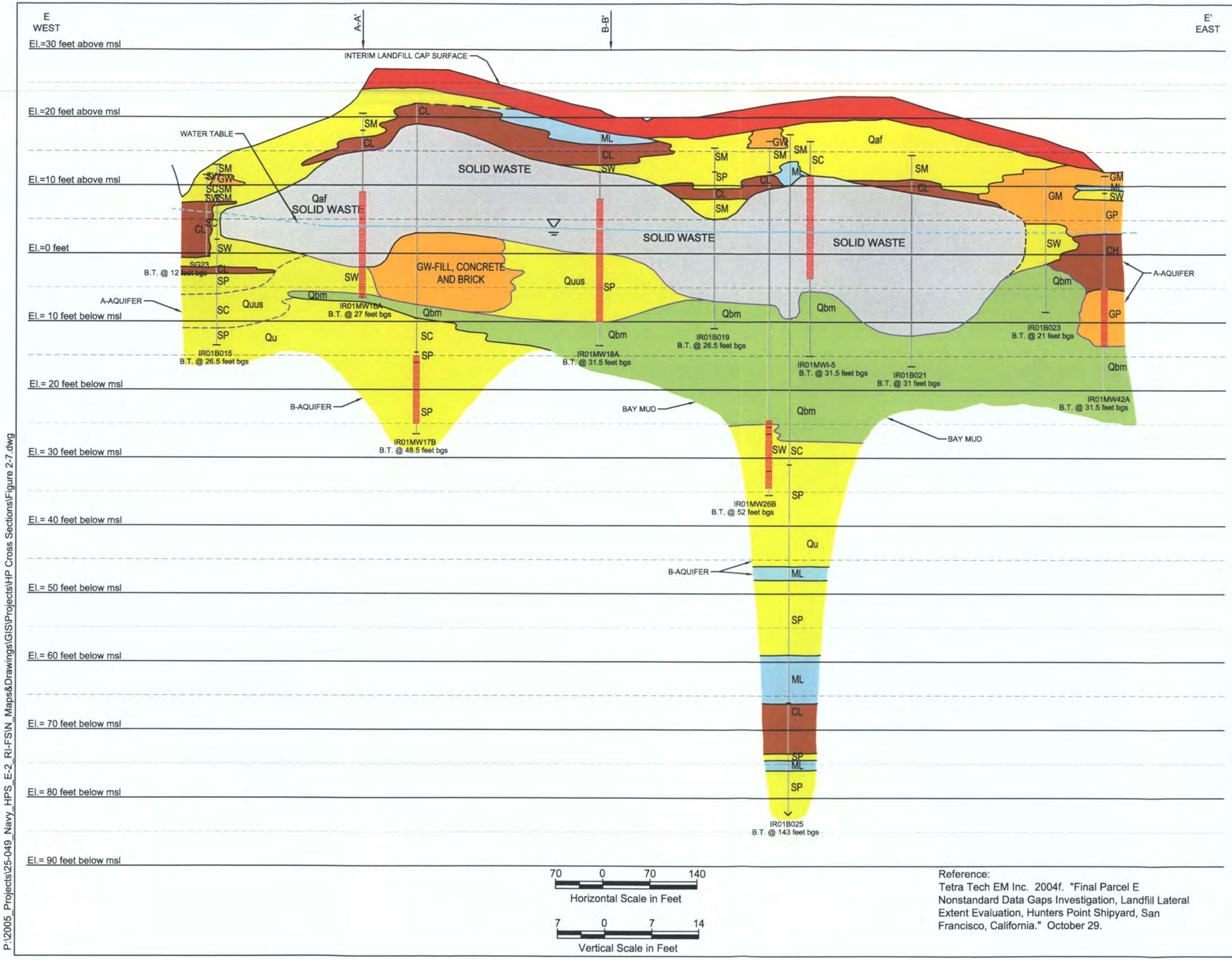
FIGURE 2-6

CROSS SECTION D-D'

Remedial Investigation/Feasibility Study for Parcel E-2

2006-10-05 P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\HP Cross Sections\Figure 2-6.dwg



Reference:
Tetra Tech EM Inc. 2004f. "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Lateral Extent Evaluation, Hunters Point Shipyard, San Francisco, California." October 29.

Water Table Measurement on February 20, 2002; Water Level Shown is A-aquifer (dashed where inferred)

Lithologic or Waste Boundary (dashed where inferred)

Formation Boundary (dashed where inferred)

Boring Location (tic marks represent change in lithology)

IR01B006

IR01MW17B Screened Area

A-A' Intersection Location of Cross Sections

Cap

Sand

Clay

Silt

Gravel

Bay Mud (clay)

Solid Waste

Notes:

bgs	below ground surface
B.T.	borehole termination
CH	high-plasticity clay
CL	clay
El.	elevation
GM	silty gravel
GP	poorly graded gravel
GW	well graded gravel
ML	silt
msl	mean sea level
Qaf	Artificial Fill
Qbm	Bay Mud (clay)
Qu	Undifferentiated Sediments
Quus	Undifferentiated Upper Sand Deposits
SC	clayey sand
SM	silty sand
SP	poorly graded sand
SW	well graded sand

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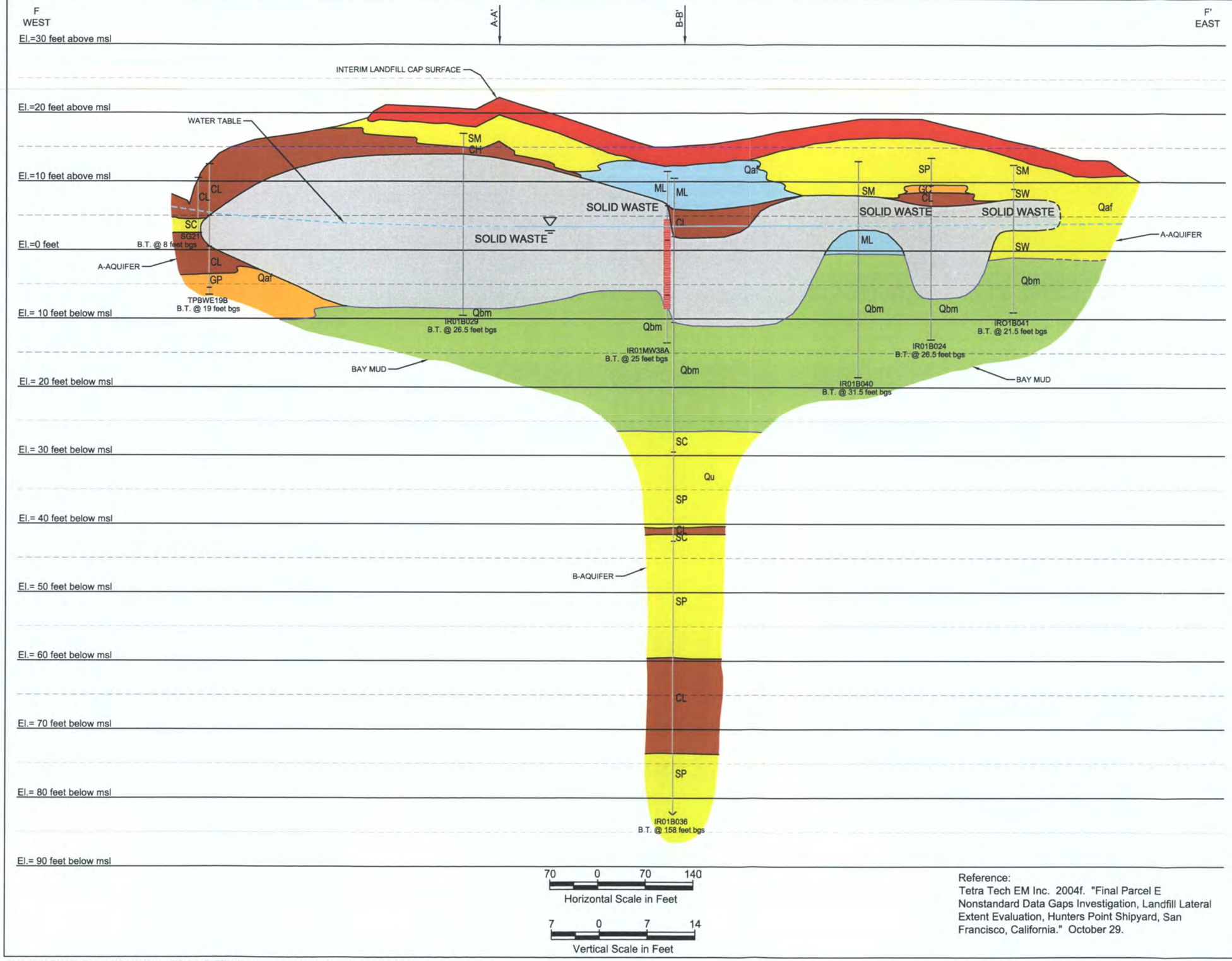
FIGURE 2-7

CROSS SECTION E-E'

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\HP Cross Sections\Figure 2-7.dwg



Reference:
Tetra Tech EM Inc. 2004f. "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Lateral Extent Evaluation, Hunters Point Shipyard, San Francisco, California." October 29.

Water Table Measurement on February 20, 2002; Water Level Shown is A-aquifer (dashed where inferred)

Lithologic or Waste Boundary (dashed where inferred)

Formation Boundary (dashed where inferred)

IR01B006 Boring Location (tic marks represent change in lithology)

IR01MW38A Screened Area

A-A' Intersection Location of Cross Sections

- Cap
- Sand
- Clay
- Silt
- Gravel
- Bay Mud (clay)
- Solid Waste

Notes:

bgs	below ground surface
B.T.	borehole termination
CH	high-plasticity clay
CL	sandy or silty clay
El.	elevation
GC	clayey gravel
GP	poorly graded gravel
ML	silt
msl	mean sea level
Qaf	Artificial Fill
Qbm	Bay Mud (clay)
Qu	Undifferentiated Sediments
SC	clayey sand
SM	silty sand
SP	poorly graded sand
SW	well graded sand

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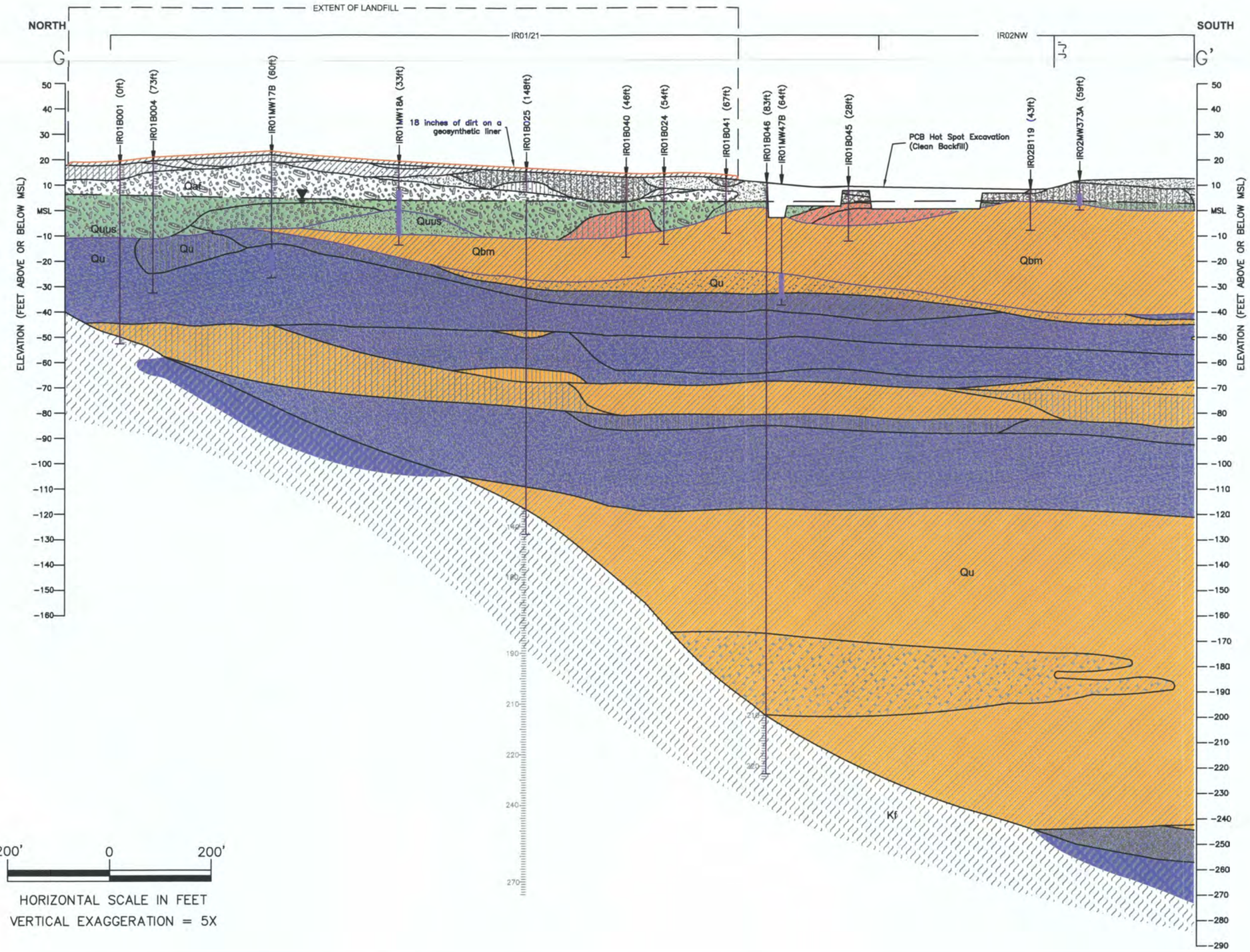
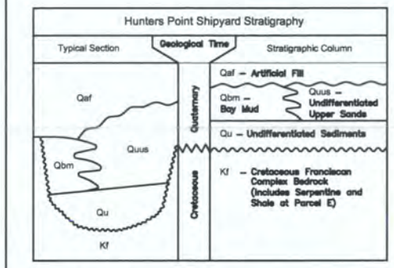
FIGURE 2-8

CROSS SECTION F-F'

Remedial Investigation/Feasibility Study for Parcel E-2

2006-10-05 P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\HP Cross Sections\Figure 2-8.dwg





Legend

- Formation Contact (dashed where inferred)
- Lithological Contact (dashed where inferred)
- Ground Surface
- Landfill Cap
- MSL Mean Sea Level
- (Disatance Projected to Cross Section) Monitoring Well/Soil Boring Location.
- Well Screen
- A–Aquifer Zone Water Table February 2002
- IR Boundary
- Intersection location of cross sections
- A–Aquifer Zone
- B–Aquifer Zone
- Aquitard Zone
- Qaf Low Permeable Zone based on Lithology

Gravel	Gravelly Silt
Clayey Gravel	Clay
Silty Gravel	Silty Clay
Sandy Gravel	Sandy Clay
Sand	Gravelly Clay
Clayey Sand	Sand/Gravel/Clay Mixture
Silty Sand	Boulder Fill
Gravelly Sand	Weathered Bedrock
Silt	Bedrock
Clayey Silt	Concrete
Sandy Silt	Debris

Notes:

1. These cross–sections represent one interpretation of the shallow subsurface along the corresponding line: alternate interpretations are possible.

2. Borings have been projected onto the lines of section. The projection of borings' lithologies may cause graphical distortions of geological features.

3. Bedrock and sediment contact is based on lithological logs and a bedrock surface map.

Reference:

Tetra Tech EM, Inc. 2004 Final Parcel E Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard. May

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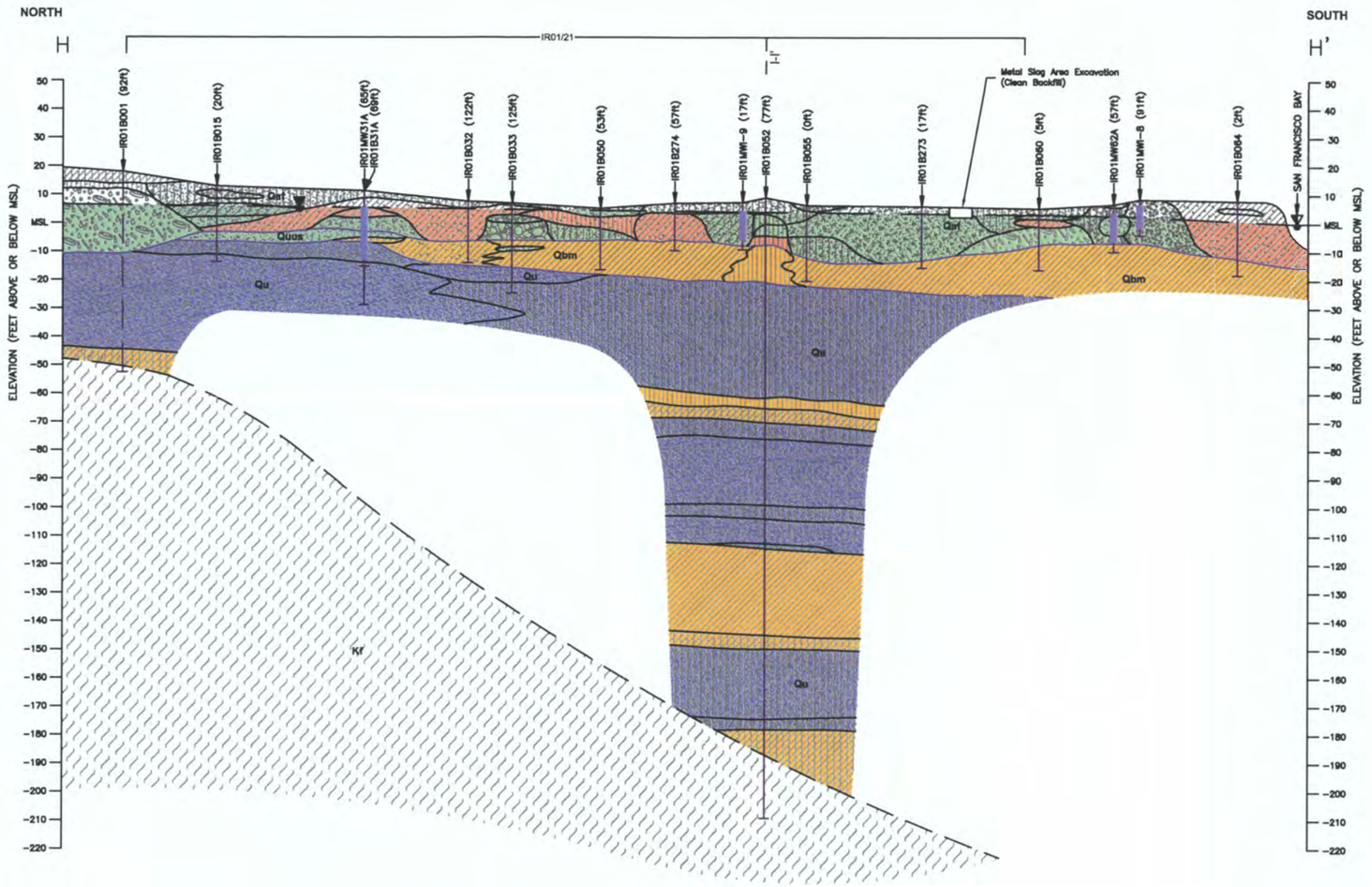
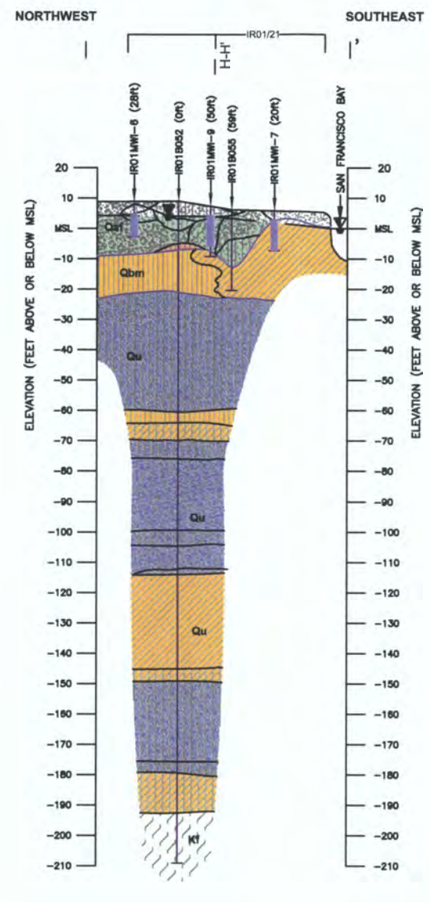
Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-9

CROSS SECTION G-G'

Remedial Investigation/Feasibility Study for Parcel E-2

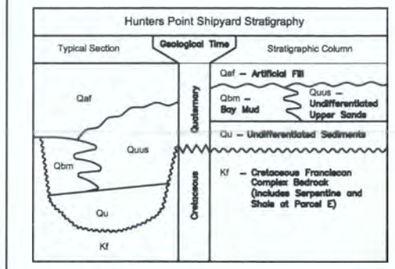




250' 0 250'

HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION = 5X



Legend

- Formation Contact (dashed where inferred)
- Lithological Contact (dashed where inferred)
- Ground Surface
- Landfill Cap
- MSL Mean Sea Level
- (Disatance Projected to Cross Section)
- Monitoring Well/Soil Boring Location.
- Well Screen
- A–Aquifer Zone Water Table February 2002
- IR Boundary
- Intersection location of cross sections
- A–Aquifer Zone
- B–Aquifer Zone
- Aquitard Zone
- Qaf Low Permeable Zone based on Lithology

- Gravel
- Clayey Gravel
- Silty Gravel
- Sandy Gravel
- Sand
- Clayey Sand
- Silty Sand
- Gravelly Sand
- Silt
- Clayey Silt
- Sandy Silt
- Gravelly Silt
- Clay
- Silty Clay
- Sandy Clay
- Gravelly Clay
- Sand/Gravel/Clay Mixture
- Boulder Fill
- Weathered Bedrock
- Bedrock
- Concrete
- Debris

Notes:

1. These cross–sections represent one interpretation of the shallow subsurface along the corresponding line: alternate interpretations are possible.

2. Borings have been projected onto the lines of section. The projection of borings' lithologies may cause graphical distortions of geological features.

3. Bedrock and sediment contact is based on lithological logs and a bedrock surface map.

Reference:

Tetra Tech EM, Inc. 2004 Revised Final Parcel E Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard. May

ERRG Engineering/Remediation Resources Group, Inc.

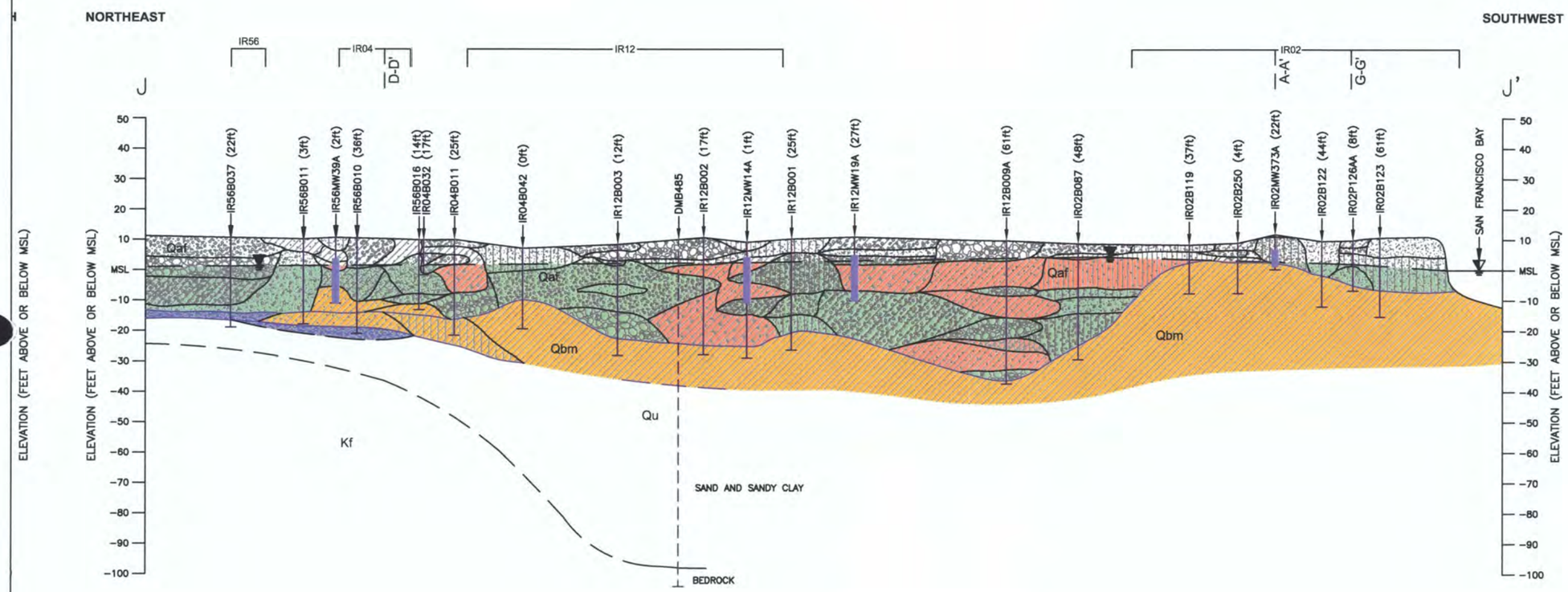
Hunters Point Shipyard, San Francisco, California

U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-10

CROSS SECTION H-H' & I-I'

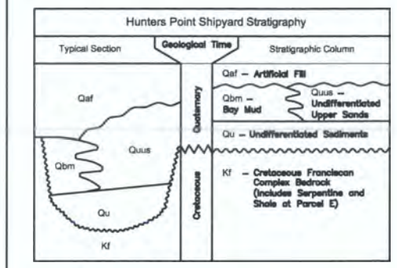
Remedial Investigation/Feasibility Study for Parcel E-2



200' 0 200'

HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION = 5X



Legend

- Formation Contact (dashed where inferred)
- Lithological Contact (dashed where inferred)
- Ground Surface
- Landfill Cap
- MSL Mean Sea Level
- (Distance Projected to Cross Section)
- Monitoring Well/Soil Boring Location.
- Well Screen
- A–Aquifer Zone Water Table February 2002
- IR Boundary
- Intersection location of cross sections
- A–Aquifer Zone
- B–Aquifer Zone
- Aquitard Zone
- Qaf Low Permeable Zone based on Lithology

- Gravel
- Clayey Gravel
- Silty Gravel
- Sandy Gravel
- Sand
- Clayey Sand
- Silty Sand
- Gravelly Sand
- Silt
- Clayey Silt
- Sandy Silt
- Gravelly Silt
- Clay
- Silty Clay
- Sandy Clay
- Gravelly Clay
- Sand/Gravel/Clay Mixture
- Boulder Fill
- Weathered Bedrock
- Bedrock
- Concrete
- Debris

Notes:

1. These cross–sections represent one interpretation of the shallow subsurface along the corresponding line: alternate interpretations are possible.

2. Borings have been projected onto the lines of section. The projection of borings' lithologies may cause graphical distortions of geological features.

3. Bedrock and sediment contact is based on lithological logs and a bedrock surface map.

Reference:

Tetra Tech EM, Inc. 2004 Revised Final Parcel E Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard. May

ERRG Engineering/Remediation Resources Group, Inc.

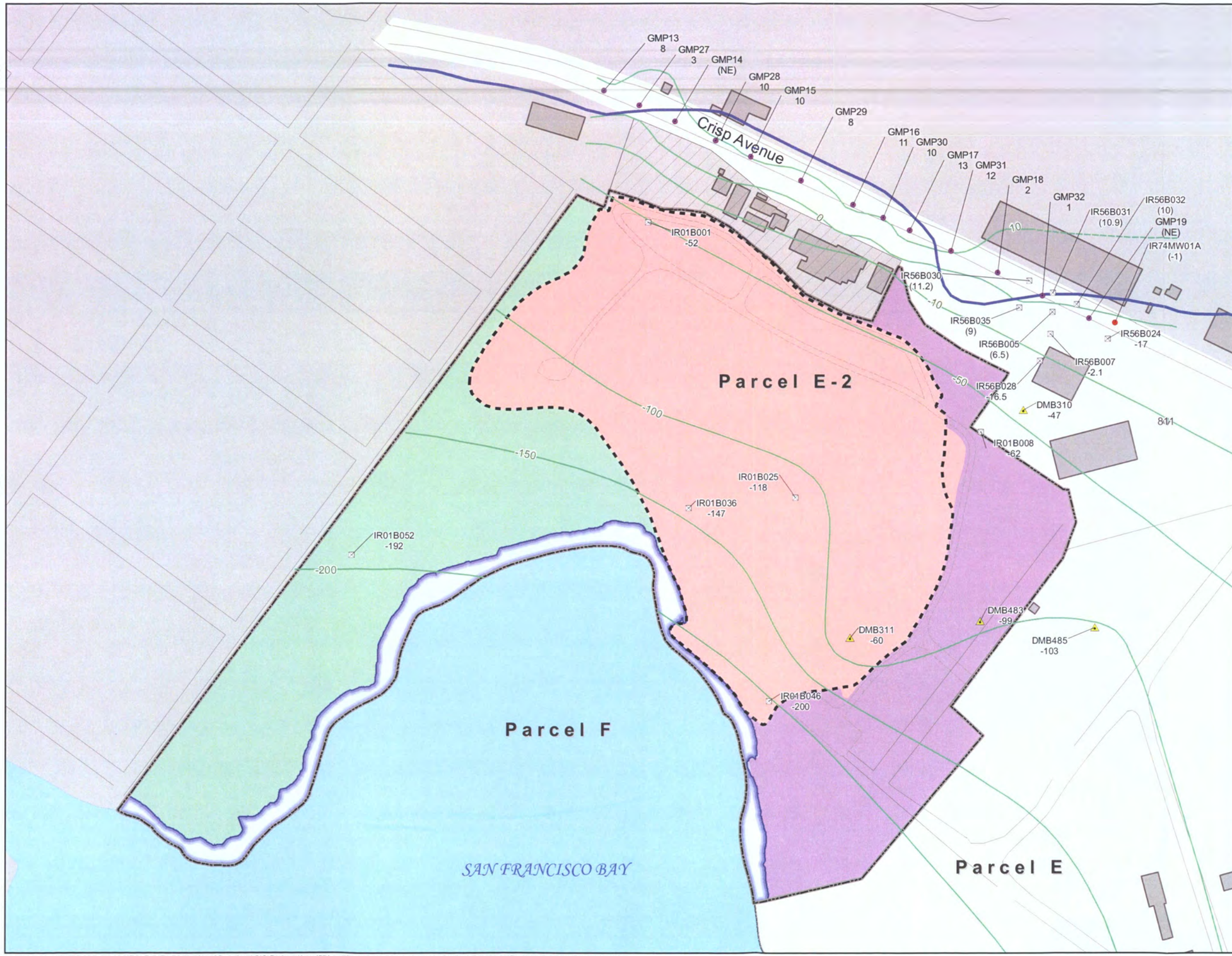
Hunters Point Shipyard, San Francisco, California

U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-11

CROSS SECTION J-J'

Remedial Investigation/Feasibility Study of Parcel E-2



Soil Boring
Dames and Moore Boring
A-Aquifer Monitoring Well
Existing Gas Monitoring Probe
—20— Bedrock Elevation Contours (dashed lines are inferred)
Bedrock-Artificial Fill Geologic Contact*
IR01B036 -147 Well Boring Label with Bedrock Surface Elevations (in feet above msl)
Parcel Boundary
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
Estimate of Solid Waste Extent
Interim Landfill Cap Extent
Non-Navy Property
UCSF Compound
Building
Road
Gravel Road

Notes:

* Geologic Conact based on Bonilla (1971)

( ) Data shown but not used in evaluation of bedrock surface contour.

NE = Bedrock Not Encountered
UCSF = University of California, San Francisco

Reference:

Bonilla, M.G. 1971. "Preliminary Geologic Map of the San Francisco South Quadrangle and Part of the Hunters Point Quadrangle." *U.S. Geological Survey Miscellaneous Field Studies Map.* MG-311. 1:24,000.

N

250 0 250

Scale in Feet

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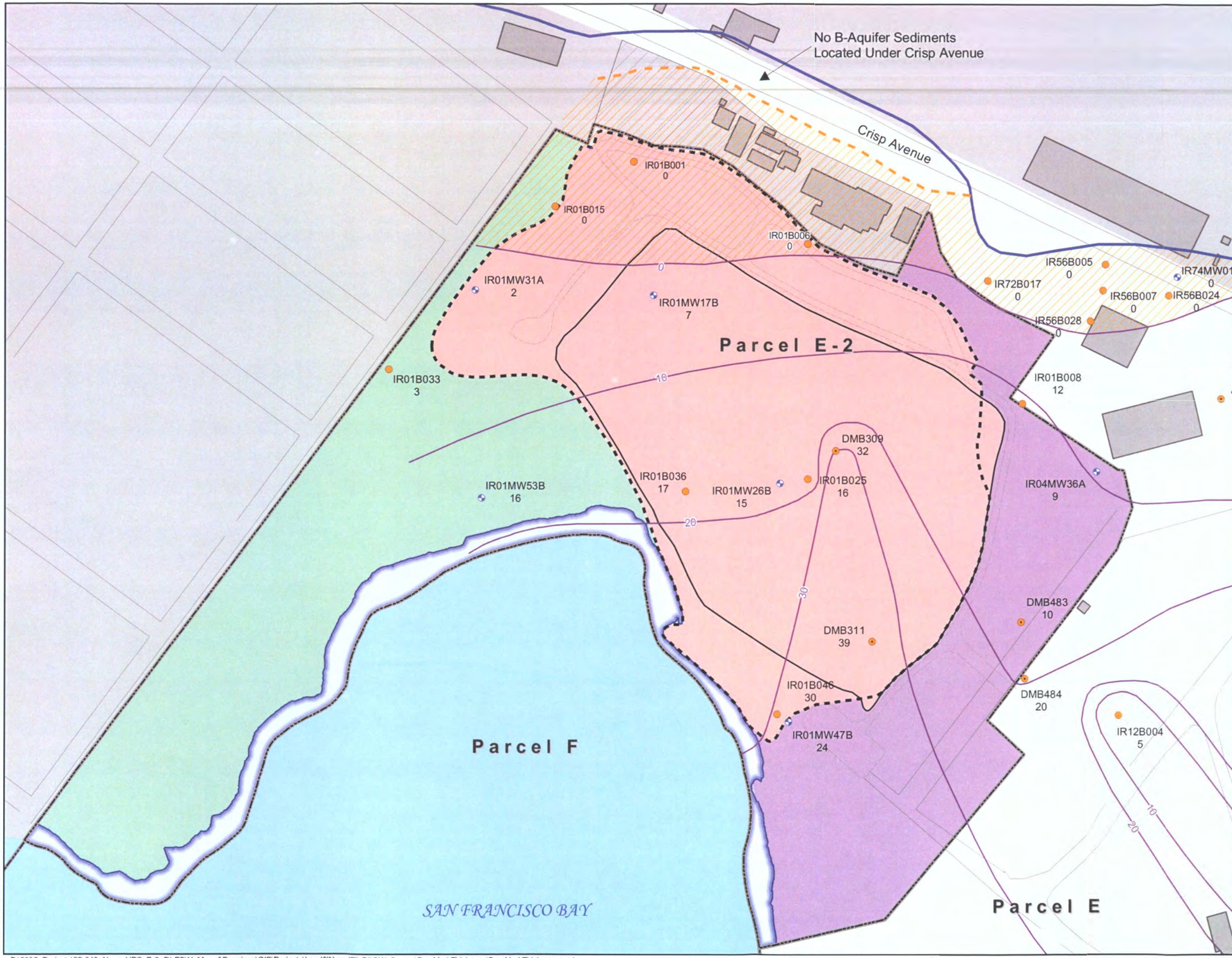
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-12

BEDROCK SURFACE ELEVATIONS

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\GW_figures\Bedrock Surface Elevations\Bedrock Surface Elevations.mxd



Monitoring Well
Piezometer
Soil Boring
Dames and Moore Boring
DMB484 20 — Well or Soil Boring Identification with Bay Mud Thickness (in feet)
—20— Bay Mud Thickness Contour Line (10-foot interval)
Bedrock-Artificial Fill Geologic Contact
Area Where A- and B-Aquifer are not Hydraulically Separated by an Aquitard (Dashed where Inferred)
Parcel Boundary
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
Estimate of Solid Waste Extent
Interim Landfill Cap Extent
Non-Navy Property
UCSF Compound
Building
Road
Gravel Road

Notes:

Mean bay water level elevation: 0.33 feet above mean sea level

UCSF = University of California, San Francisco

References:

Tetra Tech EM Inc. 2004c. "Revised Final Parcel E Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California." May 11.

N

250 0 250

Scale in Feet

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

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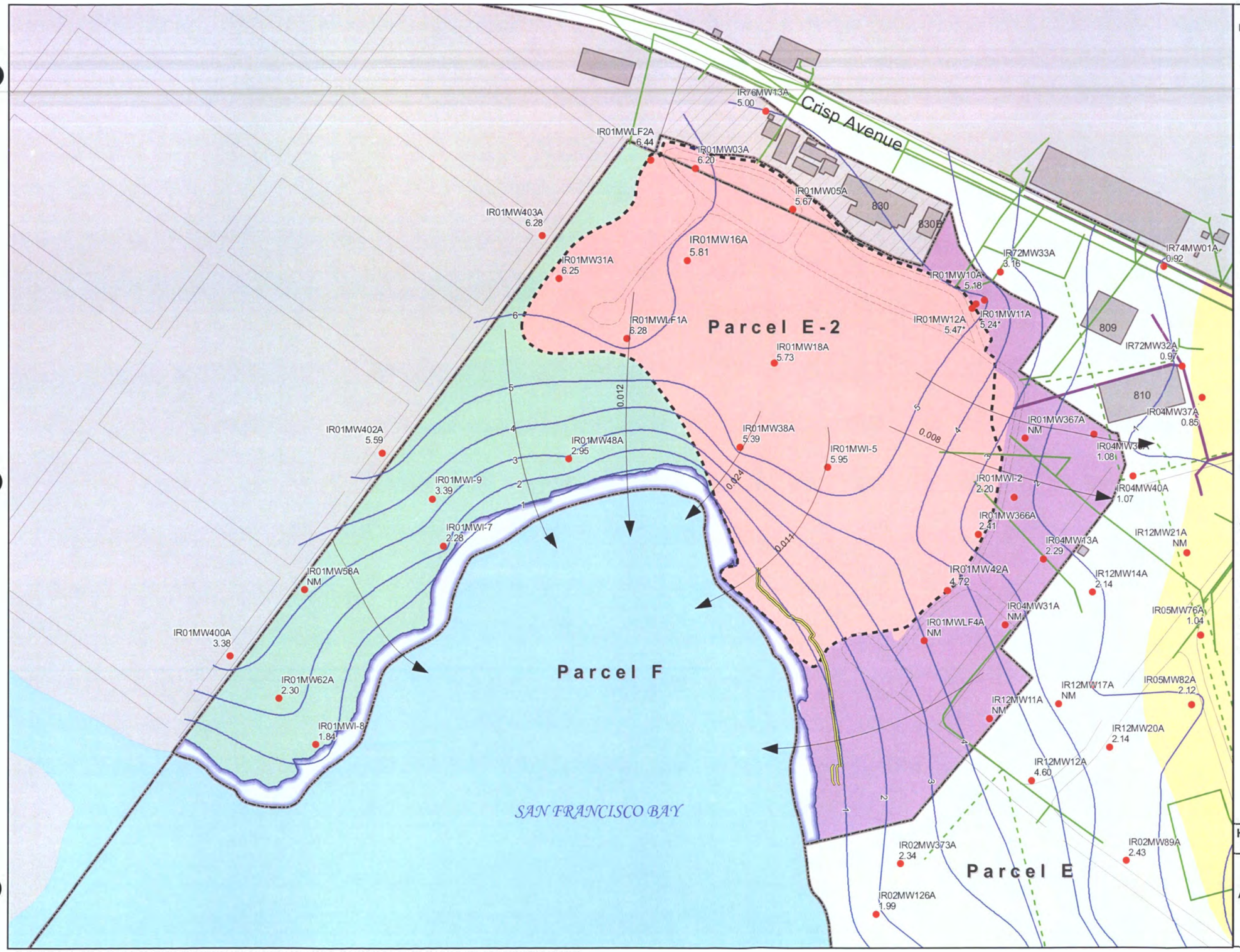
FIGURE 2-13

BAY MUD THICKNESS MAP

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\GW_figures\Bay Mud Thickness\Bay Mud Thickness.mxd



IR01MW38A
A-Aquifer Monitoring Well and Identification
A-Aquifer Groundwater Elevation Contour Line (feet above msl)
0.008 A-Aquifer Flow Direction and Flow Gradient
Storm Line (Above Groundwater)
Storm Line (Below Groundwater)
Sanitary Sewer Line (Above Groundwater)
Sheet-Pile Wall
Road
Gravel Road
Solid Waste Extent
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:
Water Table Measurement in March 2007.
Water Level shown is A-Aquifer.
* Redundant, not contoured

msl = mean sea level
NM = not measured
UCSF = University of California, San Francisco

References:
CE2-Kleinfelder Joint Venture. 2007. Parcels C, D, E, and E-2 Quarterly Groundwater Monitoring Report (January to March 2007) and Annual Report. Hunters Point Shipyard, California. November.

N

250 0 250
Scale in Feet

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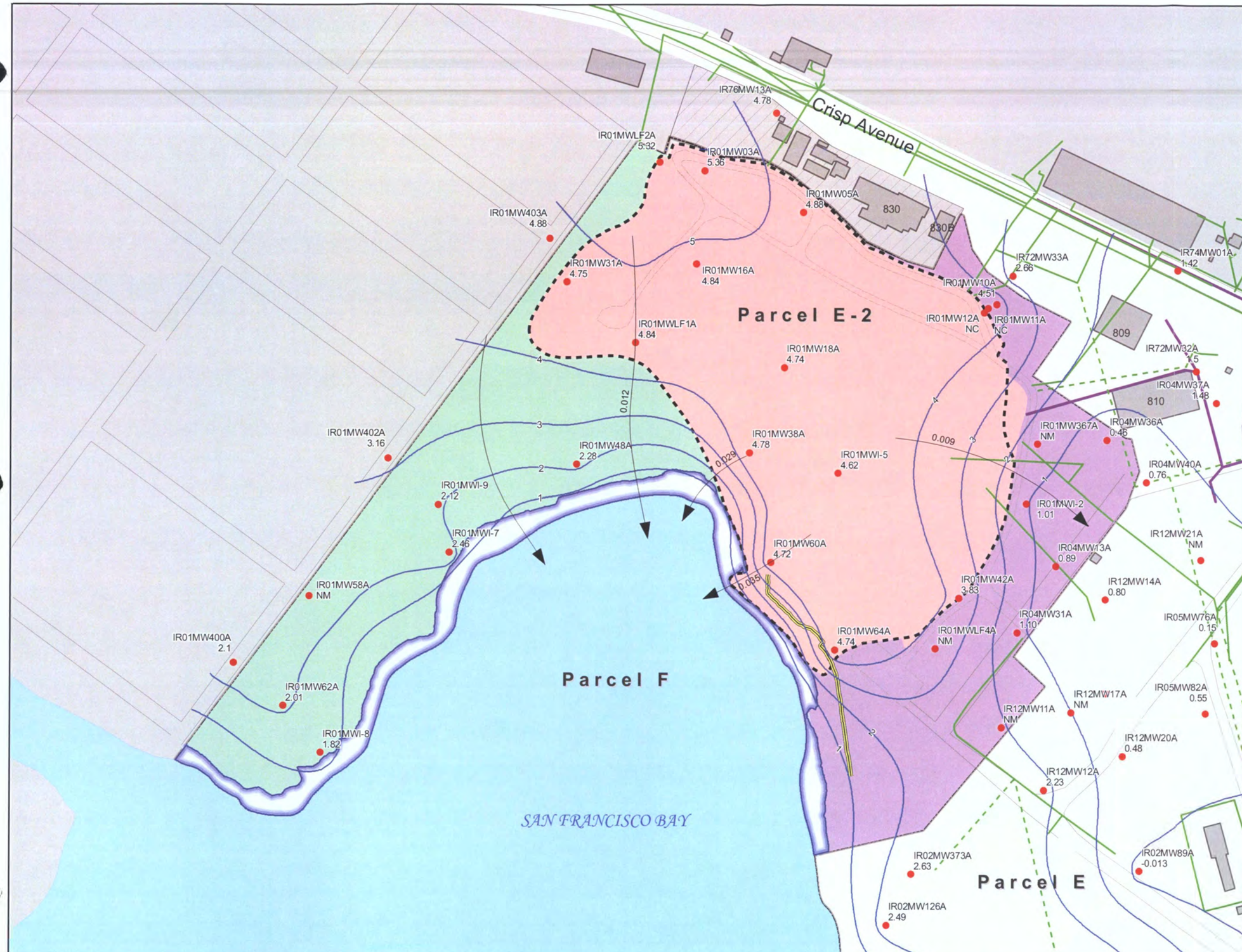
FIGURE 2-14

A-AQUIFER GROUNDWATER ELEVATIONS MARCH 2007

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\GW_figures\A-aquifer Elevations\A-Aquifer_2007_1Qtr.mxd



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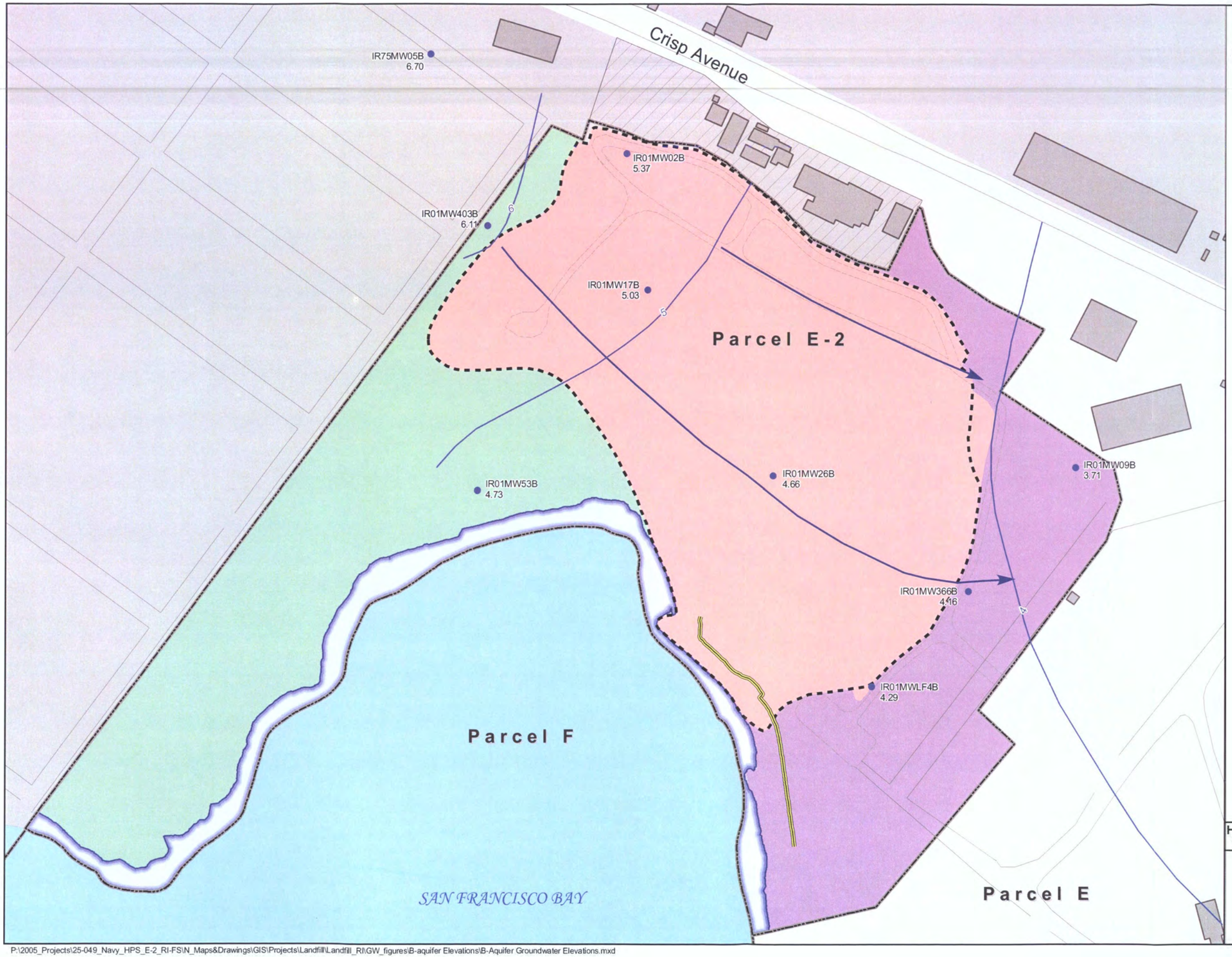
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-15

A-AQUIFER GROUNDWATER ELEVATIONS AUGUST 2007

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\GW_figures\A-aquifer Elevations\A-Aquifer_2007_3Qtr.mxd



B-Aquifer Monitoring Well

IR01MW26B 4.46 — Well Identification and Elevation (in feet above msl)

—5— B-Aquifer Groundwater Elevation Contour Line (feet above msl; dashed where inferred)

B-Aquifer Flow Direction

Sheet-Pile Wall

Parcel Boundary

Landfill Area

East Adjacent Area

Panhandle Area

Shoreline Area

Estimate of Solid Waste Extent

Interim Landfill Cap Extent

Non-Navy Property

UCSF Compound

Building

Road

Gravel Road

Notes:

Water Table Measurement in August 2007
Water Level shown is B-Aquifer.

msl = mean sea level
UCSF = University of California, San Francisco

N

250 0 250

Scale in Feet

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Hunters Point Shipyard, San Francisco, California

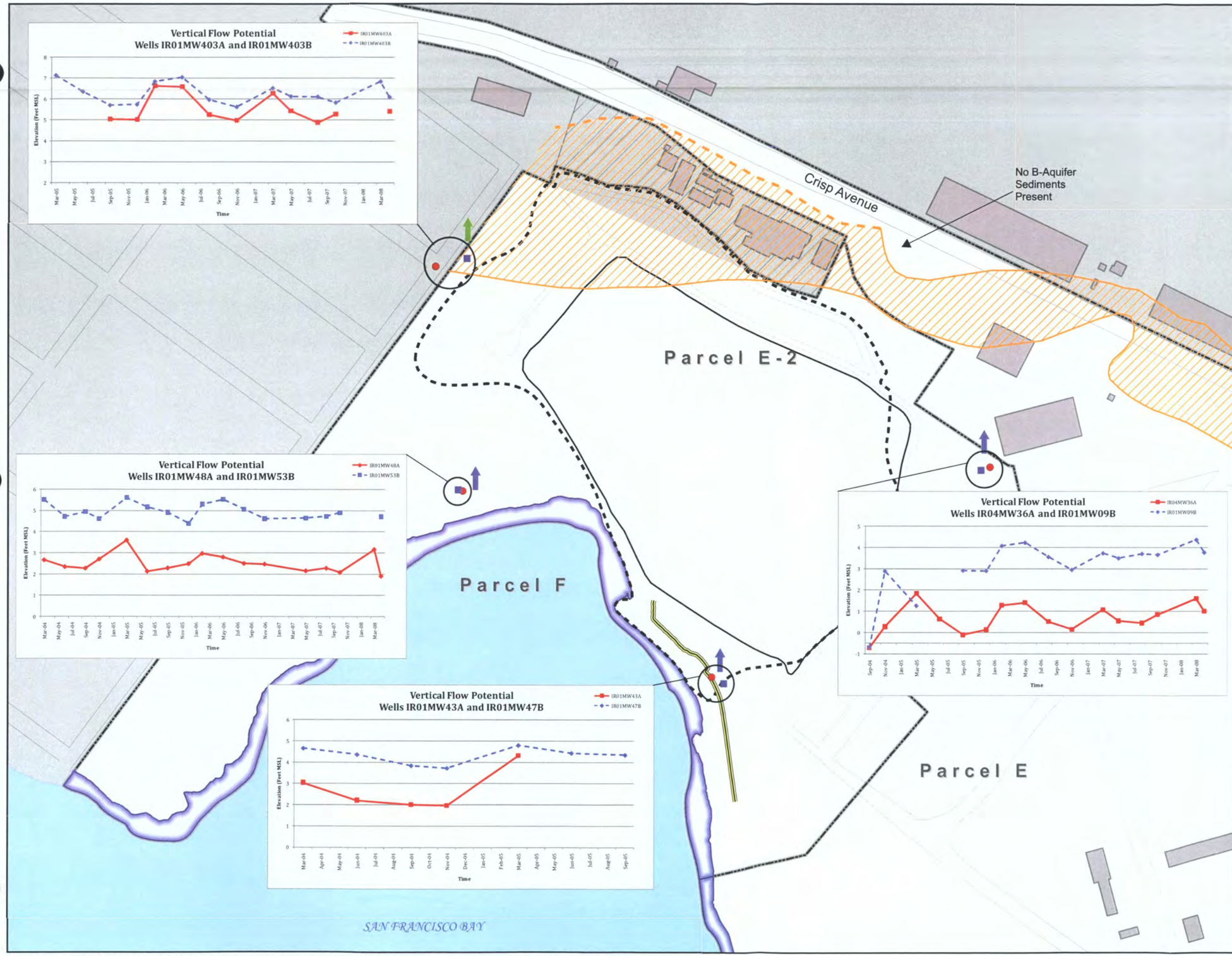
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-16

B-AQUIFER GROUNDWATER ELEVATIONS, AUGUST 2007

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\GW_figures\B-aquifer Elevations\B-Aquifer Groundwater Elevations.mxd



A-Aquifer Monitoring Well with Well Number

B-Aquifer Monitoring Well with Well Number

Vertical Groundwater Flow Potential (up or down) between A- and B-aquifer, Separated by Aquitard

Vertical Groundwater Flow Potential (up or down) between A- and B-aquifer, Not Separated by Aquitard

Area Where A- and B-Aquifer are not Hydraulically Separated by an Aquitard (Dashed where Inferred)

Sheet-Pile Wall

Parcel Boundary

Shoreline Area

Estimate of Solid Waste Extent

Interim Landfill Cap Extent

Non-Navy Property

UCSF Compound

Building

Road

Gravel Road

Notes:

Field conditions prevented measurements in certain wells over consecutive quarters; all available data during the period are plotted but trends between non-consecutive measurements are shown but not interpolated.

Wells IR01MW43A and IR01MW47B were decommissioned in June and October 2005, respectively, in conjunction with the PCB Hot Spot removal action. Available data for these wells from March 2004 to September 2005 are shown.

PCB = polychlorinated biphenyl
UCSF = University of California, San Francisco

N

250 0 250

Scale in Feet

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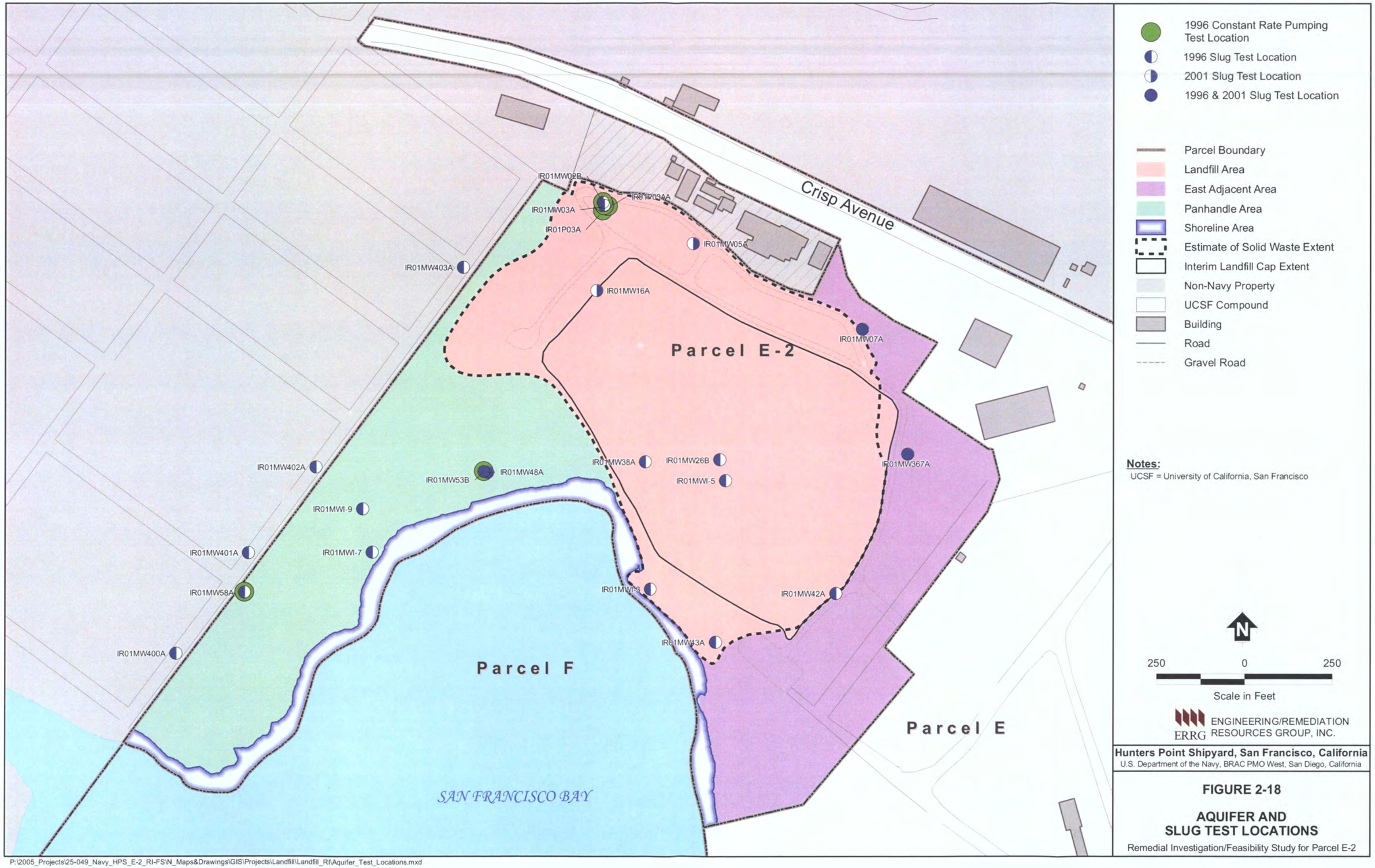
FIGURE 2-17

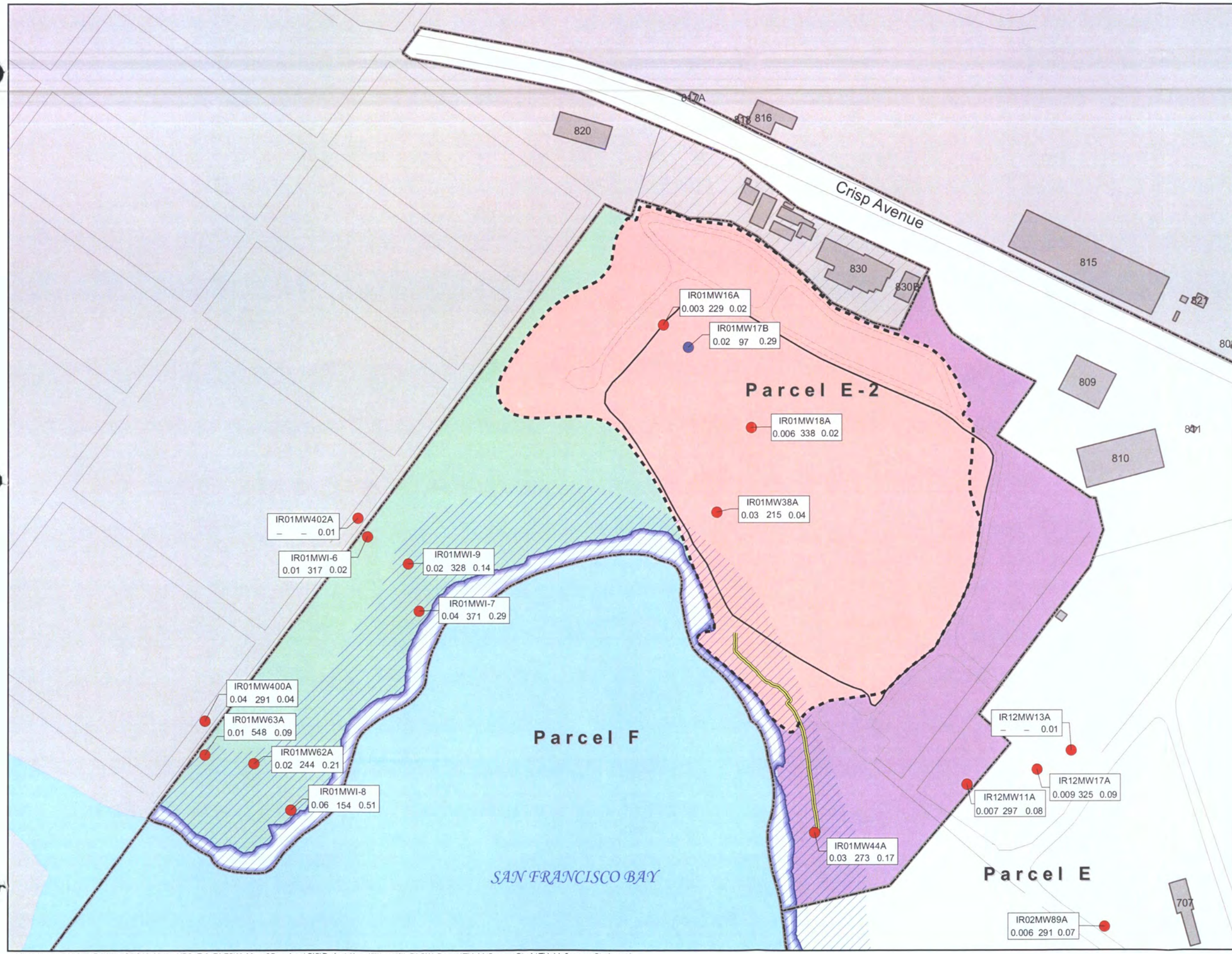
VERTICAL GROUNDWATER FLOW POTENTIAL

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\GW_figures\Vertical Groundwater Flow Direction\Vertical Groundwater Flow.mxd



P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Aquifer_Test_Locations.mxd



A-Aquifer Monitoring Well
B-Aquifer Monitoring Well
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
Estimate of Solid Waste Extent
Interim Landfill Cap Extent
Non-Navy Property
UCSF Compound
Building
Parcel Boundary
Sheet-Pile Wall
Tidal Influence Zone (Maximum Tidal Fluctuation ≥ 0.10 foot)
Road
Gravel Road

Notes:
The tidal influence study was conducted May 20 to June 3, 2002.

– Not available
UCSF = University of California, San Francisco

IR15MW10F ← Well Identification
0.05 160 0.70
Maximum Tidal Fluctation (Feet)
Time Lag (Minutes)
Tidal Efficiency

Referenes:
Tetra Tech EM Inc. 2004c. "Revised Final Parcel E Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California." May 11.

N

250 0 250
Scale in Feet

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U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-19

TIDAL INFLUENCE STUDY WELLS AND PARAMETERS

Remedial Investigation/Feasibility Study for Parcel E-2

2005-12-19 P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\GW_figures\Tidal Influence Study\Tidal-Influence_Study.mxd

A-Aquifer Monitoring Well With Well Identification and Maximum TDS Result

A-Aquifer Maximum TDS Zones

- ≥10,000 mg/L
- ≥3,000 mg/L and <10,000 mg/L
- <3,000 mg/L

- Parcel E-2 Boundary
- IR Site Boundary
- Building
- Non-Navy Property
- Storm Line-Below Groundwater
- Storm Line-Above Ground
- Sanitary Sewer Line -Below Groundwater
- Sanitary Sewer Line-Above Groundwater
- Water Line
- Saltwater Line
- Sheet-Pile Wall
- Road

Notes:

IR = Installation Restoration
mg/L = milligrams per liter
TDS = total dissolved solids

References:

Adapted from Tetra Tech EM Inc. 2004c. "Revised Final Parcel E Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California." May 11.

N

200 0 200

Scale in Feet

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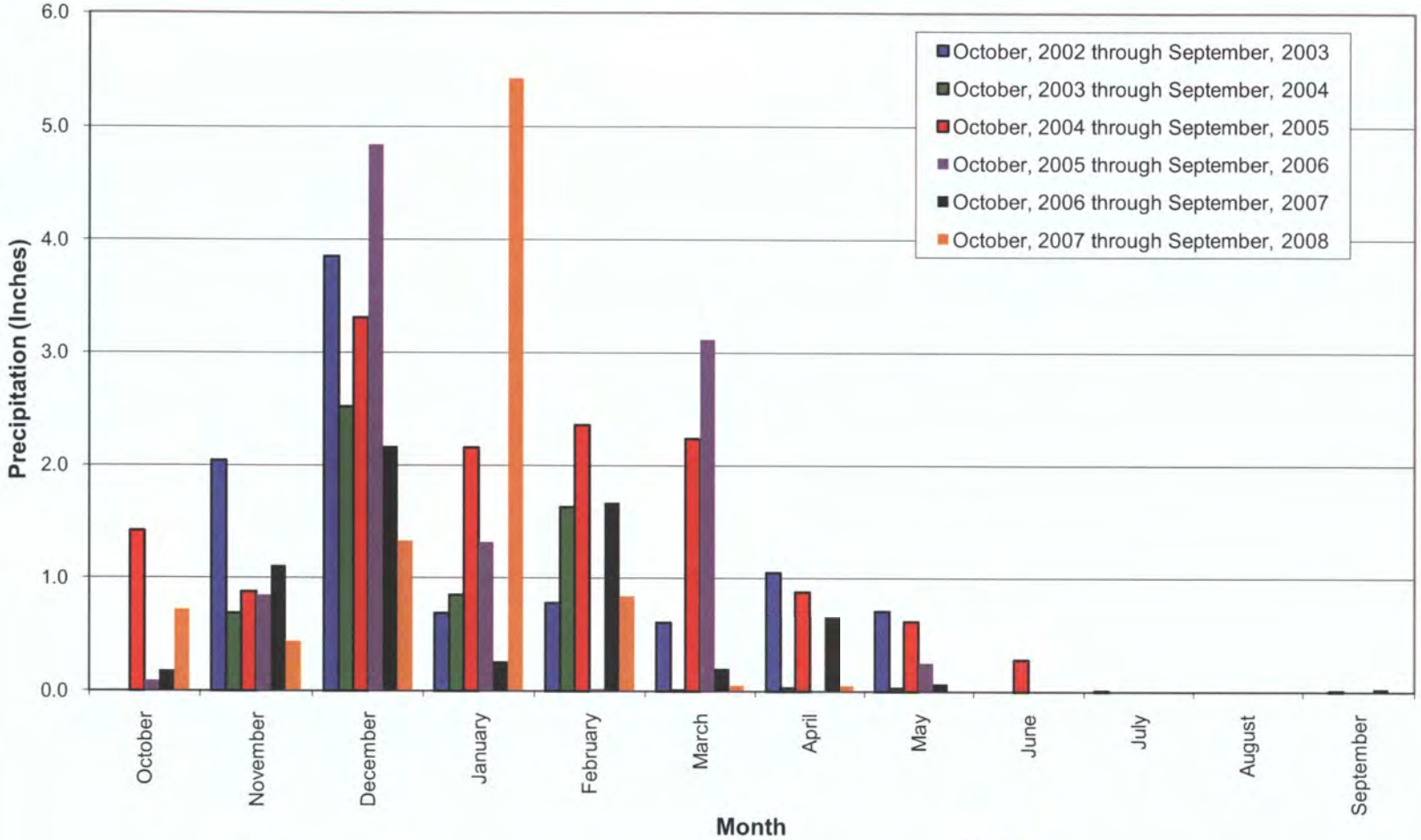
FIGURE 2-20

MAXIMUM TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN THE A-AQUIFER

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\BeneficialLUse\Maximum Total Dissolved Solids in the A-Aquifer.mxd



ENGINEERING/REMEDIATION
ERRG RESOURCES GROUP, INC.

Notes: Precipitation data collected at Hunters Point Shipyard meteorological tower located on Parcel E. The meteorological tower began operation on September 17, 2002.

Values plotted are the total precipitation per month from October, 2002 through September, 2008.

Hunters Point Shipyard, San Francisco, California

U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-21

MONTHLY PRECIPITATION AT HUNTERS POINT SHIPYARD, 2002 TO 2008

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\Graphics\Precip_figure_Oct02-Sept08

Catch Basin
Stormwater Drainage Channel
Underground Drain Pipe
Storm Line (Above Groundwater)
Storm Line (Below Groundwater)
Ground Surface Elevation (1-Foot Interval)
Surface Flow Direction
Tidal Wetland
Seasonal Freshwater Wetland
Intertidal Saltmarsh
Road
Gravel Road
Parcel Boundary
Building
UCSF Compound
Landfill Area
Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

PCB = polychlorinated biphenyl
UCSF = University of California, San Francisco

N

250 0 250

Scale in Feet

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 2-22

DRAINAGE PATTERNS AND BMPs

Remedial Investigation/Feasibility Study for Parcel E-2

P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Drainage_Patterns_BMP.mxd

Emergent Wetlands
Freshwater Wetlands
Intertidal Saltmarsh
Non-native Annual Grassland
Industrial
Ruderal
Unvegetated Shoreline
Parcel E-2 Riprap
Parcel Boundary
Estimate of Solid Waste Extent
Interim Landfill Cap Extent
Non-Navy Property
UCSF Compound
Building
Road
Gravel Road

Notes:
UCSF = University of California, San Francisco

N

250 0 250
Scale in Feet

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FIGURE 2-23

PARCEL E-2 TERRESTRIAL, WETLAND, AND INTERTIDAL HABITATS

Remedial Investigation/Feasibility Study for Parcel E-2

N:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Terrestrial-habitats.mxd

Tables

Table 2-1. Summary of Slug Test Results
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

IR Site No.	Well No	Area	Aquifer	T (ft^2/day)	K (ft/day)	Hydrostratigraphic Unit	Data Source
01/21	IR01MW02B	Landfill	B	65	1.3	Artificial Fill (well-graded sand)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW03A	Landfill	A	246	20	Artificial Fill (poorly graded sand with clay and landfill debris)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW05A	Landfill	A	--	0.15	Artificial Fill (landfill debris with silt and clay)	Groundwater Control System Evaluation Report (IT, 2001)
	IR01MW07A	Landfill	A	178	24	Artificial Fill (sandy clay with gravel)	Draft Final Parcel E RI (TtEMI, LFR, and U&A, 1997)
	IR01MW16A	Landfill	A	--	2.4	Artificial Fill (landfill debris zone, well-graded sand with gravel)	GW Control System Evaluation Report (IT, 2001)
	IR01MW26B	Landfill	B	97	0.9	Undifferentiated Upper Sand Deposits (well-graded sand with silt)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW38A	Landfill	A	16	1.2	Artificial Fill (sandy silt, well-graded gravel, and landfill debris)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW42A	Landfill	A	506	59	Artificial Fill (serpentinite gravel)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW43A	East Adjacent Area	A	77	5.4	Artificial Fill (sandy silt and well-graded sand)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW48A	Landfill	A	190	16	Artificial Fill (silty sand with gravel	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW53B	Landfill	B	701	4.43	Undifferentiated Sedimentary Deposits (silty and poorly graded sand)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)

Table 2-1. Summary of Slug Test Results *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

IR Site No.	Well No	Area	Aquifer	T (ft^2/day)	K (ft/day)	Hydrostratigraphic Unit	Data Source
01/21	IR01MW58A	Landfill	A	32	3.4	Artificial Fill (sand, silt, and gravel)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW367A	Landfill	A	92	6.27	Artificial Fill and Undifferentiated Upper Sand Deposits (silty and poorly graded sand and gravel)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW400A	Landfill	A	187	14.83	Artificial Fill (silty sand and poorly graded gravel)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW401A	Landfill	A	182	13.71	Artificial Fill and Undifferentiated Upper Sand Deposits (silty poorly and well-graded sand)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW402A	Landfill	A	147	14.05	Artificial Fill (silty sand and well-graded gravel)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW403A	Landfill	A	1,734	30.76	Artificial Fill and Undifferentiated Upper Sand Deposits (silty and poorly graded sand)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MWI-3	Landfill	A	5	0.71	Artificial Fill (sand to gravelly sand)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MWI-5	Landfill	A	115	11	Artificial Fill (clayey sand and landfill debris)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW-7	Landfill	A	500	50	Bay Mud Deposits (silty clay)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW-9	Landfill	A	10	1.2	Artificial Fill (clayey sand)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)

Table 2-1. Summary of Slug Test Results *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

IR Site No.	Well No	Area	Aquifer	T (ft^2/day)	K (ft/day)	Hydrostratigraphic Unit	Data Source
01/21	IR01P03AA	Landfill	A	688	12.29	Artificial Fill (landfill debris)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MW366A	Landfill	A	2	0.14	Artificial Fill (silty sand with gravel)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR01MWI-2	East Adjacent Area	A	625	69	Artificial Fill (clayey sand and sandy gravel)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
04	IR04MW31A	East Adjacent Area	A	181	11	Artificial Fill (clayey gravel with sand and gravel with silt)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR04MW35A	East Adjacent Area	A	523	29.42	Artificial Fill (gravelly silt)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
	IR04MW36A	East Adjacent Area	A	209	130	Artificial Fill (gravelly silt and gravelly clay with sand)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)
12	IR12MW11A	East Adjacent Area	A	113	12	Artificial Fill (gravelly silt, clayey gravel, and poorly graded gravel with sand)	Draft Final Parcel E RI Report (TtEMI, LFR, and U&A, 1997)

Notes:

--	not applicable
ft/day	feet per day
ft^2day	square feet per day
IR	Installation Restoration
IT	International Technology Corporation
K	hydraulic conductivity
LFR	Levine-Fricke-Recon
RI	Remedial Investigation
T	transmissivity
TtEMI	Tetra Tech EM Inc.
U&A	Uribe and Associates, Inc.

Table 2-2. Summary of Constant Rate Pumping Test Results in Parcel E-2,
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

IR Site No.	Pumping Test No.	Well No. [a]	Pumping Test Type	Type of Analysis	Method	Q [b] (gpm)	T [c] (ft^2/day)	S [d]	K [e] (ft/day)	Hydrostratigraphic Unit
01/21	1	IR01MW03A (P)	Drawdown	C-J	AQTESOLV[f]	4.25	48.6	NA	3.4	Clay to gravel fill and boulder
			Drawdown	Theis	AQTESOLV[f]		44.2	NA	3.7	
			Recovery	Theis	AQTESOLV[f]		328	NA	25.2	
		IR01MW02B (O)	Drawdown	C-J	AQTESOLV[f]		251	0.012	14.8	Undifferentiated Sedimentary Deposits
			Drawdown	Theis	AQTESOLV[f]		199	0.017	11.7	
			Recovery	Theis	AQTESOLV[f]		354	NA	20.8	
		IR01P03A (O)	Drawdown	C-J	AQTESOLV[f]		2,290	0.07	179	Landfill debris
			Drawdown	Theis	AQTESOLV[f]		2,290	0.07	179	
			Recovery	Theis	AQTESOLV[f]		2,460	NA	192	
		IR01P03AA (O)	Drawdown	C-J	AQTESOLV[f]		6,880	0.17	623	Clay to gravel fill
			Drawdown	Theis	AQTESOLV[f]		6,880	0.17	623	
			Recovery	Theis	AQTESOLV[f]		15,900	NA	1,440	
		IR01P03AB (O)	Drawdown	C-J	AQTESOLV[f]		6,410	0.14	526	Clay to gravel fill
			Drawdown	Theis	AQTESOLV[f]		6,410	0.14	526	
			Recovery	Theis	AQTESOLV[f]		9,560	NA	785	
	2	IR01MW53B (P)	Recovery	Theis	GWAP	10.5	150	NA	14	Undifferentiated Sedimentary Deposits
	3	IR01MW58A (P)	Recovery	Theis	GWAP	5.5	970	NA	80	Silt to gravel fill

Table 2-2. Summary of Constant Rate Pumping Test Results in Parcel E-2 *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Notes:	Table from Appendix C of Parcel E Remedial Investigation Report (Tetra Tech EM Inc., Levine-Fricke-Recon, and Uribe and Associates, Inc., 1997)
a	Wells with designation ending with "B" are screened in the B-aquifer; remaining monitoring wells are screened in the A-aquifer
b	Average pumping rate
c	Transmissivity
d	Storativity
e	Hydraulic conductivity
f	Aquifer test solver (AQTESOLV), Geraghty and Miller Modeling Group (1994)
C-J	Cooper-Jacob method (1946)
ft/day	feet per day
ft^2/day	square feet per day
gpm	gallons per minute
GWAP	Graphical Well Analysis Package
IR	Installation Restoration
NA	not applicable
O	observation well
P	pumping well
Theis	Theis method (1935)

Section 3. Remedial Investigation Activities and Removal Actions

Multiple environmental investigations have been conducted at Parcel E-2[4], beginning in 1984. These investigations included basewide investigations (such as the IAS), investigations performed throughout Parcel E (which was later subdivided into Parcels E and E-2), and landfill-specific investigations within Parcel E-2. The environmental investigations can be categorized into the following time frames:

Pre-Remedial Investigation Activities (1984 to 1988): The Parcel E-2 Landfill was initially identified as IAS Site 3 during the IAS conducted in 1984 under the NACIP program (NEESA, 1984). Additional investigations performed following the IAS included installation of nine monitoring wells (IR01MWI-1 through IR01MW-9) during the 1987 confirmation study and verification step.

Remedial Investigation Activities (1988 to 1996): The Parcel E-2 Landfill progressed to the RI stage as IR Site 1 and was grouped (along with IR Sites 02 and 03 in Parcel E) into Operable Unit (OU)-I. The first phase of the OU-I RI (from 1988 to 1989) consisted of reconnaissance activities, including a geophysical survey and test pit excavation to delineate the extent of landfill waste, a soil gas survey to evaluate the presence of VOCs in soil and groundwater, and installation of deep soil borings to define subsurface stratigraphy. Subsequent phases of the OU-I RI involved primary and contingency sampling of soil and groundwater from October 1990 to June 1992. Following the 1992 decision to align the HPS IR sites into parcels, the RI at the landfill was completed in conjunction with other Parcel E IR sites and involved additional field investigations performed from October 1995 to June 1996 (TtEMI, LFR, and U&A, 1997). In 1993, IR Site 1 was combined with IR Site 21. IR Site 21 was initially identified as a separate site during the RI/FS scoping process, but was later determined to be part of the landfill and thus was combined with IR Site 1.

Data Gaps Investigations (2000 to 2003): During preparation of the Parcel E RI and FS reports in 1997 and 1998, the Navy and regulatory agencies identified additional tasks to support the RD for Parcel E, most of which were specific to the Parcel E-2 Landfill. These tasks were performed during the NDGI, from October 2001 to September 2002, and included defining the nature and extent of landfill gas, refining the lateral extent of solid waste, evaluating liquefaction potential of the landfill, and delineating wetlands areas adjacent to the landfill. In addition, the Navy and the regulatory agencies decided that

[4] In September 2004, the Navy divided Parcel E into two parcels (E and E-2). Discussions within this report that reference documents published prior to September 2004 refer to the portion of Parcel E that became Parcel E-2.

additional data for Parcel E were needed, including data from the area now referred to as Parcel E-2, to better define the nature and extent of chemicals in soil and groundwater. As discussed in Section 1, these investigations included the GDGI, performed from July 2000 to October 2002, and the SDGI, performed from September 2002 to February 2003.

Landfill Compliance Monitoring (2003 to present): The Navy has implemented several environmental monitoring programs to help satisfy regulatory requirements (as outlined in 27 CCR) for Parcel E-2 until a final remedy is selected. As discussed in Section 1.1.2, these programs include landfill gas control and monitoring, groundwater monitoring, landfill cover integrity monitoring and maintenance, and stormwater management and monitoring. Data from the ongoing monitoring provides information on current site conditions that is helpful in verifying the nature and extent conclusions from previous site investigations.

This RI/FS Report is based on information compiled from these past investigations and ongoing monitoring, rather than from a single RI field investigation. Analytical data from pre-RI investigations are not included in the RI data set; however, the results of these investigations were incorporated into the RI field program (TtEMI, LFR, and U&A, 1997). Table 3-1 summarizes the field activities performed during the RI and subsequent data gaps investigations and compliance monitoring.

In addition, this RI/FS Report also includes information from several interim removal actions that were performed in Parcel E-2. This section includes brief summaries of the methods, actions performed, and relevant results of the investigations and removal actions conducted at Parcel E-2.

Many of the previous investigations were summarized in reports that are drawn upon and either referenced or included as appendices to this report. Previous investigations and other IR Program activities were divided into the following categories to simplify their presentation in this section: pre-RI activities (Section 3.1); landfill investigations (Section 3.2); soil investigations in non-landfill areas, including the East Adjacent Area and the Panhandle Area (Section 3.3); groundwater investigations (Section 3.4); ecological assessments (Section 3.5); radiological assessments (Section 3.6); outdoor air monitoring (Section 3.7); previous removal actions (Section 3.8); and ongoing monitoring programs (Section 3.9). Table 1-3 presents a chronology of all previous environmental investigations, as well as previous and ongoing remedial actions conducted at Parcel E-2.

3.1. PRE-REMEDIAL INVESTIGATION ACTIVITIES

The pre-RI activities are summarized in the following documents:

- "Geotechnical Investigation, Waste Disposal Sites" (Lowney-Kaldveer Associates, 1973)
- "As-Built Drawings for Storm Sewer Interceptor Phase II, MILCON Project P-261B" (Navy, 1974)

- "Initial Assessment Study of Hunters Point Naval Shipyard" (Disestablished) (NEESA, 1984)
- "Confirmation Study, Verification Step, Hunters Point Naval Shipyard (Disestablished)" (EMCON Associates [EMCON], 1987a)
- "Area Study for Asbestos-Containing Material and Organic and Inorganic Soil Contamination, Hunters Point Naval Shipyard (Disestablished)" (EMCON, 1987b)
- "Parcel E Remedial Investigation, Draft Final Report" (TtEMI, LFR, and U&A, 1997)

The following subsections are brief summaries of the findings from each of the documents listed above. Unless otherwise indicated, all information included in each summary was derived from the corresponding document listed above.

3.1.1. Geotechnical Investigation, Waste Disposal Sites (1973)

In 1973, Lowney-Kaldveer Associates performed a geotechnical investigation as part of closing the Parcel E-2 Landfill. The field investigation consisted of a surface reconnaissance and a subsurface exploration, including 12 soil borings to depths ranging from 12 to 47 feet bgs. Existing topography and the soil conditions derived from soil samples collected from the borings indicated that the east and west margins of the landfill were raised with sand and clay fill prior to using the area as a landfill. These fill activities left an inlet of San Francisco Bay open that extended through the middle of the waste disposal area.

3.1.2. As-Built Drawings for Storm Sewer Interceptor Project (1974)

Following the disestablishment of HPS as an active naval facility in 1974, several preliminary closure actions were performed at the Parcel E-2 Landfill. A stormwater interceptor line was constructed to divert stormwater runoff from the hill area north of the landfill to an outfall near Berth 36. This action prevented runoff from inundating the landfill and increasing leachate production. In addition, the landfill was covered with a minimum of 2 feet of compacted imported fill. The fill was placed in two lifts: the first lift varied in thickness but was a minimum of 1 foot thick, and the second lift was 1 foot thick (TtEMI, LFR, and U&A, 1997).

An oily waste area was also identified on the Navy's drawings along the western perimeter of the site (Figure 1-8). Ponded liquid was removed, and the top 6 inches of soil at the oily waste area was scarified before placing the soil cover. The soil cover was also graded to facilitate surface water drainage. Drawings also indicate attempts to construct a 1,000-foot-long clay dike along the southern edge of the landfill; however, it did not succeed in attaining an effective seal because of reported difficulty in excavating bulky underground debris (NEESA, 1984).

3.1.3. Initial Assessment Study (1984)

In 1984, WESTEC Services, Inc. conducted the IAS at IR-01. The IAS consisted primarily of a review of records and a visual inspection of the site. The study concluded that it was highly probable that chemicals from waste disposed of in the Parcel E-2 Landfill had reached groundwater and were migrating toward San Francisco Bay. This migration constituted a potential threat to the bay environment and a confirmation study was recommended for the site.

3.1.4. Confirmation Study, Verification Step (1987)

In 1987, the verification step of the confirmation study was conducted at IR Site 01. This study consisted of a geophysical survey, the drilling of nine soil borings, and the completion of these borings as monitoring wells (IR01MWI-1 through IR01MW-9). The verification step report concluded that soil at the Parcel E-2 Landfill contained a variety of VOCs and SVOCs that appeared to be associated with petroleum products and some chlorinated organic solvents. The report recommended further environmental investigations because contaminants were detected beyond the reported landfill boundaries. It also recommended that, because the results of the gross alpha and beta radiation scans were inconclusive, groundwater should be analyzed for radium and a gamma radiation screening should be performed.

3.1.5. Area Study for Asbestos-Containing Material and Organic and Inorganic Soil Contamination (1987)

In 1987, the Area Study for asbestos-containing material and organic and inorganic soil contamination was conducted throughout HPS to evaluate whether a release of hazardous substances to soil had occurred at construction sites outside the boundaries of previously identified investigation sites. The area study primarily concluded that soil within Study Area A, including Parcels E and E-2, contained naturally occurring asbestos derived from the serpentine bedrock.

3.1.6. Triple A Investigation, Remedial Action Order, and RI/FS Scoping Document (1986 to 1988)

The Navy leased portions of HPS to Triple A from July 1, 1976, through June 30, 1986. During this period, Triple A used dry docks, berths, machine shops, power plants, offices, and warehouses to repair commercial and naval vessels. The Navy identified 19 sites that Triple A had allegedly used to store and dispose of hazardous and other wastes during its occupancy of the site. Two of these sites, Triple A Sites 1 and 16, are located within Parcel E-2 (see Figure 1-11). At Site 16, Triple A allegedly disposed of industrial debris, sandblast waste, oily industrial sand, and asphalt over an area of approximately 5 acres along the shoreline of Parcel E-2 (SFDA, 1986). A portion of the Landfill Area was also included as part of Triple A Site 16. At Site 1, Triple A allegedly stored unlabeled, deteriorating, uncovered drums with their contents exposed to the elements in the southeast corner of Parcel E-2 (SFDA, 1986).

On January 7, 1988, the DHS issued a Remedial Action Order to the Navy and its tenant, Triple A (DHS, 1988). The Remedial Action Order listed numerous sites, including IR Site 01 and Triple A Sites 1 and 16. In response to the Remedial Action Order, the Navy completed a scoping document for the RI/FSs to be conducted at HPS. The scoping document grouped the sites into OUs and described the field investigations to be conducted under the RI (HLA, 1988).

3.2. LANDFILL INVESTIGATIONS

The results of the Parcel E-2 landfill investigations are summarized in the following documents:

- "Parcel E Remedial Investigation, Draft Final Report" (TtEMI, LFR, and U&A, 1997)
- "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Gas Characterization" (TtEMI, 2003c; provided as Appendix A to this report)
- "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Lateral Extent Evaluation" (TtEMI, 2004f; provided as Appendix B to this report)
- "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Liquefaction Potential" (TtEMI and ITSI, 2004b; provided as Appendix C to this report)

The following subsections are brief summaries of the findings from each of the documents listed above. Unless otherwise indicated, all information included in each summary was derived from the corresponding document listed above. The nature and extent of solid waste and subsurface gas in the Landfill Area is discussed in more detail in Section 4.2.

3.2.1. Remedial Investigation (1988 to 1996)

The Landfill Area was investigated during the OU-I RI from 1988 to 1992. During the RI, the Navy performed geophysical surveys and excavated test pits to characterize the lateral extent of the landfill waste layer. Figure 3-1 shows the locations of landfill characterization activities, including those performed during the RI. Table 3-2 summarizes the chronology of landfill characterization activities from the RI through the NDGI. In addition, soil borings were installed within the Landfill Area to define the vertical extent of landfill waste, assess the chemical condition of soil fill within the landfill, and evaluate the general composition of the landfill waste. Some of these soil borings were converted into groundwater monitoring wells to assess the chemical conditions of groundwater both within and underneath the landfill waste. Soil and groundwater sampling locations are shown on Figure 3-2. Tables 3-3 and 3-4 summarize the chronology of soil and groundwater sampling activities, respectively.

Data collected during the RI was adequate to define the vertical extent of landfill waste, assess the chemical condition of soil fill within the landfill, and evaluate the general composition of the landfill waste. Following evaluation of the RI results, several data gaps remained within the Landfill Area. The Navy and the regulatory agencies decided to conduct a data gaps investigation (referred to as the NDGI)

in 2002 to gather more information to characterize the nature and extent of landfill gas, better delineate the lateral extent of waste, and estimate the potential for sand layers near the landfill to liquefy during an earthquake.

3.2.2. Landfill Gas Characterization (2002)

In 2002, as part of the NDGI, the Navy conducted an evaluation to delineate and characterize landfill gas. This evaluation included outdoor air monitoring and building atmosphere surveys, a subsurface soil gas survey, and GMP installation and monitoring. Figure 3-1 shows these monitoring locations, and Table 3-2 summarizes the chronology of landfill characterization activities. Results from GMP monitoring indicated that methane, the main component of landfill gas, was present at levels that exceeded the LEL of 5 percent by volume in air in subsurface areas in the northern part of the landfill and aboveground at four areas on the UCSF compound. Trace concentrations of NMOCs were also detected in this area; however, a screening evaluation concluded that the detected concentrations of NMOCs did not pose an unacceptable risk to human health. The landfill gas characterization report is included as Appendix A to this report.

3.2.3. Landfill Lateral Extent Evaluation (2002)

In 2002, as part of the NDGI, an evaluation of the lateral extent of solid waste was conducted. After a review of the existing historical information, test pits were excavated and soil borings were drilled (Figure 3-1) to determine the edge of the continuous physical waste in the Parcel E-2 Landfill. When solid waste was encountered in a test pit, "step-out" test pits were excavated up to 50 feet from the previous location outward from the center of the landfill. The evaluation determined that the lateral extent of landfill waste encompasses approximately 22 acres (Figure 3-1), and is bounded in most areas by fill composed of soil (mainly sand and gravel) and noncontiguous waste (mainly construction debris and nonhazardous refuse). Along the northern perimeter, the landfill boundary extends to within a few feet of the fence line that separates the landfill and the UCSF compound. The landfill lateral extent evaluation report is included as Appendix B to this report.

3.2.4. Landfill Liquefaction Potential Evaluation (2002)

In 2002, as part of the NDGI, an evaluation was conducted to determine the potential for subsurface layers in the vicinity of the Parcel E-2 Landfill to liquefy during an earthquake. Data collected included visual soil classification from soil borings, standard penetration test (SPT) borings to estimate the relative stiffness and strength (bearing capacity) of soil, cone penetrometer test (CPT) borings to obtain information on soil density and lithology, seismic wave velocity, and laboratory analyses of soil geotechnical characteristics. CPTs and SPTs were performed along the perimeter of the landfill and within the landfill waste (Figure 3-1). The information was used to model the effects of soil liquefaction caused by an earthquake to determine if the integrity of the landfill cover would be compromised.

According to 27 CCR, landfill closure systems must be designed to withstand shaking from the maximum probable earthquake (MPE). The following characteristics apply to the MPE defined based on a deterministic evaluation:

- Location: San Andreas Fault Peninsula Segment
- Magnitude: 7.9
- Distance from site: 12 kilometers
- Peak ground acceleration: 0.5 and 0.6 times the acceleration of gravity

Only certain types of soil (referred to as cohesionless soil) will potentially liquefy under dynamic loading from an earthquake. These types include loosely consolidated soil classified as sand, silty sand, and sandy silt. The Artificial Fill surrounding and underlying the Parcel E-2 Landfill is heterogeneous and consists of discontinuous layers of cohesionless soil intermixed with cohesive soil (e.g., clay) and landfill waste, and is underlain by the Bay Mud, which consists predominantly of clay with discontinuous layers of sand and silt.

The liquefaction potential of cohesionless soil layers identified within the SPT and CPT borings was evaluated using standard geotechnical methods (Youd and others, 2001; Seed and others, 2001). The evaluation indicated that most of these soil layers (66 to 67 percent) would not liquefy during the MPE. The evaluation concluded that, for the remaining soil layers that could liquefy during the MPE, lateral movement of soil below the waste may be approximately 4 to 5 feet. This estimate is conservative because of the discontinuous layers and resistance from nonliquefiable soil at the boundaries, which would likely reduce the amount of lateral movement to less than the estimated 4 to 5 feet. Settlement of liquefiable soil below the waste may be up to 10 inches.

The evaluation also concluded that, if containment were selected as the final remediation measure, further analysis would be required on response of the landfill cap, overall stability of the landfill site, slope stability, and other closure features. The landfill liquefaction potential evaluation is included as Appendix C to this report. Additional slope stability analyses are discussed in Section 11.5.1.1.

3.3. SOIL INVESTIGATIONS IN NON-LANDFILL AREAS

The non-landfill areas are those beyond the landfill extent but within the Parcel E-2 boundary; these areas are the East Adjacent Area and the Panhandle Area (Figure 1-2). Investigations performed in the intertidal Shoreline Area are discussed in Section 3.5. The results of investigations in the East Adjacent Area and the Panhandle Area are summarized in the following documents:

- "Parcel E Remedial Investigation, Draft Final Report" (TtEMI, LFR, and U&A, 1997)
- "Parcels E and E-2 Standard Data Gaps Investigation, Data Summary Report (Revision 01)" (TtEMI, 2005c)
- "Draft Final Removal Action Design and Implementation Work Plan, Metal Debris Reef and Metal Slag Areas, Parcels E and E-2" (TtFW, 2005b)

The following subsections are brief summaries of the findings from each of the documents listed above. Unless otherwise indicated, all information included in each summary was derived from the corresponding document listed above. The nature and extent of chemicals in soil within the East Adjacent Area and Panhandle Area are discussed in more detail in Sections 4.3 and 4.4, respectively.

3.3.1. Remedial Investigation (1988 to 1996)

From 1988 to 1992, soil within the non-landfill areas was investigated during the OU-I RI. These areas, which lie outside the Landfill and Shoreline Area boundaries but within Parcel E-2, are mainly composed of fill material, including soil mixed with noncontiguous solid waste deposits. The Navy collected soil samples from surface locations, excavated shallow test pits, and drilled deeper soil and monitoring well borings to evaluate whether hazardous substances and petroleum hydrocarbons had been released at Parcel E-2. Figure 3-2 shows the soil sampling locations, and Table 3-3 summarizes the chronology of soil characterization activities.

Reconnaissance activities, performed from 1988 to 1989, consisted of drilling deep soil borings to define subsurface stratigraphy and performing a soil gas survey to evaluate the potential presence of VOCs in soil and groundwater. During the soil gas survey at Parcel E-2, concentrations of total petroleum hydrocarbons (TPH), excluding methane and other aliphatic hydrocarbons, were detected in the northern portion of the landfill. In addition, concentrations of less than 1 part per billion of trichloroethane (TCA); trichloroethene (TCE); tetrachloroethene (PCE); and benzene, toluene, ethylbenzene, and xylenes were detected (HLA, 1990a). From 1990 to 1992, soil sampling was performed at numerous soil borings and test pits to characterize the nature and extent of chemicals in soil within the East Adjacent Area and Panhandle Area. From 1995 to 1996, additional investigation was performed, as part of the Parcel E RI, to better define the nature and extent of chemicals in soil within the East Adjacent Area.

The RI fieldwork produced sufficient data to identify areas of potential soil contamination in most of Parcel E-2. However, following evaluation of the RI results, several data gaps remained within the East Adjacent Area and Panhandle Area. The Navy and regulatory agencies decided to conduct a data gaps investigation (referred to as the SDGI) in 2002 to characterize the landfill and shoreline interface, further delineate known source areas or chemical detections from single points, and to bound potential sources identified in aerial photographs.

3.3.2. Standard Data Gaps Investigation (2002)

The Navy conducted the onshore SDGI in 2002 to further define the nature and extent of chemicals in soil within the non-landfill areas. The Navy reviewed aerial photographs and logs from test pits, soil borings, monitoring wells, and GMPs from various investigations at Parcel E-2. The Navy then conducted an evaluation that compared soil data with human health and ecological screening criteria and evaluated the visual presence of putrescible solid waste (waste that contains significant quantities of biodegradable material such as wood) beyond the landfill extent. The evaluation identified a number of chemical detections above the SDGI screening criteria, several potential source areas identified in aerial photographs, and several known source areas. In addition, wood debris was identified at several locations outside the Landfill Area that had the potential to generate levels of methane gas above the LEL; however, none of these waste locations were contiguous with the Landfill Area and none of the locations warranted designation as hot spots because they do not contain highly toxic or mobile chemicals.

Onshore sampling locations were selected to bound known or potential source areas and chemical detections from single points. Soil samples collected from non-landfill areas were analyzed for metals (including hexavalent chromium), pesticides, PCBs, SVOCs, and TPH (in select locations). The results were used to delineate the PCB Hot Spot Area, a portion of which was removed under an interim removal action (see Section 3.8.8). Confirmation sampling results from the PCB Hot Spot Area are presented in this Draft Final RI/FS Report in Sections 4.2.4 and 4.4.2. Waste types encountered during the removal action are summarized in Sections 4.2.1 and 4.4.1. The SDGI onshore sampling adequately delineated the extent of chemicals in soil at some areas; however, the SDGI samples had detected concentrations of chemicals above both human health and ecological criteria. This finding is attributed to the heterogeneous nature of the fill material within the Panhandle Area and East Adjacent Area. The nature and extent of chemicals in soil within the Panhandle Area and East Adjacent Area are discussed in more detail in Sections 4.3 and 4.4, respectively.

In addition to the onshore sampling, the SDGI characterized the nature and extent of chemicals in sediment within, or in close proximity to, the Shoreline Area. The Parcel E-2 shoreline consists mainly of intertidal sediments between the mean tide line and a riprap wall placed along portions of the shoreline for erosion control. Results of sediment sampling in the Shoreline Area were evaluated in the Shoreline Characterization Technical Memorandum (SulTech, 2007; Appendix G to this report) and are briefly discussed in Section 3.5. In addition to the SDGI sediment sampling, soil samples were collected along the bayward side of the sheet-pile wall during the SDGI to define the extent of chemicals in soil at the interface of the landfill and shoreline. Although these soil sampling locations were considered "shoreline" locations in the SDGI, the locations fall outside of the Shoreline Area as defined for this RI/FS (Figure 3-2) and are considered part of the Landfill Area in this report. Data from these sampling locations were used to delineate the PCB hot spot and were subsequently excavated as part of the removal action (TtECI, 2007a).

3.3.3. Characterization of Metal Slag Area (2004)

The Metal Slag Area contains wastes suspected to have originated from the metal foundry (Building 241 in Parcel C) and the smelter (Building 408 in Parcel D) when the shipyard was active. Waste in the Metal Slag Area includes industrial debris and metal slag with radioactive anomalies. In support of a removal action at the Metal Slag Area, site characterization was performed to further define the vertical and horizontal extent of metal slag. The characterization activities were conducted from June through September 2004 and included (1) topographic and bathymetric surveys, (2) marine geophysics surveys, (3) landside geophysics surveys, (4) environmental resources surveys, (5) vibracoring and sonic drilling, and (6) sampling activities. The metal slag layer was found to range from 1.5 to 6 feet thick over an area of approximately 0.9 acre. Site characterization activities involved collecting samples from offshore and onshore borings and analyzing the samples for radiological and nonradiological chemicals. Elevated concentrations of cesium-137, metals, PCBs, and pesticides were identified at the Metal Slag Area. The metal slag and debris within the area were removed in 2005 and 2006 (see Section 3.8.7). Confirmation sampling results are included in Section 4.3.2 of this RI/FS Report. Waste types encountered during the removal action are summarized in Sections 4.3.1 and 4.4.1.

3.4. GROUNDWATER INVESTIGATIONS

The groundwater data presented in this report were either originally summarized in the four documents listed below, or have been collected as part of the BGMP (Section 3.9):

- "Parcel E Remedial Investigation, Draft Final Report" (TtEMI, LFR, and U&A, 1997)
- "Parcel E Information Package, Phase II Groundwater Data Gaps Investigation" (TtEMI, 2001a)
- "Revised Final Parcel E Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation" (TtEMI, 2004c)
- "Draft Final Technical Memorandum for Groundwater Investigation at Parcel E-2" (CE2-Kleinfelder Joint Venture, 2009a)

The following subsections are brief summaries of the findings from each of the documents listed above. Unless otherwise indicated, all information included in each summary was derived from the corresponding document listed above. The nature and extent of chemicals in groundwater is discussed in more detail in Section 5.

3.4.1. Remedial Investigation (1988 to 1996)

During the RI, the Navy installed monitoring wells and collected groundwater samples to evaluate whether hazardous substances and petroleum hydrocarbons had migrated to groundwater at Parcel E-2. Figure 3-2 shows the groundwater sampling locations, and Table 3-4 summarizes the chronology of groundwater characterization activities. In addition to groundwater sampling, the Navy installed piezometers and performed slug, step-drawdown, and constant-rate pumping tests to characterize the

aquifers. Lastly, the Navy conducted a 72-hour tidal influence study within the nearshore areas of Parcel E-2. The results of the aquifer characterization and tidal influence study are discussed in Sections 2.2.3 and 2.2.4, respectively.

The first monitoring wells in Parcel E-2 (IR01MWI-1 through IR01MW-9) were installed in 1986 as part of the confirmation study and verification step. Two of these nine wells (IR01MWI-1 and IR01MW-4; Figure 3-2) were subsequently decommissioned; however, no records are available on the dates or procedures used in the decommissioning. From 1990 to 1992, the Navy performed primary and contingency sampling activities as part of the OU-I RI. Activities involved collecting samples from existing A-aquifer monitoring wells and installing and collecting samples from additional A-aquifer and B-aquifer monitoring wells throughout Parcel E-2. RI activities during this period also included collecting grab groundwater samples from soil borings to assist in the location of future monitoring wells. From 1995 to 1996, additional samples were collected at existing monitoring wells and several additional monitoring wells were installed to better define the groundwater conditions in the East Adjacent Area and evaluate groundwater flow patterns west and northwest of Parcel E-2 (in non-Navy property).

The RI activities produced sufficient data to identify areas of potential groundwater contamination and assess their migration potential. Following evaluation of the RI results, it was concluded that additional data collection from existing monitoring wells was needed to assess current groundwater flow patterns and chemical conditions. The Navy and the regulatory agencies decided to conduct a multi-phase GDGI at Parcels C, D, E, and E-2.

3.4.2. Groundwater Data Gaps Investigation (2000 to 2002)

The GDGI was conducted in three phases between 2000 and 2002 to update previous assessments of groundwater conditions at HPS, supplement information gathered during the Parcel E RI, and better define the extent of groundwater contamination at HPS. The Phase I GDGI involved collection of water level data at Parcels C, D, E, and E-2 and groundwater samples at Parcels C and D. The groundwater sampling program was expanded during the Phase II and Phase III GDGI to include Parcels E and E-2. An evaluation of the condition of the monitoring wells throughout HPS was conducted during Phase II (January through April 2001), and subsequent repairs and new well installation were conducted during Phase III (February through October 2002). Three new A-aquifer wells (IR01MW10A through IR01MW12A) and one piezometer (IR01P-04A) were installed at Parcel E-2 to replace wells that were decommissioned during construction of the landfill gas control system and to monitor groundwater conditions in the vicinity of the landfill gas barrier wall. Wells IR01MW10A through IR01MW12A were installed to replace well IR01MW07A, and piezometer IR01P-04A was installed to replace piezometer IR01P03A. The well decommissioning and replacement activities are discussed in Section 2.3.4 of the Landfill Gas Removal Action Closeout Report (TtEMI, 2004a; Appendix F to the RI/FS Report).

The most prevalent chemicals with groundwater concentrations exceeding GDGI evaluation criteria in Parcel E-2 were VOCs, ammonia, and cyanide. Of the VOCs detected, benzene and 1,4-dichlorobenzene were detected over a relatively extensive area at concentrations just above the MCLs. Although other metals, SVOCs, PCBs, and pesticides were detected at concentrations exceeding GDGI evaluation criteria, the extent of these chemicals in groundwater was not widespread. The Phase III GDGI also collected groundwater samples for analysis of radionuclides at Parcel E-2; the findings of this portion of the GDGI are discussed in Section 3.6. The GDGI concluded that groundwater characterization at the Parcel E-2 Landfill is incomplete and recommended that additional groundwater samples be collected. Following evaluation of the GDGI results, the Navy and the regulatory agencies decided to implement a BGMP to regularly monitor groundwater conditions at HPS. The Parcel E-2 monitoring program was designed to comply with 27 CCR requirements and is discussed in Section 3.9.

3.4.3. Groundwater Data Gaps Investigation (2007 to 2008)

In August 2007, the Navy and the regulatory agencies decided to conduct a focused GDGI along the Parcel E-2 shoreline. The purpose of this GDGI was to provide supplemental data for this RI/FS Report to (1) evaluate chemical concentrations in A-aquifer groundwater adjacent to the Shoreline Area and within the northeast portion of the Panhandle Area (near existing freshwater wetlands); (2) evaluate the effectiveness of the PCB Hot Spot Area removal action in reducing PCBs and petroleum hydrocarbons in A-aquifer groundwater; and (3) evaluate whether A-aquifer groundwater beneath the Metal Slag Area has been affected by dissolved metals. The GDGI consisted of the following fieldwork elements:

- A geophysical survey was performed in September and November 2007 to identify potential subsurface obstructions in the planned work areas.
- Sixty-one A-aquifer temporary wells (TW01 through TW61) were installed in February and March 2008 using direct-push technology (Figure 3-2).
- Grab groundwater samples were collected in March 2008 from the 61 A-aquifer temporary wells and 7 previously installed A-aquifer piezometers (PZ131F, PZ138E, PZ138F, PZ144E, PZ150D, PZ150E, and PZ161D).

Grab groundwater samples were analyzed for one or more of the following chemical groups: (1) TPH, (2) PCBs, (3) ammonia as nitrogen, and (4) dissolved metals. These data are presented in Section 5 of this RI/FS Report. At the request of the regulatory agencies, the scope of the investigation was expanded to include collection and analysis of supplemental grab groundwater samples for specific radionuclides (cesium-137, cobalt-60, radium-226, and strontium-90). The supplemental samples were collected in June 2008, and the associated data will be presented in a separate technical memorandum.

3.5. ECOLOGICAL ASSESSMENTS

Several ecological assessments were performed at Parcels E and E-2. These assessments evaluated exposures to terrestrial wildlife within the onshore areas of Parcels E and E-2 and to aquatic wildlife in San Francisco Bay. The evaluation of aquatic wildlife was performed in conjunction with the CERCLA process at Parcel F. The results of previous ecological assessments are summarized in the following documents:

- "Intertidal Sediment Study and Environmental Sampling and Analyses Plan" (Aqua Terra Technologies [ATT], 1991)
- "Phase 1A Ecological Risk Assessment, Volumes 1 to 3" (PRC, 1994)
- "Phase 1B Ecological Risk Assessment, Parts I and II" (PRC, 1996c and 1996d)
- Baseline Ecological Risk Assessment (BERA) presented as Appendix F to the "Parcel E Remedial Investigation, Draft Final Report" (TtEMI, LFR, and U&A, 1997)
- "Draft Final Ecological Risk Assessment Validation Study" (TtEMI and LFR, 2000a)
- "Protective Soil Concentrations [PSC] Technical Memorandum" (TtEMI and LFR, 2000b)
- "Draft Parcel F Validation Study Report" (Battelle, Entrix, Inc., and Neptune and Company, 2002)
- "Final Parcel E Nonstandard Data Gaps Investigation, Wetlands Delineation and Functions and Values Assessment" (TtEMI, 2003d)
- "Parcels E and E-2 Standard Data Gaps Investigation, Data Summary Report (Revision 01)" (TtEMI, 2005c)
- Draft Parcels E and E-2 Shoreline Characterization Technical Memorandum (SulTech, 2007; Appendix G of this report)

The following subsections are brief summaries of the findings from each of the documents listed above. Unless otherwise indicated, all information included in each summary was derived from the corresponding document listed above.

3.5.1. Intertidal Sediment Studies (1991 to 1992)

In 1991 and 1992, as part of the intertidal sediment study, sediment samples were collected in the intertidal zone of HPS, including along the Parcel E-2 shoreline, to evaluate if chemicals had migrated from Parcels E and E-2 to San Francisco Bay. The Environmental Sampling and Analyses Plan's (ESAP) whole sediment study was implemented in 1991 to measure concentrations of chemicals in sediments, stormwater, and bay water near stormwater outfalls and other potential source areas within the boundaries of HPS. Mussel tissue was also collected and analyzed.

3.5.2. Phase 1A and Phase 1B ERA (1994 to 1996)

The intertidal and ESAP data were used to identify chemicals of potential ecological concern (COPECs) in the Phase 1A ERA. The Phase 1A ERA was a qualitative analysis that developed a preliminary characterization of HPS based on existing data, biotic surveys, and contaminant migration pathways and exposure routes. Both terrestrial and aquatic environments were considered in the Phase 1A ERA. Following the Phase 1A analysis, the quantitative Phase 1B ERA was performed to delineate potential gradients of contamination from onshore sources to offshore sediments and to characterize the risk to aquatic wildlife. Offshore sediment samples were collected and the sediment data were reassessed as part of the Parcel F validation study.

3.5.3. BERA (1997)

During the Parcel E RI, the terrestrial COPECs identified during the Phase 1A ERA were adopted and refined for a BERA. Habitat data from the Phase 1A ERA were also used with data from a resurvey of Parcels E and E-2 in February 1997 (see Section 2.4). The main purpose of the BERA was to evaluate whether site chemical adversely affected the terrestrial environment of Parcels E and E-2. The BERA process consisted of the following activities: (1) identifying COPECs and ecological receptors; (2) analyzing exposure of each ecological receptor; (3) researching ecotoxicological literature to develop toxicity reference values (TRVs) for use in the risk assessment; and (4) characterizing the risk to terrestrial wildlife at Parcel E IR sites.

Lead and total PCBs were identified as Category 2 COPECs, and further evaluation of these COPECs was recommended to identify whether they were likely to pose a potential risk to terrestrial vertebrates at Parcel E-2. In addition, high-molecular-weight polycyclic aromatic hydrocarbons (PAHs), total chlordane, and total dichlorodiphenyltrichloroethane (DDT) were identified as Category 2 COPECs for one ecological receptor (the American kestrel), and further evaluation of these COPECs was recommended to identify whether they were likely to pose a risk to raptors at Parcel E-2. Also, rodent and bird toxicity data were not available for several chemicals, and a recommendation was made to reevaluate potential risk for these chemicals if toxicity data were identified in the near future. Overall, the BERA classified Parcel E-2 as a site posing uncertain risks, but not one posing significant immediate ecological risks.

3.5.4. ERA Validation Study and Protective Soil Concentration Technical Memorandum (1999)

In response to regulatory agency comments on the Parcel E BERA, the Navy conducted the ERA Validation Study to address some of the uncertainties associated with dose calculations and to develop site-specific soil concentrations (referred to as protective soil concentrations [PSCs]) that would be protective of terrestrial receptors. Twelve collocated samples of soil, plant tissue, invertebrate tissue,

lizard tissue, and small mammal tissue were collected during the study (including three samples from the Panhandle Area of Parcel E-2). The analytical results were used to calculate exposure doses and hazard quotients (HQs) (by comparing these doses to the low and high TRVs used in the BERA). The results of these evaluations were used to develop PSCs for the representative receptor species: the American kestrel, the house mouse, and the red-tailed hawk. Based on the results of the validation study, cadmium, copper, lead, nickel, selenium, and zinc were determined to be of potential risk to ecological receptors and PSCs were derived for these chemicals. Figure 3-3 shows the soil, sediment, and tissue sampling locations from the ERA Validation Study.

3.5.5. Parcel F Validation Study (2000 to 2002)

The Parcel F Validation Study was conducted to more accurately define the offshore areas that required evaluation in an FS. One collocated sediment and tissue sample was collected from within the Parcel E-2 shoreline (Figure 3-3). The validation study identified copper, lead, and PCBs as the primary ecological risk drivers in South Basin (the offshore area from Parcels E and E-2). The validation study hypothesized that metals and PCBs along the shoreline were a source of contamination to Parcel F sediments. Due to these results, the Navy decided to evaluate the shoreline as a potential source of copper, lead, and PCBs to Parcel F.

3.5.6. Wetlands Delineation and Functions and Values Assessment (2002)

As discussed in Section 2.4, the wetlands delineation identified two wetland areas within Parcel E-2: (1) approximately 3.2 acres of tidal wetlands along the shoreline south of the landfill; and (2) approximately 1.3 acres of inland seasonal freshwater wetland in the Panhandle Area (Figure 1-4). The function and values assessment concluded that the wetland areas have a low ability to retain sediments and toxicants and to produce nutrients. In general, the most significant function of these wetlands is seasonal use for wintering and migrating birds. The value of these wetlands was concluded to be low because they are situated within a known hazardous waste site on manmade land. The wetlands delineation and functions and values report is discussed in more detail in Section 2.4 and is included as Appendix D to this report.

3.5.7. SDGI (2002) and Shoreline Characterization Technical Memorandum (2005)

The shoreline investigation, performed as part of the SDGI, involved the collection of additional data from intertidal sediment to evaluate whether contamination in the Parcels E and E-2 shoreline had migrated, or had the potential to migrate, to sediments in adjacent Parcel F (offshore), and to identify areas within the shoreline that posed an unacceptable ecological risk. Systematic sediment samples were collected every 100 feet at two depths (0 and 2 feet bgs) from the shoreline to identify potential sources to Parcel F. All systematic samples were analyzed for copper, lead, and PCBs. In addition, biased shoreline sediment samples were collected in suspected source areas to define the extent of known hot spots within

close proximity to the Parcel E-2 shoreline (the Landfill Area and an area containing sandblast waste within the East Adjacent Area). All biased sediment samples and 10 percent of the systematic samples were analyzed for metals, hexavalent chromium, pesticides, PCBs, and SVOCs. Figure 3-3 shows the sediment sampling locations from the SDGI.

Copper and lead in shoreline sediments, adjacent to the Landfill Area and the East Adjacent Area, were identified as a potential source of contamination to Parcel F. PCBs in shoreline sediments, adjacent to the Landfill Area, were identified as a potential source of contamination to Parcel F. Groundwater discharge was determined to be a potential pathway for migration of metals and PCBs to Parcel F. However, due to the limited solubility of metals and PCBs in site groundwater, it is unlikely to contribute to contamination in offshore sediments. The nature and extent of chemicals in shoreline sediment is discussed in more detail in the Shoreline Characterization Technical Memorandum (Appendix G of this RI Report). A SLERA for the shoreline sediment is also included in Appendix G.

Soil data collected during the onshore portion of the SDGI was also evaluated to validate the COPEC list used in the previous BERA for terrestrial receptors. Surface soil (less than 3 feet bgs) concentrations previously used in calculating PSCs, referred to as "pre-2000 data," were compared with surface soil concentrations representative of current soil in Parcel E-2, referred to as "all" data. Based on a comparison of these two data sets, additional chemicals were identified as COPECs. PSCs were calculated for these additional COPECs using the methodology established during the ERA Validation Study. A SLERA for the Parcel E-2 onshore area was performed to evaluate the new PSCs (along with the existing PSCs, which did not change) against the updated surface soil data set. The results of the SLERA are discussed in Section 7 and presented in Appendix L of this RI Report.

3.6. RADIOLOGICAL ASSESSMENTS

As discussed in Section 1.4.2, the HRA presented a comprehensive history of radiological operations conducted by the Navy and Navy contractors at HPS. The overall conclusion of the HRA is that low levels of radioactive contamination exist within the confines of HPS. The HRA identified numerous locations within Parcel E-2 as radiologically impacted, including IR Site 01/21 (which comprises most of Parcel E-2), the ship shielding area at the southwest corner of Parcel E-2, and the Parcel E-2 shoreline (NAVSEA, 2004).

Numerous investigations of potential radiological contamination have been performed throughout HPS, including Parcel E-2. Radiological investigations performed at Parcel E-2 include:

- Site Reconnaissance (1988 to 1989)
- Phase I Radiological Investigation (1991)
- Phase II Radiological Investigation (1993)

- Interim Parcel E Radiation Risk Assessment (1997)
- Interim Investigation between Phase IV and Phase V Radiological Investigations (2001)
- Phase V Radiological Investigation (2002 to 2003)
- Radiological Groundwater Investigation (2002)
- Characterization of the Metal Slag Area (2004; discussed in Section 3.3.3)
- Radiological Groundwater Investigation (2008)

A brief summary of radiological investigations performed at Parcel E-2 is provided in the following paragraphs. For each investigation, the methods used to evaluate the radionuclides of concern (ROCs) and associated release limits were current at the time of the survey. Unless otherwise indicated, the information presented in each subsection is derived from the HRA (NAVSEA, 2004).

3.6.1. Site Reconnaissance (1988 to 1989)

In 1988, HLA conducted a preliminary surface radiation survey to evaluate whether radioactivity levels at HPS posed unacceptable exposure risks to RI field workers. Project activities included a scintillation survey for radiation at surface locations at Parcel E-2. The surface gamma survey at the Parcel E-2 Landfill was conducted at grid points over the entire landfill. The average gamma count rate was determined to be significantly below the mean of the background values measured at HPS. Surface gamma counts at one location in the landfill exceeded the average level at the landfill, but were close to the mean of the HPS background values (HLA, 1990a).

3.6.2. Phase I Radiological Investigation (1991)

In 1991, the Navy began radiation investigations at HPS in four main phases as part of the RI program. Phases I and II involved field investigations at several HPS locations including Parcel E-2, while Phases III and IV were performed elsewhere at HPS (outside of Parcel E-2). Also during this period, an interim radiation risk assessment and a shoreline characterization survey were performed at Parcels E and E-2.

The portion of the Phase I radiological investigation at Parcel E-2 was conducted in two stages: (1) air monitoring and (2) the surface confirmation radiation survey (SCRS). Phase I particulate air monitoring was conducted in 1991 to evaluate the background airborne particulate alpha and beta radioactivity levels at several locations, including Parcel E-2. The gross alpha and gross beta airborne particulate concentrations were well within safety standards for airborne concentrations of general radioactive materials in outdoor air (PRC, 1992a).

The Phase I SCRS was initiated in 1992 to evaluate and confirm the nature and surficial extent of radium-bearing devices in several disposal areas at HPS, including Parcel E-2. A local grid coordinate system was developed for the Phase I SCRS to map and relocate radioactive material detected during the surface

walkover survey. Each grid section was 300 feet by 300 feet square, with each section further subdivided into 30-foot by 30-foot subgrids. During the Phase I SCRS, gamma readings exceeding two times the background level were considered potential radioactive point source anomalies associated with buried radium-containing devices (PRC, 1992a).

When elevated gamma readings were observed, the location, gamma measurements, and exposure measurements were recorded and a biased soil sample was collected to identify the present radioisotopes (PRC, 1992a). To provide additional characterization information, systematic soil samples were also collected at random, unbiased locations at a frequency of one sample per 2 acres. All soil samples were analyzed at an off-site laboratory using gamma spectroscopy to identify and quantitate gamma-emitting radioisotopes. During the surface walkover survey in Parcel E-2, a cluster of seven radioactive point source anomalies associated with radium-containing devices were observed in the vicinity of the Metal Slag Area; two additional anomalies were observed in the Panhandle Area northeast of the Metal Slag Area (PRC, 1992a). Based on the results of the Phase I SCRS, a recommendation was made for further investigation.

3.6.3. Phase II Radiological Investigation (1993)

The Phase II radiological investigation was conducted in 1993, in an attempt to delineate the subsurface distribution of radium-containing devices at several locations, including Parcel E-2 (PRC, 1996a). Six 15-foot-long test pits were excavated in the Panhandle Area at locations where point source anomalies were found during the Phase I SCRS. The test pits were excavated until Bay Mud or groundwater was encountered, or until the walls of the excavation became unstable. Trench and test pit depths ranged from 2.5 to 10.5 feet bgs, with an average depth of about 8 feet bgs.

The walls of each test pit, as well as excavated soil, were scanned for gamma-emitting radioactive material. If elevated gamma readings were observed, the location, gamma measurements, and exposure measurements were recorded. During the Phase II investigation, gamma count rates exceeding one and one-half times the background level were considered radioactive point source anomalies associated with buried radium-containing devices (PRC, 1996a). If radioactive point source anomalies were found, they were further investigated by excavation and soil samples were collected for analysis at an off-site laboratory using gamma spectroscopy to identify the present radioisotopes (PRC, 1996a).

No elevated gamma count rates were measured in the test pits or trenches installed within Parcel E-2; as a result, no additional soil samples were collected at Parcel E-2 for gamma spectroscopy analysis. However, test pits and trenches installed at IR Site 02, in close proximity to Parcel E-2, contained gamma-emitting anomalies associated with radium-containing devices and firebrick. Results of soil samples collected within IR Site 02 were used to delineate an area containing radium-containing devices,

which were subsequently removed during an interim removal action (TtECI, 2007c); this area is located entirely within the current boundary of Parcel E.

3.6.4. Interim Parcel E Radiation Risk Assessment (1997)

As part of the Parcel E RI, TtEMI performed a radiation risk assessment to evaluate potential risks associated with human exposure (for residential and industrial scenarios) to radionuclides detected in Parcels E and E-2. Radium-226 and its radioactive daughter products (lead-210 and radon-222) were identified as radionuclides of potential concern. Risks were quantified for exposure to radium-226 in soil and to radon-222 in indoor air, since risk from radon-222 occurs only if buildings are constructed in a radiologically contaminated area. As discussed in Section 1.8, the reasonably anticipated reuse for Parcel E-2 is open space. Therefore, an industrial exposure scenario was considered a more conservative risk assessment that likely over-estimated the risk to future site occupants. For exposure to radium-226 under the industrial exposure scenario, several exposure areas identified in the risk assessment had calculated excess lifetime cancer risks (ELCRs) between 1×10^{-6} and 1×10^{-5} for the reasonable maximum exposure case. Risks to radon-222 were not considered relevant for Parcel E-2 because no buildings were constructed in the parcel. The assessment report concluded that health risks for exposure to radium-226 in soil were not considered significant.

3.6.5. Interim Investigation between Phase IV and Phase V Radiological Investigations (2001)

A characterization survey of the shoreline of Parcels E and E-2 was performed in 2001. Gamma scans were conducted over pre-positioned grids within approximately 50 feet of the mean tide line. Gamma radiation levels in several areas exceeded background gamma radiation levels, most significantly the area known as the "metal reef" within Parcel E. Analysis of samples collected from those locations identified radium-226 as the contaminant.

3.6.6. Phase V Radiological Investigation (2002 to 2003)

The Phase V radiological investigation began in January 2002 prior to issuance of the HRA. The purpose of the investigation was to support the release of buildings or areas that were identified as areas where radioactive materials had been used or areas where remedial actions to remove known contamination had occurred. The Phase V investigation of what is now Parcel E-2 was performed in 2002 and 2003, and the results were not available for inclusion in the HPS HRA (NAVSEA, 2004); therefore, the Phase V investigation results were presented for the first time in the Radiological Addendum to this RI/FS Report (ERRG and Radiological Survey and Remedial Services, LLC, 2011). The Phase V investigation at Parcel E-2 consisted of a surface survey and was designed to meet the requirements of a Multi-Agency Radiation Survey and Site Investigation Manual Class 1 Final Status Survey if contamination was not found (U.S. Department of Defense et al., 2000). The objective of the Phase V investigation at Parcel E-2

was to demonstrate whether residual radioactivity on the surface met the predetermined release criteria as summarized below.

- Radium-226: 1 picocurie per gram (pCi/g) greater than background not to exceed 2 pCi/g[5]
- Stronium-90: 10.8 pCi/g
- Cesium-137: 0.13 pCi/g[6]
- Cobalt-60: 0.060 pCi/g

The release criteria were considered equivalent to EPA preliminary remediation goals (PRGs) (now called regional screening levels) for outdoor worker exposure to soil, based on agreements with EPA.

The investigation area was divided into 73 Class 1 survey units measuring 40 by 50 meters (2,000 square meters, or 21,528 square feet) each. Each survey unit was assigned an alphabetic designation. Sixteen systematic sample locations were established approximately 11 meters apart in each grid. Reference (background) readings consisted of 16 1-minute static gamma readings taken on the hillside of Parcel A and 16 samples collected at various areas within Parcels B, C, D, and E.

The Phase V investigation consisted of the following steps:

1. Perform gamma scans of 100 percent of the surface area
2. Take 16 systematic static gamma measurements in each survey unit
3. Take biased static measurements in areas where high gamma readings were measured
4. Take exposure rate measurements from the systematic static measurement locations
5. Collect soil samples at static and biased measurement locations
6. Analyze the soil samples by gamma spectroscopy at the on-site laboratory to quantify activities of a suite of 17 radionuclides, including cesium-137 and radium-226, the primary ROCs at Parcel E-2

A total of 1,168 systematic and 23 biased soil samples were collected during the Phase V investigation. Gamma scan measurements typically ranged from 4,500 to 8,000 counts per minute (cpm), with occasional scan measurements identified as being in excess of 10,000 cpm. Sample results identified residual radioactivity exceeding the release criteria for cesium-137 and radium-226 in each survey unit. The elevated levels appeared to be consistent over the surface of the area, including the landfill cap, and there was a direct correlation between gamma static readings and gamma spectroscopy results. Results for samples from the reference areas indicated mean background activity of 0.049 pCi/g for cesium-137

[5] The radium-226 release limit was 5 pCi/g when the Phase V investigation was started but was subsequently reduced to 1 pCi/g above background.
[6] The cesium-137 release limit applied to this survey when conducted in 2002 is slightly higher than the one used today (0.113 pCi/g); however, this change does not directly impact the results of this survey.

and 0.82 pCi/g for radium-226, which were consistent with the background activity levels used for the interim removal actions at Parcels E and E-2 (TtECI, 2007a, 2007b, and 2007c).

Based on the sample results, every survey unit had activity levels of radium-226 exceeding the release criterion and 46 of the survey units had activity levels of cesium-137 exceeding the release criterion. All of the eight survey units within the vicinity of the Experimental Ship-Shielding Area had activity levels of cobalt-60 exceeding the release criterion. Ten percent of the samples were sent to an off-site laboratory for quality assurance and strontium-90 analysis because the on-site laboratory did not analyze directly for strontium-90. Results from the quality assurance laboratory were within the range of results from the on-site laboratory (based on a normal distribution of results). The average ratio (3.626) of strontium-90 to cesium-137 results from the off-site laboratory was used to estimate strontium-90 activity levels. The estimated strontium-90 activity levels for each sample were calculated by multiplying the corresponding cesium-137 activity by 3.626. This methodology was considered a conservative approach to estimate potential strontium-90 activity levels at Parcel E-2. None of the survey units had elevated activity levels of strontium-90. The remedial alternatives evaluated in this report address provisions for the proper screening, handling, and disposal of radioactive materials in Parcel E-2.

3.6.7. Radionuclides in Groundwater Evaluation (2002)

The radiological groundwater investigation for the Phase III GDGI at HPS was conducted to assess the levels of specific radionuclides in site groundwater. The general approach in designing the radiological investigation for groundwater in Parcels E and E-2 was to collect isotope-specific data for "radionuclides of interest," defined as species that may be site related or may be present in the environment as natural or anthropogenic background as known at the time (prior to issuance of the HRA). The investigation was intended to supplement data collected during previous investigations for radiological indicator parameters (gross alpha and gross beta) because the nonspecific results for gross alpha and gross beta did not allow the Navy to distinguish between natural and potentially site-related components of radioactivity in A-aquifer groundwater. Radium-226 and radium-228 were considered primary radionuclides of potential concern at Parcel E-2 because debris disposed of at the landfill may have contained radium dials; however, groundwater samples collected from seven A-aquifer monitoring wells within and immediately adjacent to the Landfill Area were analyzed for 47 specific isotopes. The analytical data were evaluated by simple (nonstatistical) threshold comparisons with a fixed standard and by statistical tests comparing the site data with background data (two-sample statistical tests) and with fixed standards (one-sample statistical tests) (TtEMI, 2004c). The statistical test results for the Landfill Area are summarized as follows:

- Statistical testing comparing groundwater data from the Landfill Area for radionuclides with drinking water or other standards (one-sample t-test) showed that no standards were statistically exceeded at the 95 percent confidence level (Appendix I, Table I-9 of Parcel E Groundwater Summary Report [TtEMI, 2004c]).
- Statistical testing comparing groundwater data from the Landfill Area and background areas (parametric and nonparametric two-sample tests) indicated that differences between background and site data sets for potassium-40, radium-226, and strontium-90 are statistically significant in at least one of the tests (Appendix I, Tables I-14 and I-15 of Parcel E Groundwater Summary Report [TtEMI, 2004c]).
- The site mean activities of 0.472 picoCuries per liter (pCi/L) for radium-226 and 0.879 pCi/L for radium-228 are far below the drinking water standard of 5 pCi/L for the sum of radium-226 plus radium-228.
- Beta emissions from naturally occurring potassium-40 exceeded the screening standard of 50 pCi/L for gross beta activity (all beta-emitting isotopes, combined). Potassium-40 occurs naturally in seawater, at about 300 pCi/L, as beta emissions. Bay water samples collected for this investigation produced an average of 280 pCi/L for potassium-40.
- Other radionuclides that were detected infrequently in groundwater samples from the Landfill Area did not exceed background levels. These detections included two results for actinium-228 (a naturally occurring radioisotope) near the detection limit, one qualified result at the detection limit for americium-241 (alpha scan result), one result for lead-214 (naturally occurring) near the detection limit, four detections of uranium-234, and three detections of uranium-238.

The investigation concluded that naturally occurring potassium-40 in seawater is the main contributor to beta emissions measured in groundwater samples from nearshore monitoring wells. The gross beta values historically reported for samples collected from nearshore wells were dominated by beta emissions from natural potassium-40 in seawater, not beta emissions from radium isotopes. Background seawater contains the highest average activity of potassium-40 (280 pCi/L, beta) of all data groups, followed by nearshore IR sites where saltwater intrusion has resulted in brackish groundwater conditions. This intrusion has altered the composition of nearshore groundwater, with corresponding changes in the radiological quality (especially gross beta emissions). The results of the radiological groundwater investigation are detailed in the Parcel E Groundwater Summary Report (TtEMI, 2004c).

3.6.8. Radionuclides in Groundwater Evaluation (2008)

As part of a groundwater investigation at Parcel E-2, groundwater samples were collected in June 2008 from 61 temporary wells and 7 existing piezometers and submitted to an off-site laboratory for analysis of radionuclides. The samples provided data to evaluate whether A-Aquifer groundwater within and hydraulically downgradient of radiologically impacted sites at Parcel E-2 contained elevated concentrations of ROCs. All groundwater samples were analyzed for the primary ROCs at Parcel E-2 (cesium-137, radium-226, and strontium-90). In addition, 11 groundwater samples collected near the Experimental Ship-Shielding Area were also analyzed for cobalt-60. Sampling information from the

groundwater investigation is presented in Appendix J of the Final Technical Memorandum for Groundwater Investigation at Parcel E-2 (CE2-Kleinfelder Joint Venture, 2009a).

Also in June 2008, groundwater samples were collected from six existing monitoring wells (five in the A-aquifer and one in the B-aquifer; all wells were within or in close proximity to the Landfill Area) and submitted to an off-site laboratory for radionuclide analyses. Samples are regularly collected from the wells and analyzed for nonradioactive chemicals under the BGMP. The analyses for radioactive chemicals (cesium-137, radium-226, and strontium-90) at these wells was performed as a one-time supplement to the BGMP, to provide additional data to evaluate whether groundwater within and hydraulically downgradient of the Landfill Area contained elevated concentrations of ROCs. Sampling information from the supplemental BGMP monitoring is presented in the Semiannual Groundwater Monitoring Report for April to September 2008 (CE2-Kleinfelder Joint Venture, 2009b).

The radionuclide groundwater data collected in June 2008 were compiled as part of the radiological addendum and were evaluated, similar to the 2002 investigation, by simple (non-statistical) threshold comparisons to a fixed standard (such as drinking water standards) and by statistical tests comparing the site data to fixed standards (one-sample statistical tests). The simple threshold comparison to drinking water standards revealed no exceedances for cobalt-60, cesium-137, and strontium-90 out of 74 samples analyzed. For radium-226, the drinking water standard (5 pCi/L, combined for radium-226 and radium-228) was exceeded in 2 out of 74 samples analyzed. The two radium-226 exceedances were reported at temporary wells TW004 and TW011 (Figure 3-2), with radium-226 concentrations of 11.0 pCi/L and 6.08 pCi/L, respectively.

Temporary wells TW004 and TW011 are surrounded by numerous other temporary wells where samples also were collected in June 2008; samples from the wells did not contain radium-226 concentrations exceeding the drinking water standard. In addition, statistical testing comparing the 2008 groundwater data with drinking water standards (one-sample t-test) showed that the radium-226 concentration corresponding to the 95th percent upper confidence limit did not exceed the drinking water standard. The radionuclide groundwater data collected in June 2008 are presented in the radiological addendum to this RI/FS Report.

3.7. OUTDOOR AIR MONITORING

Previous outdoor air monitoring activities performed at Parcel E-2 are summarized in the following documents:

- "Final Draft Solid Waste Air Quality Assessment Test" (HLA, 1989)
- Appendix D, Air Sampling Investigations, in the "Parcel E Remedial Investigation, Draft Final Report" (TtEMI, LFR, and U&A, 1997)

- "Perimeter Air Monitoring Program, Final Removal Action Landfill Cap Closeout Report" (TtEMI, 2005b)
- "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Gas Characterization" (TtEMI, 2003e)

The following subsections are brief summaries of the findings from each of the documents listed above. Unless otherwise indicated, all information included in each summary was derived from the corresponding document listed above.

3.7.1. Solid Waste Air Quality Assessment Test (1988 to 1989)

Between October 1988 and February 1989, a Solid Waste Air Quality Assessment Test (SWAQAT) was conducted at several IR sites, including IR Site 01. The SWAQAT included evaluation of meteorological conditions, outdoor air quality, landfill gas compositions, surface gas emissions, and subsurface gas migration. The analysis of gases covered a wide range of organic compounds, including VOCs and methane. Surface gas emissions were not detected during this investigation. The only compounds detected were in outdoor air, upwind from possible sources off site in the surrounding industrial areas. Methane was detected in isolated pockets at IR Site 01 and at the northern edge of the IR Site 01 boundary (near the UCSF compound but within the solid waste footprint).

3.7.2. Outdoor Air Monitoring (1992 to 1996)

As part of the RI program, the Navy performed basewide outdoor air monitoring in three phases. The first phase was conducted in 1992 at IR Sites 01 through 11 and included two upwind and one downwind sampling location. The samples were analyzed for asbestos, metals, VOCs, SVOCs, pesticides, PCBs, and formaldehyde. The detected chemicals showed the highest values of asbestos and pesticides upwind, originating from the industrial areas around HPS. Low levels of VOCs were found at all locations; the highest VOC concentrations were detected at an active industrial area within Parcel D (IR Site 09).

A second phase of sampling was conducted in 1994. Phase II involved collection of samples from 17 locations throughout HPS, including 1 location in Parcel E-2. The samples were analyzed for asbestos, metals, VOCs, SVOCs, pesticides, PCBs, and formaldehyde. The general conclusion of the Phase II sampling was that chemical concentrations in air at HPS are similar to the Bay area regional air quality monitoring results, with only minor differences observed for most chemicals investigated. During the Phase II sampling, a sandblast waste pile was sorted and removed in the East Adjacent Area of Parcel E-2 (Battelle, 1996). Results of the sampling showed that sites in close proximity to the sandblast waste pile had elevated concentrations of asbestos, metals, and PCBs (specifically Aroclor-1260), and that these elevated concentrations were related to this removal. In addition, elevated VOC concentrations at Parcel E-2 may have been influenced by a light industrial park located west of Parcel E-2 (upwind of the

Phase II monitoring location). As a result, additional sampling was recommended to verify that the elevated concentrations were from off-site sources.

The Phase III outdoor air sampling was conducted in 1996 and focused on four locations from Phase II, including the one Parcel E-2 location. Two upwind sampling locations were established along the western boundary of Parcel E-2. The samples were analyzed for asbestos, metals, VOCs, and PCBs. Concentrations of asbestos, metals, and VOCs detected in the Phase III samples were similar to regional background concentrations, and concentrations of PCBs were two orders of magnitude lower than concentrations detected during Phase II. These findings supported the conclusion that removal of the sandblast waste pile in 1994 most likely contributed to the elevated concentrations of asbestos, metals, and PCBs detected during Phase II. In addition, the elevated VOC concentrations measured near IR Site 01/21 in the Phase II samples were not detected during the Phase III investigation. The Phase II and III air monitoring locations in and adjacent to Parcel E-2 are shown on Figure 3-4.

3.7.3. Perimeter Air Monitoring Program, Landfill Cap Construction (2000 to 2001)

A grass fire burned on Parcel E-2 on August 16, 2000. After the surface fire was extinguished, subsurface smoldering was discovered. An initial 24-hour outdoor air sample was collected downwind of the fire area on August 31, 2000, and an air monitoring network was established around the perimeter of Parcel E-2 on September 8, 2000. Air samples were collected at seven stations to evaluate whether chemicals were migrating toward residents and commercial workers. The air monitoring locations established under the perimeter air monitoring program (PAMP) in and adjacent to Parcel E-2 are shown on Figure 3-4.

The PAMP continued from September 8, 2000, until the cap was structurally completed on March 13, 2001. The objective of the PAMP at Parcel E was to identify any conditions requiring corrective measures necessary to ensure that public health and the environment of the nearby community were not compromised by air emissions from the subsurface smoldering and landfill capping activities.

Integrated air samples were collected for analysis of metals, VOCs, SVOCs, pesticides, PCBs, low-resolution and high-resolution dioxins and furans, chlorine compounds, and phosgene. A radioactivity sample was collected during a single sample period. During the PAMP, over 2,400 different analyses were conducted on the more than 1,700 samples collected from the seven-station monitoring network. Action levels for target chemicals were based on a combination of existing action levels established during the Parcel B soil remedial action and EPA Region 9 PRGs (now called regional screening levels).

The PAMP concluded that the PCB compound, Aroclor-1260, was the primary chemical detection that was directly attributable to landfill capping activities. Almost all of the Aroclor-1260 detections were at monitoring Station F, which was in the southeast corner of Parcel E-2 (near the PCB Hot Spot Area that was excavated in 2005 and 2006). Detections of Aroclor-1260 were attributed to construction activities

that disturbed surface soil in the area. Construction activities in the area were modified to minimize dust generation in the area. Similar precautions are being implemented during the ongoing removal action in the area, and perimeter air monitoring is also being performed.

Other conclusions from the PAMP included:

- Combustion products such as PAHs and dioxin and furans directly attributable to the fire were not prevalent and were below project duration PAMP action levels and PRGs.
- Of the more than 150 target chemicals or classes of compounds, 98 were not detected at any time during the PAMP. The following chemicals and classes of compounds were not detected: pesticides (except for one detection of endrin below action levels), chlorine or hydrogen chloride, phosgene, low resolution dioxins and furans, benzo(a)pyrene, cadmium, and vinyl chloride.
- Detected concentrations of lead, nickel, and high-resolution dioxins and furans were below the corresponding PAMP action levels and PRGs.
- Benzene and carbon tetrachloride were frequently detected, and observed concentrations exceeded project duration PAMP action levels or PRGs. These concentrations were attributed to outdoor air background concentrations because the project average concentrations of benzene and carbon tetrachloride were less than the corresponding background concentrations reported for the Bay Area Air Quality Management District (BAAQMD) outdoor air monitoring station on Arkansas Street in San Francisco.
- Bis(2-ethylhexyl)phthalate was frequently detected, and observed concentrations exceeded project duration PAMP action levels. However, the PRG was not exceeded. This chemical is ubiquitous in nature and is associated with PVC plastic, including gloves.
- Arsenic and manganese were frequently detected, and observed concentrations exceeded project duration PAMP action levels or PRGs or 24-hour PAMP action levels. These metals are naturally occurring in soil, and observed concentrations of these metals correlated with earth-moving activities during cap construction and wind direction.

The PAMP results are presented in Attachment A of the Final Removal Action Landfill Cap Closeout Report (TtEMI, 2005b; Appendix E of this report). Information on construction of the interim landfill cap is presented in Section 3.8.

3.7.4. Landfill Gas Characterization (2002)

As part of the NDGI, outdoor air and building atmosphere surveys were conducted to assess whether methane was present in outdoor air within 300 feet of the Parcel E-2 Landfill and in buildings or subterranean structures at concentrations exceeding 1.25 percent volume in air. Results of the outdoor air survey indicated that landfill gas was not present in the breathing zone or in building atmospheres within the landfill; within 300 feet of the landfill limit; or within surveyed, accessible buildings outside the 300-foot perimeter. The NDGI outdoor air monitoring locations in and adjacent to Parcel E-2 are shown

on Figure 3-4. A more detailed discussion of outdoor air monitoring performed during the landfill gas characterization study is presented in Section 4.2.3.1.

3.8. PREVIOUS REMOVAL ACTIONS

Several CERCLA removal actions and other interim actions have been performed at Parcel E-2. The following is a list of the documents that summarize the results of those removal actions.

- "Field Demonstration and Technology Transfer Report on Sandblasting Grit Recycling Project" (Battelle, 1996)
- "Field Summary Report, Storm Drain Sediment Removal Action" (IT, 1997)
- "Post Construction Report, Site IR-01/21 Industrial Landfill Removal Action (Groundwater Extraction System and Containment Barrier)" (IT, 1999)
- "Removal Action Landfill Cap Closeout Report" (TtEMI, 2005b)
- "Removal Action Closeout Report, Parcel E Landfill Gas Time-Critical Removal Action" (TtEMI, 2004a)
- "Post-Construction Report, Decontaminate Process Equipment, Conduct Waste Consolidation and Provide Asbestos Services in Parcels B, C, D, and E" (TtFW, 2004c)
- "Final Removal Action Completion Report, PCB Hot Spot Soil Excavation Site, Parcels E and E-2" (TtECI, 2007a)
- "Final Removal Action Completion Report, Metal Debris Reef and Metal Slag Area Excavation Sites, Parcels E and E-2" (TtECI, 2007b)

The following subsections are brief summaries of the findings from each of the documents listed above. Unless otherwise indicated, all information included in each summary was derived from the corresponding document listed above.

3.8.1. Sandblast Waste Fixation (1991 to 1995)

Sandblast operations that generated sandblast waste containing paint chips, heavy metals, and oil were conducted at numerous locations at HPS. A field treatment demonstration was planned to evaluate whether sandblast waste could be stabilized and recycled into asphalt (Battelle, 1989). Between 1991 and 1995, 4,665 tons of sandblast waste was collected and consolidated in Parcel E-2 (see Figure 3-4). In addition, about 245 tons of sandblast waste was collected from eight small piles around HPS, including 2 tons from IR Site 11/14/15 in Parcel E. The waste was sent to an asphalt plant, where it was successfully reused in the manufacture of asphalt. This removal action was completed in 1995.

3.8.2. Storm Drain Sediment Removal Action (1996 to 1997)

From September 1996 to September 1997, the Navy removed accumulated sediments from the storm drain system at HPS to limit potential transport of contaminated sediments to San Francisco Bay as part of a non-time-critical removal action (NTCRA). The storm drain system at HPS consists of approximately 107,000 linear feet of piping, less than 1,000 feet of which are present in Parcel E-2. Most storm drain lines within Parcel E-2 were inaccessible during the NTCRA, except for a short section of storm drain (less than 200 feet) southwest of Building 810. Activities consisted of (1) removing sediment and debris from accessible storm drain lines, catch basins, and manholes; (2) pre- and post-cleaning video inspections of the pipelines; and (3) water jetting of the pipelines, catch basins, and manholes. Sediments generated during cleaning of the accessible sewers were dewatered, sampled, analyzed for waste characterization purposes, and disposed of at a licensed, off-site facility.

3.8.3. Groundwater Extraction System and Containment Barrier (1997 to 1998)

Previous investigations identified high PCB concentrations in groundwater in the southeast portion of Parcel E-2. To prevent the potential transport of PCBs to the bay, the Navy constructed a sheet-pile wall and GES to contain groundwater in this area as part of a NTCRA. Construction activities began in August 1997 and were completed in July 1998, when the GES was activated (IT, 1999). The GES was deactivated in April 2005, and components of the system were removed; the system remains offline following implementation of the removal action at the PCB Hot Spot Area (TtECI, 2007a). The sheet-pile wall, which is 614 feet long, consists of 410 sheet piles that vary in length from 12 to 55 feet (IT, 1999). The former GES, which was located inland of the sheet-pile wall, consisted of two sections:

A 240-foot-long northern collection system consisting of seven 6-inch-diameter extraction wells (spaced 40 to 50 feet apart and ranging from 18 to 24 feet bgs in depth) connected via a 3-inch diameter discharge pipe located 2 feet bgs;

A 239-foot-long southern collection system consisting of below ground, horizontal slotted pipe (4-inch diameter, ranging from 1.7 to 1.0 feet above msl in elevation) and two collection sumps.

Figure 1-3 shows the location of the sheet-pile wall and former GES. Concentrations of chemicals in groundwater were low enough that extracted groundwater could be discharged into the San Francisco publicly owned treatment system without pre-treatment. O&M of the GES was permitted through the CCSF Industrial Wastewater Discharge Class I Permit No. 98-0301 issued on December 14, 1998, and updated on December 14, 2001.

An evaluation of the former GES (IT, 2001) concluded that, even with the presence of the extraction system, a groundwater mound occurs between the sheet-pile wall and the Parcel E-2 Landfill during winter and spring months. During heavy rainfall events, ponding occurs at the ground surface in the area

of the groundwater mound. The evaluation recommended that surface water management controls be taken to prevent increased recharge and the resulting groundwater mound in the area of the former GES, and that more passive groundwater control measures, such as phytoremediation, be evaluated as an alternative to the former GES (IT, 2001). The remedial alternative analysis in the FS portion of this report (Sections 12 through 14) evaluates groundwater containment around the Parcel E-2 Landfill (and other nearshore contaminant sources to the bay) and the appropriate means of controlling groundwater (both upgradient and downgradient).

3.8.4. Landfill Cap Construction (2000 to 2001)

On August 16, 2000, a brush fire burned approximately 45 percent of the landfill surface area. The surface fire was extinguished within 6 hours, but small subsurface areas (less than 5 acres) continued to smolder for approximately 1 month after the fire was extinguished (ATSDR, 2001). As part of a TCRA, an interim cap was constructed to extinguish the fire and prevent the occurrence of future fires under the capped areas. Figure 1-3 shows the area burned by the fire and the area capped during the removal action. The interim cap consists of a multilayer system of sub-base soil, HDPE membrane, synthetic drainage layer, and topsoil. Because the interim cap effectively limits air intrusion into the landfill, the effect was a smothering of any smoldering subsurface areas remaining from the fire. In addition, the interim cap significantly reduces stormwater infiltration through the landfill, thereby reducing the potential for hazardous substances to leach out from the landfill. The interim cap encompasses approximately 14.5 acres and has been vegetated to stabilize surface soil and limit erosion. Additional information on construction of the interim cap is provided in the Final Removal Action Landfill Cap Closeout Report (TtEMI, 2005b; Appendix E of this report).

3.8.5. Landfill Gas Removal Action (2002 to 2003)

Based on the findings of the landfill gas characterization, a TCRA was conducted to address explosion hazards and human health risks associated with off-site migration of landfill gas. The TCRA was designed to achieve the following goals: (1) reduce concentrations of methane detected at the northern edge of the Parcel E-2 Landfill (in the subsurface under both Navy and UCSF property) to less than the LEL of 5 percent; and (2) prevent landfill gas migration onto the nearby UCSF compound, including methane and NMOCs. To achieve these goals, the TCRA consisted of installation and operation of a gas control, extraction, and treatment system.

The gas extraction system consists of 2 mobile extraction unit trailers, 10 extraction wells, and 5 GMPs on the UCSF compound. The gas control system was installed along the northern boundary of the landfill and consists of an HDPE barrier wall, a gas collection trench sealed (on top) with bentonite, a horizontal perforated gas collection pipe, five gas vents, and a mobile active extraction unit to assist venting when necessary. Figure 1-3 shows the major components of the gas extraction and control system; a conceptual

cross section of the landfill gas control system is presented on Figure 3-5. Mobile and permanent treatment systems remove NMOCs from the vented and extracted gas.

The gas control system is monitored using a network of 32 GMPs: 11 GMPs located immediately adjacent to the HDPE barrier wall; 3 GMPs along the western boundary of the Parcel E-2 Landfill; 5 GMPs located on the UCSF compound; and 13 GMPs along Crisp Avenue. The locations of these GMPs, along with other components of the landfill gas monitoring program, are shown on Figure 3-6. The ongoing landfill gas monitoring program, which was initiated after completion of the TCRA, is discussed in more detail in Section 3.9.2.

During the TCRA, modifications to the gas extraction and control systems were implemented to improve the effectiveness of the systems. The gas control system was enhanced through installation of a grout curtain in the gas collection trench on the north side of the HDPE barrier wall, installation of a new treatment unit connected to an additional gas control system vent, and rehydration of the bentonite seal. Figure 1-3 shows the location of the grout curtain.

Upon completion of the TCRA, the control system was switched to a combination of passive and active operation. Four of the five vents operate passively. Active gas extraction and treatment is performed at a single vent (PV-02) to ensure that the risk of off-site migration of landfill gas is virtually eliminated. Additional information on construction of the interim landfill gas control system is provided in the Landfill Gas Time-Critical Removal Action Closeout Report (TtEMI, 2004a; Appendix F of this report). More detailed information about the landfill gas removal action is discussed in Section 4.2.3.2.

3.8.6. Shoreline Cleanup (2003 to 2004)

As part of a waste consolidation effort throughout HPS, hazardous and nonhazardous debris along the Parcels E and E-2 shoreline (including portions of the Panhandle Area) was characterized and disposed of off site. The shoreline cleanup was performed from September 2003 to June 2004. Debris consisted primarily of brick, metal scrap, concrete, and wood. The debris was subsequently characterized for disposal and fell into one of two categories: nonhazardous debris or non-Resource Conservation and Recovery Act (RCRA) hazardous wood containing creosote.

The shoreline debris also included three large wooden and metal barges within the intertidal zone of Parcel E-2 and F. The barges were removed in accordance with a site-specific plan (developed to ensure compliance with the substantive aspects of the USACE Nationwide Permit Number 38), and soil erosion and sediment controls were used to avoid or minimize adverse effects to San Francisco Bay and its aquatic life. After each barge was removed, the newly exposed areas were recontoured using hand tools. The resulting debris was consolidated with like debris for subsequent transportation and disposal or recycling.

The following materials were accumulated, characterized (as required), and disposed of as part of the Parcel E shoreline cleanup:

- Twenty-seven truckloads (containing an estimated 468 cubic yards) of non-RCRA hazardous waste debris (poles with creosote) sent to Chemical Waste Management's Kettleman Hills Landfill
- Twenty-five truckloads (containing an estimated 400 cubic yards) of non-regulated, nonhazardous debris disposed of at Waste Management's Altamont Landfill
- Eighty-one tons of metal debris sent to Circosta Metals for recycling
- A total of 344 used and waste tires was disposed of at Waste Recovery West, Livermore, California.
- Approximately 10 cubic yards of suspected asbestos-containing material was collected by a qualified asbestos abatement subcontractor during the Parcel E shoreline cleanup. This material was disposed of at Chemical Waste Management's Altamont Landfill.

Because the Parcel E shoreline has been identified as an area containing radiological devices (such as, dials and deck markers with radioluminescent paint), a screening protocol was implemented to ensure that no radiological materials were removed from the site during the Parcel E shoreline cleanup. This protocol was approved by the Navy's Radiological Affairs Support Office (RASO) prior to its implementation and involved screening suspect debris (such as metal scrap and sediment-laden debris). No radiological devices or other contamination were identified in the material collected as part of the shoreline cleanup.

3.8.7. Metal Slag Area Removal Action (2005 to 2007)

The TCRA at the Metal Slag Area was performed in conjunction with the removal of the Metal Debris Reef located in the southeast portion of Parcel E. The TCRA was designed to remove metal slag and debris containing low-level radiological material, as well as nonradiological chemical contamination incidental to the removal of the area. Site characterization was performed to delineate the vertical and lateral extents of the metal debris and slag prior to excavation (as discussed in Section 3.3.3). The excavation was performed in a series of 12-inch lifts, to maximum depths ranging between 3 and 6 feet bgs. After the initial excavation was completed, trenches were extended beyond the excavation perimeter to confirm the extent of metal debris and slag. Additional metal debris was found at the northern, southern, and southwestern edges of the excavation and, as a result, the excavation boundaries were extended to remove this material (TtECI, 2007b).

Approximately 8,200 cubic yards of soil, metal slag, and debris was removed and disposed of off site as part of this removal action (TtECI, 2007b). Out of this total volume, approximately 74 cubic yards of soil and sediment was segregated as radiologically impacted. Also, 32 radiological devices, 15 cubic yards of radiological debris (primarily fire bricks), and approximately 30 cubic yards of metal debris were identified within the removal area (Navy, 2006a and 2006b; TtECI, 2007b). In addition to this

radiologically impacted debris, six waste drums were recovered from the removal area and were characterized prior to off-site disposal. Five of the six drums contained soil and debris contaminated with PCBs; the sixth drum contained soil and debris with elevated levels of radium-226 (TtECI, 2007b). Post-excavation soil samples were collected and analyzed for cesium-137, radium-226, and strontium-90 (the ROCs identified in the HRA [NAVSEA, 2004]). Analytical results for 174 of the 185 post-excavation soil samples met the specified radiological remedial objectives. None of the samples that failed to meet the specified radiological remedial objectives indicated widespread radiological contamination is present at the Metal Slag Area. In addition, remaining radiological materials are covered with clean soil, thereby preventing direct exposure to surrounding populations and wildlife (TtECI, 2007b).

Concurrent with the radiological soil analyses, post-excavation soil samples were also collected and analyzed for metals, PCBs, and organochlorine pesticides. Because the focus of the TCRA was to remove radiological material, these chemical results did not prompt additional excavation activities and were intended only to supplement the soil characterization in the Metal Slag Area. The reported concentrations of PCBs and several metals in these samples warrant further analysis in this RI/FS Report. Post-excavation chemical sampling results are summarized in Section 4.3.2 and Section 7 (HHRA). Wetlands mitigation activities (which are associated with the removal action) are currently being planned and are anticipated to occur in conjunction with the Parcel E-2 remedial action.

3.8.8. PCB Hot Spot Area Removal Action (2005 to 2007)

The TCRA at the PCB Hot Spot Area was designed to remove PCB- and petroleum hydrocarbon-contaminated soil and debris, possibly containing low-level radiological material. Excavation involved (1) removal of soil containing PCBs at concentrations greater than the depth-based removal action goals (1 milligram per kilogram [mg/kg] from the surface to 3 feet bgs and 100 mg/kg deeper than 3 feet bgs); (2) TPH at concentrations greater than 3,500 mg/kg; or (3) radiological contaminants above the radiological remedial objectives. The removal action goals also included removal of free-phase petroleum hydrocarbons, to the extent practicable. The excavation was performed in a series of 12-inch lifts, to a maximum depth of 21 feet bgs. During excavation activities, oil-stained soil and free-phase product were observed along the western and southwestern sidewall of the excavation boundary; however, further excavation in these areas was not possible because of their proximity to San Francisco Bay. Visual observation and field-screening test kits of exploratory potholes excavated between the excavation and the bay identified contamination (including oil staining and free-phase product) (TtECI, 2007a). The Navy initiated a follow-on removal action to address contaminated soil and free-phase product between the 2007 excavation boundary and the bay (Navy, 2010); the follow-on removal action was initiated in March 2010 and was projected to be completed in 2011.

Approximately 44,500 cubic yards of soil and debris was removed and disposed of off site as part of this removal action. Out of this total volume, 533 cubic yards of soil and fire brick was segregated as radiologically impacted. Also, 40 radiological devices, 78 cubic yards of metal debris, and 19 pieces of other radioactively contaminated debris were identified within the removal area (TtECI, 2007a). In addition to this radiologically impacted debris, 110 drums and 537 assorted waste containers were recovered from the central portion of the removal area and were characterized prior to off-site disposal. The drums, which were discovered in varying degrees of decay, contained grease, oil, soil, asphalt, and tar substances. Waste characterization data indicated that the drums contained various chemicals, including PCBs. Two of the drums contained mixed waste with radiological contamination. The small containers contained various laboratory chemicals, ranging from strong acids and bases to solvents, alcohols, and inorganic salts (TtECI, 2007a).

In addition, 41 pieces of material potentially presenting an explosive hazard (MPPEH) were discovered in the removal area. MPPEH is an interim designation for any component of ordnance or explosive munitions that may have come into contact with energetic material (i.e., high explosives or propellant) and could have energetic residue remaining. This interim designation applies to items for which the presence or absence of energetic residue cannot be immediately verified by visual inspection. Following verification and documentation that MPPEH does not present an explosive hazard, as performed by two competent unexploded ordnance (UXO) technicians, such items are referred to as material documented as safe (MDAS). MPPEH encountered in the removal area primarily included expended cartridge casings of various calibers and protective caps, but also included an empty 5-inch practice projectile and a 3-pound practice bomb (TtECI, 2010). Of the 41 MPPEH items discovered in the removal area, 20 items were verified to not present an explosive hazard and were reclassified as MDAS. All MDAS were properly inspected, transported, demilitarized (i.e., crushed, shredded, or cut to no longer resemble military munitions), and shipped off site as scrap metal (TtECI, 2010). The remaining 21 MPPEH items appeared to have been subject to previous demilitarization actions and could not be completely inspected by UXO technicians for possible explosive hazards. Although the type, age, and condition of these 21 MPPEH items did not suggest a high potential for residual energetic material, the Navy, as a precautionary measure, properly handled, transported, and disposed of these items as either material documented as an explosive hazard (MDEH) (20 items consisting of expended cartridge casings of various calibers) or munitions and explosives of concern (MEC) (1 item. 3-pound practice bomb) (TtECI, 2010). All MDAS, MDEH, and MEC were also radiologically screened to verify that no radiological contamination was present.

Post-excavation soil samples were collected and analyzed for PCBs and petroleum hydrocarbons. In addition to the PCB and petroleum hydrocarbons analyses, post-excavation sidewall samples were also analyzed for organochlorine pesticides, metals, and, if petroleum hydrocarbons were present, PAHs. Additional analysis for VOCs, SVOCs, and organochlorine pesticides were performed for bottom samples

collected in the vicinity of the buried drums. The reported concentrations of PCBs and petroleum hydrocarbons in these samples warrant further analysis in this RI/FS Report. Analytical results for post-excavation samples are presented in Sections 4.2.4 and 4.4.2 and in Section 7 (HHRA) of this RI/FS Report. Additional post-excavation soil samples were collected and analyzed for cesium-137, radium-226, and strontium-90 (the ROCs identified in the HRA [NAVSEA, 2004]). Analytical results for all post-excavation soil samples met the specified radiological remedial objectives.

3.9. ONGOING MONITORING PROGRAMS

The results of the ongoing monitoring performed at Parcel E-2 are summarized in the following documents:

- Groundwater Monitoring Reports, Parcels C, D, E, and E-2 (Kleinfelder, Inc. and CDM Federal Programs Corporation, 2005a through 2005c and 2006a through 2006c; CE2-Kleinfelder Joint Venture, 2006, 2007a, 2007b, 2007d through 2007f, 2008a, and 2008d, 2009b, 2009d, 2010a, and 2010b)
- Gas Monitoring Reports (ITSI, 2004a through 2004g, 2005a through 2005n, 2006a through 2006g, 2006i through 2006m, 2007a through 2007c, 2007e through 2007g, 2008a through 2008c, 2008c, 2009a through 2009d, and 2010a through 2010c)
- Annual Reports for Stormwater Discharge Management (TtEMI, 2004d; AFA Construction Group [AFA] and Eagle Environmental Construction [EEC], 2005a; EEC, 2006 and 2007; and MARRS and MACTEC, 2008a, 2009a, and 2010)
- Annual Reports for Landfill Cap Operations and Maintenance (ITSI, 2006h, 2007d, 2008d, 2010d, and 2010e)

The following subsections are brief summaries of the monitoring programs and the current findings from each of the documents listed above. Unless otherwise indicated, all information included in each summary was derived from the corresponding documents listed above.

3.9.1. Groundwater Monitoring (2004 to present)

In June 2004, the Navy began regular monitoring at Parcel E-2 under the BGMP (TtEMI, 2004c). Since June 2004, the BGMP has been updated several times to optimize the monitoring network within Parcel E-2 and other HPS parcels (CE2-Kleinfelder Joint Venture, 2007c, 2007g, 2008b, 2008c, and 2009c). The current groundwater monitoring locations in and adjacent to Parcel E-2 are shown on Figure 3-7. Samples are collected from 13 A-aquifer wells and 6 B-aquifer wells to monitor chemicals that previously had been detected and to establish a baseline for other chemicals and water quality parameters that might be related to the landfill. Analyses at these wells, which are located within 300 feet of the Landfill Area, were selected based on 27 CCR requirements and an evaluation of previously detected chemicals. In addition, samples are collected from four A-aquifer wells in the southern end of the Panhandle Area (wells IR01MWI-7, IR01MW62A, IR01MW63A, and IR01MW65A) to monitor

chemicals previously detected at concentrations that may pose a potential risk to human health and the environment (CE2-Kleinfelder Joint Venture, 2009c).

Eleven rounds of validated groundwater monitoring data (through October 2007, when the data set was "locked" for the purposes of performing the nature and extent evaluation and risk assessments) were available for consideration in the Draft Final RI/FS Report. The groundwater monitoring data are evaluated, in conjunction with data from the RI and GDGIs (see Section 5).

In addition to the regular groundwater monitoring, groundwater flow patterns in the A-aquifer are evaluated by the development of groundwater elevation maps as part of the BGMP. A-aquifer groundwater elevation measurements are collected using a methodology designed to reduce the significance of tidal effects on the general definition of the potentiometric surface (CE2-Kleinfelder Joint Venture, 2009c).

3.9.2. Gas Monitoring and Control (2004 to present)

Landfill gas is being monitored on a regular basis under the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c) to verify that hazardous levels of landfill gas are not migrating beyond the fence line of the landfill and onto the UCSF compound. The monitoring locations include 32 GMPs, 5 passive vents, 27 groundwater wells and piezometers (used for gas monitoring), and subterranean structure locations both on Parcel E-2 and within the UCSF compound (see Figure 3-6). The gas monitoring reports present results of the landfill gas monitoring, the status of the gas extraction system (active operation and passive operation), maintenance observations on the gas control system, and meteorological data. Several subsurface utilities associated with the GES were removed in summer 2005 during implementation of the removal action at the PCB Hot Spot Area and were not available for monitoring.

The ongoing landfill gas control program, based on the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c), includes notification and response procedures in the event that hazardous levels of landfill gas are detected beyond the fence line of the landfill and beneath the UCSF compound. During monitoring performed since January 2004, all concentrations of NMOCs were below action levels and regulatory requirements identified in the Interim Landfill Gas Monitoring and Control Plan. Methane concentrations have, in nearly all cases, remained below specified action levels; however, methane concentrations exceeding specified action levels were detected occasionally. In these instances, the Navy notified the appropriate parties and implemented response measures to control methane at the fence line of the landfill and at the GMPs located on the UCSF property.

3.9.3. Stormwater Discharge Management (2003 to present)

Stormwater discharge in Parcel E-2 is managed in accordance with a SWDMP that was originally published in 2003 (TtEMI, 2003c). The 2003 SWDMP has been revised several times to reflect current site conditions, clarify or change the discharge locations, and update the list of BMPs (TtEMI, 2005a; AFA and EEC, 2005b). In 2007, the Parcel E-2 SWDMP was integrated with the basewide SWDMP to streamline the stormwater program (MARRS and MACTEC, 2007). The Parcel E-2 stormwater program involves quarterly visual observations of non-stormwater discharge, sampling and analysis of stormwater, monthly visual observations of stormwater discharge, and an annual comprehensive site compliance evaluation (MARRS and MACTEC, 2009b). Stormwater monitoring locations are shown on Figure 2-22 and are discussed in more detail in Section 2.3. Figure 2-22 also depicts BMPs that are used at Parcel E-2 to control stormwater discharges.

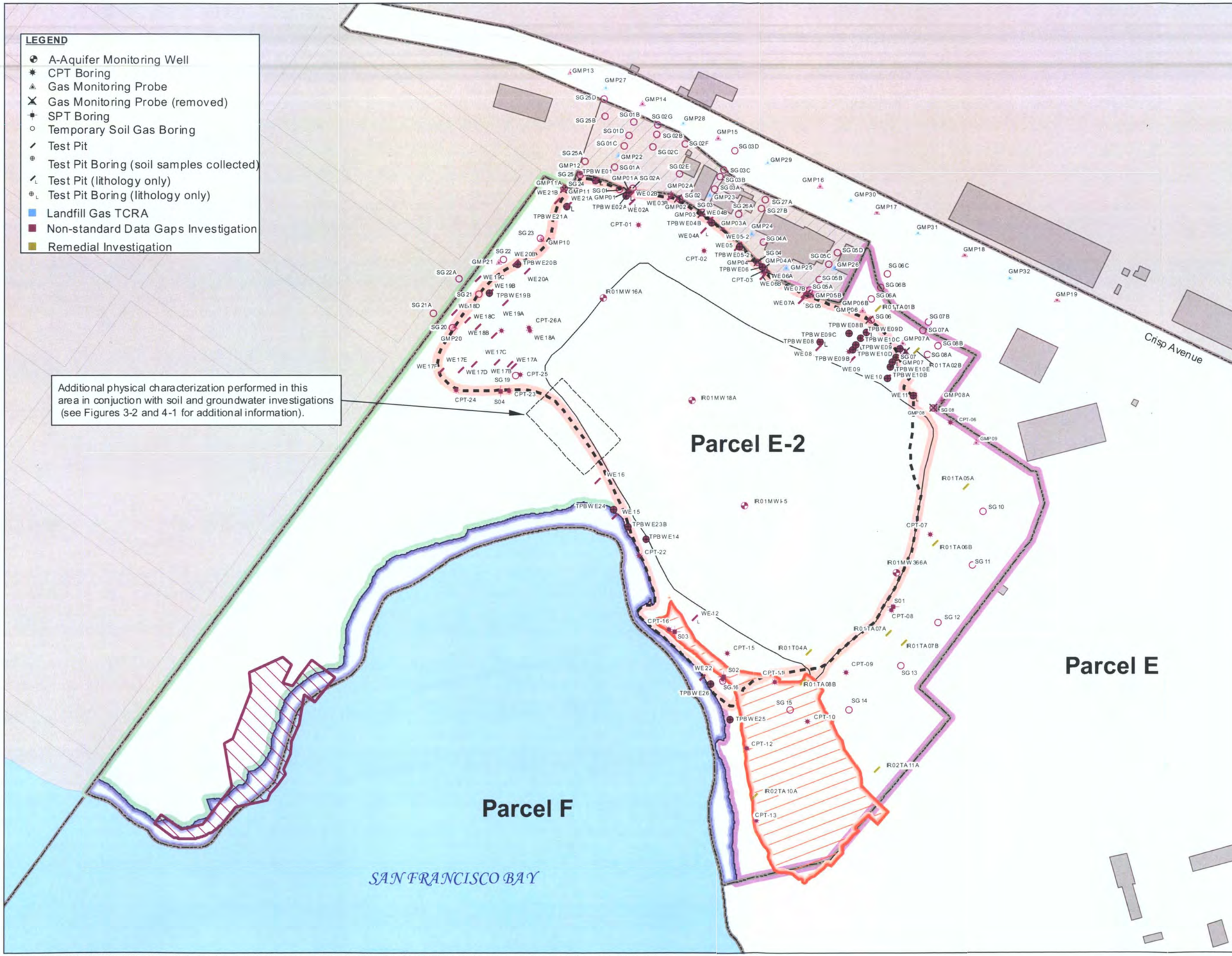
Results of the Parcel E-2 stormwater program are summarized on an annual basis (TtEMI, 2004d; AFA and EEC, 2005a; EEC, 2006 and 2007; MARRS and MACTEC, 2008a, 2009a, and 2010). Results to date indicate no incidents of noncompliance at Parcel E-2, except in isolated locations where BMPs require modification to better control erosion and sediment transport from neighboring properties.

3.9.4. Landfill Cap Inspection and Maintenance (2003 to present)

Inspection and maintenance of the interim landfill cap is performed in accordance with a site-specific O&M Plan (TtEMI, 2003b). The O&M Plan addresses and provides guidance for inspecting and reporting activities that are required to ensure the integrity of the landfill cap. In addition, the SWDMP contains requirements that facilitate and support implementation of the O&M Plan. Also included in the O&M Plan are emergency response procedures, which are to be followed in the event of flood, major storm event, earthquake, or fire.

Operations associated with the closed landfill include (1) an irrigation system to maintain the vegetative cover and (2) mowing of the vegetative cover on and adjacent to the cap to reduce potential fire hazards and prevent the growth of large shrubs and trees whose root structure could penetrate the cap. The irrigation system, along with other components of the interim cap, is inspected on a quarterly basis to ensure that it is functioning properly and providing adequate water to the vegetative cover. Inspection and mowing of the vegetative cover is performed twice per year. Results of the inspection and maintenance activities are summarized on an annual basis (ITSI, 2006h, 2007d, 2008d, 2010d, and 2010e). Results to date confirm that the landfill cap is being properly maintained in accordance with the site-specific O&M Plan (TtEMI, 2003b).

Figures



Road
Gravel Road
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property
Estimate of Solid Waste Extent

Removal Actions

Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]

Notes:

Figure depicts sample locations associated with investigations of physical characteristics of Landfill Area. See Figure 3-2 for soil and groundwater sample locations.

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

CPT = Cone Penetrometer Test
PCB = polychlorinated biphenyl
SPT = Standard Penetrometer Test
TCRA = Time-Critical Removal Action
UCSF = University of California, San Francisco

N

300 0 300

Scale in Feet

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FIGURE 3-1

LANDFILL CHARACTERIZATION SAMPLING LOCATIONS

Remedial Investigation/Feasibility Study for Parcel E-2

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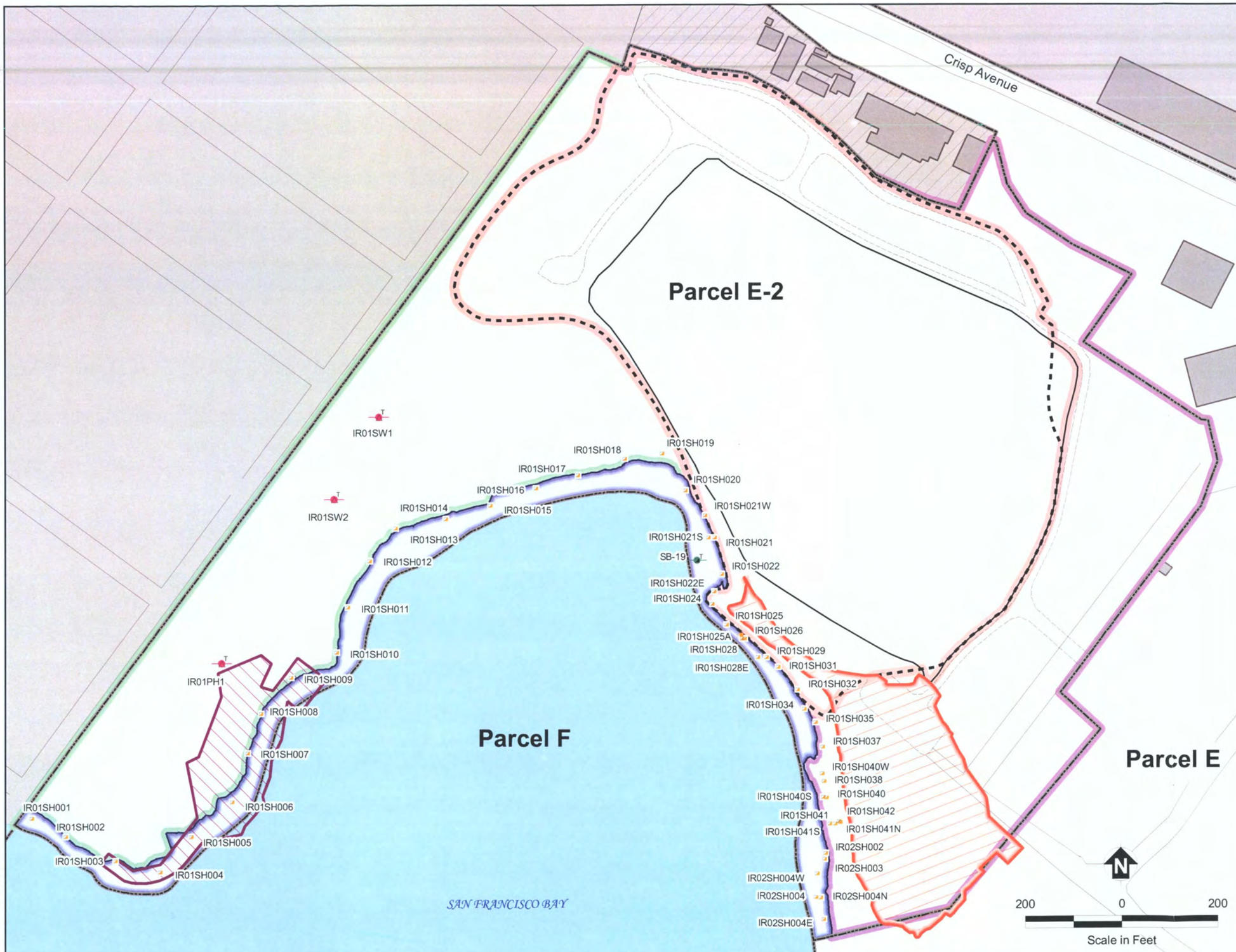
PARTIALLY SCANNED OVERSIZE ITEM(S)

See document #_2379126
for partially scanned image(s)

Figure 3-2
(1 of 2)

For complete hardcopy version of the oversize document
contact the Region IX Superfund Records Center



Shoreline Sediment Sample
Surface Sediment Sample (co-located with Tissue Sample)
Surface Soil Sample (co-located with Tissue Sample)
Tissue Sample
ERA Validation Study
Parcel F Validation Study
Standard Data Gaps Investigation
Road
Gravel Road
Estimate of Solid Waste Extent
Interim Landfill Cap Extent
Parcel Boundary
Shoreline Area
Landfill Area
East Adjacent Area
Panhandle Area
Building
UCSF Compound
San Francisco Bay
Non-Navy Property

Removal Actions

Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

ERA = Ecological Risk Assessment
PCB = polychlorinated biphenyl
UCSF = University of California, San Francisco

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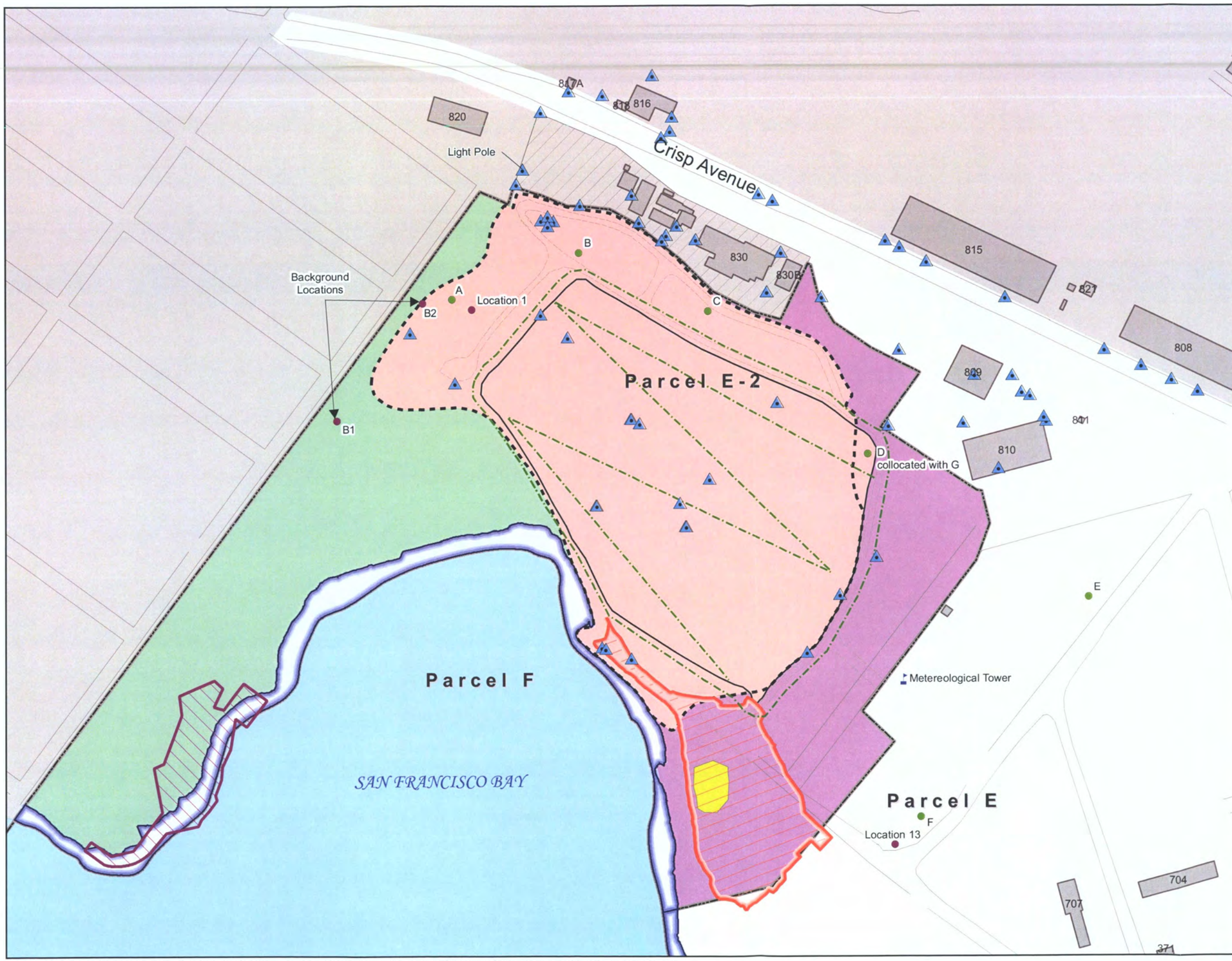
FIGURE 3-3

ECOLOGICAL SAMPLING LOCATIONS

Remedial Investigation/Feasibility Study for Parcel E-2

N:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Section 3\Current Figures\3-3 Ecological Sampling Locations.mxd



Meteorological Tower

Phase II/III Air Monitoring Locations

Air Monitoring Location During Landfill Cap Construction

Former Sandblast Waste Pile (1994) Present During Phase II Monitoring Investigation

Outdoor Air Survey Location (during gas characterization study)

Transect Location (during gas characterization study)

Parcel Boundary

Estimate of Solid Waste Extent

Interim Landfill Cap Extent

Non-Navy Property

UCSF Compound

Landfill Area

East Adjacent Area

Panhandle Area

Shoreline Area

Building

Road

Gravel Road

Removal Actions

Metal Slag Area (2007 excavation limit)[a]

PCB Hot Spot Area (2007 excavation limit)[a]

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

PCB = polychlorinated biphenyl
UCSF = University of California, San Francisco

250 0 250

Scale in Feet

ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

ERRG

Hunters Point Shipyard, San Francisco, California

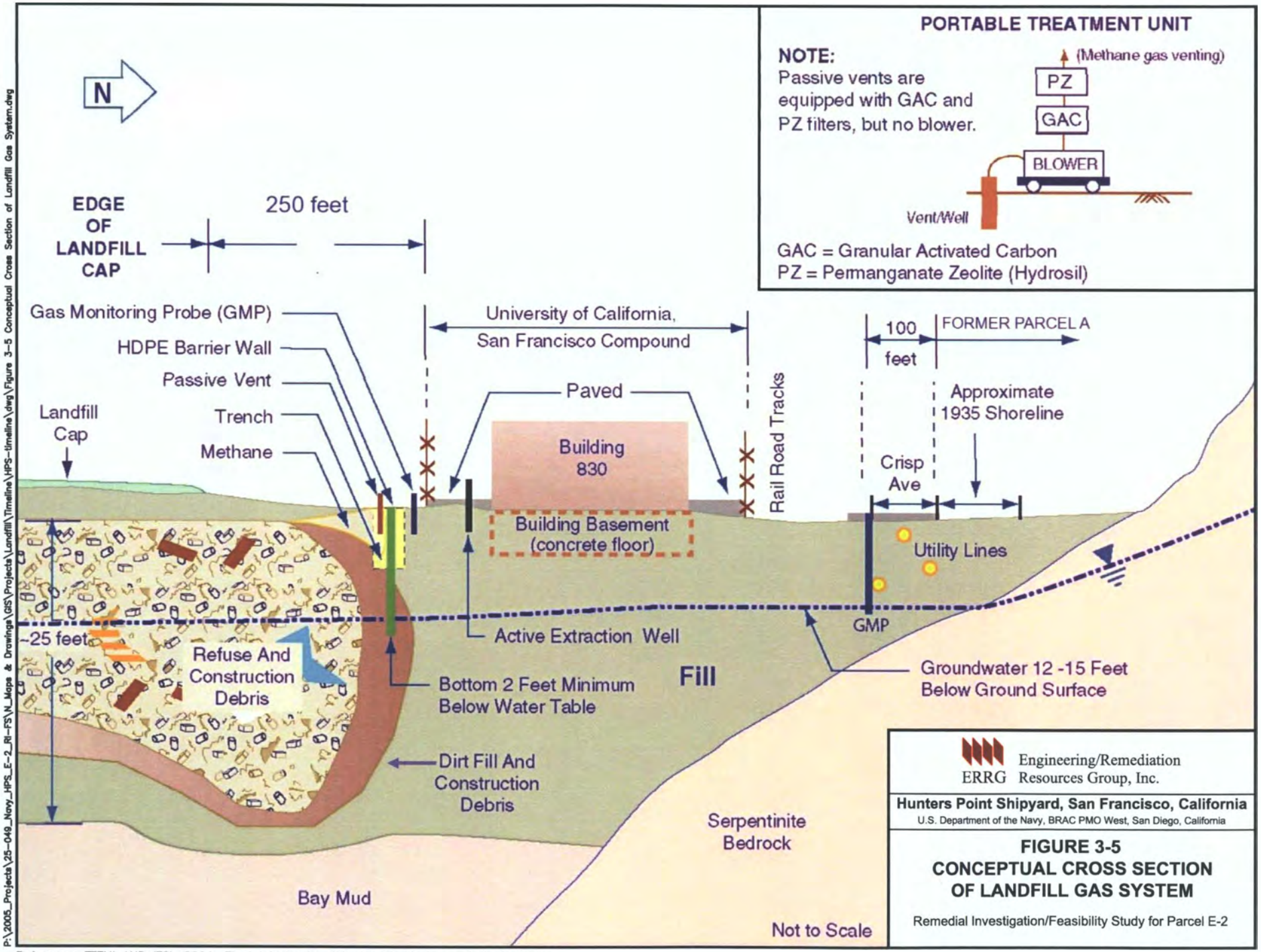
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 3-4

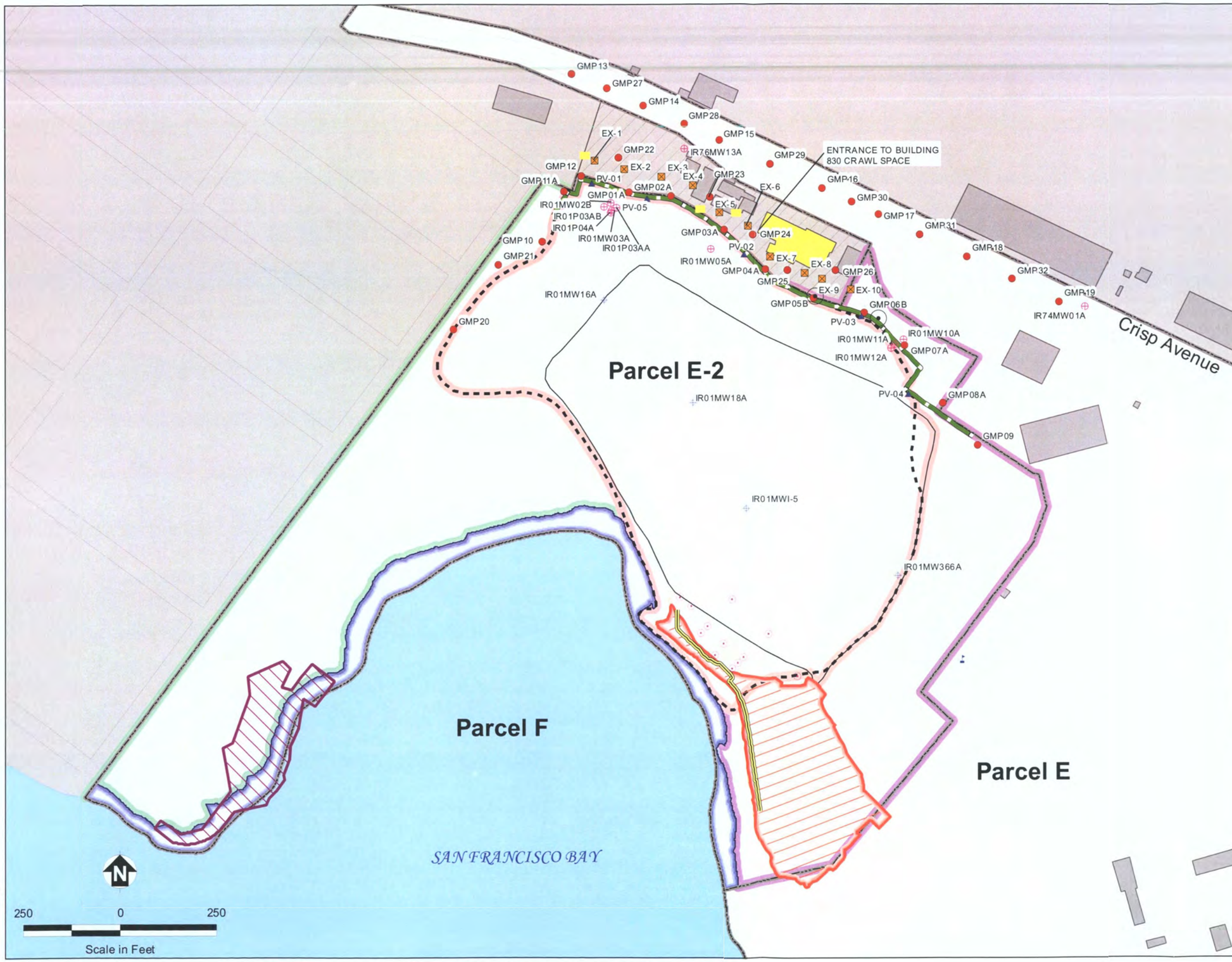
OUTDOOR AIR MONITORING LOCATIONS

Remedial Investigation/Feasibility Study for Parcel E-2

2005-12-16 P:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Landfill_RI\Section 3\Current Figures\3-4 Ambient Air Monitoring Locations.mxd



Reference: TTEMI AND ITSI, 2004. Final Interim Landfill Gas Monitoring and Control Plan



- Gas Monitoring Probe
- Extraction Well
- Passive Vent
- Groundwater Monitoring Well Under Landfill Gas Monitoring Program
- Groundwater Monitoring Well for Water Level Measurements
- Groundwater Extraction System Well/Vault
- Groundwater Extraction System Piezometer
- Meteorological Station
- Catch Basin Discharge Point
- Surface Location or Occupied Structure
- Barrier Wall
- Sheet Pile Wall
- Estimate of Solid Waste Extent
- Road
- Gravel Road
- Interim Landfill Cap Extent
- Parcel Boundary
- Shoreline Area
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Building
- UCSF Compound
- San Francisco Bay
- Non-Navy Property

Removal Actions

- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

PCB = polychlorinated biphenyl
UCSF = University of California, San Francisco

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FIGURE 3-6

LANDFILL GAS MONITORING SYSTEM LOCATIONS

Remedial Investigation/Feasibility Study for Parcel E-2

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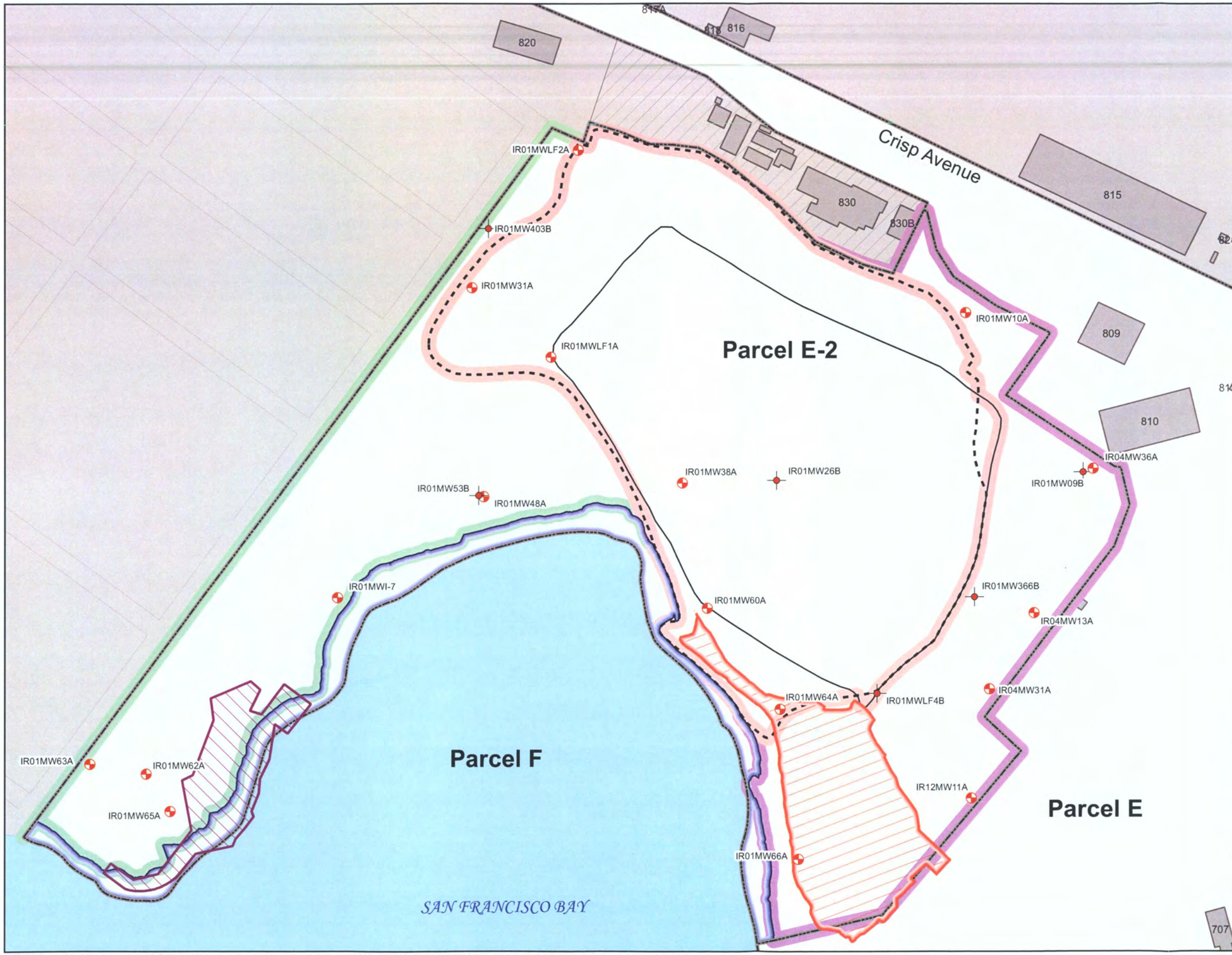

Basewide Groundwater Monitoring Program (2010)

- A-Aquifer Monitoring Well
- B-Aquifer Monitoring Well
- Road
- Gravel Road
- Estimate of Solid Waste Extent
- Interim Landfill Cap Extent
- Parcel Boundary
- Shoreline Area
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Building
- UCSF Compound
- San Francisco Bay
- Non-Navy Property

Removal Actions

- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

PCB = polychlorinated biphenyl
UCSF = University of California, San Francisco

N

250 0 250

Scale in Feet

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

Hunters Point Shipyard, San Francisco, California
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FIGURE 3-7

GROUNDWATER MONITORING NETWORK FOR PARCEL E-2 LANDFILL

Remedial Investigation/Feasibility Study for Parcel E-2

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Tables

Table 3-1. Summary of Characterization Activities
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Tasks	Number of Borings, Wells, Test Pits, or Samples	Characterization			
		Landfill	Soil	Groundwater	Aquifer
Remedial Investigation					
Soil Borings [a]	66	X	X		
Test Pits	10	X	X		
Soil Samples [b]	585		X		
Groundwater Monitoring Wells [c]	34			X	
Surface Soil Samples	18		X		
Groundwater Samples [d]	187			X	
Piezometers	4				X
Oil Samples	1	X			
Data Gaps Investigations, Landfill Compliance Monitoring, and Removal Actions (through March 2008)					
Soil Borings	58		X		
Test Pits	30	X	X		
Groundwater Monitoring Wells	8			X	
Temporary Wells	61			X	
Piezometers	7				X
Soil Samples [e]	236		X		
Surface Soil Samples	0		X		
Post-Excavation Soil Samples	274		X		
Groundwater Samples	567			X	

Additional Activities	
Geophysical Survey (RI)	Ecological Assessments
Soil Gas Surveys (RI and NDGI)	Shoreline Sediment Characterization (SDGI)
Ambient Air Surveys (RI and NDGI)	Wetland Delineation/Assessment (RI and NDGI)
Landfill Gas Monitoring (NDGI)	Aquifer Testing (RI)
Liquefaction Potential Study (NDGI)	Tidal Influence Studies (RI and GDGI)
Radiological Assessments	Stormwater Management and Monitoring

Notes:

a Includes 46 soil borings and 20 monitoring well borings

b Includes 374 samples from soil borings, 175 samples from monitoring well borings, and 11 samples from test pits

c Includes 28 A-aquifer monitoring wells and 6 B-aquifer monitoring wells

d Includes 171 samples collected from monitoring wells (147 from A-aquifer monitoring wells and 24 from B-aquifer monitoring wells), 1 sample from a Hydropunch™ boring, and 15 grab groundwater samples collected from open boreholes

e Includes 139 samples from soil borings and 55 samples from test pits, 21 from metal slag samples, and 21 from the shoreline

GDGI groundwater data gaps investigation

NDGI nonstandard data gaps investigation

RI remedial investigation

SDGI standard data gaps investigation

Table 3-2. Chronology of Landfill Characterization Activities
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Investigation Phase	Date	Sample Type(s)	Sample ID(s)	General Location	Sampling Purpose
RI, Phase I, Reconnaissance Activities	October 1988	Em Transects	NA	▪ Boundaries of IR Site 01/21	▪ Locate boundaries and areas of differing waste composition
RI, Phase I, Reconnaissance Activities	October 1988	GPR	NA	▪ Northeast boundary of IR Site 01/21	▪ Delineate the northeast boundary due to inconclusive Em data
RI, Phase I, Reconnaissance Activities	October 1988	Test Pits	IR01T001, IR01T02A, IR01T02B, IR01T03A, IR01T03B, IR01T04A*, IR01T04B	▪ Presumed landfill boundaries (based on Em and GPR results)	▪ Confirm or deny the boundaries of the landfill
RI, Phase III, Contingency Sampling	March 1992	Piezometer Oil Sample	IR01P03A	▪ North corner of IR Site 01/21	▪ Identify hazardous substances potentially in groundwater
NDGI, Landfill Gas Characterization	April 2002	Temporary Soil Gas Probes	SG01 through SG27 (including step-outs)	▪ Adjacent to landfill	▪ Delineate and characterize landfill gas
NDGI, Landfill Gas Characterization	April to November 2002	GMPs	GMP01 through GMP21	▪ Northern portion of IR Site 01/21 ▪ UCSF Compound ▪ Crisp Avenue	▪ Evaluate potential landfill gas migration ▪ Evaluate performance of landfill gas removal action ▪ Monitor landfill gas migration

Table 3-2. Chronology of Landfill Characterization Activities *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Investigation Phase	Date	Sample Type(s)	Sample ID(s)	General Location	Sampling Purpose
NDGI, Landfill Lateral Extent Evaluation	March to April 2002	Test Pits/Test Pit Borings	WE01 through WE22 (including step-outs)	▪ Adjacent to landfill	▪ Determine the edge of the continuous physical waste in the landfill
NDGI, Landfill Liquefaction Potential Evaluation	April 2002	CPT/SPT Borings	CPT-01 through CPT-26, S01 through S05	▪ Adjacent to landfill	▪ Evaluate the potential for subsurface layers, in the vicinity of the landfill to liquefy during an earthquake

Notes:

*	Sample location within Landfill Area
CPT	cone penetrometer test
Em	electromagnetic
GMP	gas monitoring probe
GPR	ground-penetrating radar
IR	Installation Restoration
NA	not applicable
NDGI	Nonstandard data gaps investigation
RI	Remedial Investigation
SPT	standard penetrometer test
UCSF	University of California, San Francisco

Table 3-3. Chronology of Soil Characterization Activities
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Investigation Phase	Date	Sample Type(s)	Sample ID(s)	General Location	Sampling Purpose
RI, Phase I, Reconnaissance Activities	November to December 1988	Soil Borings	IR01B001, IR01B008, IR01B025, IR01B036, IR01B046*, IR01B052	▪ Shoreline ▪ Central portion of the site ▪ North corner of IR Site 01/21	▪ Subsurface stratigraphy data ▪ Depth to bedrock
RI, Phase I, Reconnaissance Activities	May to June 1989	Phase I Soil Gas Survey	100-foot grid with 92 stations	▪ Throughout IR Site 01/21	▪ Qualitative indication of the distribution of VOCs in soil
RI, Phase II, Primary Sampling Activities	October to November 1990	Soil Borings / Monitoring Well Borings	IR01B01A*, IR01B023*, IR01B032, IR01B34, IR01B35, IR01B039*, IR01B040*, IR01B041*, IR01B048A, IR01B049, IR01B050, IR01B055, IR01B56, IR01B060, IR01B061, IR01B064, IR01MW42A*, IR01MW48A	▪ Within and surrounding the reported landfill boundary	▪ Investigate the nature and extent of hazardous substances present
RI, Phase II, Primary Sampling Activities	December 1990	Surface Soil Samples	IR01SS082, IR01SS083, IR01SS084	▪ Western perimeter of IR Site 01/21	▪ Characterize nature and extent of hazardous substances in surface soil and their potential impact on air quality

Table 3-3. Chronology of Soil Characterization Activities *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Investigation Phase	Date	Sample Type(s)	Sample ID(s)	General Location	Sampling Purpose
RI, Phase II, Primary Sampling Activities	March to April 1991	Soil Borings / Monitoring Well Borings	IR01B003A*, IR01B004*, IR01B005A*, IR01B031A*, IR01MW02B*, IR01MW03A*, IR01MW07A, IR01MW26B*, IR01MW38A*, IR01MW43A*, IR01MW44A, IR01MW53B, IR01MW58A	▪ Northern perimeter of the site ▪ Shoreline of IR Site 01/21	▪ Investigate the nature and extent of hazardous substances at IR Site 01/21
RI, Phase II, Primary Sampling Activities	May to June 1991	Test Pits	IR01TA01B, IR01TA02B, IR01TA05A, IR01TA05B, IR01TA07A, IR01TA07D, IR01TA08A, IR01TA08B, IR02TA09A, IR02TA09B, IR02TA10A, IR02TA10B	▪ Eastern perimeter of IR Site 01/21 and Parcel E-2	▪ Estimate the boundaries of the landfill ▪ Delineate an area of sandblast waste deposits
RI, Phase III, Contingency Sampling Activities	December 1991 to January 1992	Soil Borings / Monitoring Well Borings	IR02B249, IR01MW17B*, IR01MW47B, IR01MW62A, IR01MW63A	▪ North portion of IR Site 01/21 ▪ Southeast corner of IR Site 01/21 near the shoreline ▪ Southwest corner of Parcel E-2 ▪ In the vicinity of station IR01B061 ▪ Southwest corner of the site near the shoreline	▪ Evaluate the nature and extent of hazardous substances at IR Site 01/21 ▪ Evaluate the nature and extent of hazardous substances north of Triple A Site 14 (soil boring initially drilled for investigation of IR Site 02, now within boundary of IR Site 01/21)

Table 3-3. Chronology of Soil Characterization Activities *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Investigation Phase	Date	Sample Type(s)	Sample ID(s)	General Location	Sampling Purpose
RI, Phase III, Contingency Sampling Activities	April to May 1992	Soil Borings / Monitoring Well Borings	IR01MW05A*, IR01MW16A*, IR01MW18A*, IR01MW31A,* IR01B006*, IR01B011*, IR01B012, IR01B013*, IR01B015, IR01B018G*, IR01B019*, IR01B021*, IR01B021A*, IR01B024*, IR01B028, IR01B029*, IR01B030*, IR01B033, IR01B045	▪ Throughout Parcel E-2 ▪ Vicinities of IR01B023, IR01B040, IR01B041, IR01B035, IR01B032	▪ Characterize Parcel E-2 ▪ Resample to replace unusable analytical data
RI, Phase III, Contingency Sampling Activities	June 1992	Soil Borings	IR01B273, IR01B274, IR01B275*, IR01B364, IR01B365	▪ Vicinities of IR01B055, IR01B049, IR01B050, IR01B040	▪ Resample to replace unusable analytical data
RI, Phase III, Contingency Sampling Activities	June 1992	Surface Soil Samples	IR01SS351, IR01SS353, IR01SS366*	▪ Vicinities of IR01SS351, IR01SS353, IR01SS366	▪ Resample to replace unusable analytical data
RI, Supplemental Sampling Activities	October 1995	Monitoring Well Boring	IR01MW367A	▪ East margin of Parcel E-2	▪ Characterize the nature and extent of hazardous substances
RI, Supplemental Sampling Activities	November 1995	Surface Soil Samples	IR72SS18, IR72SS19, IR72SS20, IR72SS24	▪ Northeast corner of Parcel E-2	▪ Assess the content of metals in shallow soil ▪ Evaluate hazardous substances in shallow soils in stained areas
RI, Supplemental Sampling Activities	October 1995 to February 1996	Soil Borings	IR72B034, IR72B035, IR72B039	▪ Northeast corner of Parcel E-2	▪ Evaluate possible hazardous substances in soil at a lumber and motor storage area
RI, Supplemental Sampling Activities	June 1996	Soil Boring	IR76B002	▪ Northeast corner of Parcel E-2	▪ Investigate the extent of the landfill in the vicinity of Building 830

Table 3-3. Chronology of Soil Characterization Activities *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Investigation Phase	Date	Sample Type(s)	Sample ID(s)	General Location	Sampling Purpose
NDGI, Landfill Lateral Extent Evaluation	March and September 2002	Test Pits	WE01, WE02B, WE03B, WE04B, WE05, WE06A, WE06B, WE07B, WE08, WE09, WE10, WE15, WE16, WE17A, WE17B, WE17C, WE17D, WE17E, WE17F, WE18A, WE18B, WE18C, WE18D, WE19A, WE19B, WE19C, WE20A, WE20B, WE21A, WE21B	▪ Around landfill perimeter	▪ To determine the nature of chemicals in soil in the vicinity of the landfill
SDGI, Shoreline Soil Sampling	September 2002 to February 2003	Surface Samples	IR01SH023, IR01SH027, IR01SH030, IR01SH033, IR01SH036, IR01SH039, IR02SH001	▪ Along bayward side of sheet-pile wall	▪ Characterize the landfill and shoreline interface
SDGI, Onshore Soil Sampling	September 2002 to February 2003	Soil Borings	IR01B366 through IR01B399, IR02B402, IR02B404, IR02B409, IR02B434, IR02B435, IR02B437, IR02B438, IR02B449, IR02B452, IR02B470, IR02B512, IR02B515, IR02B517, IR02B526, IR12B037 through IR12B042	▪ Throughout Parcel E-2 (in areas adjacent to landfill) ▪ Portions of adjacent IR Sites 02 and 12	▪ Bound known source area or single-point location ▪ Bound potential source identified in aerial photographs

Notes:

*	Sample location within Landfill Area
IR	Installation Restoration
NDGI	nonstandard data gaps investigation
RI	Remedial Investigation
SDGI	standard data gaps investigation
VOCs	volatile organic compounds

Table 3-4. Chronology of Groundwater Characterization Activities
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Investigation Phase	Date	Sample Type(s)	Sample ID(s)	General Location	Sampling Purpose
Confirmation Study Verification Step	September 1986	Monitoring Well Installation	IR01MWI-1, IR01MWI-2, IR01MWI-3, IR01MWI-4, IR01MWI-5, IR01MWI-6, IR01MWI-7, IR01MWI-8, IR01MWI-9	▪ Throughout IR Site 01/21	▪ Confirmation study and verification setup
RI, Phase II, Primary Sampling Activities	October 1990	Monitoring Well Installation	IR01MW42A*, IR01MW48A	▪ East perimeter of Parcel E-2 ▪ Central portion of Parcel E-2 near the shoreline	▪ Calculate hydraulic gradients ▪ Estimate the nature and extent of hazardous substances in the A-aquifer
RI, Phase II, Primary Sampling Activities	October to November 1990	Grab Groundwater Samples[1]	IR01B039*, IR01B050, IR01B061, IR01B064	▪ Throughout IR Site 01/21	▪ Assess groundwater quality in the A-aquifer ▪ Locate future monitoring wells
RI, Phase II, Primary Sampling Activities	March to April 1991	Monitoring Well Installation	IR01MW02B*, IR01MW03A*, IR01MW07A, IR01MW26B*, IR01MW38A*, IR01MW43A*, IR01MW44A, IR01MW53B, IR01MW58A	▪ North perimeter of Parcel E-2 ▪ Shoreline of IR Site 01/21	▪ Calculate hydraulic gradients ▪ Evaluate the nature and extent of hazardous substances in the A-aquifer ▪ Monitor B-aquifer water quality
RI, Phase III, Contingency Sampling Activities	December 1991 to January 1992	Monitoring Well Installation	IR01MW17B*, IR01MW47B, IR01MW62A, IR01MW63A	▪ North portion of Parcel E-2 ▪ Southeast corner of Parcel E-2 near the shoreline ▪ Southwest corner of Parcel E-2 near the shoreline	▪ Evaluate the nature and extent of hazardous substances in the A-aquifer ▪ Evaluate groundwater flow from the west corner of the site

Table 3-4. Chronology of Groundwater Characterization Activities *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Investigation Phase	Date	Sample Type(s)	Sample ID(s)	General Location	Sampling Purpose
RI, Phase III, Contingency Sampling Activities	April to May 1992	Monitoring Well Installation	IR01MW05A*, IR01MW16A*, IR01MW18A*, IR01MW31A*	▪ North portion of IR Site 01/21 ▪ Central portion of IR Site 01/21	▪ Evaluate the nature and extent of hazardous substances in the A-aquifer ▪ Evaluate groundwater flow from the northwest corner of the site
RI, Phase III, Contingency Sampling Activities	April to June 1992	Grab Groundwater Samples[1]	IR01B011*, IR01B012*, IR01B021*, IR01B030*, IR01B274, IR01B275*	▪ Throughout IR Site 01/21	▪ Assess groundwater quality in the A-aquifer ▪ Locate future monitoring wells
RI, Supplemental Sampling Activities	October 1995	Monitoring Well Installation	IR01MW367A	▪ East perimeter of Parcel E-2	▪ Better characterize the nature and extent of hazardous substances in the A-aquifer
RI, Supplemental Sampling Activities	June 1996	Monitoring Well Installation and Hydropunch Groundwater Sample[1]	IR01MW400A, IR01MW401A, IR01MW402A, IR01MW403A, IR76B002	▪ West perimeter of the site ▪ Northeast corner of IR Site 01/21	▪ Measure the groundwater gradient along the western boundary ▪ Assess groundwater quality
Groundwater Data Gaps Investigation	October 2002	Monitoring Well Installation	IR01MW10A, IR01MW11A, and IR01MW12A	▪ Northeast corner of IR Site 01/21	▪ Measure groundwater levels and water quality adjacent to landfill gas barrier
Groundwater Data Gaps Investigation	October 2002	Piezometer Installation	IR01P04A	▪ Northeast corner of IR Site 01/21	▪ Measure groundwater levels adjacent to landfill gas barrier (replacement for decommissioned IR01P03A)
Groundwater Monitoring Program	June 2004	Monitoring Well Installation	IR01MW366B, IR01MW403B, IR01MWLF1A, IR01MWLF2A, IR01MWLF4A, and IR01MWLF4B	▪ Adjacent to landfill area	▪ Supplement monitoring well network (per 27 CCR)

Table 3-4. Chronology of Groundwater Characterization Activities *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Investigation Phase	Date	Sample Type(s)	Sample ID(s)	General Location	Sampling Purpose
Groundwater Monitoring Program	April 2007	Monitoring Well Installation and Redevelopment	IR01MW64A* IR01MW60A*[,2]	▪ Southeast portion of landfill area	▪ To replace monitoring wells decommissioned during PCB Hot Spot removal action
Groundwater Data Gaps Investigation	March 2008	Temporary Wells	TW01 through TW61[3], PZ131F, PZ138E, PZ138F, PZ144E, PZ150D, PZ150E, and PZ161D[4]	▪ Adjacent to Parcel E-2 shoreline	▪ Evaluate chemical concentrations (dissolved metals, PCBs, petroleum hydrocarbons, and ammonia) along the Parcel E-2 shoreline

Notes:

*	Sample location within Landfill Area
1	Sample collected from soil boring
2	Existing well (from 1999 – installed as part of groundwater removal action); redevelopment prior to incorporating into monitoring network
3	Grab groundwater sample collected from temporary well
4	Grab groundwater sample collected from existing piezometer (from 1999 – installed as part of groundwater removal action)
27 CCR	Title 27 California Code of Regulations
IR	Installation Restoration
PCB	polychlorinated biphenyl
RI	Remedial Investigation

Section 4. Nature and Extent of Solid Waste, Landfill Gas, and Chemicals in Soil

The information derived from the field investigations presented in Section 3 was used to define the nature and extent of solid waste, landfill gas, and chemicals in soil at Parcel E-2. The nature and extent evaluation presented in this section will document that an adequate amount of data, of sufficient quality, exist to support the HHRA and SLERA, to provide a basis for the RAOs, and to evaluate a focused set of remedial alternatives for Parcel E-2. As discussed in Section 1.1.4, this RI/FS Report addresses CERCLA hazardous substances except for radionuclides. Radionuclides in soil and groundwater are evaluated in the radiological addendum to this RI/FS Report.

The following subsections discuss the data evaluation methods (Section 4.1) and nature and extent findings for the Landfill Area (Section 4.2), the Panhandle Area (Section 4.3), and the East Adjacent Area (Section 4.4). Section 4.5 summarizes the findings of the nature and extent evaluation at Parcel E-2 for each area discussed in Sections 4.2, 4.3, and 4.4, including the analysis of deeper soil in the Shoreline Area. The nature and extent of sediment contamination within the intertidal Shoreline Area is presented, along with a SLERA for shoreline aquatic wildlife, in the Shoreline Characterization Technical Memorandum (SulTech, 2007; Appendix G to this report). The nature and extent of groundwater contamination is presented in Section 5.

4.1. EVALUATION METHODS

This subsection presents the methods used to evaluate the nature and extent of solid waste, landfill gas, and chemicals in soil in Parcel E-2. The results are presented for each of the three main areas (Landfill Area, Panhandle Area, and East Adjacent Area) of Parcel E-2 and are presented after this section. The goal of the evaluation is to characterize the nature and extent of contamination in a manner that supports the evaluation of remedial alternatives in the FS portion of this report. The nature and extent evaluations for solid waste and landfill gas are based on the NDGI findings, as summarized in the Landfill Gas Characterization and Landfill Lateral Extent Evaluation reports (TtEMI, 2003e and 2004f, which are provided in Appendices B and C to this report). The nature and extent of chemicals in soil were evaluated based on data collected during the RI, NDGI, and SDGI.

4.1.1. Solid Waste Extent Evaluation

In general, fill material at HPS can be grouped into five solid medium types:

- Native soil
- Soil and rock fill
- Dredged sediment
- Construction and demolition debris
- Industrial and municipal-type waste

The first three types are considered inert fill material based on waste definitions in 27 CCR § 20230. Inert waste does not contain hazardous waste or soluble pollutants at concentrations exceeding applicable water quality objectives, nor does it contain significant quantities of decomposable waste (as defined in 27 CCR § 20230). Inert fill material is not expected to generate leachate that would create potential risks to human health or the environment. For purposes of delineating the extent of the solid waste at HPS, native soil, soil and rock fill, and construction debris fill are considered to be the primary land mass in which the Parcel E-2 Landfill was constructed (TtEMI, 2004f).

Industrial and municipal-type waste may pose risk to humans or wildlife in two ways. First, putrescible waste (waste that contains significant quantities of biodegradable material) may decompose and generate potentially explosive levels of methane gas. The evaluation methodology discussed in this subsection focused on identifying solid waste areas with significant quantities of putrescible waste. Second, waste materials may contain toxic levels of substances that would pose a threat to exposed humans or wildlife. To evaluate this risk, chemical data from soil samples collected throughout Parcel E-2 were evaluated, as described in Section 4.1.3.

The identification of industrial and municipal-type waste within Parcel E-2 was performed in two steps: (1) defining the extent of contiguous putrescible waste within the Landfill Area; and (2) identifying isolated locations in the Panhandle Area and East Adjacent Area that contain industrial wastes, municipal-type wastes, or construction debris. The presence of construction debris, although typically considered an inert waste, was evaluated in the Panhandle and East Adjacent Areas because certain types of construction debris (mostly wood) readily biodegrade and may be considered putrescible. The following subsections discuss the methods followed in each step in the evaluation.

4.1.1.1. Contiguous Solid Waste within Landfill Area

Field logs from the test pits and soil borings installed during the RI and NDGI were reviewed to estimate the lateral and vertical extent of industrial and municipal-type waste within the Parcel E-2 Landfill and to assess the general composition of the waste. The review was supplemented with a review of historic aerial photographs and landfill design maps.

As discussed in Section 3, the NDGI included an investigation designed to better evaluate the lateral extent of industrial and municipal-type waste (TtEMI, 2004f; Appendix B to this report). Test pits were excavated at the boundary of the Parcel E-2 Landfill (adjacent to the interim cap) and in suspected areas of buried solid waste. Step-out test pits were excavated as necessary to assess the lateral extent of the solid waste. In total, 37 test pits were excavated as part of the lateral extent evaluation. The lateral extent was established at the test pit location where the solid waste (including construction debris) was 6 inches thick or less (Appendix B). Figure 3-1 presents the locations of the test pits in conjunction with the extent of solid waste. Soil borings were drilled at the final step-out test pit locations to confirm that solid waste was not present below the bottom of the test pits. In some locations near the landfill edge, soil borings were drilled to obtain additional information on the depth and thickness of solid waste.

4.1.1.2. Isolated Solid Waste Locations in Panhandle and East Adjacent Areas

The Navy reviewed aerial photographs and logs for more than 280 test pits, soil borings, monitoring wells, and GMPs from various investigations at (and adjacent to) Parcel E-2 to identify locations outside the landfill that contain industrial wastes, municipal-type wastes, or construction debris. The presence of putrescible waste, such as wood debris, was noted during the review process. Appendix J2 contains the logs from soil borings, wells, and test pits that were used for this evaluation. Figures 3-1 and 3-2 show the locations of the test pits, soil borings, monitoring wells, and GMPs in Parcel E-2. The vertical extent of solid waste is depicted in several cross sections presented in Section 2 and described in more detail in Section 4.2.2.

Several locations within the East Adjacent Area and Panhandle Area contained nonputrescible industrial waste, such as sandblast waste, and other locations contained putrescible construction debris. Waste identified in all other locations consisted of nonputrescible construction debris (such as brick, concrete, and metal). Figure 4-1 and the table below present the locations and number of borings and test pits within each area and the results of the evaluation, including locations that contained waste, and the subset of these locations that contained sandblast waste and putrescible construction debris. The results of the evaluation are discussed in more detail in Sections 4.3.1 and 4.4.1.

Waste Type	Number of Waste Locations in Panhandle Area [a]	Number of Waste Locations in East Adjacent Area [b]
Nonputrescible construction debris	28	10
Putrescible construction debris	20	21
Sandblast waste	0	9
Sandblast waste and putrescible construction debris	0	3
Total:	**48 (87 total borings and test pits)**	**43 (117 total borings and test pits)**

Notes:

a Includes borings in the shoreline area in close proximity to the Panhandle Area.

b Includes borings in the shoreline area in close proximity to the East Adjacent Area.

Figure 4-1 also includes geophysical results from the 2008 GDGI. Specifically, electromagnetic terrain conductivity anomalies, which may be indicative of potential waste deposits, were identified in the Panhandle Area (Geophysical Study Area 3 in Figure 4-1). In addition, vertical magnetic gradient anomalies, which are indicative of metal debris, were identified throughout Geophysical Study Area 3.

Figure 4-1 identifies locations within the PCB Hot Spot Area excavation where buried drums and containers were encountered. The drums and containers were removed, characterized, and disposed of off site, and their approximate locations are shown for reference. Waste types encountered during the removal action are summarized in Sections 4.2.1 and 4.4.1.

4.1.2. Landfill Gas Evaluation

The nature and extent of landfill gas was evaluated based on data collected during past investigations, including the landfill gas characterization (TtEMI, 2003e; Appendix A to this report) conducted under the NDGI and during the landfill gas TCRA (TtEMI, 2004a). As discussed in Section 3.2, the landfill gas characterization performed during the NDGI consisted of outdoor air and building atmosphere surveys, a soil gas survey using temporary sampling locations, and installation and monitoring of GMPs. Gas monitoring was initially performed using field instruments; laboratory samples were collected if field results exceeded action levels for methane and total NMOCs (TtEMI, 2002a). The following subsections discuss the evaluation methods used to assess the nature and extent of landfill gas at Parcel E-2.

4.1.2.1. Methane

Monitoring and control of landfill gas is regulated by 27 CCR. Performance standards for controlling methane gas at closed landfills are provided in 27 CCR § 20921. Concentrations of methane gas must not exceed 1.25 percent by volume in air (25 percent of the LEL) within on-site structures, and concentrations of methane gas migrating from the landfill must not exceed 5 percent by volume in air (the LEL) at the facility property boundary or an alternative boundary approved in accordance with 27 CCR § 20925. The evaluation methods for methane data involved comparing field and laboratory data against the 27 CCR standards. The methane data collection process is described in the following subsections. The methane evaluation results are discussed in Section 4.2.3.

Outdoor Air Monitoring

In 2002, outdoor air monitoring was performed throughout the Parcel E-2 Landfill and at buildings and subterranean structures (consisting of mainly well vaults) within 300 feet of the landfill. Additional buildings outside the 300-foot perimeter were surveyed based on the finding of methane concentrations greater than the LEL in GMPs along the northern perimeter of the landfill. No methane concentrations exceeded 25 percent of the LEL within any building. The Navy also collected confirmatory gas samples within the crawlspace of Building 830 because high methane levels were detected in the subsurface adjacent to the building during the soil gas survey conducted in 2002 (Appendix A).

Air monitoring continued to be performed at various surface and subsurface locations north and south of the Parcel E-2 Landfill, including the Building 830 crawlspace, under the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c). Some subsurface structures (extraction well vaults) have been removed as part of the Navy's removal action in the PCB Hot Spot Area.

Soil Gas Survey

In 2002, a soil gas survey was performed around the perimeter of the landfill and at step-out locations to characterize the nature and horizontal extent of gas at the landfill. An initial soil boring was advanced at each location to the depth of groundwater to select the depths for soil gas sampling. Concentrations of methane and total NMOCs in soil gas were measured at a new boring immediately adjacent to (approximately 1 foot from) the initial boring. Step-out borings were advanced if concentrations of methane were detected above 25 percent of the LEL. During the initial soil gas survey, high levels of methane (above the LEL) were detected at various locations, and additional step-out locations were advanced to delineate the lateral extent of methane greater than the lower quantitation limit of the instrument (0.5 percent of the LEL) (Appendix A).

Gas Monitoring Probes

After the initial soil gas survey was completed in April 2002, 12 GMPs (GMP01 through GMP12) were installed at the boundary of the Parcel E-2 Landfill next to the fence line that separates the landfill from the UCSF compound. These GMPs were installed at locations where methane exceeded 25 percent of the LEL. These GMPs serve as the compliance GMPs under the landfill perimeter monitoring network to demonstrate that the migration of landfill gas is being controlled (through the gas control system installed during the landfill gas TCRA) below the LEL at the fence line between the landfill and the UCSF compound (TtEMI and ITSI, 2004c).

In May 2002, the Navy installed seven GMPs along Crisp Avenue (GMP13 through GMP19) to provide more data on the extent of landfill gas migration. In June 2002, the Navy installed GMP20 and GMP21 along the western boundary of the landfill, southwest of existing probe GMP10, to provide additional data about possible landfill gas migration west of the landfill, an area adjacent to non-Navy property. These GMPs were installed in areas where methane was not detected greater than the lower quantitation limit of the instrument (0.5 percent of the LEL) during the initial soil gas survey. These GMPs are also part of the landfill perimeter monitoring network to ensure that landfill gas at concentrations greater than action levels does not migrate toward structures to the west (TtEMI and ITSI, 2004c).

As part of the landfill gas TCRA (TtEMI, 2004a), five GMPs (GMP22 through GMP26) were installed within the UCSF compound to monitor the performance of the TCRA. Although these GMPs are not located on Navy property, they are included in the monitoring network to ensure that landfill gas at

concentrations greater than action levels does not migrate beneath the pavement on the UCSF compound above (TtEMI and ITSI, 2004c).

In February 2004, six additional GMPs (GMP27 through GMP32) were added in the area along Crisp Avenue to supplement seven wells installed in May 2002. These wells were installed at the request of the regulatory agencies to ensure that landfill gas is not migrating between the bottom of the utility trench and the lowest groundwater level (TtEMI and ITSI, 2004c). Although no landfill gas migration was detected along Crisp Avenue, the 13 Crisp Avenue GMPs are included in the monitoring network to ensure that landfill gas is not migrating north toward non-Navy property (former Parcel A) (TtEMI and ITSI, 2004c).

The landfill gas monitoring network was designed, in accordance with 27 CCR, to ensure that any landfill gas is not allowed to accumulate above action levels. The perimeter GMPs are monitored on a regular basis to ensure that methane gas does not exceed 5 percent by volume at the boundary, as specified in the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c). GMPs on the UCSF compound and along Crisp Avenue act as secondary and tertiary lines of monitoring at increasing distances from the Parcel E-2 Landfill (TtEMI and ITSI, 2004c). The methane action level at all GMPs is set at 2.5 percent by volume in air to minimize the likelihood of exceeding the 27 CCR limit of 5 percent. All of the GMP locations are presented on Figure 3-6.

4.1.2.2. Nonmethane Organic Compounds

With regard to NMOCs at closed landfills, 27 CCR § 20921 states that trace gases should be controlled to prevent adverse acute and chronic exposure to toxic and cancer-causing chemicals. The evaluation methods for NMOCs involved comparing outdoor air data against the EPA Region 9 PRGs for outdoor air (EPA, 2004) and performing risk assessments on soil gas data collected from permanent GMPs. NMOC data collected from temporary soil gas probes installed during the landfill gas characterization were not evaluated, because site conditions had changed following implementation of the landfill gas TCRA.

To evaluate compliance with 27 CCR, the Navy has conducted several risk assessments to evaluate whether trace gases from the Parcel E-2 Landfill pose a potential risk to human health. The risk assessments were performed using the Johnson and Ettinger vapor intrusion model (EPA, 2003). Field data, analytical data, and risk assessment results for GMPs along Crisp Avenue (GMP13 through GMP16, GMP18, and GMP19) are presented in the Landfill Gas Characterization Report (Appendix A to this report). Field data, analytical data, and risk assessment results for GMP22 through GMP26 on the UCSF compound are presented in Appendices E, F, and G, respectively, of the Landfill Gas TCRA Closeout Report (Appendix F to this report). ELCR calculations for GMPs along Crisp Avenue, using the laboratory results, ranged from 6.4×10^{-7} to 2.0×10^{-8} for a residential exposure scenario. ELCR calculations for the GMPs on the UCSF compound ranged from 4.0×10^{-7} to 8.8×10^{-9} for an industrial

exposure scenario (TtEMI and ITSI, 2004c). These risk ranges are an order of magnitude below the NCP point of departure of 10^{-6} [40 CFR § 300.430(e)(2)(i)(A)(2); 55 Federal Register 8848 (1990)].

Field measurements for NMOCs, collected during the same time frame as the laboratory analytical data, ranged from 0 part per million by volume (ppmv) to 51 ppmv. Assuming that NMOCs remain at the same proportions in the landfill gas, the ELCR is directly proportionate to the total NMOC concentration. Thus, recognizing that a 10-fold increase in the ELCR would require a 10-fold increase in the NMOC measurements, 500 ppmv was selected as the action level for NMOCs detected at GMPs included in the monitoring network. If the concentration of total NMOCs increased from the 50-ppmv range to greater than 500 ppmv, then additional sampling and analysis for NMOCs and further evaluation of risk to human health is warranted in accordance with the interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c).

4.1.3. Soil Evaluation

Due to the quantity of soil data evaluated in this RI, the nature and extent evaluation of soil was focused to discuss chemicals that were detected at concentrations greater than the laboratory reporting limits (LRLs), exceeding outdoor levels or human health risk-based criteria developed for the RI. The development of the criteria is discussed in Section 4.1.3.2. All soil data, except for soil physically removed during interim actions, is summarized in Appendix J1 and is included in the HHRA and SLERA presented in this report.

Because the removal actions were performed concurrent with the Draft RI/FS Report, the nature and extent evaluation and risk assessments presented in this Draft Final RI/FS Report incorporate post-excavation soil samples from the removal action areas. At both the Metal Slag Area and PCB Hot Spot Area, post-excavation soil samples contained chemical concentrations that warrant further analysis in this Draft Final RI/FS Report. This analysis is presented in Sections 4.2.4, 4.3.2, and 4.4.2 of this RI/FS Report.

As discussed in Section 3, the Parcel E-2 soil data set consists of 1,113 samples analyzed for a wide variety of inorganic and organic chemicals. To facilitate review of the large data set, the evaluation was performed separately for each of the three study areas at Parcel E-2: the Landfill Area, the Panhandle Area, and the East Adjacent Area. The data set was further subdivided into three separate depth ranges (0 to 2 feet bgs, 2 to 10 feet bgs, and greater than 10 feet bgs) for consistency with the depth ranges evaluated in the HHRA.

Comprehensive data summary tables are presented in Appendix J1 by chemical category (i.e., metals, pesticides, PCBs, SVOCs, VOCs, and petroleum hydrocarbons) for each study area and depth interval. Each table presents a series of summary statistics of the data for each chemical, such as the number of samples collected; number of results that exceed the detection limit; minimum and maximum

concentrations detected; and median, mean, and standard deviation of the detected results for each chemical. In addition, each table lists all potential screening criteria and quantifies the number of results that exceeded each criterion.

4.1.3.1. Identification of Detected Chemicals and Comparison of Chemical Concentrations with Ambient Levels

All validated soil data collected during past investigations (i.e., the RI, the NDGI, and the SDGI, excluding data within the TCRA initial excavation boundaries) were first evaluated to determine which chemicals were detected at concentrations greater than laboratory method detection limits (MDLs). Statistical summary tables were prepared for each study area and depth interval. These tables summarize the detection frequency, range of MDLs, and range of detected concentrations. Metals data were compared with Hunters Point ambient levels (HPALs) (PRC, 1995a). The establishment of HPALs is discussed further in Section 4.1.3.3. The list of chemicals of potential concern (COPCs) within each study area and depth interval was refined by eliminating chemicals that were either not detected at concentrations greater than the MDL or did not exceed their established HPAL.

4.1.3.2. Soil Remedial Investigation Evaluation Criteria

Due to the large size of the soil data set and the wide range of detected chemicals, the evaluation of soil data focuses on chemicals with concentrations that contribute the greatest amount of potential risk to future site occupants. Summary tables were prepared for each study area and depth interval to identify those chemicals that are the primary contributors to the risk.

The risk-based thresholds used to identify COPCs are referred to as the Remedial Investigation Evaluation Criteria (RIEC). These criteria were selected as a conservative point of comparison that is generally consistent with the reasonably anticipated reuse of Parcel E-2 (open space) and the exposure pathways to be evaluated in the HHRA (direct exposure and inhalation). As discussed below, the soil RIEC were based on EPA Region 9 PRGs (EPA, 2004) and RWQCB environmental screening levels (ESLs) (RWQCB, 2005). These criteria were current when the data set was "locked" in January 2008 for the soil nature and extent evaluation and the HHRA. In May 2008, the RWQCB revised the ESLs (RWQCB, 2008) and, in September 2008, the EPA revised the PRGs (now referred to as regional screening levels, RSLs) (EPA, 2008). Because of the substantial effort associated with revising the soil nature and extent evaluation, the Navy compared the soil RIEC against the 2008 EPA RSLs and RWQCB ESLs. The results of this comparison revealed that, for the majority of COPCs, the soil RIEC were more conservative than the 2008 EPA RSLs and RWQCB ESLs. For COPCs with RIEC that were less conservative than either the 2008 RSLs or ESLs, the comparison determined that, with the exception of a single chemical (ethylbenzene), the difference did not affect the nature and extent evaluation because the RIEC exceedance frequency was comparable to the exceedance frequency relative to the more conservative 2008 criteria. As a result, the soil RIECs for all COPCs, except ethylbenzene, were not

revised for this Draft Final RI/FS Report. The nature and extent evaluation for ethylbenzene was updated to reflect the more conservative 2008 criteria.

The HHRA, presented in Section 7, evaluates the potential risk to humans for two future land use scenarios: open space (soil exposure from 0 to 2 feet bgs) and construction worker (soil exposure from 0 to 10 feet bgs). An evaluation relative to human health criteria is necessary to support the HHRA, particularly considering the wider range of chemicals and greater exposure depths, as compared with the SLERA. The SLERA, also presented in Section 7, evaluates the potential ecological risk to terrestrial wildlife (soil exposure from 0 to 3 feet bgs). The SLERA also presents a focused nature and extent evaluation using PSCs developed for terrestrial wildlife. Both of these risk assessments provide a separate analysis of COPCs and COPECs and, in general, are consistent with those chemicals selected for discussion in this section.

Table 4-1 presents the RIEC for each chemical. The various criteria that form the basis of the RIEC are also summarized in Table 4-1. The RIEC were selected using the following steps:

- Evaluation of current human health criteria for direct exposure to soil: RIEC were based on EPA Region 9 PRGs for industrial soil action levels (EPA, 2004). For chemicals with more stringent toxicity criteria, as established by the California Environmental Protection Agency (Cal/EPA), RIEC were adjusted based on information provided in the environmental screening level (ESL) document prepared by RWQCB (2005). The values specified in Table K-2 of the ESL document (direct exposure screening levels for commercial/industrial worker exposure scenario) were used because they were most comparable to the methods used in calculating the PRGs. In most cases, RIEC were established at concentrations corresponding to either a cancer risk of 1×10^{-6} or a noncancer HQ of 1.0 (if both a cancer and noncancer criteria were available, the lower value was selected). In some cases, RIEC were set at the saturation limit (as indicated in EPA Region 9 PRGs), if that concentration for a given chemical was lower than its corresponding cancer or noncancer concentration. The saturation limit is the chemical concentration at which soil pore air and pore water are saturated with the chemical and the adsorptive limits of the soil particles have been reached.
- Evaluation of current human health criteria for inhalation exposure: For volatile and semivolatile chemicals, the values specified in Table E-1b of the ESL document (soil screening levels for evaluation of potential vapor intrusion concerns) were used to provide an initial evaluation of the inhalation exposure pathway (RWQCB, 2005). The vapor intrusion screening values were calculated using the "User's Guide for Subsurface Vapor Intrusion into Buildings" (EPA, 2003).

  RIEC established based on the inhalation pathway correspond to either a cancer risk of 1×10^{-6} or a noncancer HQ of 1.0. In Table 4-1, this value is represented as ESL Industrial 2005 (inhalation).

- Identification of criteria for chemicals without current human health criteria: Several chemicals did not have any current criteria specified by either EPA Region 9 or RWQCB. For such chemicals, the SDGI industrial criteria were selected, if available, as the RIEC. SDGI industrial criteria were established based on the 2000 EPA Region 9 PRGs (TtEMI, 2002d). Although the SDGI industrial criteria are no longer current, they represent conservative screening criteria for those chemicals without current human health criteria.
- Evaluation of laboratory MDLs against human health criteria: The human health criteria for two PAHs, benzo(a)pyrene and dibenzo(a,h)anthracene, were lower than the laboratory MDL as specified in the SDGI. The RIEC for these compounds were set at the MDL of 0.33 mg/kg, consistent with the SDGI industrial criteria (TtEMI, 2002d).
- Comparison of HPALs against human health criteria: For metals with established ambient levels, the lowest risk-based value was compared with the HPAL and the greater value was selected as the RIEC. In the case of chromium, cobalt, and nickel, which have sample-specific HPALs (discussed further in Section 4.1.3.3), the RIEC selection was performed for each sample.
- Evaluation of petroleum hydrocarbon detections: Petroleum hydrocarbons are not classified as a CERCLA hazardous substance (42 USC § 9601[14]); therefore, they are excluded from consideration under the CERCLA process unless petroleum hydrocarbons are commingled with hazardous substances regulated under the CERCLA program. A screening evaluation was conducted to identify areas where petroleum hydrocarbons are commingled with other organic and inorganic chemicals that are regulated under CERCLA. The primary RIEC used in this evaluation is the HPS source criterion established under the HPS petroleum program (Shaw Environmental, Inc. [Shaw], 2007). This criterion sums all TPH categories (gasoline-range, diesel-range, and motor-oil range) and compares it against a total TPH criterion of 3,500 mg/kg. To provide a basis for evaluating detections of individual TPH categories, the values specified in Table K-2 of the ESL document (RWQCB, 2005) were used as supplemental RIEC.

4.1.3.3. Hunters Point Ambient Levels

HPALs were calculated using probability plots and histograms generated for 14 metals (antimony, arsenic, barium, beryllium, cadmium, copper, lead, mercury, molybdenum, selenium, silver, thallium, vanadium, and zinc) and lithologic category using both original and logarithmically transformed data (PRC, 1995a). These plots were assessed to identify a cut-off value (threshold limit), separating the background population from the contaminated population. In some instances, these plots were also used to identify and exclude outliers from a data set of concern.

Magnesium-based regression plots were generated for three metals (chromium, cobalt, and nickel). To approximate a normal distribution, the original data sets were logarithmically transformed. The transformed data were then used to generate regression plots of magnesium versus chromium, cobalt, and nickel. Outliers were visually identified and excluded from each data set. A regression line was obtained for each data set using the least squares method. The regression line and the 90 percent confidence interval for the regression line are included on each plot. The 90 percent confidence interval represents the 95 percent one-sided (upper or lower) confidence limit for the regression line. A sample is considered

affected by site-related activities (that is, greater than the ambient level) when chromium, cobalt, or nickel concentrations exceed the calculated naturally occurring concentrations at a statistically significant level (95 percent upper confidence limit [UCL]).

Nickel was reevaluated based on a nickel-cobalt regression, and the results were used in the RIEC selection on a sample-by-sample basis. The nickel-cobalt regression equation was presented in the "Draft Final Technical Memorandum, Nickel Screening and Implementation Plan, Hunters Point Shipyard, San Francisco, California" (TtEMI, 1999).

4.1.3.4. Graphical Presentation of Focused Evaluation Results

To evaluate the spatial distribution of chemicals exceeding the RIEC, parcel-wide figures were prepared that show all chemical results relative to the corresponding RIEC. The figures present soil data in three separate depth ranges (0 to 2 feet bgs, 2 to 10 feet bgs, and greater than 10 feet bgs) to be consistent with the depth ranges evaluated in the HHRA. The figures are referenced in the nature and extent evaluations for each of the three study areas at Parcel E-2: the Landfill Area, the Panhandle Area, and the East Adjacent Area. It is important to note that these figures are intended to focus the nature and extent evaluation and should be used in conjunction with the text and tables presented later in this section, as well as with the complete analytical results provided in Appendix J1.

Soil data within the Landfill Area is presented in a similar manner as for the Panhandle Area and East Adjacent Area for consistency purposes. However, the methods used in the nature and extent evaluation for Landfill Area soil (Section 4.2.4) differ from the methods used for soil in the Panhandle and East Adjacent Areas (Sections 4.3.2 and 4.4.2), In the Landfill Area, soil is mixed within the contiguous solid waste (discussed in Section 4.1.1.1), and the nature of the solid waste combined with the chemical characteristics of the soil fill determines the nature of the material contained within the Landfill Area. Therefore, chemical data in Landfill Area soil are used only to assess (1) the general magnitude of chemical concentrations relative to the RIEC and (2) the general extent of RIEC exceedances relative to the landfill waste volume. This assessment will provide a basis for determining whether lesser quantities of hazardous wastes are present in the landfill as compared with municipal wastes, which is one evaluation factor outlined in EPA presumptive remedy guidance (provided in Appendix H of this report). The use of EPA presumptive remedy guidance in this RI/FS Report, as it pertains to the Landfill Area, was discussed in Sections 1.4.1 and 1.4.3.

In contrast, the Panhandle and East Adjacent Areas contain soil with isolated waste deposits (see Section 4.1.1.2) and, as discussed in Section 1.4.2, require consideration more typical of a standard RI/FS. As a result, a more detailed nature and extent evaluation is performed for chemicals in Panhandle Area and East Adjacent Area soil. This evaluation uses samples adjacent to RIEC exceedances to determine whether the extent of chemical contamination is adequately delineated. An RIEC exceedance within a

given depth range will be considered adequately delineated if there are four or more nearby samples (within 150 feet) surrounding the exceedance (in a general north, south, east, and west direction) with concentrations less than the RIEC. The 150-foot distance is consistent with the definition of the 0.5-acre exposure areas (approximately 150 feet by 150 feet) used in the HHRA. The spatial criterion (general north, south, east, and west direction) is consistent with the sampling approach developed during the SDGI to delineate chemical exceedances in the Panhandle and East Adjacent Areas.

In addition, the soil data will be used to identify potential hot spots within the Landfill, Panhandle, and East Adjacent Areas. Hot spots consist of highly toxic or highly mobile material and may present a principal threat to human health or the environment (EPA, 1991a). For the purpose of the RI portion of this report, soil hot spots are defined as locations containing chemical concentrations 100 times greater than the corresponding RIEC. This criterion is based on the following rationale:

- For most carcinogenic chemicals, the RIEC correspond to an approximate ELCR of 1×10^{-6}, which is the "point of departure" risk level specified in the NCP (55 Federal Register 8848, March 8, 1990).
- A concentration that is 100 times the RIEC would correspond to an approximate ELCR of 1×10^{-4}, which is the upper limit of the acceptable risk range specified in the NCP (55 Federal Register 8848, March 8, 1990).
- Concentrations greater than 100 times the RIEC would be considered outside of the acceptable risk range and, by extension, are a reasonable basis for assessing "highly toxic" material.

As an additional evaluation step for all areas, analytical results with LRLs greater than the corresponding RIEC are identified on each figure to evaluate the potential effect of elevated LRLs on the nature and extent evaluation.

4.2. LANDFILL AREA

The nature and extent of contamination at the Parcel E-2 Landfill was evaluated based on information from the previous investigations and TCRAs described in Section 3. Based on data from the 28 soil borings, 18 monitoring wells, and 25 test pits extended within the Landfill Area, the solid waste is composed primarily of domestic refuse and construction debris. However, the following information indicates that industrial wastes were also disposed of in or around the Parcel E-2 Landfill:

- The IAS indicated that sandblast waste, asbestos-containing debris, paint sludge, solvents, and waste oils were deposited in the Parcel E-2 Landfill (NEESA, 1984).
- The HRA indicated that the Parcel E-2 Landfill, along with other areas within Parcel E-2, was a disposal area for radioluminescent devices (primarily containing radium-226). The HRA also indicated that the landfill was a potential disposal area for (1) wastes from decontamination of ships used in atomic testing, (2) building debris from demolition of radiologically impacted buildings used by the NRDL, and (3) materials used in radiological experiments by NRDL (NAVSEA, 2004).

- An oily waste area was identified on Navy drawings along the western perimeter of the Landfill Area (Navy, 1974). During preliminary closure activities in 1974, ponded liquid was removed and the top 6 inches of soil at the oily waste area was scarified before the soil cover was placed. Based on borings and exploratory trenches, this area also was partially filled with solid waste during closure; therefore, this area is included within the boundaries of solid waste at the Parcel E-2 Landfill (Appendix B).
- Triple A allegedly disposed of industrial debris, sandblast waste, oily industrial sand, and asphalt over an area of approximately 5 acres along the shoreline of Parcel E-2. In addition, Triple A allegedly stored unlabeled, deteriorating, uncovered drums with their contents exposed to the elements in the southeast corner of Parcel E-2 (Figure 1-11 of this report; San Francisco District Attorney, 1986).
- Waste fuel and waste oil containing PCBs were used at the Parcel E-2 Landfill as dust suppressants (TtEMI, LFR, and U&A, 1997).

The following subsections discuss the nature and extent of solid waste (Section 4.2.1 and Section 4.2.2), landfill gas (Section 4.2.3), and chemicals within the soil fill (Section 4.2.4).

4.2.1. Fill and Solid Waste Characteristics

The nature and extent of solid waste at the Parcel E-2 Landfill was evaluated based on the physical presence of contiguous industrial or municipal-type wastes. Based on a review of soil borings drilled in the central portion of the landfill from 1988 to 1992, landfill waste consists of wood, paper, plastic, metal, glass, nails, foam, copper wire, cloth, rubber, plywood, ceramics, asphalt, concrete, and bricks, which are mixed with sand, clay, and gravel fill. The waste is usually brown to black. In many areas within the landfill, the waste is mixed with construction debris. Construction debris is typically inert. As discussed in Section 4.1.1, inert waste does not contain hazardous waste or soluble pollutants at concentrations exceeding applicable water quality objectives, nor does it contain significant quantities of decomposable waste (as defined in 27 CCR § 20230). Inert fill material is not expected to generate leachate that would create potential risks to human health or the environment.

In some areas in and near the Parcel E-2 Landfill, solid waste and soil fill or construction debris materials appear to have a sheen that may be from petroleum products (Appendix B). Some of the wood debris was noted in boring logs as exhibiting a creosote odor, and the fibrous material was noted as possible asbestos-containing material (TtEMI, LFR, and U&A, 1997). Because soil within the Landfill Area is mixed with solid waste, the chemical characteristics of the soil fill (Section 4.2.4) combined with the nature of the solid waste determine the nature of the material contained within the Landfill Area. These characterization data are used to evaluate whether the containment presumption, as outlined in EPA guidance (EPA, 1993a, 1993b, and 1996; provided in Appendix H of this report), is appropriate for Parcel E-2.

Information on the waste types encountered within the Landfill Area was obtained during remediation activities within the PCB Hot Spot Area, which extended into a small portion the Landfill Area (see Figure 1-3). Out of a total excavation volume of 44,500 cubic yards, 533 cubic yards of soil and fire brick was segregated as radiologically impacted. Also, 40 radiological devices, 78 cubic yards of metal debris, and 19 pieces of other radioactively contaminated debris were identified within the removal area (TtECI, 2007a). In addition, 41 pieces of MPPEH were encountered in the excavation area, consisting primarily of expended cartridge casings of various calibers and protective caps, but also included an empty 5-inch practice projectile and a 3-pound practice bomb (TtECI, 2010). Of the 41 MPPEH items discovered in the removal area, 20 items were verified to not present an explosive hazard and were reclassified as MDAS. The remaining 21 MPPEH items appeared to have been subject to previous demilitarization actions and could not be completely inspected by UXO technicians for possible explosive hazards. Although the type, age, and condition of these 21 MPPEH items did not suggest a high potential for residual energetic material, the Navy, as a precautionary measure, properly handled, transported, and disposed of these items as either material documented as an explosive hazard (MDEH) (20 items consisting of expended cartridge casings of various calibers) or munitions and explosives of concern (MEC) (1 item. 3-pound practice bomb) (TtECI, 2010). Additional information on the findings from the removal activities within the East Adjacent Area is provided in Section 4.4.1.

In September 1997, during installation of the sheet-pile wall in the Landfill Area, an obstruction was encountered at a depth of about 20 feet bgs, accompanied by a release of pressurized gas that escaped to the surface. The atmosphere in this area was monitored for health and safety purposes, specifically for explosive conditions (using an LEL meter) and various compounds, including natural gas, chlorine, and hydrogen sulfide (using colorimetric indicator tubes). Sporadic detections of atmospheric conditions greater than 10 percent of the LEL and chlorine gas greater than 5 ppm were encountered during health and safety monitoring. Approximately 80 feet of the sheet-pile wall (as originally designed) was realigned to avoid the subsurface obstructions. The alternate alignment consisted of an approximate 50-foot-long section that was offset approximately 20 feet from the design alignment, with the remaining portion gradually angling back to the design alignment. The remainder of the sheet-pile wall was completed with no additional releases of subsurface gas (IT, 1999).

Solid waste in the landfill is in contact with groundwater and constitutes the majority of the A-aquifer within the Landfill Area. Additional information on the fill and solid waste characteristics is provided in the Landfill Lateral Extent Evaluation Report (Appendix B to this report).

4.2.2. Landfill Solid Waste Extent

The Landfill Lateral Extent Evaluation Report presents the results of the evaluation of data collected from test pits and soil borings installed during the NDGI, along with historic soil and well boring log information, to assess the lateral and vertical extent of solid waste at the Parcel E-2 Landfill. All

information on the extent of solid waste at the landfill in this section is from the Landfill Lateral Extent Evaluation Report (Appendix B to this report).

4.2.2.1. Lateral Extent of Solid Waste

Figure 3-1 shows the estimated lateral extent of solid waste at the Parcel E-2 Landfill, along with the locations of test pits and soil borings used in the lateral extent evaluation. The lateral boundaries of the solid waste are based on the soil borings and test pits shown on Figure 3-1, as discussed below.

Along the northern perimeter of the Parcel E-2 Landfill, the landfill lateral extent was encountered along the fence line at boring TPBWE01 and test pits WE01, WE02B, WE03B, WE04B, WE05B, and WE06A. The northern extent continues just north of TPBWE09D, and then just south of TPBWE10C, where no solid waste was encountered. From this location, the extent of solid waste continues south through boring TPBWE11, which contained only minor amounts of wood debris.

The eastern edge of the solid waste is located beneath the interim landfill cap. Based on a review of historic information that included boring logs, aerial photographs, and maps, the lateral extent of solid waste ends approximately 10 feet before the eastern edge of the cap.

At the southern end of the Parcel E-2 Landfill, solid waste was not observed in test pits WE15, WE16, or WE22. Although solid waste was not encountered in WE22, this location is considered to define the southern extent of the solid waste, because debris placed by Triple A is present along the shoreline in this area. Because of the lack of solid waste in WE15 and WE16, solid waste is considered to extend just north of these test pits. Test pits WE21B and WE20B did not contain solid waste; therefore, they are considered as defining the western extent of solid waste at the landfill. The nearest test pits to these locations (WE21A and WE20A, respectively) contained solid waste. Farther south along the western perimeter, the extent of solid waste is considered to be located between test pits WE19C and WE19B, WE18D and WE18C, and WE17F and WE17E, because solid waste was present in test pits WE19B, WE18C, and WE17E, but not in test pits WE19C, WE18D, or WE17F, respectively. As shown on Figure 3-1, additional physical characterization was performed in the area between test pits WE16 and WE 17F that further delineates the landfill waste (see Figures 3-2 and 4-1).

These assessments provide a good estimate of the contiguous solid waste associated with the Parcel E-2 Landfill but, as discussed in Sections 4.3.1 and 4.4.1, isolated solid waste is present at numerous locations in the Panhandle and East Adjacent Areas. As discussed in Section 1.4.2, site conditions at these areas and their proximity to the Landfill Area present opportunities to streamline the remedy evaluation process by focusing on remediation technologies that can be closely aligned with actions at the Landfill Area. This type of focused remedy evaluation process for the Panhandle Area, East Adjacent Area, and Shoreline Area is consistent with the streamlining approach outlined in pages 8704-8705 of the 1990 NCP

Preamble (55 Federal Register 8704-8705, March 8, 1990) and in Section 4.1.3.1 of EPA's RI/FS guidance (EPA, 1988a).

4.2.2.2. Vertical Extent of Solid Waste

Figures 2-3 through 2-8 show the vertical extent of solid waste at the Parcel E-2 Landfill, along with the locations of the test pits and soil borings used in the extent evaluation. The vertical boundaries of the solid waste are discussed below.

Soil boring data confirm that the bottom of the solid waste is usually deeper than the test pit excavation depths. As a result, soil borings were drilled at most test pit locations to determine the depth of solid waste. Data from the test pits and historic soil borings were used to construct geologic cross sections that show the depth and extent of waste at the landfill (Figures 2-3 through 2-8).

The waste is generally located between 21 feet above and 14 feet below msl. The waste generally varies from 10 to 25 feet thick. The solid waste lies atop Bay Mud clays in the southern and eastern portions of the landfill and atop B-aquifer sands in the northwestern area of the landfill. In other areas, solid waste is bounded by fill (construction debris, sand, and gravel). In most borings, solid waste is located both above and below the water table. The only area where solid waste is located above the water table is in the northwest corner of the landfill.

4.2.3. Landfill Gas

This subsection discusses the nature and extent of landfill gas at Parcel E-2. The evaluation methods were discussed in Section 4.1.2. The results of relevant landfill gas investigations are summarized below, including those related to the landfill gas characterization study (Appendix A) and the landfill gas TCRA (Appendix F). This subsection also presents a description of the ongoing landfill gas activities, based on the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c).

4.2.3.1. Landfill Gas Characterization

As discussed in Sections 3.2 and 4.1.2, the landfill gas characterization investigation was conducted in 2002 as part of the NDGI to define the nature and extent of landfill gas within and immediately adjacent to the Parcel E-2 Landfill. Section 3.2 discusses field activities and the report associated with this investigation. Data evaluation and results for the main components of the investigation are described below and include (1) outdoor air monitoring and building atmosphere surveys, (2) a subsurface soil gas survey, and (3) GMP installation and monitoring. Unless otherwise indicated, all information in this subsection is from the Landfill Gas Characterization Report (provided in Appendix A of this report). Figure 3-1 shows the locations of the soil gas survey locations and GMPs at Parcel E-2. Outdoor air and building surveys locations are shown on Figure 3-4.

Outdoor Air Monitoring and Building Atmosphere Surveys

Data from outdoor air monitoring and building atmosphere surveys were evaluated to assess whether methane (the main component of landfill gas) was present in outdoor air, buildings, or subterranean structures within 300 feet of the Parcel E-2 Landfill at concentrations exceeding the 27 CCR regulatory limit of 1.25 percent by volume in air (25 percent of the LEL). Figure 4-2 shows the air monitoring locations within 300 feet of the landfill. Air monitoring data were also evaluated to assess whether NMOCs were present at concentrations exceeding EPA Region 9 PRGs for ambient air (EPA, 2004).

Results of the outdoor air survey indicated that landfill gas is not present in the breathing zone within the Landfill Area; in building atmospheres within 300 feet of the Landfill Area; or within surveyed, accessible buildings outside the 300-foot perimeter. Methane was not detected at locations to the east, south, or west of the landfill during the outdoor air survey. Methane was detected at several locations north of the landfill as summarized below.

- Methane exceeded the LEL at the ground surface around the light pole near the southwestern corner of the UCSF compound (Location F, subsequently referred to as simply the "light pole").
- Methane detections were between 5 and 18 percent of the LEL at two locations along a suspected utility corridor along the fence between the landfill and the UCSF compound (Locations A and C).
- Methane exceeded 25 percent of the LEL at a location on the basketball court on the UCSF compound, just west of the Building 830 crawlspace (Location B).

During additional outdoor air monitoring performed using field instruments within a month of the initial outdoor air survey during spring 2002, methane was not detected at Locations A, B, C, or F. Air samples were collected and analyzed at three locations around the light pole and four locations within the Building 830 crawlspace. Methane was detected at a maximum concentration of 0.6 percent of the LEL in one light pole sample; all gas samples from within the Building 830 crawlspace were less than 1 percent of the LEL. Based on these results, the concentrations of methane in outdoor air around the landfill were considered negligible. Outdoor air at the light pole and Locations A and B were monitored on a monthly basis for more than 2 years following the removal action to verify that methane concentrations remained less than 1 percent (TtEMI and ITSI, 2004c). Monitoring at these locations was discontinued in August 2006 after methane and NMOC concentrations were shown to consistently be less than action levels. The Navy's decision to discontinue monitoring at these locations was consistent with the rationale presented in the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c).

Outdoor air monitoring performed on the landfill surface (consisting of breathing zone measurements at cap penetrations and a surface transect over and around the cap surface) did not detect methane at concentrations exceeding 25 percent of the LEL. Methane was detected at concentrations exceeding 25 percent or more of the LEL at several wells (shown on Figure 4-2); however, these measurements were

taken at the top of the well casing, with the wells open to the atmosphere, and were not representative of outdoor air within the Landfill Area. Based on these results, the amount of landfill gas in outdoor air within the landfill limits was considered to be negligible. Methane results from the outdoor air survey are shown on Figure 4-2, and the outdoor air field data are presented in Table 3 in Appendix A.

Laboratory results (presented in Table 4 in Appendix A) indicated that certain NMOCs were present in outdoor air at concentrations exceeding their respective PRGs at two locations, as summarized below.

- At the light pole near the southwestern corner of the UCSF compound (Figure 4-2), 1,1,2,2-tetrachloroethane, 1,3,5-trimethylbenzene, benzene, and PCE exceeded the 2004 PRGs for ambient air. Chloromethane and ethylbenzene concentrations exceeded the 2002 PRGs for ambient air; however, changes reflected in the 2004 PRGs resulted in these compounds no longer exceeding the established risk-based criteria.
- In the Building 830 crawlspace, benzene and PCE exceeded the 2004 PRGs for ambient air. Chloromethane concentrations exceeded the 2002 PRGs for ambient air; however, changes reflected in the 2004 PRGs resulted in chloromethane no longer exceeding the established risk-based criteria.

No NMOCs were detected at concentrations greater than PRGs in samples collected at these locations in November 2002. The November 2002 monitoring was performed after the gas control system was installed and active gas extraction was initiated from the extraction wells within the UCSF compound, as part of the landfill gas TCRA.

Subsurface Soil Gas Survey

Data from the subsurface soil gas survey were evaluated to assess the nature and extent of methane and other landfill gas components (such as NMOCs) in the vadose zone at the Parcel E-2 Landfill. Data were evaluated to identify subsurface locations where methane exceeded 25 percent of the LEL (1.25 percent by volume) and where NMOCs exceeded a screening criterion of 5 ppmv above background concentrations, as measured at a location upwind from the sampling locations. Field screening data and laboratory results corresponded well to one another. The main findings of the data evaluation are summarized below.

- Methane was detected at concentrations exceeding 25 percent of the LEL along the northern side of the landfill, where solid waste extends up to the boundary of the UCSF compound. NMOCs were also detected in this area at concentrations exceeding 5 ppmv above background.
- Methane was detected on the UCSF compound at concentrations exceeding the LEL, indicating that methane had migrated north of the landfill beneath the UCSF compound.
- No methane was detected north of the UCSF compound on Crisp Avenue. Thus, methane had not migrated beyond the UCSF compound beneath non-Navy property north of Crisp Avenue (former Parcel A).

- Methane concentrations were not detected at levels exceeding 25 percent of the LEL along the east, south, and west sides of the landfill. Thus, methane dissipated quickly with distance from the landfill in these directions.
- During field screening, NMOCs were detected at 11 soil gas locations at concentrations exceeding 5 ppmv above background.
- At one location (SG12) east of the delineated extent of waste, near IR04MW13A, laboratory analysis detected PCE, TCE, and their degradation products at concentrations above the shallow soil gas screening levels for evaluation of potential vapor intrusions.

Figure 4-3 shows the extent of landfill gas based on the results of the subsurface soil gas survey. Tables 5 and 7 in Appendix A present field screening and laboratory analytical results of the soil gas survey, respectively. As discussed in Section 3.9, the Navy performed an interim removal action to remove landfill gas that had migrated beneath the UCSF compound and to control future migration north of the solid waste boundary.

The soil gas survey identified the nature and approximate lateral extent of landfill gas prior to the landfill gas removal action. The nature and extent delineation was further refined during several rounds of sampling conducted at GMPs installed in 2002, as discussed in the following subsection. The landfill gas barrier wall installed to control landfill gas migration is shown on Figure 4-3 and represents the current northern extent of landfill gas above 25 percent of the LEL.

Gas Monitoring Probe Installation and Monitoring

Data from GMPs installed in 2002 were evaluated to monitor the presence of landfill gas at Parcel E-2, the UCSF compound, and along Crisp Avenue. Monitoring was conducted on a weekly basis using field instruments. Four rounds of sampling were conducted between April and November 2002. Methane concentrations were compared with 27 CCR limits. NMOC concentrations were not compared with any specific criteria; rather, their concentrations were monitored over time during four rounds of sampling conducted in 2002. Table 4-2 lists the detection frequencies and range of results for NMOCs collected from GMPs during this time period. Findings of the data evaluation are summarized below.

During the first three rounds of monitoring from April to July 2002, methane concentrations exceeded the LEL (5 percent by volume) in GMP01A through GMP12; these GMPs are all located along the fence line on the northern edge of the Parcel E-2 Landfill. Methane was not detected in any of the GMPs located along Crisp Avenue (GMP13 through GMP19). Methane was also not detected in GMPs 20 and 21 located on the western edge of the landfill.

The fourth round of monitoring was conducted in November 2002, after the initiation of active gas extraction within the UCSF compound. Methane concentrations decreased to less than the LEL in all GMPs along the northern edge of the Parcel E-2 Landfill except at GMP08A, which is located on the northeastern side of the landfill. Results measured during this round also indicated that methane

concentrations in the UCSF compound GMPs were all less than the LEL for methane. As during previous sampling rounds, methane was not detected in the GMPs on Crisp Avenue (GMP13 through GMP19). This finding further supported the conclusion that methane had not migrated beyond the UCSF compound beneath non-Navy property north of Crisp Avenue (former Parcel A).

Several NMOCs were detected during GMP monitoring, with the highest concentrations detected in GMPs around the perimeter of the Parcel E-2 Landfill and within the UCSF compound. NMOC concentrations were detected in the GMPs located along Crisp Avenue, but at lower concentrations than concentrations detected at the GMPs along the fence line and within the UCSF compound. NMOC concentrations at all GMPs decreased after the landfill gas extraction system became operational in October 2002.

A risk assessment was conducted prior to operation of the gas extraction system to evaluate potential human health risks resulting from the low levels of NMOCs detected in GMPs along Crisp Avenue. An additional risk assessment was performed on NMOC data from GMPs within the UCSF compound. As discussed in Section 4.1.2.2, the assessments concluded that NMOC concentrations do not pose an unacceptable risk to human health.

4.2.3.2. Landfill Gas Removal Action

Based on the results of the landfill gas characterization investigation, the Navy initiated a TCRA to (1) remove landfill gas and reduce subsurface methane concentrations at the UCSF compound to less than the LEL (5 percent by volume in air); and (2) control future landfill gas migration to off-site areas. The TCRA consisted of active landfill gas extraction, post-extraction monitoring, and a response action to address potential methane migration pathways through the landfill gas control system. The results of each of these TCRA components are described in the following paragraphs. Unless otherwise indicated, all information in this subsection was derived from the Landfill Gas TCRA Closeout Report (TtEMI, 2004a; Appendix F).

Active Landfill Gas Extraction

The goals of the active extraction phase of the TCRA were to (1) reduce methane to concentrations equal to or less than 0.5 percent by volume in air in all extraction wells (EX-1 through EX-10); and (2) to reduce methane to concentrations equal to or less than 1 percent by volume in air in all GMPs within the UCSF compound (GMP22 through GMP26). Two cycles of active extraction were planned but not needed at all wells to achieve these goals. The active extraction phase of the TCRA was conducted from October 4, 2002, to January 20, 2003, when the TCRA goals for reducing the concentrations of methane were achieved. From January 2003 to present, active landfill gas extraction is conducted as necessary to ensure landfill gas concentrations do not exceed action levels.

Post-Extraction Monitoring

The landfill gas control system consists of an HDPE barrier wall, a gas collection trench sealed (on top) with bentonite, a horizontal perforated gas collection pipe, five gas vents, and a mobile active extraction unit to assist venting when necessary. Construction of the landfill gas control system was completed on October 3, 2002. After active gas extraction was halted on January 20, 2003, methane concentrations were monitored in extraction wells and GMPs, weekly for 4 weeks and then monthly for 4 months. At the end of each monitoring period (weekly and monthly), gas samples were collected in Summa™ canisters from GMP22 through GMP26 (located within the UCSF compound) and analyzed at an off-site stationary laboratory to confirm the field monitoring results. GMP analytical results are shown in Appendix J1.

During the first 2 weeks of monitoring, the landfill gas control system was operated passively. However, methane levels at GMP01A began to rise within 1 week after extraction was halted, with corresponding increases in adjacent GMPs to the east (GMP02A) and west (GMP12). To address these methane increases, the landfill gas control system was switched from passive to active mode on February 5, 2003, by extracting gas through passive vent (PV)-01 at a low-flow rate. Laboratory analysis of GMPs (Appendix J1) demonstrates that gas migration is effectively controlled through operation of the landfill gas control system. The activities of the TCRA have successfully controlled the migration of landfill gas beneath non-Navy property.

Methane Migration Response Action

During active gas extraction and subsequent monitoring, increases in methane concentrations were observed that were consistent with a physical problem with the landfill gas control system that allowed methane to migrate beyond the barrier wall. A detailed evaluation was conducted to determine the cause of the methane increases and to identify appropriate mitigative measures; the evaluation is documented in Appendix K to the Landfill Gas Removal Action Closeout Report (provided in Appendix F to this report) and briefly summarized below.

Data collected from temporary gas probes installed along the gas collection trench indicated that methane was migrating in two locations either through a tear in the barrier or over the barrier through the bentonite seal.

The following response actions were taken to address methane migration:

- A grout curtain was installed in the gas collection trench on the north (UCSF) side of the HDPE barrier wall to control the migration of methane gas through the barrier wall. The grout curtain was installed in June 2003 using pressure grouting to fill voids in gravel and soil along the northern side of the barrier wall and to seal any tears or separated seams. Figure 1-3 shows the grout curtain location.

- The bentonite cover was rehydrated to control the migration of methane gas above the barrier wall. Trenches were excavated to the top of the barrier wall in areas where temporary gas probe monitoring results indicated methane migration was occurring. Inspection of these trenches indicated several areas of inadequate hydration of the bentonite cover, with bentonite pellets clearly visible. The entire length of the bentonite cover was rehydrated by injecting water into the cover using a water jet constructed of perforated PVC pipe.
- A fifth PV (-05) was added to increase the venting capability of the trench. The vent was created by converting one of the risers connected to the main pipe of the barrier trench to a vent and connecting it to a treatment unit. The new passive vent was connected between PV-01 and PV-02, in the area of the observed methane increases. Figure 3-6 shows all the passive vent locations.

Based on subsequent monitoring, these response actions have reduced gas migration beneath the UCSF compound. Ongoing landfill gas monitoring and control system operation, in accordance with the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c), is performed to control gas migration beneath the UCSF compound.

4.2.3.3. Ongoing Landfill Gas Activities

The ongoing landfill gas monitoring and control system operation is based on the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c). Monitoring is conducted to verify that hazardous levels of landfill gas are not migrating beyond the fence line of the landfill and onto the UCSF compound. The monitoring locations include 32 GMPs and 5 PVs, 4 groundwater wells on the landfill cap, and outdoor air and subterranean structure locations both on Parcel E-2 and within the UCSF compound (Figure 3-6). As discussed in Section 3.9, regular monitoring is being conducted at GMPs and along the gas control system. In addition, the gas control system is inspected and maintained on a regular basis. The gas monitoring reports present results of the landfill gas monitoring, the status of the gas extraction system (active operation and passive operation), maintenance observations on the gas control system, and meteorological data (ITSI, 2004a through 2004g, 2005a through 2005n, 2006a through 2006g, 2006i through 2006m, 2007a through 2007c, 2007e through 2007g, 2008a through 2008c, 2008e, 2009a through 2009d, and 2010a through 2010c).

4.2.4. Chemicals Detected in Soil

Soil data within the Landfill Area is presented in a similar manner as for the Panhandle Area and East Adjacent Area for consistency purposes. However, as discussed in Section 4.1.3.4, chemical data in Landfill Area soil are used only to assess (1) the general magnitude of chemical concentrations relative to the RIEC and (2) the general extent of RIEC exceedances relative to the landfill waste volume. In addition, potential soil hot spots are identified at locations containing chemical concentrations 100 times greater than the corresponding RIEC. EPA recommends that hot spots in municipal landfills be identified and evaluated to decide if more extensive characterization and development of remedial alternatives is

appropriate (EPA, 1991a). The evaluation decision of whether or not these hot spots require more extensive characterization and development of remedial alternatives is summarized in Section 8.

As discussed in Section 4.1.3, comprehensive data summary tables for the Landfill Area are presented in Appendix J1 by chemical category (i.e., metals, pesticides, PCBs, SVOCs, VOCs, and petroleum hydrocarbons) and depth interval (0 to 2 feet, 2 to 10 feet, and greater than 10 feet). In addition, each table presents a series of summary statistics of the data for each chemical, such as the number of samples collected; the number of results that exceed the detection limit; minimum and maximum concentrations detected; and median, mean, and standard deviation of the detected results for each chemical. Each table also lists all potential screening criteria and quantifies the number of results that exceed each criterion.

The following subsections describe the chemical characteristics of the soil fill within the Landfill Area.

4.2.4.1. Landfill Area Surface Soil (0 to 2 feet bgs)

Table 4-3 presents a statistical summary for all of the analyses performed within the depth range of 0 to 2 feet below the surface of the landfill cap. Table 4-4 lists the chemicals that were detected within this depth range at concentrations exceeding the RIEC.

Metals

In total, 28 samples were analyzed for one or more metals. As shown in Table 4-3, nine metals (antimony, barium, beryllium, cobalt, copper, lead, manganese, mercury, and zinc) were detected at concentrations greater than HPALs. As shown in Table 4-4, one of the metals (lead) was detected at concentrations exceeding the selected RIEC. None of the LRLs for the metals exceeded the selected RIEC.

Lead was detected in all 22 samples analyzed. This metal was detected in 19 of the 22 samples at concentrations greater than the HPAL (8.99 mg/kg). One sample contained concentrations exceeding the selected RIEC (800 mg/kg). As shown on Figure 4-4, the sample results exceeding the RIEC are near samples with concentrations that are less than the RIEC. None of the LRLs for lead exceeded the selected RIEC. Based on the available characterization data, the extent of lead in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (9,700 mg/kg) is not indicative of a hot spot. However, lead concentrations greater than the RIEC were reported in the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Pesticides and PCBs

In total, 23 samples were analyzed for one or more pesticides and PCBs. As shown in Table 4-3, eight pesticides (4,4'-dichlorodiphenyldichloroethane [DDD], 4,4'-dichlorodiphenyldichloro-ethene [DDE], 4,4'-DDT, alpha-chlordane, endosulfan sulfate, heptachlor epoxide, methoxychlor, and trans-chlordane),

and total high risk PCBs (consisting of all Aroclor compounds except Aroclor-1016) were detected at least once at concentrations greater than the LRL. One pesticide (heptachlor epoxide) and total high risk PCBs were detected at concentrations exceeding the selected RIEC.

Heptachlor epoxide was detected in 2 of 22 samples analyzed. One sample had a concentration exceeding the selected RIEC (0.19 mg/kg). As shown on Figure 4-5, the exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. None of the LRLs for heptachlor epoxide exceeded the selected RIEC. Based on this information, the extent of heptachlor epoxide in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (0.39 mg/kg) is not indicative of a hot spot.

Total PCBs (high risk) were detected in 5 of 23 samples analyzed. Two samples contained total PCBs (high risk) at concentrations exceeding the selected RIEC (0.74 mg/kg). As shown on Figures 4-6 and 4-7, the samples are within the portion of the PCB Hot Spot Area that extends into the Landfill Area. In addition, seven of the LRLs for individual PCB compounds exceeded the selected RIEC. Based on the available characterization data, the extent of total PCBs (high risk) in soil within this depth range is limited when compared to the overall Landfill Area. However, total PCBs (high risk) within this depth range are present at concentrations exceeding the RIEC throughout the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Semivolatile Organic Compounds

In total, 24 samples were analyzed for SVOCs. As shown in Table 4-3, 28 SVOCs were detected at least once at concentrations greater than the LRL. The following 13 SVOCs had LRLs that exceeded RIEC due to dilutions of samples and the limitations of analytical methods at the time: 1,4-dichlorobenzene (DCB), 3,3'-dichlorobenzidine, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)-fluoranthene, bis(2-chloroethyl)ether, dibenz(a,h)anthracene, hexachlorobenzene, indeno(1,2,3-cd)pyrene, naphthalene, n-nitrosodimethylamine, and n-nitroso-di-n-propylamine. However, five SVOCs—benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and naphthalene—were detected at concentrations exceeding the selected RIEC (Table 4-4).

Benzo(a)anthracene was detected in 11 of 24 samples analyzed. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (1.3 mg/kg). As shown on Figure 4-8, these benzo(a)anthracene exceedances are within the area of the landfill and are near samples with concentrations that are less than the RIEC. In addition, LRLs for benzo(a)anthracene exceeded the selected RIEC in one sidewall sample. Based on the available characterization data, the extent of benzo(a)anthracene in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (2.3 mg/kg) is not indicative of a hot spot.

Benzo(a)pyrene was detected in 11 of 24 samples analyzed. This SVOC was detected in nine samples at concentrations exceeding the selected RIEC (0.33 mg/kg). As shown on Figure 4-9, these benzo(a)pyrene exceedances are within the area of the landfill and, in addition, LRLs for benzo(a)pyrene exceeded the selected RIEC in 10 locations. Based on the available characterization data, benzo(a)pyrene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (3.1 mg/kg) is not indicative of a hot spot.

Benzo(b)fluoranthene was detected in 13 of 24 samples analyzed. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (1.3 mg/kg). As shown on Figure 4-10, these benzo(b)fluoranthene exceedances are within the area of the landfill and are near locations with concentrations less than the RIEC. In addition, LRLs for benzo(b)fluoranthene exceeded the selected RIEC in one sidewall sample. Based on the available characterization data, the extent of benzo(b)fluoranthene in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (4.1 mg/kg) is not indicative of a hot spot.

Indeno(1,2,3-cd)pyrene was detected in 10 of 24 samples analyzed. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (1.3 mg/kg). As shown on Figure 4-11, these indeno(1,2,3-cd)pyrene exceedances are within the area of the landfill and are near locations with concentrations less than the RIEC. In addition, LRLs for indeno(1,2,3-cd)pyrene exceeded the selected RIEC in one sidewall sample. Based on the available characterization data, the extent of indeno(1,2,3-cd)pyrene in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (3.1 mg/kg) is not indicative of a hot spot.

Naphthalene was detected in 8 of 24 samples analyzed. As shown on Figure 4-12, this SVOC was detected in one sample at a concentration exceeding the selected RIEC (1.5 mg/kg). In addition, LRLs for naphthalene exceeded the selected RIEC in one sidewall sample. Based on the available characterization data, the extent of naphthalene in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (2.12589 mg/kg) is not indicative of a hot spot.

Volatile Organic Compounds

In total, 21 samples were analyzed for VOCs. As shown in Table 4-3, four VOCs (1,1,1-TCA, carbon disulfide, toluene, and vinyl acetate) were detected at least once at concentrations greater than the LRLs. As shown in Table 4-4, none of these VOCs was detected at concentrations exceeding the selected RIEC. None of the LRLs for the VOCs exceeded the selected RIEC.

Petroleum Hydrocarbons

Total TPH is the sum of the concentrations of TPH as gasoline (TPH-g), TPH as diesel (TPH-d), TPH as motor oil (TPH-mo), TPH as unknown purgeables, and TPH as unknown extractables (Shaw, 2007).

None of the 23 samples contained total TPH at concentrations greater than the source screening criterion (3,500 mg/kg). As shown in Table 4-4, one sample from boring IR01B011 had a total oil and grease (TOG) concentration (5,000 mg/kg) exceeding the source screening criterion (3,500 mg/kg).

4.2.4.2. Landfill Area Subsurface Soil (2 to 10 feet bgs)

Table 4-5 presents a statistical summary for all of the analyses performed within this depth range. Table 4-6 lists the chemicals that were detected within this depth range at concentrations exceeding RIEC.

Metals

In total, 113 samples were analyzed for one or more metals. As shown in Table 4-5, all metals were detected at least once at concentrations greater than the LRL. Seventeen metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, vanadium, and zinc) were detected at concentrations greater than HPALs. Eight metals (antimony, arsenic, cadmium, chromium (total), copper, iron, lead, and vanadium) were detected at concentrations exceeding the selected RIEC (Table 4-6).

Antimony was detected in 78 of 113 samples analyzed. As shown on Figure 4-13, this metal was detected in 33 samples at concentrations greater than the HPAL (9.05 mg/kg) and in four samples at concentrations exceeding the RIEC (380 mg/kg). None of the LRLs for antimony exceeded the RIEC. Based on the available characterization data, the extent of antimony in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (1,930 mg/kg) is not indicative of a hot spot.

Arsenic was detected in 108 of 113 samples analyzed. As shown on Figure 4-14, this metal was detected in five samples at concentrations greater than the HPAL (11.1 mg/kg), which is the selected RIEC. None of the LRLs for arsenic exceeded the selected RIEC. Based on the available characterization data, the extent of arsenic in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (66.6 mg/kg) is not indicative of a hot spot.

Cadmium was detected in 80 of 113 samples analyzed. As shown on Figure 4-15, this metal was detected in 15 samples at concentrations greater than the HPAL (3.14 mg/kg), and 8 samples, including 1 grid sidewall sample, contained cadmium concentrations exceeding the selected RIEC (7.4 mg/kg). None of the LRLs for cadmium exceeded the selected RIEC. Based on the available characterization data, the extent of cadmium in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (330 mg/kg) is not indicative of a hot spot.

Chromium (total) was detected in all 113 samples analyzed. This metal was detected in 16 samples at concentrations greater than the location-specific HPALs, and 8 samples contained chromium concentrations exceeding the selected RIEC, which is based on the HPAL and the 2004 industrial PRG

(450 mg/kg), whichever is the higher value. As shown on Figure 4-16, all chromium exceedances are within the area of the landfill and most exceedances are near locations with concentrations less than the RIEC. None of the LRLs for chromium exceeded the selected RIEC. Based on the available characterization data, the extent of chromium in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (6,940 mg/kg) is not indicative of a hot spot.

Copper was detected in all 113 samples. This metal was detected in 54 samples at concentrations greater than the HPAL (124.3 mg/kg). As shown on Figure 4-17, three samples contained concentrations exceeding the selected RIEC (38,000 mg/kg). None of the LRLs for copper exceeded the selected RIEC. Based on the available characterization data, the extent of copper in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (175,000 mg/kg) is not indicative of a hot spot.

Iron was detected in all 87 samples. This metal was detected in four samples at concentrations exceeding the selected RIEC (100,000 mg/kg). As shown on Figure 4-18, all four iron exceedances are within the area of the landfill and most exceedances are near locations with concentrations less than the RIEC. None of the LRLs for iron exceeded the selected RIEC. Based on the available characterization data, the extent of iron in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (201,000 mg/kg) is not indicative of a hot spot.

Lead was detected in 112 of 113 samples analyzed. This metal was detected in 106 samples at concentrations greater than the HPAL (8.99 mg/kg). Sixteen of the samples (14 locations) contained lead concentrations exceeding the selected RIEC (800 mg/kg). As shown on Figure 4-19, all lead exceedances are within the area of the landfill and most of the exceedances are near locations with concentrations less than the RIEC. None of the LRLs for lead exceeded the selected RIEC. Based on the available characterization data, the extent of lead in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (3,840 mg/kg) is not indicative of a hot spot. However, lead concentrations greater than the RIEC were reported throughout the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Vanadium was detected in all 113 samples analyzed. This metal was detected in ten samples at concentrations greater than the HPAL (117.2 mg/kg). One of the samples contained a concentration exceeding the RIEC (1,000 mg/kg). As shown on Figure 4-20, the vanadium exceedance is within the area of the landfill and is adjacent to a location with concentrations less than the RIEC. None of the LRLs for vanadium exceeded the selected RIEC. Based on the available characterization data, the extent of vanadium in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (24,900 mg/kg) is not indicative of a hot spot.

Pesticides and PCBs

In total, 122 samples were analyzed for pesticides and PCBs. As shown in Table 4-5, 18 pesticides and PCBs were detected at least once at concentrations greater than the LRL. As shown in Table 4-6, two pesticides (dieldrin and heptachlor epoxide), Aroclor-1016 (also referred to as total low risk PCBs), and total high risk PCBs (consisting of all Aroclor compounds except Aroclor-1016) were detected at concentrations exceeding the selected RIEC. Most of the pesticides and PCBs exhibited LRLs greater than the screening criteria for one or more samples due to dilutions of samples and the limitations of analytical methods at the time.

Dieldrin was detected in 19 of 112 samples analyzed. Seven samples (five locations) had concentrations exceeding the selected RIEC (0.11 mg/kg). As shown on Figure 4-21, the exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Fourteen of the LRLs for dieldrin exceeded the selected RIEC. Based on this information, dieldrin within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (0.71 mg/kg) is not indicative of a hot spot.

Heptachlor epoxide was detected in 19 of 112 samples analyzed. Five samples (four locations) had concentrations exceeding the selected RIEC (0.19 mg/kg). As shown on Figure 4-22, the exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Eight of the LRLs for heptachlor epoxide exceeded the selected RIEC. Based on this information, the extent of heptachlor epoxide in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (1.0 mg/kg) is not indicative of a hot spot. However, heptachlor epoxide concentrations greater than the RIEC were reported in the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Total PCBs (high risk) were detected in 82 of 122 samples analyzed. Forty-five samples (28 locations) contained total PCBs (high risk) at concentrations exceeding the selected RIEC (0.74 mg/kg). As shown on Figure 4-23 and 4-24, the samples are within the area of the landfill. Nineteen of the LRLs for individual PCB compounds exceeded the selected RIEC. Based on the available characterization data, total PCBs (high risk) within this depth range are present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area. In addition, concentrations detected in three samples (Grid 171 Sidewall, 3 feet bgs, 380 mg/kg; Grid 165 Sidewall, 5 feet bgs, 99 mg/kg; and IR01MW05A, 8.31 feet bgs, 370 mg/kg) can be considered as hot spot contamination within the landfill when compared to the RIEC.

Aroclor-1016 was detected in 4 of 122 samples analyzed. Two samples contained Aroclor-1016 (also referred to as total low risk PCBs) at concentrations exceeding the selected RIEC (21 mg/kg). As shown on Figure 4-25, the samples are within the area of the landfill and are near samples with concentrations that are less than the RIEC. Two of the LRLs for individual PCB compounds exceeded the selected RIEC. Based on the available characterization data, the extent of total PCBs (low risk) in soil within this depth range is limited when compared to the overall Landfill Area, and the maximum detected concentration (740 mg/kg) is not indicative of a hot spot.

Semivolatile Organic Compounds

In total, 113 samples were analyzed for SVOCs. As shown in Table 4-5, 38 SVOCs were detected at least once at concentrations greater than LRLs. Several SVOCs have LRLs exceeding the RIEC for some samples due to dilutions of samples and the limitations of analytical methods at the time. However, 11 SVOCs (1,4-DCB, 2-methylnaphthalene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)-fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene) were detected at concentrations exceeding the selected RIEC (Table 4-6).

1,4-DCB was detected in 8 of 62 samples analyzed. As shown on Figure 4-26, this SVOC was detected in all eight samples (seven locations) at concentrations exceeding the selected RIEC (0.13 mg/kg). In addition, all but one of the LRLs for 1,4-DCB exceeded the selected RIEC. Based on the available characterization data, 1,4-DCB within this depth range is present, or may be present (at locations with elevated LRLs), at concentrations exceeding the RIEC throughout a large portion of the Landfill Area, and the maximum detected concentration (59 mg/kg) may be indicative of a hot spot.

2-Methylnaphthalene was detected in 26 of 61 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (550 mg/kg). As shown on Figure 4-27, the exceedance is adjacent to a location with a concentration less than the RIEC. None of the LRLs for 2-methylnaphthalene exceeded the selected RIEC. Based on the available characterization data, the extent of 2-methylnaphthalene in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (650 mg/kg) is not indicative of a hot spot.

Anthracene was detected in 23 of 113 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (31 mg/kg). As shown on Figure 4-28, the exceedance is adjacent to a location with a concentration less than the RIEC. One of the LRLs for anthracene exceeded the selected RIEC. Based on the available characterization data, the extent of anthracene in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (210 mg/kg) is not indicative of a hot spot.

Benzo(a)anthracene was detected in 37 of 113 samples analyzed. This SVOC was detected in five samples, including one grid sidewall sample, at concentrations exceeding the selected RIEC (1.3 mg/kg). As shown on Figure 4-29, most of the exceedances are near locations with concentrations less than the RIEC; however, 30 samples had LRLs for benzo(a)anthracene exceeding the selected RIEC. Based on the available characterization data, benzo(a)anthracene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (80 mg/kg) is not indicative of a hot spot.

Benzo(a)pyrene was detected in 41 of 113 samples analyzed. This SVOC was detected in 11 samples at concentrations exceeding the selected RIEC (0.33 mg/kg). One location (Grid 167 Sidewall) had two samples with concentrations exceeding the RIEC; however, only one sample (the maximum concentration, 3 mg/kg) is shown on the figure. As shown on Figure 4-30, most of the exceedances are near locations with concentrations less than the RIEC; however, 41 of the LRLs for benzo(a)pyrene exceeded the selected RIEC. Based on the available characterization data, benzo(a)pyrene within this depth range is present, or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (16 mg/kg) is not indicative of a hot spot.

Benzo(b)fluoranthene was detected in 47 of 113 samples analyzed. This SVOC was detected in seven samples at concentrations exceeding the selected RIEC (1.3 mg/kg). As shown on Figure 4-31, most of the exceedances are near locations with concentrations less than the RIEC; however, 27 of the LRLs for benzo(b)fluoranthene exceeded the selected RIEC. Based on the available characterization data, benzo(a)fluoranthene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (43 mg/kg) is not indicative of a hot spot.

Benzo(k)fluoranthene was detected in 33 of 113 samples analyzed. This SVOC was detected in six samples, including two grid sidewall samples, at concentrations exceeding the selected RIEC (1.3 mg/kg). As shown on Figure 4-32, most of the exceedances are near locations with concentrations less than the RIEC; however, 31 of the LRLs for benzo(k)fluoranthene exceeded the selected RIEC. Based on the available characterization data, benzo(k)fluoranthene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (13 mg/kg) is not indicative of a hot spot.

Chrysene was detected in 51 of 113 samples analyzed. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (13 mg/kg). As shown on Figure 4-33, the exceedances are near locations with concentrations less than the RIEC. One of the LRLs for chrysene exceeded the selected RIEC. Based on the available characterization data, the extent of chrysene in soil within this

depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (77 mg/kg) is not indicative of a hot spot.

Dibenz(a,h)anthracene was detected in 7 of 113 samples analyzed. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (0.33 mg/kg). As shown on Figure 4-34, 48 of the LRLs for dibenz(a,h)anthracene exceeded the selected RIEC. Based on the available characterization data, dibenz(a,h)anthracene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (1.5 mg/kg) is not indicative of a hot spot.

Indeno(1,2,3-cd)pyrene was detected in 27 of 113 samples analyzed. This SVOC was detected in four samples at concentrations exceeding the selected RIEC (1.3 mg/kg). As shown on Figure 4-35, most of the exceedances are near locations with concentrations less than the RIEC; however, 33 of the LRLs for indeno(1,2,3-cd)pyrene exceeded the selected RIEC. Based on the available characterization data, indeno(1,2,3-cd)pyrene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (5.6 mg/kg) is not indicative of a hot spot.

Naphthalene was detected in 32 of 113 samples greater than detection limits. This SVOC was detected in 11 samples at concentrations exceeding the selected RIEC (1.5 mg/kg). As shown on Figure 4-36, 24 of the LRLs for naphthalene exceeded the selected RIEC. Based on the available characterization data, naphthalene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area and the maximum detected concentration (1,400 mg/kg) may be indicative of a hot spot.

Volatile Organic Compounds

In total, 56 samples were analyzed for VOCs. As shown in Table 4-5, 11 VOCs (1,1,2-TCA, 2-butanone, 4-methyl-2-pentanone, acetone, benzene, carbon disulfide, chlorobenzene, ethylbenzene, styrene, toluene, and xylenes [total]) were detected in at least one sample. Seven VOCs (1,1,2,2-tetrichloroethane, 1,1,2-TCA, 1,1-dichloroethane [DCA], 1,2-DCA, 1,2-dichloropropane, chloroform, and TCE) had LRLs exceeding the RIEC due to dilutions of samples. One VOC (ethylbenzene) exceeded the RIEC (Table 4-6).

Ethylbenzene was detected in 18 of 56 samples greater than detection limits. As shown on Figure 4-37, this VOC was detected in four samples at concentrations exceeding the selected RIEC (5 mg/kg). Based on the available characterization data, the extent of ethylbenzene in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (40 mg/kg) is not indicative of a hot spot.

Petroleum Hydrocarbons

Total TPH is the sum of the concentrations of TPH-g, TPH-d, TPH-mo, TPH as unknown purgeables, and TPH as unknown extractables (Shaw, 2007). Total TPH was calculated for 107 samples (Table 4-5). Ninety-two samples contained detectable concentrations of total TPH. As described in Section 4.1.3.2, the total value was mapped and the other compounds will be used as additional information. As shown on Figure 4-38, total TPH was detected exceeding the selected RIEC (3,500 mg/kg) in 13 samples, but most of these exceedances were near locations with concentrations less than the RIEC. Thirteen samples contained concentrations of TOG exceeding the selected RIEC (3,500 mg/kg), and 16 samples contained concentrations of TPH-d exceeding the selected RIEC (750 mg/kg). Three samples contained concentrations of TPH-mo exceeding the selected RIEC (4,600 mg/kg). Based on the available characterization data, the extent of total TPH in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected total TPH concentration (22,080 mg/kg) is not indicative of a hot spot. However, total TPH concentrations greater than the RIEC were reported throughout the shoreline portion of the PCB Hot Spot Area, which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

4.2.4.3. Landfill Area Deep Soil (greater than 10 feet bgs)

Table 4-7 shows all the chemicals that were detected in samples collected at depths greater than 10 feet, and Table 4-8 lists the chemicals that exceeded screening criteria at a depth greater than 10 feet.

Metals

In total, 108 samples were analyzed for one or more metals. As shown in Table 4-7, all metals were detected in at least one sample. Fifteen metals (antimony, arsenic, barium, beryllium, cadmium, chromium [total], cobalt, copper, lead, manganese, mercury, molybdenum, silver, vanadium, and zinc) were detected at concentrations greater than HPALs. As shown in Table 4-8, five metals (arsenic, cadmium, chromium [total], iron, and lead) were detected at concentrations exceeding the RIEC.

Arsenic was detected in 86 of 97 samples analyzed. As shown on Figure 4-39, this metal was detected in 21 samples (16 locations) at concentrations exceeding the HPAL (11.1 mg/kg), which is the selected RIEC. None of the LRLs for arsenic exceeded the selected RIEC. Based on the available characterization data, arsenic within this depth range is present at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (49 mg/kg) is not indicative of a hot spot.

Cadmium was detected in 51 of 97 samples analyzed. This metal was detected in 17 samples at concentrations greater than the HPAL (3.14 mg/kg). As shown on Figure 4-40, two samples contained concentrations of cadmium exceeding the selected RIEC (38 mg/kg). None of the LRLs for cadmium exceeded the selected RIEC. Based on the available characterization data, the extent of cadmium in soil

within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (113 mg/kg) is not indicative of a hot spot.

Chromium (total) was detected in 96 of 97 samples analyzed. This metal was detected in 23 samples at concentrations greater than the location-specific HPALs. As shown on Figure 4-41, 17 samples (12 locations) contained concentrations of chromium exceeding the selected RIEC, which is based on the HPAL and the 2004 industrial PRG (450 mg/kg), whichever is the higher value. None of the LRLs for chromium exceeded the selected RIEC. Based on the available characterization data, chromium within this depth range is present at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (3,590 mg/kg) is not indicative of a hot spot.

Iron was detected in all 96 samples analyzed. This metal was detected in two samples at concentrations exceeding the selected RIEC (100,000 mg/kg). As shown on Figure 4-42, the iron exceedances are near locations with concentrations less than the RIEC. None of the LRLs for iron exceeded the selected RIEC. Based on the available characterization data, the extent of iron in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (163,000 mg/kg) is not indicative of a hot spot.

Lead was detected in 96 of 97 samples analyzed. This metal was detected in 74 samples at concentrations greater than the HPAL (8.99 mg/kg). As shown on Figure 4-43, seven samples (five locations) contained concentrations of lead exceeding the selected RIEC (800 mg/kg). None of the LRLs for lead exceeded the selected RIEC. Based on the available characterization data, the extent of lead in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (15,700 mg/kg) is not indicative of a hot spot.

Pesticides and PCBs

In total, 103 samples were analyzed for pesticides and PCBs. As shown in Table 4-7, five pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan sulfate, and heptachlor epoxide), Aroclor-1016 (also referred to as total low risk PCBs), and total high risk PCBs (consisting of all Aroclor compounds except Aroclor-1016) were detected in at least one sample. Most PCBs had LRLs exceeding the selected RIEC in some samples due to dilutions of samples and the limitations of analytical methods at the time. As shown in Table 4-8, only total high risk and low risk PCBs were detected at concentrations exceeding the RIEC; no pesticides were detected at concentrations exceeding the RIEC.

Total PCBs (high risk) were detected in 55 of 103 samples analyzed. As shown on Figure 4-44, 31 samples (23 locations) contained concentrations of total high risk PCBs exceeding the RIEC (0.74 mg/kg). In addition, fifteen of the LRLs for individual high risk PCB compounds exceeded the selected RIEC. Based on the available characterization data, the extent of total PCBs within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the

RIEC throughout a large portion of the landfill, and the magnitude of several PCB concentrations are indicative of potential hot spots. Concentrations (103.9, 2,540, and 32,000 mg/kg, respectively) detected in three samples from IR01B012 (at 16.97 feet bgs), IR01MW17B (at 11.25 feet bgs), and IR01B019 (at 16.25 feet bgs) can be considered as hot spot contamination within the landfill when compared to the RIEC.

Aroclor-1016 was detected in 2 of 103 samples analyzed. One sample contained Aroclor-1016 (also referred to as total low risk PCBs) at a concentration exceeding the RIEC (21 mg/kg). As shown on Figure 4-45, the exceedance is nearby a location with a concentration less than the RIEC. In addition, three of the LRLs for individual PCB compounds exceeded the selected RIEC. Based on the available characterization data, the extent of total PCBs (low risk) in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (250 mg/kg) is not indicative of a hot spot.

Semivolatile Organic Compounds

In total, 98 samples were analyzed for SVOCs. As shown in Table 4-7, 35 SVOCs were detected at least once at concentrations greater than the LRL. Six SVOCs [1,4-DCB, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, naphthalene, and n-nitroso-di-n-propylamine] were detected at concentrations exceeding the selected RIEC (Table 4-8). Several SVOCs had LRLs greater than the screening criteria for some samples due to dilutions of samples and the limitations of analytical methods at the time.

1,4-DCB was detected in 13 of 81 samples analyzed. As shown on Figure 4-46, this SVOC was detected in nine samples (six locations) at concentrations exceeding the selected RIEC (0.13 mg/kg). In addition, 24 of the LRLs for 1,4-DCB exceeded the selected RIEC. Based on the available characterization data, 1,4-DCB within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (6.46 mg/kg) is not indicative of a hot spot.

Benzo(a)anthracene was detected in 15 of 97 samples analyzed. As shown on Figure 4-47, this SVOC was detected in one sample at a concentration exceeding the selected RIEC (2.1 mg/kg). In addition, 25 of the LRLs for benzo(a)anthracene exceeded the selected RIEC. Based on the available characterization data, benzo(a)anthracene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (3.78 mg/kg) is not indicative of a hot spot.

Benzo(a)pyrene was detected in 10 of 97 samples analyzed. As shown on Figure 4-48, this SVOC was detected in six samples (five locations) at concentrations exceeding the selected RIEC (0.33 mg/kg). One location (IR01SH030) had two samples with concentrations exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, 39 of the LRLs for

benzo(a)pyrene exceeded the selected RIEC. Based on the available characterization data, benzo(a)pyrene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (1.8 mg/kg) is not indicative of a hot spot.

Benzo(b)fluoranthene was detected in 12 of 97 samples analyzed. As shown on Figure 4-49, this SVOC was detected in one sample at a concentration exceeding the selected RIEC (2.1 mg/kg). In addition, 30 of the LRLs for benzo(b)fluoranthene exceeded the selected RIEC. Based on the available characterization data, benzo(b)fluoranthene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (2.7 mg/kg) is not indicative of a hot spot.

Naphthalene was detected in 23 of 98 samples analyzed. As shown on Figure 4-50, this SVOC was detected in 13 samples (10 locations) at concentrations exceeding the selected RIEC (1.5 mg/kg). In addition, 23 of the LRLs for naphthalene exceeded the selected RIEC. Based on the available characterization data, naphthalene within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (31.1 mg/kg) is not indicative of a hot spot.

n-Nitroso-di-n-propylamine was detected in 1 of 97 samples analyzed. As shown on Figure 4-51, the detected concentration exceeded the selected RIEC (0.25 mg/kg). In addition, all of the LRLs for n-nitroso-di-n-propylamine exceeded the selected RIEC. Based on the available characterization data, n-nitroso-di-n-propylamine within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (0.43 mg/kg) is not indicative of a hot spot.

Volatile Organic Compounds

In total, 78 samples were analyzed for VOCs. As shown in Table 4-7, 21 VOCs were detected at least once at concentrations greater than the LRL. In addition, four VOCs (carbon tetrachloride, ethylbenzene, PCE, and xylenes [total]) were detected at concentrations exceeding the selected RIEC (Table 4-8). Several VOCs had LRLs exceeding the selected RIEC for some samples due to dilutions of samples and the limitations of analytical methods at the time.

Carbon tetrachloride was detected in 1 of the 78 samples analyzed. As shown on Figure 4-52, the detected concentration exceeded the selected RIEC (0.034 mg/kg). In addition, eight of the LRLs for carbon tetrachloride exceeded the selected RIEC. Based on the available characterization data, carbon tetrachloride within this depth range is present or may be present (at locations with elevated LRLs) at concentrations exceeding the RIEC throughout a large portion of the Landfill Area; however, the maximum detected concentration (0.37 mg/kg) is not indicative of a hot spot.

Ethylbenzene was detected in 26 of 78 samples greater than detection limits. As shown on Figure 4-53, This VOC was detected in 3 samples at concentrations exceeding the selected RIEC (5 mg/kg). None of the LRLs for ethylbenzene exceeded the selected RIEC. Based on the available characterization data, the extent of ethylbenzene in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (55.7 mg/kg) is not indicative of a hot spot.

Tetrachloroethene was detected in 1 of the 78 samples analyzed. As shown on Figure 4-54, the detected concentration exceeded the selected RIEC (0.24 mg/kg). In addition, five of the LRLs for tetrachloroethene exceeded the selected RIEC. Based on the available characterization data, the extent of tetrachloroethene in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (0.29 mg/kg) is not indicative of a hot spot.

Xylenes (total) was detected in 32 of 77 samples analyzed. As shown on Figure 4-55, this VOC was detected in one sample at a concentration exceeding the selected RIEC (420 mg/kg). None of the LRLs for xylenes (total) exceeded the selected RIEC. Based on the available characterization data, the extent of xylenes (total) in soil within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (519 mg/kg) is not indicative of a hot spot.

Petroleum Hydrocarbons

Total TPH is the sum of the concentrations of TPH-g, TPH-d, TPH-mo, TPH as unknown purgeables, and TPH as unknown extractables (Shaw, 2007). Total TPH was calculated for 89 samples (Table 4-7). Fifty-nine samples exhibited concentrations greater than the LRLs. As shown on Figure 4-56, total TPH was detected at concentrations exceeding the RIEC (3,500 mg/kg) in nine samples (seven locations), but most of these exceedances were near locations with concentrations less than the RIEC. Eighteen samples had concentrations of TOG exceeding the RIEC (3,500 mg/kg). TPH-d was detected in two samples at concentrations exceeding the RIEC (750 mg/kg). Based on the available characterization data, the extent of total TPH within this depth range is limited when compared to the overall Landfill Area and the maximum detected concentration (22,900 mg/kg) is not indicative of a hot spot. However, total TPH concentrations greater than the RIEC were reported near the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

4.3. PANHANDLE AREA

The nature and extent of contamination at the Panhandle Area was evaluated based on information from the previous investigations and TCRAs described in Section 3. Based on data from the 82 soil borings and five test pits extended within the Panhandle Area, fill material consists primarily of soil and rock fill, with lesser quantities of inert construction debris and isolated locations of putrescible construction debris (e.g., wood). Some of the industrial waste types reportedly disposed of in the Landfill Area may also be

present within the Panhandle Area. The following information summarizes the industrial wastes that may have been disposed of in or around the Panhandle Area:

- The HRA indicated that areas within IR Site 01/21, including areas outside of the landfill boundaries, were a disposal area for radioluminescent devices (primarily containing radium-226) and a potential disposal area for wastes from decontamination of ships used in atomic testing (NAVSEA, 2004).
- Previous shoreline investigations identified a Metal Slag Area within the Panhandle and Shoreline Areas. The metal slag is composed of discontinuous industrial debris and metal slag with radioactive anomalies. This area was excavated under an interim removal action (TtECI, 2007b).
- Triple A allegedly disposed of industrial debris, sandblast waste, oily industrial sand, and asphalt over an area of approximately 5 acres along the shoreline of Parcel E-2, which extends into the Panhandle Area (see Figure 1-11; San Francisco District Attorney, 1986).
- Waste fuel and waste oil containing PCBs were used at the Parcel E-2 Landfill as dust suppressants (TtEMI, LFR, and U&A, 1997).

As discussed in Section 4.1.3.4, chemical concentrations in soil that exceed the corresponding RIEC will be considered adequately delineated in a given direction if there are four or more nearby samples (within 150 feet) surrounding the exceedance (in a general north, south, east, and west direction) with concentrations less than the RIEC. The following subsections discuss the characteristics of the fill and isolated solid waste locations (Section 4.3.1) and the nature and extent of chemicals in soil (Section 4.3.2). The data presented in Section 4.3.2 include post-excavation data from the removal action at the Metal Slag Area. Some of this post-excavation data extended into the Shoreline Area, but is presented in this section because it represents soil conditions underlying the Metal Slag Area (as opposed to intertidal sediment evaluated in Appendix G).

4.3.1. Characteristics and Extent of Fill and Isolated Solid Waste Locations

The Panhandle Area includes isolated solid waste locations and soil within the Parcel E-2 boundary but outside the Landfill and Shoreline Area boundaries. The methods for identifying these isolated solid waste locations were discussed in Section 4.1.1.2.

The evaluation revealed 48 locations in the Panhandle Area where solid waste was encountered. Of these 48 locations, 28 contained inert construction debris and 20 contained putrescible construction debris. The isolated waste locations are shown on Figure 4-1.

Construction debris encountered in the Panhandle Area include concrete, brick, wood, gravel, sand, soil, and asphalt, with limited amounts of ceramic, glass, and metals. With the exception of wood, the remaining types of construction debris are considered inert and are not expected to generate methane gas or leachate that would create potential risks to human health or the environment.

The industrial and municipal-type wastes encountered within the Metal Slag Area include metal slag and debris containing low-level radiological material and devices (TtECI, 2007b). All excavated soil and waste removed from the Metal Slag Area was handled and screened as potential low-level radioactive waste (LLRW) based on the findings of the HRA (NAVSEA, 2004). Out of a total excavated volume of 8,200 cubic yards, approximately 74 cubic yards of soil and sediment was segregated as radiologically impacted. In addition, 32 radiological devices, 15 cubic yards of radiological debris (primarily fire bricks), and approximately 30 cubic yards of metal debris were identified within the removal area (Navy, 2006a and 2006b; TtECI, 2007b). In addition to this radiologically impacted debris, six waste drums were recovered from the removal area and were characterized prior to off-site disposal. The drums, which were discovered in varying degrees of deterioration, contained grease, soil, plastic, metal, and wood. Waste characterization data indicated that five of the six drums contained various chemicals, including PCBs and petroleum hydrocarbons; the sixth drum contained elevated activity levels of radium-226 (TtECI, 2007b).

4.3.2. Chemicals Detected in Panhandle Area Soil

Soil data within the Panhandle Area are presented in a similar manner as for the Landfill Area and East Adjacent Area for consistency purposes. As discussed in Section 4.1.3, comprehensive data summary tables for the Panhandle Area are presented in Appendix J1 by chemical category (i.e., metals, pesticides, PCBs, dioxins, furans, SVOCs, VOCs, and petroleum hydrocarbons) and depth interval (0 to 2 feet bgs, 2 to 10 feet bgs, and greater than 10 feet bgs). In addition, each table presents a series of summary statistics of the data for each chemical, such as the number of samples collected; number of results that exceed the detection limit; minimum and maximum concentrations detected; and median, mean, and standard deviation of the detected results for each chemical. Each table also lists all potential screening criteria and quantifies the number of results that exceed each criterion.

The following subsections describe the chemical characteristics of the soil fill within the Panhandle Area.

4.3.2.1. Panhandle Area Surface Soil (0 to 2 feet bgs)

Table 4-9 shows all of the chemicals that were detected in at least one sample collected at a depth of 2 feet bgs or less; Table 4-10 lists the detected chemicals that exceeded screening criteria at the 0- to 2-foot depth interval.

Metals

In total, 77 samples were analyzed for one or more metals. As shown in Table 4-9, all metals, except tin, were detected in at least one sample at concentrations greater than the LRL. Seventeen metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, selenium, silver, thallium, vanadium, and zinc) were detected at concentrations greater than HPALs. As shown in Table 4-10, only seven metals (antimony, arsenic, cadmium, iron, lead, mercury, and vanadium)

exceeded the selected RIEC. One metal (arsenic) had LRLs exceeding the selected RIEC due to dilutions of samples.

Antimony was detected in 27 of 77 samples analyzed. This metal was detected in 14 samples at concentrations greater than the HPAL (9.05 mg/kg). One sample had a concentration exceeding the selected RIEC (380 mg/kg). None of the LRLs for antimony exceeded the selected RIEC. As shown on Figure 4-57, the detected exceedance is surrounded to the west and south by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of antimony in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (530 mg/kg) is not indicative of a hot spot.

Arsenic was detected in 65 of 77 samples analyzed. This metal was detected in 12 samples (11 locations) at concentrations exceeding the RIEC (11.1 mg/kg). One location (IR01B368) had two samples with concentrations exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. Three of the LRLs for arsenic exceeded the selected RIEC. As shown on Figure 4-58, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of arsenic in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (215 mg/kg) is not indicative of a hot spot.

Cadmium was detected in 31 of 77 samples analyzed. This metal was detected in 14 samples at concentrations greater than the HPAL (3.14 mg/kg). Three samples from two locations contained concentrations exceeding the selected RIEC (7.4 mg/kg). One location (IR01B368) had two samples with concentrations exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. None of the LRLs for cadmium exceeded the selected RIEC. As shown on Figure 4-59, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of cadmium in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (37 mg/kg) is not indicative of a hot spot.

Iron was detected in 67 of 68 samples analyzed. No comparison against ambient levels was made because an HPAL has not been established for iron. Three samples contained concentrations of iron exceeding the selected RIEC (100,000 mg/kg). One location (IR01B368) had two samples with concentrations exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. None of the LRLs for iron exceeded the selected RIEC. As shown on Figure 4-60, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of iron in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (190,000 mg/kg) is not indicative of a hot spot.

Lead was detected in 75 of 77 samples analyzed. This metal was detected in 72 samples at concentrations greater than the HPAL (8.99 mg/kg). Sixteen samples (14 locations) contained concentrations exceeding the selected RIEC (800 mg/kg). Two locations (IR01B368 and IR01SW2) had results exceeding the RIEC; however, only one sample per location (the maximum concentration) is shown on the figure. None of the LRLs for lead exceeded the selected RIEC. As shown on Figure 4-4, one detected exceedance at location IR01SW2 is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. The detected exceedances in the southwestern portion of the Panhandle Area are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of lead in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC. Although the maximum detected concentration (9,300 mg/kg) is not indicative of a hot spot, this concentration and other lead concentrations greater than the RIEC were reported throughout the Metal Slag Area.

Mercury was detected in 67 of 77 samples analyzed. This metal was detected in four samples at concentrations greater than the HPAL (2.28 mg/kg). One sample contained a concentration exceeding the selected RIEC (180 mg/kg). None of the LRLs for mercury exceeded the selected RIEC. As shown on Figure 4-61, the detected exceedance is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of mercury in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the maximum detected concentration (190 mg/kg) is not indicative of a hot spot.

Vanadium was detected in 76 of 77 samples analyzed. This metal was detected in 9 samples at concentrations greater than the HPAL (117.2 mg/kg). One sample contained a concentration exceeding the selected RIEC (1,000 mg/kg). None of the LRLs for vanadium exceeded the selected RIEC. As shown on Figure 4-62, the detected exceedance is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of vanadium in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the maximum detected concentration (2,100 mg/kg) is not indicative of a hot spot.

Pesticides and PCBs

In total, 77 samples were analyzed for pesticides and PCBs. As shown in Table 4-9, 26 pesticides and PCBs have at least one detection greater than the LRL. As shown in Table 4-10, two pesticides (4,4'-DDE, and dieldrin) and total high risk PCBs (consisting of all Aroclor compounds except Aroclor-1016) were detected at concentrations exceeding the selected RIEC. Nine pesticides (aldrin, alpha-BHC, beta-BHC, delta-BHC, dieldrin, gamma-BHC [lindane], heptachlor, heptachlor epoxide, and toxaphene) had LRLs exceeding the selected RIEC due to dilutions of samples.

4,4'-DDE was detected in 20 of 77 samples analyzed. This pesticide was detected in one sample at a concentration exceeding the selected RIEC (6.3 mg/kg). None of the LRLs for 4,4'-DDE exceeded the selected RIEC. As shown on Figure 4-63, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of total 4,4'-DDE in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (7.7 mg/kg) is not indicative of a hot spot.

Dieldrin was detected in 15 of 77 samples analyzed. This pesticide was detected in two samples at concentrations exceeding the selected RIEC (0.11 mg/kg). In addition, four of the LRLs for dieldrin exceeded the selected RIEC. As shown on Figure 4-64, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of dieldrin in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (6.4 mg/kg) is not indicative of a hot spot.

Total PCBs (high risk) were detected in 41 of 70 samples analyzed. This PCB was detected in eight samples at concentrations exceeding the selected RIEC (0.74 mg/kg). One additional exceedance (Grid 94) is located in the portion of the Metal Slag Area excavation that extended into the offshore parcel (Parcel F), thus the PCB concentrations at this location are not discussed in this report but are identified in Figure 4-6 for reference purposes. Two of the LRLs for individual PCB compounds exceeded the selected RIEC. As shown on Figure 4-6, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC, except for location IR01B390. Based on this information, the extent of total PCBs in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (20 mg/kg) is not indicative of a hot spot.

Semivolatile Organic Compounds

In total, 61 samples were analyzed for SVOCs. As shown in Table 4-9, 23 SVOCs were detected at least once at concentrations greater than the LRL. Nine SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene] were detected at concentrations exceeding the selected RIEC in at least one sample (Table 4-10). Several of the SVOCs had LRLs exceeding the selected RIEC due to dilutions of samples and the limitations of analytical methods at the time.

Benzo(a)anthracene was detected in 24 of 61 samples analyzed. This SVOC was detected in five samples (four locations) at concentrations exceeding the selected RIEC (1.3 mg/kg). One location (IR01B390) had two samples with concentrations of benzo(a)anthracene exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, four of the LRLs for

benzo(a)anthracene exceeded the selected RIEC. As shown on Figure 4-8, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC, except for location IR01B385. Based on this information, the extent of benzo(a)anthracene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (51 mg/kg) is not indicative of a hot spot.

Benzo(a)pyrene was detected in 25 of 61 samples analyzed. This SVOC was detected in 10 samples (nine locations) at concentrations exceeding the selected RIEC (0.33 mg/kg). One location (IR01B390) had two samples with concentrations of benzo(a)pyrene exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, 15 of the LRLs for benzo(a)pyrene exceeded the selected RIEC. As shown on Figure 4-9, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of benzo(a)pyrene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (16 mg/kg) is not indicative of a hot spot.

Benzo(b)fluoranthene was detected in 39 of 61 samples analyzed. This SVOC was detected in seven samples (six locations) at concentrations exceeding the selected RIEC (1.3 mg/kg). One location (IR01B390) had two samples with concentrations of benzo(b)fluoranthene exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, one of the LRLs for benzo(b)fluoranthene exceeded the selected RIEC. As shown on Figure 4-10, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of benzo(b)fluoranthene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (64 mg/kg) is not indicative of a hot spot.

Benzo(k)fluoranthene was detected in 30 of 61 samples analyzed. This SVOC was detected in nine samples (eight locations) at concentrations exceeding the selected RIEC (1.3 mg/kg). One location (IR01B390) had two samples with concentrations of benzo(k)fluoranthene exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, one of the LRLs for benzo(k)fluoranthene exceeded the selected RIEC. As shown on Figure 4-65, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of benzo(k)fluoranthene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (53 mg/kg) is not indicative of a hot spot.

Bis(2-ethylhexyl)phthalate was detected in 7 of 61 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (120 mg/kg). None of the LRLs for bis(2-ethylhexyl)phthalate exceeded the selected RIEC. As shown on Figure 4-66, the detected

exceedance is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of bis(2-ethylhexyl)phthalate in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the maximum detected concentration (740 mg/kg) is not indicative of a hot spot.

Chrysene was detected in 33 of 61 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (13 mg/kg). None of the LRLs for chrysene exceeded the selected RIEC. As shown on Figure 4-67, the detected exceedance is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of chrysene in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the maximum detected concentration (57 mg/kg) is not indicative of a hot spot.

Dibenz(a,h)anthracene was detected in 5 of 61 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (0.33 mg/kg). In addition, 20 of the LRLs for dibenz(a,h)anthracene exceeded the selected RIEC. As shown on Figure 4-68, the detected exceedance is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of dibenz(a,h)anthracene within this depth range is not adequately delineated; however, the maximum detected concentration (5.3 mg/kg) is not indicative of a hot spot.

Indeno(1,2,3-cd)pyrene was detected in 20 of 61 samples analyzed. This SVOC was detected in four samples (three locations) at concentrations exceeding the selected RIEC (1.3 mg/kg). One location (IR01B390) had two samples with concentrations of indeno(1,2,3-cd)pyrene exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, two of the LRLs for indeno(1,2,3-cd)pyrene exceeded the selected RIEC. As shown on Figure 4-11, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of indeno(1,2,3-cd)pyrene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (17 mg/kg) is not indicative of a hot spot.

Naphthalene was detected in 10 of 62 samples analyzed. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (1.5 mg/kg). In addition, one of the LRLs for naphthalene exceeded the selected RIEC. As shown on Figure 4-12, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of naphthalene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (47 mg/kg) is not indicative of a hot spot.

Volatile Organic Compounds

In total, 14 samples were analyzed for VOCs. As shown in Table 4-9, three VOCs were detected in at least one sample at concentrations greater than the LRL. None of the VOCs were detected at concentrations exceeding the selected RIEC (Table 4-10). Several of the VOCs had LRLs exceeding the RIEC due to dilutions of samples. Because none of the VOCs exceeded the RIEC, they are not shown on a figure.

Petroleum Hydrocarbons

Total TPH is the sum of the concentrations of TPH-g, TPH-d, TPH-mo, TPH as unknown purgeables, and TPH as unknown extractables (Shaw, 2007). Three samples contained total TPH at concentrations exceeding the RIEC (3,500 mg/kg). As shown on Figure 4-69, these exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. TPH-d was found in three samples at concentrations exceeding the RIEC (750 mg/kg). Based on this information, the extent of total TPH in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (7,000 mg/kg) is not indicative of a hot spot.

4.3.2.2. Panhandle Area Subsurface Soil (2 to 10 feet bgs)

Table 4-11 shows all of the chemicals that were detected in samples collected from 2 to 10 foot bgs; Table 4-12 lists the chemicals that exceeded the screening criteria at the 2- to 10-foot depth interval.

Metals

In total, 64 samples were analyzed for one or more metals. As shown in Table 4-11, all metals were detected in at least one sample at concentrations greater than the LRL. Sixteen metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, selenium, silver, vanadium, and zinc) were detected at concentrations greater than HPALs. As shown in Table 4-12, five metals (arsenic, cadmium, iron, lead, and zinc) were detected at concentrations exceeding the selected RIEC.

Arsenic was detected in 62 of 64 samples analyzed. This metal was detected in 12 samples (10 locations) at concentrations exceeding the RIEC (11.1 mg/kg). None of the LRLs for arsenic exceeded the selected RIEC. As shown in Figure 4-14, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of arsenic in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (315 mg/kg) is not indicative of a hot spot.

Cadmium was detected in 44 of 64 samples analyzed. This metal was detected in twelve samples at concentrations greater than the HPAL (3.14 mg/kg). Four samples contained concentrations exceeding the selected RIEC (7.4 mg/kg). None of the LRLs for cadmium exceeded the selected RIEC. As shown on Figure 4-15, none of the detected exceedances, except at MS-07A, MS-13B(1), and Grid 60, are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of cadmium in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (78.4 mg/kg) is not indicative of a hot spot.

Iron was detected in all 38 samples analyzed. Two samples had concentrations exceeding the selected RIEC (100,000 mg/kg). None of the LRLs for iron exceeded the selected RIEC. As shown on Figure 4-18, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of iron in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (471,000 mg/kg) is not indicative of a hot spot.

Lead was detected in all 64 samples analyzed. This metal was detected in 62 samples at concentrations greater than the HPAL (8.99 mg/kg). Thirteen samples (10 locations) contained lead at concentrations exceeding the selected RIEC (800 mg/kg). None of the LRLs for lead exceeded the selected RIEC. As shown on Figure 4-19, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of lead in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC. Although the maximum detected concentration (5,600 mg/kg) is not indicative of a hot spot, lead concentrations greater than the RIEC were reported throughout the Metal Slag Area.

Zinc was detected in all 64 samples analyzed. This metal was detected in 43 samples at concentrations greater than the HPAL (109.9 mg/kg). One sample contained zinc at a concentration exceeding the selected RIEC (100,000 mg/kg). None of the LRLs for zinc exceeded the selected RIEC. As shown on Figure 4-70, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of zinc in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (116,000 mg/kg) is not indicative of a hot spot.

Pesticides and PCBs

In total, 64 samples were analyzed for pesticides and PCBs. As shown in Table 4-11, 20 pesticides and PCBs were detected in at least one sample at concentrations greater than the LRL. As shown in Table 4-12, total high risk PCBs (consisting of all Aroclor compounds except Aroclor-1016) were detected at concentrations exceeding the selected RIEC. Two pesticides (dieldrin and toxaphene) and six

Aroclor compounds (Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260) had LRLs exceeding the selected RIEC due to dilutions of samples.

Total PCBs (high risk) were detected in 38 of 64 samples analyzed. This PCB was detected in seven samples (five locations) at concentrations exceeding the selected RIEC (0.74 mg/kg). In addition, two of the LRLs for individual PCB compounds exceeded the selected RIEC. As shown on Figure 4-23, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of total PCBs in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (3.9 mg/kg) is not indicative of a hot spot.

Dioxins and Furans

Ten samples were analyzed for chlorinated dibenzo-p-dioxins (simply referred to as "dioxins") and chlorinated dibenzofurans (simply referred to as "furans"). As shown in Table 4-11, all of these chemicals were detected in at least one sample at concentrations greater than the LRL. Dioxins and furans are commonly assessed and reported as a single dioxin toxicity equivalent quotient (TEQ) concentration relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). The dioxin and furan TEQ concentration is calculated by multiplying the concentration of each dioxin and furan congener by a toxicity equivalency factor established by the 2005 World Health Organization and based on each congener's toxicity relative to 2,3,7,8-TCDD (Van den Berg, et. al, 2006). As shown in Table 4-12, the dioxin and furan TEQs were reported at concentrations exceeding the selected RIEC. No dioxins and furans have LRLs exceeding the selected RIEC.

The dioxin and furan TEQ was reported in 8 of 10 samples at concentrations exceeding the selected RIEC (0.016 μg/kg). As shown on Figure 4-71, the reported exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of dioxins and furans (as represented by the 2,3,7,8-TCDD TEQ) in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum reported concentration (0.183 μg/kg) is not indicative of a hot spot.

Semivolatile Organic Compounds

In total, 52 samples were analyzed for SVOCs. As shown in Table 4-11, 32 SVOCs were detected in at least one sample at concentrations greater than the LRL. Three analytes [1,4-DCB, benzo(a)pyrene, and naphthalene] were detected at concentrations exceeding the selected RIEC (Table 4-12). Several of the SVOCs had LRLs exceeding the selected RIEC for some samples due to dilutions of samples and the limitations of analytical methods at the time.

1,4-DCB was detected in 2 of 50 samples analyzed. One sample had a concentration exceeding the selected RIEC (0.13 mg/kg). In addition, 25 of the LRLs for 1,4-DCB exceeded the selected RIEC. As shown on Figure 4-26, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of 1,4-DCB within this depth range is not adequately delineated; however, the maximum detected concentration (0.21 mg/kg) is not indicative of a hot spot.

Benzo(a)pyrene was detected in 15 of 52 samples analyzed. Six samples (four locations) had concentrations exceeding the selected RIEC (0.33 mg/kg). In addition, 18 of the LRLs for benzo(a)pyrene exceeded the selected RIEC. As shown on Figure 4-30, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of benzo(a)pyrene within this depth range is not adequately delineated; however, the maximum detected concentration (0.65 mg/kg) is not indicative of a hot spot.

Naphthalene was detected in 14 of 56 samples at concentrations greater than the LRL. This SVOC was detected in seven samples (six locations) at concentrations exceeding the selected RIEC (1.5 mg/kg). One location (IR01MW58A) had two samples with concentrations of naphthalene exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, seven of the LRLs for naphthalene exceeded the selected RIEC. As shown on Figure 4-36, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of naphthalene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (120 mg/kg) is not indicative of a hot spot.

Volatile Organic Compounds

In total, 35 samples were analyzed for VOCs. As shown in Table 4-11, 16 VOCs were detected in at least one sample at concentrations greater than the LRL. One VOC (ethylbenzene) exceeded the selected RIEC (Table 4-12). Several of the analytes had LRLs exceeding the selected RIEC for some samples due to dilutions of samples and the limitations of analytical methods at the time.

Ethylbenzene was detected in 3 of 35 samples greater than detection limits. This VOC was detected in one sample at concentrations exceeding the selected RIEC (5 mg/kg). As shown on Figure 4-37, three of the LRLs for ethylbenzene exceeded the selected RIEC. As shown on Figure 4-37, the exceedance is surrounded on three sides within 150 feet and to the east within 175 feet. Based on this information, the extent of ethylbenzene in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the single detected exceedance (6.7 mg/kg) is not indicative of a hot spot.

Petroleum Hydrocarbons

Total TPH is the sum of the concentrations of TPH-g, TPH-d, TPH-mo, TPH as unknown purgeables, and TPH as unknown extractables (Shaw, 2007). In total, 29 samples were used to calculate total TPH values. As shown on Figure 4-38, none of the samples contained total TPH at concentrations exceeding the selected RIEC (3,500 mg/kg). TPH-d was detected in one sample at a concentration exceeding the RIEC (750 mg/kg). Two samples from IR01MW58A and IR01MW63A had TOG concentrations (3,900 and 5,800 mg/kg, respectively) exceeding the RIEC. Because none of the total TPH concentrations exceeded the RIEC, they are not shown on a figure.

4.3.2.3. Panhandle Area Deep Soil (greater than 10 feet)

Table 4-13 shows all of the chemicals that were detected in samples collected at depths greater than 10 feet bgs; Table 4-14 list the chemicals that exceeded the screening criteria at the greater than 10-foot depth interval.

Metals

In total, 62 samples were analyzed for one or more metals. As shown in Table 4-13, all metals, except tin, were detected in at least one sample at concentrations greater than the LRL. As shown in Table 4-14, 15 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, selenium, silver, vanadium, and zinc) were detected at concentrations greater than HPALs. Three metals (arsenic, chromium [total], and lead) were detected at concentrations exceeding the selected RIEC. No metals have LRLs exceeding the selected RIEC.

Arsenic was detected in 36 of 40 samples analyzed. This metal was detected in six samples (five locations) at concentrations exceeding the HPAL (11.1 mg/kg), which is the selected RIEC. One location (MS-12A) had two samples with arsenic concentrations exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. None of the LRLs for arsenic exceeded the selected RIEC. As shown on Figure 4-39, none of the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of arsenic in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (20 mg/kg) is not indicative of a hot spot.

Chromium (total) was detected in all 40 samples analyzed. This metal was detected in two samples at concentrations exceeding the location-specific HPALs (171.57 mg/kg and 48.56 mg/kg, respectively) and the selected RIEC (450 mg/kg). None of the LRLs for chromium exceeded the selected RIEC. As shown on Figure 4-41, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) in all directions with concentrations less than the RIEC. Based on this information, the extent of chromium in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the single detected exceedance (700 mg/kg) is not indicative of a hot spot.

Lead was detected in 39 of 40 samples analyzed. This metal was detected in 28 samples at concentrations greater than the HPAL (8.99 mg/kg). Five samples (four locations) had concentrations exceeding the selected RIEC (800 mg/kg). One location (MS-12A) had two samples with concentrations of lead exceeding the RIEC; however, only the maximum concentration is shown on the figure. None of the LRLs for lead exceeded the selected RIEC. As shown on Figure 4-43, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of lead in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (3,200 mg/kg) is not indicative of a hot spot.

Pesticides and PCBs

In total, 38 samples were analyzed for pesticides and PCBs. As shown in Table 4-13, eight pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, beta-BHC, dieldrin, endrin ketone, heptachlor epoxide, and methoxychlor) and total high risk PCBs (consisting of all Aroclor compounds except Aroclor-1016) were detected in at least one sample at concentrations greater than the LRL. One pesticide (aldrin) and five Aroclor compounds (Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1254, and Aroclor-1260) had LRLs exceeding the selected RIEC for some samples due to dilutions of samples and the limitations of analytical methods at the time. As shown in Table 4-14, none of the pesticides and PCBs have been detected at concentrations exceeding the selected RIEC. As a result, these chemicals are not shown on a figure for this depth interval.

Dioxins and Furans

Two samples were analyzed for chlorinated dibenzo-p-dioxins (simply referred to as "dioxins") and chlorinated dibenzofurans (simply referred to as "furans"). As shown in Table 4-13, all but three of these chemicals were detected in at least one sample at concentrations greater than the LRL. Dioxins and furans are commonly assessed and reported as a single dioxin TEQ concentration relative to 2,3,7,8-TCDD. The dioxin and furan TEQ concentration is calculated by multiplying the concentration of each dioxin and furan congener by a toxicity equivalency factor established by the 2005 World Health Organization and based on each congener's toxicity relative to 2,3,7,8-TCDD (Van den Berg, et. al, 2006). As shown in Table 4-14, the dioxin and furan TEQs were reported at concentrations exceeding the selected RIEC. No dioxins and furans have LRLs exceeding the selected RIEC.

The dioxin and furan TEQ was reported in both samples analyzed at concentrations exceeding the selected RIEC (0.016 µg/kg). As shown on Figure 4-72, the reported exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of dioxins and furans (as represented by the 2,3,7,8-TCDD TEQ) in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the reported concentration (0.959 µg/kg) is not indicative of a hot spot.

Semivolatile Organic Compounds

In total, 40 samples were analyzed for SVOCs. As shown in Table 4-13, 24 SVOCs were detected in at least one sample at concentrations greater than the LRL. Five SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and naphthalene] were detected at concentrations exceeding the selected RIEC (Table 4-14). Several of the SVOCs had LRLs exceeding the selected RIEC for some samples due to dilutions of samples and the limitations of analytical methods at the time.

Benzo(a)anthracene was detected in 4 of 40 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (2.1 mg/kg). In addition, three of the LRLs for benzo(a)anthracene exceeded the selected RIEC. As shown on Figure 4-47, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of benzo(a)anthracene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the single detected exceedance (3.3 mg/kg) is not indicative of a hot spot.

Benzo(a)pyrene was detected in 5 of 40 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (0.33 mg/kg). In addition, 14 of the LRLs for benzo(a)pyrene exceeded the selected RIEC. As shown on Figure 4-48, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of benzo(a)pyrene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the single detected exceedance (1.4 mg/kg) is not indicative of a hot spot.

Benzo(b)fluoranthene was detected in 4 of 40 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (2.1 mg/kg). In addition, three of the LRLs for benzo(a)fluoranthene exceeded the selected RIEC. As shown on Figure 4-49, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of benzo(a)fluoranthene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the single detected exceedance (3.6 mg/kg) is not indicative of a hot spot.

Indeno(1,2,3-cd)pyrene was detected in 1 of 40 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (2.1 mg/kg). In addition, three of the LRLs for indeno(1,2,3-cd)pyrene exceeded the selected RIEC. As shown on Figure 4-73, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of indeno(1,2,3-cd)pyrene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the single detected exceedance (2.7 mg/kg) is not indicative of a hot spot.

Naphthalene was detected in 7 of 40 samples analyzed. This SVOC was detected in three samples (two locations) at concentrations exceeding the selected RIEC (1.5 mg/kg). One location (IR01MW58A) had two samples with concentrations of naphthalene exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, one of the LRLs for naphthalene exceeded the selected RIEC. As shown on Figure 4-50, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations that are less than the RIEC. Based on this information, the extent of naphthalene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (110 mg/kg) is not indicative of a hot spot.

Volatile Organic Compounds

In total, 34 samples were analyzed for VOCs. As shown in Table 4-13, four VOCs were detected in at least one sample at concentrations greater than the LRL. None of the VOCs were detected at concentrations exceeding the selected RIEC. As a result, VOCs greater than 10 feet bgs are not shown on a figure.

Petroleum Hydrocarbons

Total TPH is the sum of the concentrations of TPH-g, TPH-d, TPH-mo, TPH as unknown purgeables, and TPH as unknown extractables (Shaw, 2007). Total TPH was calculated for 33 samples. Total TPH concentrations in 17 samples are greater than the LRLs. As shown on Figure 4-56, one sample had a total TPH concentration exceeding the RIEC (3,500 mg/kg). This total TPH exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations that are less than the RIEC. Four samples contained concentrations of TOG exceeding the RIEC (3,500 mg/kg). Based on this information, the extent of total TPH in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the single total TPH exceedance (6,700 mg/kg) is not indicative of a hot spot.

4.4. EAST ADJACENT AREA

The nature and extent of contamination at the East Adjacent Area was evaluated based on information from the previous investigations and TCRAs described in Section 3. Based on data from the 106 soil borings and nine test pits extended within the East Adjacent Area, fill material consists primarily of soil and rock fill, with lesser quantities of inert construction debris and isolated locations of putrescible construction debris (e.g., wood). Some of the industrial waste types reportedly disposed of in the Landfill Area may also be present within the East Adjacent Area. The following information summarizes the industrial wastes that may have been disposed of in or around the East Adjacent Area:

- The HRA indicated that areas within IR Site 01/21, including areas outside of the landfill boundaries, were a disposal area for radioluminescent devices (primarily containing radium-226) and a potential disposal area for wastes from decontamination of ships used in atomic testing (NAVSEA, 2004).
- The SDGI identified a hot spot of PCBs within the East Adjacent and Landfill Areas. The area contains elevated concentrations of PCBs and petroleum hydrocarbons that are attributed to the disposal of waste oils. This area was partially excavated under an interim removal action (TtECI, 2007a).
- The presence of sandblast waste was encountered in the East Adjacent Area in several borings and test pits installed during the RI and SDGI. Figure 4-1 identifies these borings and test pits. The presence of sandblast waste within the East Adjacent Area was confirmed during implementation of the PCB Hot Spot Area removal (Navy, 2005b and 2005c). Sandblast waste is of radiological concern because it contains naturally occurring radioactive materials and it was used in the decontamination of ships used in atomic testing.
- 110 drums and 537 assorted waste containers were recovered from the central portion of the PCB Hot Spot Area. The drums, which were discovered in varying degrees of decay, contained grease, oil, soil, asphalt, and tar substances. The small containers contained various laboratory chemicals, ranging from strong acids and bases to solvents, alcohols, and inorganic salts (TtECI, 2007a).
- Waste fuel and waste oil containing PCBs were used at the Parcel E-2 Landfill as dust suppressants (TtEMI, LFR, and U&A, 1997).
- Triple A allegedly disposed of lead-based paints, asbestos-containing debris, paint chips, chlorinated solvents, and other waste liquids in a disposal trench area located adjacent to Parcel E-2 (San Francisco District Attorney, 1986; TtEMI, LFR, and U&A, 1997). The area, known as Triple A Site 4 (Figure 1-11), was investigated by the Navy as part of IR Site 12 and is discussed in the Parcel E RI Report (Barajas & Associates, Inc., 2008).

As discussed in Section 4.1.3.4, chemical concentrations in soil that exceed the corresponding RIEC will be considered adequately delineated in a given direction if there are four or more nearby samples (within 150 feet) surrounding the exceedance (in a general north, south, east, and west direction) with concentrations less than the RIEC. The following subsections discuss the characteristics of the fill and isolated solid waste locations (Section 4.4.1), and the nature and extent of chemicals in soil (Section 4.4.2). The data presented in Section 4.4.2 include post-excavation data within the PCB Hot Spot Area.

4.4.1. Characteristics and Extent of Fill and Isolated Solid Waste Locations

The East Adjacent Area includes isolated solid waste locations and soil within the Parcel E-2 boundary but outside the Landfill and Shoreline Area boundaries. The methodology for identifying these isolated solid waste locations was discussed in Section 4.1.1.2.

The evaluation revealed 43 locations in the East Adjacent Area where solid waste was encountered. Of these 43 locations, 10 contained inert construction debris and 24 contained putrescible construction

debris. Sandblast waste was encountered in 12 locations, including 3 locations that also contained putrescible construction debris. Locations of the isolated waste locations are shown on Figure 4-1.

Construction debris encountered in the East Adjacent Area include concrete, brick, wood, gravel, sand, soil, and asphalt, with limited amounts of ceramic, glass, and metals (primarily as wire or rebar in concrete). With the exception of wood, the remaining types of construction debris are considered inert and are not expected to generate methane gas or leachate that would create potential risks to human health or the environment.

Additional information on the waste types encountered within the East Adjacent Area was obtained during remediation activities within the PCB Hot Spot Area, which encountered oily wastes, radioluminescent devices, and sandblast waste (Navy, 2005b through 2005f). All excavated soil and waste from the PCB Hot Spot Area removal action was handled and screened as potential LLRW based on the findings of the HRA (NAVSEA, 2004). Out of a total excavation volume of 44,500 cubic yards, 533 cubic yards of soil and fire brick was segregated as radiologically impacted. Also, 40 radiological devices, 78 cubic yards of metal debris, and 19 pieces of other radioactively contaminated debris were identified within the removal area (TtECI, 2007a).

Also, 110 drums and 537 assorted waste containers were recovered from the central portion of the PCB Hot Spot Area and were characterized prior to off-site disposal. The drums, which were discovered in varying degrees of decay, contained grease, oil, soil, asphalt, and tar substances. Waste characterization data indicated that the drums contained various chemicals, including PCBs and pesticides. Two of the drums contained mixed waste with radiological contamination. The small containers contained various laboratory chemicals, ranging from strong acids and bases to solvents, alcohols, and inorganic salts (TtECI, 2007a). In addition, 41 pieces of MPPEH were encountered in the excavation area, consisting primarily of expended cartridge casings of various calibers and protective caps, but also included a 5-inch empty practice projectile and a 3-pound practice bomb (TtECI, 2010). Of the 41 MPPEH items discovered in the removal area, 20 items were verified to not present an explosive hazard and were reclassified as MDAS. The remaining 21 MPPEH items appeared to have been subject to previous demilitarization actions and could not be completely inspected by UXO technicians for possible explosive hazards. Although the type, age, and condition of these 21 MPPEH items did not suggest a high potential for residual energetic material, the Navy, as a precautionary measure, properly handled, transported, and disposed of these items as either material documented as an explosive hazard (MDEH) (20 items consisting of expended cartridge casings of various calibers) or munitions and explosives of concern (MEC) (1 item. 3-pound practice bomb) (TtECI, 2010).

4.4.2. Chemicals Detected in East Adjacent Area Soil

Soil data within the East Adjacent Area are presented in a similar manner as for the Landfill Area and Panhandle Area for consistency purposes. As discussed in Section 4.1.3, comprehensive data summary tables for the East Adjacent Area are presented in Appendix J1 by chemical category (i.e., metals, pesticides, PCBs, SVOCs, VOCs, and petroleum hydrocarbons) and depth interval (0 to 2 feet bgs, 2 to 10 feet bgs, and greater than 10 feet bgs). In addition, each table presents a series of summary statistics of the data for each chemical, such as the number of samples collected; the number of results that exceed the detection limit; minimum and maximum concentrations detected; and median, mean, and standard deviation of the detected results for each chemical. Each table also lists all potential screening criteria and quantifies the number of results that exceed each criterion.

The following subsections describe the chemical characteristics of the soil fill within the East Adjacent Area.

4.4.2.1. East Adjacent Area Surface Soil (0 to 2 feet bgs)

Table 4-15 shows all of the chemicals that were detected in samples collected at less than 2 feet bgs; Table 4-16 list the chemicals that exceeded the screening criteria at a 0- to 2-foot depth interval.

Metals

In total, 55 samples were analyzed for one or more metals. As shown in Table 4-15, all but two metals (cyanide[7] and tin) were detected in at least one sample at concentrations greater than the LRL. Seventeen metals (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) were detected greater than HPALs. One metal (arsenic) had an LRL exceeding the selected RIEC for some samples due to dilutions of samples. As shown in Table 4-16, six metals (antimony, arsenic, cadmium, chromium [total], iron, and lead) have been found at concentrations exceeding the selected RIEC.

Antimony was detected in 41 of 55 samples analyzed. This metal was detected in 13 samples at concentrations greater than the HPAL (9.05 mg/kg). One sample had a concentration exceeding the selected RIEC (380 mg/kg). None of the LRLs for antimony exceeded the selected RIEC. As shown on Figure 4-57, the detected exceedance is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of antimony in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the single detected exceedance (409 mg/kg) is not indicative of a hot spot.

[7] Cyanides are salts or esters of hydrogen cyanide (hydrocyanic acid) formed by replacing the hydrogen with a metal (e.g., sodium or potassium) or a radical (e.g., ammonium or ethyl) and are discussed as metals within this section.

Arsenic was detected in 50 of 55 samples analyzed. This metal was detected in five samples at concentrations exceeding the selected RIEC (11.1 mg/kg). In addition, one of the LRLs for arsenic exceeded the selected RIEC. As shown on Figure 4-58, most of the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of arsenic in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (22 mg/kg) is not indicative of a hot spot.

Cadmium was detected in 19 of 55 samples analyzed. This metal was detected in seven samples at concentrations greater than the HPAL (3.14 mg/kg). Two samples had concentrations exceeding the selected RIEC (7.4 mg/kg). None of the LRLs for cadmium exceeded the selected RIEC. As shown on Figure 4-59, the detected exceedances are surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC (including samples from adjacent Parcel E IR sites that are shown in Figure 4.3.7-2 of the Revised Parcel E RI Report [Barajas & Associates, Inc., 2008]). Based on this information, the extent of cadmium in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the maximum detected concentration (11.8 mg/kg) is not indicative of a hot spot.

Chromium (total) was detected in all 55 samples analyzed. This metal was detected in two samples at concentrations greater than the location-specific HPAL (100.1 mg/kg) and the selected RIEC (450 mg/kg). None of the LRLs for chromium exceeded the selected RIEC. As shown on Figure 4-74, the detected exceedance is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC (including samples from adjacent Parcel E IR sites that are shown in Figure 4.3.7-2 of the Revised Parcel E RI Report [Barajas & Associates, Inc., 2008]). Based on this information, the extent of chromium in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the maximum detected concentration (586 mg/kg) is not indicative of a hot spot.

Iron was detected in all 42 samples analyzed. No comparison against ambient levels was made because an HPAL has not been established for iron. Two samples had concentrations exceeding the selected RIEC (100,000 mg/kg). None of the LRLs for iron exceeded the selected RIEC. As shown on Figure 4-60, the detected exceedance at IR01B030 is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC (including samples from adjacent Parcel E IR sites that are shown in Figure 4.3.7-2 of the Revised Parcel E RI Report [Barajas & Associates, Inc., 2008]); however, the detected exceedance at IR02B452 is not surrounded by nearby sample locations (within 150 feet) with concentrations that are less than the RIEC. Based on this information, the extent of iron in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC in the southern portion of the East Adjacent Area; however, the maximum detected concentration (140,000 mg/kg) is not indicative of a hot spot.

Lead was detected in all 55 samples analyzed. This metal was detected in all 52 samples at concentrations greater than the HPAL (8.99 mg/kg). Nine samples had lead concentrations exceeding the selected RIEC (800 mg/kg). None of the LRLs for lead exceeded the selected RIEC. As shown on Figure 4-4, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of lead in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (11,200 mg/kg) is not indicative of a hot spot.

Pesticides and PCBs

In total, 68 samples were analyzed for pesticides and PCBs. As shown in Table 4-15, 16 pesticides and PCBs were detected in at least one sample. As shown in Table 4-16, two pesticides (dieldrin and heptachlor epoxide) and total high risk PCBs (consisting of all Aroclor compounds except Aroclor-1016) were detected at concentrations exceeding the selected RIEC. Several of the LRLs for the pesticides and PCBs exceeded the selected RIEC for some samples due to dilutions of samples and the limitations of analytical methods at the time.

Dieldrin was detected in 10 of 52 samples analyzed. Four samples (three locations) had concentrations exceeding the selected RIEC (0.11 mg/kg). One location (Grid 56 Sidewall) had two samples with concentrations of dieldrin exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, eight of the LRLs for dieldrin exceeded the selected RIEC. As shown on Figure 4-64, most of the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of dieldrin in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (0.25 mg/kg) is not indicative of a hot spot.

Heptachlor epoxide was detected in 9 of 52 samples analyzed. Two samples had concentrations exceeding the selected RIEC (0.19 mg/kg). One of the LRLs for dieldrin exceeded the selected RIEC. As shown on Figure 4-5, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of dieldrin in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (3.2 mg/kg) is not indicative of a hot spot.

Total PCBs (high risk) were detected in 39 of 55 samples analyzed. Total PCBs was detected in 30 samples (27 locations) at concentrations exceeding the selected RIEC (0.74 mg/kg). Eleven of the LRLs for individual PCB compounds exceeded the selected RIEC. As shown on Figures 4-6 and 4-7, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of total high risk PCBs in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC. Also, the total high risk PCB concentrations detected in two samples (sidewall sample at Grid 110 and boring

IR02B512) are greater than 100 times the RIEC, and confirm the known conditions along the shoreline portion of the PCB Hot Spot Area.

Semivolatile Organic Compounds

In total, 52 samples were analyzed for SVOCs. As shown in Table 4-15, 50 SVOCs were detected in at least one sample at concentrations greater than the LRL. Four SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene] were detected at concentrations exceeding the selected RIEC (Table 4-16). Several of the SVOCs had LRLs exceeding the selected RIEC for some samples due to dilutions of samples and the limitations of analytical methods at the time.

Benzo(a)anthracene was detected in 26 of 52 samples analyzed. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (1.3 mg/kg). In addition, nine of the LRLs for benzo(a)anthracene exceeded the selected RIEC. As shown on Figure 4-8, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of benzo(a)anthracene within this depth range is not adequately delineated by adjacent concentrations less than the RIEC ; however, the maximum detected concentration (2.3 mg/kg) is not indicative of a hot spot.

Benzo(a)pyrene was detected in 26 of 52 samples analyzed. This SVOC was detected in 10 samples at concentrations exceeding the selected RIEC (0.33 mg/kg). In addition, 17 of the LRLs for benzo(a)pyrene exceeded the selected RIEC. As shown on Figure 4-9, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of benzo(a)pyrene within this depth range is not adequately delineated by adjacent concentrations less than the RIEC ; however, the maximum detected concentration (3.4 mg/kg) is not indicative of a hot spot. In addition, several benzo(a)pyrene concentrations greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Benzo(b)fluoranthene was detected in 26 of 52 samples analyzed. This SVOC was detected in five samples at concentrations exceeding the selected RIEC (1.3 mg/kg). In addition, eight of the LRLs for benzo(b)fluoranthene exceeded the selected RIEC. As shown on Figure 4-10, the detected exceedances are not surrounded by nearby samples (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of benzo(b)fluoranthene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (6.6 mg/kg) is not indicative of a hot spot. In addition, several benzo(b)fluoranthene concentrations greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Benzo(k)fluoranthene was detected in 13 of 52 samples at concentrations greater than detection limits. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (1.3 mg/kg). In addition, 10 of the LRLs for benzo(k)fluoranthene exceeded the selected RIEC. As shown on Figure 4-65, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of benzo(k)fluoranthene within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (2.1 mg/kg) is not indicative of a hot spot. In addition, several benzo(k)fluoranthene concentrations greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Volatile Organic Compounds

In total, 24 samples were analyzed for VOCs. As shown in Table 4-15, 16 VOCs were detected in at least one sample at concentrations greater than the LRL. One VOC (1,1,2,2-tetrachloroethane) was detected at a concentration exceeding the selected RIEC (Table 4-16). Three of the LRLs exceeded the selected RIEC.

1,1,2,2-Tetrachloroethane was detected in 2 of 22 samples analyzed. This VOC was detected in two samples at concentrations exceeding the selected RIEC (0.025 mg/kg). Three of the LRLs for 1,1,2,2-tetrachloroethane exceeded the selected RIEC. As shown on Figure 4-75, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of 1,1,2,2-tetrachloroethane in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (0.74 mg/kg) is not indicative of a hot spot.

Petroleum Hydrocarbons

Total TPH is the sum of the concentrations of TPH-g, TPH-d, TPH-mo, TPH as unknown purgeables, and TPH as unknown extractables (Shaw, 2007). Total TPH was calculated for 51 samples. Seven samples contained total TPH at concentrations exceeding the RIEC (3,500 mg/kg). As shown on Figure 4-69, these exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Six samples contained concentrations of TOG exceeding the RIEC (3,500 mg/kg). TPH-d was detected at concentrations exceeding the RIEC (750 mg/kg) in 8 samples. Similarly, TPH-mo was detected exceeding the RIEC (4,600 mg/kg) in three samples. Based on this information, the extent of total TPH in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (83,500 mg/kg) is not indicative of a hot spot. In addition, several total TPH concentrations greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

4.4.2.2. East Adjacent Area Subsurface Soil (2 to 10 feet bgs)

Table 4-17 shows all of the chemicals that were detected in samples collected between 2 and 10 feet bgs; Table 4-18 lists the chemicals that exceeded the screening criteria at a 2- to 10-foot depth interval.

Metals

In total, 126 samples were analyzed for metals. As shown in Table 4-17, all metals, except tin, were detected in at least one sample at concentrations greater than the LRL. Eighteen metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) were detected at concentrations greater than HPALs. As shown in Table 4-18, four metals (antimony, arsenic, chromium [total], and lead) were detected at concentrations exceeding the selected RIEC. One of the metals had an LRL exceeding the selected RIEC.

Antimony was detected in 87 of 126 samples analyzed. This metal was detected in 26 samples at concentrations exceeding the HPAL (9.05 mg/kg). Two samples had concentrations exceeding the selected RIEC (380 mg/kg). None of the LRLs for antimony exceeded the selected RIEC. As shown on Figure 4-13, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of antimony in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (976 mg/kg) is not indicative of a hot spot.

Arsenic was detected in 97 of 126 samples analyzed. This metal was detected in 14 samples (11 locations) at concentrations exceeding the RIEC (11.1 mg/kg). One location (IR01MW09B) had three samples with concentrations of arsenic exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. Another location (IR72B037) had two samples with concentrations of arsenic exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, one of the LRLs for arsenic exceeded the selected RIEC. As shown on Figure 4-14, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations that are less than the RIEC. Based on the available characterization data, arsenic within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (106 mg/kg) is not indicative of a hot spot.

Chromium (total) was detected in all 126 samples analyzed. This metal was detected in four samples at concentrations greater than the location-specific HPALs. One sample had a concentration exceeding the selected RIEC, which is based on the location-specific HPAL (913.7 mg/kg). None of the LRLs for chromium exceeded the selected RIEC. As shown on Figure 4-16, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of chromium in soil within this depth range is not adequately delineated by

adjacent concentrations less than the RIEC; however, the single detected exceedance (924 mg/kg) is not indicative of a hot spot.

Lead was detected in 117 of 126 samples analyzed. This metal was detected in 95 samples at concentrations greater than the HPAL (8.99 mg/kg). Eleven samples (ten locations) had concentrations exceeding the selected RIEC (800 mg/kg). One location (IR04B025) had two results exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. None of the LRLs for lead exceeded the selected RIEC. As shown on Figure 4-19, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of lead in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC. In addition, lead is present in the central portion of the East Adjacent Area (IR04B020 and IR04B025) at concentrations greater than 100 times the RIEC and thus indicative of potential hot spots.

Pesticides and PCBs

In total, 232 samples were analyzed for pesticides and PCBs. As shown in Table 4-17, 18 pesticides and PCBs were detected in at least one sample. As shown in Table 4-18, four pesticides (4,4'-DDE, 4,4'-DDT, dieldrin, and heptachlor epoxide) and total high risk PCBs (consisting of all Aroclor compounds except Arolcor-1016) were detected at concentrations exceeding the selected RIEC. Several pesticides and Aroclor-1016 had LRLs greater than the selected RIEC in some samples due to dilutions of samples and the limitations of analytical methods at the time.

4,4'-DDE was detected in 37 of 128 samples analyzed. One sample had a concentration exceeding the selected RIEC (6.3 mg/kg). One of the LRLs for 4,4'-DDE exceeded the selected RIEC. As shown on Figure 4-76, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of 4,4'-DDE in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (24 mg/kg) is not indicative of a hot spot.

4,4'-DDT was detected in 47 of 128 samples analyzed. Three samples had concentrations exceeding the selected RIEC (6.3 mg/kg). One of the LRLs for 4,4'-DDT exceeded the selected RIEC. As shown on Figure 4-77, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of 4,4'-DDT in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (110 mg/kg) is not indicative of a hot spot.

Dieldrin was detected in 25 of 128 samples analyzed. Nine samples (five locations) had concentrations exceeding the selected RIEC (0.11 mg/kg). Four locations had two samples with concentrations of dieldrin exceeding the RIEC; however, only one sample per location (the maximum concentration) is

shown on the figure. In addition, 10 of the LRLs for dieldrin exceeded the selected RIEC. As shown on Figure 4-21, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of dieldrin in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (7.9 mg/kg) is not indicative of a hot spot. In addition, several dieldrin concentrations greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Heptachlor epoxide was detected in 35 of 128 samples analyzed. Eleven samples (seven locations) had concentrations exceeding the selected RIEC (0.19 mg/kg). Five of the LRLs for heptachlor epoxide exceeded the selected RIEC. As shown on Figure 4-22, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of heptachlor epoxide in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC, and the maximum detected concentration (at the Grid 159 sidewall along the shoreline portion of the PCB Hot Spot Area) is indicative of a potential hot spot. In addition, several other heptachlor epoxide concentrations greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Total PCBs (high risk) were detected in 157 of 232 samples analyzed. Total PCBs (high risk) was detected in 81 samples (52 locations) at concentrations exceeding the selected RIEC (0.74 mg/kg). As shown on Figures 4-23 and 4-24, most of the exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. In addition, 24 of the LRLs for individual high risk PCB compounds exceeded the selected RIEC. Based on the available characterization data, the extent of total high risk PCBs within this depth range is not adequately delineated by adjacent concentrations less than the RIEC. Also, the total high risk PCB concentrations detected in 11 post-excavation samples are greater than 100 times the RIEC, and confirm the known conditions along the along the shoreline portion of the PCB Hot Spot Area. In addition, total high risk PCBs are present in the central portion of the East Adjacent Area (IR01TA07A and IR01TA07B) at concentrations greater than 100 times the RIEC and thus indicative of potential hot spots.

Semivolatile Organic Compounds

In total, 127 samples were analyzed for SVOCs. As shown in Table 4-17, 58 SVOCs were detected in at least one sample at concentrations greater than the LRL. Ten SVOCs (1,2,4-trichlorobenzene, 1,4-DCB, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)-anthracene, indeno(1,2,3-cd)pyrene, and naphthalene) were detected at concentrations exceeding the

selected RIEC (Table 4-18). Several SVOCs had samples with LRLs exceeding the RIEC due to dilutions of samples and the limitations of analytical methods at the time.

1,2,4-Trichlorobenzene was detected in 3 of 76 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (5 mg/kg). In addition, four of the LRLs for 1,2,4-trichlorobenzene exceeded the selected RIEC. As shown on Figure 4-78, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of 1,2,4-trichlorobenzene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the single detected exceedance (280 mg/kg) is not indicative of a hot spot.

1,4-DCB was detected in 1 of 76 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (0.13 mg/kg). In addition, 41 of the LRLs for 1,4-DCB exceeded the selected RIEC. As shown on Figure 4-26, the detected exceedance is not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, 1,4-DCB within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (5.8 mg/kg) is not indicative of a hot spot.

Benzo(a)anthracene was detected in 38 of 127 samples analyzed. This SVOC was detected in seven samples (six locations) at concentrations exceeding the selected RIEC (1.3 mg/kg). One location (Grid 60 Sidewall) had two results (one was a duplicate) exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, 17 of the LRLs for benzo(a)anthracene exceeded the selected RIEC. As shown on Figure 4-29, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of benzo(a)anthracene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (7.3 mg/kg) is not indicative of a hot spot. In addition, several benzo(a)anthracene concentrations greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Benzo(a)pyrene was detected in 37 of 127 samples at concentrations greater than detection limits. This SVOC was detected in 14 samples (9 locations) at concentrations exceeding the selected RIEC (0.33 mg/kg). In addition, 44 of the LRLs for benzo(a)pyrene exceeded the selected RIEC. As shown on Figure 4-30, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of benzo(a)anthracene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (13 mg/kg) is not indicative of a hot

spot. In addition, several benzo(a)pyrene concentrations greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Benzo(b)fluoranthene was detected in 43 of 127 samples analyzed. This SVOC was detected in 13 samples (9 locations) at concentrations exceeding the selected RIEC (1.3 mg/kg). In addition, 16 of the LRLs for benzo(b)fluoranthene exceeded the selected RIEC. As shown on Figure 4-31, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of benzo(b)fluoranthene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (5.9 mg/kg) is not indicative of a hot spot. In addition, several benzo(b)fluoranthene concentrations greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

Benzo(k)fluoranthene was detected in 33 of 127 samples analyzed. This SVOC was detected in five samples (four locations) at concentrations exceeding the selected RIEC (1.3 mg/kg). One location (Grid 58-1 Sidewall) had two results exceeding the RIEC; however, only one (the maximum concentration) is shown on the figure. In addition, 17 of the LRLs for benzo(k)fluoranthene exceeded the selected RIEC. As shown on Figure 4-32, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of benzo(b)fluoranthene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (6.6 mg/kg) is not indicative of a hot spot.

Chrysene was detected in 58 of 127 samples analyzed. This SVOC was detected in one sample at a concentration exceeding the selected RIEC (13 mg/kg). In addition, three of the LRLs for chrysene exceeded the selected RIEC. As shown on Figure 4-33, the detected exceedance is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of chrysene in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the detected exceedance is not indicative of a hot spot.

Dibenz(a,h)anthracene was detected in 4 of 127 samples analyzed. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (0.33 mg/kg). In addition, LRLs for dibenz(a,h)anthracene exceeded the selected RIEC in most samples. As shown on Figure 4-34, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on the available characterization data, the extent of dibenz(a,h)anthracene in soil within this depth range is not adequately delineated by adjacent

concentrations less than the RIEC; however, the maximum detected concentration (0.71 mg/kg) is not indicative of a hot spot.

Indeno(1,2,3-cd)pyrene was detected in 16 of 127 samples analyzed. This SVOC was detected in two samples at concentrations exceeding the selected RIEC (1.3 mg/kg). In addition, 18 of the LRLs for indeno(1,2,3-cd)pyrene exceeded the selected RIEC. As shown on Figure 4-35, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of indeno(1,2,3-cd)pyrene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (5.1 mg/kg) is not indicative of a hot spot.

Naphthalene was detected in 13 of 127 samples analyzed. This SVOC was detected in three samples (two locations) at concentrations exceeding the selected RIEC (1.5 mg/kg). One location (Grid 57-1 Sidewall) had two results exceeding the RIEC; however, only one sample (the maximum concentration) is shown on the figure. In addition, 18 of the LRLs for naphthalene exceeded the selected RIEC. As shown on Figure 4-36, one of the two detected exceedances, located along the shoreline portion of the PCB Hot Spot Area, are not surrounded by nearby sample locations with concentrations less than the RIEC. Based on the available characterization data, the extent of naphthalene in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (7.9 mg/kg) is not indicative of a hot spot.

Volatile Organic Compounds

Up to 69 samples were analyzed for VOCs. As shown in Table 4-17, 16 VOCs were detected at least once at concentrations greater than the LRL. One VOC (1,1,2,2-tetrachloroethane) was detected at concentrations greater than the selected RIEC (Table 4-18). Several of the VOCs had LRLs greater than the selected RIEC due to dilutions of samples and the limitations of analytical methods at the time.

1,1,2,2-Tetrachloroethane was detected in 7 of 76 samples analyzed. This VOC was detected in seven samples (five locations) at concentrations exceeding the selected RIEC (0.025 mg/kg). In addition, three of the LRLs for 1,1,2,2-tetrachloroethane exceeded the selected RIEC. As shown on Figure 4-79, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of 1,1,2,2-tetrachloroethane in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (1.2 mg/kg) is not indicative of a hot spot.

Petroleum Hydrocarbons

Total TPH is the sum of the concentrations of TPH-g, TPH-d, TPH-mo, TPH as unknown purgeables, and TPH as unknown extractables (Shaw, 2007). Total TPH was calculated for 231 samples. Two-hundred and five samples contained total TPH at concentrations greater than the LRLs. Total TPH was detected in

27 samples (17 locations) at concentrations exceeding the selected RIEC (3,500 mg/kg). As shown on Figure 4-38, most of the exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Six samples contained concentrations of TOG exceeding the RIEC (3,500 mg/kg). TPH-d exceeded the RIEC (750 mg/kg) in 36 samples. TPH-mo exceeded the RIEC (4,600 mg/kg) in 18 samples. Based on this information, the extent of total TPH in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC. Although the maximum detected concentration (34,120 mg/kg) is not indicative of a hot spot, this total TPH concentration and several others greater than the RIEC were reported along the shoreline portion of the PCB Hot Spot Area which, as discussed in Section 3.8.8, was not excavated during the removal action (2006–2007) because of its proximity to San Francisco Bay.

4.4.2.3. East Adjacent Area Deep Soil (greater than 10 feet bgs)

Table 4-19 shows all of the chemicals that were detected in samples collected at greater than 10 feet bgs Table 4-20 list the chemicals that exceeded the screening criteria at greater than 10 feet bgs.

Metals

In total, 85 samples were analyzed for metals. As shown in Table 4-19, all but three metals (chromium VI, thallium, and tin) were detected in at least one sample at concentrations greater than the LRL. Twelve metals (antimony, arsenic, barium, beryllium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, and zinc) were detected at concentrations greater than HPALs. One of the metals had an LRL greater than the selected RIEC. As shown in Table 4-20, three metals (arsenic, chromium [total], and lead) were detected at concentrations exceeding the selected RIEC.

Arsenic was detected in 46 of 60 samples analyzed. This metal was detected in 12 samples (7 locations) at concentrations exceeding the RIEC (11.1 mg/kg). One of the LRLs for arsenic exceeded the selected RIEC. As shown on Figure 4-39, the detected exceedances are not surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of arsenic in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (26 mg/kg) is not indicative of a hot spot.

Chromium (total) was detected in all 60 samples analyzed. This metal was detected in three samples at concentrations greater than the location-specific HPALs. One sample had a concentration exceeding the selected RIEC, which is based on the location-specific HPAL (719.1 mg/kg). None of the LRLs for chromium exceeded the selected RIEC. As shown on Figure 4-41, the detected exceedance is not surrounded by nearby sample locations (within 150 feet to the west) with concentrations less than the RIEC. Based on this information, the extent of chromium in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (903 mg/kg) is not indicative of a hot spot.

Lead was detected in 57 of 60 samples analyzed. This metal was detected in 37 of the samples at concentrations greater than the HPAL (8.99 mg/kg). One sample had a concentration exceeding the selected RIEC (800 mg/kg). None of the LRLs for lead exceeded the selected RIEC. As shown on Figure 4-43, the detected exceedance is surrounded by nearby sample locations (within 150 feet) with concentrations less than the RIEC. Based on this information, the extent of lead in soil within this depth range is adequately delineated by adjacent concentrations less than the RIEC, and the maximum detected concentration (24,600 mg/kg) is not indicative of a hot spot.

Pesticides and PCBs

In total, 55 samples were analyzed for pesticides and PCBs. As shown in Table 4-19, seven pesticides (4,4'-DDD, 4,4'-DDE, beta-BHC, endosulfan I, endosulfan sulfate, endrin ketone, and heptachlor epoxide) and total high risk PCBs (consisting of all Aroclor compounds except Aroclor-1016) were detected in at least one sample at a concentration greater than the LRL. As shown in Table 4-20, only total high risk PCBs were detected at concentrations exceeding the selected RIEC.

Total PCBs (high risk) were detected in 18 of 55 samples analyzed. Total PCBs (high risk) were detected in three samples at concentrations exceeding the selected RIEC (0.74 mg/kg). One of the LRLs for individual Aroclor compounds exceeded the selected RIEC. As shown on Figure 4-44, the detected exceedances are not surrounded by nearby sample locations with a concentration less than the RIEC. Based on this information, the extent of total PCBs in soil within this depth range is not adequately delineated by adjacent concentrations less than the RIEC; however, the maximum detected concentration (8.6 mg/kg) is not indicative of a hot spot.

Semivolatile Organic Compounds

In total, 62 samples were analyzed for SVOCs. As shown in Table 4-19, 36 SVOCs were detected in at least one sample at concentrations greater than the LRL. Several SVOCs had LRLs exceeding the selected RIEC due to dilutions of samples and the limitations of analytical methods at the time. None of the SVOCs were detected at concentrations exceeding the RIEC (Table 4-20). As a result, SVOCs at depths greater than 10 feet bgs are not shown on a figure.

Volatile Organic Compounds

In total, 62 samples were analyzed for VOCs. As shown in Table 4-19, 14 VOCs were detected in at least one sample at concentrations greater than the LRL. None of the VOCs were detected at concentrations exceeding the selected RIEC (Table 4-20). As a result, VOCs at depths greater than 10 feet bgs are not shown on a figure.

Petroleum Hydrocarbons

Total TPH is the sum of the concentrations of TPH-g, TPH-d, TPH-mo, TPH as unknown purgeables, and TPH as unknown extractables (Shaw, 2007). Total TPH was calculated for 55 samples. None of the samples contained total TPH at concentrations exceeding the RIEC (3,500 mg/kg) (Table 4-20). As a result, total TPH at depths greater than 10 feet bgs are not shown on a figure.

4.5. SUMMARY OF FINDINGS

The nature and extent evaluation presented in this section demonstrates that an adequate quantity of data, of sufficient quality, exist to support the HHRA and SLERA, to provide the basis for the RAOs, and to evaluate a focused set of remedial alternatives for Parcel E-2. The following subsections summarize the nature and extent findings for solid waste (Section 4.5.1), landfill gas (Section 4.5.2), and chemicals in soil (Section 4.5.3). Each subsection discusses the resolution of data quality objectives (DQOs) and outlines potential data gaps. Section 4.5.4 summarizes the data gaps identified during the nature and extent evaluation.

4.5.1. Nature and Extent of Solid Waste

Evaluation of the nature and extent of solid waste at the Parcel E-2 Landfill is based on the physical presence of contiguous industrial or municipal-type wastes. Based on data from 28 soil borings, 18 monitoring wells, and 25 test pits extended within the Landfill Area, solid waste comprises primarily municipal-type waste and construction debris. Solid waste includes wood, paper, plastic, metal, glass, asphalt, concrete, and bricks that are mixed with sand, clay, and gravel fill. Historic information indicates that industrial wastes were also disposed of in or around the Landfill Area, including sandblast waste, radioluminescent devices, asbestos-containing debris, paint sludge, solvents, and waste oils (NEESA, 1984; NAVSEA, 2004). The available characterization data suggest that the quantity of industrial waste within the Landfill Area is less than the quantity of municipal-type waste and construction debris.

The nature of hazardous substances within the Landfill Area, based on an evaluation of soil data, is summarized in Section 4.5.3. According to EPA guidance, characterization of a landfill's contents is not necessary or appropriate for selecting a response action for these sites, when applying the presumptive remedy methodology for remedial alternatives evaluation (EPA, 1993a; provided in Appendix H to this report). The evaluation summarized in Section 4.5.3 consists of identifying potential hot spots within the Landfill Area. EPA recommends that hot spots in municipal landfills be identified and evaluated to decide if more extensive characterization and development of remedial alternatives is appropriate (EPA, 1991a). The evaluation decision whether or not these hot spots require more extensive characterization and development of remedial alternatives is summarized in Section 8.

The lateral and vertical extent of solid waste at the Parcel E-2 Landfill was delineated during fieldwork performed under the RI and NDGI. All information on the extent of solid waste at the landfill in this

section is from the Landfill Lateral Extent Evaluation report (Appendix B to this report). The lateral extent of waste at the Landfill Area is shown on Figure 3-1. Along the northern perimeter of the Parcel E-2 Landfill, the landfill lateral extent was determined to be along the fence line separating Parcel E-2 from the UCSF compound. The eastern edge of the solid waste is located beneath the interim landfill cap (estimated to end approximately 10 feet before the eastern edge of the cap). The southeastern edge of solid waste is located adjacent to the shoreline, and the southwestern edge of the solid waste is located adjacent to the freshwater wetlands within the Panhandle Area. The western edge of solid waste is located adjacent to the drainage channel along the western property boundary.

The waste is generally located between 21 feet above and 14 feet below msl. The waste generally varies from 10 to 25 feet thick. In all areas of the Parcel E-2 Landfill, solid waste extends beneath the water table.

Isolated solid waste locations are present within the Panhandle and East Adjacent Areas (Figure 4-1). Waste at these locations is not contiguous with the Landfill Area and consists primarily of construction debris, with lesser quantities of nonputrescible industrial waste (including sandblast waste).

4.5.1.1. Resolution of Data Quality Objectives

DQOs were presented in the Field Sampling Plan/Quality Assurance Project Plan (FSP/QAPP) for the Parcel E NDGI (TtEMI, 2002a) to outline the decision questions to be answered by the landfill lateral extent evaluation. The nature and extent evaluation presented in this report is based primarily on the landfill lateral extent evaluation. Therefore, an assessment of how the data for landfill lateral extent compares with the DQOs will help verify whether or not the existing data are sufficient to support this RI/FS.

The DQOs focus on (1) delineating the edge of waste for the southwest, northwest, and northern portions of the Parcel E-2 Landfill and (2) determining the thickness of waste at the northern portion of the landfill to support future RDs (TtEMI, 2002a). DQO evaluations are summarized in Table 4-21. Based on an evaluation of the available data, the installation of primary and step-out test pits adequately delineated the landfill lateral extent. In addition, the installation of test pit borings provided additional data on the thickness of waste at the edge of the landfill. This determination supports the nature and extent evaluation of solid waste as presented in this report.

4.5.1.2. Data Gaps

Upon completion of the NDGI, the extent of solid waste at the Parcel E-2 Landfill has been adequately delineated with no data gaps remaining. Overall, characterization data on the nature and extent of solid waste are sufficient to support the focused remedy evaluation process that will accelerate cleanup and transfer of Parcel E-2.

4.5.2. Nature and Extent of Landfill Gas

Upon completion of the landfill gas characterization study, the extent of landfill gas beyond the landfill perimeter was determined to be at the northern edge of the UCSF compound. To the east, west, and south, landfill gas had not migrated beyond the perimeter of the Parcel E-2 Landfill (Appendix A). The landfill gas TCRA was conducted to remove landfill gas that had migrated onto the UCSF compound and to control future migration north of the solid waste boundary. Ongoing monitoring of landfill gas and operation of the gas control system is performed on a regular basis to verify that hazardous levels of landfill gas are not migrating beyond the fence line of the landfill and onto the UCSF compound. The ongoing landfill gas control program, which is based on the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c), includes notification and response procedures in the event that hazardous levels of landfill gas are detected beyond the fence line of the landfill and beneath the UCSF compound. The data collected as part of the landfill gas characterization study, the TCRA, and the ongoing landfill gas monitoring have adequately defined the nature and extent of landfill gas at Parcel E-2.

4.5.2.1. Resolution of Data Quality Objectives

The nature and extent evaluation presented in this report is supported by the data collected as part of the landfill gas characterization study, the landfill gas TCRA, and the ongoing landfill gas monitoring and control system operation. Two sets of DQOs were established to outline decision questions to be answered by the landfill gas characterization study (which identified landfill gas migration onto the UCSF compound) and the ongoing landfill gas monitoring and control system operation (which is effectively controlling landfill gas migration following implementation of the TCRA). An evaluation of how the data from both the landfill gas characterization study and the landfill gas and control system operation compares with the respective DQOs will help verify whether or not the existing data are sufficient to support this RI/FS.

DQOs were presented in the FSP/QAPP for the Parcel E NDGI (TtEMI, 2002a) to outline the decision questions to be answered by the landfill gas characterization study. These decision questions focused on defining the nature and extent of landfill gas in and around the Parcel E-2 Landfill. DQO evaluations for the landfill gas characterization study are summarized in Table 4-22. The data collected during the landfill gas characterization study determined that subsurface gas from the Parcel E-2 Landfill had not resulted in unacceptable levels of methane and NMOCs in outdoor or indoor air. In addition, the data defined the extent of subsurface methane and NMOCs surrounding the Parcel E-2 Landfill.

The findings of the landfill gas characterization study prompted the Navy to initiate a TCRA to (1) remove landfill gas and reduce subsurface methane concentrations at the UCSF compound to below the LEL (5 percent by volume in air); and (2) control future landfill gas migration to off-site areas. DQOs were presented in the Interim Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c) to

outline the decision questions to be answered by the ongoing landfill gas monitoring and control system operation. The DQOs were developed using 27 CCR as guidance, and set limits for landfill gas concentrations at the various locations that make up the monitoring network. DQOs were developed for landfill gas monitoring at all GMPs, UCSF surface locations, the Building 830 crawlspace, on-site utilities, and the landfill gas control system. The DQOs focus on the monitoring criteria to (1) ensure that hazardous levels of landfill gas are not migrating beyond the fence line of the Parcel E-2 Landfill and onto the UCSF compound, (2) demonstrate that landfill gas is not migrating under Crisp Avenue toward non-Navy property, and (3) monitor the performance of the landfill gas control system (TtEMI and ITSI, 2004c).

DQO evaluations are summarized in Table 4-23. Based on an evaluation of the available data from January 2004 through June 2010, the control system is functioning to control the migration of hazardous levels of methane beyond the fence line of the Parcel E-2 Landfill. In January and February 2006, hazardous levels of methane were detected at the fence line of the landfill. The Navy promptly performed active extraction at these locations to control the migration of hazardous levels of methane beyond the fence line of the landfill. Ongoing monitoring performed since February 2006 supports the nature and extent of landfill gas (for both methane and NMOCs) as presented in this report.

4.5.2.2. Data Gaps

Sufficient landfill gas data exist to evaluate remedial alternatives for Parcel E-2. However, the potential presence of subsurface utilities within the eastern portion of the Landfill Area (Figure 1-4) should be verified during the RD. Such utilities may serve as preferential pathways for gas migration; however, previous soil gas measurements in the vicinity (Figure 4-3) have not detected methane above 25 percent of the LEL. Additional studies are planned, in conjunction with the RD, to more thoroughly evaluate soil gas concentrations in the Panhandle Area and East Adjacent Area and assess whether methane or NMOCs are present in the areas at concentrations that may be hazardous to human health.

4.5.3. Nature and Extent of Soil Contamination

This subsection summarizes the nature and extent of chemicals in soil within Parcel E-2. Data from the 1,113 soil samples collected within Parcel E-2 are sufficient to support the HHRA and SLERA, to provide the basis for the RAOs, and to evaluate a focused set of remedial alternatives for Parcel E-2.

Metals, pesticides, PCBs, dioxins, furans, SVOCs, VOCs, and petroleum hydrocarbons were detected at concentrations exceeding the RIEC in soil samples collected at Parcel E-2. As shown in Table 4-24, chemical concentrations exceeding RIEC were found in all three study areas at Parcel E-2 and all depth ranges evaluated. The following list provides a general summary of the distribution of these chemicals throughout Parcel E-2, and the frequency at which concentrations exceeded the RIEC.

- Ten metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, vanadium, and zinc) were detected at concentrations exceeding the RIEC in soil at Parcel E-2. Arsenic, chromium, and lead were the prevalent metals detected at concentrations exceeding the RIEC, with exceedances in greater than 10 percent of the samples analyzed within a given depth range. Two lead concentrations in the East Adjacent Area were greater than 100 times the RIEC and, as defined in Section 4.1.3.4, may be considered potential hot spots. Overall, metals concentrations in the Landfill Area (0 to 2 feet bgs) and the East Adjacent Area (greater than 10 feet bgs) exceeded the RIEC less frequently as compared to other Parcel E-2 areas and depth ranges. Most of the metals were detected in samples collected between 0 and 10 feet bgs, and the greatest number of RIEC exceedances was present in the Landfill and Panhandle Areas.
- Four pesticides (4,4'-DDE, 4,4'-DDT, dieldrin, and heptachlor epoxide) were detected at concentrations exceeding the RIEC in soil from 0 to 10 feet bgs at Parcel E-2. Dieldrin and heptachlor epoxide were the most prevalent pesticides detected at concentrations exceeding the RIEC, and most of these exceedances were located at the edges of the PCB Hot Spot Area excavation.
- Total high risk PCBs were detected at concentrations exceeding the RIEC in all soil except Panhandle Area soil greater than 10 feet bgs. PCB exceedances were most frequent at the edges of the PCB Hot Spot Area excavation, which comprises portions of the Landfill and East Adjacent Areas, and at depths from 0 to 10 feet bgs. Outside of the PCB Hot Spot Area excavation, four PCB concentrations in the Landfill Area and two in the East Adjacent Area were greater than 100 times the RIEC (0.74 mg/kg) and, as defined in Section 4.1.3.4, may be considered potential hot spots.
- Two dioxins and six furans were detected at concentrations exceeding the RIEC in pre-excavation soil samples collected from the Metal Slag Area (southwest portion of the Panhandle Area). These exceedances were reported in the majority of samples analyzed between 2.5 and 19 feet bgs. Although the exceedance frequency is high, the magnitudes of these exceedances were relatively low, with all but one exceedance less than 10 times the RIEC. The highest exceedance was for the furan 2,3,4,7,8-PeCDF, which was detected at a concentration of 0.986 µg/kg or 18 times the RIEC (0.055 µg/kg).
- Fourteen SVOCs were detected in soil at concentrations exceeding the RIEC in Parcel E-2. Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, 1,4-DCB, and naphthalene were the prevalent SVOCs detected at concentrations exceeding the RIEC, with exceedances in greater than 10 percent of the samples analyzed within a given depth range. Benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene exceedances were dispersed throughout Parcel E-2, but were found infrequently in deep (greater than 10 feet bgs) soil. 1,4-DCB, and naphthalene exceedances were more frequent in and around the Landfill Area (at depths greater than 2 feet bgs), including one 1,4-DCB concentration and one naphthalene concentration that were greater than 100 times the RIEC and, as defined in Section 4.1.3.4, may be considered potential hot spots within the landfill.

- VOCs were detected at concentrations exceeding the RIEC in soil samples greater than 10 feet bgs in the Landfill Area and in soil samples from between 0 to 10 feet bgs in the East Adjacent Area. 1,1,2,2-tetrachloroethane was the most prevalent VOC detected at concentrations exceeding the RIEC, with exceedances in greater than 10 percent of the samples analyzed within a given depth range. These exceedances were concentrated in the northern portion of the East Adjacent Area.
- Petroleum hydrocarbons (including TPH-g, TPH-d, TPH-mo, and TOG) were detected in soil at concentrations exceeding the RIEC for total TPH in most Parcel E-2 areas. Total TPH exceedances were most frequent at the edges of the PCB Hot Spot Area excavation, which comprises portions of the Landfill and East Adjacent Areas, and at depths from 0 to 10 feet bgs.

Based on the data presented in Table 4-24, soil contamination is less extensive between 0 and 2 feet bgs within the Landfill Area and greater than 10 feet bgs within the East Adjacent Area. In the Landfill Area from 0 to 2 feet bgs, only two chemicals (total high risk PCBs and benzo(a)pyrene) exceeded the RIEC in more than 10 percent of samples analyzed. In the East Adjacent Area greater than 10 feet bgs, only one chemical (arsenic) exceeded the RIEC in more than 10 percent of samples analyzed. These observations contrast with conditions found in other depth ranges, where no less than 4 (and in some areas up to 10) chemicals exceeded the RIEC in more than 10 percent of samples analyzed. The conclusion that contamination is less extensive in the surface soil within the Landfill Area and deep soil within the East Adjacent Area is attributed to the fact that most fill material in these areas was not associated with shipyard operations. Specifically, surface soil within the Landfill Area was placed during closure activities in 1974, and residual contamination in this interval can be attributed to surface releases after 1974. In addition, deep soil within the East Adjacent Area consists of either natural sediments or fill material placed during expansion of the shipyard in the early 1940s.

Soil contamination is more widely distributed in the Panhandle Area and the shallow zones (0 to 10 feet bgs) of the East Adjacent Area. The heterogeneous distribution of chemicals in these areas indicates that fill material placed at Parcel E-2 during shipyard operations may contain unacceptable levels of contamination. The heterogeneous distribution of chemicals makes delineation of potential areas of concern problematic. This problem is evidenced by the findings of the SDGI, which was only partially successful in delineating known and potential soil contamination in the Panhandle and East Adjacent Areas (further discussed in Section 4.5.4). RIEC exceedances in the Panhandle and East Adjacent Areas that are not completely delineated are shown in bold text (inside shaded cells) in Table 4-24. Despite the inherent difficulty in delineating potential point sources of soil contamination within heterogeneous fill material, the characterization efforts from the RI, NDGI, and SDGI have provided sufficient data to evaluate potential risk to humans and wildlife at Parcel E-2.

As discussed in Section 4.1.3.4, soil characterization data within the Landfill Area are used to assess the general extent of RIEC exceedances relative to the landfill waste volume. This assessment provides a basis for determining whether lesser quantities of hazardous wastes are present in the landfill as compared

with municipal wastes, which is one evaluation factor outlined in EPA presumptive remedy guidance (provided in Appendix H of this report). Based on the information presented in Section 4.2.4, nearly all of the hazardous substances detected in Landfill Area soil were of a limited extent relative to the overall waste volume. Several SVOCs and PCBs, such as benzo(a)pyrene and total high risk PCBs, were detected throughout a large portion of the Landfill Area at concentrations exceeding the RIEC but at concentrations that were not indicative of hot spots. These findings demonstrate that lesser quantities of hazardous wastes are present in the landfill as compared with municipal-type waste and construction debris.

4.5.3.1. Identification of Potential Hot Spots

As discussed in Section 4.1.3.4, soil hot spots are defined as locations containing chemical concentrations 100 times greater than the corresponding RIEC. Based on the information presented in Sections 4.2.4, 4.3.2, and 4.4.2, the following potential hot spots were identified at Parcel E-2:

- Edges of PCB Hot Spot Area excavation within Landfill and East Adjacent Areas (0 to 10 feet bgs): 19 samples (18 locations) contained total high risk PCBs at concentrations greater than 100 times the RIEC (0.74 mg/kg). The majority of these locations were along the western and southwestern sidewall of the PCB Hot Spot Area excavation. As discussed in Section 3.8.8, oil-stained soil and free-phase product were observed along and adjacent to this sidewall during the removal action. In addition, one of these 18 locations (Grid 159 sidewall) also contained heptachlor epoxide at a concentration greater than 100 times the RIEC (0.19 mg/kg).
- East Adjacent Area (2 to 10 feet bgs): Two samples (IR01TA07A and IR01TA07B, 4 feet bgs) contained total high risk PCBs at concentrations greater than 100 times the RIEC (0.74 mg/kg). IR01TA07A and IR01TA07B are located about 50 feet apart. Also, two samples (IR04B020 and IR04B025; both at a depth of 4 feet bgs) contained lead at concentrations greater than 100 times the RIEC (800 mg/kg). IR04B020 and IR04B025 are located about 70 feet apart.
- Landfill Area (2 to 10 feet bgs): One sample (IR01MW05A, 8 feet bgs) contained total high risk PCBs at a concentration greater than 100 times the RIEC (0.74 mg/kg). In addition, one sample (IR01MW02B, 9 feet bgs) contained 1,4-DCB at a concentration greater than 100 times the RIEC (0.13 mg/kg). Also, one sample (IR01B021A, 9 feet bgs) contained naphthalene at a concentration greater than 100 times the RIEC (1.5 mg/kg). These locations are over 300 feet apart.
- Landfill Area (greater than 10 feet bgs): Three samples (IR01MW17B, 11 feet bgs; IR01B012, 17 feet bgs; IR01B019, 16 feet bgs) contained total high risk PCBs at concentrations greater than 100 times the RIEC (0.74 mg/kg). These locations are more than 400 apart from each other.

The potential hot spots within the Landfill Area will be analyzed in further detail in Section 8.2.3.2. The potential hot spots within the East Adjacent Area, as well as the western and southwestern sidewall of the PCB Hot Spot Area excavation, will be further evaluated in the FS portions of this report (Sections 11 through 14). Because of the inadequate delineation of most RIEC exceedances in the East Adjacent Area, additional characterization may be required for potential hot spots considered for removal in the FS.

4.5.3.2. Resolution of Data Quality Objectives

DQOs were presented in the Sampling and Analysis Plan for the SDGI (TtEMI, 2002d) to focus the additional soil characterization efforts needed to complete the RI. The nature and extent evaluation presented in this report relies heavily on the SDGI characterization efforts. Therefore, an evaluation of how the soil and sediment characterization data compares with the DQOs will help verify whether or not the existing data are sufficient to support this RI/FS.

DQO evaluations are summarized in Table 4-25. The SDGI was successful in delineating several source areas in the Parcel E-2 onshore areas, most notably the PCB Hot Spot Area in the East Adjacent Area. However, based on the data presented in the SDGI Data Summary Report (TtEMI, 2005c), a number of locations have not been completely delineated. As discussed in Section 4.5.3, this finding is consistent with the heterogeneous distribution of chemicals in the Panhandle and East Adjacent Areas.

The shoreline component of the SDGI is also summarized in Table 4-25. The shoreline investigation found contaminated sediment within the intertidal Shoreline Area that may pose a risk to aquatic receptors. The findings of the shoreline investigation are discussed in more detail in Appendix G.

4.5.4. Data Gaps

Although the SDGI was only partially successful in delineating known and potential soil contamination in the Panhandle and East Adjacent Areas, it substantially increased the soil data set in the Panhandle Area and East Adjacent Area. The inability to delineate potential point sources of soil contamination within heterogeneous fill material does not necessarily constitute a data gap. Overall, the SDGI data did not affect the overall maximum concentrations of chemicals in soil relative to the original RI data set from 1997. For most chemicals detected at Parcel E-2, the maximum detected concentration in the post-SDGI data set is within 10 percent of the maximum detected concentration in the original RI data set. This finding helps demonstrate that the heterogeneous site conditions at Parcel E-2 present severe challenges to completing a standard investigation and cleanup for a point source or sources.

Data gaps may exist at locations along the Parcel E-2 boundary where exceedances of the RIEC are not adequately delineated. Table 4-26 identifies locations of exceedances of the RIEC that are located adjacent to the Parcel E-2 boundary (within 150 feet) that are not delineated by data from adjacent borings. The locations are identified for consideration during development of remedial alternatives at Parcels E and E-2. The need to collect additional data in the areas will depend on the types of remedial alternatives evaluated. For example, additional data may be required for remedial alternatives involving excavation of chemical concentrations exceeding risk-based concentrations (RBCs) (that may be comparable with RIECs) because such data would be needed to refine the excavation limits or demonstrate compliance with remediation goals. However, for remedial alternatives involving containment and excavation of chemical hot spots (areas with chemical concentrations exceeding RBCs

by one to two orders of magnitude), additional data may not be required in areas where no excavation is required to meet the RAOs.

In summary, the adequacy of the data set should be measured against the remediation decision to be made for Parcel E-2. Given the focused set of remedial alternatives envisioned for the FS component of this report, complete delineation of known and potential soil contamination in the Panhandle and East Adjacent Areas is not necessary. Overall, characterization data are sufficient to support the risk assessments and a more focused remedy evaluation process that will accelerate cleanup and transfer of Parcel E-2. However, it is acknowledged that additional characterization may be required to support future remediation activities. For example, if hot spot removal is implemented in conjunction with containment technologies, additional characterization would be needed prior to the removal. Specific DQOs for additional characterization, as needed to support future remediation activities, will be developed during the RD (or, for an interim removal action, during work planning process).

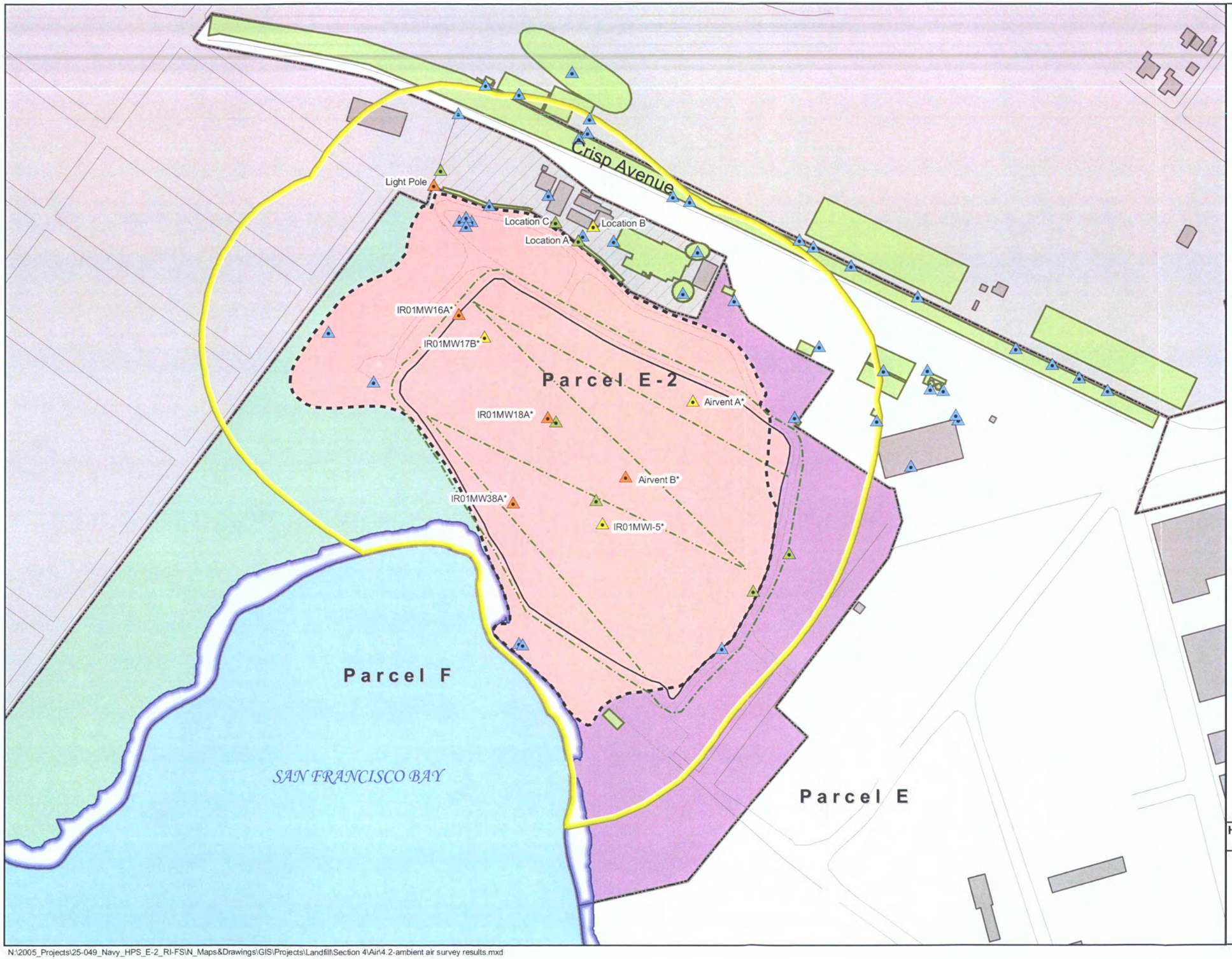
Figures

PARTIALLY SCANNED OVERSIZE ITEM(S)

See document #_2379126
for partially scanned image(s)

Figure 4-1
(2 of 2)

For complete hardcopy version of the oversize document
contact the Region IX Superfund Records Center



Outdoor Air Survey Results (2002)

- >100% LEL
- 25-<100% LEL
- 1-<25% LEL
- <1% LEL
- Transect Location
- Building/Area Survey Location
- 300-foot Landfill Buffer
- Parcel Boundary
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- Estimate of Solid Waste Extent
- Interim Landfill Cap Extent
- Non-Navy Property
- UCSF Compound
- Building
- Road
- Gravel Road

Notes:

LEL readings measured by a gas indicator or a flame ionization detector. All LEL results associated with methane concentrations in ambient air.

LEL = lower explosive limit
UCSF = University of California, San Francisco

Outdoor air survey was performed in 2002 (prior to landfill gas removal action); subsequent air monitoring at locations A, B, and C, and the light pole showed methane levels to be less than 1 percent.

* Air monitoring was performed at the top of the well casing with the well/vent open to the atmosphere; results are not considered representative of outdoor air within the landfill area.

N

250 0 250

Scale in Feet

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 4-2

OUTDOOR AIR SURVEY RESULTS FOR METHANE

Remedial Investigation/Feasibility Study for Parcel E-2

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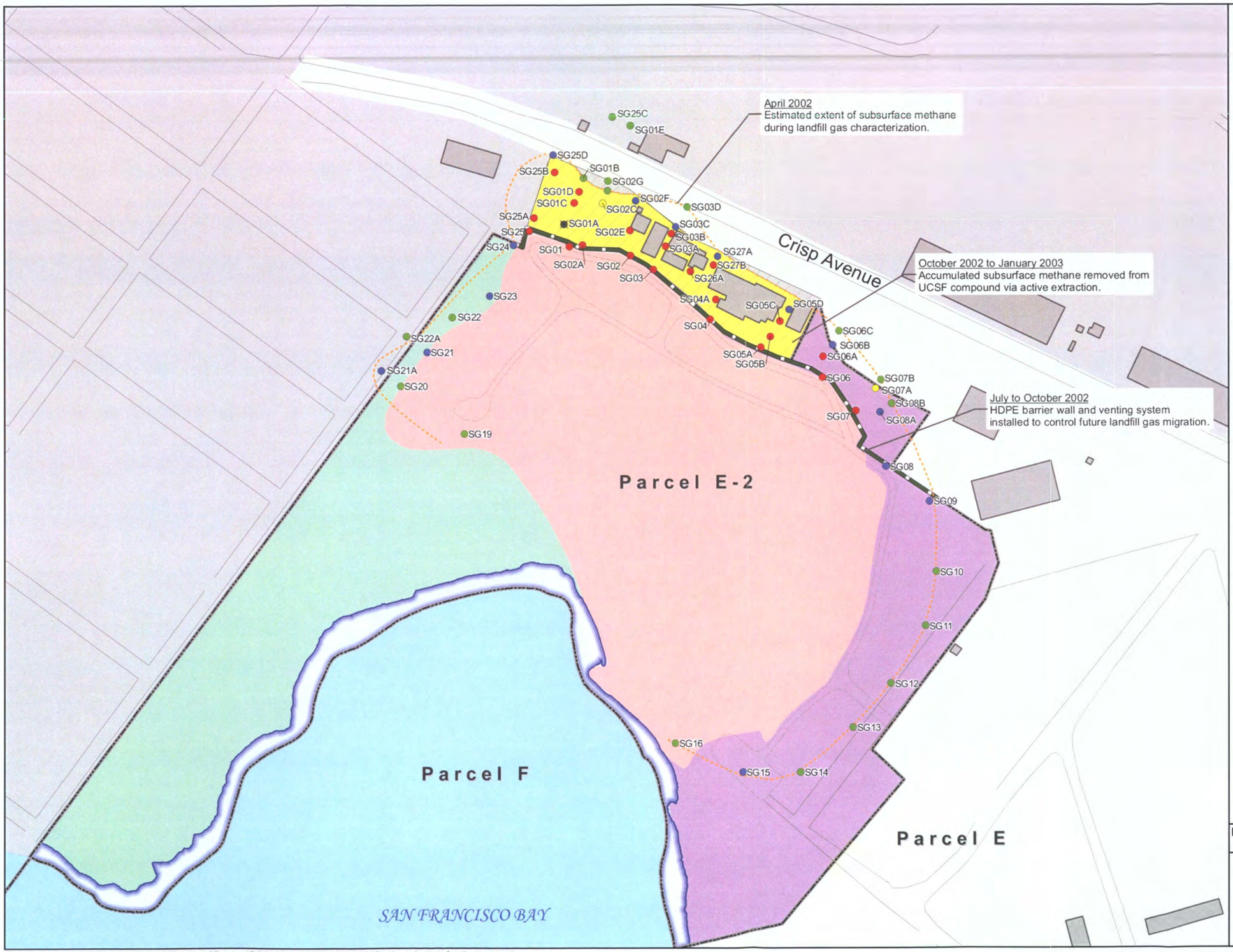


April 2002 Soil Gas Survey*

- No Survey Conducted
- Methane Not Detected
- Methane Less Than 25% LEL
- Methane Equal to or Greater than 25% LEL and Less than 100% LEL
- Methane Greater Than 100% LEL
- Estimated Extent of Methane Detected During April 2002 Field Survey
- HDPE Barrier Wall
- Area within UCSF Compound Targeted for Active Gas Extraction
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- Parcel Boundary
- Non-Navy Property
- UCSF Compound
- Building
- Road
- Gravel Road

Notes:
EPA = U.S. Environmental Protection Agency
HDPE = high-density polyethylene
LEL = lower explosive limit
UCSF = University of California, San Francisco

LEL for methane is 5 percent by volume

* Soil gas survey performed using field instruments (with lower quantitation limit for methane at 0.5% of the LEL) and supplemented with laboratory data (analyzed for methane by EPA Method 3C).

N

250 0 250

Scale in Feet

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

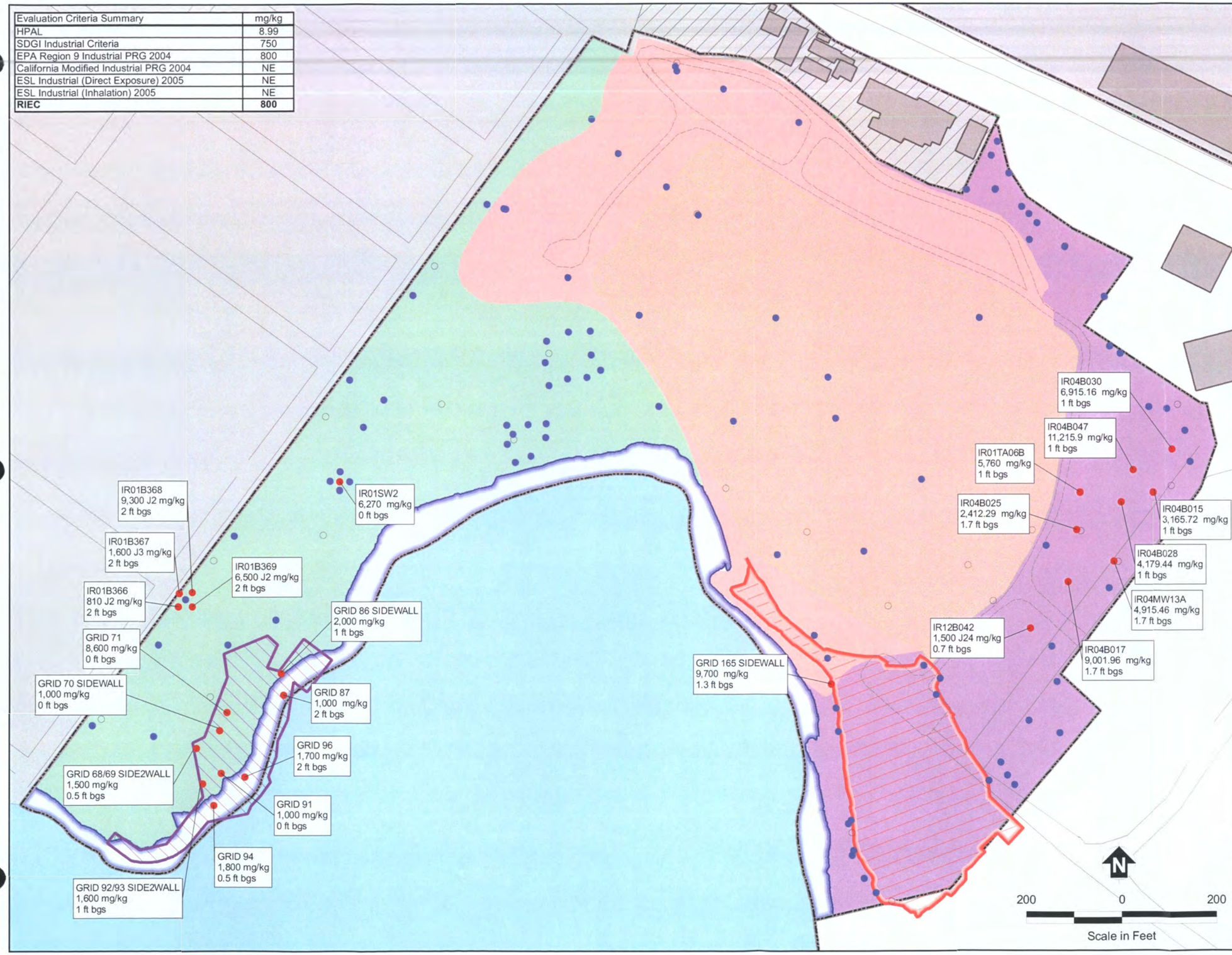
FIGURE 4-3

EXTENT OF SUBSURFACE METHANE PRIOR TO REMOVAL ACTION

Remedial Investigation/Feasibility Study for Parcel E-2

N:\2005_Projects\25-049_Navy_HPS_E-2_RI-FS\N_Maps&Drawings\GIS\Projects\Landfill\Section 4\Air\4.3-estimated extent of methane gas.mxd

Evaluation Criteria Summary	mg/kg
HPAL	8.99
SDGI Industrial Criteria	750
EPA Region 9 Industrial PRG 2004	800
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**800**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-4

LEAD IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.27
EPA Region 9 Industrial PRG 2004	0.19
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	0.31
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.19**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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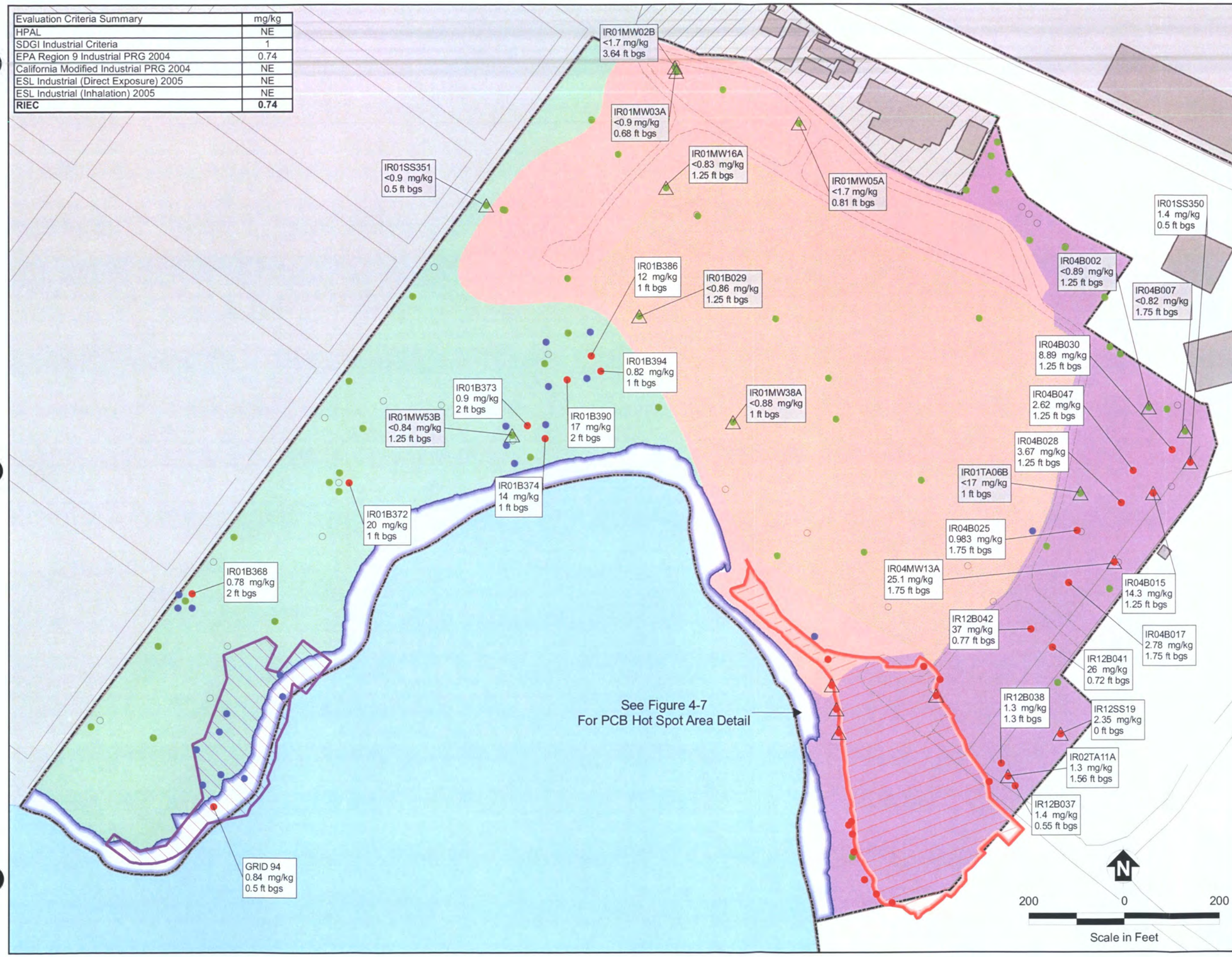
FIGURE 4-5

HEPTACHLOR EPOXIDE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1
EPA Region 9 Industrial PRG 2004	0.74
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.74**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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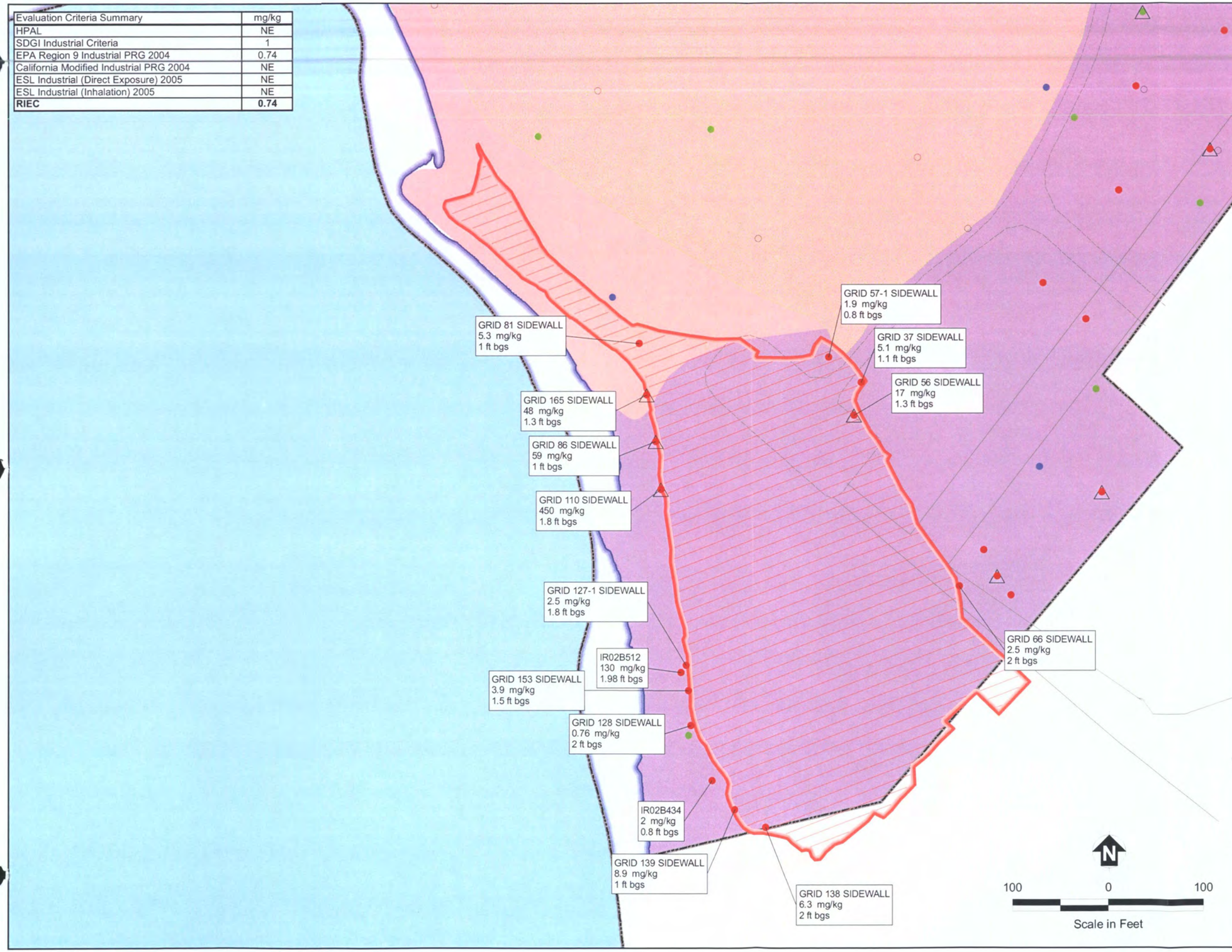
FIGURE 4-6

TOTAL PCBS (HIGH RISK) IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1
EPA Region 9 Industrial PRG 2004	0.74
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.74**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Landfill Area
East Adjacent Area
Shoreline Area
San Francisco Bay

Notes:

[a] The post-excavation boundary in the PCB Hot Spot Area is consistent with information presented in final removal action completion report (Tetra Tech EC Inc., 2007a).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-7

TOTAL PCBS (HIGH RISK)
PCB HOT SPOT AREA
IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	1.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**1.3**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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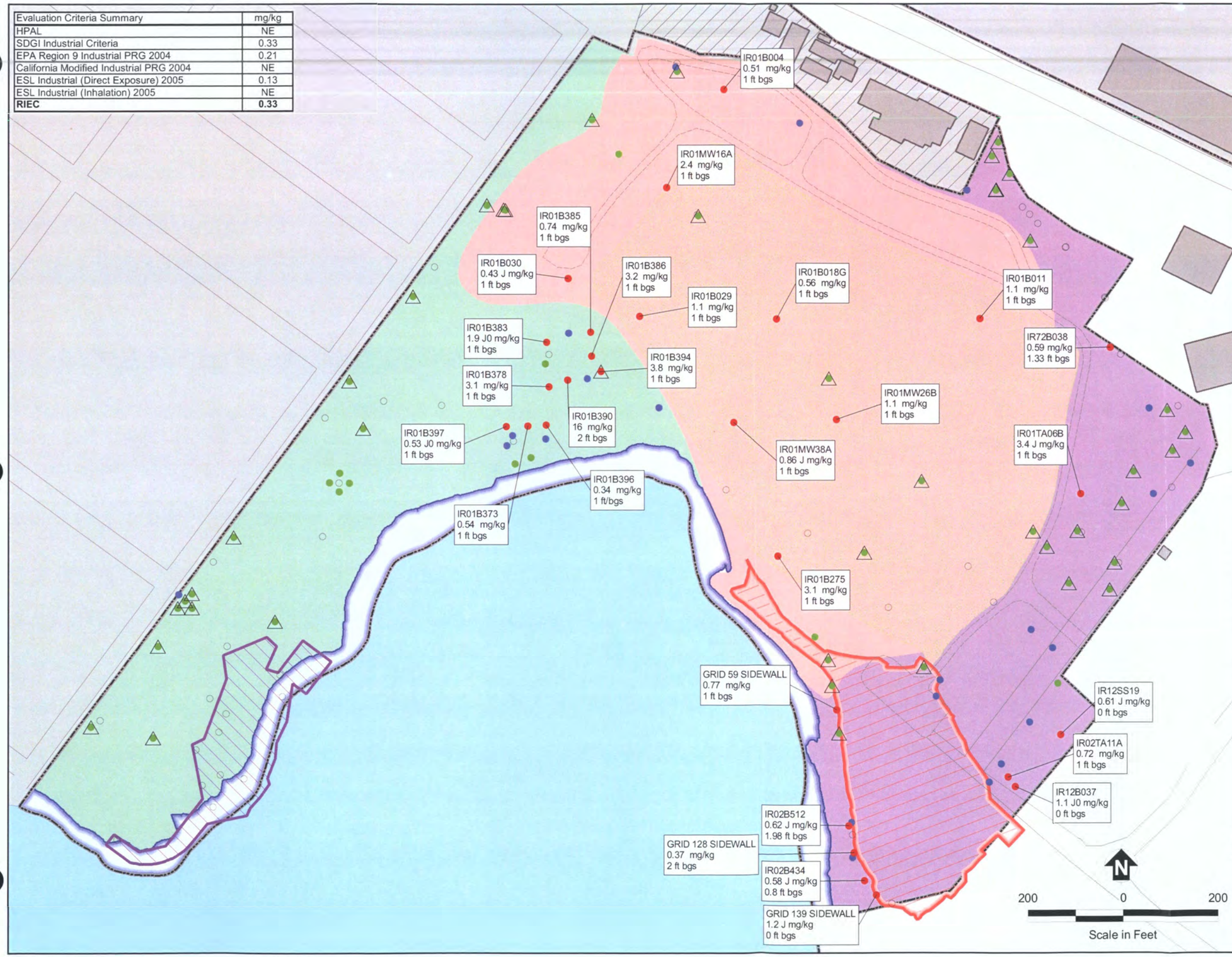
FIGURE 4-8

BENZO (A) ANTHRACENE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.33
EPA Region 9 Industrial PRG 2004	0.21
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	0.13
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.33**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-9

BENZO (A) PYRENE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	1.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**1.3**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco
Y = chromatogram indicates the presence of petroleum fuel

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-10

BENZO (B) FLUORANTHENE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	1.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**1.3**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-11

INDENO (1,2,3 - CD) PYRENE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	190
EPA Region 9 Industrial PRG 2004	190
California Modified Industrial PRG 2004	4.2
ESL Industrial (Direct Exposure) 2005	3.8
ESL Industrial (Inhalation) 2005	1.5
RIEC	**1.5**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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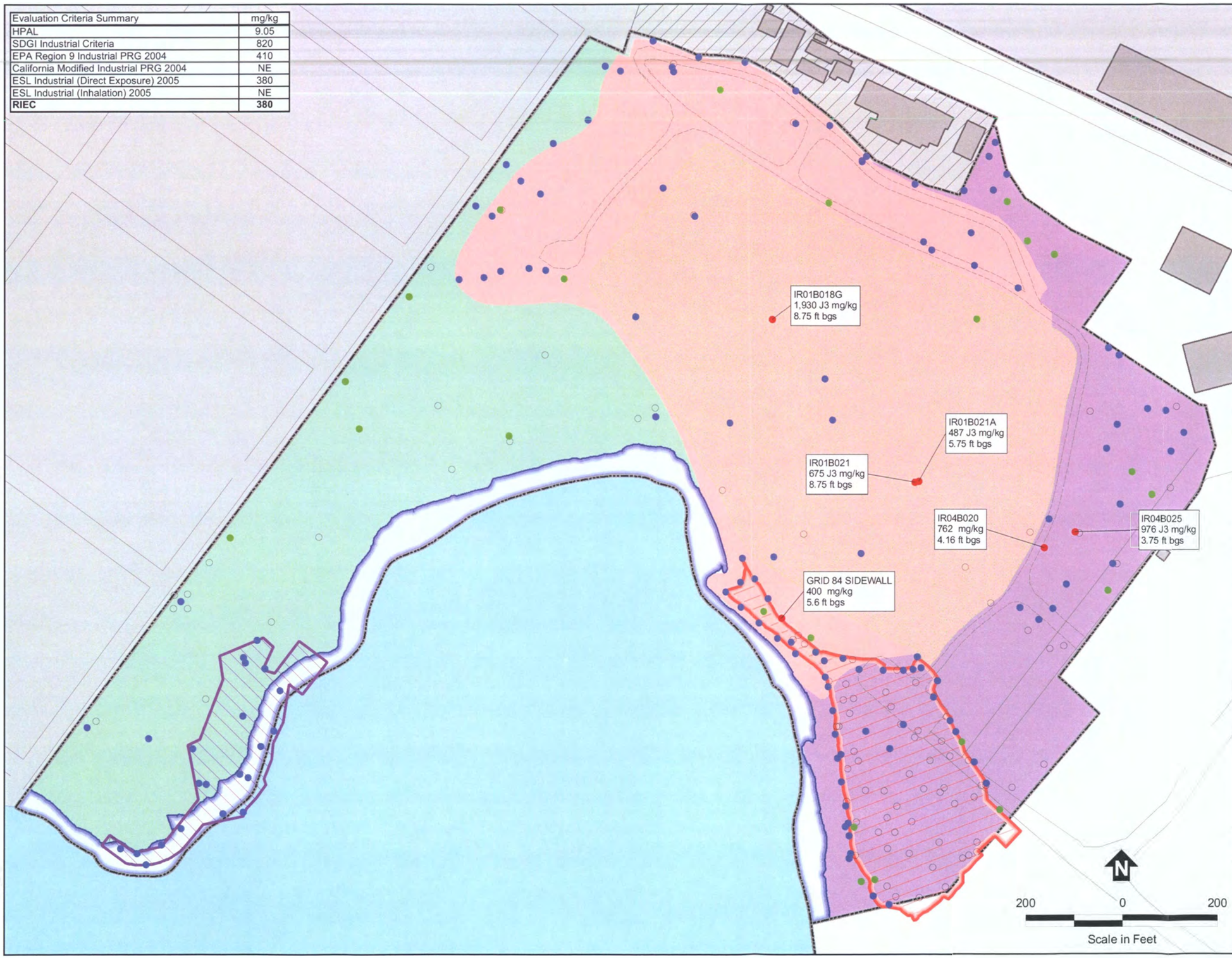
FIGURE 4-12

NAPHTHALENE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	9.05
SDGI Industrial Criteria	820
EPA Region 9 Industrial PRG 2004	410
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	380
ESL Industrial (Inhalation) 2005	NE
RIEC	**380**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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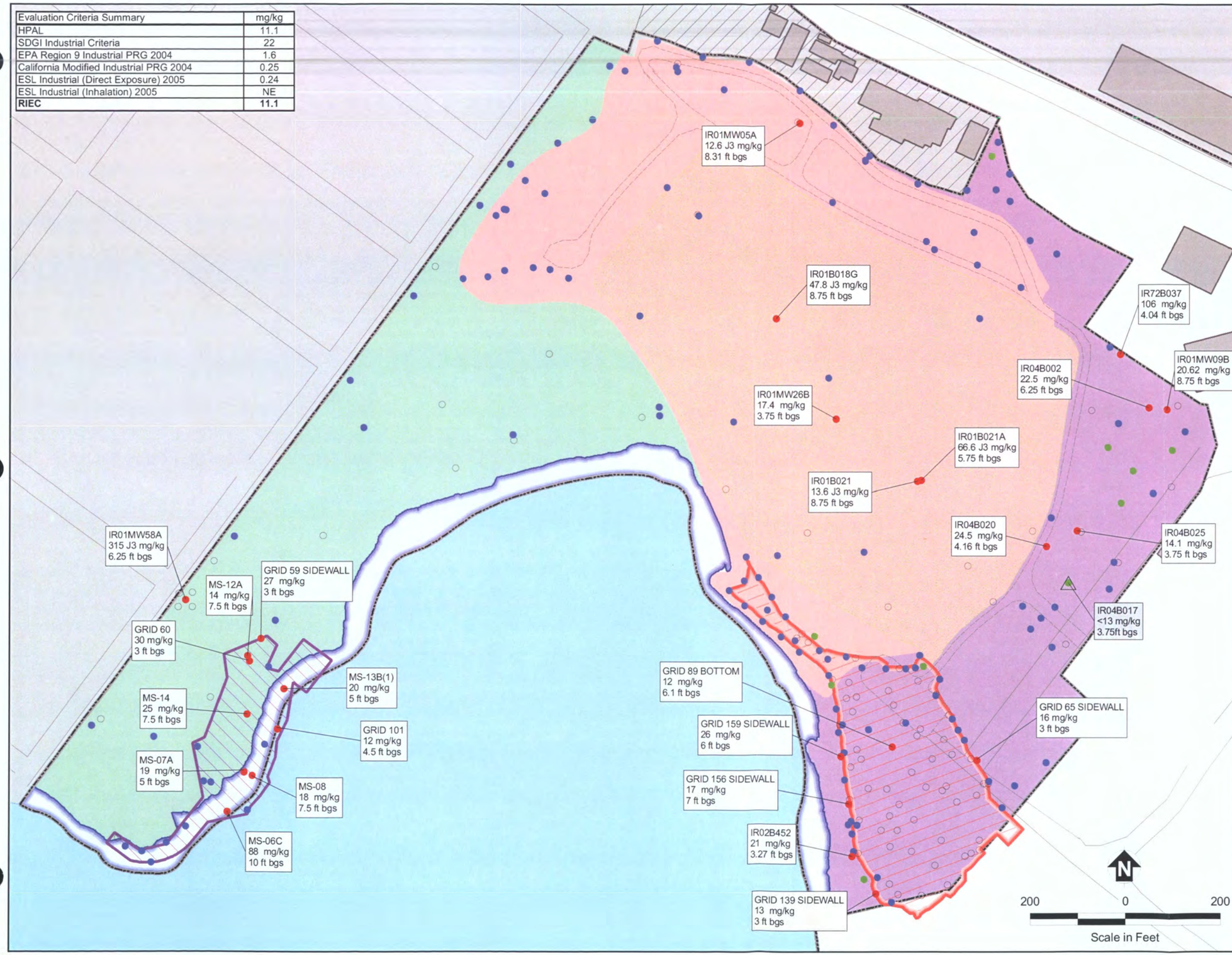
FIGURE 4-13

ANTIMONY IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	11.1
SDGI Industrial Criteria	22
EPA Region 9 Industrial PRG 2004	1.6
California Modified Industrial PRG 2004	0.25
ESL Industrial (Direct Exposure) 2005	0.24
ESL Industrial (Inhalation) 2005	NE
RIEC	**11.1**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-14

ARSENIC IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	3.14
SDGI Industrial Criteria	15
EPA Region 9 Industrial PRG 2004	450
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	7.4
ESL Industrial (Inhalation) 2005	NE
RIEC	**7.4**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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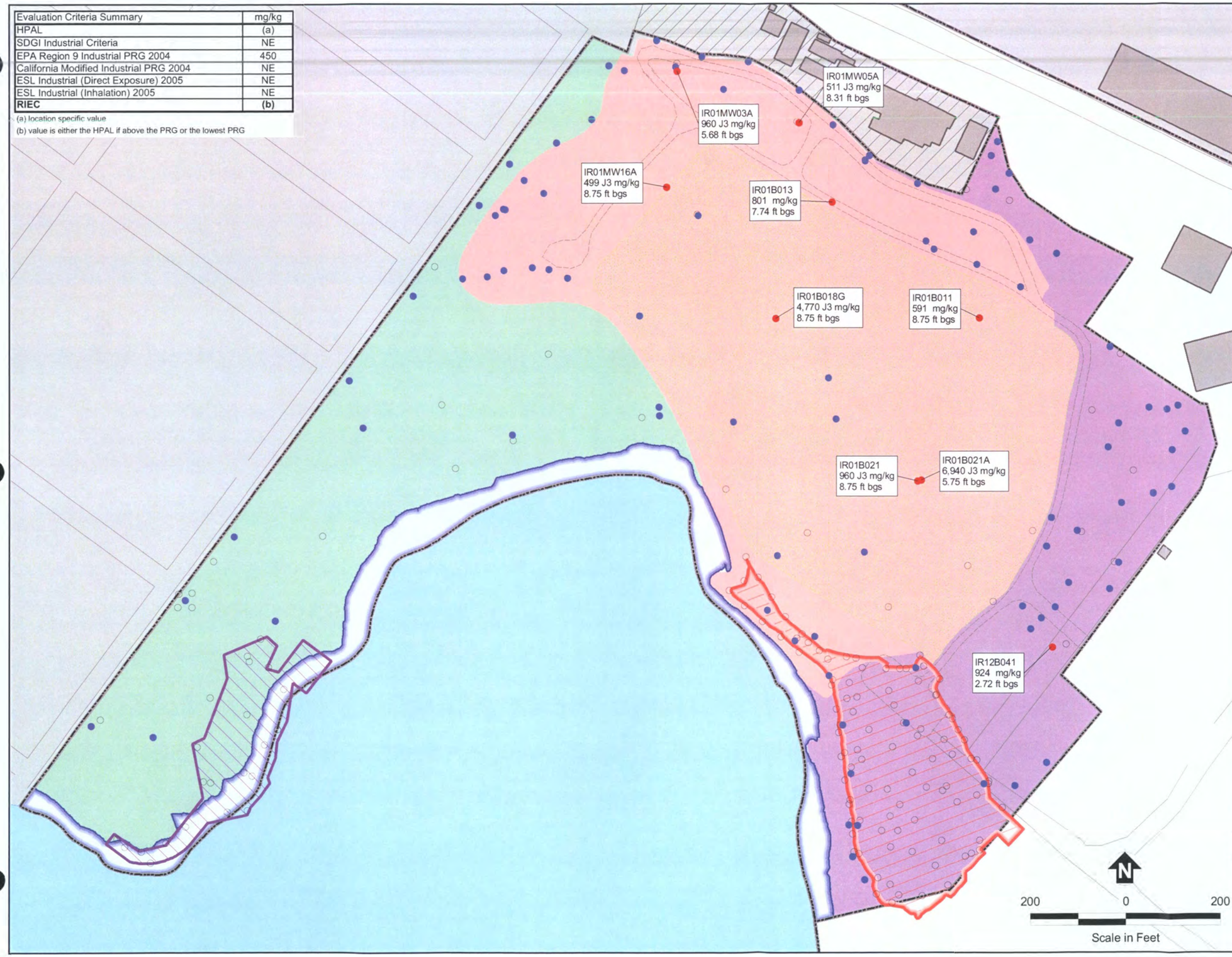
FIGURE 4-15

CADMIUM IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	(a)
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	450
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**(b)**

(a) location specific value
(b) value is either the HPAL if above the PRG or the lowest PRG



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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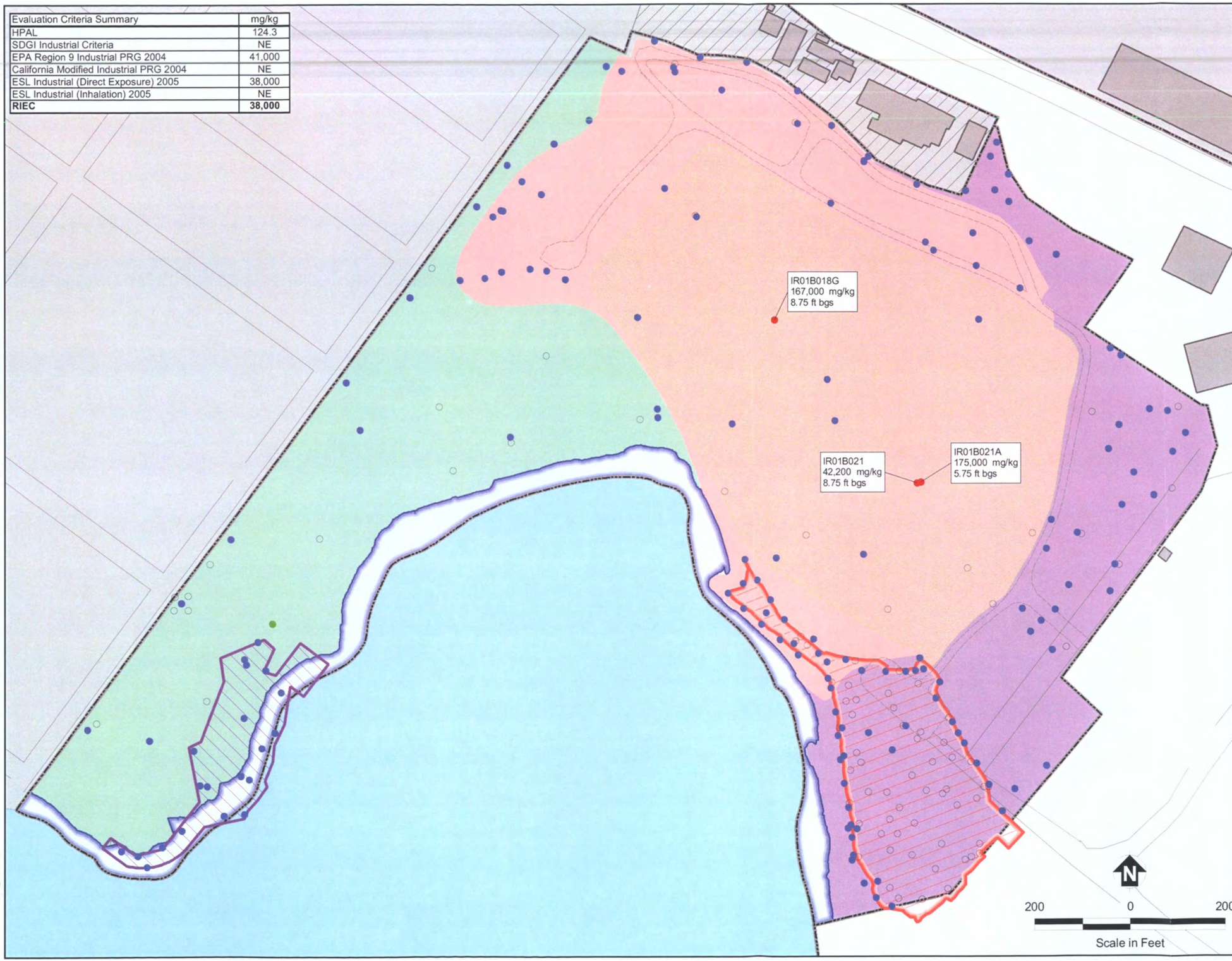
FIGURE 4-16

CHROMIUM (TOTAL) IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	124.3
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	41,000
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	38,000
ESL Industrial (Inhalation) 2005	NE
RIEC	**38,000**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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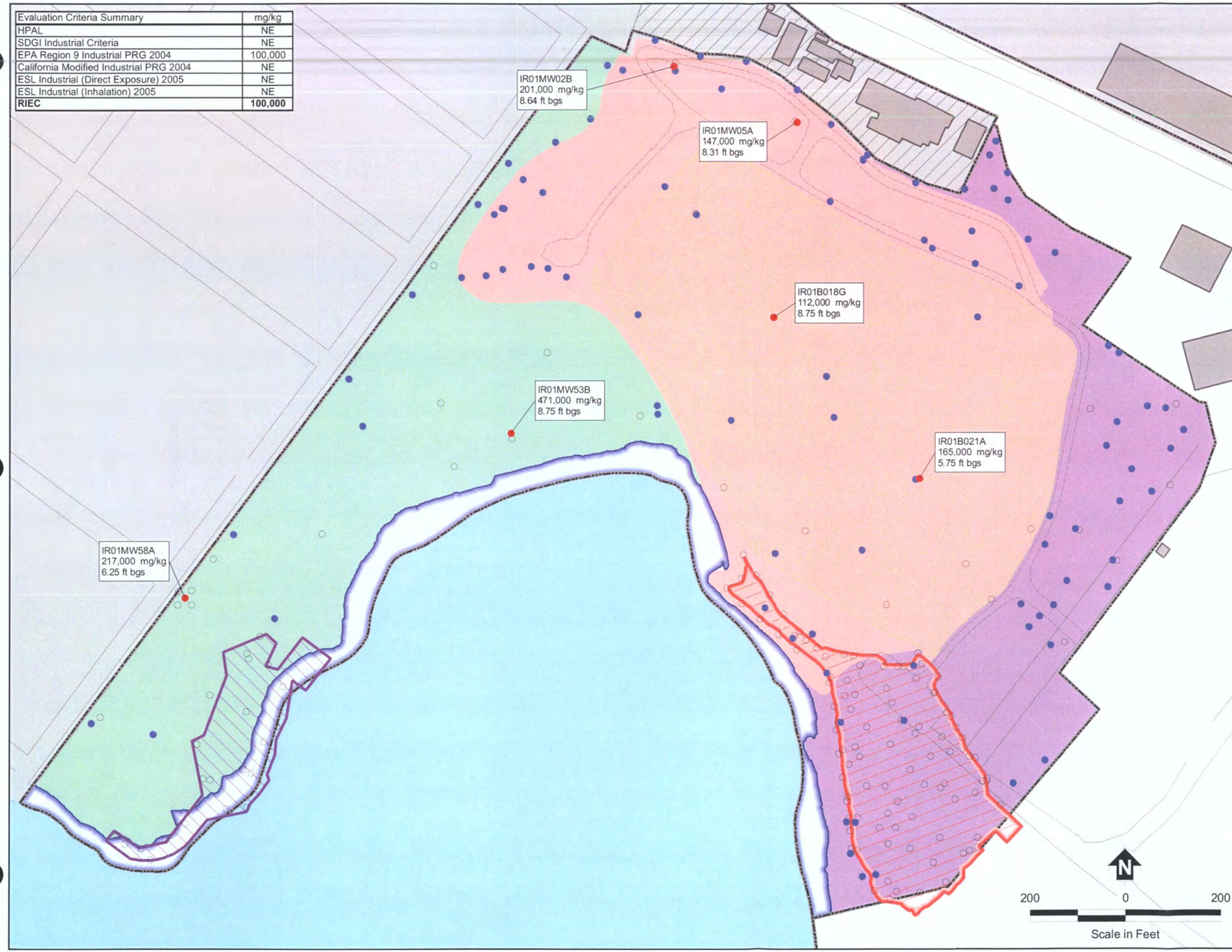
FIGURE 4-17

COPPER IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	100,000
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**100,000**



- Reporting Limit Exceeds the RIEC (for at least one sample)
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds RIEC
- Road
- Gravel Road
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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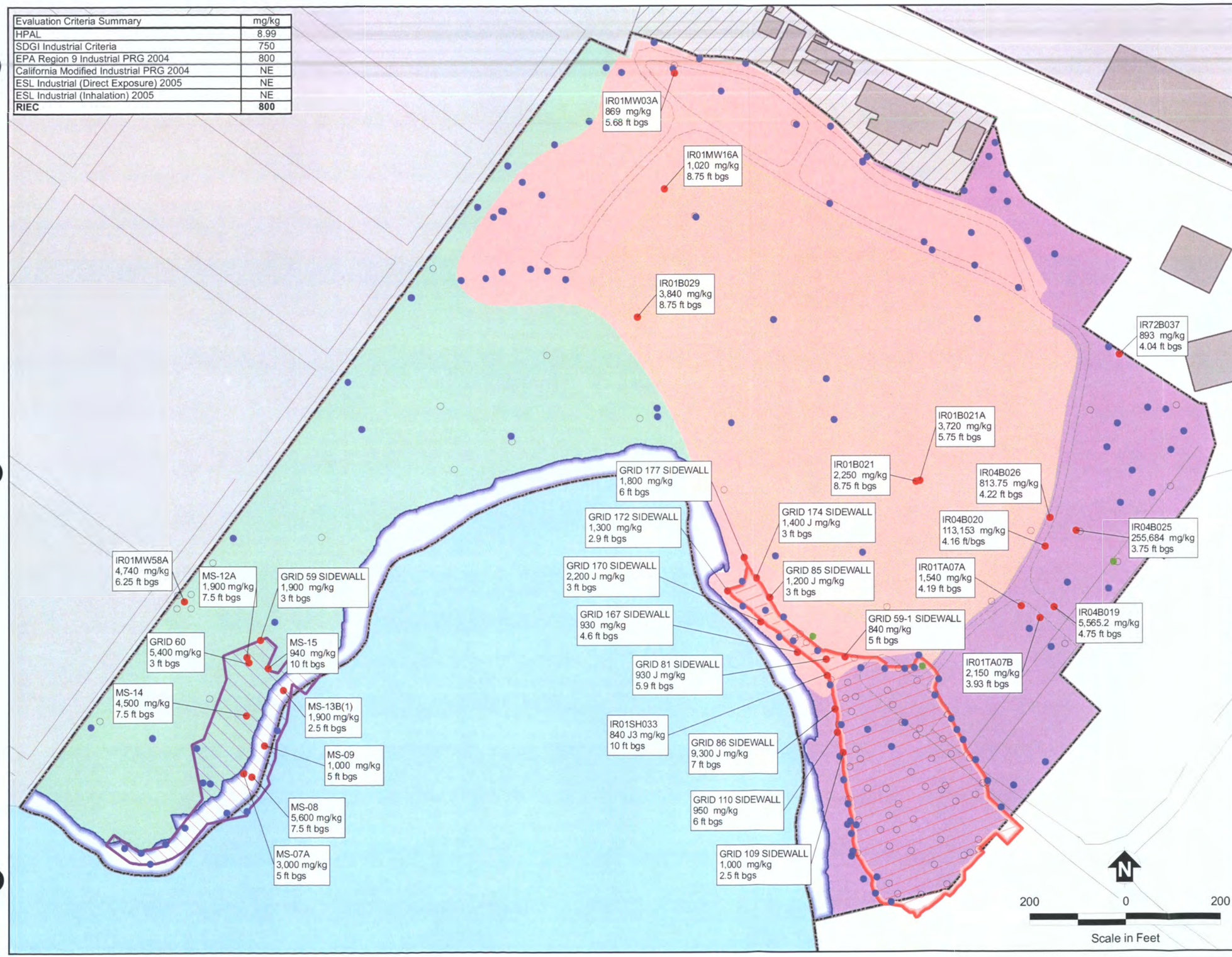
FIGURE 4-18

IRON IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	8.99
SDGI Industrial Criteria	750
EPA Region 9 Industrial PRG 2004	800
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**800**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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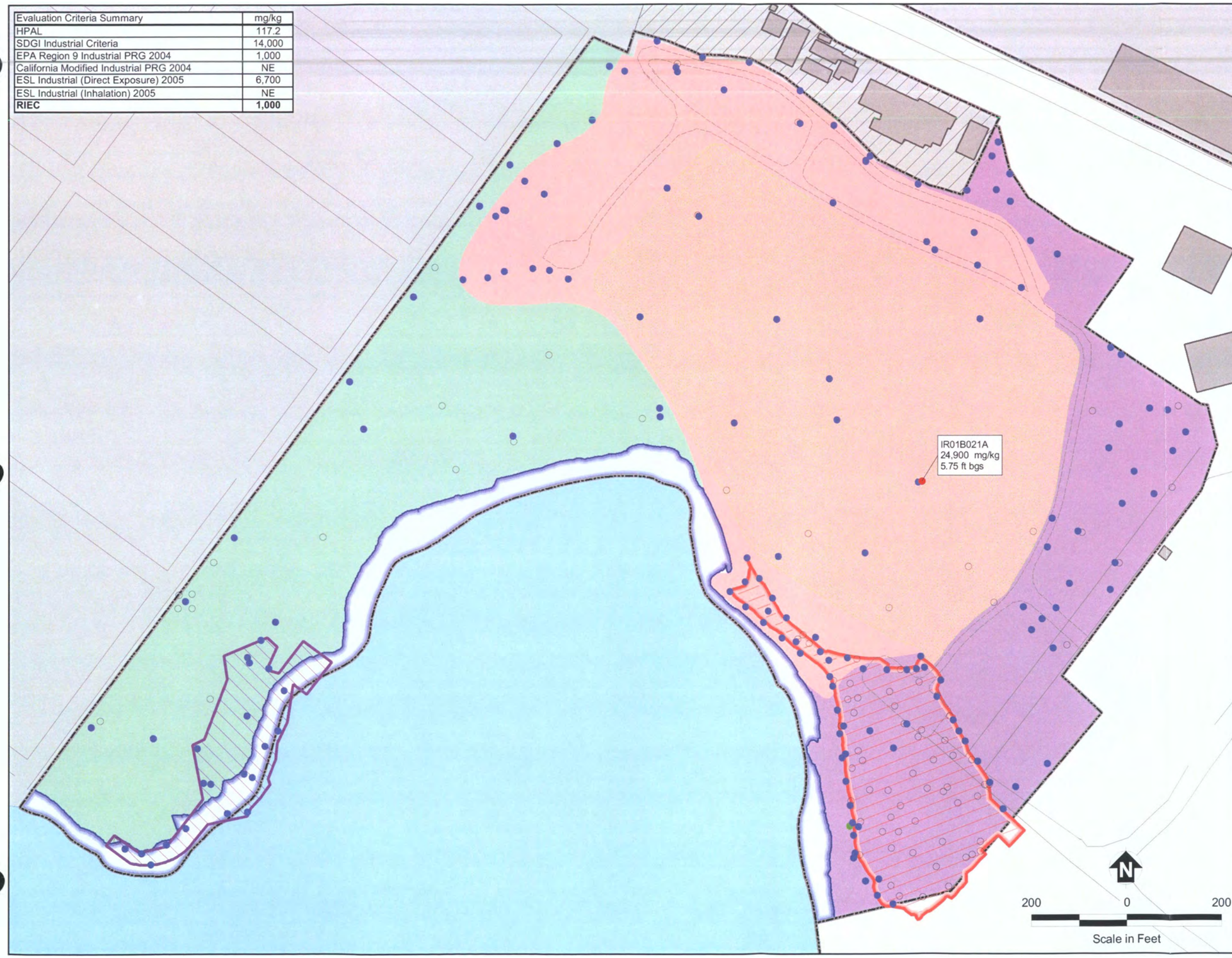
FIGURE 4-19

LEAD IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	117.2
SDGI Industrial Criteria	14,000
EPA Region 9 Industrial PRG 2004	1,000
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	6,700
ESL Industrial (Inhalation) 2005	NE
RIEC	**1,000**



- Reporting Limit Exceeds the RIEC (for at least one sample)
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds RIEC
- Road
- Gravel Road
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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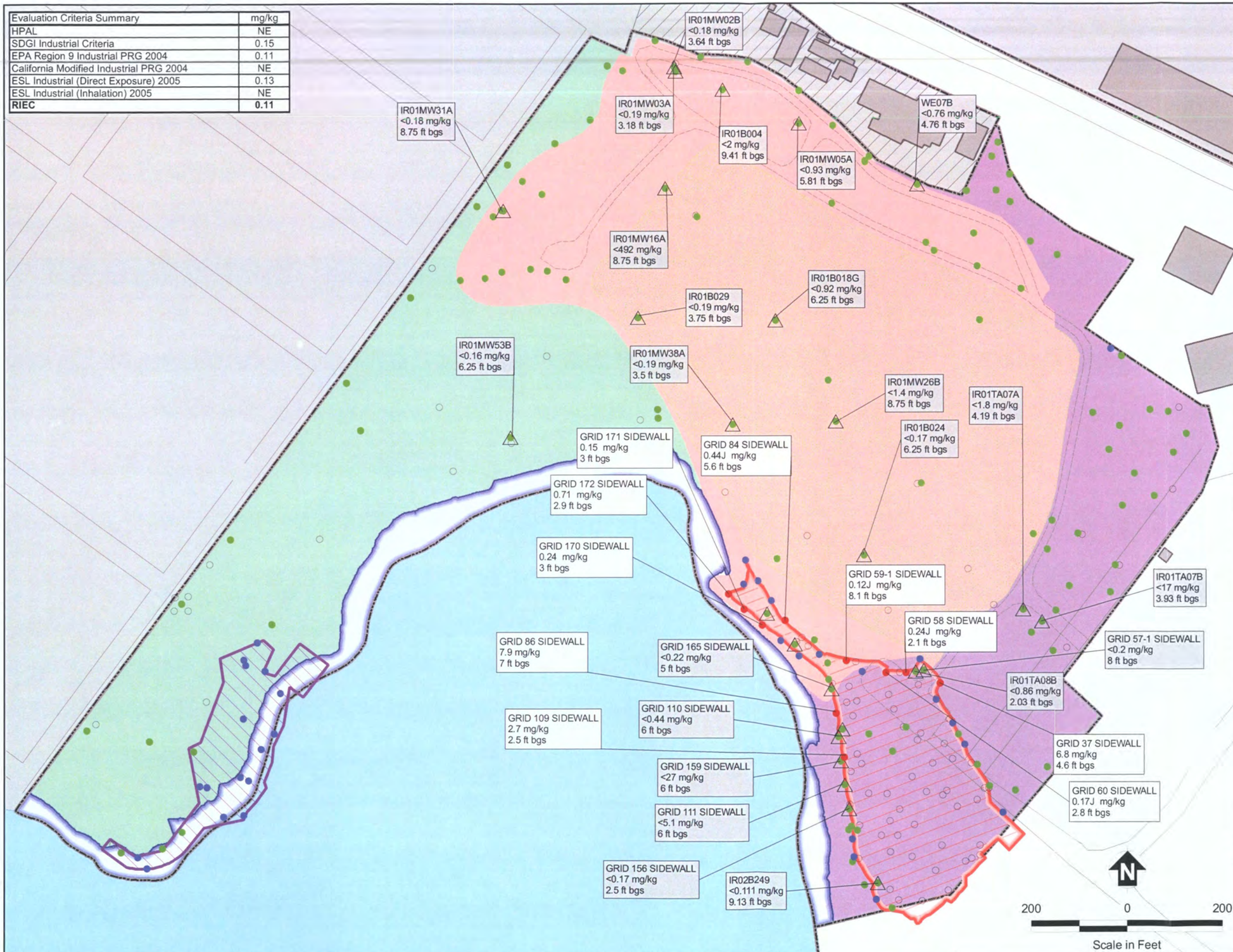
FIGURE 4-20

VANADIUM IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.15
EPA Region 9 Industrial PRG 2004	0.11
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	0.13
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.11**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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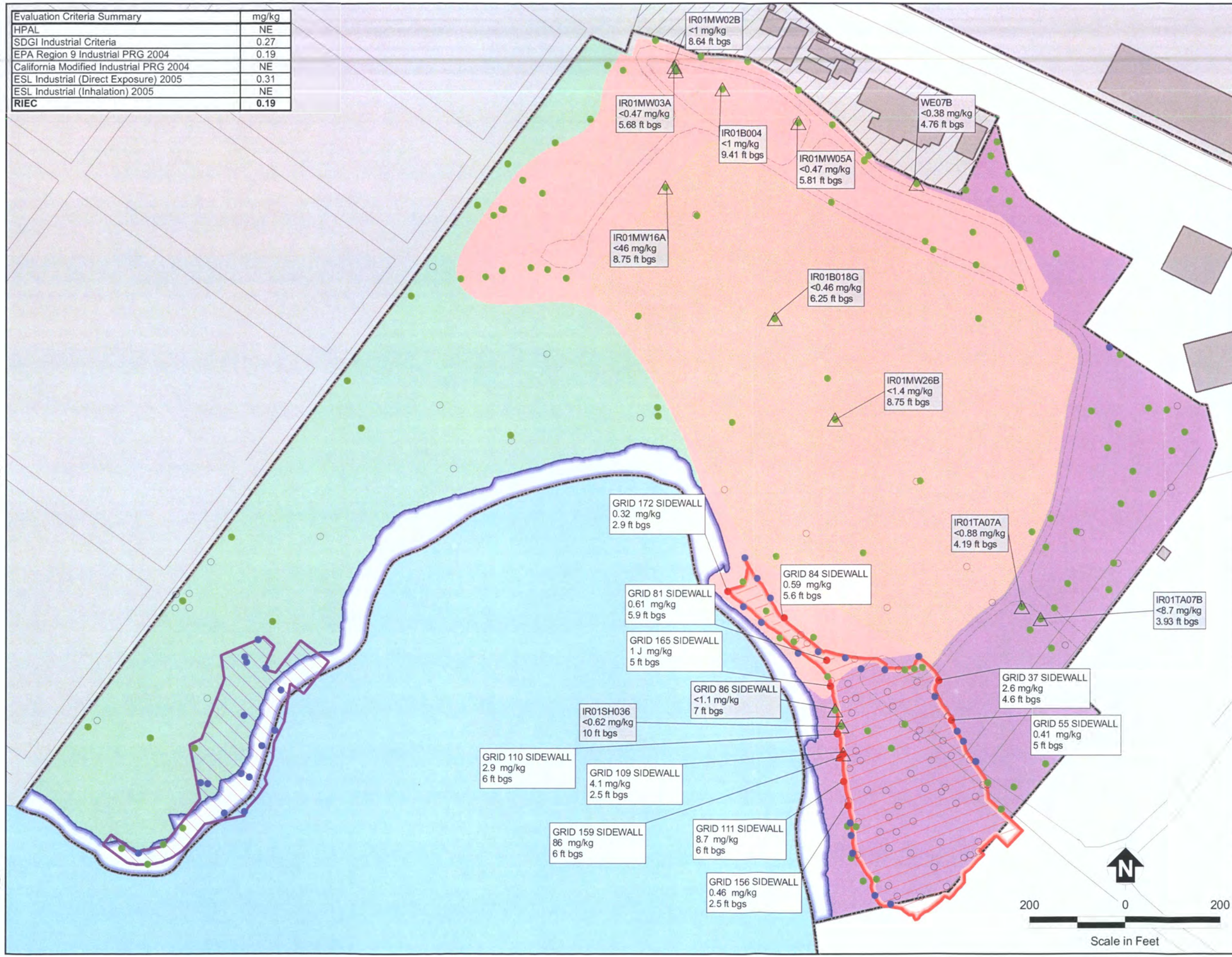
FIGURE 4-21

DIELDRIN IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.27
EPA Region 9 Industrial PRG 2004	0.19
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	0.31
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.19**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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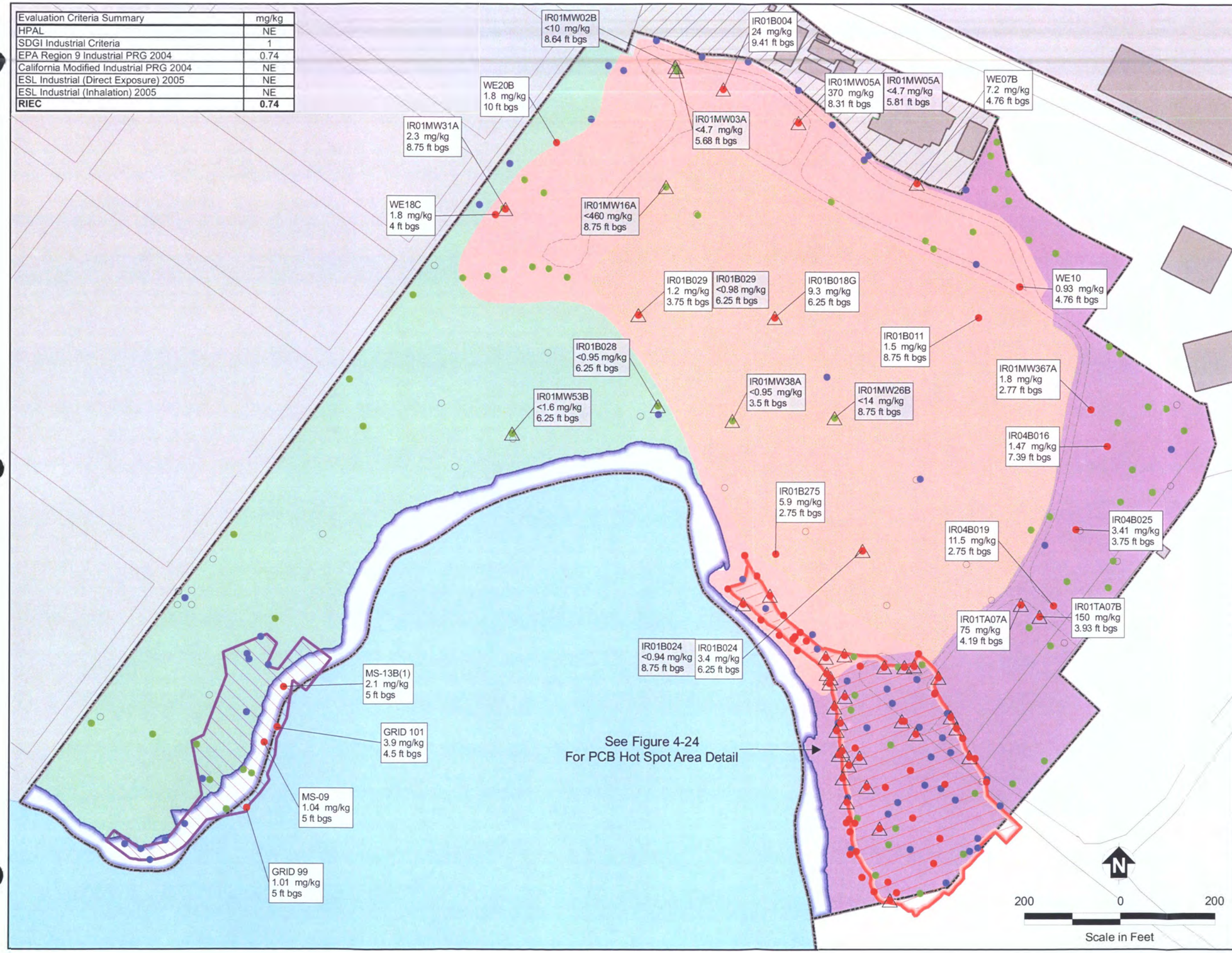
FIGURE 4-22

HEPTACHLOR EPOXIDE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1
EPA Region 9 Industrial PRG 2004	0.74
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.74**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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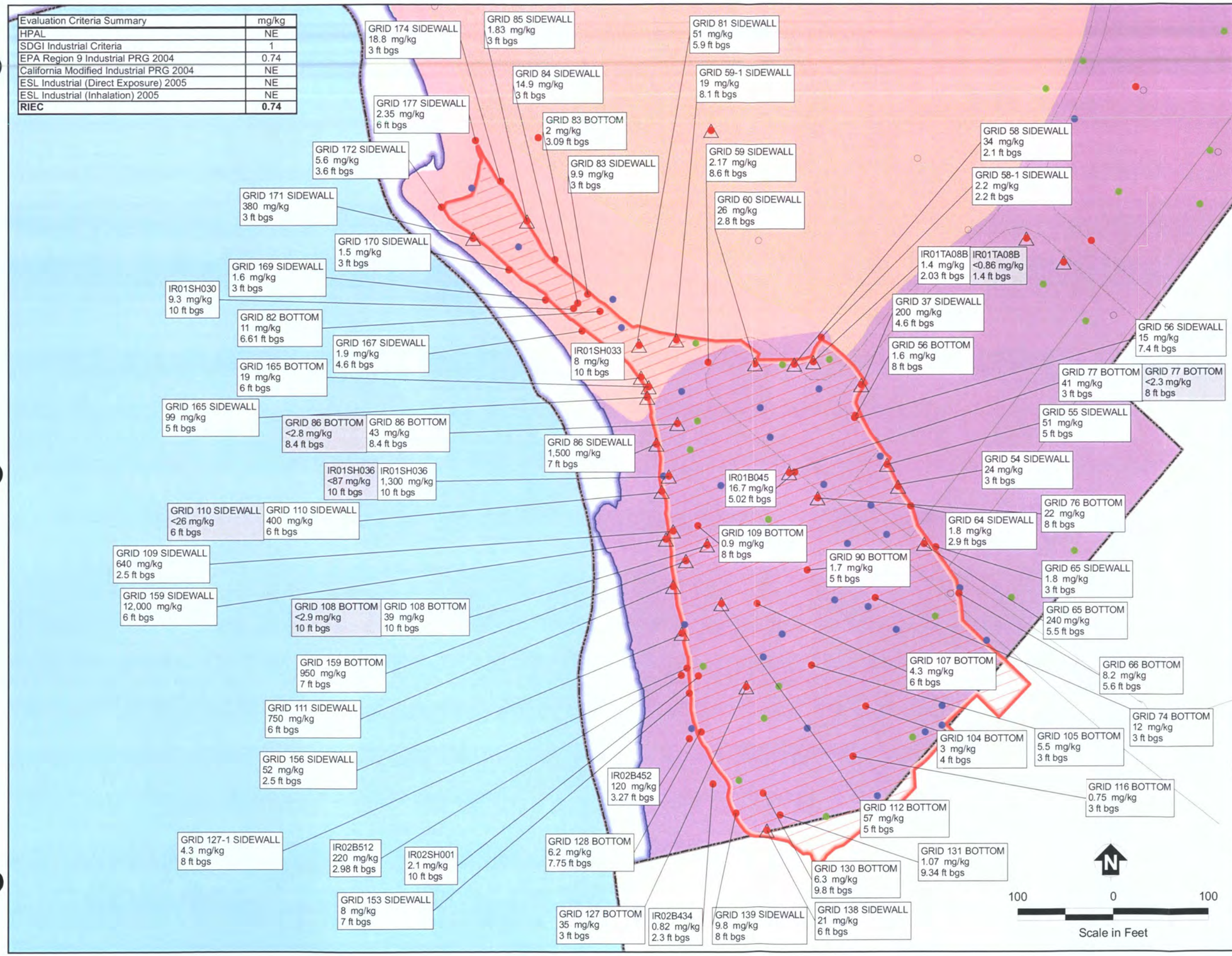
FIGURE 4-23

TOTAL PCBS (HIGH RISK) IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1
EPA Region 9 Industrial PRG 2004	0.74
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.74**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Landfill Area
East Adjacent Area
Shoreline Area
San Francisco Bay

Notes:

[a] The post-excavation boundary in the PCB Hot Spot Area is consistent with information presented in final removal action completion report (Tetra Tech EC Inc., 2007a).

Results are shown for locations where data have exceeded the RIEC.
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EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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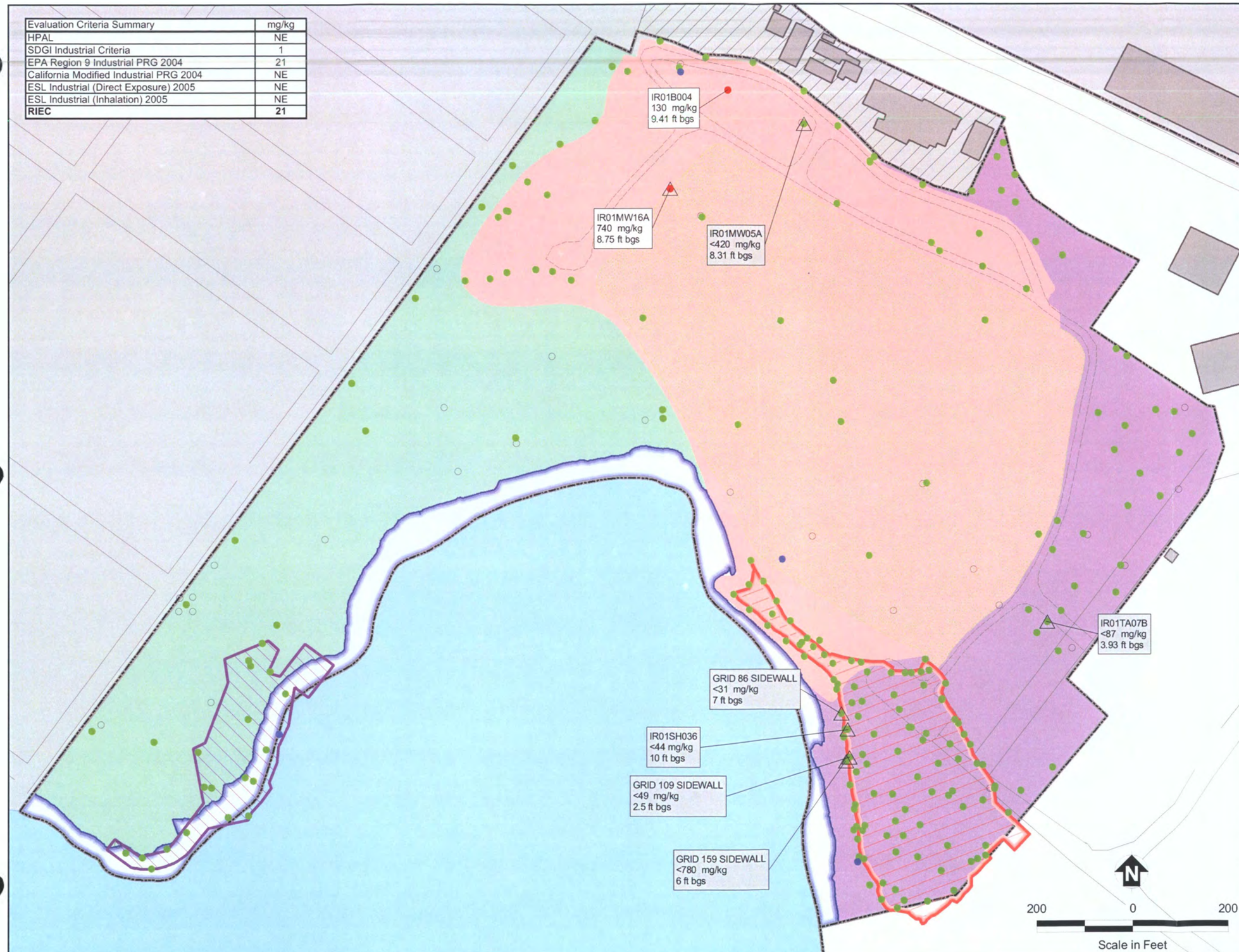
FIGURE 4-24

TOTAL PCBS (HIGH RISK)
PCB HOTSPOT AREA
IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1
EPA Region 9 Industrial PRG 2004	21
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**21**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Landfill Area
East Adjacent Area
Shoreline Area
San Francisco Bay

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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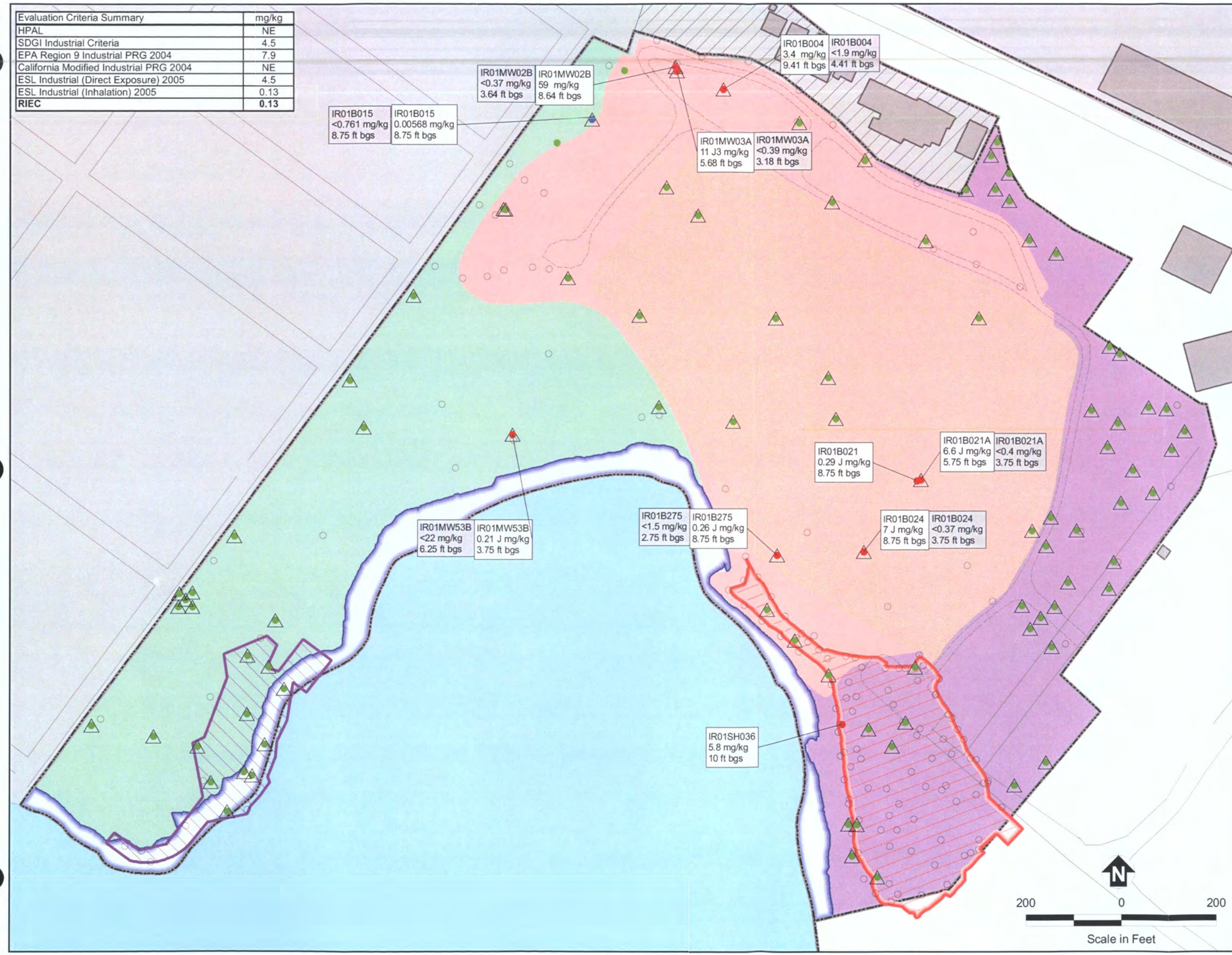
FIGURE 4-25

TOTAL PCBS (LOW RISK) IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	4.5
EPA Region 9 Industrial PRG 2004	7.9
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	4.5
ESL Industrial (Inhalation) 2005	0.13
RIEC	**0.13**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
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PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
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Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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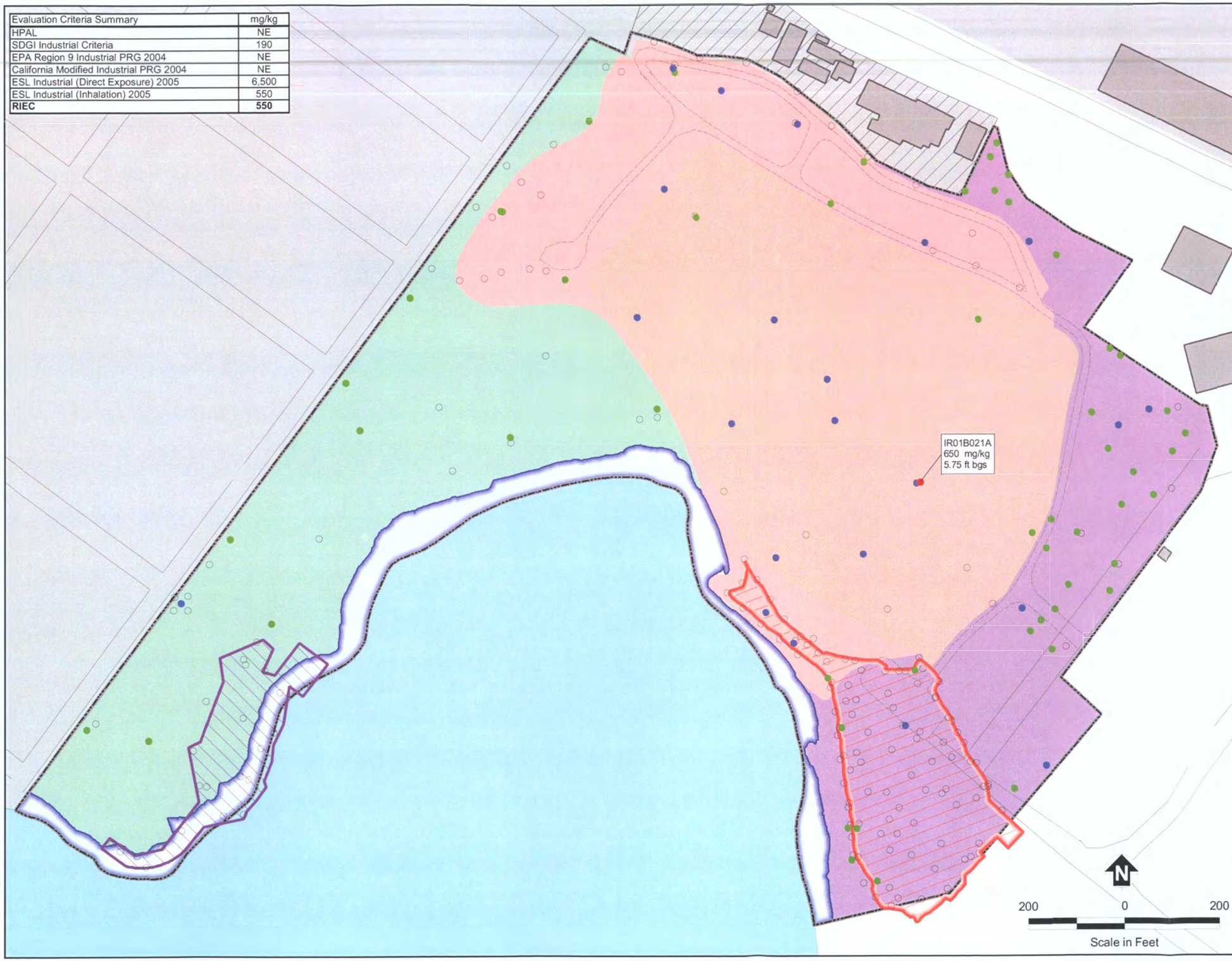
FIGURE 4-26

1,4 - DICHLOROBENZENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	190
EPA Region 9 Industrial PRG 2004	NE
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	6,500
ESL Industrial (Inhalation) 2005	550
RIEC	**550**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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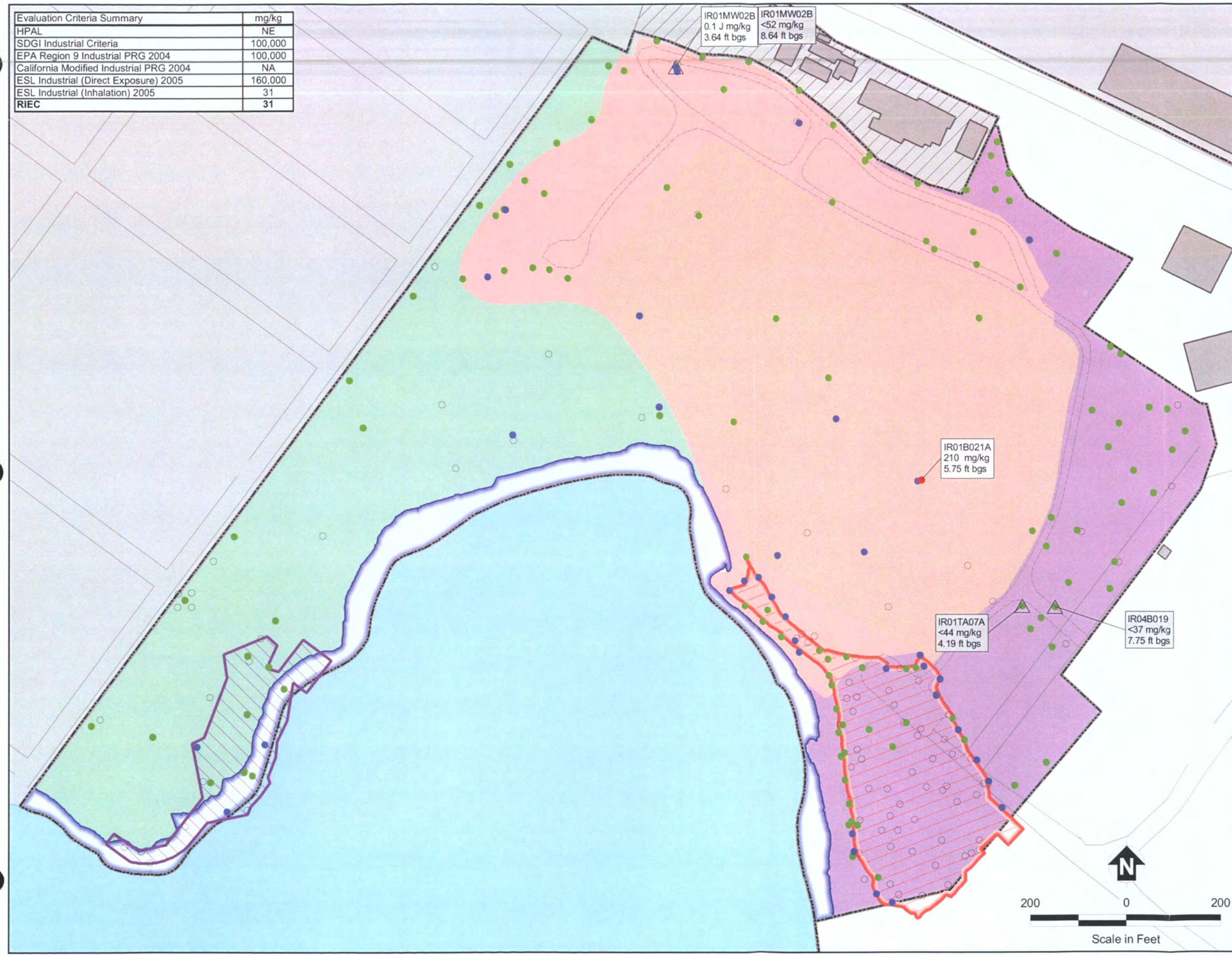
FIGURE 4-27

2 - METHYLNAPHTHALENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	100,000
EPA Region 9 Industrial PRG 2004	100,000
California Modified Industrial PRG 2004	NA
ESL Industrial (Direct Exposure) 2005	160,000
ESL Industrial (Inhalation) 2005	31
RIEC	**31**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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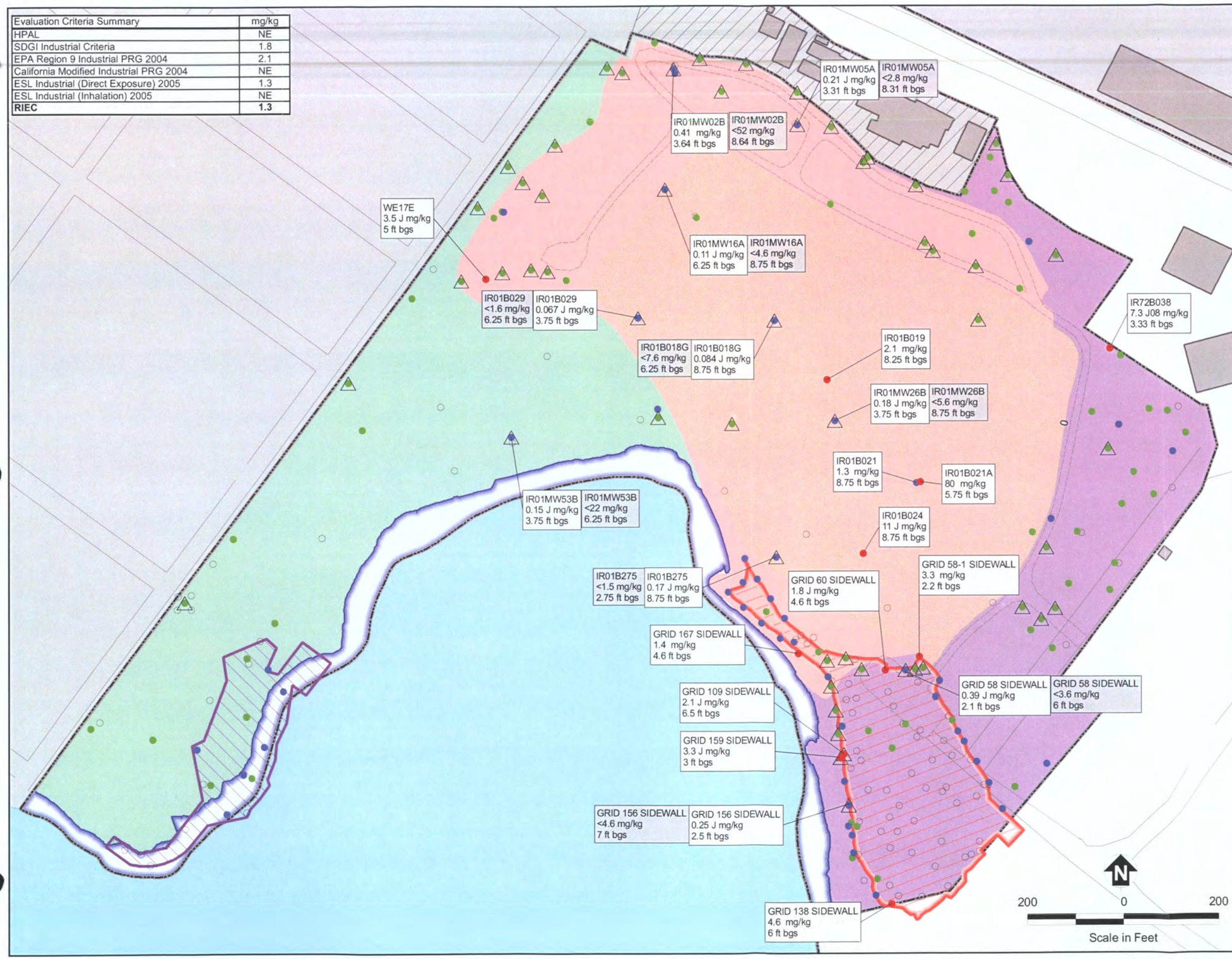
FIGURE 4-28

ANTHRACENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	1.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**1.3**



- Reporting Limit Exceeds the RIEC (for at least one sample)
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds RIEC
- Road
- Gravel Road
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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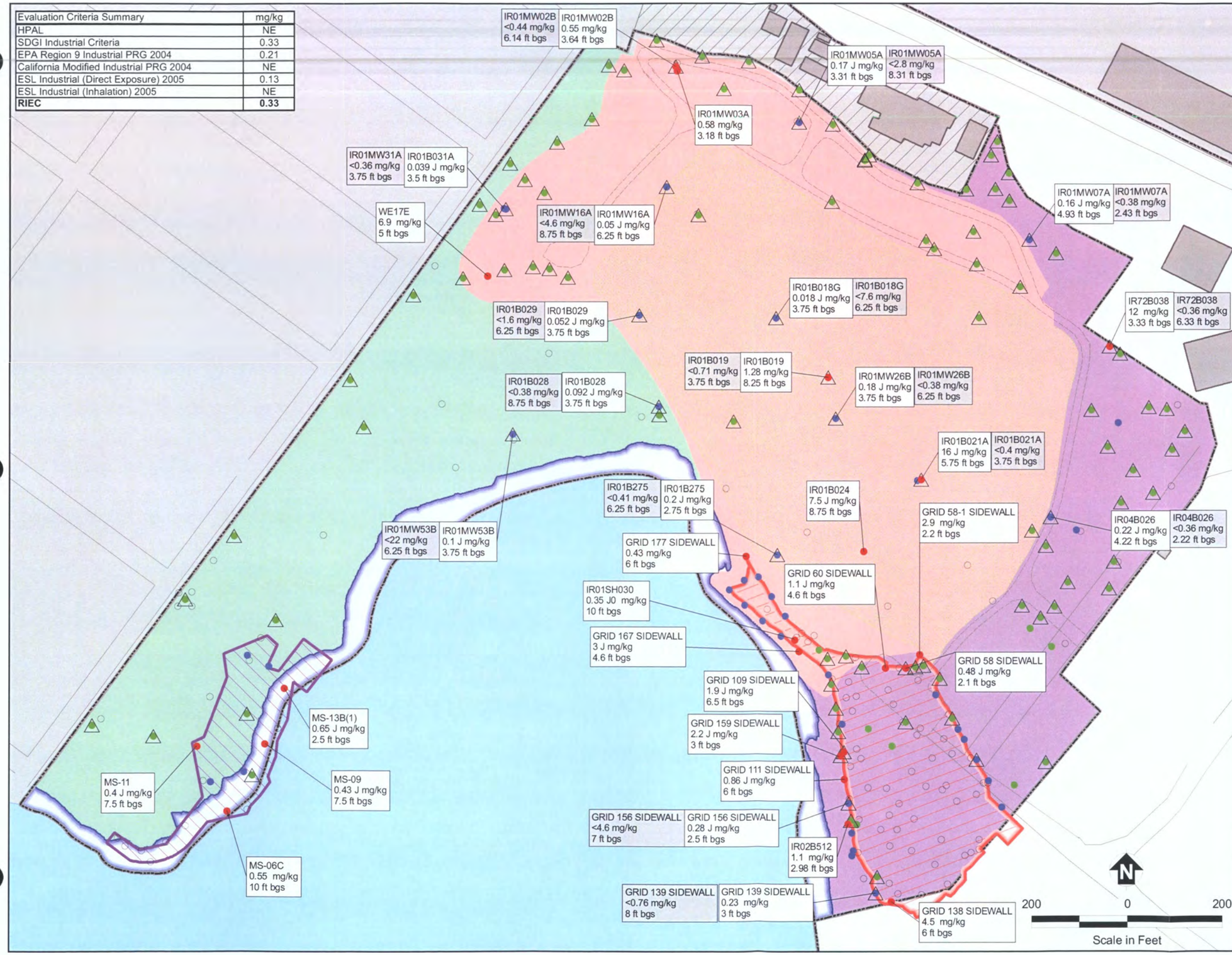
FIGURE 4-29

BENZO (A) ANTHRACENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.33
EPA Region 9 Industrial PRG 2004	0.21
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	0.13
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.33**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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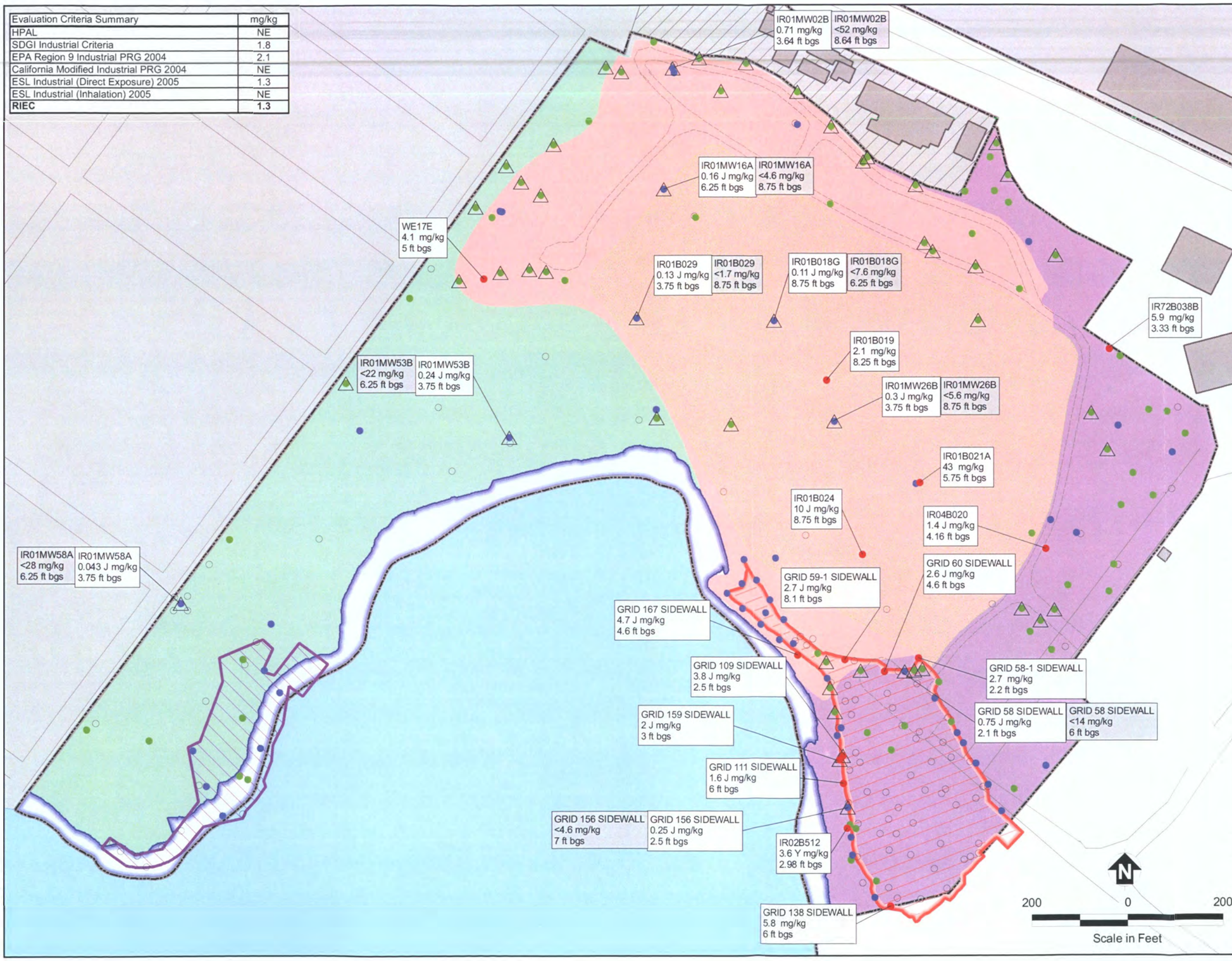
FIGURE 4-30

BENZO (A) PYRENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	1.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**1.3**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco
Y = chromatogram indicates the presence of petroleum fuel

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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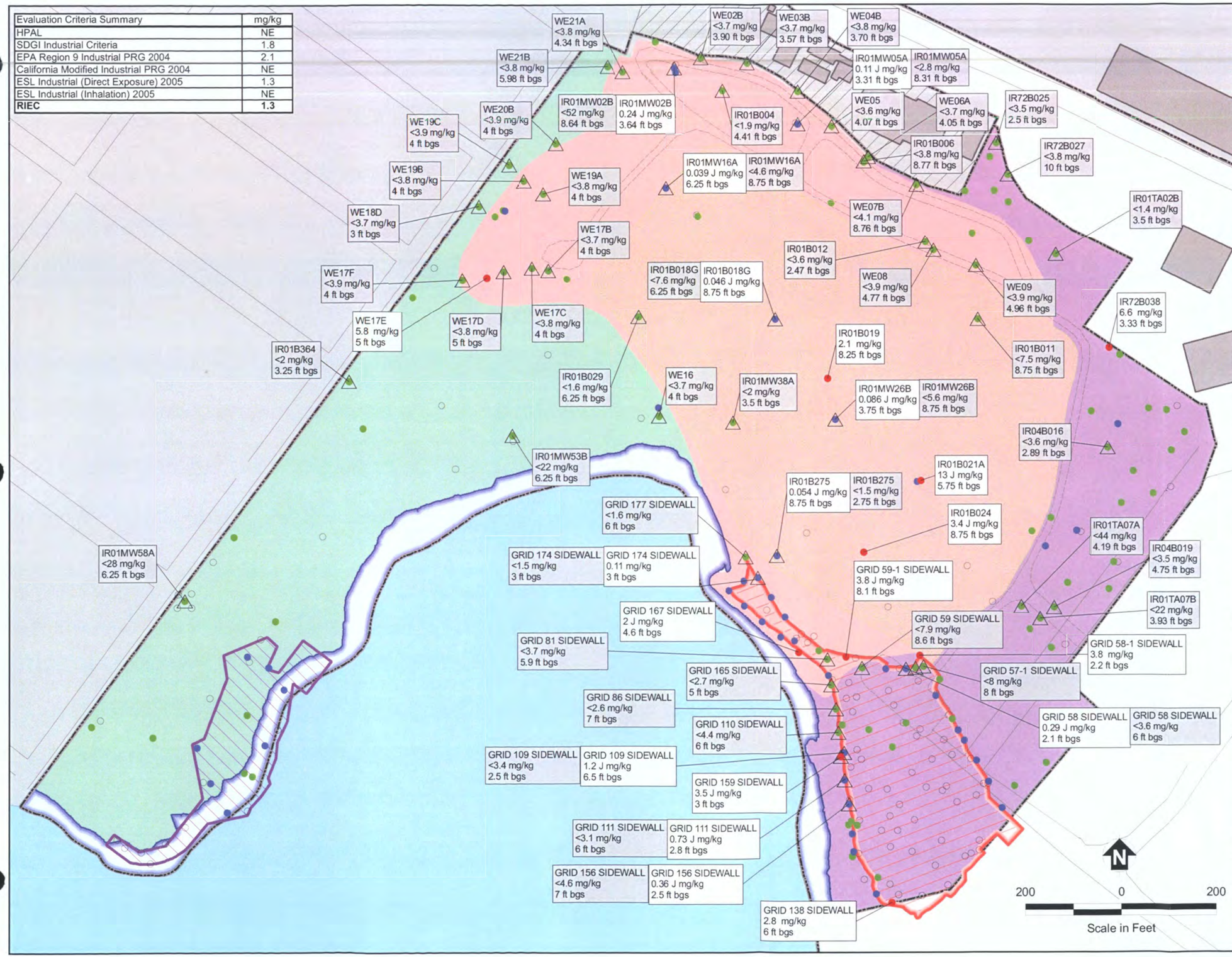
FIGURE 4-31

BENZO (B) FLUORANTHENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	1.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**1.3**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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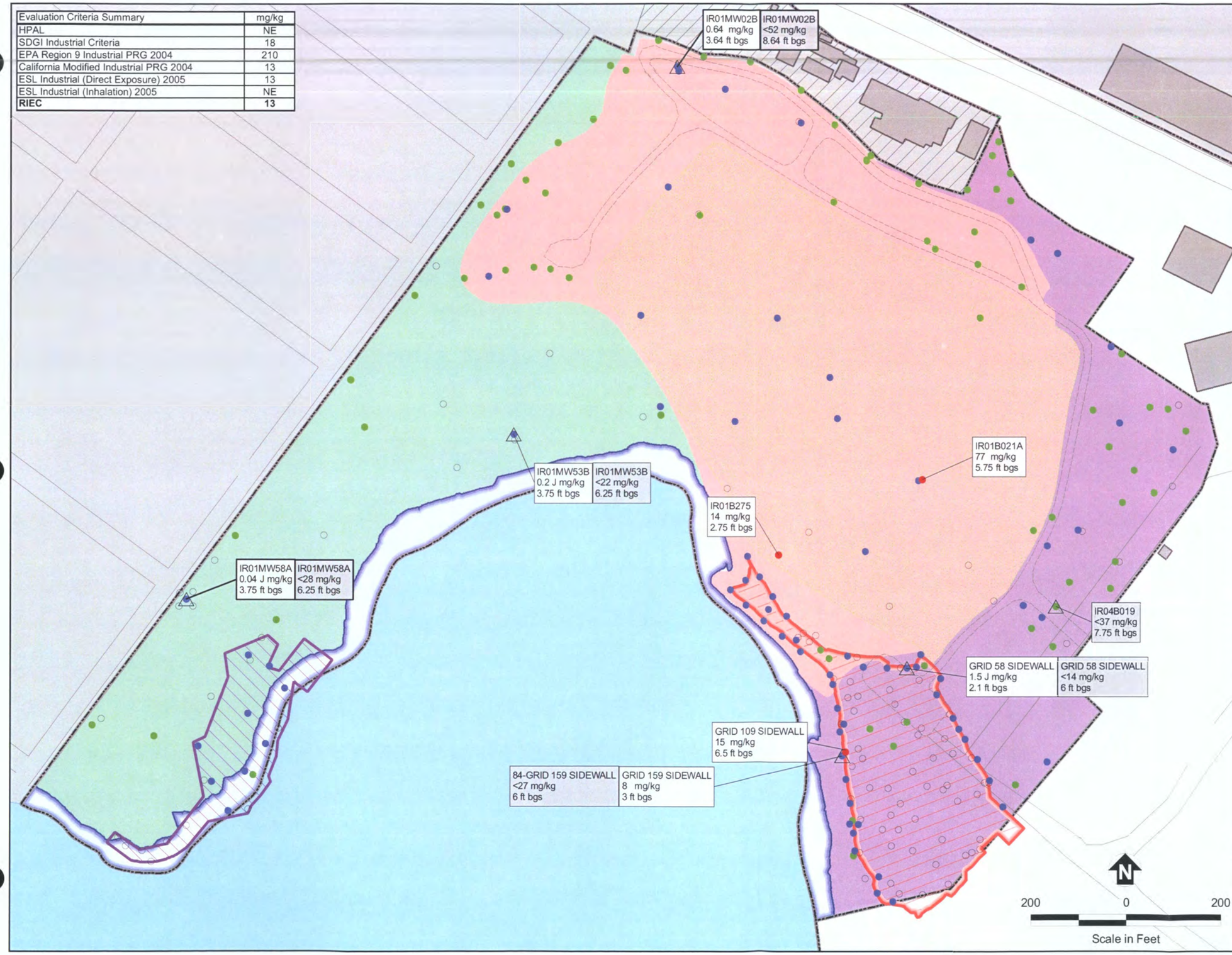
FIGURE 4-32

BENZO (K) FLUORANTHENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	18
EPA Region 9 Industrial PRG 2004	210
California Modified Industrial PRG 2004	13
ESL Industrial (Direct Exposure) 2005	13
ESL Industrial (Inhalation) 2005	NE
RIEC	**13**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-33

CHRYSENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.33
EPA Region 9 Industrial PRG 2004	0.21
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	0.38
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.33**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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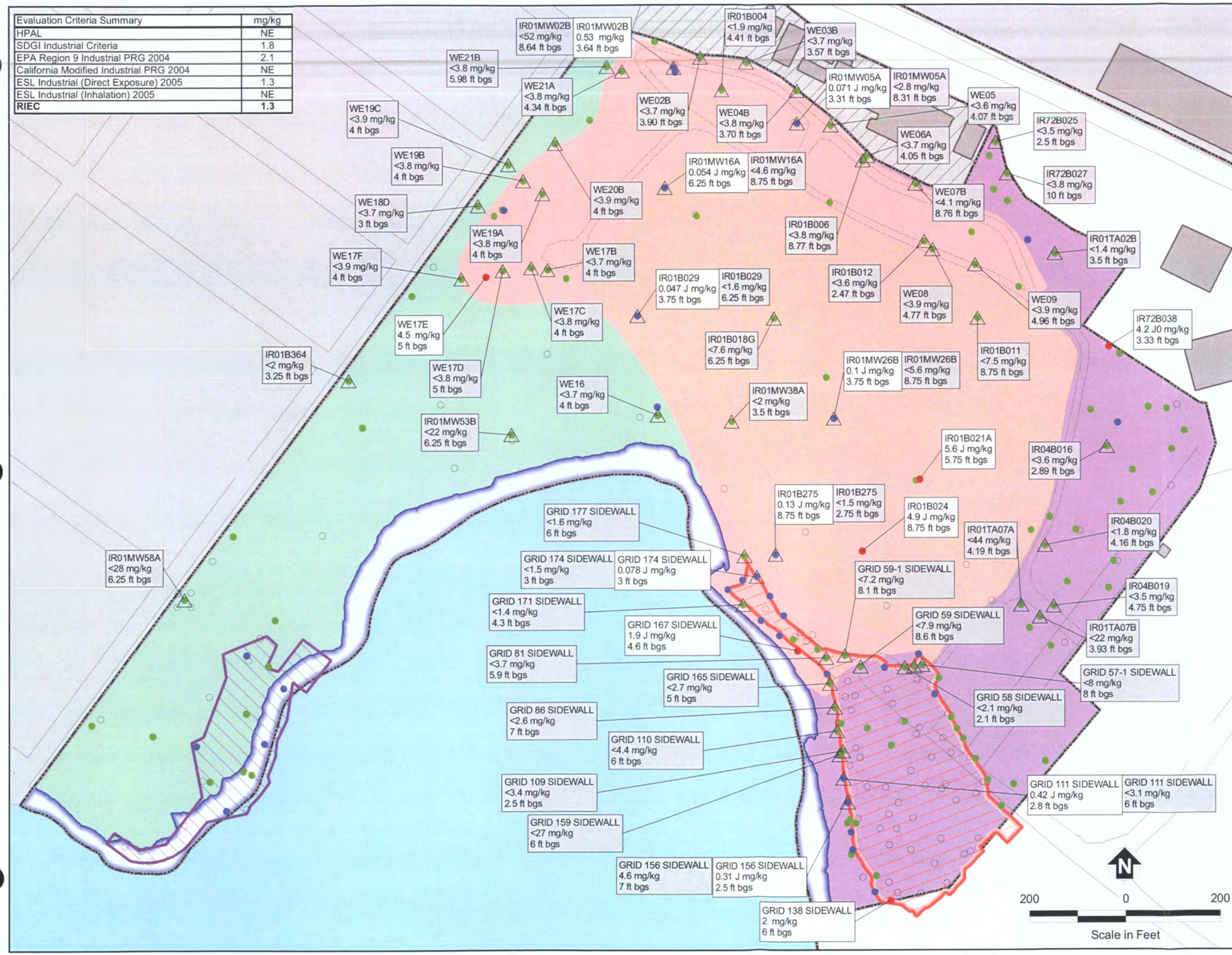
FIGURE 4-34

DIBENZ (A,H) ANTHRACENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	1.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**1.3**



- Reporting Limit Exceeds the RIEC (for at least one sample)
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds RIEC
- Road
- Gravel Road
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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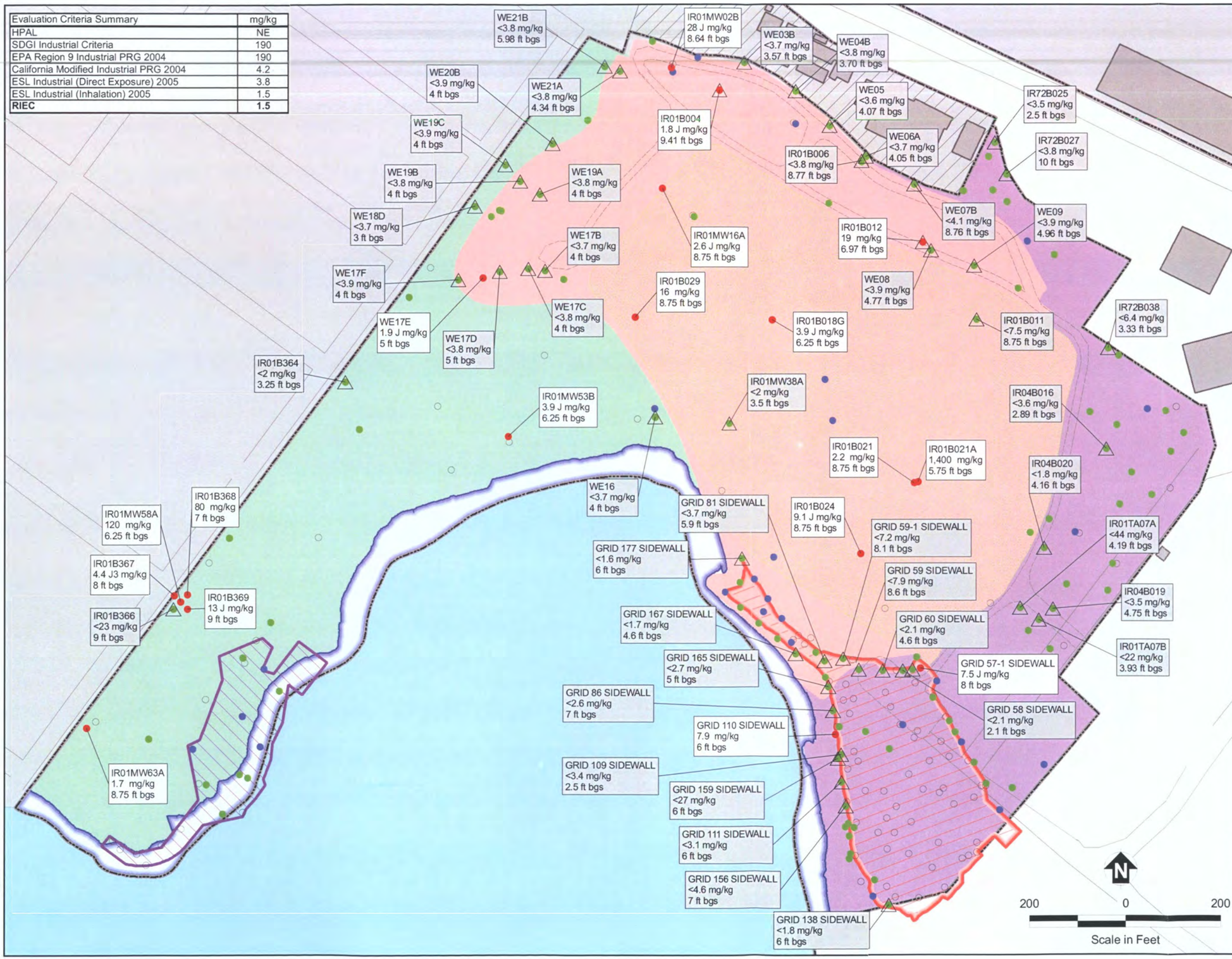
FIGURE 4-35

INDENO (1,2,3-CD) PYRENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	190
EPA Region 9 Industrial PRG 2004	190
California Modified Industrial PRG 2004	4.2
ESL Industrial (Direct Exposure) 2005	3.8
ESL Industrial (Inhalation) 2005	1.5
RIEC	**1.5**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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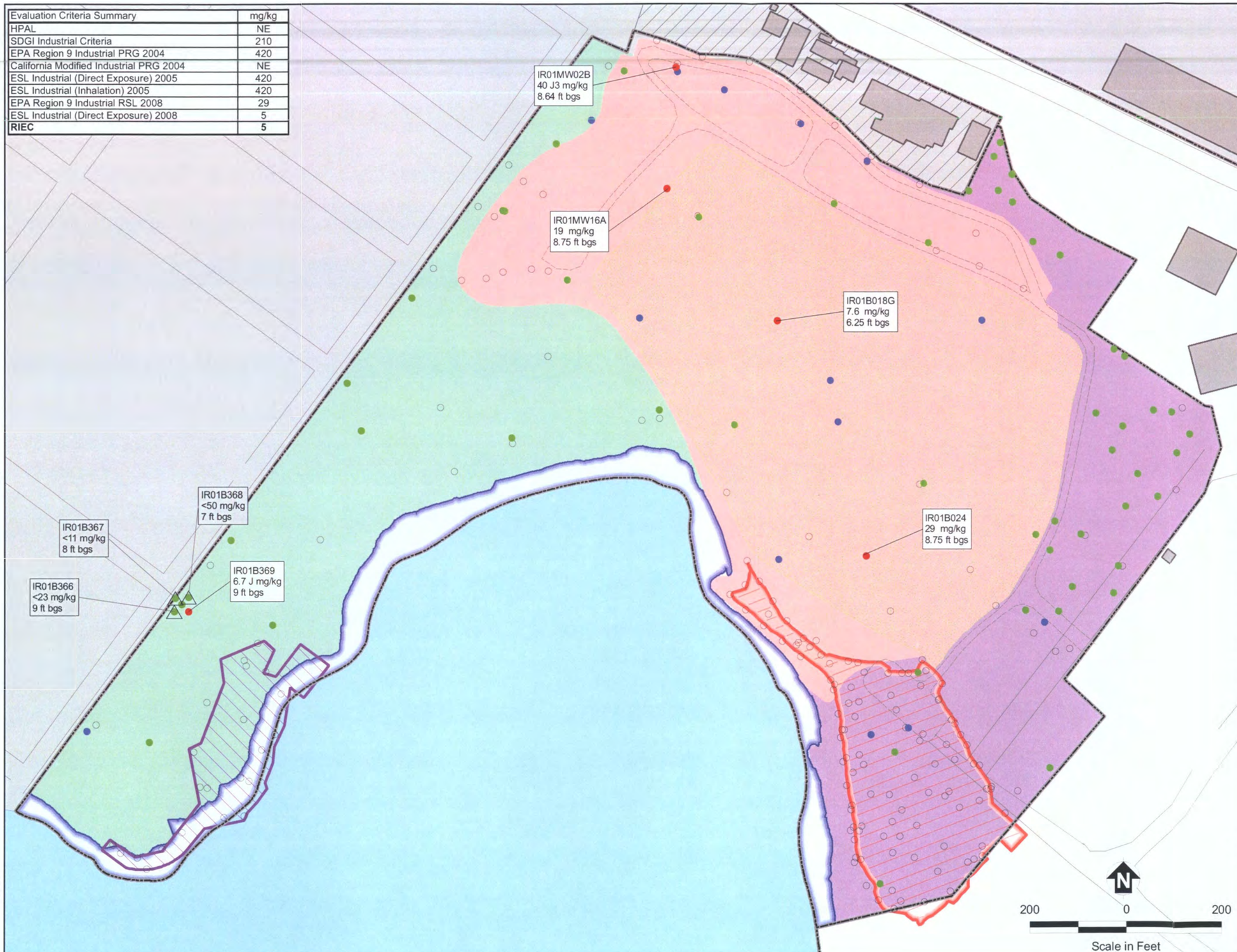
FIGURE 4-36

NAPHTHALENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	210
EPA Region 9 Industrial PRG 2004	420
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	420
ESL Industrial (Inhalation) 2005	420
EPA Region 9 Industrial RSL 2008	29
ESL Industrial (Direct Exposure) 2008	5
RIEC	**5**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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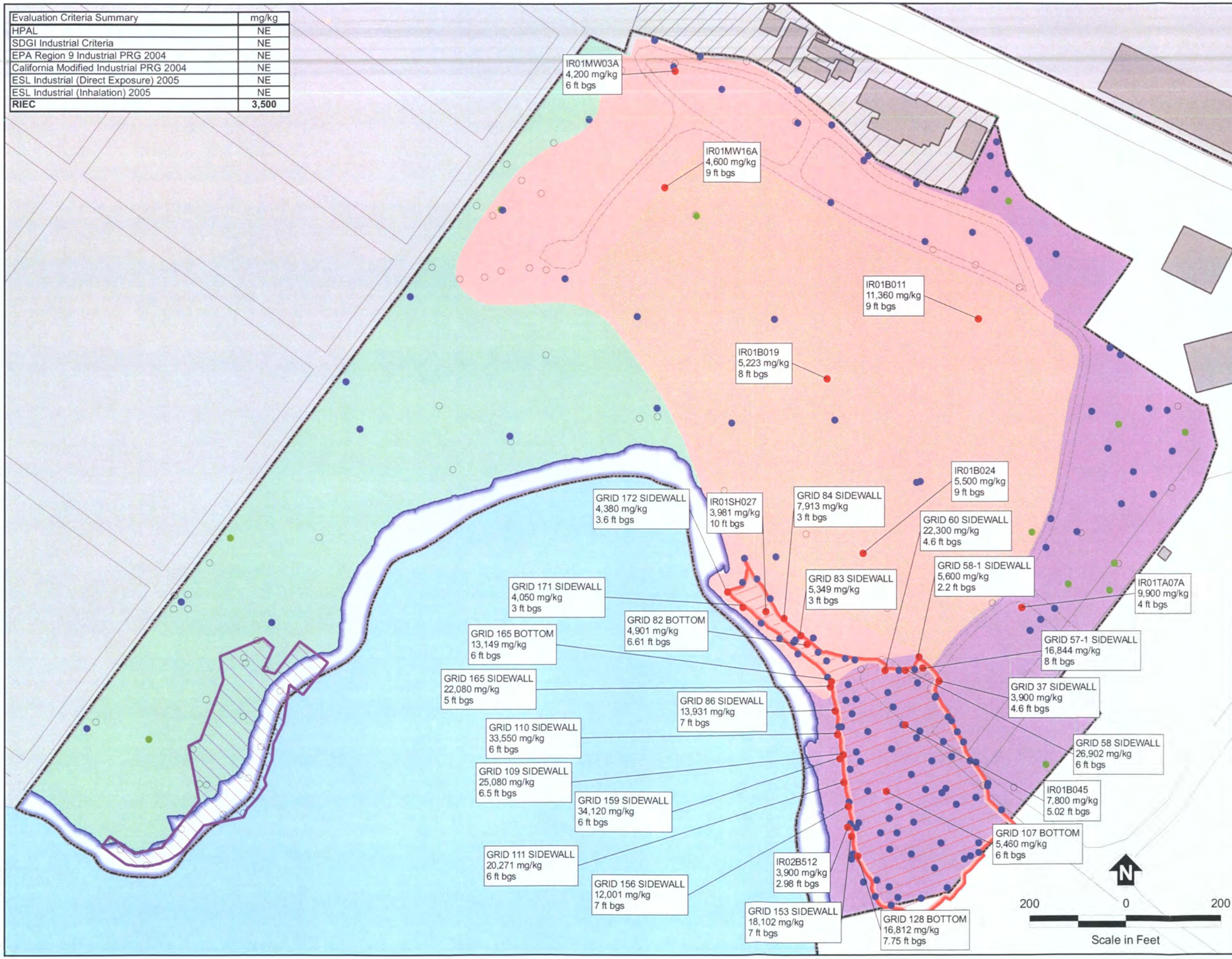
FIGURE 4-37

ETHYLBENZENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	NE
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**3,500**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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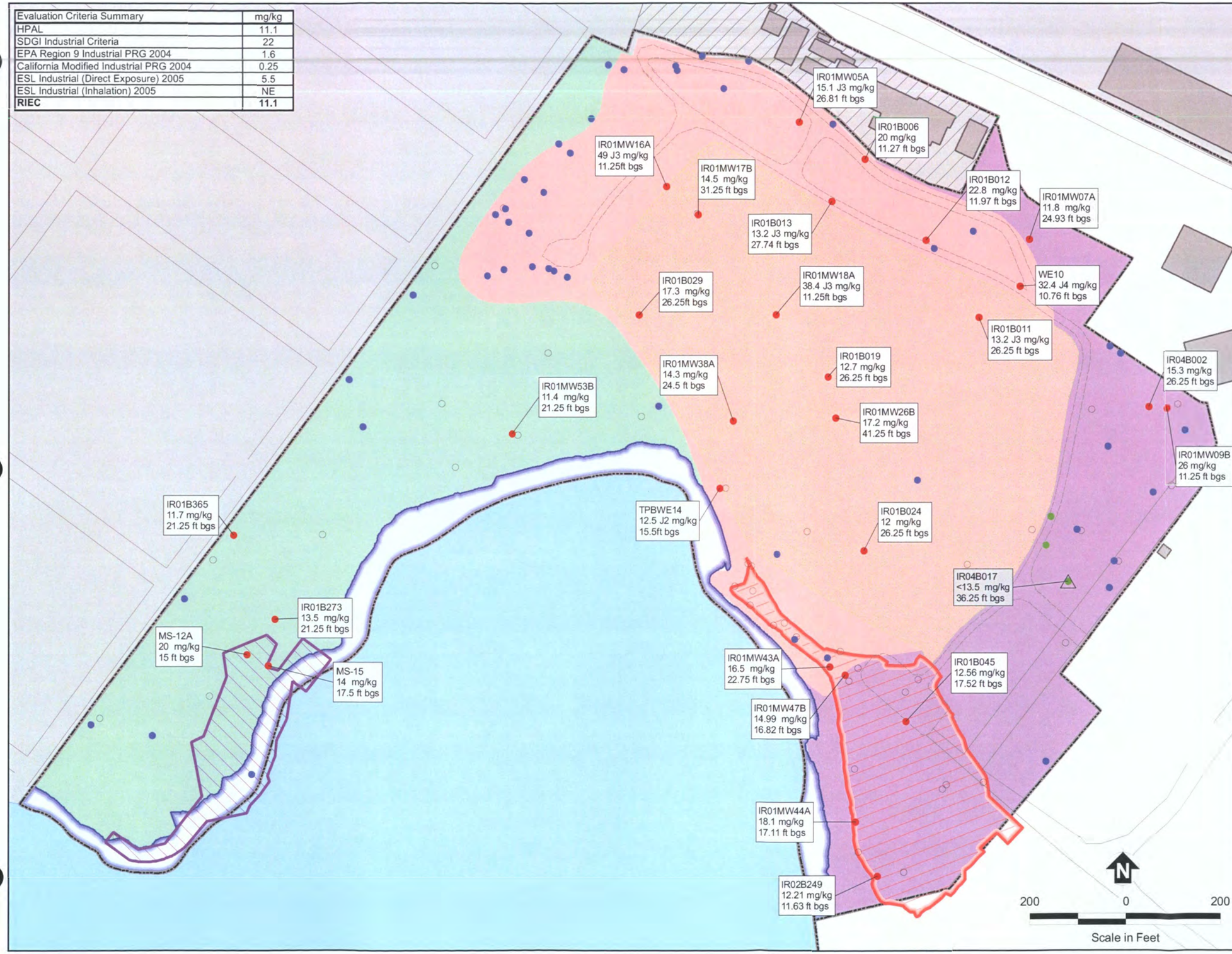
FIGURE 4-38

TOTAL TPH IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	11.1
SDGI Industrial Criteria	22
EPA Region 9 Industrial PRG 2004	1.6
California Modified Industrial PRG 2004	0.25
ESL Industrial (Direct Exposure) 2005	5.5
ESL Industrial (Inhalation) 2005	NE
RIEC	**11.1**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-39

ARSENIC IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	3.14
SDGI Industrial Criteria	15
EPA Region 9 Industrial PRG 2004	450
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	38
ESL Industrial (Inhalation) 2005	NE
RIEC	**38**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-40

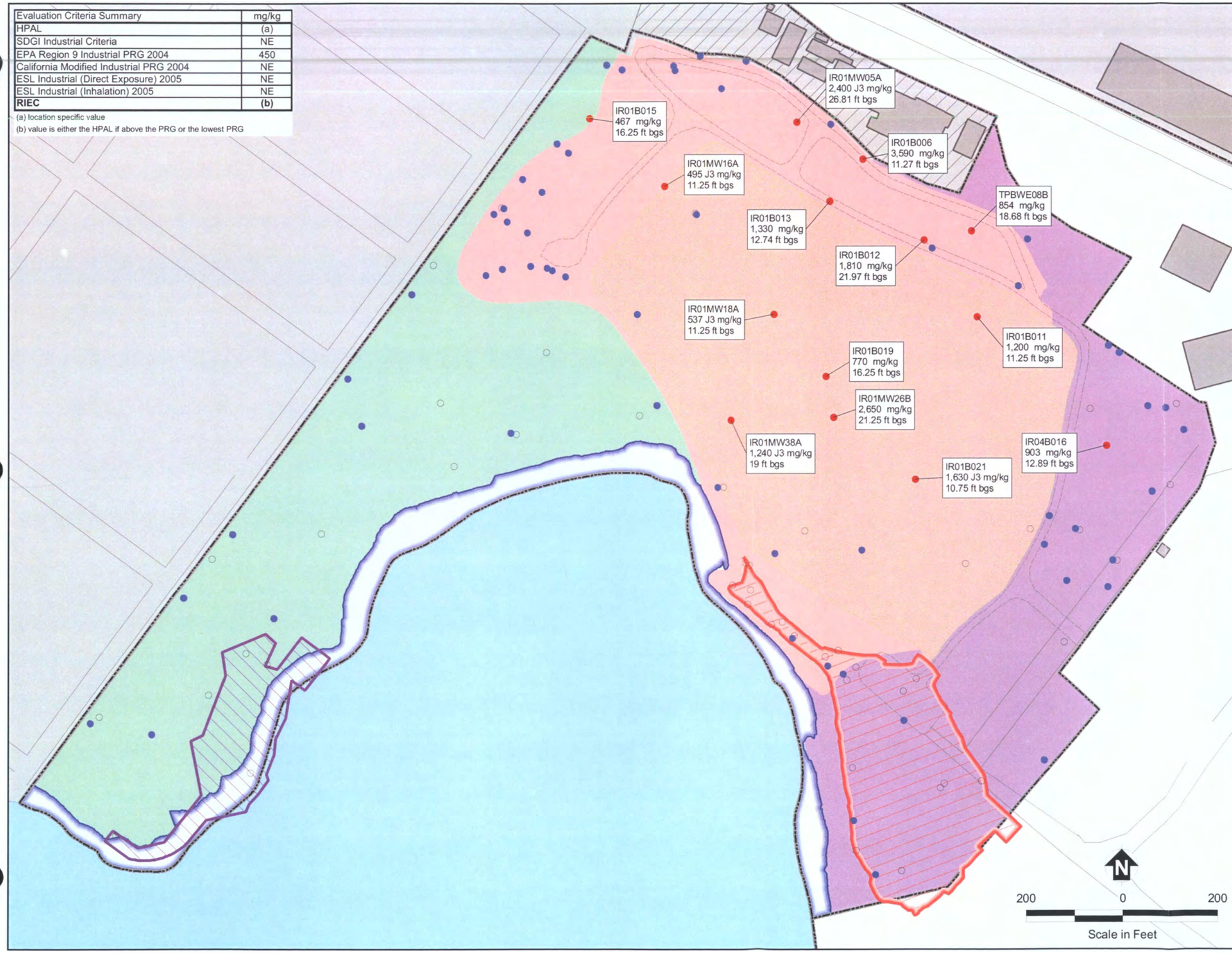
CADMIUM IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	(a)
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	450
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**(b)**

(a) location specific value

(b) value is either the HPAL if above the PRG or the lowest PRG



Reporting Limit Exceeds the RIEC (for at least one sample)

Not Analyzed for Analyte

Analyte Not Detected

Analyte Exceeds Reporting Limit

Analyte Exceeds RIEC

Road

Gravel Road

Metal Slag Area (2007 excavation limit)[a]

PCB Hot Spot Area (2007 excavation limit)[a]

Limit of Landfill Cap

Parcel Boundary

Building

UCSF Compound

Landfill Area

East Adjacent Area

Panhandle Area

Shoreline Area

San Francisco Bay

Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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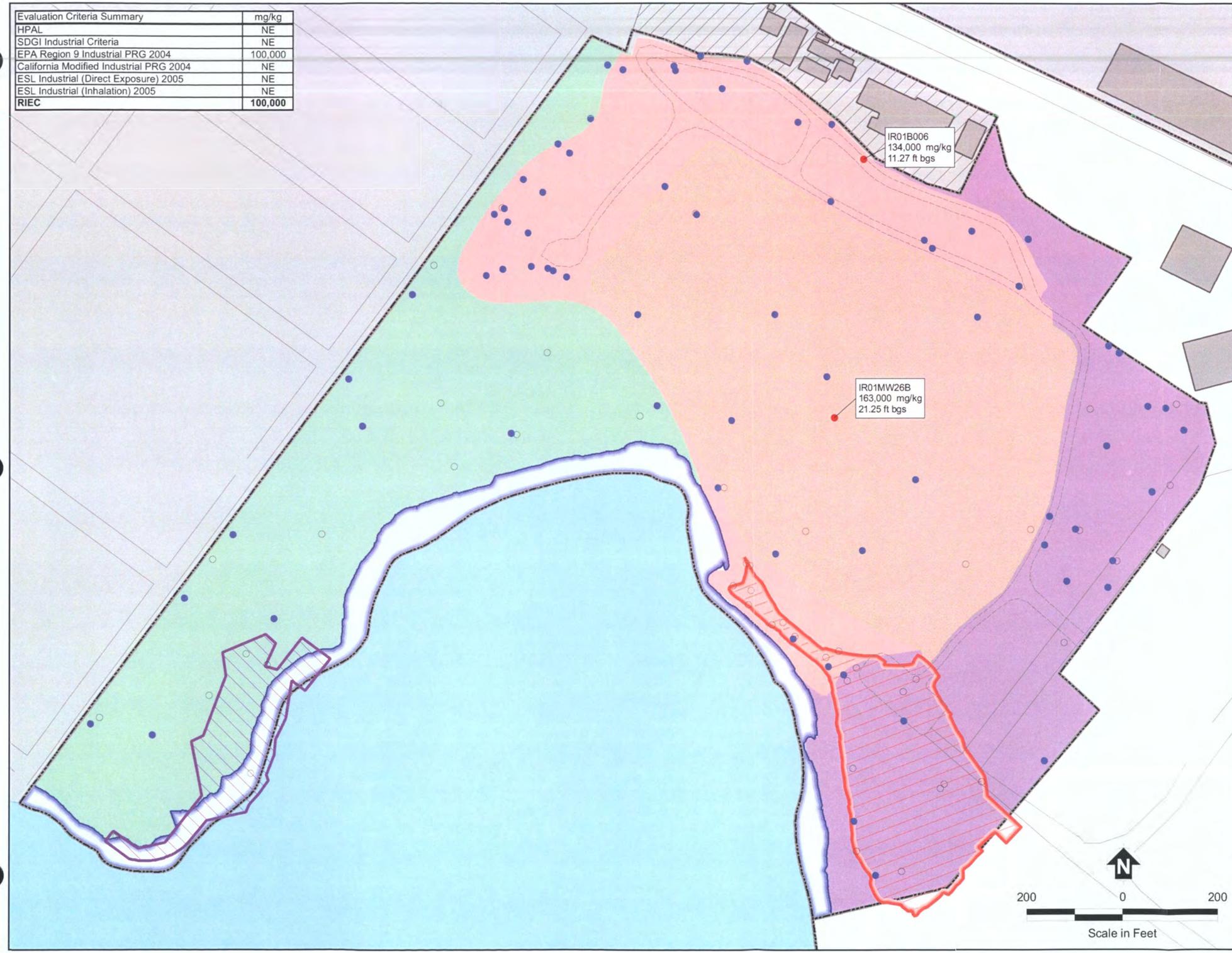
FIGURE 4-41

CHROMIUM (TOTAL) IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	100,000
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**100,000**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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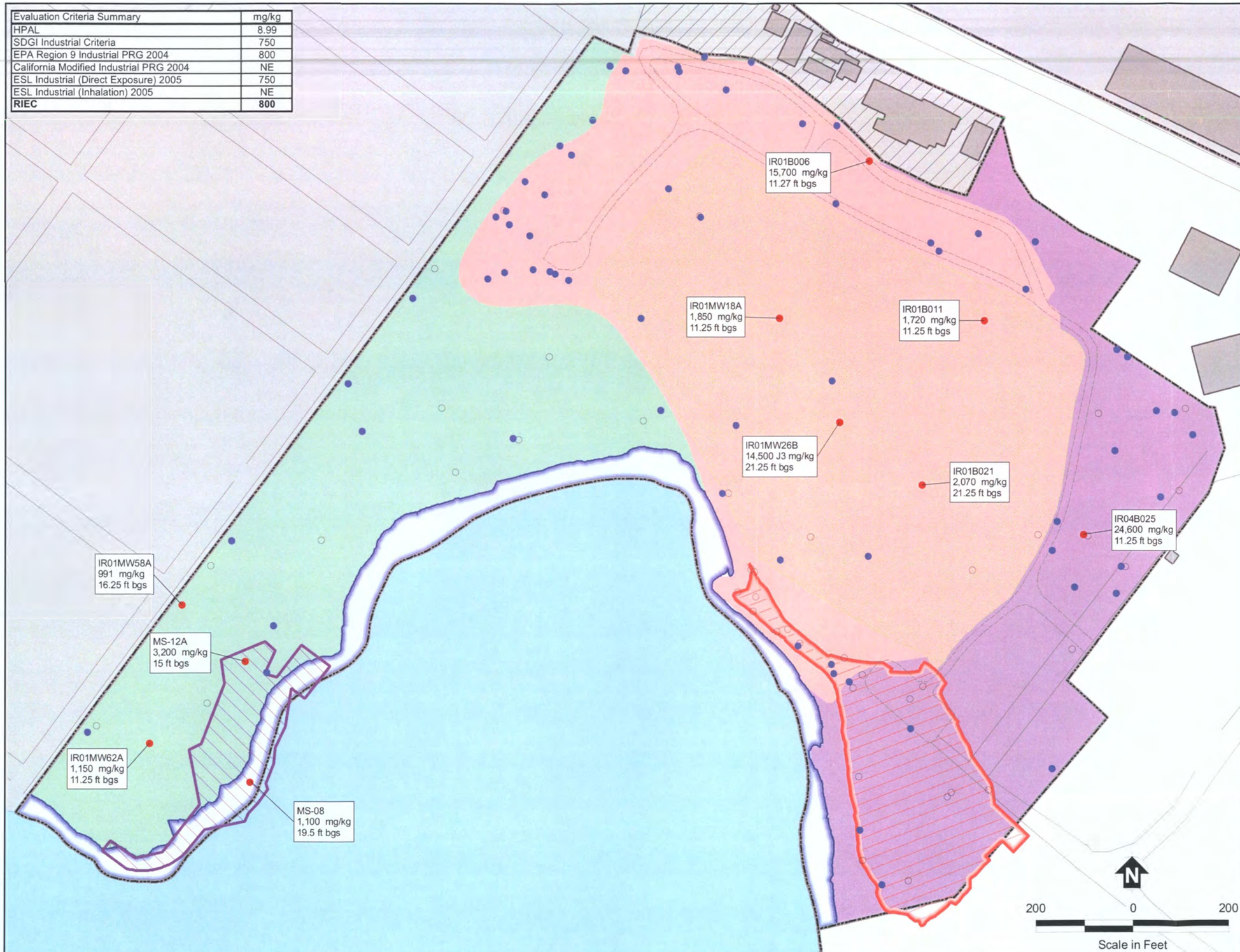
FIGURE 4-42

IRON IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	8.99
SDGI Industrial Criteria	750
EPA Region 9 Industrial PRG 2004	800
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	750
ESL Industrial (Inhalation) 2005	NE
RIEC	**800**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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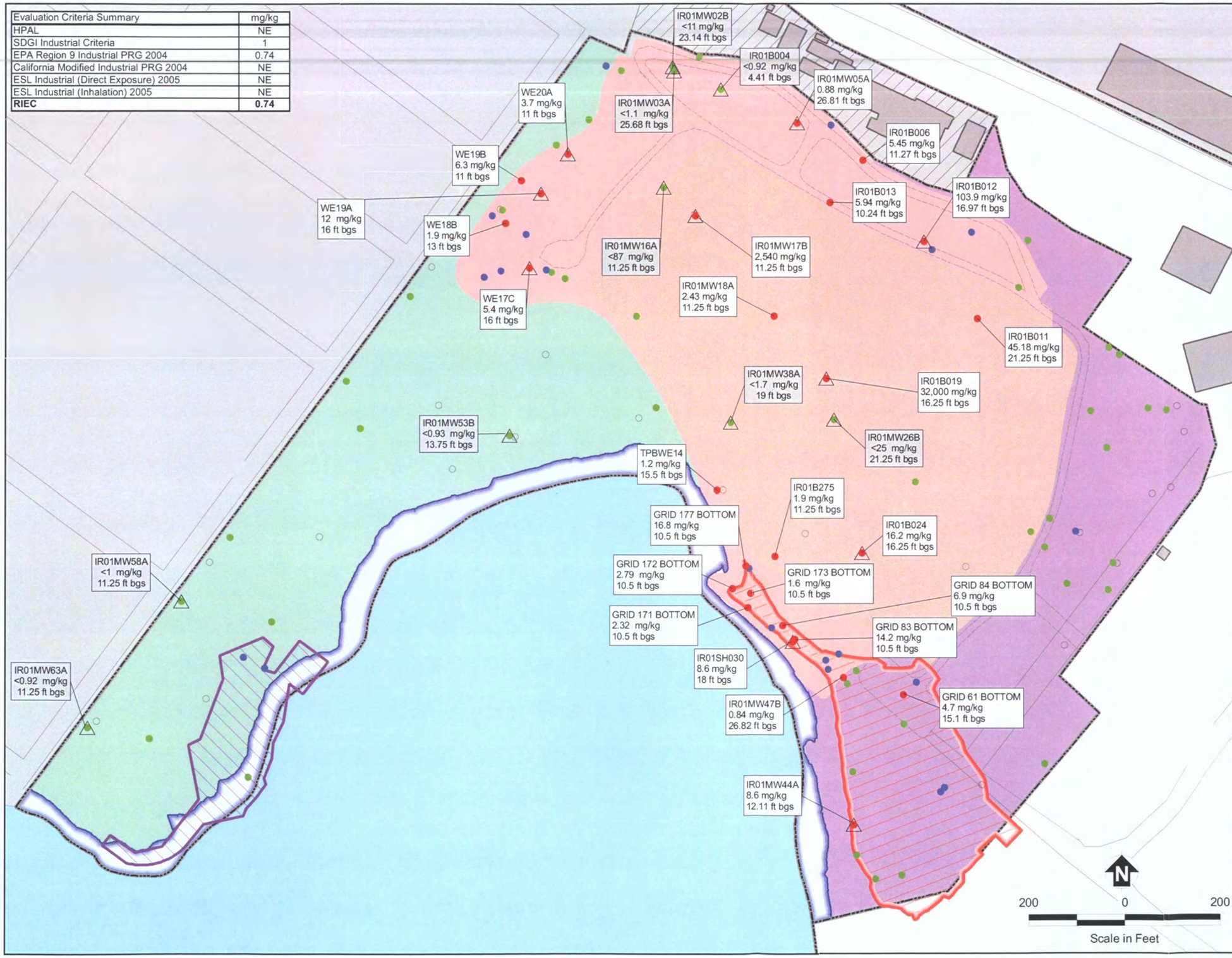
FIGURE 4-43

LEAD IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1
EPA Region 9 Industrial PRG 2004	0.74
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.74**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-44

TOTAL PCBS (HIGH RISK) IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1
EPA Region 9 Industrial PRG 2004	21
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**21**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
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PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
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UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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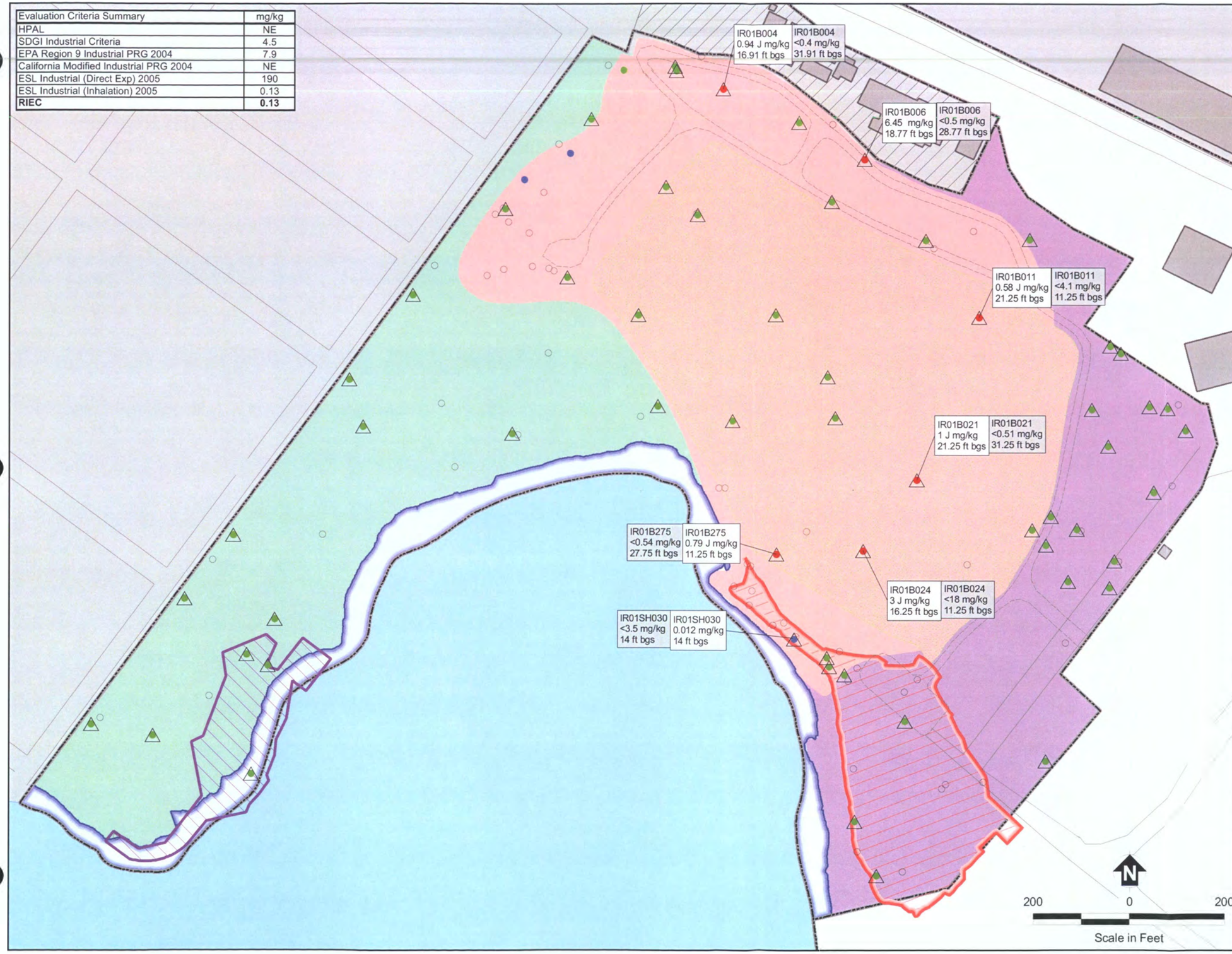
FIGURE 4-45

TOTAL PCBS (LOW RISK) IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	4.5
EPA Region 9 Industrial PRG 2004	7.9
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exp) 2005	190
ESL Industrial (Inhalation) 2005	0.13
RIEC	**0.13**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
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HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
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PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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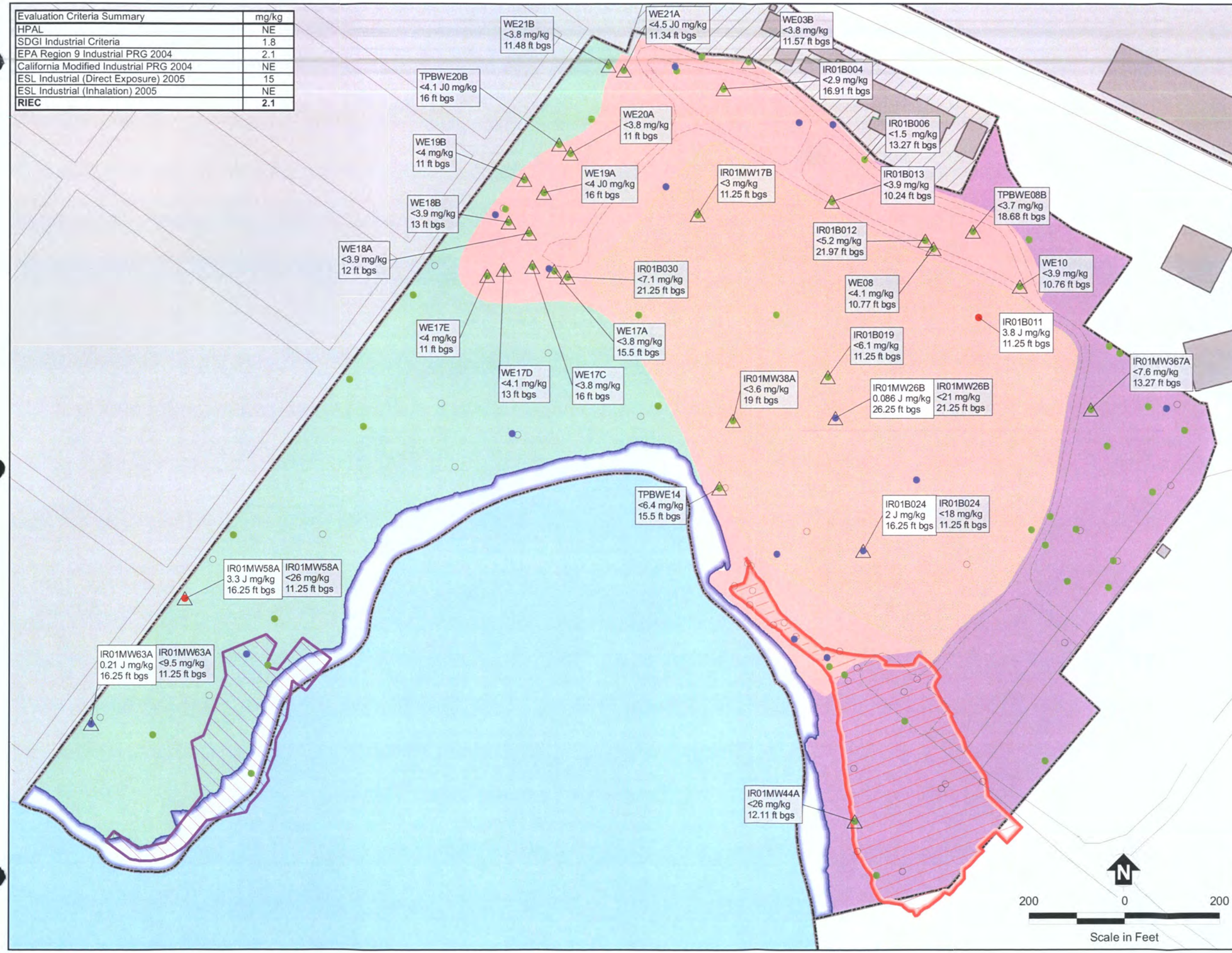
FIGURE 4-46

1,4 - DICHLOROBENZENE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	15
ESL Industrial (Inhalation) 2005	NE
RIEC	**2.1**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-47

BENZO (A) ANTHRACENE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.33
EPA Region 9 Industrial PRG 2004	0.21
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	1.5
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.33**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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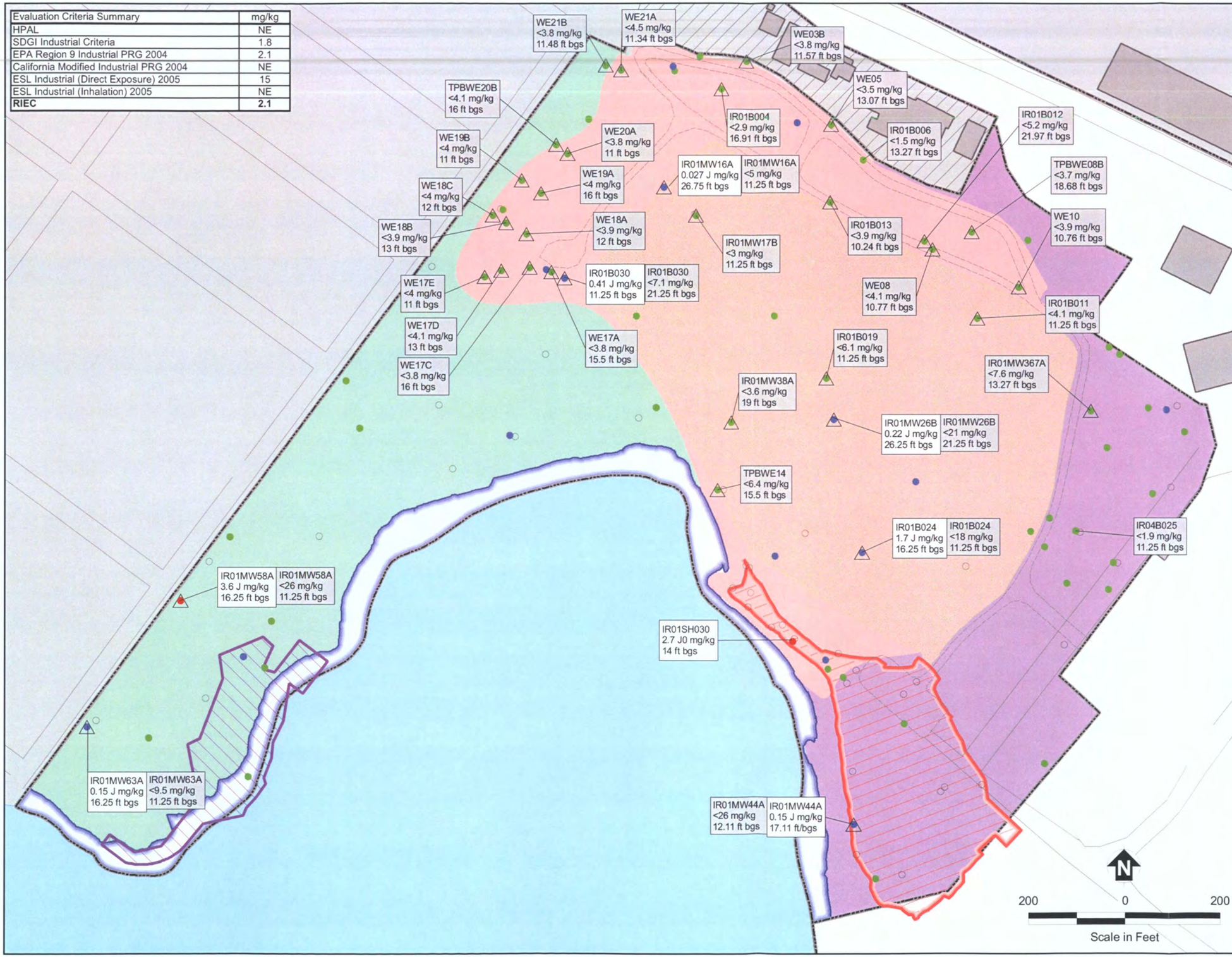
FIGURE 4-48

BENZO (A) PYRENE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	15
ESL Industrial (Inhalation) 2005	NE
RIEC	**2.1**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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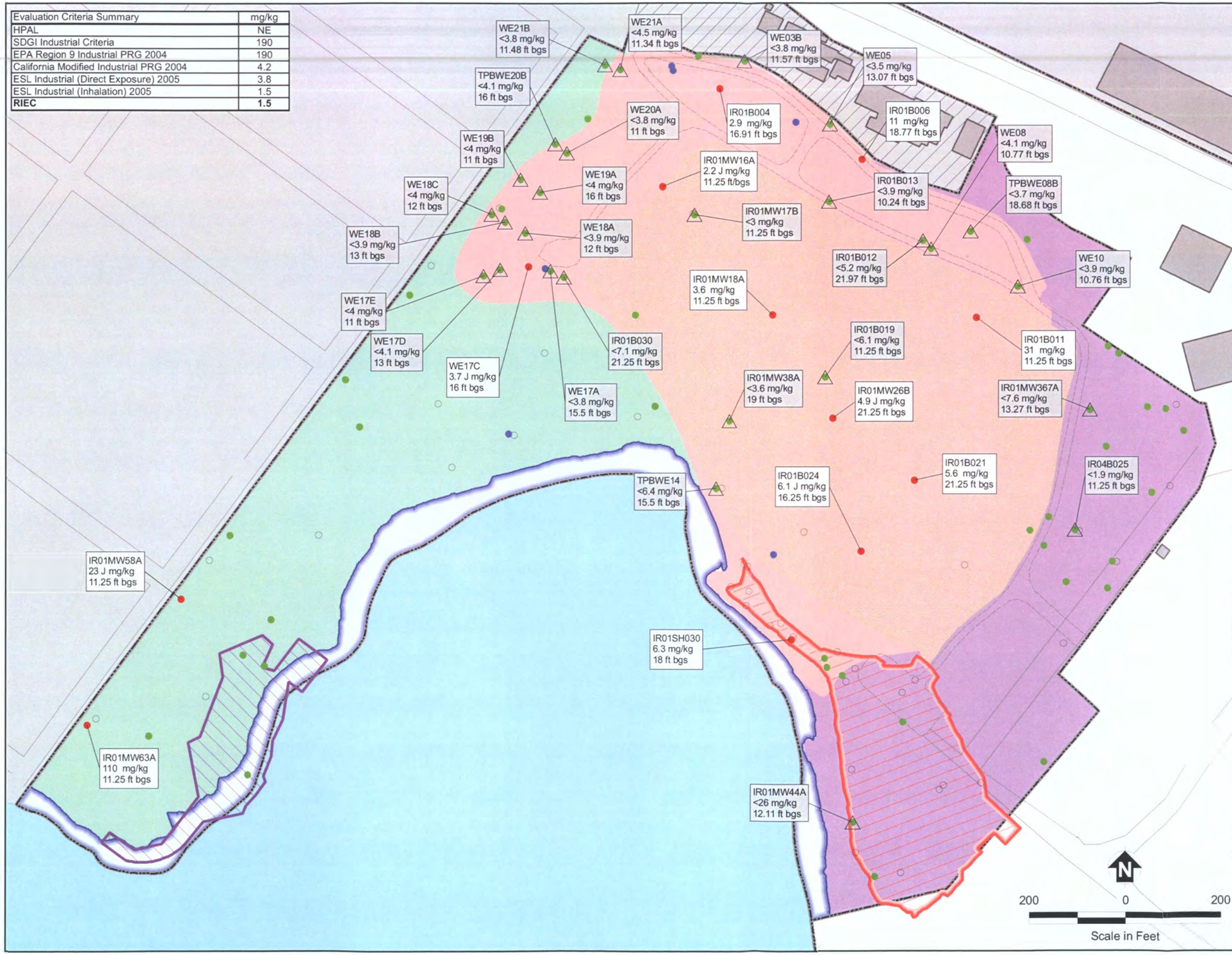
FIGURE 4-49

BENZO (B) FLUORANTHENE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	190
EPA Region 9 Industrial PRG 2004	190
California Modified Industrial PRG 2004	4.2
ESL Industrial (Direct Exposure) 2005	3.8
ESL Industrial (Inhalation) 2005	1.5
RIEC	**1.5**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-50

NAPHTHALENE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.35
EPA Region 9 Industrial PRG 2004	0.25
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.25**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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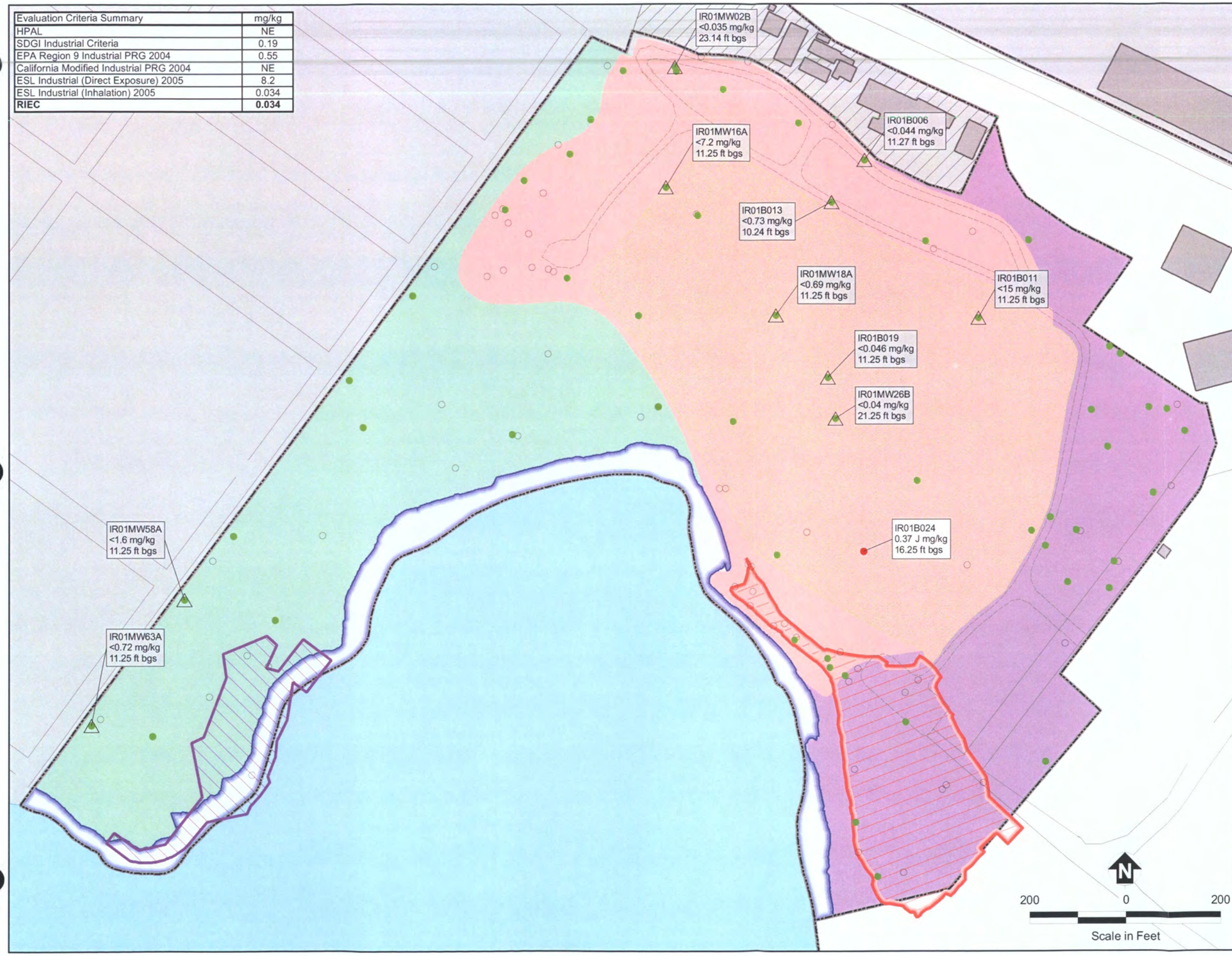
FIGURE 4-51

N-NITROSO-DI-N-PROPYLAMINE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.19
EPA Region 9 Industrial PRG 2004	0.55
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	8.2
ESL Industrial (Inhalation) 2005	0.034
RIEC	**0.034**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
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East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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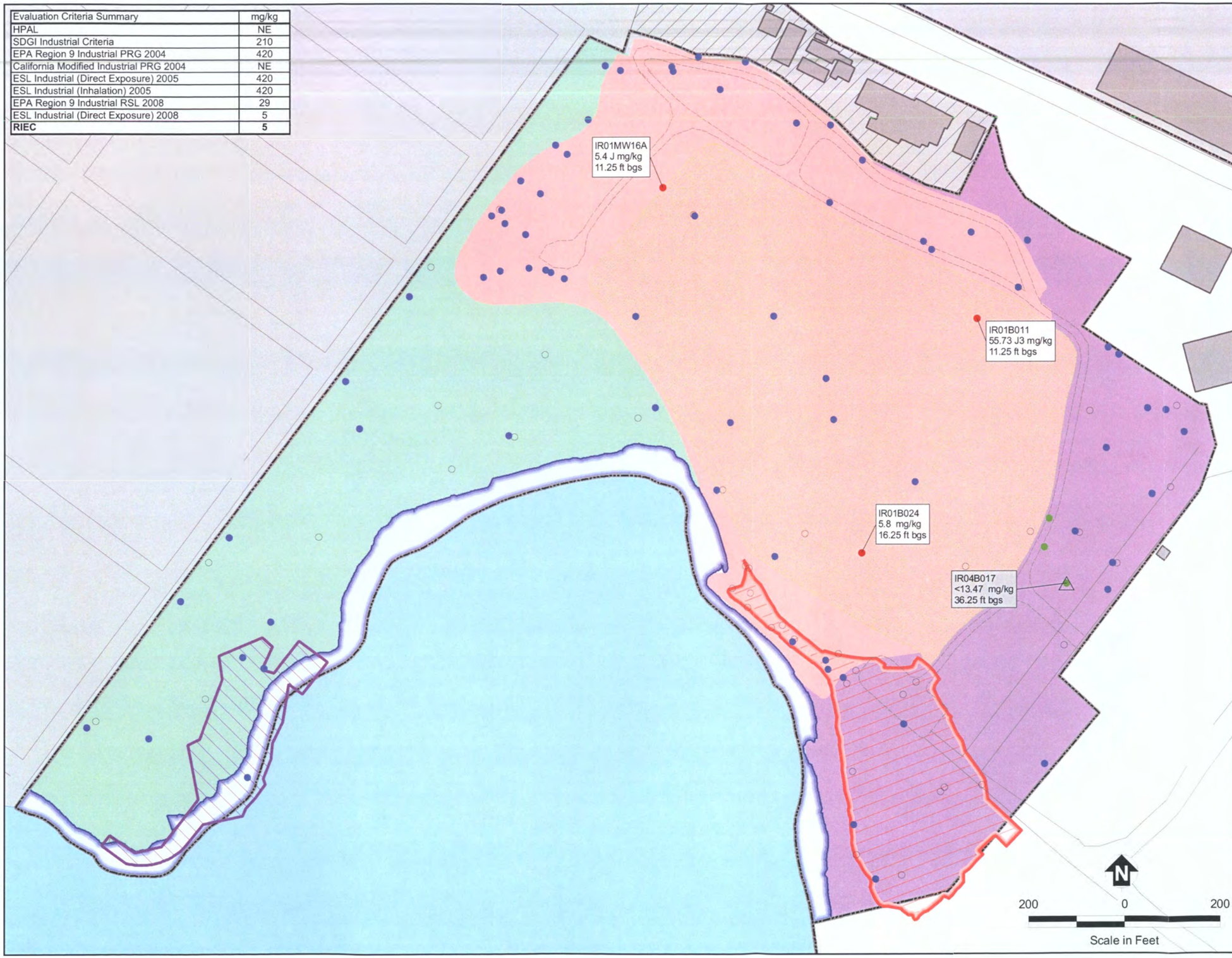
FIGURE 4-52

CARBON TETRACHLORIDE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	210
EPA Region 9 Industrial PRG 2004	420
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	420
ESL Industrial (Inhalation) 2005	420
EPA Region 9 Industrial RSL 2008	29
ESL Industrial (Direct Exposure) 2008	5
RIEC	**5**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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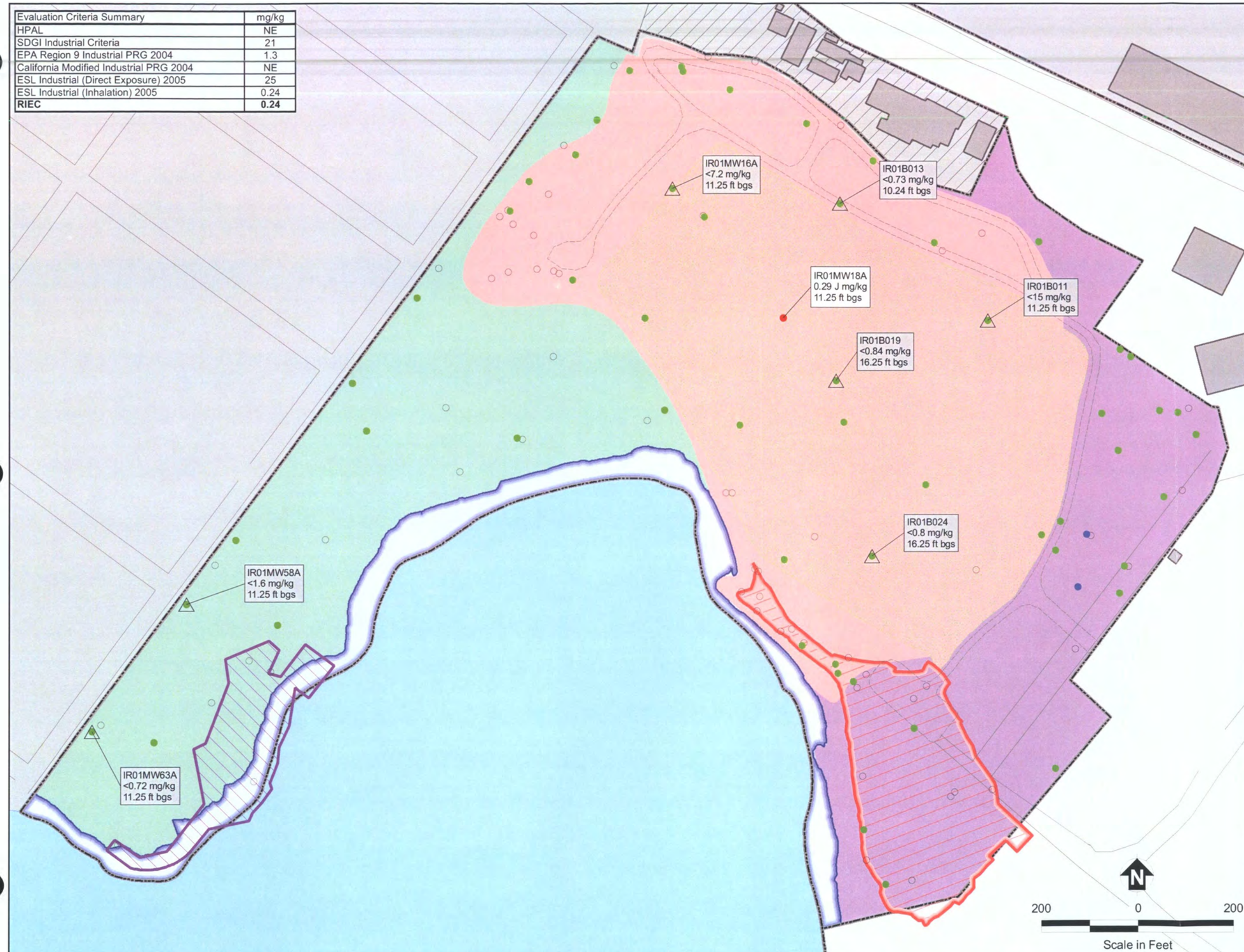
FIGURE 4-53

ETHYLBENZENE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	21
EPA Region 9 Industrial PRG 2004	1.3
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	25
ESL Industrial (Inhalation) 2005	0.24
RIEC	**0.24**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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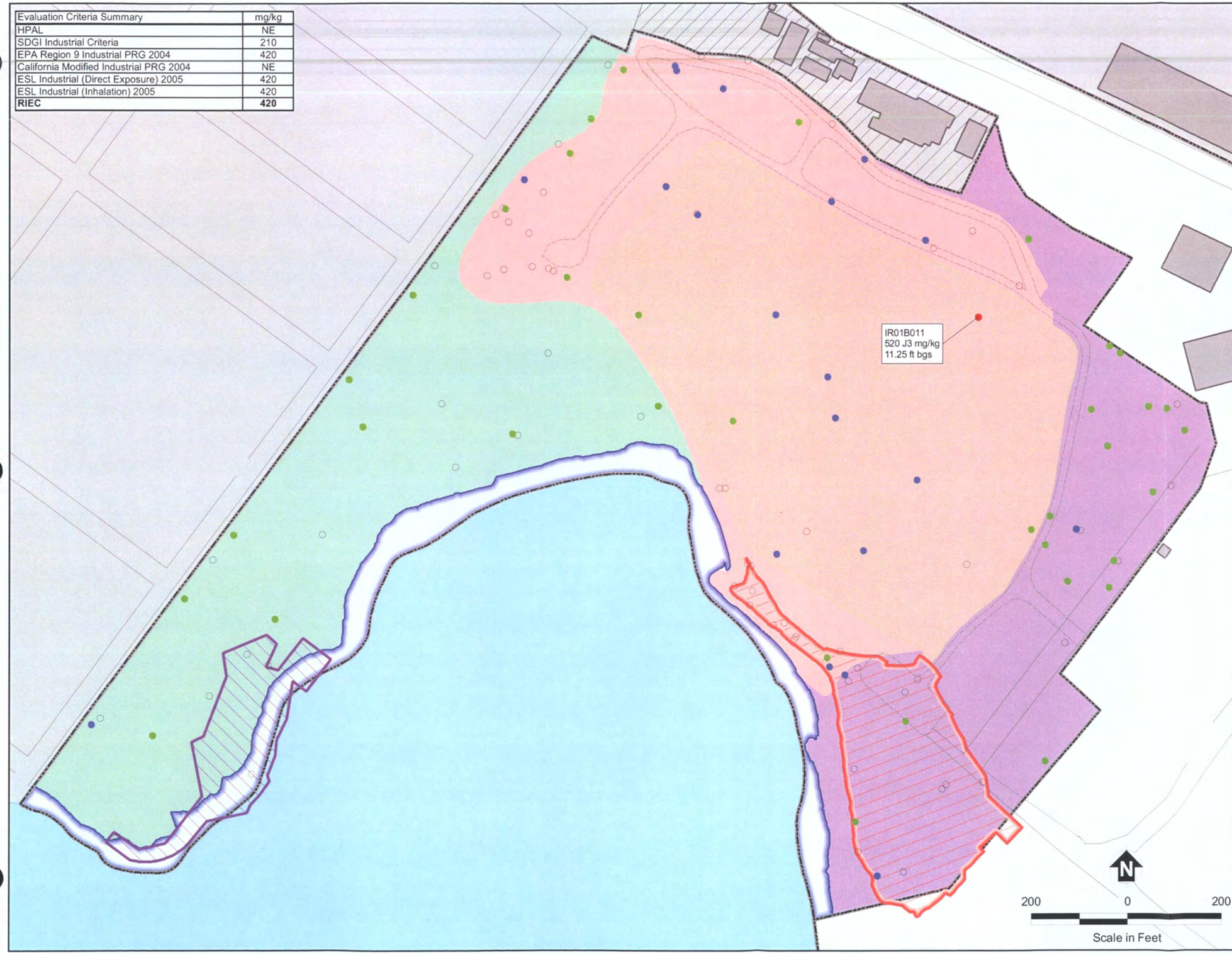
FIGURE 4-54

TETRACHLOROETHENE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	210
EPA Region 9 Industrial PRG 2004	420
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	420
ESL Industrial (Inhalation) 2005	420
RIEC	**420**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-55

XYLENE (TOTAL) IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	NE
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**3,500**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-56

TOTAL TPH IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	9.05
SDGI Industrial Criteria	820
EPA Region 9 Industrial PRG 2004	410
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	380
ESL Industrial (Inhalation) 2005	NE
RIEC	**380**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

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Results are shown for locations where data have exceeded the RIEC.

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
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Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-57

ANTIMONY IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	11.1
SDGI Industrial Criteria	22
EPA Region 9 Industrial PRG 2004	1.6
California Modified Industrial PRG 2004	0.25
ESL Industrial (Direct Exposure) 2005	0.24
ESL Industrial (Inhalation) 2005	NE
RIEC	**11.1**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

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mg/kg = milligram per kilogram
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Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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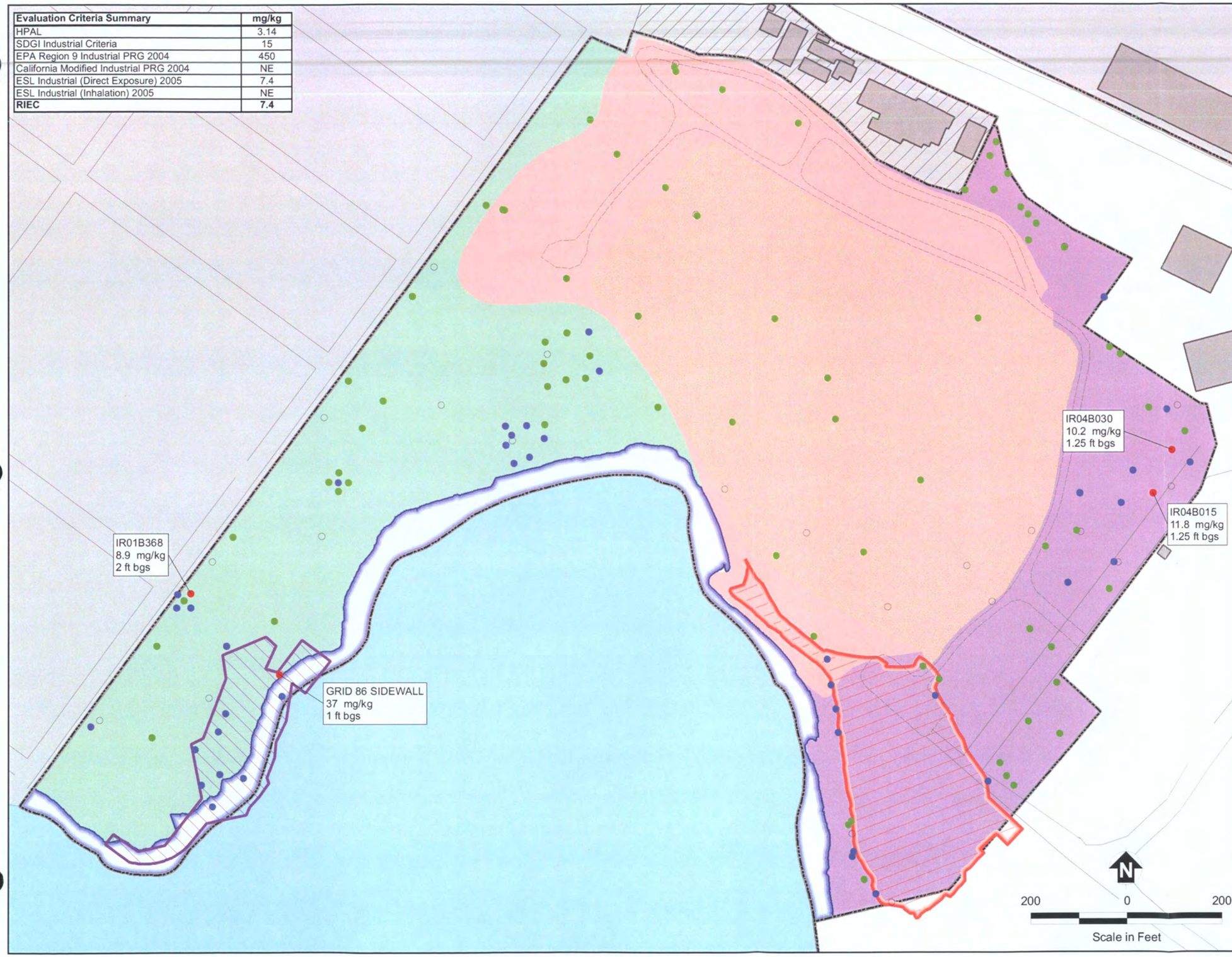
FIGURE 4-58

ARSENIC IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	3.14
SDGI Industrial Criteria	15
EPA Region 9 Industrial PRG 2004	450
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	7.4
ESL Industrial (Inhalation) 2005	NE
RIEC	**7.4**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-59

CADMIUM IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	100,000
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**100,000**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
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IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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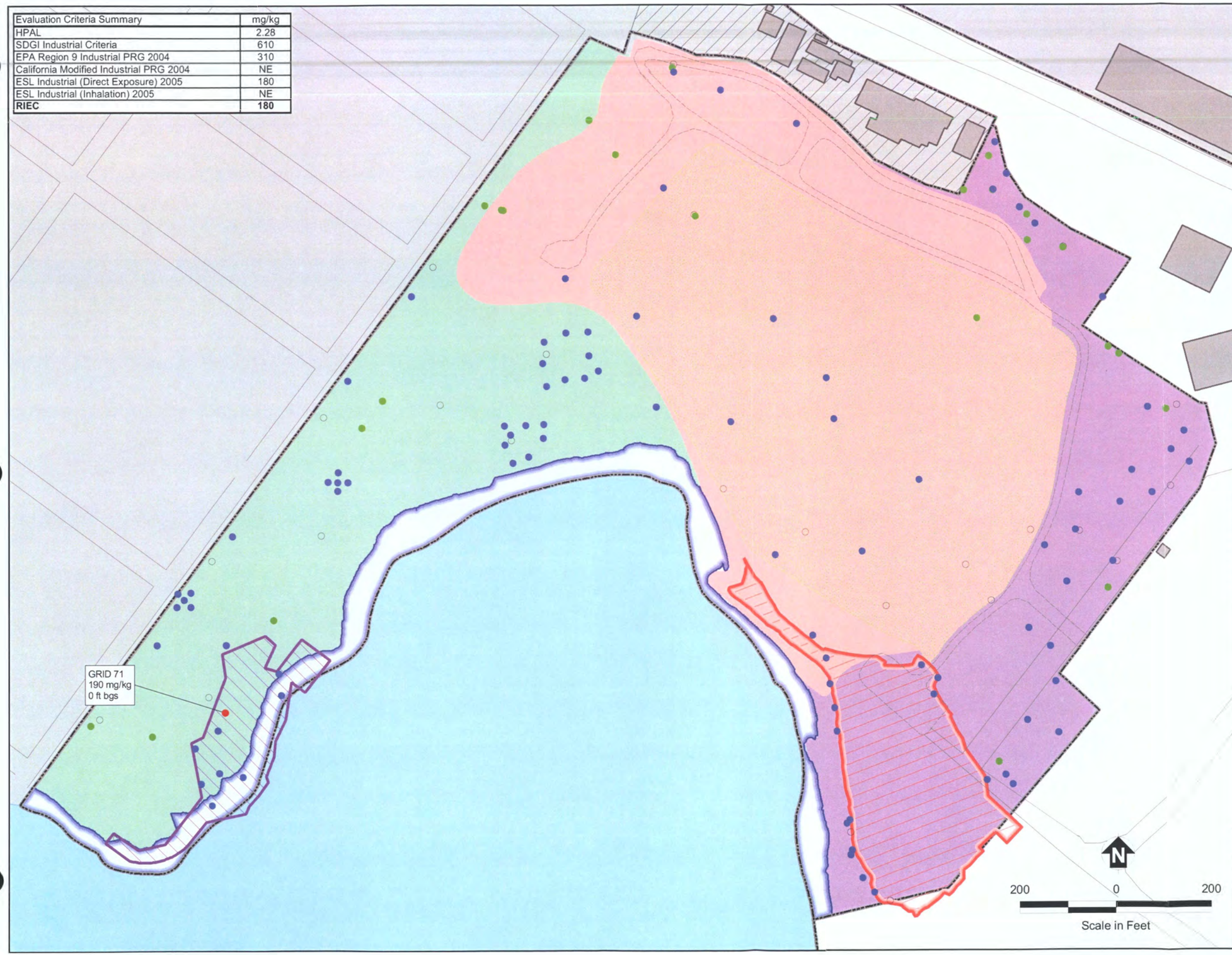
FIGURE 4-60

IRON IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	2.28
SDGI Industrial Criteria	610
EPA Region 9 Industrial PRG 2004	310
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	180
ESL Industrial (Inhalation) 2005	NE
RIEC	**180**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

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ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
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IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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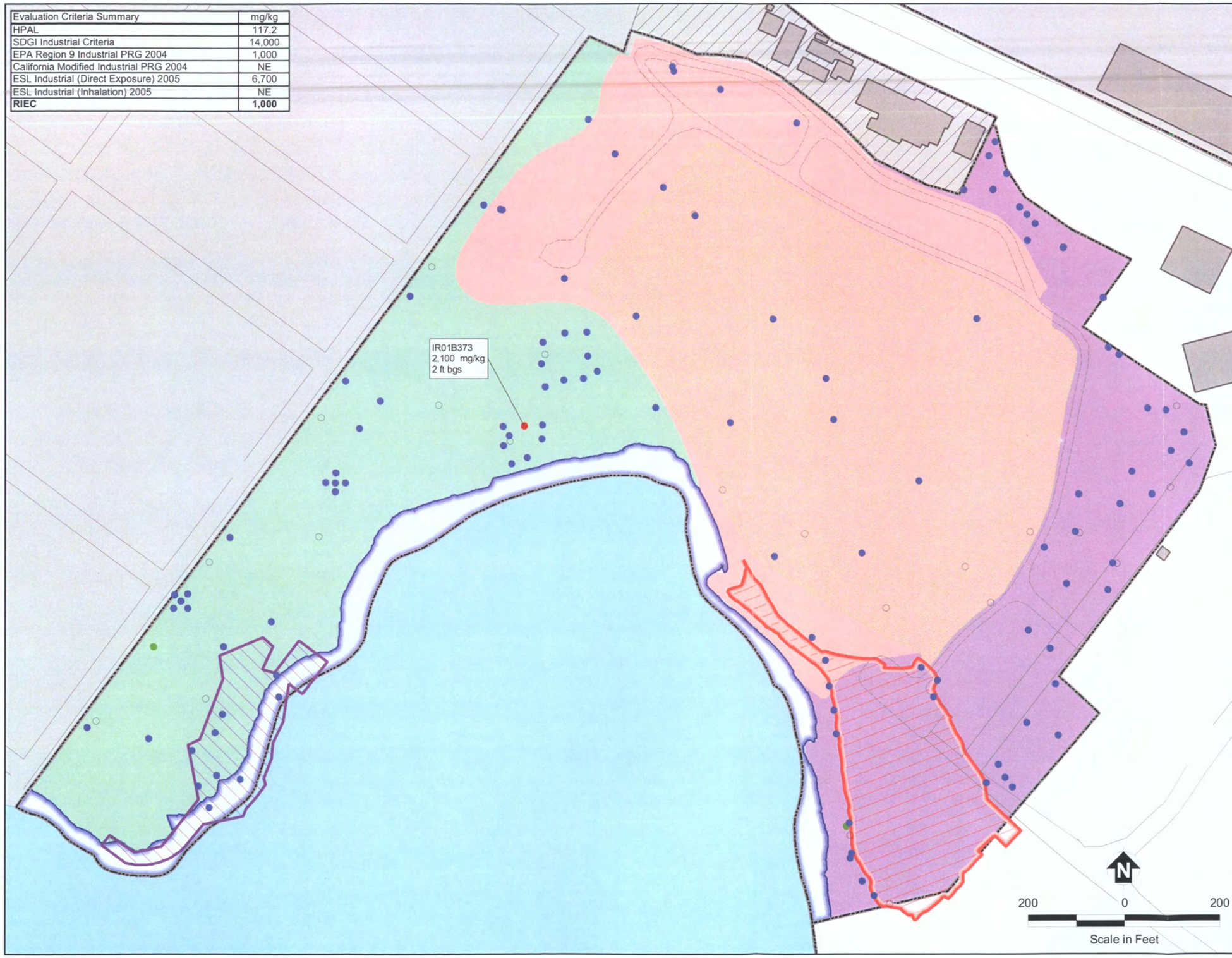
FIGURE 4-61

MERCURY IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	117.2
SDGI Industrial Criteria	14,000
EPA Region 9 Industrial PRG 2004	1,000
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	6,700
ESL Industrial (Inhalation) 2005	NE
RIEC	**1,000**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275	Location ID
150 J mg/kg	Concentration and Qualifier
3.93 ft bgs	Depth

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FIGURE 4-62

VANADIUM IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	12
EPA Region 9 Industrial PRG 2004	7
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	6.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**6.3**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

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ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-63

4,4' -DDE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.15
EPA Region 9 Industrial PRG 2004	0.11
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	0.13
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.11**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

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HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
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PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-64

DIELDRIN IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	1.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**1.3**

- Reporting Limit Exceeds the RIEC (for at least one sample)
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds RIEC
- Road
- Gravel Road
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

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J = estimated value
mg/kg = milligram per kilogram
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RIEC = Remedial Investigation Evaluation Criterion
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150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-65

BENZO (K) FLUORANTHENE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	180
EPA Region 9 Industrial PRG 2004	120
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	570
ESL Industrial (Inhalation) 2005	NE
RIEC	**120**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
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San Francisco Bay
Non-Navy Property

Notes:

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ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275	Location ID
150 J mg/kg	Concentration and Qualifier
3.93 ft bgs	Depth

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FIGURE 4-66

BIS (2-ETHYLHEXYL) PHTHALATE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	18
EPA Region 9 Industrial PRG 2004	210
California Modified Industrial PRG 2004	13
ESL Industrial (Direct Exposure) 2005	13
ESL Industrial (Inhalation) 2005	NE
RIEC	**13**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-67

CHRYSENE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.33
EPA Region 9 Industrial PRG 2004	0.21
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	0.38
ESL Industrial (Inhalation) 2005	NE
RIEC	**0.33**

- Reporting Limit Exceeds the RIEC (for at least one sample)
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds RIEC
- Road
- Gravel Road
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-68

DIBENZ (A,H) ANTHRACENE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	NE
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**3,500**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-69

TOTAL TPH IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	109.9
SDGI Industrial Criteria	100,000
EPA Region 9 Industrial PRG 2004	100,000
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	290,000
ESL Industrial (Inhalation) 2005	NE
RIEC	**100,000**

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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FIGURE 4-70

ZINC IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

DIOXIN/FURAN	RIEC (ug/kg)
2,3,7,8-TCDD TEQ	0.016

MS-12A

DIOXIN/FURAN	Conc. (ug/kg)	Depth (ft bgs)
TEQ	0.0522	7.5

MS-14

DIOXIN/FURAN	Conc. (ug/kg)	Depth (ft bgs)
TEQ	0.107	7.5

MS-15

DIOXIN/FURAN	Conc. (ug/kg)	Depth (ft bgs)
TEQ	0.183	10

MS-13B(1)

DIOXIN/FURAN	Conc. (ug/kg)	Depth (ft bgs)
TEQ	0.094	2.5

MS-11

DIOXIN/FURAN	Conc. (ug/kg)	Depth (ft bgs)
TEQ	0.067	4.5
TEQ	0.044	7.5

MS-09

DIOXIN/FURAN	Conc. (ug/kg)	Depth (ft bgs)
TEQ	0.101	5
TEQ	0.085	7.5

MS-08

DIOXIN/FURAN	Conc. (ug/kg)	Depth (ft bgs)
TEQ	0.131	7.5

MS-07A

DIOXIN/FURAN	Conc. (ug/kg)	Depth (ft bgs)
TEQ	0.148	5

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

Conc. = concentration
ft bgs = feet below ground surface
PCB = polychlorinated biphenyl
RIEC = Remedial Investigation Evaluation Criterion
TEQ = toxicity equivalency quotient
UCSF = University of California, San Francisco
ug/kg = microgram per kilogram

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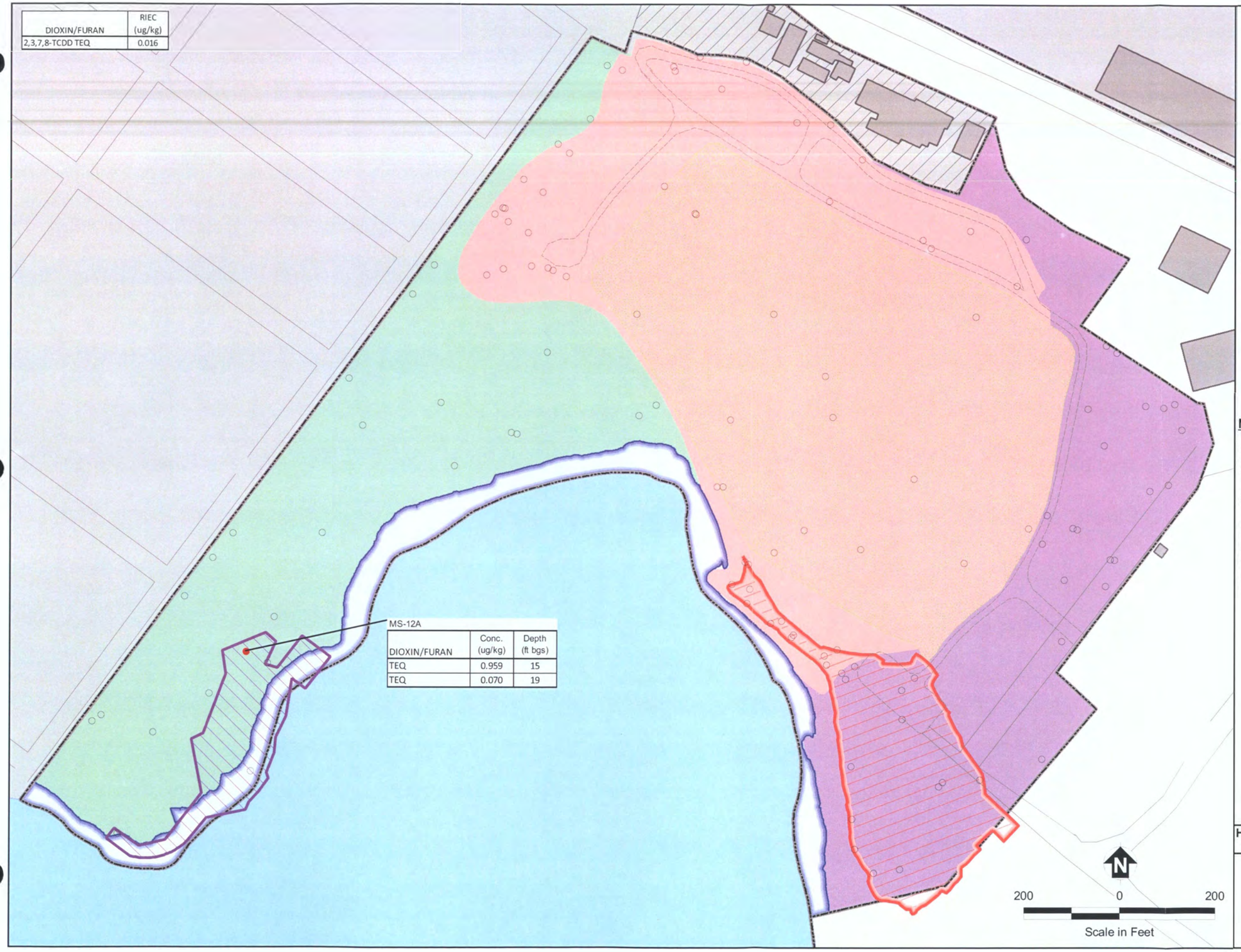
FIGURE 4-71

DIOXINS AND FURANS IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2



DIOXIN/FURAN	RIEC (ug/kg)
2,3,7,8-TCDD TEQ	0.016

DIOXIN/FURAN	Conc. (ug/kg)	Depth (ft bgs)
TEQ	0.959	15
TEQ	0.070	19

Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

Conc. = concentration
ft bgs = feet below ground surface
PCB = polychlorinated biphenyl
RIEC = Remedial Investigation Evaluation Criterion
TEQ = toxicity equivalency quotient
UCSF = University of California, San Francisco
ug/kg = microgram per kilogram

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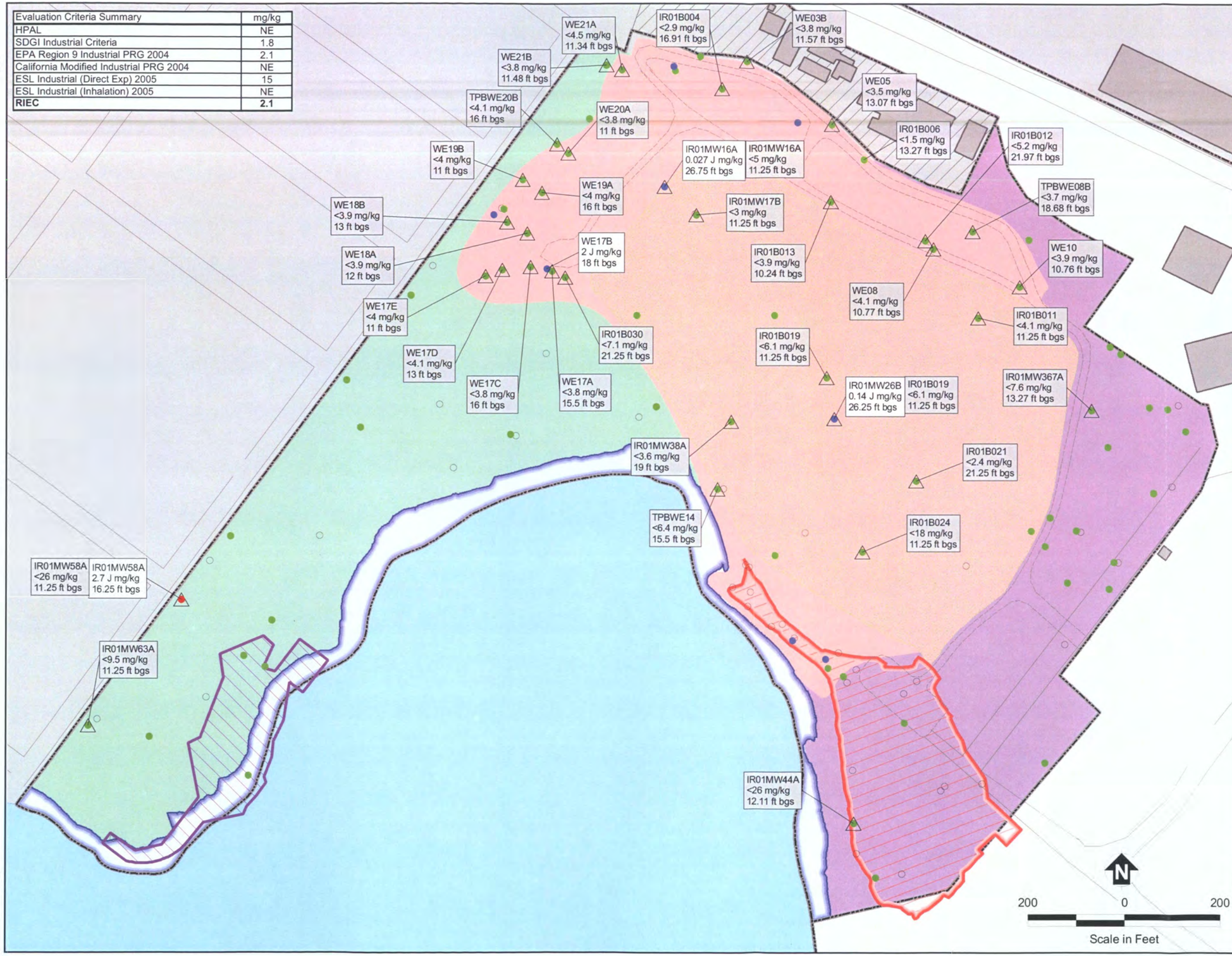
FIGURE 4-72

DIOXINS AND FURANS IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1.8
EPA Region 9 Industrial PRG 2004	2.1
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exp) 2005	15
ESL Industrial (Inhalation) 2005	NE
RIEC	**2.1**



- Reporting Limit Exceeds the RIEC (for at least one sample)
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds RIEC
- Road
- Gravel Road
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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FIGURE 4-73

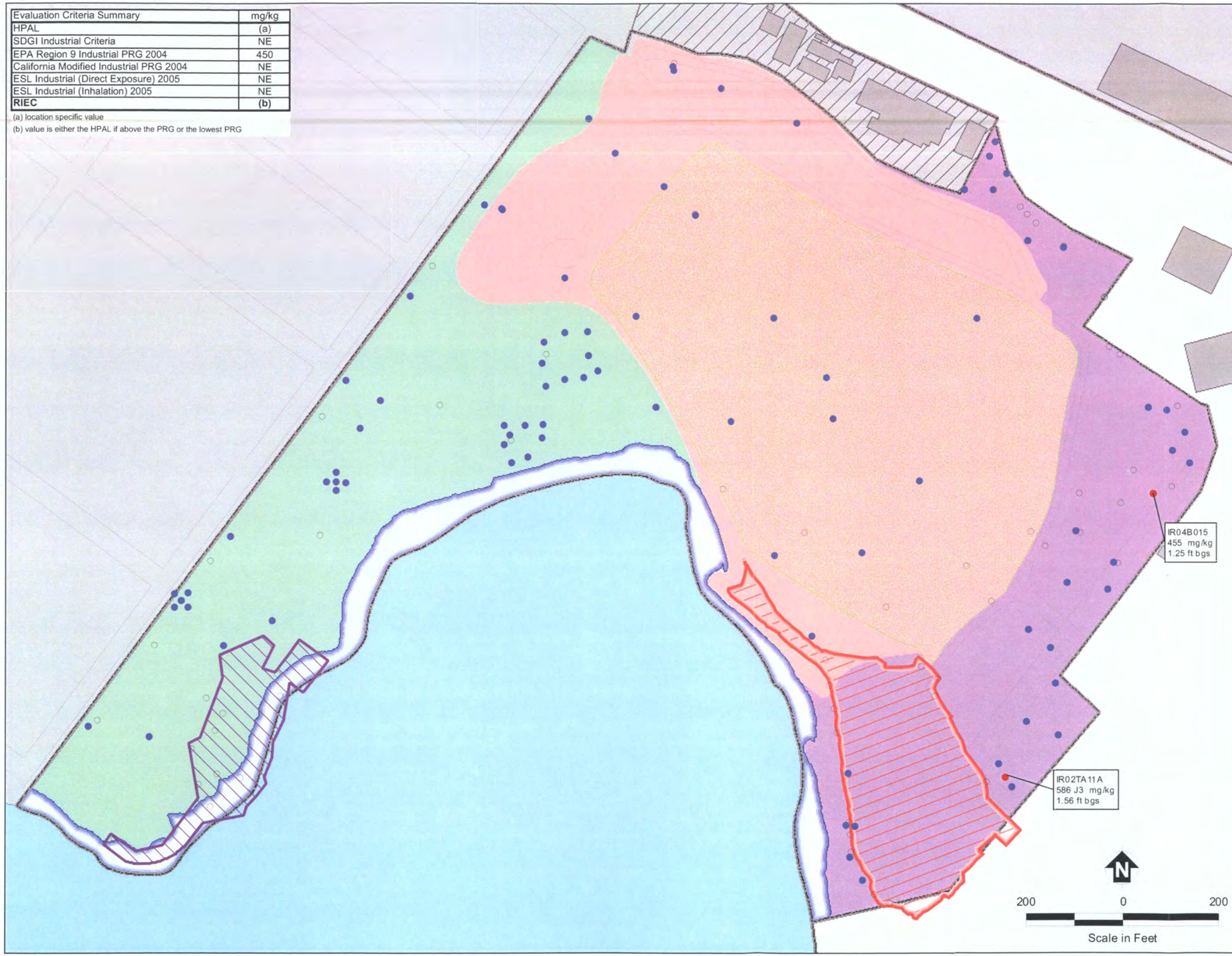
INDENO (1,2,3-CD) PYRENE IN >10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	(a)
SDGI Industrial Criteria	NE
EPA Region 9 Industrial PRG 2004	450
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	NE
ESL Industrial (Inhalation) 2005	NE
RIEC	**(b)**

(a) location specific value

(b) value is either the HPAL if above the PRG or the lowest PRG



Reporting Limit Exceeds the RIEC (for at least one sample)

Not Analyzed for Analyte

Analyte Not Detected

Analyte Exceeds Reporting Limit

Analyte Exceeds RIEC

Road

Gravel Road

Metal Slag Area (2007 excavation limit)[a]

PCB Hot Spot Area (2007 excavation limit)[a]

Limit of Landfill Cap

Parcel Boundary

Building

UCSF Compound

Landfill Area

East Adjacent Area

Panhandle Area

Shoreline Area

San Francisco Bay

Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

Numbers associated with qualifiers are further defined in Appendix J.

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

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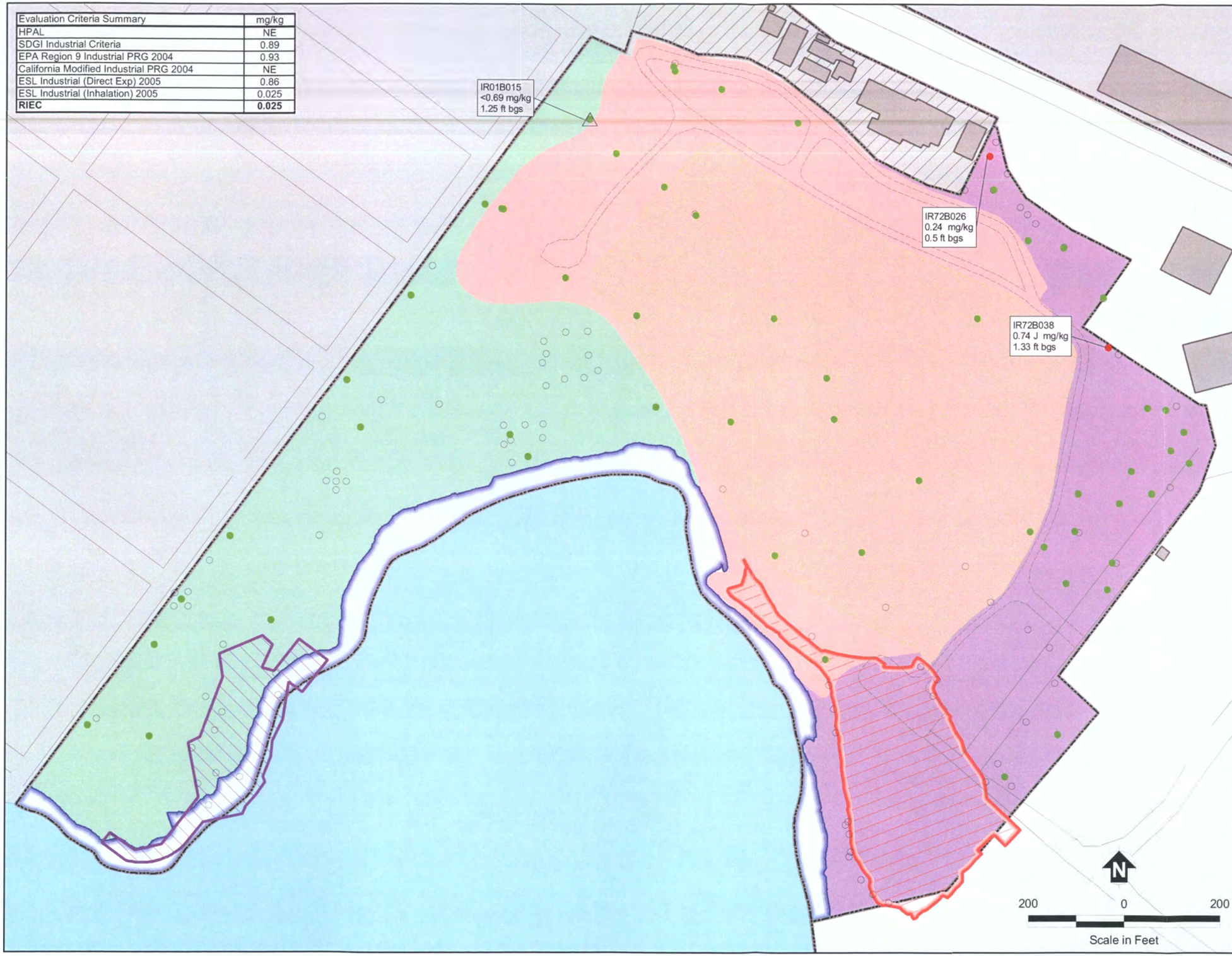
FIGURE 4-74

CHROMIUM (TOTAL) IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.89
EPA Region 9 Industrial PRG 2004	0.93
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exp) 2005	0.86
ESL Industrial (Inhalation) 2005	0.025
RIEC	**0.025**



- Reporting Limit Exceeds the RIEC (for at least one sample)
- Not Analyzed for Analyte
- Analyte Not Detected
- Analyte Exceeds Reporting Limit
- Analyte Exceeds RIEC
- Road
- Gravel Road
- Metal Slag Area (2007 excavation limit)[a]
- PCB Hot Spot Area (2007 excavation limit)[a]
- Limit of Landfill Cap
- Parcel Boundary
- Building
- UCSF Compound
- Landfill Area
- East Adjacent Area
- Panhandle Area
- Shoreline Area
- San Francisco Bay
- Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275	Location ID
150 J mg/kg	Concentration and Qualifier
3.93 ft bgs	Depth

IR04B025	Location ID
<37 mg/kg	Reporting Limit
2.0 ft bgs	Depth

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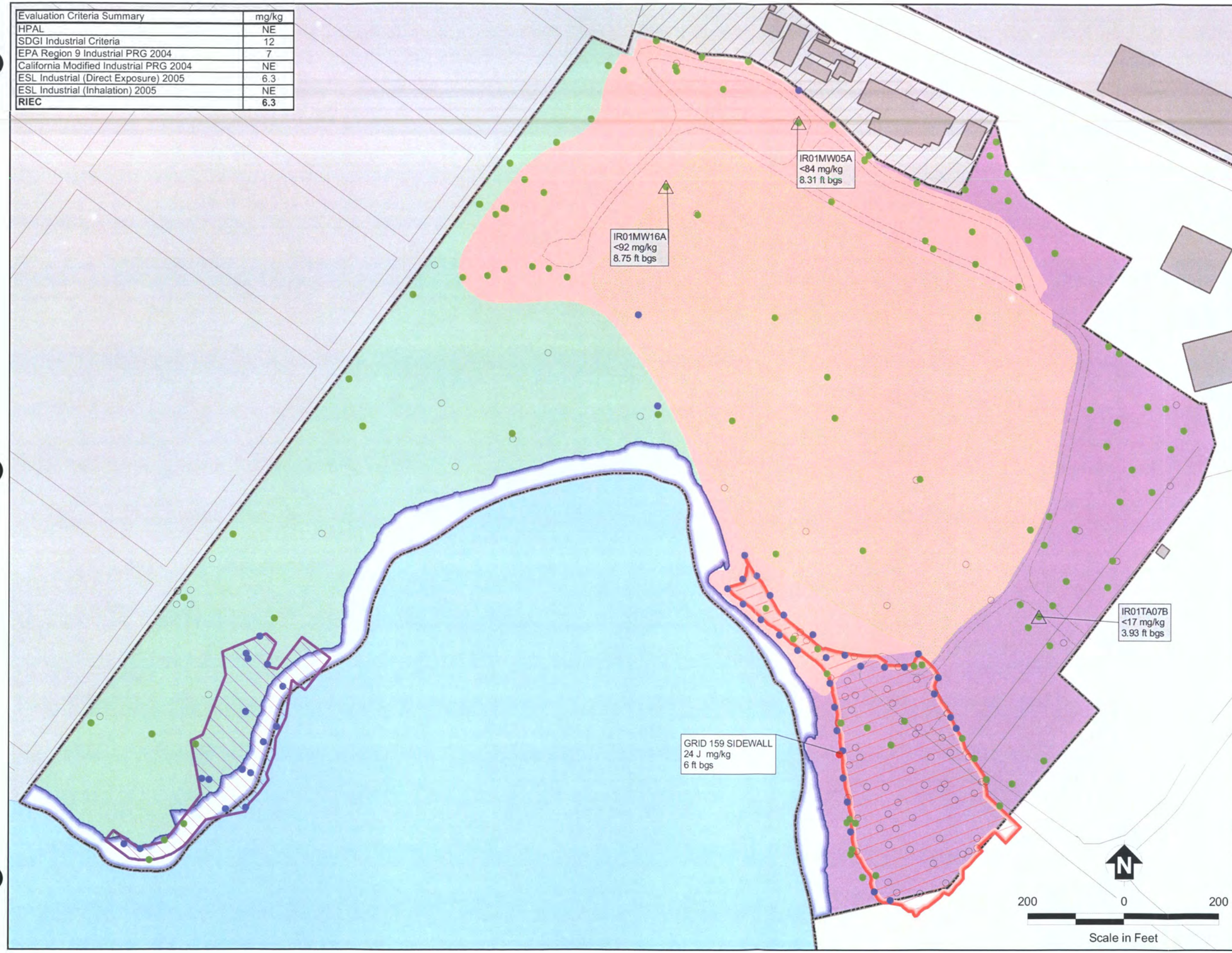
FIGURE 4-75

1,1,2,2-TETRACHLOROETHANE IN 0 - 2' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	12
EPA Region 9 Industrial PRG 2004	7
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	6.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**6.3**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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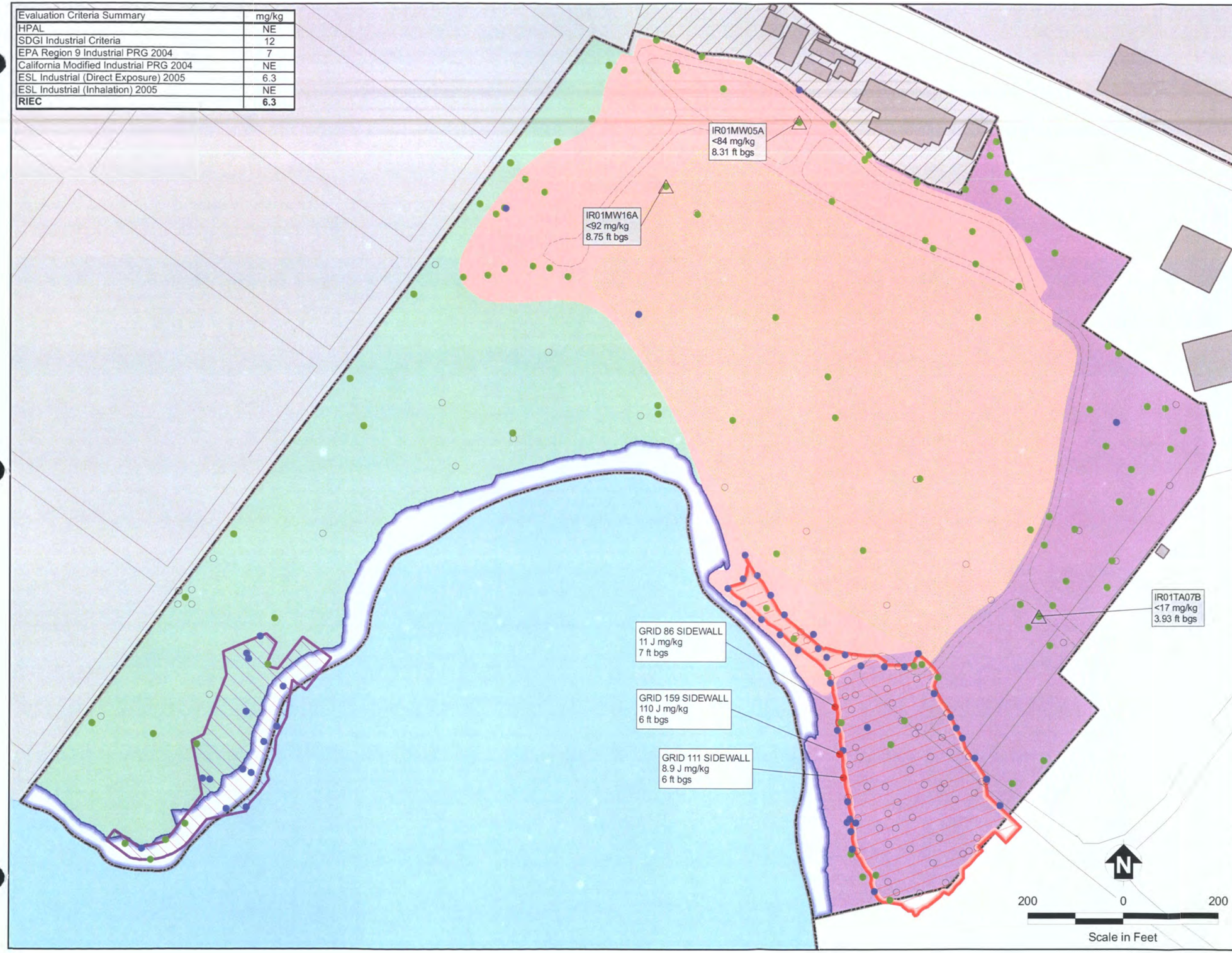
FIGURE 4-76

4, 4' - DDE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	12
EPA Region 9 Industrial PRG 2004	7
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exposure) 2005	6.3
ESL Industrial (Inhalation) 2005	NE
RIEC	**6.3**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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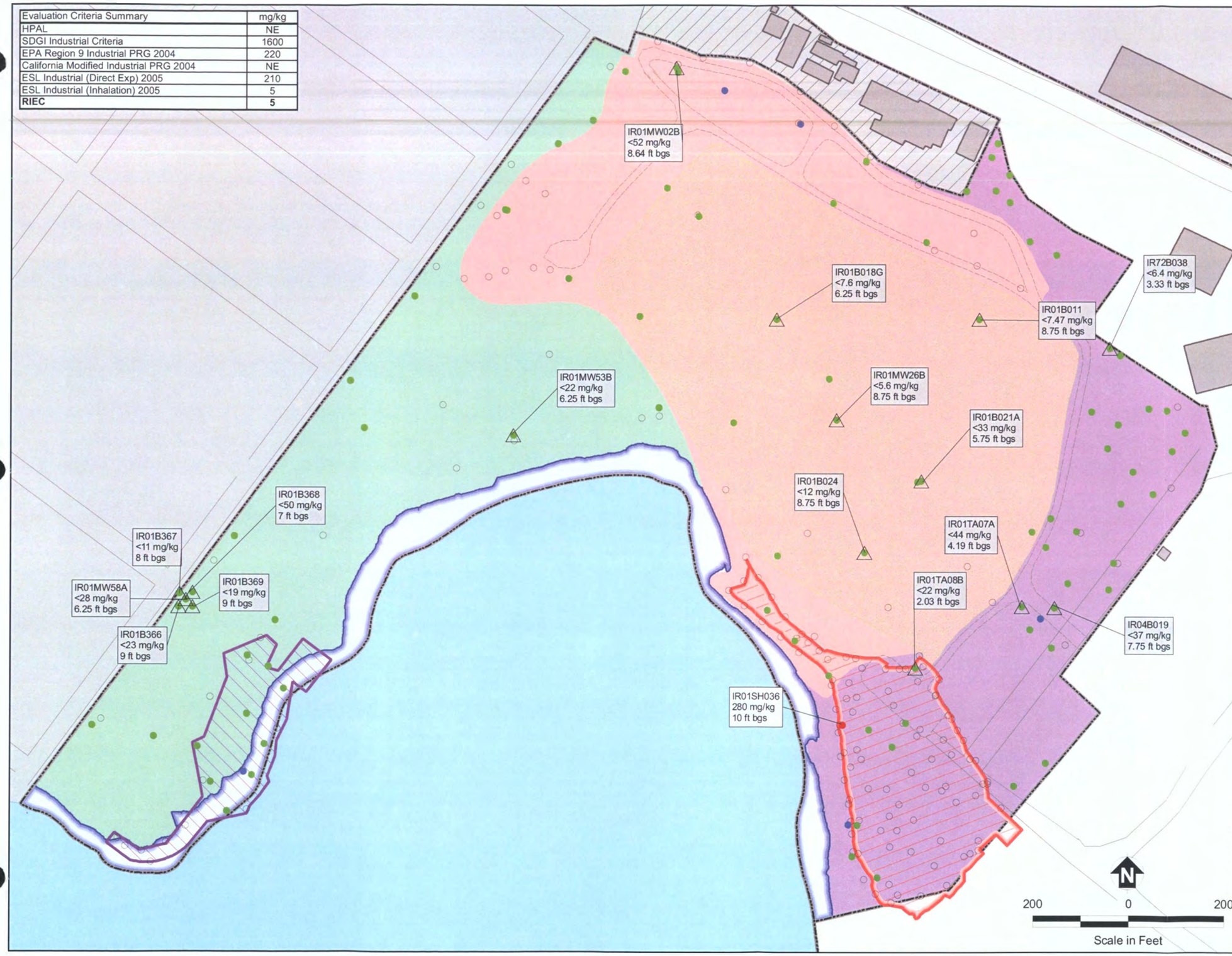
FIGURE 4-77

4,4' - DDT IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	1600
EPA Region 9 Industrial PRG 2004	220
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exp) 2005	210
ESL Industrial (Inhalation) 2005	5
RIEC	**5**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

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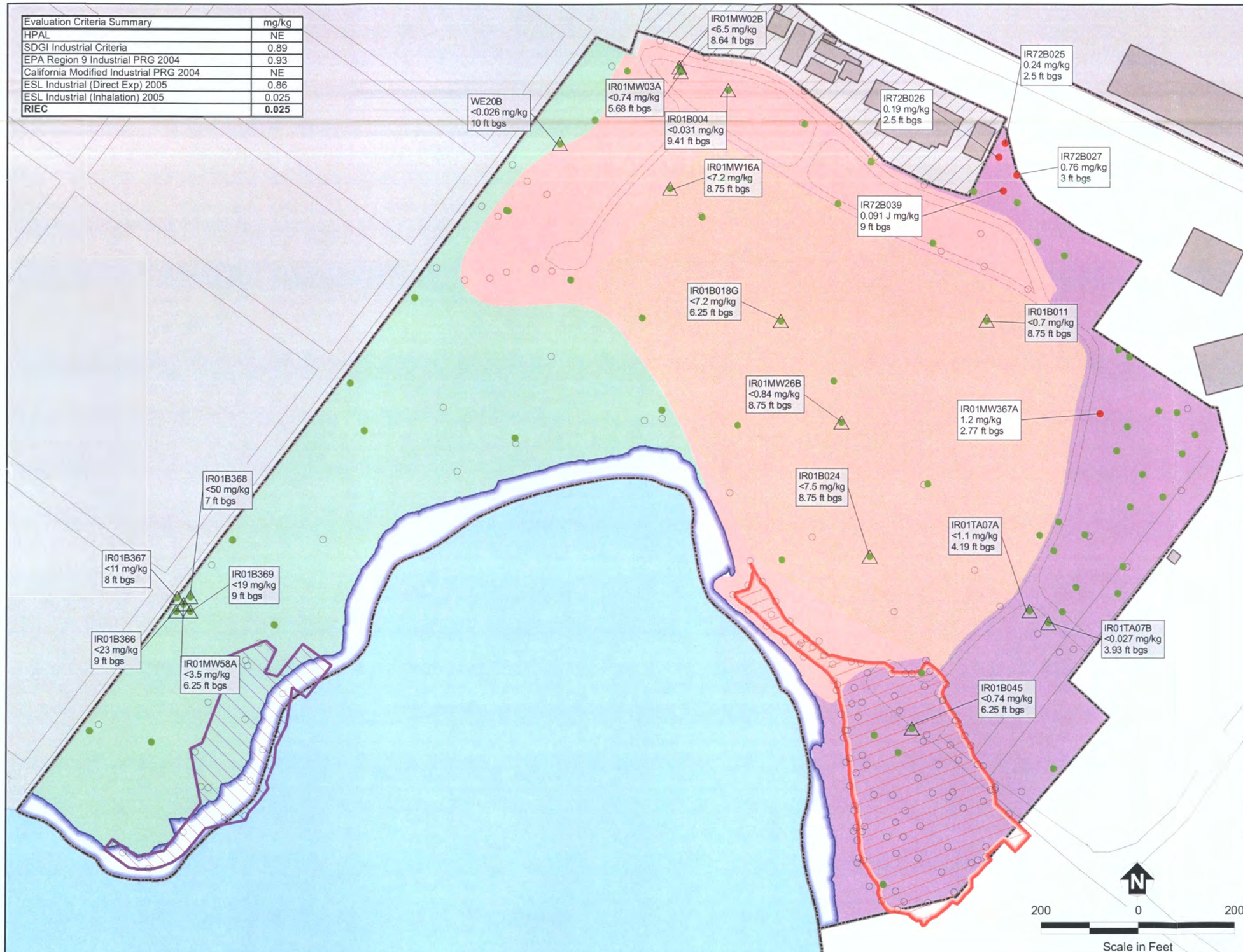
FIGURE 4-78

1,2,4-TRICHLOROBENZENE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Evaluation Criteria Summary	mg/kg
HPAL	NE
SDGI Industrial Criteria	0.89
EPA Region 9 Industrial PRG 2004	0.93
California Modified Industrial PRG 2004	NE
ESL Industrial (Direct Exp) 2005	0.86
ESL Industrial (Inhalation) 2005	0.025
RIEC	**0.025**



Reporting Limit Exceeds the RIEC (for at least one sample)
Not Analyzed for Analyte
Analyte Not Detected
Analyte Exceeds Reporting Limit
Analyte Exceeds RIEC
Road
Gravel Road
Metal Slag Area (2007 excavation limit)[a]
PCB Hot Spot Area (2007 excavation limit)[a]
Limit of Landfill Cap
Parcel Boundary
Building
UCSF Compound
Landfill Area
East Adjacent Area
Panhandle Area
Shoreline Area
San Francisco Bay
Non-Navy Property

Notes:

[a] Post- excavation boundaries in PCB Hot Spot Area and Metal Slag Area are consistent with information presented in final removal action completion reports (Tetra Tech EC Inc., 2007a and 2007b).

Results are shown for locations where data have exceeded the RIEC.
Where results are shown as non-detect (<), the reporting limit follows.

EPA = Environmental Protection Agency
ESL = environmental screening level
ft bgs = feet below ground surface
HPAL = Hunters Point ambient level
J = estimated value
mg/kg = milligram per kilogram
NE = not established
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RIEC = Remedial Investigation Evaluation Criterion
SDGI = Standard Data Gaps Investigation
UCSF = University of California, San Francisco

IR01B275 — Location ID
150 J mg/kg — Concentration and Qualifier
3.93 ft bgs — Depth

IR04B025 — Location ID
<37 mg/kg — Reporting Limit
2.0 ft bgs — Depth

ERRG ENGINEERING/REMEDIATION RESOURCES GROUP, INC.

Hunters Point Shipyard, San Francisco, California
U.S. Department of the Navy, BRAC PMO West, San Diego, California

FIGURE 4-79

1,1,2,2-TETRACHLOROETHANE IN 2 - 10' SOIL

Remedial Investigation/Feasibility Study for Parcel E-2

Tables

Table 4-1. Summary of Human Health Evaluation Criteria for Soil

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	HPAL [a]		SDGI Industrial Screening Criteria [b]		EPA PRG Industrial 2004 [c]		ESL Industrial 2005 (direct exp) [d,e,g]		ESL Industrial 2005 (inhalation) [e,f,g]		RIEC
	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)
Metals											
Aluminum	NA		100,000		100,000		-		--		100,000
Antimony	9.05		820		410		380	noncancer (HQ=1.0)	--		380
Arsenic	11.1		22		1.6		0.24	cancer PRG	--		11.1
Barium	314.4		100,000		67,000		63,000	noncancer (HQ=1.0)	--		63,000
Beryllium	0.71		2,200		1,900		36	noncancer (HQ=1.0)	--		36
Cadmium	3.14		15		450		7.4	cancer PRG	--		7.4
Calcium	NA		--		--		-		--		--
Chromium (total)	a		--	assume CrVI:CrIII at 1:6	450		-		--		a
Chromium VI	NA		17		64		37	noncancer (HQ=1.0)	--		37
Cobalt	a		100,000		1,900		3,200	noncancer (HQ=1.0)	--		a
Copper	124.3		--		41,000		38,000	noncancer (HQ=1.0)	--		38,000
Cyanide (free)	NA		--		12,000		12,000	noncancer (HQ=1.0)	--		12,000
Iron	NA		--		100,000		-		--		100,000
Lead	8.99		750		800		-		--		800
Magnesium	NA		--		-		-		--		--
Manganese	1,431.2		32,000		19,000		-		--		19,000
Mercury	2.28		610		310		180	noncancer (HQ=1.0)	--		180
Molybdenum	2.68		10,000		5,100		4,800	noncancer (HQ=1.0)	--		4,800
Nickel	a		--		20,000		20,000	noncancer (HQ=1.0)	--		a
Potassium	NA		--				-		--		--
Selenium	1.95		10,000		5,100		4,800	noncancer (HQ=1.0)	--		4,800
Silver	1.43		10,000		5,100		4,800	noncancer (HQ=1.0)	--		4,800
Sodium	-		--		--		-		--		--
Thallium	0.81		130		67		63	noncancer (HQ=1.0)	--		63
Tin	NA		--		100,000		-		--		100,000
Vanadium	117.2		14,000		1,000		6,700	noncancer (HQ=1.0)	--		1,000
Zinc	109.9		100,000		100,000		290,000	noncancer (HQ=1.0)	--		100,000
Pesticides											
2,4'-DDD			17	4,4'-DDD criteria	10.0	Total DDD criteria	9	cancer PRG (Total DDD)	--		9
2,4'-DDE			12	4,4'-DDE criteria	7.0	Total DDE criteria	6.3	cancer PRG (Total DDE)	--		6.3
2,4'-DDT			12	4,4'-DDT criteria	7.0	Total DDT criteria	6.3	cancer PRG (Total DDT)	--		6.3
4,4'-DDD			17		10.0	Total DDD criteria	9	cancer PRG (Total DDD)	--		9
4,4'-DDE			12		7.0	Total DDE criteria	6.3	cancer PRG (Total DDE)	--		6.3
4,4'-DDT			12		7.0	Total DDT criteria	6.3	cancer PRG (Total DDT)	--		6.3
Aldrin			0.15		0.10		0.13	cancer PRG	--		0.1
alpha-BHC			0.59		0.36		--		--		0.36
Alpha-chlordane			2.9		--		--		--		2.9
beta-BHC			2.1		1.3		--		--		1.3
Chlordane			--		6.5		1.7	cancer PRG	--		1.7
cis-Nonachlor			--		--		--		--		--
delta-BHC			0.59		--		--		--		0.59
Dieldrin			0.15		0.11		0.13	cancer PRG	--		0.11
Endosulfan I			5,300		3,700		3,700	noncancer (HQ=1.0)	--		3,700

Table 4-1. Summary of Human Health Evaluation Criteria for Soil *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	HPAL [a]		SDGI Industrial Screening Criteria [b]		EPA PRG Industrial 2004 [c]		ESL Industrial 2005 (direct exp) [d,e,g]		ESL Industrial 2005 (inhalation) [e,f,g]		RIEC
	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)
Pesticides *(continued)*											
Endosulfan II			5,300		3,700		3,700	noncancer (HQ=1.0)	--		3,700
Endosulfan sulfate			5,300		--		--		--		5300
Endrin			260		180		230	noncancer (HQ=1.0)	--		180
Endrin aldehyde			260		--		--		--		260
Endrin ketone			260		--		--		--		260
Gamma-BHC (lindane)			2.9		1.7		2	cancer PRG	--		1.7
Gamma-chlordane			2.9		--		--		--		2.9
Heptachlor			0.55		0.38		0.52	cancer PRG	--		0.38
Heptachlor epoxide			0.27		0.19		0.31	cancer PRG	--		0.19
Methoxychlor			4,400		3,100		3,800	noncancer (HQ=1.0)	--		3,100
Mirex			--		--		--		--		--
Oxychlordane			--		--		--		--		--
Toxaphene			--		1.6		1.8	cancer PRG	--		1.6
trans-Chlordane			--		--		--		--		--
trans-Nonachlor			--		21		--		--		21
Polychlorinated Biphenyls											
Aroclor-1016 (low risk PCB)			1	Total PCB criteria	21	Total PCB criteria	--		--		21
Aroclor-1221 (high risk PCB)			1	Total PCB criteria	0.74	Total PCB criteria	--		--		0.74
Aroclor-1232 (high risk PCB)			1	Total PCB criteria	0.74	Total PCB criteria	--		--		0.74
Aroclor-1242 (high risk PCB)			1	Total PCB criteria	0.74	Total PCB criteria	--		--		0.74
Aroclor-1248 (high risk PCB)			1	Total PCB criteria	0.74	Total PCB criteria	--		--		0.74
Aroclor-1254 (high risk PCB)			1	Total PCB criteria	0.74	Total PCB criteria	--		--		0.74
Aroclor-1260 (high risk PCB)			1	Total PCB criteria	0.74	Total PCB criteria	--		--		0.74
Total (high risk) PCBs			1	Total PCB criteria	0.74	Total PCB criteria	--		--		0.74
Dioxins and Furans											
1,2,3,4,6,7,8,9-OCDD			0.027		--		--		--		0.027
1,2,3,4,6,7,8,9-OCDF			0.027		--		--		--		0.027
1,2,3,4,6,7,8-Heptachlorooxanthrene			--		--		--		--		-
1,2,3,4,6,7,8-HpCDD			0.0027		--		--		--		0.0027
1,2,3,4,6,7,8-HpCDF			0.0027		--		--		--		0.0027
1,2,3,4,7,8,9-HpCDF			0.0027		--		--		--		0.0027
1,2,3,4,7,8-HxCDD			0.00027		--		--		--		0.00027
1,2,3,4,7,8-HxCDF			0.00027		--		--		--		0.00027
1,2,3,6,7,8-HxCDD			0.00027		--		--		--		0.00027
1,2,3,6,7,8-HxCDF			0.00027		--		--		--		0.00027
1,2,3,7,8,9-HxCDD			0.00027		--		--		--		0.00027
1,2,3,7,8,9-HxCDF			0.00027		--		--		--		0.00027
1,2,3,7,8-PeCDD			0.000055		--		--		--		0.000055
1,2,3,7,8-PeCDF			0.00055		--		--		--		0.00055
2,3,4,6,7,8-HxCDF			0.00027		--		--		--		0.00027
2,3,4,7,8-PeCDF			0.000055		--		--		--		0.000055
2,3,7,8-TCDD			0.000027		0.000016		0.000019	cancer PRG	--		0.000016
2,3,7,8-TCDF			0.00027		--		--		--		0.00027

Table 4-1. Summary of Human Health Evaluation Criteria for Soil *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	HPAL [a]		SDGI Industrial Screening Criteria [b]		EPA PRG Industrial 2004 [c]		ESL Industrial 2005 (direct exp) [d,e,g]		ESL Industrial 2005 (inhalation) [e,f,g]		RIEC
	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)
Semivolatile Organic Compounds											
1-(Ethenyloxy)-octadecane			--		--		--		--		--
1,2,3,4-Tetrahydronaphthalene			--		--		--		--		--
1,2,4,5-Tetramethylbenzene			--		--		--		--		--
1,2,4-Trichlorobenzene			1,600		220		210	noncancer (HQ=1.0)	5	noncancer (HQ=1.0)	5
1,2-Dichlorobenzene			370		600		600	saturation limit	21		21
1,3-Dichlorobenzene			52		600		600	saturation limit	--		600
1,4-Dichlorobenzene			4.5		7.9		4.5	cancer PRG	0.13		0.13
11H-Benzo(a)fluorene			--		--		--		--		--
17-Pentatriacontene			--		--		--		--		--
1-Docosene			--		--		--		--		--
1-Hexacosanol			--		--		--		--		--
1-Methylpyrene			--		--		--		--		--
1-Octadecanol			--		--		--		--		--
2-(2-Butoxyethoxy)-ethanol			--		--		--		--		--
2,2'-Oxybis(1-chloropropane)			--		7.4		--		--		7.4
2,3-Dimethylphenanthrene			--		--		--		--		--
2,4,5,7-Tetramethylphenanthrene			--		--		--		--		--
2,4,5-Trichlorophenol			--		62,000		11,000	noncancer (HQ=1.0)	305	noncancer (HQ=1.0)	61
2,4,6-Trichlorophenol			--		62		25	cancer PRG	--		25
2,4-Dichlorophenol			--		1,800		1,800	noncancer (HQ=1.0)	--		1,800
2,4-Dimethylphenol			18,000		12,000		3,600	noncancer (HQ=1.0)	1500	noncancer (HQ=1.0)	1,500
2,4-Dinitrophenol			--		1,200		1,200	noncancer (HQ=1.0)	--		1,200
2,4-Dinitrotoluene			--		1,200		5.6	cancer PRG	--		5.6
2,6,10,14-Tetramethylhexadecane			--		--		--		--		--
2,6,10,14-Tetramethylpentadecane			--		--		--		--		--
2,6,10-Trimethyl-dodecane			--		--		--		--		--
2,6,11,15-Tetramethylhexadecane			--		--		--		--		--
2,6,11-Trimethyl-dodecane			--		--		--		--		--
2,6-Dinitrotoluene			880		620		--		--		620
2-Chloronaphthalene			27,000		23,000		--		--		23,000
2-Chlorophenol			--		240		230	noncancer (HQ=1.0)	10	noncancer (HQ=1.0)	10
2-Methylnaphthalene			190		--		6,500	noncancer (HQ=1.0)	550	noncancer (HQ=1.0)	550
2-Methylphenol			44,000		31,000		--		--		31,000
2-Nitroaniline			50		1,800		--		--		1,800
2-Nitrophenol			--		--		--		--		--
3,3'-Dichlorobenzidine			2.1		3.8		1.4	cancer PRG	--		1.4
3,6-Dimethylphenanthrene			--		--		--		--		--
3-Heptanone,2,4-Dimethyl-C9H18O			--		--		--		--		--
3-Nitroaniline			--		82		--		--		82
4,4-Dimethylbiphenyl			--		--		--		--		--
4,6-Dinitro-2-methylphenol			--		--		--		--		--
4-Bromophenyl-phenylether			--		--		--		--		--
4-Chloro-3-methylphenol			--		--		--		--		--

Table 4-1. Summary of Human Health Evaluation Criteria for Soil *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	HPAL [a]		SDGI Industrial Screening Criteria [b]		EPA PRG Industrial 2004 [c]		ESL Industrial 2005 (direct exp) [d,e,g]		ESL Industrial 2005 (inhalation) [e,f,g]		RIEC
	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)
Semivolatile Organic Compounds *(continued)*											
4-Chloroaniline			--		2,500		--		--		2,500
4-Chlorophenyl-phenylether			--		--		--		--		--
4H-Cyclopenta(def)phenanthrene			--		--		--		--		--
4-Methylphenol			4,400		3,100		--		--		3,100
4-Nitroaniline			--		82		--		--		82
4-Nitrophenol			7,000		--		--		--		7,000
5-Methylhex-5-en-2-one			--		--		--		--		--
7H-Benzo[c]fluorene			--		--		--		--		--
9,10-Anthracenedione			--		--		--		--		--
9-Methylanthracene			--		--		--		--		--
Acenaphthene			38,000		29,000		22,000	noncancer (HQ=1.0)	650	noncancer (HQ=1.0)	650
Acenaphthylene			--		--		18,000	noncancer (HQ=1.0)	--		18,000
Aniline			--		300		--		--		300
Anthracene			100,000		100,000		160,000	noncancer (HQ=1.0)	31	noncancer (HQ=1.0)	31
Azobenzene			--		16		--		--		16
Benzidine			--		--		--		--		--
Benzo(a)anthracene			1.8		2.1		1.3	cancer PRG	--		1.3
Benzo(a)pyrene			0.33	reporting limit	0.21		0.13	cancer PRG	--		0.33
Benzo(b)fluoranthene			1.8		2.1		1.3	cancer PRG	--		1.3
Benzo(e)pyrene			--		--		--		--		--
Benzo(g,h,i)perylene			54,000		--		22,000	noncancer (HQ=1.0)	--		22,000
Benzo(k)fluoranthene			1.8		21		1.3	cancer PRG	--		1.3
Benzoic acid			--		100,000		--		--		100,000
Benzyl alcohol			--		100,000		--		--		100,000
Biphenyl			--		23,000		18,000	noncancer (HQ=1.0)	--		18,000
Bis(2-chloroethoxy)methane			--		--		--		--		--
Bis(2-chloroethyl)ether			--		0.58		0.22	cancer PRG	0.012		0.012
Bis(2-chloroisopropyl)ether			--		7.4		--		--		7.4
Bis(2-ethylhexyl)adipate			--		--		--		--		--
Bis(2-ethylhexyl)phthalate			180		120		570	cancer PRG	--		120
Butylbenzylphthalate			100,000		100,000		--		--		100,000
Carbazole			120		86		--		--		86
Chrysene			18		210		13	cancer PRG	--		13
Cyclic octaatomic sulfur			--		--		--		--		--
Cyclopenta(cd)pyrene			--		--		--		--		--
Dibenz(a,h)anthracene			0.33	reporting limit	0.21		0.38	cancer PRG	--		0.33
Dibenzofuran			5,100		1,600		--		--		1,600
Diethylphthalate			100,000		100,000		490,000	noncancer (HQ=1.0)	--		100,000
Dimethylphthalate			--		100,000		6,200,000	noncancer (HQ=1.0)	--		100,000
Di-n-butylphthalate			88,000		62,000		--		--		62,000
Di-n-octylphthalate			10,000		25,000		--		--		25,000
Dioctadecyl phosphonic acid			--		--		--		--		--
Dioctyl ester hexanedioic acid			--		--		--		--		--

Table 4-1. Summary of Human Health Evaluation Criteria for Soil *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	HPAL [a]		SDGI Industrial Screening Criteria [b]		EPA PRG Industrial 2004 [c]		ESL Industrial 2005 (direct exp) [d,e,g]		ESL Industrial 2005 (inhalation) [e,f,g]		RIEC
	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)
Semivolatile Organic Compounds *(continued)*											
Docosane			--		--		--		--		--
Dodecane			--		--		--		--		--
Dotriacontane			--		--		--		--		--
Eicosane			--		--		--		--		--
Fluoranthene			30,000		22,000		22,000	noncancer (HQ=1.0)	--		22,000
Fluorene			33,000		26,000		18,000	noncancer (HQ=1.0)	800	noncancer (HQ=1.0)	800
Heneicosane			--		--		--		--		--
Heptacosane			--		--		--		--		--
Heptadecane			--		--		--		--		--
Hexachlorobenzene			1.4		1.1		0.96	cancer PRG	--		0.96
Hexachlorobutadiene			--		22		22	cancer PRG	--		22
Hexachlorocyclopentadiene			--		3700		--		--		3,700
Hexachloroethane			--		120		44	cancer PRG	--		44
Hexacosane			--		--		--		--		--
Hexadecane			--		--		--		--		--
Hexadecanoic acid			--		--		--		--		--
Hexatriacontane			--		--		--		--		--
Indeno(1,2,3-cd)pyrene			1.8		2.1		1.3	cancer PRG	--		1.3
Isophorone			2,600		510		--		--		510
m-Terphenyl			--		--		--		--		--
Naphthalene			190		190		3.8	cancer PRG	1.5		1.5
Nitrobenzene			NA		100		--		--		100
n-Nitrosodimethylamine			NA		0.034		--		--		0.034
n-Nitroso-di-n-propylamine			0.35		0.25		--		--		0.25
n-Nitrosodiphenylamine			270		350		--		--		350
Nonacosane			--		--		--		--		--
Nonadecane			--		--		--		--		--
Octacosane			--		--		--		--		--
Octadecane			--		--		--		--		--
Octadecanoic acid			--		--		--		--		--
o-Terphenyl			--		--		--		--		--
Pentachlorophenol			11		9.0		13	cancer PRG	--		9
Pentacosane			--		--		--		--		--
Pentadecane			--		--		--		--		--
Pentatriacontane			--		--		--		--		--
Perylene			--		--		--		--		--
Phenacetin			--		--		--		--		--
Phenanthrene			100,000		--		18,000	noncancer (HQ=1.0)	--		18,000
Phenol			100,000		100,000		180,000	noncancer (HQ=1.0)	--		100,000
p-Terphenyl			--		--		--		--		--
Pyrene			54,000		29,000		18,000	noncancer (HQ=1.0)	425	noncancer (HQ=1.0)	425
Terphenyl			--		--		--		--		--
Tetracosane			--		--		--		--		--

Table 4-1. Summary of Human Health Evaluation Criteria for Soil *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	HPAL [a]		SDGI Industrial Screening Criteria [b]		EPA PRG Industrial 2004 [c]		ESL Industrial 2005 (direct exp) [d,e,g]		ESL Industrial 2005 (inhalation) [e,f,g]		RIEC
	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)
Semivolatile Organic Compounds *(continued)*											
Tetradecane			--		--		--		--		--
Tetratetracontane			--		--		--		--		--
Triacontane			--		--		--		--		--
Tricosane			--		--		--		--		--
Tridecane			--		--		--		--		--
Tri-m-cresyl phosphate			--		--		--		--		--
Triphenylene			--		--		--		--		--
Tri-p-tolyl phosphate			--		--		--		--		--
Volatile Organic Compounds											
1,1,1,2-Tetrachloroethane			--		7.3		6.9	cancer PRG	--		6.9
1,1,1-Trichloroethane			1,400		1,200		1,200	saturation limit	230		230
1,1,2,2-Tetrachloroethane			0.89		0.93		0.86	cancer PRG	0.025		0.025
1,1,2-Trichloro-1,2,2-trifluoroethane			--		--		--		--		--
1,1,2-Trichloroethane			1.9		1.6		1.5	cancer PRG	0.089		0.089
1,1-Dichloroethane			7.1		1,700		5.9	cancer PRG	0.89		0.89
1,1-Dichloroethene			0.12		410		410	noncancer (HQ=1.0)	105	noncancer (HQ=1.0)	105
1,1-Dichloropropene			--		--		--		--		--
1,2,3,5-Tetramethylbenzene			--		--		--		--		--
1,2,3-Trichlorobenzene			--		--		--		--		--
1,2,3-Trichloropropane			--		--		--		--		--
1,2,3-Trimethylbenzene			--		--		--		--		--
1,2,4-Trimethylbenzene			--		170		--		--		170
1,2-Dibromo-3-chloropropane			--		2		0.067	cancer PRG	--		0.067
1,2-Dibromoethane			--		--		0.25	cancer PRG	0.02		0.02
1,2-Dichloroethane			0.76		0.60		0.74	cancer PRG	0.07		0.07
1,2-Dichloroethene (Total)			150		--		--		--		150
1,2-Dichloropropane			--		0.74		1.4	cancer PRG	0.14		0.14
1,3,5-Trimethylbenzene			--		70		--		--		70
1,3-Dichloropropane			--		--		--		--		--
1-Ethyl-2,3-dihydro-1H-indene			--		--		--		--		--
1-Ethyl-2,4-dimethyl benzene			--		--		--		--		--
1-Ethyl-2-methylbenzene			--		--		--		--		--
2,2-Dichloropropane			--		--		--		--		--
2-Butanone			28,000		110,000		26,000	noncancer (HQ=1.0)	6,500	noncancer (HQ=1.0)	6,500
2-Chloroethyl vinyl ether			--		--		--		--		--
2-Chlorotoluene			--		--		--		--		--
2-Hexanone			--		--		--		--		--
4-Chlorotoluene			--		-		-		-		-
4-Ethyl-1,2-dimethylbenzene			--		-		-		-		-
4-Isopropyltoluene			--		-		-		-		-
4-Methyl-2-pentanone			2,900		47,000		2,800	noncancer (HQ=1.0)	1,550	noncancer (HQ=1.0)	1,550
Acetone			6,200		54,000		52,000	noncancer (HQ=1.0)	16,500	noncancer (HQ=1.0)	16,500
Benzene			0.4		1.4		0.38	cancer PRG	0.51		0.38

Table 4-1. Summary of Human Health Evaluation Criteria for Soil *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	HPAL [a]		SDGI Industrial Screening Criteria [b]		EPA PRG Industrial 2004 [c]		ESL Industrial 2005 (direct exp) [d,e,g]		ESL Industrial 2005 (inhalation) [e,f,g]		RIEC
	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)
Volatile Organic Compounds *(continued)*											
Bicyclo[3.3.1]nonane			--		-		-		-		-
Bromobenzene			--		-		-		-		-
Bromochloromethane			--		-		-		-		-
Bromodichloromethane			--		1.8		0.84	cancer PRG	0.039		0.039
Bromoform			310		220		220	cancer PRG	-		220
Bromomethane			13		13		13	noncancer (HQ=1.0)	2.6	noncancer (HQ=1.0)	2.6
Carbon disulfide			720		720		-		-		720
Carbon tetrachloride			0.19		0.55		0.19	cancer PRG	0.034		0.034
Chlorobenzene			540		530		520	noncancer (HQ=1.0)	31	noncancer (HQ=1.0)	31
Chloroethane			6.5		6.5		6.4	cancer PRG	1.8		1.8
Chloroform			0.52		0.47		1.9	cancer PRG	330		0.47
Chloromethane			2.7		160		0.63	cancer PRG	0.2		0.2
cis-1,2-Dichloroethene			--		150		140	noncancer (HQ=1.0)	18	noncancer (HQ=1.0)	18
cis-1,3-Dichloropropene			--		1.8		0.46	cancer PRG	0.093		0.093
cis-Bicyclo[4.3.0]nonane			--		--		--		--		--
Dibromochloromethane			--		2.6		2.2	cancer PRG	0.054		0.054
Dibromomethane			--		--		--		--		--
Dichlorodifluoromethane			--		310		--		--		310
Ethylbenzene			230		400		400	saturation limit	390		5 [h]
Isopropylbenzene			--		2,000		--		--		2,000
m.p-Xylenes			210		--		--		--		210
Methylcyclohexane			--		2,600		--		--		2,600
Methylene chloride			9.7		21		9.2	cancer PRG	1.5		1.5
n-Butylbenzene			--		240		--		--		240
o-Xylene			210		--		--		--		210
Propylbenzene			--		240		--		--		240
sec-Butylbenzene			--		220		--		--		220
Styrene			1,700		1,700		1,500	saturation limit	1,100		1,100
tert-Butyl methyl ether			--		70		68	cancer PRG	5.6		5.6
tert-Butylbenzene			--		390		--		--		390
Tetrachloroethene			2.1		1.3		1.1	cancer PRG	0.24		0.24
Toluene			520		520		650	saturation limit	1,550	noncancer (HQ=1.0)	520
trans-1,2-Dichloroethene			--		230		230	noncancer (HQ=1.0)	37	noncancer (HQ=1.0)	37
trans-1,3-Dichloropropene			--		1.8		0.46	cancer PRG	0.093		0.093
Trichloroethene			3.7		0.11		6.3	cancer PRG	0.73		0.11
Trichlorofluoromethane			--		2,000		--		--		2,000
Vinyl acetate			--		1,400		--		--		1,400
Vinyl chloride			0.054		0.75		0.054	cancer PRG	0.019		0.019
Xylene (Total)			210		420		420	saturation limit	420		420

Table 4-1. Summary of Human Health Evaluation Criteria for Soil *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	HPAL [a]		SDGI Industrial Screening Criteria [b]		EPA PRG Industrial 2004 [c]		ESL Industrial 2005 (direct exp) [d,e,g]		ESL Industrial 2005 (inhalation) [e,f,g]		RIEC
	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)	Comments	Conc. (mg/kg)
Petroleum Hydrocarbons											
Gasoline-range organics			--		--		750	noncancer (HQ=0.5)	--		750
Diesel-range organics			--		--		750	noncancer (HQ=0.5)	--		750
Motor oil-range organics			--		--		4,600	noncancer (HQ=0.5)	--		4,600
TPH-extractable unknown hydrocarbon			--		--		4,600	noncancer (HQ=0.5)	--		4,600
TPH-purgeable unknown hydrocarbon			--		--		750	noncancer (HQ=0.5)	--		750
Total TPH			--		--		--		--		3,500
Total oil and grease			--		--		--		--		3,500

Notes:

a PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

b Tetra Tech EM Inc. 2002d. "Revised Draft Final Sampling and Analysis Plan (Field Sampling Plan/Quality Assurance Project Plan) for Parcel E Standard Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California." August 27.

c EPA. 2004. "Preliminary Remediation Goals, Region 9." December. Available Online at: <http://www.epa.gov/Region9/waste/sfund/prg/index.htm>.

d Table K-2 from Regional Water Quality Control Board, San Francisco Bay Region. 2005. "Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater." Interim Final. February.

e Noncancer screening levels, except TPH compounds, adjusted by a factor of five to be comparable with EPA PRGs (i.e., equivalent to a HQ of 1.0)

f Table E-1b from Regional Water Quality Control Board, San Francisco Bay Region. 2005. "Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater." Interim Final. February.

g For depths greater than 10 feet,Table D-2 from Regional Water Quality Control Board, San Francisco Bay Region. 2005. "Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater." Interim Final. February.

h ESL for ethylbenzene was revised in 2008 to 5 mg/kg; the updated 2008 ESL for ethylbenzene was used as the RIEC (to ensure the nature and extent evaluation was adequately conservative)

-- No criteria available for this chemical
BHC benzene hexachloride
Conc. Concentration
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethene
DDT dichlorodiphenyltrichloroethane
EPA U.S. Environmental Protection Agency
ESL environmental screening level
HPAL Hunters Point ambient level
HpCDD heptachlorodibenzo-p-dioxin
HpCDF heptachlorodibenzofuran
HQ hazard quotient
HxCDD hexachlorodibenzo-p-dioxin
HxCDF hexachlorodibenzofuran
mg/kg milligrams per kilogram
OCDD octachlorodibenzo-p-dioxin
OCDF octachlorodibenzofuran
PCB polychlorinated biphenyl
PeCDD pentachlorodibeno-p-dioxin
PeCDF pentachlorodibenzofuran
PRG preliminary remediation goal
RI Remedial Investigation
SDGI standard data gaps investigation
TPH total petroleum hydrocarbons

Table 4-2. Landfill Gas Characterization Monitoring Probes Result Summary

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency	Range of Detection Limits	Range of Results
Gas		%	%
Carbon dioxide	55/55	0.1 - 0.29	0.12 - 30
Carbon monoxide	0/55	0.1 - 0.29	0
Methane	47/55	0.1 - 0.29	0.57 - 71
Nitrogen	55/55	0.1 - 0.29	5.8 - 94
Oxygen	53/55	0.1 - 0.29	0.3 - 20
Methane (ppmv)	15/23	0.13 - 0.22	424 - 733,813
Nonmethane organic carbon compounds (ppmv)	47/55	0.13 - 0.22	2.4 - 330
Volatile Organic Compounds		ppmv	ppmv
1,1,1-Trichloroethane	11/57	4.5346 - 77.42	13.272 - 51.982
1,1,2,2-Tetrachloroethane	1/57	5.7236 - 97.72	69.8 - 69.8
1,1,2-Trichloro-1,2,2-trifluoroethane	2/57	6.3714 - 108.78	29.526 - 31.857
1,1,2-Trichloroethane	1/57	4.5346 - 77.42	21.567 - 21.567
1,1-Dichloroethane	37/57	3.3784 - 57.68	6.592 - 412
1,1-Dichloroethene	11/57	3.3046 - 56.42	4.03 - 44.33
1,2,4-Trichlorobenzene	7/57	6.1664 - 105.28	7.144 - 48.5792
1,2,4-Trimethylbenzene	39/57	4.0918 - 69.86	3.8922 - 16,966
1,2-Dibromoethane	10/57	6.4124 - 109.48	13.294 - 50.83
1,2-Dichloro-1,1,2,2-tetrafluoroethane	49/57	5.8302 - 99.54	16.353 - 1673.267
1,2-Dichlorobenzene	21/57	5.0102 - 85.54	4.4603 - 59.878
1,2-Dichloroethane	15/57	3.3784 - 57.68	4.0376 - 61.8
1,2-Dichloropropane	2/57	3.854 - 65.8	11.75 - 18.8
1,3,5-Trimethylbenzene	36/57	4.0918 - 69.86	4.3413 - 8,982
1,3-Butadiene	1/57	1.8368 - 31.36	10.752 - 10.752
1,3-Dichlorobenzene	14/57	5.0102 - 85.54	7.943 - 53.768
1,4-Dichlorobenzene	29/57	5.0102 - 85.54	5.9878 - 916.5
1,4-Dioxane	1/57	3.0012 - 51.24	10.98 - 10.98
2-Butanone	5/57	2.4518 - 41.86	101.66 - 478.4
2-Hexanone	0/57	3.4112 - 58.24	ND
4-Ethyltoluene	28/57	3.6162 - 61.74	3.1752 - 2513.7
4-Methyl-2-pentanone	1/57	3.4112 - 58.24	220.48 - 220.48
Acetone	6/57	1.9762 - 33.74	11.086 - 5061
Benzene	50/57	2.665 - 45.5	2.8925 - 552.5
Benzyl chloride	0/57	4.3296 - 73.92	ND
Bromodichloromethane	4/57	5.5596 - 94.92	8.136 - 33.9
Bromoform	3/57	8.61 - 147	33.6 - 80.85
Bromomethane	10/57	3.239 - 55.3	6.715 - 43.45
Carbon disulfide	31/57	2.5912 - 44.24	6.8572 - 1042.8
Carbon tetrachloride	12/57	5.248 - 89.6	5.952 - 45.44
Chlorobenzene	23/57	3.854 - 65.8	122.2 - 2256
Chloroethane	45/57	2.1976 - 37.52	5.762 - 7236
Chloroform	14/57	4.059 - 69.3	5.445 - 54.45
Chloromethane	8/57	1.722 - 29.4	14.7 - 798
cis-1,2-Dichloroethene	38/57	3.2718 - 55.86	3.7506 - 67.83
cis-1,3-Dichloropropene	8/57	3.7802 - 64.54	12.447 - 27.66
Cyclohexane	48/57	2.8618 - 48.86	4.886 - 3839
Dibromochloromethane	8/57	7.093 - 121.1	11.245 - 53.63
Dichlorodifluoromethane	48/57	4.1246 - 70.42	4.7785 - 4174.9
Ethanol	7/57	1.5662 - 26.74	80.6402 - 9932
Ethylbenzene	39/57	3.608 - 61.6	4.4 - 880
Heptane	49/57	3.4112 - 58.24	8.736 - 3260.691
Hexachlorobutadiene	14/57	8.897 -151.9	20.615 - 97.65

Table 4-2. Landfill Gas Characterization Monitoring Probes Result Summary *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency	Range of Detection Limits	Range of Results
Volatile Organic Compounds *(continued)*		ppmv	ppmv
Hexane	49/57	2.9274 - 49.98	35.7 - 14,994
Isopropyl alcohol	12/57	2.0418 - 34.86	6.225 - 473.8221
Methylene chloride	8/57	2.8946 - 49.42	45.89 - 165.91
o-Xylene	44/57	3.608 - 61.6	6.6 - 756.028
Propylene	42/57	1.435 - 24.5	36.75 - 26,250
Styrene	6/57	3.5424 - 60.48	5.184 - 56.16
t-Butyl mercaptan	3/3	18.75 - 37.5	56.25 - 1500
tert-Butyl methyl ether	0/57	3.0012 - 51.24	ND
Tetrachloroethene	31/57	2.829 - 96.6	5.658 - 65.55
Tetrahydrofuran	5/57	2.4518 - 41.86	3.289 - 23.7705
Tetrahydrothiophene	0/3	18.35 - 36.7	ND
Toluene	12/57	3.1406 - 53.62	18.001 - 472.5837
trans-1,2-Dichloroethene	25/57	3.2718 - 55.86	6.384 - 79.8
trans-1,3-Dichloropropene	7/57	3.7802 - 64.54	10.142 - 23.511
Trichloroethene	35/57	4.5346 - 77.42	6.636 - 199.08
Trichlorofluoromethane	19/57	4.674 - 79.8	5.016 - 96.9
Vinyl acetate	0/57	2.9274 - 49.98	ND
Vinyl chloride	42/57	2.132 - 36.4	3.9 - 218.842

Notes:

ND Nondetected

ppmv parts per million by volume

Table 4-3. Summary of Analyses and Detections in the Landfill Area (0-2 feet bgs)

Hunters Point Shipyard Parcel E-2 Remedial Investigation/Feasibility Study

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Metals					
Aluminum	20 / 20	1.4 - 13	968J - 18,000J	NA	--
Antimony	5 / 14	1.6 - 6.3	0.53J - 42	9.05	1
Arsenic	20 / 22	0.1 - 3	1.5J - 7.58J	11.1	0
Barium	22 / 22	0.03 - 0.89	11.3 - 601	314.4	3
Beryllium	19 / 22	0.022 - 0.2	0.2J - 1.4	0.71	7
Cadmium	2 / 22	0.26 - 0.63	0.36 - 0.84	3.14	0
Calcium	20 / 20	2.7 - 13	570 - 20,000	NA	--
Chromium	22 / 22	0.13 - 0.87	6.8J - 340	(a)	0
Chromium VI	0 / 23	0.05 - 0.07	--	NA	--
Cobalt	21 / 22	0.19 - 1.8	3.5J - 79.7	(a)	2
Copper	22 / 22	0.23 - 13	24.7J - 1,100	124.3	3
Cyanide	6 / 17	0.1 - 2	0.28 - 6.6	NA	--
Iron	20 / 20	0.39 - 11	3,840 - 45,400	NA	--
Lead	22 / 22	0.16 - 7.8	4.3 - 9,700J	8.99	19
Magnesium	20 / 20	2.8 - 13	473 - 106,000	NA	--
Manganese	20 / 20	0.08 - 0.16	35.6 - 1,550	1,431.2	2
Mercury	16 / 22	0.00093 - 0.47	0.095 - 2.7	2.28	1
Molybdenum	3 / 21	0.62 - 1.1	0.8 - 2	2.68	0
Nickel	22 / 22	1 - 6.3	4J - 982	(a)	0
Potassium	20 / 20	39 - 193	227 - 3,000	NA	--
Selenium	2 / 20	0.1 - 2.5	0.63 - 1.3	1.95	0
Silver	10 / 22	0.11 - 0.54	0.32 - 0.94	1.43	0
Sodium	20 / 20	2.2 - 14.06	32.2 - 1,340	NA	--
Thallium	3 / 22	0.19 - 0.58	0.25 - 0.6	0.81	0
Tin	3 / 7	2.9 - 3	3.8 - 8.2	NA	--
Vanadium	22 / 22	0.21 - 0.85	3.5 - 116	117.2	0
Zinc	22 / 22	0.29 - 52	45 - 800	109.9	4
Pesticides					
4,4'-DDD	1 / 23	0.0037 - 0.18	0.02J	NA	--
4,4'-DDE	1 / 22	0.0037 - 0.18	0.38J	NA	--
4,4'-DDT	2 / 23	0.0037 - 0.18	0.0086J - 0.51J	NA	--
Aldrin	0 / 22	0.0019 - 0.088	--	NA	--
Alpha-BHC	0 / 22	0.0019 - 0.088	--	NA	--
Alpha-chlordane	1 / 21	0.0019 - 0.88	0.014J	NA	--
Beta-BHC	0 / 22	0.0019 - 0.088	--	NA	--
Chlordane	0 / 0	--	--	NA	--
Delta-BHC	0 / 22	0.0019 - 0.088	--	NA	--
Dieldrin	0 / 22	0.0037 - 0.18	--	NA	--
Endosulfan I	0 / 22	0.0019 - 0.088	--	NA	--
Endosulfan II	0 / 22	0.0037 - 0.18	--	NA	--
Endosulfan sulfate	2 / 22	0.0037 - 0.18	0.032J - 1.8	NA	--
Endrin	0 / 22	0.0019 - 0.18	--	NA	--
Endrin aldehyde	0 / 4	0.0037 - 0.068	--	NA	--
Endrin ketone	0 / 22	0.0037 - 0.18	--	NA	--
Gamma-BHC (lindane)	0 / 22	0.0019 - 0.088	--	NA	--
Gamma-chlordane	0 / 2	0.32 - 0.62	--	NA	--
Heptachlor	0 / 22	0.0019 - 0.088	--	NA	--
Heptachlor epoxide	2 / 22	0.0019 - 0.088	0.0086 - 0.39	NA	--
Methoxychlor	1 / 22	0.0075 - 0.88	0.0036J	NA	--
Mirex	0 / 0	--	--	NA	--
Toxaphene	0 / 21	0.16 - 1.8	--	NA	--
trans-Chlordane	1 / 21	0.0019 - 0.88	0.013J	NA	--

Table 4-3. Summary of Analyses and Detections in the Landfill Area (0-2 feet bgs) *(continued)*
Hunters Point Shipyard Parcel E-2 Remedial Investigation/Feasibility Study

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Polychlorinated Biphenyls					
Aroclor-1016 (low risk PCB)	0 / 23	0.037 - 0.99	--	NA	--
Aroclor-1221 (high risk PCB)	0 / 23	0.037 - 2	--	NA	--
Aroclor-1232 (high risk PCB)	0 / 23	0.037 - 0.99	--	NA	--
Aroclor-1242 (high risk PCB)	1 / 23	0.037 - 0.99	0.024J	NA	--
Aroclor-1248 (high risk PCB)	0 / 23	0.037 - 0.99	--	NA	--
Aroclor-1254 (high risk PCB)	0 / 23	0.037 - 1.8	--	NA	--
Aroclor-1260 (high risk PCB)	4 / 23	0.037 - 1.8	0.1 - 48	NA	--
Total (high risk) PCBs	5 / 23	0.037 - 1.8	0.1 - 48	NA	--
Semivolatile Organic Compounds					
1-(Ethenyloxy)-octadecane	1 / 1	0.16 - 0.16	0.16	NA	--
1,2,4,5-Tetramethylbenzene	0 / 0	--	--	NA	--
1,2,4-Trichlorobenzene	0 / 23	0.18 - 3.6	--	NA	--
1,2-Dichlorobenzene	0 / 23	0.18 - 3.6	--	NA	--
1,3-Dichlorobenzene	0 / 23	0.18 - 3.6	--	NA	--
1,4-Dichlorobenzene	0 / 23	0.18 - 3.6	--	NA	--
1-Hexacosanol	0 / 0	--	--	NA	--
1-Octadecanol	0 / 0	--	--	NA	--
2,2'-Oxybis(1-chloropropane)	0 / 0	0.7 - 1.4	--	NA	--
2,4,5-Trichlorophenol	0 / 22	0.37 - 7	--	NA	--
2,4,6-Trichlorophenol	0 / 22	0.18 - 3.6	--	NA	--
2,4-Dichlorophenol	0 / 22	0.18 - 3.6	--	NA	--
2,4-Dimethylphenol	0 / 23	0.18 - 3.6	--	NA	--
2,4-Dinitrophenol	0 / 22	0.87 - 7.2	--	NA	--
2,4-Dinitrotoluene	0 / 23	0.18 - 3.6	--	NA	--
2,6-Dinitrotoluene	0 / 23	0.18 - 3.6	--	NA	--
2-Chloronaphthalene	0 / 23	0.18 - 3.6	--	NA	--
2-Chlorophenol	0 / 23	0.18 - 3.6	--	NA	--
2-Methylnaphthalene	3 / 22	0.073 - 1.5	0.056J - 0.076J	NA	--
2-Methylphenol	0 / 23	0.18 - 3.6	--	NA	--
2-Nitroaniline	0 / 23	0.73 - 7.2	--	NA	--
2-Nitrophenol	0 / 22	0.18 - 7.2	--	NA	--
3,3'-Dichlorobenzidine	0 / 23	0.36 - 7.2	--	NA	--
3-Nitroaniline	0 / 22	0.73 - 7.2	--	NA	--
4,6-Dinitro-2-methylphenol	0 / 22	0.87 - 7.2	--	NA	--
4-Bromophenyl-phenylether	0 / 22	0.18 - 3.6	--	NA	--
4-Chloro-3-methylphenol	0 / 23	0.18 - 3.6	--	NA	--
4-Chloroaniline	0 / 22	0.18 - 3.6	--	NA	--
4-Chlorophenyl-phenylether	0 / 22	0.18 - 3.6	--	NA	--
4-Methylphenol	0 / 23	0.18 - 3.6	--	NA	--
4-Nitroaniline	0 / 22	0.73 - 7.2	--	NA	--
4-Nitrophenol	0 / 23	0.73 - 7.2	--	NA	--
Acenaphthene	2 / 24	0.073 - 4.1	0.13 - 0.32J	NA	--
Acenaphthylene	8 / 24	0.073 - 4.1	0.04J - 1.1	NA	--
Anthracene	9 / 24	0.073 - 4.1	0.044J - 0.66	NA	--
Azobenzene	0 / 1	0.37 - 1.4	--	NA	--
Benzo(a)anthracene	11 / 24	0.073 - 4.1	0.089J - 2.3	NA	--
Benzo(a)pyrene	11 / 24	0.073 - 4.1	0.26J - 3.1	NA	--
Benzo(b)fluoranthene	13 / 24	0.073 - 4.1	0.043J - 4.1	NA	--
Benzo(e)pyrene	0 / 0	--	--	NA	--
Benzo(g,h,i)perylene	10 / 24	0.073 - 4.1	0.031J - 3.4	NA	--
Benzo(k)fluoranthene	12 / 24	0.073 - 4.1	0.0097J - 1.1	NA	--
Benzoic acid	1 / 20	0.87 - 7	0.31J	NA	--
Benzyl alcohol	0 / 20	0.18 - 1.5	--	NA	--

Table 4-3. Summary of Analyses and Detections in the Landfill Area (0-2 feet bgs) *(continued)*
Hunters Point Shipyard Parcel E-2 Remedial Investigation/Feasibility Study

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Biphenyl	0 / 0	--	--	NA	--
Bis(2-chloroethoxy)methane	0 / 22	0.18 - 3.6	--	NA	--
Bis(2-chloroethyl)ether	0 / 22	0.18 - 3.6	--	NA	--
Bis(2-chloroisopropyl)ether	0 / 22	0.18 - 3.6	--	NA	--
Bis(2-ethylhexyl)adipate	0 / 23	--	--	NA	--
Bis(2-ethylhexyl)phthalate	0 / 0	0.18 - 3.6	--	NA	--
Butylbenzylphthalate	0 / 23	0.18 - 3.6	--	NA	--
Carbazole	0 / 2	0.37 - 1.4	--	NA	--
Chrysene	13 / 24	0.073 - 4.1	0.023J - 2.3	NA	--
Cyclic Octaatomic sulfur	0 / 0	--	--	NA	--
Dibenz(a,h)anthracene	6 / 24	0.073 - 4.1	0.043J - 0.25J	NA	--
Dibenzofuran	1 / 23	0.18 - 3.6	0.043J	NA	--
Diethylphthalate	0 / 23	0.18 - 3.6	--	NA	--
Dimethylphthalate	0 / 22	0.18 - 3.6	--	NA	--
Di-n-butylphthalate	0 / 23	0.18 - 3.6	--	NA	--
Di-n-octylphthalate	0 / 23	0.18 - 3.6	--	NA	--
Dioctadecyl phosphonic acid	1 / 1	0.35 - 0.35	0.35	NA	--
Docosane	0 / 0	--	--	NA	--
Eicosane	1 / 1	0.12 - 0.12	0.12	NA	--
Fluoranthene	15 / 24	0.073 - 4.1	0.022J - 6	NA	--
Fluorene	8 / 24	0.073 - 4.1	0.04J - 0.54	NA	--
Hexachlorobenzene	0 / 23	0.18 - 3.6	--	NA	--
Hexachlorobutadiene	0 / 22	0.18 - 3.6	--	NA	--
Hexachlorocyclopentadiene	0 / 22	0.18 - 7.2	--	NA	--
Hexachloroethane	0 / 22	0.18 - 3.6	--	NA	--
Hexadecanoic acid	1 / 1	0.26 - 0.26	0.26	NA	--
Hexatriacontane	1 / 1	0.19 - 0.19	0.19	NA	--
Indeno(1,2,3-cd)pyrene	10 / 24	0.073 - 4.1	0.15J - 3.1	NA	--
Isophorone	0 / 22	0.18 - 1.5	--	NA	--
m-Terphenyl	0 / 0	--	--	NA	--
Naphthalene	8 / 24	0.073 - 4.1	0.13J - 2.13	NA	--
Nitrobenzene	0 / 22	0.18 - 3.6	--	NA	--
n-Nitrosodimethylamine	0 / 1	0.37 - 1.4	--	NA	--
n-Nitroso-di-n-propylamine	0 / 23	0.18 - 3.6	--	NA	--
n-Nitrosodiphenylamine	0 / 23	0.18 - 3.6	--	NA	--
o-Terphenyl	0 / 0	--	--	NA	--
Octadecanoic acid	1 / 1	0.37 - 0.37	0.37	NA	--
p-Terphenyl	0 / 0	--	--	NA	--
Pentachlorophenol	1 / 23	0.73 - 7.2	0.059J	NA	--
Phenacetin	0 / 0	--	--	NA	--
Phenanthrene	13 / 24	0.073 - 4.1	0.044J - 5	NA	--
Phenol	1 / 23	0.18 - 3.6	0.036J	NA	--
Pyrene	15 / 24	0.073 - 4.1	0.023J - 7.1	NA	--
Terphenyl	0 / 0	--	--	NA	--
Tricosane	0 / 0	--	--	NA	--
Tridecane	1 / 1	0.09 - 0.09	0.09	NA	--
Volatile Organic Compounds					
1,1,1,2-Tetrachloroethane	0 / 0	--	--	--	--
1,1,1-Trichloroethane	1 / 21	0.005 - 0.011	0.0016J	NA	--
1,1,2,2-Tetrachloroethane	0 / 21	0.005 - 0.011	--	NA	--
1,1,2-Trichloro-1,2,2-trifluoroethane	0 / 0	--	--	NA	--
1,1,2-Trichloroethane	0 / 21	0.005 - 0.011	--	NA	--
1,1-Dichloroethane	0 / 21	0.005 - 0.011	-	NA	-

Table 4-3. Summary of Analyses and Detections in the Landfill Area (0-2 feet bgs) *(continued)*
Hunters Point Shipyard Parcel E-2 Remedial Investigation/Feasibility Study

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Volatile Organic Compounds *(continued)*					
1,1-Dichloroethene	0 / 21	0.005 - 0.011	--	NA	--
1,1-Dichloropropene	0 / 0	--	--	NA	--
1,2,3-Trichlorobenzene	0 / 0	--	--	NA	--
1,2,3-Trichloropropane	0 / 0	--	--	NA	--
1,2,4-Trimethylbenzene	0 / 0	--	--	NA	--
1,2-Dibromo-3-chloropropane	0 / 0	--	--	NA	--
1,2-Dibromoethane	0 / 0	--	--	NA	--
1,2-Dichloroethane	0 / 21	0.005 - 0.011	--	NA	--
1,2-Dichloroethene (Total)	0 / 20	0.005 - 0.011	--	NA	--
1,2-Dichloropropane	0 / 21	0.005 - 0.011	--	NA	--
1,3,5-Trimethylbenzene	0 / 0	--	--	NA	--
1,3-Dichloropropane	0 / 0	--	--	NA	--
2,2-Dichloropropane	0 / 0	--	--	NA	--
2-Butanone	0 / 21	0.01 - 0.012	--	NA	--
2-Chlorotoluene	0 / 0	--	--	NA	--
2-Hexanone	0 / 21	0.01 - 0.012	--	NA	--
4-Chlorotoluene	0 / 0	--	--	NA	--
4-Isopropyltoluene	0 / 0	--	--	NA	--
4-Methyl-2-pentanone	0 / 21	0.01 - 0.012	--	NA	--
Acetone	0 / 21	0.01 - 0.02	--	NA	--
Benzene	0 / 21	0.005 - 0.011	--	NA	--
Bromobenzene	0 / 0	--	--	NA	--
Bromochloromethane	0 / 0	--	--	NA	--
Bromodichloromethane	0 / 21	0.005 - 0.011	--	NA	--
Bromoform	0 / 21	0.005 - 0.011	--	NA	--
Bromomethane	0 / 21	0.01 - 0.012	--	NA	--
Carbon disulfide	1 / 21	0.005 - 0.011	0.001J	NA	--
Carbon tetrachloride	0 / 21	0.005 - 0.011	--	NA	--
Chlorobenzene	0 / 21	0.005 - 0.011	--	NA	--
Chloroethane	0 / 21	0.01 - 0.012	--	NA	--
Chloroform	0 / 21	0.005 - 0.011	--	NA	--
Chloromethane	0 / 21	0.01 - 0.012	--	NA	--
cis-1,2-Dichloroethene	0 / 1	0.005 - 0.005	--	NA	--
cis-1,3-Dichloropropene	0 / 21	0.005 - 0.011	--	NA	--
Dibromochloromethane	0 / 21	0.005 - 0.011	--	NA	--
Dibromomethane	0 / 0	--	--	NA	--
Dichlorodifluoromethane	0 / 0	--	--	NA	--
Ethylbenzene	0 / 21	0.005 - 0.011	--	NA	--
Isopropylbenzene	0 / 0	--	--	NA	--
Methylene chloride	0 / 21	0.005 - 0.011	--	NA	--
n-Butylbenzene	0 / 0	--	--	NA	--
o-Xylene	0 / 0	--	--	NA	--
Propylbenzene	0 / 0	--	--	NA	--
sec-Butylbenzene	0 / 0	--	--	NA	--
Styrene	0 / 21	0.005 - 0.011	--	NA	--
tert-Butylbenzene	0 / 0	--	--	NA	--
tert-Butyl methyl ether	0 / 1	0.005 - 0.005	--	NA	--
Tetrachloroethene	0 / 21	0.005 - 0.011	--	NA	--
Toluene	3 / 21	0.005 - 0.011	0.002J - 0.019	NA	--
trans-1,2-Dichloroethene	0 / 1	0.005 - 0.005	--	NA	--
trans-1,3-Dichloropropene	0 / 21	0.005 - 0.011	--	NA	--
Trichloroethene	0 / 21	0.005 - 0.011	--	NA	--
Trichlorofluoromethane	0 / 0	--	--	NA	--
Vinyl acetate	1 / 20	0.01 - 0.05	0.001J	NA	-
Vinyl chloride	0 / 21	0.01 - 0.012	-	NA	-
Xylene (Total)	0 / 21	0.005 - 0.011	--	NA	--

Table 4-3. Summary of Analyses and Detections in the Landfill Area (0-2 feet bgs) *(continued)*

Hunters Point Shipyard Parcel E-2 Remedial Investigation/Feasibility Study

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Petroleum Hydrocarbons					
Gasoline-range organics	1 / 23	0.2 - 5.8	0.11	NA	--
Diesel-range organics	6 / 23	2.2 - 12	7.7J - 240	NA	--
Motor oil-range organics	4 / 4	11 - 26	55J - 770	NA	--
TPH-extractable unknown hydrocarbon	4 / 8	10 - 11	18 - 170	NA	--
TPH-purgeable unknown hydrocarbon	0 / 7	0.18 - 1.1	--	NA	--
Total TPH	10 / 23	--	18 - 1,010.11	NA	--
Total oil and grease	14 / 18	0 - 58	57 - 5,000J	NA	--

Notes:

(1) rejected data are not included in detection frequency

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical

bgs below ground surface

BHC benzene hexachloride

DDD dichlorodiphenyldichloroethane

DDE dichlorodiphenyldichloroethene

DDT dichlorodiphenyltrichloroethane

HPAL Hunters Point ambient level

mg/kg milligrams per kilogram

NA not available

J estimated value

TPH total petroleum hydrocarbons

Table 4-4. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (0-2 feet bgs)

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Metals				
Aluminum	100,000	2004 PRG Industrial	0	0
Antimony	380	2005 ESL Industrial (direct exp)	0	0
Arsenic	11.1	HPAL	0	0
Barium	63,000	2005 ESL Industrial (direct exp)	0	0
Beryllium	36	2005 ESL Industrial (direct exp)	0	0
Cadmium	7.4	2005 ESL Industrial (direct exp)	0	0
Calcium	--		--	--
Chromium (total)	a	See note	0	0
Chromium VI	37	2005 ESL Industrial (direct exp)	0	0
Cobalt	a	See note	0	0
Copper	38,000	2005 ESL Industrial (direct exp)	0	0
Cyanide (free)	12,000	2004 PRG Industrial	0	0
Iron	100,000	2004 PRG Industrial	0	0
Lead	800	2004 PRG Industrial	1	0
Magnesium	--		--	--
Manganese	19,000	2004 PRG Industrial	0	0
Mercury	180	2005 ESL Industrial (direct exp)	0	0
Molybdenum	4,800	2005 ESL Industrial (direct exp)	0	0
Nickel	a	See note	0	0
Potassium	--		--	--
Selenium	4,800	2005 ESL Industrial (direct exp)	0	0
Silver	4,800	2005 ESL Industrial (direct exp)	0	0
Sodium	--		--	--
Thallium	63	2005 ESL Industrial (direct exp)	0	0
Tin	100,000	2004 PRG Industrial	0	0
Vanadium	1,000	2004 PRG Industrial	0	0
Zinc	100,000	2004 PRG Industrial	0	0
Pesticides				
2,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
2,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
2,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
4,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
Aldrin	0.1	2004 PRG Industrial	0	0
alpha-BHC	0.36	2004 PRG Industrial	0	0
Alpha-chlordane	2.9	SDGI Industrial Criteria	0	0
beta-BHC	1.3	2004 PRG Industrial	0	0
Chlordane	1.7	2005 ESL Industrial (direct exp)	0	0
cis-Nonachlor	--		--	--
delta-BHC	0.59	SDGI Industrial Criteria	0	0
Dieldrin	0.11	2004 PRG Industrial	0	0
Endosulfan I	3,700	2004 PRG Industrial	0	0
Endosulfan II	3,700	2004 PRG Industrial	0	0
Endosulfan sulfate	5,300	SDGI Industrial Criteria	0	0
Endrin	180	2004 PRG Industrial	0	0
Endrin aldehyde	260	SDGI Industrial Criteria	0	0
Endrin ketone	260	SDGI Industrial Criteria	0	0
Gamma-BHC (lindane)	1.7	2004 PRG Industrial	0	0
Gamma-chlordane	2.9	SDGI Industrial Criteria	0	0
Heptachlor	0.38	2004 PRG Industrial	0	0
Heptachlor epoxide	0.19	2004 PRG Industrial	1	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Methoxychlor	3,100	2004 PRG Industrial	0	0
Mirex	--		--	--
Oxychlordane	--		--	--
Toxaphene	1.6	2004 PRG Industrial	0	0
trans-Nonachlor	21	2004 PRG Industrial	0	0

Table 4-4. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Polychlorinated Biphenyls				
Aroclor-1016 (low risk PCB)	21	2004 PRG Industrial	0	0
Aroclor-1221 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1232 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1242 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1248 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1254 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1260 (high risk PCB)	0.74	2004 PRG Industrial	2	1
Total (high risk) PCBs	0.74	2004 PRG Industrial	2	0
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	0	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2'-Oxybis(1-chloropropane)	7.4	2004 PRG Industrial	0	0
2,4,5-Trichlorophenol	61	2005 ESL Industrial (inhalation)	0	0
2,4,6-Trichlorophenol	25	2005 ESL Industrial (direct exp)	0	0
2,4-Dichlorophenol	1,800	2004 PRG Industrial	0	0
2,4-Dimethylphenol	1,500	2005 ESL Industrial (inhalation)	0	0
2,4-Dinitrophenol	1,200	2004 PRG Industrial	0	0
2,4-Dinitrotoluene	5.6	2005 ESL Industrial (direct exp)	0	0
2,6-Dinitrotoluene	620	2004 PRG Industrial	0	0
2-Chloronaphthalene	23,000	2004 PRG Industrial	0	0
2-Chlorophenol	10	2005 ESL Industrial (inhalation)	0	0
2-Methylnaphthalene	550	2005 ESL Industrial (inhalation)	0	0
2-Methylphenol	31,000	2004 PRG Industrial	0	0
2-Nitroaniline	1,800	2004 PRG Industrial	0	0
2-Nitrophenol	--		--	--
3,3'-Dichlorobenzidine	1.4	2005 ESL Industrial (direct exp)	0	0
3-Nitroaniline	82	2004 PRG Industrial	0	0
4,6-Dinitro-2-methylphenol	--		--	--
4-Bromophenyl-phenylether	--		--	--
4-Chloro-3-methylphenol	--		--	--
4-Chloroaniline	2,500	2004 PRG Industrial	0	0
4-Chlorophenyl-phenylether	--		--	--
4-Methylphenol	3,100	2004 PRG Industrial	0	0
4-Nitroaniline	82	2004 PRG Industrial	0	0
4-Nitrophenol	7,000	SDGI Industrial Criteria	0	0
Acenaphthene	650	2005 ESL Industrial (inhalation)	0	0
Acenaphthylene	18,000	2005 ESL Industrial (direct exp)	0	0
Aniline	300	2004 PRG Industrial	0	0
Anthracene	31	2005 ESL Industrial (inhalation)	0	0
Azobenzene	16	2004 PRG Industrial	0	0
Benzidine	--		--	--
Benzo(a)anthracene	1.3	2005 ESL Industrial (direct exp)	2	0
Benzo(a)pyrene	0.33	SDGI Industrial Criteria	9	0
Benzo(b)fluoranthene	1.3	2005 ESL Industrial (direct exp)	2	0
Benzo(e)pyrene	--		--	--
Benzo(g,h,i)perylene	22,000	2005 ESL Industrial (direct exp)	0	0
Benzo(k)fluoranthene	1.3	2005 ESL Industrial (direct exp)	0	0
Benzoic acid	100,000	2004 PRG Industrial	0	0
Benzyl alcohol	100,000	2004 PRG Industrial	0	0
Biphenyl	18,000	2005 ESL Industrial (direct exp)	0	0
Bis(2-chloroethoxy)methane	--		--	--
Bis(2-chloroethyl)ether	0.012	2005 ESL Industrial (inhalation)	0	0
Bis(2-ethylhexyl)phthalate	120	2004 PRG Industrial	0	0
Butylbenzylphthalate	100,000	2004 PRG Industrial	0	0
Carbazole	86	2004 PRG Industrial	0	0
Chrysene	13	2005 ESL Industrial (direct exp)	0	0
Dibenz(a,h)anthracene	0.33	SDGI Industrial Criteria	0	0

Table 4-4. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (0-2 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Semivolatile Organic Compounds *(continued)*				
Dibenzofuran	1,600	2004 PRG Industrial	0	0
Diethylphthalate	100,000	2004 PRG Industrial	0	0
Dimethylphthalate	100,000	2004 PRG Industrial	0	0
Di-n-butylphthalate	62,000	2004 PRG Industrial	0	0
Di-n-octylphthalate	25,000	2004 PRG Industrial	0	0
Fluoranthene	22,000	2004 PRG Industrial	0	0
Fluorene	800	2005 ESL Industrial (inhalation)	0	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Hexachlorocyclopentadiene	3,700	2004 PRG Industrial	0	0
Hexachloroethane	44	2005 ESL Industrial (direct exp)	0	0
Indeno(1,2,3-cd)pyrene	1.3	2005 ESL Industrial (direct exp)	2	0
Isophorone	510	2004 PRG Industrial	0	0
Naphthalene	1.5	2005 ESL Industrial (inhalation)	1	0
Nitrobenzene	100	2004 PRG Industrial	0	0
n-Nitrosodimethylamine	0.034	2004 PRG Industrial	0	0
n-Nitroso-di-n-propylamine	0.25	2004 PRG Industrial	0	0
n-Nitrosodiphenylamine	350	2004 PRG Industrial	0	0
Pentachlorophenol	9	2004 PRG Industrial	0	0
Phenacetin	--		--	--
Phenanthrene	18,000	2005 ESL Industrial (direct exp)	0	0
Phenol	100,000	2004 PRG Industrial	0	0
Pyrene	425	2005 ESL Industrial (inhalation)	0	0
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	6.9	2005 ESL Industrial (direct exp)	0	0
1,1,1-Trichloroethane	230	2005 ESL Industrial (inhalation)	0	0
1,1,2,2-Tetrachloroethane	0.025	2005 ESL Industrial (inhalation)	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	--		--	--
1,1,2-Trichloroethane	0.089	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethane	0.89	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethene	105	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloropropene	--		--	--
1,2,3-Trichlorobenzene	--		--	--
1,2,3-Trichloropropane	--		--	--
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dibromo-3-chloropropane	0.067	2005 ESL Industrial (direct exp)	0	0
1,2-Dibromoethane	0.02	2005 ESL Industrial (inhalation)	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethane	0.07	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethene (Total)	150	SDGI Industrial Criteria	0	0
1,2-Dichloropropane	0.14	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,3-Dichloropropane	--		--	--
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2-Dichloropropane	-		0	0
2-Butanone	6,500	2005 ESL Industrial (inhalation)	0	0
2-Chloroethyl vinyl ether	--		--	--
2-Chlorotoluene	--		--	--
2-Hexanone	--		--	--
4-Chlorotoluene	--		--	--
4-Methyl-2-pentanone	1,550	2005 ESL Industrial (inhalation)	0	0
Acetone	16,500	2005 ESL Industrial (inhalation)	0	0
Benzene	0.38	2005 ESL Industrial (direct exp)	0	0
Bromobenzene	--		--	--
Bromochloromethane	--		--	--
Bromodichloromethane	0.039	2005 ESL Industrial (inhalation)	0	0
Bromoform	220	2004 PRG Industrial	0	0
Bromomethane	2.6	2005 ESL Industrial (inhalation)	0	0
Carbon disulfide	720	2004 PRG Industrial	0	0
Carbon tetrachloride	0.034	2005 ESL Industrial (inhalation)	0	0

Table 4-4. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (0-2 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Volatile Organic Compounds *(continued)*				0
Chlorobenzene	31	2005 ESL Industrial (inhalation)	0	0
Chloroethane	1.8	2005 ESL Industrial (inhalation)	0	0
Chloroform	0.47	2004 PRG Industrial	0	0
Chloromethane	0.2	2005 ESL Industrial (inhalation)	0	0
cis-1,2-Dichloroethene	18	2005 ESL Industrial (inhalation)	0	0
cis-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Dibromochloromethane	0.054	2005 ESL Industrial (inhalation)	0	0
Dibromomethane	--		--	--
Dichlorodifluoromethane	310	2004 PRG Industrial	0	0
Ethylbenzene	5	2008 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Isopropylbenzene	2,000	2004 PRG Industrial	0	0
Methylcyclohexane	2,600	2004 PRG Industrial	0	0
Methylene chloride	1.5	2005 ESL Industrial (inhalation)	0	0
n-Butylbenzene	240	2004 PRG Industrial	0	0
o-Xylene	210	SDGI Industrial Criteria	0	0
para-Isopropyl toluene	--		--	--
Propylbenzene	240	2004 PRG Industrial	0	0
sec-Butylbenzene	220	2004 PRG Industrial	0	0
Styrene	1,100	2005 ESL Industrial (inhalation)	0	0
tert-Butyl methyl ether	5.6	2005 ESL Industrial (inhalation)	0	0
tert-Butylbenzene	390	2004 PRG Industrial	0	0
Tetrachloroethene	0.24	2005 ESL Industrial (inhalation)	0	0
Toluene	520	2004 PRG Industrial	0	0
trans-1,2-Dichloroethene	37	2005 ESL Industrial (inhalation)	0	0
trans-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Trichloroethene	0.11	2004 PRG Industrial	0	0
Trichlorofluoromethane	2,000	2004 PRG Industrial	0	0
Vinyl acetate	1,400	2004 PRG Industrial	0	0
Vinyl chloride	0.019	2005 ESL Industrial (inhalation)	0	0
Xylene (Total)	420	2004 PRG Industrial	0	0
Petroleum Hydrocarbons				
Gasoline-range organics	750	2005 ESL Industrial (direct exp)	0	0
Diesel-range organics	750	2005 ESL Industrial (direct exp)	0	0
Motor oil-range organics	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-extractable unknown hydrocarbon	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-purgeable unknown hydrocarbon	750	2005 ESL Industrial (direct exp)	0	0
Total TPH	3,500	HPS TPH source criterion	0	0
Total oil and grease	3,500	HPS TPH source criterion	1	0

Notes:

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical

bgs below ground surface

BHC benzene hexachloride

Conc. concentration

DDD dichlorodiphenyldichloroethane

DDE dichlorodiphenyldichloroethene

DDT dichlorodiphenyltrichloroethane

HPAL Hunters Point ambient level

HPS Hunters Point Shipyard

mg/kg milligrams per kilogram

ESL environmental screening level

NE not established

PCB polychlorinated biphenyl

PRG preliminary remediation goal

RIEC remedial investigation evaluation criteria

SDGI standard data gaps investigation

TPH total petroleum hydrocarbons

Table 4-5. Summary of Analyses and Detections in the Landfill Area (2-10 feet bgs)

Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Metals					
Aluminum	87 / 87	0.18 - 12	1,617.1 - 28,700	NA	--
Antimony	78 / 113	0.01 - 8.6	0.069J - 1,930J	9.05	33
Arsenic	108 / 113	0.05 - 2.7	0.68J - 66.6J	11.1	5
Barium	113 / 113	0.02 - 4.3	9.4J - 1,400	314.4	11
Beryllium	100 / 113	0.01 - 0.29	0.03J - 12.1	0.71	12
Cadmium	80 / 113	0.01 - 0.91	0.06J - 330	3.14	15
Calcium	87 / 87	0.91 - 660	1,310J - 54,000	NA	--
Chromium	113 / 113	0.05 - 5.8	37.3 - 6,940J	(a)	16
Chromium VI	12 / 103	0.05 - 0.062	0.01J - 1.2	NA	--
Cobalt	113 / 113	0.01 - 2.6	2.3 - 170	(a)	1
Copper	113 / 113	0.01 - 5.8	5.8 - 175,000	124.3	54
Cyanide	22 / 73	0.11 - 1.2	0.09J - 11	NA	--
Iron	87 / 87	0.42 - 130	11,700 - 201,000	NA	--
Lead	112 / 113	0.01 - 99.2	4.1 - 3,840	8.99	106
Magnesium	87 / 87	0.12 - 29	2,400J - 220,000	NA	--
Manganese	87 / 87	0.01 - 0.57	170 - 2,080	1,431.20	4
Mercury	103 / 113	0.0056 - 2.2	0.01J - 38	2.28	25
Molybdenum	64 / 112	0.01 - 1.4	0.15 - 306J	2.68	23
Nickel	113 / 113	0.01 - 9.4	18J - 8,440	(a)	7
Potassium	85 / 87	0.54 - 288	157 - 3,030	NA	--
Selenium	46 / 113	0.02 - 4.45	0.06J - 3.4	1.95	1
Silver	62 / 113	0.01 - 0.62	0.04J - 245	1.43	11
Sodium	87 / 87	0.74 - 140	44 - 2,950	NA	--
Thallium	15 / 113	0.039 - 5.9	0.04J - 0.24J	0.81	0
Tin	17 / 21	2.9 - 4.5	3.4 - 31,600	NA	0
Vanadium	113 / 113	0.18 - 4.8	6J - 24,900	117.2	10
Zinc	113 / 113	0.11 - 23	20.95 - 15,800	109.9	64
Pesticides					
4,4'-DDD	12 / 112	0.0034 - 92	0.0064J - 0.76	NA	--
4,4'-DDE	23 / 112	0.0034 - 92	0.0007J - 0.72J	NA	--
4,4'-DDT	31 / 112	0.0034 - 92	0.0083J - 1.2J	NA	--
Aldrin	8 / 112	0.0018 - 46	0.0032J - 0.014J	NA	--
Alpha-BHC	2 / 112	0.0018 - 46	0.0039J - 0.056	NA	--
Alpha-chlordane	0 / 86	0.0019 - 460	--	NA	--
Beta-BHC	4 / 112	0.0018 - 46	0.0044J - 0.017J	NA	--
Chlordane	0 / 10	0.02 - 3.8	--	NA	--
Delta-BHC	2 / 112	0.0018 - 46	0.0029 - 0.0039J	NA	--
Dieldrin	19 / 112	0.0034 - 92	0.0022J - 0.71	NA	--
Endosulfan I	2 / 112	0.0018 - 46	0.017J - 0.078J	NA	--
Endosulfan II	12 / 112	0.0034 - 92	0.0052J - 2.3	NA	--
Endosulfan sulfate	15 / 112	0.0034 - 92	0.0076J - 6.2	NA	--
Endrin	17 / 112	0.0019 - 92	0.0028J - 0.25J	NA	--
Endrin aldehyde	6 / 58	0.0034 - 1.5	0.012J - 0.61	NA	--
Endrin ketone	3 / 108	0.0034 - 92	0.0043J - 0.053J	NA	--
Gamma-BHC (lindane)	11 / 112	0.0018 - 46	--	NA	--
Gamma-chlordane	0 / 40	0.002 - 2	0.00046J - 0.27J	NA	--
Heptachlor	6 / 112	0.0018 - 46	0.0014J - 0.0075J	NA	--
Heptachlor epoxide	19 / 112	0.0018 - 46	0.00089J - 1J	NA	--
Methoxychlor	7 / 112	0.0073 - 460	0.07J - 1.2J	NA	--
Mirex	0 / 26	0.0019 - 0.38	--	NA	--
Toxaphene	0 / 111	0.062 - 920	--	NA	--
trans-Chlordane	0 / 72	0.0019 - 460	--	NA	--
Polychlorinated Biphenyls					
Aroclor-1016 (low risk PCB)	4 / 122	0.003 - 460	0.22 - 740	NA	--
Aroclor-1221 (high risk PCB)	0 / 122	0.017 - 460	--	NA	--
Aroclor-1232 (high risk PCB)	0 / 122	0.01 - 460	--	NA	--
Aroclor-1242 (high risk PCB)	9 / 122	0.01 - 460	0.039J - 15	NA	--
Aroclor-1248 (high risk PCB)	5 / 122	0.01 - 460	0.075 - 1	NA	--
Aroclor-1254 (high risk PCB)	15 / 122	0.01 - 920	0.038 - 7.1J	NA	--
Aroclor-1260 (high risk PCB)	77 / 122	0.006 - 920	0.0032J - 380	NA	--
Total (high risk) PCBs	82 / 122	0.006 - 920	0.0032J - 380	NA	--

Table 4-5. Summary of Analyses and Detections in the Landfill Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds					
1-(Ethenyloxy)-octadecane	0 / 0	--	--	NA	--
1,2,4,5-Tetramethylbenzene	0 / 1	--	--	NA	--
1,2,4-Trichlorobenzene	3 / 62	0.018 - 52	0.049J - 4.8	NA	--
1,2-Dichlorobenzene	2 / 61	0.018 - 52	0.19J - 4J	NA	--
1,3-Dichlorobenzene	1 / 61	0.018 - 52	0.73J	NA	--
1,4-Dichlorobenzene	8 / 62	0.018 - 52	0.26J - 59	NA	--
1-Hexacosanol	0 / 0	--	--	NA	--
1-Octadecanol	1 / 1	0.32 - 0.32	0.32	NA	--
2,2'-Oxybis(1-chloropropane)	0 / 4	0.69 - 3	--	NA	--
2,4,5-Trichlorophenol	0 / 61	0.69 - 260	--	NA	--
2,4,6-Trichlorophenol	0 / 61	0.18 - 52	--	NA	--
2,4-Dichlorophenol	0 / 61	0.18 - 52	--	NA	--
2,4-Dimethylphenol	6 / 61	0.18 - 52	0.15J - 30J	NA	--
2,4-Dinitrophenol	0 / 61	0.87 - 260	--	NA	--
2,4-Dinitrotoluene	0 / 61	0.18 - 52	--	NA	--
2,6-Dinitrotoluene	0 / 61	0.18 - 52	--	NA	--
2-Chloronaphthalene	0 / 61	0.18 - 52	--	NA	--
2-Chlorophenol	0 / 61	0.18 - 52	--	NA	--
2-Methylnaphthalene	26 / 61	0.14 - 52	0.019J - 650	NA	--
2-Methylphenol	4 / 61	0.18 - 52	0.12J - 6.8J	NA	--
2-Nitroaniline	0 / 61	0.87 - 260	--	NA	--
2-Nitrophenol	0 / 61	0.18 - 52	--	NA	--
3,3'-Dichlorobenzidine	0 / 61	0.36 - 100	--	NA	--
3-Nitroaniline	0 / 61	0.87 - 260	--	NA	--
4,6-Dinitro-2-methylphenol	0 / 61	0.87 - 260	--	NA	--
4-Bromophenyl-phenylether	0 / 61	0.18 - 52	--	NA	--
4-Chloro-3-methylphenol	0 / 61	0.18 - 52	--	NA	--
4-Chloroaniline	0 / 61	0.18 - 52	--	NA	--
4-Chlorophenyl-phenylether	0 / 61	0.18 - 52	--	NA	--
4-Methylphenol	8 / 61	0.18 - 52	0.31J - 30	NA	--
4-Nitroaniline	0 / 61	0.87 - 260	--	NA	--
4-Nitrophenol	0 / 61	0.87 - 260	--	NA	--
Acenaphthene	16 / 87	0.068 - 52	0.032J - 530	NA	--
Acenaphthylene	9 / 113	0.068 - 52	0.027J - 14J	NA	--
Anthracene	23 / 113	0.068 - 52	0.016J - 210	NA	--
Azobenzene	0 / 4	0.69 - 3	--	NA	--
Benzo(a)anthracene	37 / 113	0.068 - 52	0.0075J - 80	NA	--
Benzo(a)pyrene	41 / 113	0.068 - 52	0.0088J - 16J	NA	--
Benzo(b)fluoranthene	47 / 113	0.068 - 52	0.013J - 43	NA	--
Benzo(e)pyrene	1 / 26	0.38 - 4.1	2.8J	NA	--
Benzo(g,h,i)perylene	31 / 113	0.068 - 52	0.025J - 5.6	NA	--
Benzo(k)fluoranthene	33 / 113	0.068 - 52	0.014J - 13J	NA	--
Benzoic acid	0 / 60	0.87 - 260	--	NA	--
Benzyl alcohol	0 / 60	0.18 - 52	--	NA	--
Biphenyl	0 / 26	0.34 - 3.7	--	NA	--
Bis(2-chloroethoxy)methane	0 / 61	0.18 - 52	--	NA	--
Bis(2-chloroethyl)ether	0 / 61	0.18 - 52	--	NA	--
Bis(2-chloroisopropyl)ether	0 / 57	0.18 - 52	--	NA	--
Bis(2-ethylhexyl)adipate	0 / 87	--	--	NA	--
Bis(2-ethylhexyl)phthalate	0 / 0	0.15 - 52	--	NA	--
Butylbenzylphthalate	0 / 61	0.18 - 52	--	NA	--
Carbazole	0 / 31	0.38 - 4.1	--	NA	--
Chrysene	51 / 113	0.068 - 52	0.0093J - 77	NA	--
Cyclic Octaatomic sulfur	2 / 2	--	0.16J - 0.23J	NA	--
Dibenz(a,h)anthracene	7 / 113	0.068 - 52	0.027J - 1.5J	NA	--
Dibenzofuran	7 / 113	0.18 - 52	0.039J - 390	NA	--
Diethylphthalate	0 / 87	0.18 - 52	--	NA	--
Dimethylphthalate	0 / 61	0.18 - 52	--	NA	--
Di-n-butylphthalate	0 / 61	0.18 - 52	--	NA	--
Di-n-octylphthalate	0 / 61	0.18 - 52	--	NA	--
Dioctadecyl phosphonic acid	0 / 0	--	--	NA	--
Docosane	1 / 1	--	21J	NA	--

Table 4-5. Summary of Analyses and Detections in the Landfill Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Eicosane	0 / 0	--	--	NA	--
Fluoranthene	48 / 113	0.068 - 52	0.012J - 570	NA	--
Fluorene	23 / 113	0.068 - 52	0.012J - 550	NA	--
Hexachlorobenzene	0 / 61	0.18 - 52	--	NA	--
Hexachlorobutadiene	0 / 61	0.18 - 52	--	NA	--
Hexachlorocyclopentadiene	0 / 61	0.18 - 52	--	NA	--
Hexachloroethane	0 / 61	0.18 - 52	--	NA	--
Hexadecanoic acid	1 / 1	0.16 - 0.16	0.16	NA	--
Hexatriacontane	0 / 0	--	--	NA	--
Indeno(1,2,3-cd)pyrene	27 / 113	0.068 - 52	0.022J - 5.6J	NA	--
Isophorone	0 / 61	0.18 - 52	--	NA	--
m-Terphenyl	1 / 1	--	5.1J	NA	--
Naphthalene	32 / 113	0.068 - 52	0.012J - 1400	NA	--
Nitrobenzene	0 / 61	0.18 - 52	--	NA	--
n-Nitrosodimethylamine	0 / 4	0.69 - 3	--	NA	--
n-Nitroso-di-n-propylamine	0 / 87	0.18 - 52	--	NA	--
n-Nitrosodiphenylamine	2 / 87	0.18 - 52	0.099J - 0.65J	NA	--
o-Terphenyl	2 / 2	--	1.6J - 1.9J	NA	--
Octadecanoic acid	0 / 0	--	--	NA	--
p-Terphenyl	2 / 2	--	5.5J - 12J	NA	--
Pentachlorophenol	1 / 87	0.87 - 260	7.7J	NA	--
Phenacetin	0 / 26	0.76 - 8.2	--	NA	--
Phenanthrene	50 / 113	0.068 - 52	0.0071J - 1200	NA	--
Phenol	8 / 87	0.18 - 52	0.074J - 9.1J	NA	--
Pyrene	52 / 113	0.068 - 52	0.021J - 340	NA	--
Terphenyl	1 / 1	--	14J	NA	--
Tricosane	1 / 1	0.082 - 0.082	0.082	NA	--
Tridecane	0 / 0	--	--	NA	--
Volatile Organic Compounds					
1,1,1,2-Tetrachloroethane	0 / 0	--	--	NA	--
1,1,2-Trichloroethane	0 / 56	0.005 - 7.5	--	NA	--
1,1,2,2-Tetrachloroethane	0 / 56	0.005 - 7.5	--	NA	--
1,1,2-Trichloro-1,2,2-trifluoroethane	0 / 1	0.037 - 0.037	--	NA	--
1,1,2-Trichloroethane	1 / 56	0.005 - 7.5	0.001J	NA	--
1,1-Dichloroethane	0 / 56	0.005 - 7.5	--	NA	--
1,1-Dichloroethene	0 / 56	0.005 - 7.5	--	NA	--
1,1-Dichloropropene	0 / 0	--	--	NA	--
1,2,3-Trichlorobenzene	0 / 1	0.018 - 0.018	--	NA	--
1,2,3-Trichloropropane	0 / 0	--	--	NA	--
1,2,4-Trimethylbenzene	0 / 1	--	--	NA	--
1,2-Dibromo-3-chloropropane	0 / 1	0.037 - 0.037	--	NA	--
1,2-Dibromoethane	0 / 1	0.018 - 0.018	--	NA	--
1,2-Dichloroethane	0 / 56	0.005 - 7.5	--	NA	--
1,2-Dichloroethene (Total)	0 / 56	0.005 - 7.5	--	NA	--
1,2-Dichloropropane	0 / 56	0.005 - 7.5	--	NA	--
1,3,5-Trimethylbenzene	0 / 0	--	--	NA	--
1,3-Dichloropropane	0 / 0	--	--	NA	--
2,2-Dichloropropane	0 / 0	--	--	NA	--
2-Butanone	1 / 56	0.011 - 15	0.047	NA	--
2-Chlorotoluene	0 / 0	--	--	NA	--
2-Hexanone	0 / 56	0.011 - 15	--	NA	--
4-Chlorotoluene	0 / 0	--	--	NA	--
4-Isopropyltoluene	0 / 0	--	--	NA	--
4-Methyl-2-pentanone	1 / 56	0.011 - 15	10J	NA	--
Acetone	1 / 56	0.005 - 15	0.135	NA	--
Benzene	6 / 56	0.005 - 7.5	0.001J - 0.02J	NA	--
Bromobenzene	0 / 0	--	--	NA	--
Bromochloromethane	0 / 1	0.018 - 0.018	--	NA	--
Bromodichloromethane	0 / 56	0.005 - 7.5	--	NA	--
Bromoform	0 / 56	0.005 - 7.5	--	NA	--
Bromomethane	0 / 56	0.011 - 15	--	NA	--
Carbon disulfide	6 / 56	0.005 - 7.5	0.002J - 0.017	NA	--

Table 4-5. Summary of Analyses and Detections in the Landfill Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Volatile Organic Compounds *(continued)*					
Carbon tetrachloride	0 / 56	0.005 - 7.5	--	NA	--
Chlorobenzene	8 / 56	0.005 - 7.5	0.002J - 1.7J	NA	--
Chloroethane	0 / 56	0.011 - 15	--	NA	--
Chloroform	0 / 56	0.005 - 7.5	--	NA	--
Chloromethane	0 / 56	0.011 - 15	--	NA	--
cis-1,2-Dichloroethene	0 / 1	0.018 - 0.018	--	NA	--
cis-1,3-Dichloropropene	0 / 56	0.005 - 7.5	--	NA	--
Dibromochloromethane	0 / 56	0.005 - 7.5	--	NA	--
Dibromomethane	0 / 0	--	--	NA	--
Dichlorodifluoromethane	0 / 1	0.018 - 0.018	--	NA	--
Ethylbenzene	18 / 56	0.005 - 7.5	0.001J - 40J	NA	--
Isopropylbenzene	0 / 1	0.018 - 0.018	--	NA	--
Methylene chloride	0 / 56	0.005 - 7.5	--	NA	--
n-Butylbenzene	0 / 0	--	--	NA	--
o-Xylene	0 / 0	--	--	NA	--
Propylbenzene	0 / 0	--	--	NA	--
sec-Butylbenzene	0 / 0	--	--	NA	--
Styrene	1 / 56	0.005 - 7.5	0.00486J	NA	--
tert-Butylbenzene	0 / 0	--	--	NA	--
tert-Butyl methyl ether	0 / 1	0.037 - 0.037	--	NA	--
Tetrachloroethene	0 / 56	0.005 - 7.5	--	NA	--
Toluene	16 / 56	0.005 - 7.5	0.001J - 10	NA	--
trans-1,2-Dichloroethene	0 / 1	0.018 - 0.018	--	NA	--
trans-1,3-Dichloropropene	0 / 56	0.005 - 7.5	--	NA	--
Trichloroethene	0 / 56	0.005 - 7.5	--	NA	--
Trichlorofluoromethane	0 / 1	0.018 - 0.018	--	NA	--
Vinyl acetate	0 / 54	0.011 - 15	--	NA	--
Vinyl chloride	0 / 56	0.011 - 15	--	NA	--
Xylene (Total)	24 / 56	0.005 - 7.5	0.001J - 320	NA	--
Petroleum Hydrocarbons					
Gasoline-range organics	31 / 92	0.17 - 650	0.03J - 380J	NA	--
Diesel-range organics	66 / 107	1 - 1800	5.3 - 11,000	NA	--
Motor oil-range organics	51 / 52	5.1 - 560	11J - 12,000	NA	--
TPH-extractable unknown hydrocarbon	18 / 23	11 - 790	21 - 2,800	NA	--
TPH-purgeable unknown hydrocarbon	13 / 23	0.2 - 59	0.4 - 3,000	NA	--
Total TPH	92 / 107	0.19 - 1,800	6.8 - 22,080	NA	--
Total oil and grease	49 / 54	27 - 84	99J - 300,000	NA	--

Notes:

(1) rejected data are not included in detection frequency

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical

bgs below ground surface
BHC benzene hexachloride
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethene
DDT dichlorodiphenyltrichloroethane
HPAL Hunters Point ambient level
J estimated value
mg/kg milligrams per kilogram
NA not available
PCB polychlorinated biphenyl
TPH total petroleum hydrocarbons

Table 4-6. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (2-10 feet bgs)

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Metals				
Aluminum	100,000	2004 PRG Industrial	0	0
Antimony	380	2005 ESL Industrial (direct exp)	4	0
Arsenic	11.1	HPAL	5	0
Barium	63,000	2005 ESL Industrial (direct exp)	0	0
Beryllium	36	2005 ESL Industrial (direct exp)	0	0
Cadmium	7.4	2005 ESL Industrial (direct exp)	8	0
Calcium	--		--	--
Chromium (total)	a	See note	8	0
Chromium VI	37	2005 ESL Industrial (direct exp)	0	0
Cobalt	a	See note	0	0
Copper	38,000	2005 ESL Industrial (direct exp)	3	0
Cyanide (free)	12,000	2004 PRG Industrial	0	0
Iron	100,000	2004 PRG Industrial	4	0
Lead	800	2004 PRG Industrial	16	0
Magnesium	--		--	--
Manganese	19,000	2004 PRG Industrial	0	0
Mercury	180	2005 ESL Industrial (direct exp)	0	0
Molybdenum	4,800	2005 ESL Industrial (direct exp)	0	0
Nickel	a	See note	0	0
Potassium	--		--	--
Selenium	4,800	2005 ESL Industrial (direct exp)	0	0
Silver	4,800	2005 ESL Industrial (direct exp)	0	0
Sodium	-		0	0
Thallium	63	2005 ESL Industrial (direct exp)	0	0
Tin	100,000	2004 PRG Industrial	0	0
Vanadium	1,000	2004 PRG Industrial	1	0
Zinc	100,000	2004 PRG Industrial	0	0
Pesticides				
2,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
2,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
2,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
4,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
Aldrin	0.1	2004 PRG Industrial	0	0
alpha-BHC	0.36	2004 PRG Industrial	0	0
Alpha-chlordane	2.9	SDGI Industrial Criteria	0	0
beta-BHC	1.3	2004 PRG Industrial	0	0
Chlordane	1.7	2005 ESL Industrial (direct exp)	0	0
cis-Nonachlor	--		--	--
delta-BHC	0.59	SDGI Industrial Criteria	0	0
Dieldrin	0.11	2004 PRG Industrial	7	0
Endosulfan I	3,700	2004 PRG Industrial	0	0
Endosulfan II	3,700	2004 PRG Industrial	0	0
Endosulfan sulfate	5300	SDGI Industrial Criteria	0	0
Endrin	180	2004 PRG Industrial	0	0
Endrin aldehyde	260	SDGI Industrial Criteria	0	0
Endrin ketone	260	SDGI Industrial Criteria	0	0
Gamma-BHC (lindane)	1.7	2004 PRG Industrial	0	0
Gamma-chlordane	2.9	SDGI Industrial Criteria	0	0
Heptachlor	0.38	2004 PRG Industrial	0	0
Heptachlor epoxide	0.19	2004 PRG Industrial	5	0
Heptachlor epoxide A	--		--	--
Heptachlor epoxide B	--		--	--
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Methoxychlor	3,100	2004 PRG Industrial	0	0
Mirex	--		--	--
Oxychlordane	--		--	--
Toxaphene	1.6	2004 PRG Industrial	0	0
trans-Nonachlor	21	2004 PRG Industrial	0	0

Table 4-6. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Polychlorinated Biphenyls				
Aroclor-1016 (low risk PCB)	21	2004 PRG Industrial	2	0
Aroclor-1221 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1232 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1242 (high risk PCB)	0.74	2004 PRG Industrial	7	0
Aroclor-1248 (high risk PCB)	0.74	2004 PRG Industrial	1	0
Aroclor-1254 (high risk PCB)	0.74	2004 PRG Industrial	9	0
Aroclor-1260 (high risk PCB)	0.74	2004 PRG Industrial	40	4
Total (high risk) PCBs	0.74	2004 PRG Industrial	45	0
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	0	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	8	1
2,2'-Oxybis(1-chloropropane)	7.4	2004 PRG Industrial	0	0
2,4,5-Trichlorophenol	61	2005 ESL Industrial (inhalation)	0	0
2,4,6-Trichlorophenol	25	2005 ESL Industrial (direct exp)	0	0
2,4-Dichlorophenol	1,800	2004 PRG Industrial	0	0
2,4-Dimethylphenol	1,500	2005 ESL Industrial (inhalation)	0	0
2,4-Dinitrophenol	1,200	2004 PRG Industrial	0	0
2,4-Dinitrotoluene	5.6	2005 ESL Industrial (direct exp)	0	0
2,6-Dinitrotoluene	620	2004 PRG Industrial	0	0
2-Chloronaphthalene	23,000	2004 PRG Industrial	0	0
2-Chlorophenol	10	2005 ESL Industrial (inhalation)	0	0
2-Methylnaphthalene	550	2005 ESL Industrial (inhalation)	1	0
2-Methylphenol	31,000	2004 PRG Industrial	0	0
2-Nitroaniline	1,800	2004 PRG Industrial	0	0
2-Nitrophenol	--		--	--
3,3'-Dichlorobenzidine	1.4	2005 ESL Industrial (direct exp)	0	0
3-Nitroaniline	82	2004 PRG Industrial	0	0
4,6-Dinitro-2-methylphenol	--		--	--
4-Bromophenyl-phenylether	--		--	--
4-Chloro-3-methylphenol	--		--	--
4-Chloroaniline	2,500	2004 PRG Industrial	0	0
4-Chlorophenyl-phenylether	--		--	--
4-Methylphenol	3,100	2004 PRG Industrial	0	0
4-Nitroaniline	82	2004 PRG Industrial	0	0
4-Nitrophenol	7,000	SDGI Industrial Criteria	0	0
Acenaphthene	650	2005 ESL Industrial (inhalation)	0	0
Acenaphthylene	18,000	2005 ESL Industrial (direct exp)	0	0
Aniline	300	2004 PRG Industrial	0	0
Anthracene	31	2005 ESL Industrial (inhalation)	1	0
Azobenzene	16	2004 PRG Industrial	0	0
Benzidine	--		--	--
Benzo(a)anthracene	1.3	2005 ESL Industrial (direct exp)	5	0
Benzo(a)pyrene	0.33	SDGI Industrial Criteria	10	0
Benzo(b)fluoranthene	1.3	2005 ESL Industrial (direct exp)	7	0
Benzo(e)pyrene	--		--	--
Benzo(g,h,i)perylene	22,000	2005 ESL Industrial (direct exp)	0	0
Benzo(k)fluoranthene	1.3	2005 ESL Industrial (direct exp)	6	0
Benzoic acid	100,000	2004 PRG Industrial	0	0
Benzyl alcohol	100,000	2004 PRG Industrial	0	0
Biphenyl	18,000	2005 ESL Industrial (direct exp)	0	0
Bis(2-chloroethoxy)methane	--		--	--
Bis(2-chloroethyl)ether	0.012	2005 ESL Industrial (inhalation)	0	0
Bis(2-ethylhexyl)phthalate	120	2004 PRG Industrial	0	0
Butylbenzylphthalate	100,000	2004 PRG Industrial	0	0
Carbazole	86	2004 PRG Industrial	0	0

Table 4-6. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Semivolatile Organic Compounds *(continued)*				
Chrysene	13	2005 ESL Industrial (direct exp)	2	0
Dibenz(a,h)anthracene	0.33	SDGI Industrial Criteria	2	0
Dibenzofuran	1,600	2004 PRG Industrial	0	0
Diethylphthalate	100,000	2004 PRG Industrial	0	0
Dimethylphthalate	100,000	2004 PRG Industrial	0	0
Di-n-butylphthalate	62,000	2004 PRG Industrial	0	0
Di-n-octylphthalate	25,000	2004 PRG Industrial	0	0
Fluoranthene	22,000	2004 PRG Industrial	0	0
Fluorene	800	2005 ESL Industrial (inhalation)	0	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Hexachlorocyclopentadiene	3,700	2004 PRG Industrial	0	0
Hexachloroethane	44	2005 ESL Industrial (direct exp)	0	0
Indeno(1,2,3-cd)pyrene	1.3	2005 ESL Industrial (direct exp)	4	0
Isophorone	510	2004 PRG Industrial	0	0
Naphthalene	1.5	2005 ESL Industrial (inhalation)	11	1
Nitrobenzene	100	2004 PRG Industrial	0	0
n-Nitrosodimethylamine	0.034	2004 PRG Industrial	0	0
n-Nitroso-di-n-propylamine	0.25	2004 PRG Industrial	0	0
n-Nitrosodiphenylamine	350	2004 PRG Industrial	0	0
Pentachlorophenol	9	2004 PRG Industrial	0	0
Phenacetin	--		--	--
Phenanthrene	18,000	2005 ESL Industrial (direct exp)	0	0
Phenol	100,000	2004 PRG Industrial	0	0
Pyrene	425	2005 ESL Industrial (inhalation)	0	0
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	6.9	2005 ESL Industrial (direct exp)	0	0
1,1,1-Trichloroethane	230	2005 ESL Industrial (inhalation)	0	0
1,1,2,2-Tetrachloroethane	0.025	2005 ESL Industrial (inhalation)	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	--		--	--
1,1,2-Trichloroethane	0.089	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethane	0.89	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethene	105	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloropropene	--		--	--
1,2,3-Trichlorobenzene	--		--	--
1,2,3-Trichloropropane	--		--	--
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dibromo-3-chloropropane	0.067	2005 ESL Industrial (direct exp)	0	0
1,2-Dibromoethane	0.02	2005 ESL Industrial (inhalation)	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethane	0.07	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethene (Total)	150	SDGI Industrial Criteria	0	0
1,2-Dichloropropane	0.14	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,3-Dichloropropane	--		--	--
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2-Dichloropropane	--		--	--
2-Butanone	6,500	2005 ESL Industrial (inhalation)	0	0
2-Chloroethyl vinyl ether	-		-	-
2-Chlorotoluene	-		-	-
2-Hexanone	-		-	-
4-Chlorotoluene	-		-	-
4-Methyl-2-pentanone	1,550	2005 ESL Industrial (inhalation)	0	0
Acetone	16,500	2005 ESL Industrial (inhalation)	0	0
Benzene	0.38	2005 ESL Industrial (direct exp)	0	0
Bromobenzene	--		--	--
Bromochloromethane	--		--	--
Bromodichloromethane	0.039	2005 ESL Industrial (inhalation)	0	0

Table 4-6. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Volatile Organic Compounds *(continued)*				
Bromoform	220	2004 PRG Industrial	0	0
Bromomethane	2.6	2005 ESL Industrial (inhalation)	0	0
Carbon disulfide	720	2004 PRG Industrial	0	0
Carbon tetrachloride	0.034	2005 ESL Industrial (inhalation)	0	0
Chlorobenzene	31	2005 ESL Industrial (inhalation)	0	0
Chloroethane	1.8	2005 ESL Industrial (inhalation)	0	0
Chloroform	0.47	2004 PRG Industrial	0	0
Chloromethane	0.2	2005 ESL Industrial (inhalation)	0	0
cis-1,2-Dichloroethene	18	2005 ESL Industrial (inhalation)	0	0
cis-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Dibromochloromethane	0.054	2005 ESL Industrial (inhalation)	0	0
Dibromomethane	--		--	--
Dichlorodifluoromethane	310	2004 PRG Industrial	0	0
Ethylbenzene	5	2008 ESL Industrial (direct exp)	4	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Isopropylbenzene	2,000	2004 PRG Industrial	0	0
Methylcyclohexane	2,600	2004 PRG Industrial	0	0
Methylene chloride	1.5	2005 ESL Industrial (inhalation)	0	0
n-Butylbenzene	240	2004 PRG Industrial	0	0
o-Xylene	210	SDGI Industrial Criteria	0	0
para-Isopropyl toluene	--		--	--
Propylbenzene	240	2004 PRG Industrial	0	0
sec-Butylbenzene	220	2004 PRG Industrial	0	0
Styrene	1,100	2005 ESL Industrial (inhalation)	0	0
tert-Butyl methyl ether	5.6	2005 ESL Industrial (inhalation)	0	0
tert-Butylbenzene	390	2004 PRG Industrial	0	0
Tetrachloroethene	0.24	2005 ESL Industrial (inhalation)	0	0
Toluene	520	2004 PRG Industrial	0	0
trans-1,2-Dichloroethene	37	2005 ESL Industrial (inhalation)	0	0
trans-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Trichloroethene	0.11	2004 PRG Industrial	0	0
Trichlorofluoromethane	2,000	2004 PRG Industrial	0	0
Vinyl acetate	1,400	2004 PRG Industrial	0	0
Vinyl chloride	0.019	2005 ESL Industrial (inhalation)	0	0
Xylene (Total)	420	2004 PRG Industrial	0	0
Petroleum Hydrocarbons				
Gasoline-range organics	750	2005 ESL Industrial (direct exp)	0	0
Diesel-range organics	750	2005 ESL Industrial (direct exp)	16	0
Motor oil-range organics	4,600	2005 ESL Industrial (direct exp)	3	0
TPH-extractable unknown hydrocarbon	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-purgeable unknown hydrocarbon	750	2005 ESL Industrial (direct exp)	0	0
Total TPH	3,500	HPS TPH source criterion	13	0
Total oil and grease	3,500	HPS TPH source criterion	13	0

Notes:

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical

bgs	below ground surface	HPS	Hunters Point Shipyard
BHC	benzene hexachloride	mg/kg	milligrams per kilogram
Conc.	concentration	NE	not established
DDD	dichlorodiphenyldichloroethane	PCB	polychlorinated biphenyl
DDE	dichlorodiphenyldichloroethene	PRG	preliminary remediation goal
DDT	dichlorodiphenyltrichloroethane	RIEC	remedial investigation evaluation criteria
ESL	environmental screening level	SDGI	standard data gaps investigation
HPAL	Hunters Point ambient level	TPH	total petroleum hydrocarbon

Table 4-7. Summary of Analyses and Detections in the Landfill Area (greater than 10 feet bgs)
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency [1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Metals					
Aluminum	96/96	0.18 - 7.5	921.32 - 41,000	NA	--
Antimony	49/97	0.01 - 9.4	0.05J - 278J	9.05	22
Arsenic	86/97	0.05 - 2.1	0.64J - 49J	11.1	21
Barium	97/97	0.04 - 1.83	6.2 - 588.08	314.4	7
Beryllium	71/97	0.01 - 0.32	0.03J - 1.77	0.71	14
Cadmium	51/97	0.01 - 1.2	0.067J - 112.79	3.14	17
Calcium	96/96	0.89 - 1,900	1,018.03 - 200,000J	NA	--
Chromium	96/97	0.05 - 1.4	22.96 - 3,589.21	a	23
Chromium VI	8/108	0.05 - 0.48	0.01J - 0.15	NA	--
Cobalt	97/97	0.01 - 2.8	1.8 - 106	a	3
Copper	97/97	0.01 - 0.75	4.4 - 13,371	124.3	35
Cyanide	30/83	0.1 - 1.9	0.07J - 1.6	NA	--
Iron	96/96	0.47 - 48	6,810 - 163,000	NA	--
Lead	96/97	0.01 - 45.2	1.5 - 15,700	8.99	74
Magnesium	96/96	0.12 - 38	2,410 - 209,000	NA	--
Manganese	96/96	0.01 - 0.75	69.87 - 2,120.88	1,431.20	3
Mercury	61/97	0.0057 - 1.6	0.02J - 22.4	2.28	18
Molybdenum	49/95	0.01 - 1.88	0.17 - 641	2.68	22
Nickel	97/97	0.01 - 10.3	13J - 1,524.62	a	0
Potassium	91/96	0.53 - 315	197 - 6,150	NA	--
Selenium	22/97	0.02 - 6.71	0.19J - 1.8J	1.95	0
Silver	50/97	0.01 - 1.1	0.05J - 13.71	1.43	14
Sodium	96/96	0.72 - 38	40.5 - 10,300J	NA	--
Thallium	10/97	0.038 - 2.92	0.04J - 0.29	0.81	0
Tin	10/17	3 - 5	5.2 - 591	NA	--
Vanadium	96/97	0.3 - 1.74	5.9 - 220.52	117.2	2
Zinc	97/97	0.11 - 3.5	10.9J - 14,800	109.9	40
Pesticides					
4,4'-DDD	1/93	0.0037 - 43	0.16586	NA	--
4,4'-DDE	1/93	0.0037 - 43	0.15059	NA	--
4,4'-DDT	1/93	0.0037 - 43	0.43J	NA	--
Aldrin	0/93	0.0018 - 21.55	--	NA	--
Alpha-BHC	0/93	0.0018 - 21.55	--	NA	--
Alpha-chlordane	0/92	0.0018 - 220	--	NA	--
beta-BHC	0/93	0.0018 - 21.55	--	NA	--
Chlordane	0/3	0.019 - 0.36	--	NA	--
delta-BHC	0/93	0.0018 - 21.55	--	NA	--
Dieldrin	0/93	0.0037 - 43	--	NA	--
Endosulfan I	0/93	0.0018 - 21.55	--	NA	--
Endosulfan II	0/93	0.0037 - 43	--	NA	--
Endosulfan sulfate	1/93	0.0037 - 43	0.15	NA	--
Endrin	0/93	0.0037 - 43	--	NA	--
Endrin aldehyde	0/25	0.0037 - 0.99	--	NA	--
Endrin ketone	0/91	0.0037 - 43	--	NA	--
Gamma-BHC (lindane)	0/93	0.0018 - 21.55	--	NA	--
Gamma-chlordane	0/6	0.002 - 0.31	--	NA	--
Heptachlor	0/93	0.0018 - 21.55	--	NA	--
Heptachlor epoxide	1/93	0.0018 - 21.55	0.035	NA	--
Methoxychlor	0/93	0.018 - 220	--	NA	--
Mirex	0/20	0.0019 - 0.1	--	NA	--
Toxaphene	0/93	0.076 - 430	--	NA	--
trans-Chlordane	0/87	0.0018 - 220	--	NA	--
Polychlorinated Biphenyls					
Aroclor-1016 (low risk PCB)	2/103	0.01 - 220	0.21 - 250	NA	--
Aroclor-1221 (high risk PCB)	0/103	0.017 - 220	--	NA	--
Aroclor-1232 (high risk PCB)	0/103	0.01 - 220	--	NA	--
Aroclor-1242 (high risk PCB)	14/103	0.01 - 220	0.036J - 32,000	NA	--
Aroclor-1248 (high risk PCB)	7/103	0.01 - 220	0.089J - 6	NA	--
Aroclor-1254 (high risk PCB)	9/103	0.01 - 430	0.034J - 6.4	NA	--
Aroclor-1260 (high risk PCB)	48/103	0.006 - 430	0.0052J - 25.977	NA	--
Total (high risk) PCBs	55/103	0.006 - 430	0.0052 - 32,000	NA	--

Table 4-7. Summary of Analyses and Detections in the Landfill Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency [1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds					
1-(Ethenyloxy)-octadecane	0/0	--	--	NA	--
1,2,4,5-Tetramethylbenzene	1/1	--	0.28J	NA	--
1,2,4-Trichlorobenzene	1/81	0.0051 - 21	0.0093J	NA	--
1,2-Dichlorobenzene	5/81	0.0051 - 21	0.002J - 1.8J	NA	--
1,3-Dichlorobenzene	3/81	0.0051 - 21	0.003J - 0.03	NA	--
1,4-Dichlorobenzene	13/81	0.0051 - 21	0.0048J - 6.46	NA	--
1-Hexacosanol	1/1	0.13 - 0.13	0.13	NA	--
1-Octadecanol	0/0	--	--	NA	--
2,2'-Oxybis(1-chloropropane)	0/2	2.3 - 3.5	--	NA	--
2,4,5-Trichlorophenol	0/77	0.97 - 100	--	NA	--
2,4,6-Trichlorophenol	0/77	0.2 - 21	--	NA	--
2,4-Dichlorophenol	0/77	0.2 - 21	--	NA	--
2,4-Dimethylphenol	4/77	0.2 - 21	0.69273 - 11.0323	NA	--
2,4-Dinitrophenol	0/77	0.97 - 100	--	NA	--
2,4-Dinitrotoluene	0/77	0.2 - 21	--	NA	--
2,6-Dinitrotoluene	0/77	0.2 - 21	--	NA	--
2-Chloronaphthalene	0/77	0.2 - 21	--	NA	--
2-Chlorophenol	0/77	0.2 - 21	--	NA	--
2-Methylnaphthalene	18/76	0.2 - 21	0.066J - 21.1491	NA	--
2-Methylphenol	0/77	0.2 - 21	--	NA	--
2-Nitroaniline	0/77	0.97 - 100	--	NA	--
2-Nitrophenol	0/77	0.2 - 21	--	NA	--
3,3'-Dichlorobenzidine	0/77	0.4 - 42	--	NA	--
3-Nitroaniline	0/77	0.97 - 100	--	NA	--
4,6-Dinitro-2-methylphenol	0/77	0.97 - 100	--	NA	--
4-Bromophenyl-phenylether	0/77	0.2 - 21	--	NA	--
4-Chloro-3-methylphenol	0/77	0.2 - 21	--	NA	--
4-Chloroaniline	0/77	0.2 - 21	--	NA	--
4-Chlorophenyl-phenylether	0/77	0.2 - 21	--	NA	--
4-Methylphenol	5/77	0.2 - 21	0.19J - 8.9J	NA	--
4-Nitroaniline	0/77	0.97 - 100	--	NA	--
4-Nitrophenol	0/77	0.97 - 100	--	NA	--
Acenaphthene	11/77	0.2 - 21	0.14J - 6.98355	NA	--
Acenaphthylene	0/97	0.2 - 21	--	NA	--
Anthracene	9/97	0.2 - 21	0.083J - 2.3J	NA	--
Azobenzene	0/2	2.3 - 3.5	--	NA	--
Benzo(a)anthracene	15/97	0.2 - 21	0.086J - 3.78333J	NA	--
Benzo(a)pyrene	10/97	0.2 - 21	0.028J - 1.8J	NA	--
Benzo(b)fluoranthene	12/97	0.2 - 21	0.027J - 2.7J	NA	--
Benzo(e)pyrene	0/20	0.4 - 6.4	-	NA	--
Benzo(g,h,i)perylene	9/97	0.2 - 21	0.026J - 2.8J	NA	--
Benzo(k)fluoranthene	7/97	0.2 - 21	0.088J - 2.7J	NA	--
Benzoic acid	0/75	0.97 - 100	--	NA	--
Benzyl alcohol	1/75	0.2 - 21	0.038J	NA	--
Biphenyl	0/20	0.36 - 5.8	--	NA	--
Bis(2-chloroethoxy)methane	0/77	0.2 - 21	--	NA	--
Bis(2-chloroethyl)ether	0/77	0.2 - 21	--	NA	--
Bis(2-chloroisopropyl)ether	0/75	0.2 - 21	--	NA	--
Bis(2-ethylhexyl)adipate	1/1	0.44 - 0.44	0.44	NA	--
Bis(2-ethylhexyl)phthalate	3/97	0.16 - 21	13.1184 - 67.5371	NA	--
Butylbenzylphthalate	0/77	0.2 - 21	--	NA	--
Carbazole	0/23	0.4 - 6.4	--	NA	--
Chrysene	18/97	0.2 - 21	0.041J - 5	NA	--
Cyclic Octaatomic sulfur	2/2	--	0.32J - 6.5J	NA	--
Dibenz(a,h)anthracene	1/97	0.2 - 21	0.099J	NA	--
Dibenzofuran	10/97	0.2 - 21	0.08J - 5.04079	NA	--
Diethylphthalate	0/97	0.2 - 21	--	NA	--
Dimethylphthalate	0/77	0.2 - 21	--	NA	--
Di-n-butylphthalate	0/77	0.2 - 21	--	NA	--
Di-n-octylphthalate	1/77	0.2 - 21	97.8349	NA	--
Dioctadecyl phosphonic acid	0/0	--	--	NA	--
Docosane	0/0	--	--	NA	--

Table 4-7. Summary of Analyses and Detections in the Landfill Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency [1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Eicosane	0/0	--	--	NA	--
Fluoranthene	24/97	0.2 - 21	0.031J - 11.7333	NA	--
Fluorene	14/97	0.2 - 21	0.048J - 7.41534	NA	--
Hexachlorobenzene	0/77	0.2 - 21	--	NA	--
Hexachlorobutadiene	0/78	0.0051 - 21	--	NA	--
Hexachlorocyclopentadiene	0/77	0.2 - 21	--	NA	--
Hexachloroethane	0/77	0.2 - 21	--	NA	--
Hexadecanoic acid	0/0	--	--	NA	--
Hexatriacontane	0/0	--	--	NA	--
Indeno(1,2,3-cd)pyrene	8/97	0.2 - 21	0.027J - 2J	NA	--
Isophorone	0/76	0.2 - 21	--	NA	--
m-Terphenyl	0/0	--	--	NA	--
Naphthalene	23/98	0.0051 - 21	0.074J - 31.1198	NA	--
Nitrobenzene	0/77	0.2 - 21	--	NA	--
n-Nitrosodimethylamine	0/2	2.3 - 3.5	--	NA	--
n-Nitroso-di-n-propylamine	1/97	0.2 - 21	0.43J	NA	--
n-Nitrosodiphenylamine	2/97	0.2 - 21	0.2J - 1.53104	NA	--
o-Terphenyl	1/1	--	22J	NA	--
Octadecanoic acid	0/0	--	--	NA	--
p-Terphenyl	0/0	--	--	NA	--
Pentachlorophenol	0/97	0.97 - 100	--	NA	--
Phenacetin	0/20	0.79 - 13	--	NA	--
Phenanthrene	26/97	0.2 - 21	0.066J - 20.9162	NA	--
Phenol	3/97	0.2 - 21	0.2J - 3.6J	NA	--
Pyrene	25/97	0.2 - 21	0.036J - 10.3746	NA	--
Terphenyl	1/1	--	84J	NA	--
Tricosane	0/0	--	--	NA	--
Tridecane	0/0	--	--	NA	--
Volatile Organic Compounds					
1,1,1,2-Tetrachloroethane	0/1	0.0051 - 0.0051	--	NA	--
1,1,1-Trichloroethane	0/78	0.005 - 15.451	--	NA	--
1,1,2,2-Tetrachloroethane	0/78	0.005 - 15.451	--	NA	--
1,1,2-Trichloro-1,2,2-trifluoroethane	0/4	0.0051 - 0.039	--	NA	--
1,1,2-Trichloroethane	1/78	0.005 - 15.451	0.002J	NA	--
1,1-Dichloroethane	0/78	0.005 - 15.451	--	NA	--
1,1-Dichloroethene	0/78	0.005 - 15.451	--	NA	--
1,1-Dichloropropene	0/1	0.0051 - 0.0051	--	NA	--
1,2,3-Trichlorobenzene	1/4	0.0051 - 0.02	0.0028J	NA	--
1,2,3-Trichloropropane	0/1	0.0051 - 0.0051	--	NA	--
1,2,4-Trimethylbenzene	0/1	0.0051 - 0.0051	--	NA	--
1,2-Dibromo-3-chloropropane	0/4	0.0051 - 0.039	--	NA	--
1,2-Dibromoethane	0/4	0.0051 - 0.02	--	NA	--
1,2-Dichloroethane	0/78	0.005 - 15.451	--	NA	--
1,2-Dichloroethene (Total)	0/76	0.005 - 15.451	--	NA	--
1,2-Dichloropropane	0/78	0.005 - 15.451	--	NA	--
1,3,5-Trimethylbenzene	0/1	0.0051 - 0.0051	--	NA	--
1,3-Dichloropropane	0/1	0.0051 - 0.0051	--	NA	--
2,2-Dichloropropane	0/1	0.0051 - 0.0051	--	NA	--
2-Butanone	3/78	0.006 - 30.902	0.02594 - 0.04549	NA	--
2-Chlorotoluene	0/1	0.0051 - 0.0051	--	NA	--
2-Hexanone	0/78	0.01 - 30.902	--	NA	--
4-Chlorotoluene	0/1	0.0051 - 0.0051	--	NA	--
4-Isopropyltoluene	0/1	0.0051 - 0.0051	--	NA	--
4-Methyl-2-pentanone	4/78	0.01 - 30.902	0.083 - 1.7	NA	--
Acetone	4/78	0.01 - 30.902	0.1557J - 0.29683	NA	--
Benzene	12/78	0.005 - 15.451	0.00077J - 0.05063J	NA	--
Bromobenzene	0/1	0.0051 - 0.0051	--	NA	--
Bromochloromethane	0/4	0.0051 - 0.02	--	NA	--
Bromodichloromethane	0/78	0.005 - 15.451	--	NA	--
Bromoform	0/78	0.005 - 15.451	--	NA	--
Bromomethane	0/78	0.0097 - 30.902	--	NA	--
Carbon disulfide	20/77	0.005 - 15.451	0.002J - 0.021	NA	--

Table 4-7. Summary of Analyses and Detections in the Landfill Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency [1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Volatile Organic Compounds *(continued)*					
Carbon tetrachloride	1/78	0.005 - 15.451	0.37J	NA	--
Chlorobenzene	18/78	0.005 - 15.451	0.002J - 6.25516	NA	--
Chloroethane	1/78	0.0097 - 30.902	0.0065J	NA	--
Chloroform	2/78	0.005 - 15.451	0.0021J - 0.0026J	NA	--
Chloromethane	0/78	0.0097 - 30.902	--	NA	--
cis-1,2-Dichloroethene	0/5	0.0051 - 0.02	--	NA	--
cis-1,3-Dichloropropene	0/78	0.005 - 15.451	--	NA	--
Dibromochloromethane	0/78	0.005 - 15.451	--	NA	--
Dibromomethane	0/1	0.0051 - 0.0051	--	NA	--
Dichlorodifluoromethane	1/4	0.0097 - 0.02	0.092	NA	--
Ethylbenzene	26/78	0.005 - 15.451	0.0016J - 55.7J	NA	--
Isopropylbenzene	1/4	0.0051 - 0.02	0.0058J	NA	--
Methylene chloride	1/78	0.005 - 15.451	0.4673	NA	--
n-Butylbenzene	1/1	0.0051 - 0.0051	0.018J	NA	--
o-Xylene	0/1	0.0051 - 0.0051	--	NA	--
Propylbenzene	0/1	0.0051 - 0.0051	--	NA	--
sec-Butylbenzene	1/1	0.0051 - 0.0051	0.02	NA	--
Styrene	0/78	0.005 - 15.451	--	NA	--
tert-Butyl methyl ether	0/5	0.0051 - 0.039	--	NA	--
tert-Butylbenzene	1/1	0.0051 - 0.0051	0.0043J	NA	--
Tetrachloroethene	1/78	0.005 - 15.451	0.29J	NA	--
Toluene	19/78	0.005 - 15.451	0.0005J - 2.2	NA	--
trans-1,2-Dichloroethene	0/5	0.0051 - 0.02	--	NA	--
trans-1,3-Dichloropropene	0/78	0.005 - 15.451	--	NA	--
Trichloroethene	0/78	0.005 - 15.451	--	NA	--
Trichlorofluoromethane	0/4	0.0051 - 0.02	--	NA	--
Vinyl acetate	0/74	0.011 - 30.902	--	NA	--
Vinyl chloride	0/78	0.0097 - 30.902	--	NA	--
Xylene (Total)	32/77	0.005 - 15.451	0.0023J - 519.451J	NA	--
Petroleum Hydrocarbons					
Gasoline-range organics	31/80	0.18 - 620	0.14J - 9,200	NA	--
Diesel-range organics	48/89	1.2 - 1,100	7.4 - 9,600H	NA	--
Motor oil-range organics	18/20	6.1 - 1,100	33 - 3,400LM	NA	--
TPH-extractable unknown hydrocarbon	8/18	12 - 540	45 - 2,300	NA	--
TPH-purgeable unknown hydrocarbon	6/16	1.1 - 340	1.8 - 10,000J	NA	--
Total TPH	59/89	0.18 - 1,100	15 - 22,900	NA	--
Total oil and grease	52/67	26 - 110	32 - 100,000J	NA	--

Notes

(1) rejected data are not included in detection frequency

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical

bgs below ground surface

BHC benzene hexachloride

DDD dichlorodiphenyldichloroethane

DDE dichlorodiphenyldichloroethene

DDT dichlorodiphenyltrichloroethane

H Pattern is heavier hydrocarbon end of the analyte's range in the standard

HPAL Hunters Point ambient level

J estimated value

L pattern is lighter hydrocarbon end of the analyte's range in the standard

M pattern resembles motor oil

mg/kg milligrams per kilogram

NA not available

PCB polychlorinated biphenyl

TPH total petroleum hydrocarbons

Table 4-8. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (greater than 10 feet bgs)

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Metals				
Aluminum	100,000	2004 PRG Industrial	0	0
Antimony	380	2005 ESL Industrial (direct exp)	0	0
Arsenic	11.1	HPAL	21	0
Barium	63,000	2005 ESL Industrial (direct exp)	0	0
Beryllium	36	2005 ESL Industrial (direct exp)	0	0
Cadmium	38	2005 ESL Industrial (direct exp)	2	0
Calcium	--		--	--
Chromium (total)	a	See note	17	0
Chromium VI	37	2005 ESL Industrial (direct exp)	0	0
Cobalt	a	See note	0	0
Copper	38,000	2005 ESL Industrial (direct exp)	0	0
Cyanide (free)	12,000	2004 PRG Industrial	0	0
Iron	100,000	2004 PRG Industrial	2	0
Lead	800	2004 PRG Industrial	7	0
Magnesium	--		--	--
Manganese	19,000	2004 PRG Industrial	0	0
Mercury	180	2005 ESL Industrial (direct exp)	0	0
Molybdenum	4,800	2005 ESL Industrial (direct exp)	0	0
Nickel	a	See note	0	0
Potassium	--		--	--
Selenium	4,800	2005 ESL Industrial (direct exp)	0	0
Silver	4,800	2005 ESL Industrial (direct exp)	0	0
Sodium	--		--	--
Thallium	63	2005 ESL Industrial (direct exp)	0	0
Tin	100,000	2004 PRG Industrial	0	0
Vanadium	1,000	2004 PRG Industrial	0	0
Zinc	100,000	2004 PRG Industrial	0	0
Pesticides				
2,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
2,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
2,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
4,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
Aldrin	0.1	2004 PRG Industrial	0	0
alpha-BHC	0.36	2004 PRG Industrial	0	0
Alpha-chlordane	2.9	SDGI Industrial Criteria	0	0
beta-BHC	1.3	2004 PRG Industrial	0	0
Chlordane	1.7	2005 ESL Industrial (direct exp)	0	0
cis-Nonachlor	--		--	--
delta-BHC	0.59	SDGI Industrial Criteria	0	0
Dieldrin	0.11	2004 PRG Industrial	0	0
Endosulfan I	3,700	2004 PRG Industrial	0	0
Endosulfan II	3,700	2004 PRG Industrial	0	0
Endosulfan sulfate	5300	SDGI Industrial Criteria	0	0
Endrin	180	2004 PRG Industrial	0	0
Endrin aldehyde	260	SDGI Industrial Criteria	0	0
Endrin ketone	260	SDGI Industrial Criteria	0	0
Gamma-BHC (lindane)	1.7	2004 PRG Industrial	0	0
Gamma-chlordane	2.9	SDGI Industrial Criteria	0	0
Heptachlor	0.38	2004 PRG Industrial	0	0
Heptachlor epoxide	0.19	2004 PRG Industrial	0	0
Heptachlor epoxide A	--		--	--
Heptachlor epoxide B	--		--	--
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Methoxychlor	3,100	2004 PRG Industrial	0	0
Mirex	--		--	--
Oxychlordane	--		--	--
Toxaphene	1.6	2004 PRG Industrial	0	0
trans-Nonachlor	21	2004 PRG Industrial	0	0

Table 4-8. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (greater than 10 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Polychlorinated Biphenyls				
Aroclor-1016 (low risk PCB)	21	2004 PRG Industrial	1	0
Aroclor-1221 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1232 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1242 (high risk PCB)	0.74	2004 PRG Industrial	10	3
Aroclor-1248 (high risk PCB)	0.74	2004 PRG Industrial	4	0
Aroclor-1254 (high risk PCB)	0.74	2004 PRG Industrial	5	0
Aroclor-1260 (high risk PCB)	0.74	2004 PRG Industrial	25	0
Total (high risk) PCBs	0.74	2004 PRG Industrial	31	0
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	0	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	9	0
2,2'-Oxybis(1-chloropropane)	7.4	2004 PRG Industrial	0	0
2,4,5-Trichlorophenol	61	2005 ESL Industrial (inhalation)	0	0
2,4,6-Trichlorophenol	25	2005 ESL Industrial (direct exp)	0	0
2,4-Dichlorophenol	1,800	2004 PRG Industrial	0	0
2,4-Dimethylphenol	1,500	2005 ESL Industrial (inhalation)	0	0
2,4-Dinitrophenol	1,200	2004 PRG Industrial	0	0
2,4-Dinitrotoluene	5.6	2005 ESL Industrial (direct exp)	0	0
2,6-Dinitrotoluene	620	2004 PRG Industrial	0	0
2-Chloronaphthalene	23,000	2004 PRG Industrial	0	0
2-Chlorophenol	10	2005 ESL Industrial (inhalation)	0	0
2-Methylnaphthalene	550	2005 ESL Industrial (inhalation)	0	0
2-Methylphenol	31,000	2004 PRG Industrial	0	0
2-Nitroaniline	1,800	2004 PRG Industrial	0	0
2-Nitrophenol	--		--	--
3,3'-Dichlorobenzidine	1.4	2005 ESL Industrial (direct exp)	0	0
3-Nitroaniline	82	2004 PRG Industrial	0	0
4,6-Dinitro-2-methylphenol	--		--	--
4-Bromophenyl-phenylether	--		--	--
4-Chloro-3-methylphenol	--		--	--
4-Chloroaniline	2,500	2004 PRG Industrial	0	0
4-Chlorophenyl-phenylether	--		--	--
4-Methylphenol	3,100	2004 PRG Industrial	0	0
4-Nitroaniline	82	2004 PRG Industrial	0	0
4-Nitrophenol	7,000	SDGI Industrial Criteria	0	0
Acenaphthene	650	2005 ESL Industrial (inhalation)	0	0
Acenaphthylene	18,000	2005 ESL Industrial (direct exp)	0	0
Aniline	300	2004 PRG Industrial	0	0
Anthracene	31	2005 ESL Industrial (inhalation)	0	0
Azobenzene	16	2004 PRG Industrial	0	0
Benzidine	--		--	--
Benzo(a)anthracene	2.1	2005 ESL Industrial (direct exp)	1	0
Benzo(a)pyrene	0.33	2004 PRG Industrial	6	0
Benzo(b)fluoranthene	2.1	2005 ESL Industrial (direct exp)	1	0
Benzo(e)pyrene	--		--	--
Benzo(g,h,i)perylene	22,000	2005 ESL Industrial (direct exp)	0	0
Benzo(k)fluoranthene	15	2005 ESL Industrial (direct exp)	0	0
Benzoic acid	100,000	2004 PRG Industrial	0	0
Benzyl alcohol	100,000	2004 PRG Industrial	0	0
Biphenyl	18,000	2005 ESL Industrial (direct exp)	0	0
Bis(2-chloroethoxy)methane	--		--	--
Bis(2-chloroethyl)ether	0.012	2005 ESL Industrial (inhalation)	0	0
Bis(2-ethylhexyl)phthalate	120	2004 PRG Industrial	0	0
Butylbenzylphthalate	100,000	2004 PRG Industrial	0	0
Carbazole	86	2004 PRG Industrial	0	0
Chrysene	13	2005 ESL Industrial (direct exp)	0	0
Dibenz(a,h)anthracene	0.33	SDGI Industrial Criteria	0	0

Table 4-8. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (greater than 10 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Semivolatile Organic Compounds *(continued)*				
Dibenzofuran	1,600	2004 PRG Industrial	0	0
Diethylphthalate	100,000	2004 PRG Industrial	0	0
Dimethylphthalate	100,000	2004 PRG Industrial	0	0
Di-n-butylphthalate	62,000	2004 PRG Industrial	0	0
Di-n-octylphthalate	25,000	2004 PRG Industrial	0	0
Fluoranthene	22,000	2004 PRG Industrial	0	0
Fluorene	800	2005 ESL Industrial (inhalation)	0	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Hexachlorocyclopentadiene	3,700	2004 PRG Industrial	0	0
Hexachloroethane	44	2005 ESL Industrial (direct exp)	0	0
Indeno(1,2,3-cd)pyrene	2.1	2005 ESL Industrial (direct exp)	0	0
Isophorone	510	2004 PRG Industrial	0	0
Naphthalene	1.5	2005 ESL Industrial (inhalation)	13	0
Nitrobenzene	100	2004 PRG Industrial	0	0
n-Nitrosodimethylamine	0.034	2004 PRG Industrial	0	0
n-Nitroso-di-n-propylamine	0.25	2004 PRG Industrial	1	0
n-Nitrosodiphenylamine	350	2004 PRG Industrial	0	0
Pentachlorophenol	9	2004 PRG Industrial	0	0
Phenacetin	--		--	--
Phenanthrene	18,000	2005 ESL Industrial (direct exp)	0	0
Phenol	100,000	2004 PRG Industrial	0	0
Pyrene	425	2005 ESL Industrial (inhalation)	0	0
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	6.9	2005 ESL Industrial (direct exp)	0	0
1,1,1-Trichloroethane	230	2005 ESL Industrial (inhalation)	0	0
1,1,2,2-Tetrachloroethane	0.025	2005 ESL Industrial (inhalation)	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	--		--	--
1,1,2-Trichloroethane	0.089	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethane	0.89	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethene	105	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloropropene	--		--	--
1,2,3-Trichlorobenzene	--		--	--
1,2,3-Trichloropropane	--		--	--
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dibromo-3-chloropropane	0.067	2005 ESL Industrial (direct exp)	0	0
1,2-Dibromoethane	0.02	2005 ESL Industrial (inhalation)	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethane	0.07	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethene (Total)	150	SDGI Industrial Criteria	0	0
1,2-Dichloropropane	0.14	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,3-Dichloropropane	--		--	--
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	9	0
2,2-Dichloropropane	--		--	0
2-Butanone	6,500	2005 ESL Industrial (inhalation)	0	0
2-Chloroethyl vinyl ether	--		--	--
2-Chlorotoluene	--		--	--
2-Hexanone	--		--	--
4-Chlorotoluene	--		--	--
4-Methyl-2-pentanone	1,550	2005 ESL Industrial (inhalation)	0	0
Acetone	16,500	2005 ESL Industrial (inhalation)	0	0
Benzene	0.38	2005 ESL Industrial (direct exp)	0	0
Bromobenzene	--		--	--
Bromochloromethane	--		--	--
Bromodichloromethane	0.039	2005 ESL Industrial (inhalation)	0	0
Bromoform	220	2004 PRG Industrial	0	0
Bromomethane	2.6	2005 ESL Industrial (inhalation)	0	0
Carbon disulfide	720	2004 PRG Industrial	0	0
Carbon tetrachloride	0.034	2005 ESL Industrial (inhalation)	1	0

Table 4-8. Summary of Detected Exceedances of Evaluation Criteria in the Landfill Area (greater than 10 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Volatile Organic Compounds *(continued)*				
Chlorobenzene	31	2005 ESL Industrial (inhalation)	0	0
Chloroethane	1.8	2005 ESL Industrial (inhalation)	0	0
Chloroform	0.47	2004 PRG Industrial	0	0
Chloromethane	0.2	2005 ESL Industrial (inhalation)	0	0
cis-1,2-Dichloroethene	18	2005 ESL Industrial (inhalation)	0	0
cis-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Dibromochloromethane	0.054	2005 ESL Industrial (inhalation)	0	0
Dibromomethane	--		--	--
Dichlorodifluoromethane	310	2004 PRG Industrial	0	0
Ethylbenzene	5	2008 ESL Industrial (direct exp)	3	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Isopropylbenzene	2,000	2004 PRG Industrial	0	0
Methylcyclohexane	2,600	2004 PRG Industrial	0	0
Methylene chloride	1.5	2005 ESL Industrial (inhalation)	0	0
n-Butylbenzene	240	2004 PRG Industrial	0	0
o-Xylene	210	SDGI Industrial Criteria	0	0
para-Isopropyl toluene	--		--	--
Propylbenzene	240	2004 PRG Industrial	0	0
sec-Butylbenzene	220	2004 PRG Industrial	0	0
Styrene	1,100	2005 ESL Industrial (inhalation)	0	0
tert-Butyl methyl ether	5.6	2005 ESL Industrial (inhalation)	0	0
tert-Butylbenzene	390	2004 PRG Industrial	0	0
Tetrachloroethene	0.24	2005 ESL Industrial (inhalation)	1	0
Toluene	520	2004 PRG Industrial	0	0
trans-1,2-Dichloroethene	37	2005 ESL Industrial (inhalation)	0	0
trans-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Trichloroethene	0.11	2004 PRG Industrial	0	0
Trichlorofluoromethane	2,000	2004 PRG Industrial	0	0
Vinyl acetate	1,400	2004 PRG Industrial	0	0
Vinyl chloride	0.019	2005 ESL Industrial (inhalation)	0	0
Xylene (Total)	420	2004 PRG Industrial	1	0
Petroleum Hydrocarbons				
Gasoline-range organics	750	2005 ESL Industrial (direct exp)	0	0
Diesel-range organics	750	2005 ESL Industrial (direct exp)	2	0
Motor oil-range organics	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-extractable unknown hydrocarbon	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-purgeable unknown hydrocarbon	750	2005 ESL Industrial (direct exp)	0	0
Total TPH	3,500	HPS TPH source criterion	9	0
Total oil and grease	3,500	HPS TPH source criterion	18	0

Notes:

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical

bgs below ground surface

BHC benzene hexachloride

Conc. concentration

DDD dichlorodiphenyldichloroethane

DDE dichlorodiphenyldichloroethene

DDT dichlorodiphenyltrichloroethane

ESL environmental screening level

HPAL Hunters Point ambient level

HPS Hunters Point Shipyard

mg/kg milligrams per kilogram

NE not established

PCB polychlorinated biphenyl

PRG preliminary remediation goal

RIEC remedial investigation evaluation criteria

SDGI standard data gaps investigation

TPH total petroleum hydrocarbon

Table 4-9. Summary of Analyses and Detections in the Panhandle Area (0-2 feet bgs)

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Metals					
Aluminum	67/68	1.3 - 260	1,800 - 30,000	NA	--
Antimony	27/77	0.77 - 8.1	2.1 - 530J	9.05	14
Arsenic	65/77	0.08 - 28	1.8 - 215J	11.1	12
Barium	69/77	0.03 - 29	26.4 - 2,400	314.4	15
Beryllium	48/77	0.01 - 1	0.05 - 1.18	0.71	3
Cadmium	31/77	0.05 - 2.9	0.22 - 37	3.14	14
Calcium	67/68	0.89 - 270	2,114.56 - 81,000	NA	--
Chromium	76/77	0.1 - 13	24 - 1,800	a	5
Chromium VI	6/73	0.05 - 0.71	0.06 - 10J	NA	--
Cobalt	71/77	0.16 - 9	4.1 - 100	a	4
Copper	75/77	0.23 - 120	11.2 - 27,000	124.3	34
Cyanide	5/13	0.07 - 0.6	0.06J - 0.51	NA	--
Iron	67/68	0.37 - 230	6,500 - 190,000	NA	--
Lead	75/77	0.17 - 33	2.4 - 9,300J	8.99	72
Magnesium	67/68	2.6 - 250	1,400 - 180,000	NA	--
Manganese	77/77	0.06 - 29	0.15 - 12,000	1,431.20	7
Mercury	67/77	0.01 - 5.3	0.03J - 190	2.28	4
Molybdenum	37/75	0.16 - 6.5	0.21J - 70	2.68	16
Nickel	76/77	0.26 - 22	21 - 1,600	a	0
Potassium	66/68	16.7 - 848	190J - 2,160	NA	--
Selenium	15/77	0.08 - 25	0.28 - 6.4	1.95	3
Silver	12/77	0.08 - 37.3	0.22 - 5.5	1.43	5
Sodium	49/68	2.1 - 180	11.9 - 1,600J	NA	--
Thallium	10/77	0.14 - 0.68	0.2 - 7.2	0.81	3
Tin	0/1	3	--	NA	--
Vanadium	76/77	0.14 - 8	3.8 - 2,100	117.2	9
Zinc	76/77	0.28 - 58	36 - 6,900J	109.9	45
Pesticides					
2,4'-DDD	1/7	0.0001 - 0.011	0.0001J	NA	--
2,4'-DDE	0/7	0.0001 - 0.011	--	NA	--
2,4'-DDT	1/7	0.0001 - 0.011	0.0002J - 0.056	NA	--
4,4'-DDD	14/77	0.0001 - 4.2	0.0004J - 0.24J	NA	--
4,4'-DDE	20/77	0.0001 - 4.2	0.0004J - 7.7	NA	--
4,4'-DDT	22/77	0.0002 - 4.2	0.001J - 0.09	NA	--
Aldrin	9/77	0.0001 - 2.1	0.002 - 0.046	NA	--
alpha-BHC	11/77	0.0001 - 2.1	0.002 - 0.083	NA	--
alpha-Chlordane	6/68	0.0001 - 2.1	0.0003 - 0.34J	NA	--
beta-BHC	15/77	0.0001 - 2.1	0.0001J - 0.41	NA	--
Chlordane	0/0	--	--	NA	--
cis-Nonachlor	2/7	0.0001 - 0.011	0.0001J - 0.0005J	NA	--
delta-BHC	9/77	0.0001 - 2.1	0.002 - 0.046	NA	--
Dieldrin	15/77	0.0001 - 4.2	0.0022 - 6.4J	NA	--
Endosulfan I	10/77	0.0001 - 2.1	0.0004J - 0.046	NA	--
Endosulfan II	9/77	0.0001 - 4.2	0.0039 - 0.09	NA	--
Endosulfan sulfate	11/77	0.0001 - 4.2	0.0029J - 0.09	NA	--
Endrin	10/77	0.0001 - 4.2	0.0039 - 0.09	NA	--
Endrin aldehyde	15/75	0.0001 - 4.2	0.0039 - 0.09	NA	--
Endrin ketone	9/31	0.0001 - 0.09	0.001 - 0.09	NA	--
gamma-BHC (lindane)	9/77	0.0001 - 2.1	0.002 - 0.046	NA	--
gamma-Chlordane	9/9	0.035 - 0.81	0.015 - 0.81	NA	--
Heptachlor	10/77	0.0001 - 2.1	0.002 - 0.046	NA	--
Heptachlor epoxide	9/77	0.0001 - 2.1	0.0011 - 0.046	NA	--
Methoxychlor	10/77	0.0003 - 21	0.0068 - 4.2	NA	--
Mirex	0/7	0.0001 - 0.011	--	NA	--
Oxychlordane	0/7	0.0001 - 0.011	--	NA	--
Toxaphene	9/75	0.05 - 75	0.071 - 1.6	NA	--
trans-Chlordane	3/68	0.0001 - 2.1	0.0002 - 0.0026J	NA	--
trans-Nonachlor	5/7	0.0001 - 0.011	0.0003J - 0.0008J	NA	--
Polychlorinated Biphenyls					
Aroclor-1016 (low risk PCB)	9/70	0.011 - 0.45	0.011 - 0.026	NA	--
Aroclor-1221 (high risk PCB)	9/70	0.022 - 0.45	0.022 - 0.52	NA	--
Aroclor-1232 (high risk PCB)	9/70	0.011 - 0.45	0.011 - 0.026	NA	--
Aroclor-1242 (high risk PCB)	9/70	0.011 - 0.45	0.011 - 0.026	NA	--
Aroclor-1248 (high risk PCB)	14/70	0.011 - 0.72	0.011 - 12	NA	--
Aroclor-1254 (high risk PCB)	19/70	0.011 - 0.9	0.011 - 17	NA	--
Aroclor-1260 (high risk PCB)	34/70	0.011 - 1.7	0.0099 - 20	NA	--
Total (high risk) PCBs	41/70	0.011 - 0.72	0.018 - 20	NA	--

Table 4-9. Summary of Analyses and Detections in the Panhandle Area (0-2 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Dioxins and Furans					
1,2,3,4,6,7,8,9-OCDD	0/0	--	--	NA	--
1,2,3,4,6,7,8,9-OCDF	0/0	--	--	NA	--
1,2,3,4,6,7,8-Heptachlorooxanthrene	0/0	--	--	NA	--
1,2,3,4,6,7,8-HpCDD	0/0	--	--	NA	--
1,2,3,4,6,7,8-HpCDF	0/0	--	--	NA	--
1,2,3,4,7,8,9-HpCDF	0/0	--	--	NA	--
1,2,3,4,7,8-HxCDD	0/0	--	--	NA	--
1,2,3,4,7,8-HxCDF	0/0	--	--	NA	--
1,2,3,6,7,8-HxCDD	0/0	--	--	NA	--
1,2,3,6,7,8-HxCDF	0/0	--	--	NA	--
1,2,3,7,8,9-HxCDD	0/0	--	--	NA	--
1,2,3,7,8,9-HxCDF	0/0	--	--	NA	--
1,2,3,7,8-PeCDD	0/0	--	--	NA	--
1,2,3,7,8-PeCDF	0/0	--	--	NA	--
2,3,4,6,7,8-HxCDF	0/0	--	--	NA	--
2,3,4,7,8-PeCDF	0/0	--	--	NA	--
2,3,7,8-TCDD	0/0	--	--	NA	--
2,3,7,8-TCDF	0/0	--	--	NA	--
Semivolatile Organic Compounds					
1,2,3,4-Tetrahydronaphthalene	0/0	--	--	--	--
1,2,4-Trichlorobenzene	0/62	0.0046 - 52	--	NA	--
1,2-Dichlorobenzene	0/62	0.0046 - 52	--	NA	--
1,3-Dichlorobenzene	0/62	0.0046 - 52	--	NA	--
1,4-Dichlorobenzene	0/62	0.0046 - 52	--	NA	--
2,2'-Oxybis(1-chloropropane)	0/0	--	--	NA	--
2,4,5-Trichlorophenol	0/59	0.34 - 52	--	NA	--
2,4,6-Trichlorophenol	0/59	0.34 - 52	--	NA	--
2,4-Dichlorophenol	0/59	0.34 - 52	--	NA	--
2,4-Dimethylphenol	0/61	0.34 - 52	--	NA	--
2,4-Dinitrophenol	0/59	1.6 - 260	--	NA	--
2,4-Dinitrotoluene	0/61	0.34 - 52	--	NA	--
2,6,10,14-Tetramethylpentadecane	0/0	--	--	NA	--
2,6-Dinitrotoluene	0/61	0.34 - 52	--	NA	--
2-Chloronaphthalene	0/61	0.34 - 52	--	NA	--
2-Chlorophenol	0/61	0.34 - 52	--	NA	--
2-Methylnaphthalene	8/61	0.067 - 10	0.038J - 3.1	NA	--
2-Methylphenol	0/61	0.34 - 52	--	NA	--
2-Nitroaniline	0/61	0.68 - 100	--	NA	--
2-Nitrophenol	0/59	0.34 - 100	--	NA	--
3,3'-Dichlorobenzidine	0/61	0.39 - 100	--	NA	--
3-Heptanone,2,4-Dimethyl-C9H18O	0/0	--	--	NA	--
3-Nitroaniline	0/59	0.68 - 100	--	NA	--
4,6-Dinitro-2-methylphenol	0/59	1.6 - 260	--	NA	--
4-Bromophenyl-phenylether	0/59	0.34 - 52	--	NA	--
4-Chloro-3-methylphenol	0/61	0.34 - 52	--	NA	--
4-Chloroaniline	0/59	0.34 - 52	--	NA	--
4-Chlorophenyl-phenylether	0/59	0.34 - 52	--	NA	--
4-Methylphenol	0/61	0.34 - 52	--	NA	--
4-Nitroaniline	0/59	0.68 - 100	--	NA	--
4-Nitrophenol	0/61	0.68 - 100	--	NA	--
5-Methylhex-5-en-2-one	0/0	--	--	NA	--
Acenaphthene	4/61	0.067 - 10	0.048J - 1.2	NA	--
Acenaphthylene	2/61	0.067 - 10	0.052J - 0.88	NA	--
Anthracene	16/61	0.067 - 10	0.038J - 7.6J	NA	--
Azobenzene	0/46	0.34 - 52	--	NA	--
Benzo(a)anthracene	24/61	0.067 - 10	0.045J - 51	NA	--
Benzo(a)pyrene	25/61	0.067 - 10	0.038J - 16	NA	--
Benzo(b)fluoranthene	39/61	0.067 - 10	0.045J - 64	NA	--
Benzo(e)pyrene	0/0	--	--	NA	--
Benzo(g,h,i)perylene	4/61	0.067 - 10	0.036J - 0.37	NA	--
Benzo(k)fluoranthene	30/61	0.067 - 10	0.058J - 53	NA	--
Benzoic acid	1/59	1.6 - 260	1.5J	NA	--
Benzyl alcohol	0/59	0.34 - 52	--	NA	--
Biphenyl	0/0	--	--	NA	--
Bis(2-chloroethoxy)methane	0/59	0.34 - 52	--	NA	--
Bis(2-chloroethyl)ether	0/59	0.34 - 52	--	NA	--

Table 4-9. Summary of Analyses and Detections in the Panhandle Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Bis(2-chloroisopropyl)ether	0/59	0.34 - 52	--	NA	--
Bis(2-ethylhexyl)phthalate	7/61	0.34 - 52	2.6 - 740	NA	--
Butylbenzylphthalate	0/61	0.34 - 52	--	NA	--
Carbazole	0/2	0.39 - 0.7	--	NA	--
Chrysene	33/61	0.067 - 10	0.039J - 57	NA	--
Cyclic Octaatomic sulfur	0/0	--	--	NA	--
Dibenz(a,h)anthracene	5/61	0.067 - 10	0.073J - 5.3J	NA	--
Dibenzofuran	1/61	0.34 - 52	0.88J	NA	--
Diethylphthalate	0/61	0.34 - 52	--	NA	--
Dimethylphthalate	0/59	0.34 - 52	--	NA	--
Di-n-butylphthalate	0/61	0.34 - 52	--	NA	--
Di-n-octylphthalate	0/61	0.34 - 52	--	NA	--
Dioctyl ester hexanedioic acid	1/1	--	--	NA	--
Fluoranthene	35/61	0.067 - 10	0.039J - 84	NA	--
Fluorene	4/61	0.067 - 10	0.044J - 1.7	NA	--
Heptadecane	0/0	--	--	NA	--
Hexachlorobenzene	2/68	0.0002 - 52	--	NA	--
Hexachlorobutadiene	0/60	0.0046 - 52	--	NA	--
Hexachlorocyclopentadiene	0/59	0.34 - 260	--	NA	--
Hexachloroethane	0/59	0.34 - 52	--	NA	--
Hexadecane	0/0	--	--	NA	--
Hexadecanoic acid	0/0	--	--	NA	--
Indeno(1,2,3-cd)pyrene	20/61	0.067 - 10	0.037J - 17	NA	--
Isophorone	0/61	0.34 - 52	--	NA	--
Naphthalene	10/62	0.0046 - 10	0.055J - 47	NA	--
Nitrobenzene	0/59	0.34 - 52	--	NA	--
n-Nitrosodimethylamine	0/46	0.34 - 52	--	NA	--
n-Nitroso-di-n-propylamine	0/61	0.34 - 52	--	NA	--
n-Nitrosodiphenylamine	0/61	0.34 - 52	--	NA	--
Octacosane	1/1	--	--	NA	--
Pentachlorophenol	0/61	0.68 - 100	--	NA	--
Phenacetin	0/0	--	--	NA	--
Phenanthrene	28/61	0.067 - 10	0.039J - 43	NA	--
Phenol	0/61	0.34 - 52	--	NA	--
Pyrene	35/61	0.067 - 10	0.04J - 35	NA	--
Volatile Organic Compounds					
1,1,1,2-Tetrachloroethane	0/1	0.0046	--	NA	--
1,1,1-Trichloroethane	0/14	0.0046 - 0.692	--	NA	--
1,1,2,2-Tetrachloroethane	0/14	0.0046 - 0.692	--	NA	--
1,1,2-Trichloro-1,2,2-trifluoroethane	0/1	0.0046	--	NA	--
1,1,2-Trichloroethane	0/14	0.0046 - 0.692	--	NA	--
1,1-Dichloroethane	0/14	0.0046 - 0.692	--	NA	--
1,1-Dichloroethene	0/14	0.0046 - 0.692	--	NA	--
1,1-Dichloropropene	0/1	0.0046	--	NA	--
1,2,3-Trichlorobenzene	0/1	0.0046	--	NA	--
1,2,3-Trichloropropane	0/1	0.0046	--	NA	--
1,2,4-Trichlorobenzene	0/0	--	--	NA	--
1,2,4-Trimethylbenzene	0/1	0.0046	--	NA	--
1,2-Dibromo-3-chloropropane	0/1	0.0046	--	NA	--
1,2-Dibromoethane	0/1	0.0046	--	NA	--
1,2-Dichloroethane	0/14	0.0046 - 0.692	--	NA	--
1,2-Dichloroethene (Total)	0/13	0.005 - 0.692	--	NA	--
1,2-Dichloropropane	0/14	0.0046 - 0.692	--	NA	--
1,3,5-Trimethylbenzene	0/1	0.0046	--	NA	--
1,3-Dichloropropane	0/1	0.0046	--	NA	--
2,2-Dichloropropane	0/1	0.0046	--	NA	--
2-Butanone	2/14	0.0093 - 1.384	0.001J - 0.01716	NA	--
2-Chloroethyl vinyl ether	0/1	0.0046	--	NA	--
2-Chlorotoluene	0/1	0.0046	--	NA	--
2-Hexanone	0/14	0.0093 - 1.384	--	NA	--
4-Chlorotoluene	0/1	0.0046	--	NA	--
4-Isopropyltoluene	1/1	0.0046	0.0068	NA	--
4-Methyl-2-pentanone	0/13	0.0093 - 1.384	--	NA	--
Acetone	0/13	0.0093 - 1.384	--	NA	--
Benzene	0/14	0.0046 - 0.692	--	NA	--
Bromobenzene	0/1	0.0046	--	NA	--

Table 4-9. Summary of Analyses and Detections in the Panhandle Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Volatile Organic Compounds *(continued)*					
Bromochloromethane	0/1	0.0046	--	NA	--
Bromodichloromethane	0/14	0.0046 - 0.692	--	NA	--
Bromoform	0/14	0.0046 - 0.692	--	NA	--
Bromomethane	0/14	0.0046 - 1.384	--	NA	--
Carbon disulfide	0/14	0.005 - 0.692	--	NA	--
Carbon tetrachloride	0/14	0.0046 - 0.692	--	NA	--
Chlorobenzene	0/14	0.0046 - 0.692	--	NA	--
Chloroethane	0/14	0.0046 - 1.384	--	NA	--
Chloroform	0/14	0.0046 - 0.692	--	NA	--
Chloromethane	0/14	0.0046 - 1.384	--	NA	--
cis-1,2-Dichloroethene	0/1	0.0046	--	NA	--
cis-1,3-Dichloropropene	0/14	0.0046 - 0.692	--	NA	--
Dibromochloromethane	0/14	0.0046 - 0.692	--	NA	--
Dibromomethane	0/1	0.0046	--	NA	--
Dichlorodifluoromethane	0/1	0.0046	--	NA	--
Ethylbenzene	0/14	0.0046 - 0.692	--	NA	--
Isopropylbenzene	0/1	0.0046 - 0.0046	--	NA	--
Methylene chloride	0/14	0.0046 - 0.692	--	NA	--
n-Butylbenzene	0/1	0.0046	--	NA	--
o-Xylene	0/1	0.0046	--	NA	--
Propylbenzene	0/1	0.0046	--	NA	--
sec-Butylbenzene	0/1	0.0046	--	NA	--
Styrene	0/14	0.0046 - 0.692	--	NA	--
tert-Butyl methyl ether	0/1	0.0046	--	NA	--
tert-Butylbenzene	0/1	0.0046	--	NA	--
Tetrachloroethene	0/14	0.0046 - 0.692	--	NA	--
Toluene	1/14	0.0046 - 0.692	0.019	NA	--
trans-1,2-Dichloroethene	0/1	0.0046	--	NA	--
trans-1,3-Dichloropropene	0/14	0.0046 - 0.692	--	NA	--
Trichloroethene	0/14	0.0046 - 0.692	--	NA	--
Trichlorofluoromethane	0/1	0.0046	--	NA	--
Vinyl acetate	0/14	0.0093 - 1.384	--	NA	--
Vinyl chloride	0/14	0.0046 - 1.384	--	NA	--
Xylene (Total)	0/14	0.0046 - 0.692	--	NA	--
Petroleum Hydrocarbons					
Gasoline-range organics	1/13	1 - 5.9	0.98	NA	--
Diesel-range organics	4/16	10 - 160	17 - 3400J	NA	--
Motor oil-range organics	3/3	120 - 320	1,400J - 3,600J	NA	--
TPH-extractable unknown hydrocarbon	2/3	10 - 12	2J - 15	NA	--
TPH-purgeable unknown hydrocarbon	0/1	1.1	-	NA	--
Total TPH	6/16	10 - 12	2.98 - 7,000	NA	--
Total oil and grease	10/13	26 - 60	100 - 1,600	NA	--

Notes

(1) rejected data are not included in detection frequency

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical
bgs below ground surface
BHC benzene hexachloride
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethene
DDT dichlorodiphenyltrichloroethane
HpCDD heptachlorodibenzo-p-dioxin
HpCDF heptachlorodibenzofuran
HQ hazard quotient
HxCDD hexachlorodibenzo-p-dioxin
HxCDF hexachlorodibenzofuran
J estimated value
mg/kg milligrams per kilogram
NA not available
OCDD octachlorodibenzo-p-dioxin
OCDF octachlorodibenzofuran
PCB polychlorinated biphenyl
PeCDD pentachlorodibeno-p-dioxin
PeCDF pentachlorodibenzofuran
TPH total petroleum hydrocarbons

Table 4-10. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (0-2 feet bgs)
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Metals				
Aluminum	100,000	2004 PRG Industrial	0	0
Antimony	380	2005 ESL Industrial (direct exp)	1	0
Arsenic	11.1	HPAL	12	0
Barium	63,000	2005 ESL Industrial (direct exp)	0	0
Beryllium	36	2005 ESL Industrial (direct exp)	0	0
Cadmium	7.4	2005 ESL Industrial (direct exp)	3	0
Calcium	--		--	--
Chromium (total)	a	See note	0	0
Chromium VI	37	2005 ESL Industrial (direct exp)	0	0
Cobalt	a	See note	0	0
Copper	38,000	2005 ESL Industrial (direct exp)	0	0
Cyanide (free)	12,000	2004 PRG Industrial	0	0
Iron	100,000	2004 PRG Industrial	3	0
Lead	800	2004 PRG Industrial	16	0
Magnesium	--		--	--
Manganese	19,000	2004 PRG Industrial	0	0
Mercury	180	2005 ESL Industrial (direct exp)	1	0
Molybdenum	4,800	2005 ESL Industrial (direct exp)	0	0
Nickel	a	See note	0	0
Potassium	--		--	--
Selenium	4,800	2005 ESL Industrial (direct exp)	0	0
Silver	4,800	2005 ESL Industrial (direct exp)	0	0
Sodium	--		--	--
Thallium	63	2005 ESL Industrial (direct exp)	0	0
Tin	100,000	2004 PRG Industrial	0	0
Vanadium	1,000	2004 PRG Industrial	1	0
Zinc	100,000	2004 PRG Industrial	0	0
Pesticides				
2,4-DDD	9	2005 ESL Industrial (direct exp)	0	0
2,4-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
2,4-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
4,4-DDD	9	2005 ESL Industrial (direct exp)	0	0
4,4-DDE	6.3	2005 ESL Industrial (direct exp)	1	0
4,4-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
Aldrin	0.1	2004 PRG Industrial	0	0
alpha-BHC	0.36	2004 PRG Industrial	0	0
Alpha-chlordane	2.9	SDGI Industrial Criteria	0	0
beta-BHC	1.3	2004 PRG Industrial	0	0
Chlordane	1.7	2005 ESL Industrial (direct exp)	0	0
cis-Nonachlor	--		--	--
delta-BHC	0.59	SDGI Industrial Criteria	0	0
Dieldrin	0.11	2004 PRG Industrial	2	0
Endosulfan I	3,700	2004 PRG Industrial	0	0
Endosulfan II	3,700	2004 PRG Industrial	0	0
Endosulfan sulfate	5300	SDGI Industrial Criteria	0	0
Endrin	180	2004 PRG Industrial	0	0
Endrin aldehyde	260	SDGI Industrial Criteria	0	0
Endrin ketone	260	SDGI Industrial Criteria	0	0
Gamma-BHC (lindane)	1.7	2004 PRG Industrial	0	0
Gamma-chlordane	2.9	SDGI Industrial Criteria	0	0
Heptachlor	0.38	2004 PRG Industrial	0	0
Heptachlor epoxide	0.19	2004 PRG Industrial	0	0
Heptachlor epoxide A	--		--	--
Heptachlor epoxide B	--		--	--
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Methoxychlor	3,100	2004 PRG Industrial	0	0
Mirex	--		--	--
Oxychlordane	--		--	--
Toxaphene	1.6	2004 PRG Industrial	0	0
trans-Nonachlor	21	2004 PRG Industrial	0	0

Table 4-10. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Polychlorinated Biphenyls				
Aroclor-1016 (low risk PCB)	21	2004 PRG Industrial	0	0
Aroclor-1221 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1232 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1242 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1248 (high risk PCB)	0.74	2004 PRG Industrial	1	0
Aroclor-1254 (high risk PCB)	0.74	2004 PRG Industrial	3	0
Aroclor-1260 (high risk PCB)	0.74	2004 PRG Industrial	4	0
Total (high risk) PCBs	0.74	2004 PRG Industrial	8	0
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	0	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2'-Oxybis(1-chloropropane)	7.4	2004 PRG Industrial	0	0
2,4,5-Trichlorophenol	61	2005 ESL Industrial (inhalation)	0	0
2,4,6-Trichlorophenol	25	2005 ESL Industrial (direct exp)	0	0
2,4-Dichlorophenol	1,800	2004 PRG Industrial	0	0
2,4-Dimethylphenol	1,500	2005 ESL Industrial (inhalation)	0	0
2,4-Dinitrophenol	1,200	2004 PRG Industrial	0	0
2,4-Dinitrotoluene	5.6	2005 ESL Industrial (direct exp)	0	0
2,6-Dinitrotoluene	620	2004 PRG Industrial	0	0
2-Chloronaphthalene	23,000	2004 PRG Industrial	0	0
2-Chlorophenol	10	2005 ESL Industrial (inhalation)	0	0
2-Methylnaphthalene	550	2005 ESL Industrial (inhalation)	0	0
2-Methylphenol	31,000	2004 PRG Industrial	0	0
2-Nitroaniline	1,800	2004 PRG Industrial	0	0
2-Nitrophenol	--		--	--
3,3'-Dichlorobenzidine	1.4	2005 ESL Industrial (direct exp)	0	0
3-Nitroaniline	82	2004 PRG Industrial	0	0
4,6-Dinitro-2-methylphenol	--		--	--
4-Bromophenyl-phenylether	--		--	--
4-Chloro-3-methylphenol	--		--	--
4-Chloroaniline	2,500	2004 PRG Industrial	0	0
4-Chlorophenyl-phenylether	--		--	--
4-Methylphenol	3,100	2004 PRG Industrial	0	0
4-Nitroaniline	82	2004 PRG Industrial	0	0
4-Nitrophenol	7,000	SDGI Industrial Criteria	0	0
Acenaphthene	650	2005 ESL Industrial (inhalation)	0	0
Acenaphthylene	18,000	2005 ESL Industrial (direct exp)	0	0
Aniline	300	2004 PRG Industrial	0	0
Anthracene	31	2005 ESL Industrial (inhalation)	0	0
Azobenzene	16	2004 PRG Industrial	0	0
Benzidine	--		--	--
Benzo(a)anthracene	1.3	2005 ESL Industrial (direct exp)	5	0
Benzo(a)pyrene	0.33	SDGI Industrial Criteria	10	0
Benzo(b)fluoranthene	1.3	2005 ESL Industrial (direct exp)	7	0
Benzo(e)pyrene	--		--	--
Benzo(g,h,i)perylene	22,000	2005 ESL Industrial (direct exp)	0	0
Benzo(k)fluoranthene	1.3	2005 ESL Industrial (direct exp)	9	0
Benzoic acid	100,000	2004 PRG Industrial	0	0
Benzyl alcohol	100,000	2004 PRG Industrial	0	0
Biphenyl	18,000	2005 ESL Industrial (direct exp)	0	0
Bis(2-chloroethoxy)methane	--		--	--
Bis(2-chloroethyl)ether	0.012	2005 ESL Industrial (inhalation)	0	0
Bis(2-ethylhexyl)phthalate	120	2004 PRG Industrial	1	0
Butylbenzylphthalate	100,000	2004 PRG Industrial	0	0
Carbazole	86	2004 PRG Industrial	0	0
Chrysene	13	2005 ESL Industrial (direct exp)	1	0

Table 4-10. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Semivolatile Organic Compounds *(continued)*				
Dibenz(a,h)anthracene	0.33	SDGI Industrial Criteria	1	0
Dibenzofuran	1,600	2004 PRG Industrial	0	0
Diethylphthalate	100,000	2004 PRG Industrial	0	0
Dimethylphthalate	100,000	2004 PRG Industrial	0	0
Di-n-butylphthalate	62,000	2004 PRG Industrial	0	0
Di-n-octylphthalate	25,000	2004 PRG Industrial	0	0
Fluoranthene	22,000	2004 PRG Industrial	0	0
Fluorene	800	2005 ESL Industrial (inhalation)	0	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Hexachlorocyclopentadiene	3700	2004 PRG Industrial	0	0
Hexachloroethane	44	2005 ESL Industrial (direct exp)	0	0
Indeno(1,2,3-cd)pyrene	1.3	2005 ESL Industrial (direct exp)	4	0
Isophorone	510	2004 PRG Industrial	0	0
Naphthalene	1.5	2005 ESL Industrial (inhalation)	2	0
Nitrobenzene	100	2004 PRG Industrial	0	0
n-Nitrosodimethylamine	0.034	2004 PRG Industrial	0	0
n-Nitroso-di-n-propylamine	0.25	2004 PRG Industrial	0	0
n-Nitrosodiphenylamine	350	2004 PRG Industrial	0	0
Pentachlorophenol	9	2004 PRG Industrial	0	0
Phenacetin	--		--	--
Phenanthrene	18,000	2005 ESL Industrial (direct exp)	0	0
Phenol	100,000	2004 PRG Industrial	0	0
Pyrene	425	2005 ESL Industrial (inhalation)	0	0
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	6.9	2005 ESL Industrial (direct exp)	0	0
1,1,1-Trichloroethane	230	2005 ESL Industrial (inhalation)	0	0
1,1,2,2-Tetrachloroethane	0.025	2005 ESL Industrial (inhalation)	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	--		--	--
1,1,2-Trichloroethane	0.089	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethane	0.89	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethene	105	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloropropene	--		--	--
1,2,3-Trichlorobenzene	--		--	--
1,2,3-Trichloropropane	--		--	--
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dibromo-3-chloropropane	0.067	2005 ESL Industrial (direct exp)	0	0
1,2-Dibromoethane	0.02	2005 ESL Industrial (inhalation)	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethane	0.07	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethene (Total)	150	SDGI Industrial Criteria	0	0
1,2-Dichloropropane	0.14	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,3-Dichloropropane	--		--	--
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2-Dichloropropane	--		--	--
2-Butanone	6,500	2005 ESL Industrial (inhalation)	0	0
2-Chloroethyl vinyl ether	--		--	--
2-Chlorotoluene	--		--	--
2-Hexanone	--		--	--
4-Chlorotoluene	--		--	--
4-Methyl-2-pentanone	1,550	2005 ESL Industrial (inhalation)	0	0
Acetone	16,500	2005 ESL Industrial (inhalation)	0	0
Benzene	0.38	2005 ESL Industrial (direct exp)	0	0
Bromobenzene	--		--	--
Bromochloromethane	--		--	--
Bromodichloromethane	0.039	2005 ESL Industrial (inhalation)	0	0
Bromoform	220	2004 PRG Industrial	0	0
Bromomethane	2.6	2005 ESL Industrial (inhalation)	0	0

Table 4-10. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Volatile Organic Compounds *(continued)*				
Carbon disulfide	720	2004 PRG Industrial	0	0
Carbon tetrachloride	0.034	2005 ESL Industrial (inhalation)	0	0
Chlorobenzene	31	2005 ESL Industrial (inhalation)	0	0
Chloroethane	1.8	2005 ESL Industrial (inhalation)	0	0
Chloroform	0.47	2004 PRG Industrial	0	0
Chloromethane	0.2	2005 ESL Industrial (inhalation)	0	0
cis-1,2-Dichloroethene	18	2005 ESL Industrial (inhalation)	0	0
cis-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Dibromochloromethane	0.054	2005 ESL Industrial (inhalation)	0	0
Dibromomethane	--		--	--
Dichlorodifluoromethane	310	2004 PRG Industrial	0	0
Ethylbenzene	5	2008 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Isopropylbenzene	2,000	2004 PRG Industrial	0	0
Methylcyclohexane	2,600	2004 PRG Industrial	0	0
Methylene chloride	1.5	2005 ESL Industrial (inhalation)	0	0
n-Butylbenzene	240	2004 PRG Industrial	0	0
o-Xylene	210	SDGI Industrial Criteria	0	0
para-Isopropyl toluene	--		--	--
Propylbenzene	240	2004 PRG Industrial	0	0
sec-Butylbenzene	220	2004 PRG Industrial	0	0
Styrene	1,100	2005 ESL Industrial (inhalation)	0	0
tert-Butyl methyl ether	5.6	2005 ESL Industrial (inhalation)	0	0
tert-Butylbenzene	390	2004 PRG Industrial	0	0
Tetrachloroethene	0.24	2005 ESL Industrial (inhalation)	0	0
Toluene	520	2004 PRG Industrial	0	0
trans-1,2-Dichloroethene	37	2005 ESL Industrial (inhalation)	0	0
trans-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Trichloroethene	0.11	2004 PRG Industrial	0	0
Trichlorofluoromethane	2,000	2004 PRG Industrial	0	0
Vinyl acetate	1,400	2004 PRG Industrial	0	0
Vinyl chloride	0.019	2005 ESL Industrial (inhalation)	0	0
Xylene (Total)	420	2004 PRG Industrial	0	0
Petroleum Hydrocarbons				
Gasoline-range organics	750	2005 ESL Industrial (direct exp)	0	0
Diesel-range organics	750	2005 ESL Industrial (direct exp)	3	0
Motor oil-range organics	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-extractable unknown hydrocarbon	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-purgeable unknown hydrocarbon	750	2005 ESL Industrial (direct exp)	0	0
Total TPH	3,500	HPS TPH source criterion	3	0
Total oil and grease	3,500	HPS TPH source criterion	0	0

Notes:

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical
bgs below ground surface
BHC benzene hexachloride
Conc. concentration
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethene
DDT dichlorodiphenyltrichloroethane
ESL environmental screening level
HPAL Hunters Point ambient level
HPS Hunters Point Shipyard
mg/kg milligrams per kilogram
NE not established
PCB polychlorinated biphenyl
PRG preliminary remediation goal
RIEC remedial investigation evaluation criteria
SDGI standard data gaps investigation
TPH total petroleum hydrocarbon

Table 4-11. Summary of Analyses and Detections in the Panhandle Area (2-10 feet bgs)
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Metals					
Aluminum	38/38	0.18 - 14	1,990 - 22,776.6	NA	--
Antimony	40/64	0.01 - 9.4	0.21J - 59	9.05	14
Arsenic	62/64	0.05 - 8.1	0.17 - 315J	11.1	12
Barium	63/64	0.04 - 10	7.8J - 1,100	314.4	18
Beryllium	63/64	0.01 - 1	0.04J - 0.93	0.71	2
Cadmium	44/64	0.01 - 5	0.03 - 78.4	3.14	12
Calcium	37/38	0.95 - 30	805 - 53,300	NA	--
Chromium	64/64	0.05 - 9	26.26J - 607	a	3
Chromium VI	4/56	0.05 - 0.125	0.03J - 0.59J	NA	--
Cobalt	64/64	0.01 - 9	4.9J - 96.27	a	4
Copper	61/64	0.01 - 4	3.94 - 1,500	124.3	28
Cyanide	10/34	0.07 - 1.3	0.07J - 0.69J	NA	--
Iron	38/38	0.38 - 14.6	8,207 - 471,000	NA	--
Lead	64/64	0.01 - 33	1.7 - 5,600	8.99	62
Magnesium	38/38	0.12 - 29	2,078.76 - 157,000	NA	--
Manganese	64/64	0.01 - 10	125 - 2,700	1431.2	4
Mercury	54/64	0.01 - 1	0.09 - 13	2.28	6
Molybdenum	36/59	0.01 - 1.8	0.34 - 32	2.68	14
Nickel	64/64	0.01 - 16	19.88 - 1,451.92	a	0
Potassium	64/38	0.56 - 848	133J - 2,250	NA	--
Selenium	32/64	0.02 - 1	0.14J - 6.3	1.95	13
Silver	36/64	0.01 - 0.89	0.11J - 11	1.43	5
Sodium	37/38	0.77 - 23	87.6 - 2,200	NA	--
Thallium	10/64	0.04 - 3.5	0.04J - 0.25	0.81	0
Tin	2/3	3.2 - 3.3	11.4 - 39.8	NA	--
Vanadium	64/64	0.33 - 8	15.1 - 508	117.2	10
Zinc	64/64	0.11 - 20	15.51 - 116,000	109.9	43
Pesticides					
2,4'-DDD	0/0	--	--	NA	--
2,4'-DDE	0/0	--	--	NA	--
2,4'-DDT	0/0	--	--	NA	--
4,4'-DDD	20/64	0.0038 - 0.16	0.0016J - 0.51	NA	--
4,4'-DDE	22/64	0.0038 - 0.16	0.004J - 0.28	NA	--
4,4'-DDT	16/64	0.0038 - 0.45	0.0037J - 0.12	NA	--
Aldrin	7/64	0.002 - 0.082	0.0094 - 0.033	NA	--
alpha-BHC	8/64	0.002 - 0.082	0.0014 - 0.033	NA	--
alpha-Chlordane	0/38	0.0099 - 0.82	--	NA	--
beta-BHC	11/64	0.002 - 0.082	0.0009 - 0.033	NA	--
Chlordane	0/5	0.041 - 0.35	--	NA	--
cis-Nonachlor	0/0	--	--	NA	--
delta-BHC	8/64	0.002 - 0.082	0.00051 - 0.028	NA	--
Dieldrin	19/64	0.0038 - 0.16	0.0013J - 0.11	NA	--
Endosulfan I	7/64	0.002 - 0.082	0.0094 - 0.033	NA	--
Endosulfan II	7/64	0.0038 - 0.16	0.018 - 0.065	NA	--
Endosulfan sulfate	9/64	0.0038 - 0.16	0.0013 - 0.065	NA	--
Endrin	9/64	0.0038 - 0.45	0.0014 - 0.065	NA	--
Endrin aldehyde	8/35	0.0038 - 0.21	0.007 - 0.065	NA	--
Endrin ketone	8/64	0.0038 - 0.16	0.0012 - 0.065	NA	--
gamma-BHC (lindane)	7/64	0.002 - 0.082	0.0094 - 0.033	NA	--
gamma-Chlordane	7/12	0.37	0.17 - 0.59	NA	--
Heptachlor	8/64	0.002 - 0.082	0.0094 - 0.033	NA	--
Heptachlor epoxide	17/64	0.002 - 0.082	0.0014 - 0.053	NA	--
Methoxychlor	17/64	0.0035 - 0.82	0.0035 - 0.33	NA	--
Mirex	0/9	0.0099 - 0.048	--	NA	--
Oxychlordane	0/0	--	--	NA	--
Toxaphene	7/64	0.07 - 1.9	0.33 - 1.2	NA	--
trans-Chlordane	0/38	0.084 - 1.1	--	NA	--
trans-Nonachlor	0/0	--	--	NA	--

Table 4-11. Summary of Analyses and Detections in the Panhandle Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Polychlorinated Biphenyls					
Aroclor-1016 (low risk PCB)	7/64	0.015 - 0.82	0.011 - 0.094	NA	--
Aroclor-1221 (high risk PCB)	7/64	0.018 - 0.82	0.021 - 0.19	NA	--
Aroclor-1232 (high risk PCB)	7/64	0.015 - 0.82	0.011 - 0.094	NA	--
Aroclor-1242 (high risk PCB)	7/64	0.015 - 0.82	0.011 - 0.094	NA	--
Aroclor-1248 (high risk PCB)	7/64	0.015 - 0.82	0.011 - 0.094	NA	--
Aroclor-1254 (high risk PCB)	16/64	0.015 - 1.6	0.011 - 2.6	NA	--
Aroclor-1260 (high risk PCB)	38/64	0.015 - 1.6	0.018 - 1.8	NA	--
Total (high risk) PCBs	38/64	0.015 - 1.6	0.018 - 3.9	NA	--
Dioxins and Furans					
1,2,3,4,6,7,8,9-OCDD	10/10	--	0.000581 - 0.0152	NA	--
1,2,3,4,6,7,8,9-OCDF	7/7	--	0.0000839 - 0.000879	NA	--
1,2,3,4,6,7,8-Heptachlorooxanthrene	3/3	--	0.000177 - 0.000981	NA	--
1,2,3,4,6,7,8-HpCDD	7/7	--	0.00041 - 0.00198	NA	--
1,2,3,4,6,7,8-HpCDF	10/10	--	0.000183 - 0.00319	NA	--
1,2,3,4,7,8,9-HpCDF	10/10	--	0.00000904 - 0.000377	NA	--
1,2,3,4,7,8-HxCDD	10/10	--	0.00000659 - 0.0000603	NA	--
1,2,3,4,7,8-HxCDF	10/10	--	0.00000973 - 0.000788	NA	--
1,2,3,6,7,8-HxCDD	10/10	--	0.000025 - 0.00012	NA	--
1,2,3,6,7,8-HxCDF	10/10	--	0.00000957 - 0.0006	NA	--
1,2,3,7,8,9-HxCDD	10/10	--	0.0000181 - 0.0000995	NA	--
1,2,3,7,8,9-HxCDF	10/10	--	0.000002 - 0.000157	NA	--
1,2,3,7,8-PeCDD	10/10	--	0.00000666 - 0.0000625	NA	--
1,2,3,7,8-PeCDF	10/10	--	0.00000501 - 0.000365	NA	--
2,3,4,6,7,8-HxCDF	10/10	--	0.0000153 - 0.000525	NA	--
2,3,4,7,8-PeCDF	10/10	--	0.0000111 - 0.000452	NA	--
2,3,7,8-TCDD	10/10	--	0.00000151 - 0.0000161	NA	--
2,3,7,8-TCDF	10/10	--	0.00000426 - 0.000154	NA	--
Semivolatile Organic Compounds					
1,2,3,4-Tetrahydronaphthalene	1/1	0.98 - 0.98	0.39216	--	--
1,2,4-Trichlorobenzene	1/43	0.017 - 50	0.063J	NA	--
1,2-Dichlorobenzene	0/43	0.017 - 50	--	NA	--
1,3-Dichlorobenzene	0/43	0.017 - 50	--	NA	--
1,4-Dichlorobenzene	2/50	0.006 - 50	0.21J	NA	--
2,2'-Oxybis(1-chloropropane)	0/9	0.38 - 0.88	--	NA	--
2,4,5-Trichlorophenol	1/43	0.38 - 140	0.076J	NA	--
2,4,6-Trichlorophenol	0/43	0.35 - 28	--	NA	--
2,4-Dichlorophenol	0/43	0.35 - 28	--	NA	--
2,4-Dimethylphenol	0/43	0.35 - 28	--	NA	--
2,4-Dinitrophenol	0/43	1.7 - 140	--	NA	--
2,4-Dinitrotoluene	0/43	0.35 - 28	--	NA	--
2,6,10,14-Tetramethylpentadecane	1/1	0.5 - 0.5	0.67829	NA	--
2,6-Dinitrotoluene	0/43	0.35 - 28	--	NA	--
2-Chloronaphthalene	0/43	0.35 - 28	--	NA	--
2-Chlorophenol	0/43	0.35 - 28	--	NA	--
2-Methylnaphthalene	1/29	0.35 - 28	9J	NA	--
2-Methylphenol	0/43	0.35 - 28	--	NA	--
2-Nitroaniline	0/43	0.76 - 140	--	NA	--
2-Nitrophenol	1/43	0.35 - 28	0.3	NA	--
3,3'-Dichlorobenzidine	0/43	0.69 - 55	--	NA	--
3-Heptanone,2,4-Dimethyl-C9H18O	0/0	--	--	NA	--
3-Nitroaniline	0/43	0.76 - 140	--	NA	--
4,6-Dinitro-2-methylphenol	0/43	1.7 - 140	--	NA	--
4-Bromophenyl-phenylether	0/43	0.35 - 28	--	NA	--
4-Chloro-3-methylphenol	0/43	0.35 - 28	--	NA	--
4-Chloroaniline	0/43	0.35 - 28	--	NA	--
4-Chlorophenyl-phenylether	0/43	0.35 - 28	--	NA	--
4-Methylphenol	0/43	0.35 - 28	--	NA	--
4-Nitroaniline	0/43	0.76 - 140	--	NA	--
4-Nitrophenol	0/43	0.76 - 140	--	NA	--
5-Methylhex-5-en-2-one	0/0	--	--	NA	--

Table 4-11. Summary of Analyses and Detections in the Panhandle Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Acenaphthene	6/43	0.35 - 28	0.041J - 2.3J	NA	--
Acenaphthylene	6/52	0.35 - 28	0.014J - 0.054J	NA	--
Anthracene	7/52	0.35 - 28	0.037J - 0.081J	NA	--
Azobenzene	0/0	--	--	NA	--
Benzo(a)anthracene	13/52	0.35 - 28	0.02J - 0.5J	NA	--
Benzo(a)pyrene	15/52	0.35 - 28	0.02J - 0.65J	NA	--
Benzo(b)fluoranthene	15/52	0.35 - 28	0.039J - 0.88	NA	--
Benzo(e)pyrene	0/9	3.7 - 4.4	--	NA	--
Benzo(g,h,i)perylene	10/52	0.35 - 28	0.031J - 0.45J	NA	--
Benzo(k)fluoranthene	11/52	0.35 - 28	0.019J - 0.33J	NA	--
Benzoic acid	0/29	1.7 - 140	--	NA	--
Benzyl alcohol	0/29	0.35 - 28	--	NA	--
Biphenyl	0/9	3.4 - 4	--	NA	--
Bis(2-chloroethoxy)methane	0/43	0.35 - 28	--	NA	--
Bis(2-chloroethyl)ether	0/43	0.35 - 28	--	NA	--
Bis(2-chloroisopropyl)ether	0/34	0.35 - 28	--	NA	--
Bis(2-ethylhexyl)phthalate	10/52	0.33 - 28	0.12J - 1.1	NA	--
Butylbenzylphthalate	0/43	0.35 - 28	--	NA	--
Carbazole	0/9	3.7 - 4.4	--	NA	--
Chrysene	18/52	0.35 - 28	0.018J - 0.47J	NA	--
Cyclic Octaatomic sulfur	2/2	--	1.25969 - 4.16667	NA	--
Dibenz(a,h)anthracene	0/52	0.35 - 28	--	NA	--
Dibenzofuran	1/52	0.35 - 28	0.17J	NA	--
Diethylphthalate	0/52	0.35 - 28	--	NA	--
Dimethylphthalate	1/43	0.35 - 28	2	NA	--
Di-n-butylphthalate	3/43	0.35 - 28	0.075J - 3.7	NA	--
Di-n-octylphthalate	0/43	0.35 - 28	--	NA	--
Dioctyl ester hexanedioic acid	1/1	--	11.7708	NA	--
Fluoranthene	18/52	0.35 - 28	0.02J - 0.99J	NA	--
Fluorene	4/52	0.35 - 28	0.037J - 0.1J	NA	--
Heptadecane	1/1	0.25	0.5814	NA	--
Hexachlorobenzene	0/43	0.35 - 28	--	NA	--
Hexachlorobutadiene	0/43	0.35 - 50	--	NA	--
Hexachlorocyclopentadiene	0/43	0.35 - 28	--	NA	--
Hexachloroethane	0/43	0.35 - 28	--	NA	--
Hexadecane	1/1	0.25	0.3876	NA	--
Hexadecanoic acid	0/0	--	--	NA	--
Indeno(1,2,3-cd)pyrene	8/52	0.35 - 28	0.02J - 0.32J	NA	--
Isophorone	0/29	0.35 - 28	--	NA	--
Naphthalene	14/56	0.35 - 50	0.039J - 120	NA	--
Nitrobenzene	0/43	0.35 - 28	--	NA	--
n-Nitrosodimethylamine	0/0	--	--	NA	--
n-Nitroso-di-n-propylamine	0/52	0.35 - 28	--	NA	--
n-Nitrosodiphenylamine	0/52	0.35 - 28	--	NA	--
Octacosane	0/0	--	--	NA	--
Pentachlorophenol	1/52	0.76 - 140	0.11J	NA	--
Phenacetin	0/9	7.4 - 8.7	--	NA	--
Phenanthrene	18/52	0.11 - 28	0.019J - 2.3J	NA	--
Phenol	2/52	0.35 - 28	0.043J - 0.048J	NA	--
Pyrene	20/52	0.35 - 28	0.023J - 1.3	NA	--
Volatile Organic Compounds					
1,1,1,2-Tetrachloroethane	0/4	11 - 50	--	NA	--
1,1,1-Trichloroethane	0/35	0.005 - 50	--	NA	--
1,1,2,2-Tetrachloroethane	0/35	0.005 - 50	--	NA	--
1,1,2-Trichloro-1,2,2-trifluoroethane	0/6	0.034 - 50	--	NA	--
1,1,2-Trichloroethane	0/35	0.005 - 50	--	NA	--
1,1-Dichloroethane	0/35	0.005 - 50	--	NA	--
1,1-Dichloroethene	0/35	0.005 - 50	--	NA	--

Table 4-11. Summary of Analyses and Detections in the Panhandle Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Volatile Organic Compounds *(continued)*					
1,1-Dichloropropene	0/4	11 - 50	--	NA	--
1,2,3-Trichlorobenzene	0/6	0.017 - 50	--	NA	--
1,2,3-Trichloropropane	0/4	11 - 50	--	NA	--
1,2,3-Trimethylbenzene	1/1	0.006 - 0.006	0.01646	NA	--
1,2,4-Trimethylbenzene	2/5	11 - 330	1.56863 - 48	NA	--
1,2-Dibromo-3-chloropropane	0/6	0.034 - 50	--	NA	--
1,2-Dibromoethane	0/6	0.017 - 50	--	NA	--
1,2-Dichloroethane	0/35	0.005 - 50	--	NA	--
1,2-Dichloroethene (Total)	0/31	0.005 - 3.5	--	NA	--
1,2-Dichloropropane	0/35	0.005 - 50	--	NA	--
1,3,5-Trimethylbenzene	3/6	0.006 - 50	0.02289 - 12J	NA	--
1,3-Dichloropropane	0/4	11 - 50	--	NA	--
2,2-Dichloropropane	0/4	11 - 50	--	NA	--
2-Butanone	6/35	0.01 - 100	0.001J - 0.02553	NA	--
2-Chloroethyl vinyl ether	0/3	11 - 50	--	NA	--
2-Chlorotoluene	0/4	11 - 50	--	NA	--
2-Hexanone	1/35	0.01 - 100	0.01085J	NA	--
4-Chlorotoluene	0/4	11 - 50	--	NA	--
4-Isopropyl toluene	0/4	11 - 50	--	NA	--
4-Methyl-2-pentanone	0/35	0.01 - 100	--	NA	--
Acetone	0/33	0.01 - 100	--	NA	--
Benzene	0/35	0.005 - 50	--	NA	--
Bromobenzene	0/4	11 - 50	--	NA	--
Bromochloromethane	0/6	0.017 - 50	--	NA	--
Bromodichloromethane	0/35	0.005 - 50	--	NA	--
Bromoform	0/35	0.005 - 50	--	NA	--
Bromomethane	0/35	0.01 - 50	--	NA	--
Carbon disulfide	3/35	0.005 - 100	0.002J - 0.01001	NA	--
Carbon tetrachloride	0/35	0.005 - 50	--	NA	--
Chlorobenzene	0/35	0.005 - 50	--	NA	--
Chloroethane	0/35	0.01 - 50	--	NA	--
Chloroform	1/35	0.005 - 50	0.0015J	NA	--
Chloromethane	0/35	0.01 - 50	--	NA	--
cis-1,2-Dichloroethene	0/6	0.017 - 50	--	NA	--
cis-1,3-Dichloropropene	0/35	0.005 - 50	--	NA	--
Dibromochloromethane	0/35	0.005 - 50	--	NA	--
Dibromomethane	0/4	11 - 50	--	NA	--
Dichlorodifluoromethane	0/6	0.017 - 50	--	NA	--
Ethylbenzene	3/35	0.005 - 50	0.01152 - 6.7J	NA	--
Isopropylbenzene	4/6	0.017 - 50	--	NA	--
Methylene chloride	0/35	0.005 - 50	--	NA	--
n-Butylbenzene	2/4	11 - 50	3.8J - 27J	NA	--
o-Xylene	1/4	11 - 50	4.9J	NA	--
Propylbenzene	3/4	11 - 50	4.3J - 37J	NA	--
sec-Butylbenzene	3/4	11 - 50	11J - 33J	NA	--
Styrene	0/35	0.005 - 50	--	NA	--
tert-Butyl methyl ether	0/6	0.034 - 50	--	NA	--
tert-Butylbenzene	1/4	11 - 50	1.8J	NA	--
Tetrachloroethene	0/35	0.005 - 50	--	NA	--
Toluene	6/35	0.005 - 50	0.001J - 2.1J	NA	--
trans-1,2-Dichloroethene	0/6	0.017 - 50	--	NA	--
trans-1,3-Dichloropropene	0/35	0.005 - 50	--	NA	--
Trichloroethene	0/35	0.005 - 50	--	NA	--
Trichlorofluoromethane	0/6	0.017 - 50	--	NA	--
Vinyl acetate	0/33	0.01 - 100	--	NA	--
Vinyl chloride	0/35	0.01 - 50	--	NA	--
Xylene (Total)	3/35	0.005 - 50	0.00656 - 15J	NA	--

Table 4-11. Summary of Analyses and Detections in the Panhandle Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Petroleum Hydrocarbons					
Gasoline-range organics	5/28	1 - 69	0.15J - 79	NA	--
Diesel-range organics	16/29	11 - 380	3.8J - 830	NA	--
Motor oil-range organics	0/0	--	--	NA	--
TPH-extractable unknown hydrocarbo	4/8	11 - 88	9J - 220	NA	--
TPH-purgeable unknown hydrocarbon	0/3	1.2	--	NA	--
Total TPH	20/29	1 - 380	3.95 - 887	NA	--
Total oil and grease	26/29	27 - 120	56 - 5,800	NA	--

Notes

(1) rejected data are not included in detection frequency

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical
bgs below ground surface
BHC benzene hexachloride
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethene
DDT dichlorodiphenyltrichloroethane
HpCDD heptachlorodibenzo-p-dioxin
HpCDF heptachlorodibenzofuran
HQ hazard quotient
HxCDD hexachlorodibenzo-p-dioxin
HxCDF hexachlorodibenzofuran
J estimated value
mg/kg milligrams per kilogram
NA not available
OCDD octachlorodibenzo-p-dioxin
OCDF octachlorodibenzofuran
PCB polychlorinated biphenyl
PeCDD pentachlorodibeno-p-dioxin
PeCDF pentachlorodibenzofuran
TPH total petroleum hydrocarbons

Table 4-12. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (2-10 feet bgs)
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Metals				
Aluminum	100,000	2004 PRG Industrial	0	0
Antimony	380	2005 ESL Industrial (direct exp)	0	0
Arsenic	11.1	HPAL	12	0
Barium	63,000	2005 ESL Industrial (direct exp)	0	0
Beryllium	36	2005 ESL Industrial (direct exp)	0	0
Cadmium	7.4	2005 ESL Industrial (direct exp)	4	0
Calcium	--		--	--
Chromium (total)	a	See note	0	0
Chromium VI	37	2005 ESL Industrial (direct exp)	0	0
Cobalt	a	See note	0	0
Copper	38,000	2005 ESL Industrial (direct exp)	0	0
Cyanide (free)	12,000	2004 PRG Industrial	0	0
Iron	100,000	2004 PRG Industrial	2	0
Lead	800	2004 PRG Industrial	13	0
Magnesium	--		--	--
Manganese	19,000	2004 PRG Industrial	0	0
Mercury	180	2005 ESL Industrial (direct exp)	0	0
Molybdenum	4,800	2005 ESL Industrial (direct exp)	0	0
Nickel	a	See note	0	0
Potassium	--		--	--
Selenium	4,800	2005 ESL Industrial (direct exp)	0	0
Silver	4,800	2005 ESL Industrial (direct exp)	0	0
Sodium	--		--	--
Thallium	63	2005 ESL Industrial (direct exp)	0	0
Tin	100,000	2004 PRG Industrial	0	0
Vanadium	1,000	2004 PRG Industrial	0	0
Zinc	100,000	2004 PRG Industrial	1	0
Pesticides				
2,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
2,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
2,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
4,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
Aldrin	0.1	2004 PRG Industrial	0	0
alpha-BHC	0.36	2004 PRG Industrial	0	0
Alpha-chlordane	2.9	SDGI Industrial Criteria	0	0
beta-BHC	1.3	2004 PRG Industrial	0	0
Chlordane	1.7	2005 ESL Industrial (direct exp)	0	0
cis-Nonachlor	--		--	--
delta-BHC	0.59	SDGI Industrial Criteria	0	0
Dieldrin	0.11	2004 PRG Industrial	0	0
Endosulfan I	3,700	2004 PRG Industrial	0	0
Endosulfan II	3,700	2004 PRG Industrial	0	0
Endosulfan sulfate	5,300	SDGI Industrial Criteria	0	0
Endrin	180	2004 PRG Industrial	0	0
Endrin aldehyde	260	SDGI Industrial Criteria	0	0
Endrin ketone	260	SDGI Industrial Criteria	0	0
Gamma-BHC (lindane)	1.7	2004 PRG Industrial	0	0
Gamma-chlordane	2.9	SDGI Industrial Criteria	0	0
Heptachlor	0.38	2004 PRG Industrial	0	0
Heptachlor epoxide	0.19	2004 PRG Industrial	0	0
Heptachlor epoxide A	--		--	--
Heptachlor epoxide B	--		--	--
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Methoxychlor	3,100	2004 PRG Industrial	0	0
Mirex	--		--	--
Oxychlordane	--		--	--
Toxaphene	1.6	2004 PRG Industrial	0	0
trans-Nonachlor	21	2004 PRG Industrial	0	0

Table 4-12. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Polychlorinated Biphenyls				
Aroclor-1016 (low risk PCB)	21	2004 PRG Industrial	0	0
Aroclor-1221 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1232 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1242 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1248 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1254 (high risk PCB)	0.74	2004 PRG Industrial	3	0
Aroclor-1260 (high risk PCB)	0.74	2004 PRG Industrial	4	0
Total (high risk) PCBs	0.74	2004 PRG Industrial	7	0
Dioxins and Furans				
1,2,3,4,6,7,8,9-OCDD	0.027	SDGI Industrial Criteria	0	0
1,2,3,4,6,7,8,9-OCDF	0.027	SDGI Industrial Criteria	0	0
1,2,3,4,6,7,8-HpCDD	0.0027	SDGI Industrial Criteria	0	0
1,2,3,4,6,7,8-HpCDF	0.0027	SDGI Industrial Criteria	0	0
1,2,3,4,7,8,9-HpCDF	0.0027	SDGI Industrial Criteria	0	0
1,2,3,4,7,8-HxCDD	0.00027	SDGI Industrial Criteria	0	0
1,2,3,4,7,8-HxCDF	0.00027	SDGI Industrial Criteria	1	0
1,2,3,6,7,8-HxCDD	0.00027	SDGI Industrial Criteria	0	0
1,2,3,6,7,8-HxCDF	0.00027	SDGI Industrial Criteria	1	0
1,2,3,7,8,9-HxCDD	0.00027	SDGI Industrial Criteria	0	0
1,2,3,7,8,9-HxCDF	0.00027	SDGI Industrial Criteria	0	0
1,2,3,7,8-PeCDD	0.000055	SDGI Industrial Criteria	1	0
1,2,3,7,8-PeCDF	0.00055	SDGI Industrial Criteria	0	0
2,3,4,6,7,8-HxCDF	0.00027	SDGI Industrial Criteria	1	0
2,3,4,7,8-PeCDF	0.000055	SDGI Industrial Criteria	8	0
2,3,7,8-TCDD	0.000016	2004 PRG Industrial	1	0
2,3,7,8-TCDF	0.00027	SDGI Industrial Criteria	1	0
TEQ (for 2,3,7,8-TCDD)	0.000016	2004 PRG Industrial	8	0
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	0	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	1	0
2,2'-Oxybis(1-chloropropane)	7.4	2004 PRG Industrial	0	0
2,4,5-Trichlorophenol	61	2005 ESL Industrial (inhalation)	0	0
2,4,6-Trichlorophenol	25	2005 ESL Industrial (direct exp)	0	0
2,4-Dichlorophenol	1,800	2004 PRG Industrial	0	0
2,4-Dimethylphenol	1,500	2005 ESL Industrial (inhalation)	0	0
2,4-Dinitrophenol	1,200	2004 PRG Industrial	0	0
2,4-Dinitrotoluene	5.6	2005 ESL Industrial (direct exp)	0	0
2,6-Dinitrotoluene	620	2004 PRG Industrial	0	0
2-Chloronaphthalene	23,000	2004 PRG Industrial	0	0
2-Chlorophenol	10	2005 ESL Industrial (inhalation)	0	0
2-Methylnaphthalene	550	2005 ESL Industrial (inhalation)	0	0
2-Methylphenol	31,000	2004 PRG Industrial	0	0
2-Nitroaniline	1,800	2004 PRG Industrial	0	0
2-Nitrophenol	--		--	--
3,3'-Dichlorobenzidine	1.4	2005 ESL Industrial (direct exp)	0	0
3-Nitroaniline	82	2004 PRG Industrial	0	0
4,6-Dinitro-2-methylphenol	--		--	--
4-Bromophenyl-phenylether	--		--	--
4-Chloro-3-methylphenol	--		--	--
4-Chloroaniline	2,500	2004 PRG Industrial	0	0
4-Chlorophenyl-phenylether	--		--	--
4-Methylphenol	3,100	2004 PRG Industrial	0	0
4-Nitroaniline	82	2004 PRG Industrial	0	0
4-Nitrophenol	7,000	SDGI Industrial Criteria	0	0
Acenaphthene	650	2005 ESL Industrial (inhalation)	0	0
Acenaphthylene	18,000	2005 ESL Industrial (direct exp)	0	0

Table 4-12. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Semivolatile Organic Compounds *(continued)*				
Aniline	300	2004 PRG Industrial	0	0
Anthracene	31	2005 ESL Industrial (inhalation)	0	0
Azobenzene	16	2004 PRG Industrial	0	0
Benzidine	--		--	--
Benzo(a)anthracene	1.3	2005 ESL Industrial (direct exp)	0	0
Benzo(a)pyrene	0.33	SDGI Industrial Criteria	6	0
Benzo(b)fluoranthene	1.3	2005 ESL Industrial (direct exp)	0	0
Benzo(e)pyrene	--		--	--
Benzo(g,h,i)perylene	22,000	2005 ESL Industrial (direct exp)	0	0
Benzo(k)fluoranthene	1.3	2005 ESL Industrial (direct exp)	0	0
Benzoic acid	100,000	2004 PRG Industrial	0	0
Benzyl alcohol	100,000	2004 PRG Industrial	0	0
Biphenyl	18,000	2005 ESL Industrial (direct exp)	0	0
Bis(2-chloroethoxy)methane	--		--	--
Bis(2-chloroethyl)ether	0.012	2005 ESL Industrial (inhalation)	0	0
Bis(2-ethylhexyl)phthalate	120	2004 PRG Industrial	0	0
Butylbenzylphthalate	100,000	2004 PRG Industrial	0	0
Carbazole	86	2004 PRG Industrial	0	0
Chrysene	13	2005 ESL Industrial (direct exp)	0	0
Dibenz(a,h)anthracene	0.33	SDGI Industrial Criteria	0	0
Dibenzofuran	1600	2004 PRG Industrial	0	0
Diethylphthalate	100,000	2004 PRG Industrial	0	0
Dimethylphthalate	100,000	2004 PRG Industrial	0	0
Di-n-butylphthalate	62,000	2004 PRG Industrial	0	0
Di-n-octylphthalate	25,000	2004 PRG Industrial	0	0
Fluoranthene	22,000	2004 PRG Industrial	0	0
Fluorene	800	2005 ESL Industrial (inhalation)	0	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Hexachlorocyclopentadiene	3,700	2004 PRG Industrial	0	0
Hexachloroethane	44	2005 ESL Industrial (direct exp)	0	0
Indeno(1,2,3-cd)pyrene	1.3	2005 ESL Industrial (direct exp)	0	0
Isophorone	510	2004 PRG Industrial	0	0
Naphthalene	1.5	2005 ESL Industrial (inhalation)	7	0
Nitrobenzene	100	2004 PRG Industrial	0	0
n-Nitrosodimethylamine	0.034	2004 PRG Industrial	0	0
n-Nitroso-di-n-propylamine	0.25	2004 PRG Industrial	0	0
n-Nitrosodiphenylamine	350	2004 PRG Industrial	0	0
Pentachlorophenol	9	2004 PRG Industrial	0	0
Phenacetin	--		--	--
Phenanthrene	18,000	2005 ESL Industrial (direct exp)	0	0
Phenol	100,000	2004 PRG Industrial	0	0
Pyrene	425	2005 ESL Industrial (inhalation)	0	0
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	6.9	2005 ESL Industrial (direct exp)	0	0
1,1,1-Trichloroethane	230	2005 ESL Industrial (inhalation)	0	0
1,1,2,2-Tetrachloroethane	0.025	2005 ESL Industrial (inhalation)	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	--		--	--
1,1,2-Trichloroethane	0.089	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethane	0.89	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethene	105	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloropropene	--		--	--
1,2,3-Trichlorobenzene	--		--	--
1,2,3-Trichloropropane	--		--	--
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dibromo-3-chloropropane	0.067	2005 ESL Industrial (direct exp)	0	0
1,2-Dibromoethane	0.02	2005 ESL Industrial (inhalation)	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethane	0.07	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethene (Total)	150	SDGI Industrial Criteria	0	0

Table 4-12. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Volatile Organic Compounds *(continued)*				
1,2-Dichloropropane	0.14	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,3-Dichloropropane	--		--	--
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	1	0
2,2-Dichloropropane	--		--	--
2-Butanone	6,500	2005 ESL Industrial (inhalation)	0	0
2-Chloroethyl vinyl ether	--		--	--
2-Chlorotoluene	--		--	--
2-Hexanone	--		--	--
4-Chlorotoluene	--		--	0
4-Methyl-2-pentanone	1,550	2005 ESL Industrial (inhalation)	0	0
Acetone	16,500	2005 ESL Industrial (inhalation)	0	0
Benzene	0.38	2005 ESL Industrial (direct exp)	0	0
Bromobenzene	--		--	--
Bromochloromethane	--		--	--
Bromodichloromethane	0.039	2005 ESL Industrial (inhalation)	0	0
Bromoform	220	2004 PRG Industrial	0	0
Bromomethane	2.6	2005 ESL Industrial (inhalation)	0	0
Carbon disulfide	720	2004 PRG Industrial	0	0
Carbon tetrachloride	0.034	2005 ESL Industrial (inhalation)	0	0
Chlorobenzene	31	2005 ESL Industrial (inhalation)	0	0
Chloroethane	1.8	2005 ESL Industrial (inhalation)	0	0
Chloroform	0.47	2004 PRG Industrial	0	0
Chloromethane	0.2	2005 ESL Industrial (inhalation)	0	0
cis-1,2-Dichloroethene	18	2005 ESL Industrial (inhalation)	0	0
cis-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Dibromochloromethane	0.054	2005 ESL Industrial (inhalation)	0	0
Dibromomethane	--		--	--
Dichlorodifluoromethane	310	2004 PRG Industrial	0	0
Ethylbenzene	5	2008 ESL Industrial (direct exp)	1	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Isopropylbenzene	2,000	2004 PRG Industrial	0	0
Methylcyclohexane	2,600	2004 PRG Industrial	0	0
Methylene chloride	1.5	2005 ESL Industrial (inhalation)	0	0
n-Butylbenzene	240	2004 PRG Industrial	0	0
o-Xylene	210	SDGI Industrial Criteria	0	0
para-Isopropyl toluene	--		--	--
Propylbenzene	240	2004 PRG Industrial	0	0
sec-Butylbenzene	220	2004 PRG Industrial	0	0
Styrene	1,100	2005 ESL Industrial (inhalation)	0	0
tert-Butyl methyl ether	5.6	2005 ESL Industrial (inhalation)	0	0
tert-Butylbenzene	390	2004 PRG Industrial	0	0
Tetrachloroethene	0.24	2005 ESL Industrial (inhalation)	0	0
Toluene	520	2004 PRG Industrial	0	0
trans-1,2-Dichloroethene	37	2005 ESL Industrial (inhalation)	0	0
trans-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Trichloroethene	0.11	2004 PRG Industrial	0	0
Trichlorofluoromethane	2,000	2004 PRG Industrial	0	0
Vinyl acetate	1,400	2004 PRG Industrial	0	0
Vinyl chloride	0.019	2005 ESL Industrial (inhalation)	0	0
Xylene (Total)	420	2004 PRG Industrial	0	0
Petroleum Hydrocarbons				
Gasoline-range organics	750	2005 ESL Industrial (direct exp)	0	0
Diesel-range organics	750	2005 ESL Industrial (direct exp)	1	0
Motor oil-range organics	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-extractable unknown hydrocarbons	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-purgeable unknown hydrocarbons	750	2005 ESL Industrial (direct exp)	0	0
Total TPH	3,500	HPS TPH source criterion	0	0
Total oil and grease	3,500	HPS TPH source criterion	2	0

Table 4-12. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Notes:

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

–	No criteria available for this chemical
bgs	below ground surface
BHC	benzene hexachloride
Conc.	concentration
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
ESL	environmental screening level
HPAL	Hunters Point ambient level
HPS	Hunters Point Shipyard
mg/kg	milligrams per kilogram
NE	not established
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
RIEC	remedial investigation evaluation criteria
SDGI	standard data gaps investigation
TEQ	toxicity equivalent quotient
TPH	total petroleum hydrocarbon

Table 4-13. Summary of Analyses and Detections in the Panhandle Area (greater than 10 feet bgs)
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Metals					
Aluminum	36/36	0.2 - 15	2,090 - 25,300	NA	--
Antimony	11/40	0.01 - 8.8	0.22J - 27	9.05	5
Arsenic	36/40	0.05 - 8	1.3J - 20	11.1	6
Barium	38/40	0.04 - 435	11.69 - 1,300	314.4	5
Beryllium	25/40	0.01 - 1.5	0.12 - 0.91	0.71	4
Cadmium	13/40	0.01 - 1.5	0.35 - 6.3	3.14	1
Calcium	36/36	0.93 - 59	1,315.87 - 73,800	NA	--
Chromium	40/40	0.05 - 43	16.8 - 699.74	a	2
Chromium VI	1/62	0.05 - 0.12	0.58J	NA	--
Cobalt	39/40	0.01 - 108	3.65 - 115.03	a	1
Copper	36/40	0.01 - 54	1.65 - 4190	124.3	9
Cyanide	16/31	0.07 - 1.2	0.08J - 2.61J	NA	--
Iron	36/36	0.4 - 13.7	7,141.99 - 55,860.8	NA	--
Lead	39/40	0.01 - 33	1.2 - 3,200	8.99	28
Magnesium	36/36	0.14 - 59	1,340J - 136,981	NA	--
Manganese	40/40	0.01 - 108	46.81 - 2,370	1431.2	2
Mercury	17/40	0.07 - 1.3	0.09J - 0.86	2.28	0
Molybdenum	11/34	0.01 - 2.9	0.68 - 12.7	2.68	6
Nickel	40/40	0.01 - 108	15.8 - 2,557.66	a	0
Potassium	32/36	0.58 - 848	428 - 4,390	NA	--
Selenium	8/40	0.02 - 1.4	0.25 - 3.9	1.95	4
Silver	10/40	0.01 - 4	0.13 - 2.7	1.43	1
Sodium	36/36	0.78 - 59	147 - 6,793.88	NA	--
Thallium	1/40	0.04 - 3.8	0.09J	0.81	0
Tin	0/3	3.2 - 3.6	--	NA	--
Vanadium	40/40	0.32 - 108	5.4 - 200	117.2	1
Zinc	40/40	0.12 - 108	12.82 - 3,600	109.9	13
Pesticides					
2,4'-DDD	0/0	--	--	NA	--
2,4'-DDE	0/0	--	--	NA	--
2,4'-DDT	0/0	--	--	NA	--
4,4'-DDD	1/38	0.0042 - 0.093	0.0044J	NA	--
4,4'-DDE	3/38	0.003 - 0.093	0.003J - 0.0046	NA	--
4,4'-DDT	2/38	0.0042 - 0.093	0.0024J - 0.082	NA	--
Aldrin	0/38	0.0021 - 0.17	--	NA	--
alpha-BHC	0/38	0.0021 - 0.17	--	NA	--
alpha-Chlordane	0/34	0.0021 - 0.46	--	NA	--
beta-BHC	1/38	0.0021 - 0.17	0.0032J	NA	--
Chlordane	0/3	0.048 - 0.16	--	NA	--
cis-Nonachlor	0/0	--	--	NA	--
delta-BHC	0/38	0.0021 - 0.17	--	NA	--
Dieldrin	4/38	0.0042 - 0.093	0.0011J - 0.024	NA	--
Endosulfan I	0/38	0.0021 - 0.046	--	NA	--
Endosulfan II	0/38	0.0042 - 0.093	--	NA	--
Endosulfan sulfate	0/38	0.0042 - 0.093	--	NA	--
Endrin	0/38	0.0042 - 0.093	--	NA	--
Endrin aldehyde	0/6	0.0042 - 0.02	--	NA	--
Endrin ketone	1/38	0.0042 - 0.093	0.0069J	NA	--
gamma-BHC (lindane)	0/38	0.0021 - 0.17	--	NA	--
gamma-Chlordane	0/0	--	--	NA	--
Heptachlor	0/38	0.0021 - 0.17	--	NA	--
Heptachlor epoxide	2/38	0.0021 - 0.046	0.00096J - 0.0021J	NA	--
Methoxychlor	2/38	0.021 - 0.46	0.01J - 0.013J	NA	--
Mirex	0/2	0.0021 - 0.0098	--	NA	--
Oxychlordane	0/0	--	--	NA	--
Toxaphene	0/38	0.076 - 0.93	--	NA	--
trans-Chlordane	0/34	0.021 - 0.46	--	NA	--
trans-Nonachlor	0/0	--	--	NA	--

Table 4-13. Summary of Analyses and Detections in the Panhandle Area (greater than 10 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Polychlorinated Biphenyls					
Aroclor-1016 (low risk PCB)	0/38	0.018 - 1	--	NA	--
Aroclor-1221 (high risk PCB)	0/38	0.018 - 1	--	NA	--
Aroclor-1232 (high risk PCB)	0/38	0.018 - 1	--	NA	--
Aroclor-1242 (high risk PCB)	0/38	0.018 - 1	--	NA	--
Aroclor-1248 (high risk PCB)	0/38	0.018 - 0.46	--	NA	--
Aroclor-1254 (high risk PCB)	2/38	0.018 - 0.93	0.052J - 0.19	NA	--
Aroclor-1260 (high risk PCB)	5/38	0.018 - 0.93	0.0041 - 0.22	NA	--
Total (high risk) PCBs	5/38	0.018 - 1	0.0041 - 0.41	NA	--
Dioxins and Furans					
1,2,3,4,6,7,8,9-OCDD	2/2	--	0.000173 - 0.00584	NA	--
1,2,3,4,6,7,8,9-OCDF	0/0	--	--	NA	--
1,2,3,4,6,7,8-Heptachlorooxanthrene	2/2	--	0.0000711 - 0.0016	NA	--
1,2,3,4,6,7,8-HpCDD	2/2	--	0.0000234 - 0.00042	NA	--
1,2,3,4,6,7,8-HpCDF	0/0	--	0.000196 - 0.00495	NA	--
1,2,3,4,7,8,9-HpCDF	0/0	--	0.0000234 - 0.00042	NA	--
1,2,3,4,7,8-HxCDD	2/2	--	0.00000695 - 0.000104	NA	--
1,2,3,4,7,8-HxCDF	2/2	--	0.0000763 - 0.00127	NA	--
1,2,3,6,7,8-HxCDD	2/2	--	0.0000124 - 0.00021	NA	--
1,2,3,6,7,8-HxCDF	2/2	--	0.0000631 - 0.00107	NA	--
1,2,3,7,8,9-HxCDD	2/2	--	0.00000965 - 0.000153	NA	--
1,2,3,7,8,9-HxCDF	2/2	--	0.0000187 - 0.000276	NA	--
1,2,3,7,8-PeCDD	2/2	--	0.0000092 - 0.0000953	NA	--
1,2,3,7,8-PeCDF	2/2	--	0.0000447 - 0.000507	NA	--
2,3,4,6,7,8-HxCDF	2/2	--	0.0000747 - 0.0012	NA	--
2,3,4,7,8-PeCDF	2/2	--	0.0000808 - 0.000986	NA	--
2,3,7,8-TCDD	2/2	--	0.00000237 - 0.0000207	NA	--
2,3,7,8-TCDF	2/2	--	0.0000352 - 0.000323	NA	--
Semivolatile Organic Compounds					
1,2,3,4-Tetrahydronaphthalene	0/0	--	--	NA	--
1,2,4-Trichlorobenzene	0/38	0.36 - 26	--	NA	--
1,2-Dichlorobenzene	0/38	0.36 - 26	--	NA	--
1,3-Dichlorobenzene	0/38	0.36 - 26	--	NA	--
1,4-Dichlorobenzene	0/38	0.36 - 26	--	NA	--
2,2'-Oxybis(1-chloropropane)	0/1	0.42 - 0.42	--	NA	--
2,4,5-Trichlorophenol	0/38	0.42 - 130	--	NA	--
2,4,6-Trichlorophenol	0/38	0.36 - 26	--	NA	--
2,4-Dichlorophenol	0/38	0.36 - 26	--	NA	--
2,4-Dimethylphenol	0/38	0.36 - 26	--	NA	--
2,4-Dinitrophenol	0/38	1.7 - 130	--	NA	--
2,4-Dinitrotoluene	0/38	0.36 - 26	--	NA	--
2,6,10,14-Tetramethylpentadecane	0/0	--	--	NA	--
2,6-Dinitrotoluene	0/38	0.36 - 26	--	NA	--
2-Chloronaphthalene	0/38	0.36 - 26	--	NA	--
2-Chlorophenol	0/38	0.36 - 26	--	NA	--
2-Methylnaphthalene	3/34	0.015 - 26	0.041J - 7.4	NA	--
2-Methylphenol	0/38	0.36 - 26	--	NA	--
2-Nitroaniline	0/38	0.84 - 130	--	NA	--
2-Nitrophenol	0/38	0.36 - 26	--	NA	--
3,3'-Dichlorobenzidine	0/38	0.72 - 52	--	NA	--
2,4-Dimethylheptan-3-one	2/2	--	1.21951 - 1.74863	NA	--
3-Nitroaniline	0/38	0.84 - 130	--	NA	--
4,6-Dinitro-2-methylphenol	0/38	1.7 - 130	--	NA	--
4-Bromophenyl-phenylether	0/38	0.36 - 26	--	NA	--
4-Chloro-3-methylphenol	0/38	0.36 - 26	--	NA	--
4-Chloroaniline	0/38	0.36 - 26	--	NA	--
4-Chlorophenyl-phenylether	0/38	0.36 - 26	--	NA	--
4-Methylphenol	0/38	0.36 - 26	--	NA	--
4-Nitroaniline	0/38	0.84 - 130	--	NA	--
4-Nitrophenol	1/38	0.84 - 130	0.091J	NA	--
5-Methylhex-5-en-2-one	1/1	--	2.51366	NA	--

Table 4-13. Summary of Analyses and Detections in the Panhandle Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Acenaphthene	1/38	0.36 - 26	0.078J	NA	--
Acenaphthylene	0/40	0.36 - 26	--	NA	--
Anthracene	3/40	0.36 - 26	0.07J - 1.6J	NA	--
Azobenzene	0/0	--	--	NA	--
Benzo(a)anthracene	4/40	0.36 - 26	0.096J - 3.3J	NA	--
Benzo(a)pyrene	5/40	0.36 - 26	0.13J - 1.4J	NA	--
Benzo(b)fluoranthene	4/40	0.36 - 26	0.15J - 3.6J	NA	--
Benzo(e)pyrene	0/2	3.8 - 4.1	--	NA	--
Benzo(g,h,i)perylene	3/40	0.36 - 26	0.052J - 1.9J	NA	--
Benzo(k)fluoranthene	3/40	0.36 - 26	0.076J - 0.22J	NA	--
Benzoic acid	2/34	1.7 - 130	0.15J - 0.34J	NA	--
Benzyl alcohol	0/34	0.36 - 26	--	NA	--
Biphenyl	0/2	3.5 - 3.7	--	NA	--
Bis(2-chloroethoxy)methane	0/38	0.36 - 26	--	NA	--
Bis(2-chloroethyl)ether	0/38	0.36 - 26	--	NA	--
Bis(2-chloroisopropyl)ether	0/37	0.36 - 26	--	NA	--
Bis(2-ethylhexyl)phthalate	2/40	0.36 - 26	0.23J - 0.24J	NA	--
Butylbenzylphthalate	0/38	0.36 - 26	--	NA	--
Carbazole	0/2	3.8 - 4.1	--	NA	--
Chrysene	4/40	0.36 - 26	0.12J - 3.7J	NA	--
Cyclic Octaatomic sulfur	2/2	--	0.87432 - 2.76423	NA	--
Dibenz(a,h)anthracene	1/40	0.36 - 26	0.11J	NA	--
Dibenzofuran	0/40	0.36 - 26	--	NA	--
Diethylphthalate	0/40	0.36 - 26	--	NA	--
Dimethylphthalate	0/38	0.36 - 26	--	NA	--
Di-n-butylphthalate	0/38	0.36 - 26	--	NA	--
Di-n-octylphthalate	0/38	0.36 - 26	--	NA	--
Dioctyl ester hexanedioic acid	0/0	--	--	NA	--
Fluoranthene	4/40	0.36 - 26	0.13J - 5.3J	NA	--
Fluorene	2/40	0.36 - 26	0.067J - 0.086J	NA	--
Heptadecane	0/0	--	--	NA	--
Hexachlorobenzene	0/38	0.36 - 26	--	NA	--
Hexachlorobutadiene	0/38	0.36 - 26	--	NA	--
Hexachlorocyclopentadiene	0/38	0.36 - 26	--	NA	--
Hexachloroethane	0/38	0.36 - 26	--	NA	--
Hexadecane	0/0	--	--	NA	--
Hexadecanoic acid	1/1	--	1.95122 - 1.95122	NA	--
Indeno(1,2,3-cd)pyrene	1/40	0.36 - 26	2.7J	NA	--
Isophorone	0/34	0.36 - 26	--	NA	--
Naphthalene	7/40	0.015 - 26	0.073J - 110	NA	--
Nitrobenzene	0/38	0.36 - 26	--	NA	--
n-Nitrosodimethylamine	0/0	--	--	NA	--
n-Nitroso-di-n-propylamine	0/40	0.36 - 26	--	NA	--
n-Nitrosodiphenylamine	0/40	0.36 - 26	--	NA	--
Octacosane	1/1	--	0.56911	NA	--
Pentachlorophenol	0/40	0.84 - 130	--	NA	--
Phenacetin	4/2	7.6 - 8.2	0.08J - 6.3J	NA	--
Phenanthrene	0/40	0.36 - 26	--	NA	--
Phenol	0/40	0.36 - 26	--	NA	--
Pyrene	6/40	0.36 - 26	0.036J - 5J	NA	--
Volatile Organic Compounds					
1,1,1,2-Tetrachloroethane	0/0	--	--	NA	--
1,1,1-Trichloroethane	0/34	0.005 - 1.6	--	NA	--
1,1,2,2-Tetrachloroethane	0/34	0.005 - 1.6	--	NA	--
1,1,2-Trichloro-1,2,2-trifluoroethane	0/0	--	--	NA	--
1,1,2-Trichloroethane	0/34	0.005 - 1.6	--	NA	--
1,1-Dichloroethane	0/34	0.005 - 1.6	--	NA	--
1,1-Dichloroethene	0/34	0.005 - 1.6	--	NA	--
1,1-Dichloropropene	0/0	--	--	NA	--
1,2,3-Trichlorobenzene	0/0	--	--	NA	--
1,2,3-Trichloropropane	0/0	--	--	NA	--

Table 4-13. Summary of Analyses and Detections in the Panhandle Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Volatile Organic Compounds *(continued)*					
1,2,3-Trimethylbenzene	0/0	--	--	NA	--
1,2,4-Trimethylbenzene	0/0	--	--	NA	--
1,2-Dibromo-3-chloropropane	0/0	--	--	NA	--
1,2-Dibromoethane	0/0	--	--	NA	--
1,2-Dichloroethane	0/34	0.005 - 1.6	--	NA	--
1,2-Dichloroethene (Total)	0/34	0.005 - 1.6	--	NA	--
1,2-Dichloropropane	0/34	0.005 - 1.6	--	NA	--
1,3,5-Trimethylbenzene	0/0	--	--	NA	--
1,3-Dichloropropane	0/0	--	--	NA	--
2,2-Dichloropropane	0/0	--	--	NA	--
2-Butanone	3/34	0.011 - 3.2	0.002J - 0.01444	NA	--
2-Chloroethyl vinyl ether	0/0	--	--	NA	--
2-Chlorotoluene	0/0	--	--	NA	--
2-Hexanone	0/34	0.011 - 3.2	--	NA	--
4-Chlorotoluene	0/0	--	--	NA	--
4-Isopropyl toluene	0/0	--	--	NA	--
4-Methyl-2-pentanone	0/34	0.011 - 3.2	--	NA	--
Acetone	0/34	0.011 - 3.2	--	NA	--
Benzene	0/34	0.005 - 1.6	--	NA	--
Bromobenzene	0/0	--	--	NA	--
Bromochloromethane	0/0	--	--	NA	--
Bromodichloromethane	0/34	0.005 - 1.6	--	NA	--
Bromoform	0/34	0.005 - 1.6	--	NA	--
Bromomethane	0/34	0.011 - 3.2	--	NA	--
Carbon disulfide	8/34	0.005 - 1.6	0.0022J - 0.05238	NA	--
Carbon tetrachloride	0/34	0.005 - 1.6	--	NA	--
Chlorobenzene	0/34	0.005 - 1.6	--	NA	--
Chloroethane	0/34	0.011 - 3.2	--	NA	--
Chloroform	0/34	0.005 - 1.6	--	NA	--
Chloromethane	0/34	0.011 - 3.2	--	NA	--
cis-1,2-Dichloroethene	0/0	--	--	NA	--
cis-1,3-Dichloropropene	0/34	0.005 - 1.6	--	NA	--
Dibromochloromethane	0/34	0.005 - 1.6	--	NA	--
Dibromomethane	0/0	--	--	NA	--
Dichlorodifluoromethane	0/0	--	--	NA	--
Ethylbenzene	0/34	0.005 - 1.6	--	NA	--
Isopropylbenzene	0/0	-	--	NA	--
Methylene chloride	0/34	0.005 - 1.6	--	NA	--
n-Butylbenzene	0/0	--	--	NA	--
o-Xylene	0/0	--	--	NA	--
Propylbenzene	0/0	--	--	NA	--
sec-Butylbenzene	0/0	--	--	NA	--
Styrene	0/34	0.005 - 1.6	--	NA	--
tert-Butyl methyl ether	0/0	--	--	NA	--
tert-Butylbenzene	0/0	--	--	NA	--
Tetrachloroethene	0/34	0.005 - 1.6	--	NA	--
Toluene	6/34	0.005 - 1.6	0.0031J - 0.77J	NA	--
trans-1,2-Dichloroethene	0/0	--	--	NA	--
trans-1,3-Dichloropropene	0/34	0.005 - 1.6	--	NA	--
Trichloroethene	0/34	0.005 - 1.6	--	NA	--
Trichlorofluoromethane	0/0	--	--	NA	--
Vinyl acetate	0/34	0.011 - 3.2	--	NA	--
Vinyl chloride	0/34	0.011 - 3.2	--	NA	--
Xylene (Total)	1/34	0.005 - 1.6	0.001J	NA	--
Petroleum Hydrocarbons					
Gasoline-range organics	3/32	1 - 200	3J - 3,900	NA	--
Diesel-range organics	13/33	1 - 430	4.8 - 2,800	NA	--
Motor oil-range organics	1/1	62 - 62	190	NA	--
TPH-extractable unknown hydrocarbons	4/7	11 - 14	8J - 22	NA	--
TPH-purgeable unknown hydrocarbons	0/3	1.2 - 1.3	--	NA	--

Table 4-13. Summary of Analyses and Detections in the Panhandle Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Petroleum Hydrocarbons *(continued)*					
Total TPH	17/33	1 - 430	6.5 - 6,700	NA	--
Total oil and grease	27/32	27 - 130	32J - 12,000	NA	--

Notes:

(1) rejected data are not included in detection frequency

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical
bgs below ground surface
BHC benzene hexachloride
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethene
DDT dichlorodiphenyltrichloroethane
HpCDD heptachlorodibenzo-p-dioxin
HpCDF heptachlorodibenzofuran
HQ hazard quotient
HxCDD hexachlorodibenzo-p-dioxin
HxCDF hexachlorodibenzofuran
J estimated value
mg/kg milligrams per kilogram
NA not available
OCDD octachlorodibenzo-p-dioxin
OCDF octachlorodibenzofuran
PCB polychlorinated biphenyl
PeCDD pentachlorodibeno-p-dioxin
PeCDF pentachlorodibenzofuran
TPH total petroleum hydrocarbons

Table 4-14. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Metals				
Aluminum	100,000	2004 PRG Industrial	0	0
Antimony	380	2005 ESL Industrial (direct exp)	0	0
Arsenic	11.1	HPAL	6	0
Barium	63,000	2005 ESL Industrial (direct exp)	0	0
Beryllium	36	2005 ESL Industrial (direct exp)	0	0
Cadmium	38	2005 ESL Industrial (direct exp)	0	0
Calcium	--		--	--
Chromium (total)	a	See note	1	0
Chromium VI	37	2005 ESL Industrial (direct exp)	0	0
Cobalt	a	See note	0	0
Copper	38,000	2005 ESL Industrial (direct exp)	0	0
Cyanide (free)	12,000	2004 PRG Industrial	0	0
Iron	100,000	2004 PRG Industrial	0	0
Lead	800	2004 PRG Industrial	5	0
Magnesium	--		--	--
Manganese	19,000	2004 PRG Industrial	0	0
Mercury	180	2005 ESL Industrial (direct exp)	0	0
Molybdenum	4,800	2005 ESL Industrial (direct exp)	0	0
Nickel	a	See note	0	0
Potassium	--		--	--
Selenium	4,800	2005 ESL Industrial (direct exp)	0	0
Silver	4,800	2005 ESL Industrial (direct exp)	0	0
Sodium	--		--	--
Thallium	63	2005 ESL Industrial (direct exp)	0	0
Tin	100,000	2004 PRG Industrial	0	0
Vanadium	1,000	2004 PRG Industrial	0	0
Zinc	100,000	2004 PRG Industrial	0	0
Pesticides				
2,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
2,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
2,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
4,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
Aldrin	0.1	2004 PRG Industrial	0	0
alpha-BHC	0.36	2004 PRG Industrial	0	0
Alpha-chlordane	2.9	SDGI Industrial Criteria	0	0
beta-BHC	1.3	2004 PRG Industrial	0	0
Chlordane	1.7	2005 ESL Industrial (direct exp)	0	0
cis-Nonachlor	--		--	--
delta-BHC	0.59	SDGI Industrial Criteria	0	0
Dieldrin	0.11	2004 PRG Industrial	0	0
Endosulfan I	3,700	2004 PRG Industrial	0	0
Endosulfan II	3,700	2004 PRG Industrial	0	0
Endosulfan sulfate	5300	SDGI Industrial Criteria	0	0
Endrin	180	2004 PRG Industrial	0	0
Endrin aldehyde	260	SDGI Industrial Criteria	0	0
Endrin ketone	260	SDGI Industrial Criteria	0	0
Gamma-BHC (lindane)	1.7	2004 PRG Industrial	0	0
Gamma-chlordane	2.9	SDGI Industrial Criteria	0	0
Heptachlor	0.38	2004 PRG Industrial	0	0
Heptachlor epoxide	0.19	2004 PRG Industrial	0	0
Heptachlor epoxide A	--		--	--
Heptachlor epoxide B	--		--	--
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Methoxychlor	3,100	2004 PRG Industrial	0	0
Mirex	--		--	--
Oxychlordane	--		--	--
Toxaphene	1.6	2004 PRG Industrial	0	0
trans-Nonachlor	21	2004 PRG Industrial	0	0
Polychlorinated Biphenyls				
Aroclor-1016 (low risk PCB)	21	2004 PRG Industrial	0	0
Aroclor-1221 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1232 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1242 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1248 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1254 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1260 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Total (high risk) PCBs	0.74	2004 PRG Industrial	0	0

Table 4-14. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Dioxins and Furans				
1,2,3,4,6,7,8,9-OCDD	0.027	SDGI Industrial Criteria	0	0
1,2,3,4,6,7,8,9-OCDF	0.027	SDGI Industrial Criteria	0	0
1,2,3,4,6,7,8-HpCDD	0.0027	SDGI Industrial Criteria	0	0
1,2,3,4,6,7,8-HpCDF	0.0027	SDGI Industrial Criteria	0	0
1,2,3,4,7,8,9-HpCDF	0.0027	SDGI Industrial Criteria	0	0
1,2,3,4,7,8-HxCDD	0.00027	SDGI Industrial Criteria	0	0
1,2,3,4,7,8-HxCDF	0.00027	SDGI Industrial Criteria	1	0
1,2,3,6,7,8-HxCDD	0.00027	SDGI Industrial Criteria	0	0
1,2,3,6,7,8-HxCDF	0.00027	SDGI Industrial Criteria	1	0
1,2,3,7,8,9-HxCDD	0.00027	SDGI Industrial Criteria	0	0
1,2,3,7,8,9-HxCDF	0.00027	SDGI Industrial Criteria	1	0
1,2,3,7,8-PeCDD	0.000055	SDGI Industrial Criteria	1	0
1,2,3,7,8-PeCDF	0.00055	SDGI Industrial Criteria	0	0
2,3,4,6,7,8-HxCDF	0.00027	SDGI Industrial Criteria	1	0
2,3,4,7,8-PeCDF	0.000055	SDGI Industrial Criteria	2	0
2,3,7,8-TCDD	0.000016	2004 PRG Industrial	1	0
2,3,7,8-TCDF	0.00027	SDGI Industrial Criteria	1	0
TEQ (for 2,3,7,8-TCDD)	0.000016	2004 PRG Industrial	2	0
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	0	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2'-Oxybis(1-chloropropane)	7.4	2004 PRG Industrial	0	0
2,4,5-Trichlorophenol	61	2005 ESL Industrial (inhalation)	0	0
2,4,6-Trichlorophenol	25	2005 ESL Industrial (direct exp)	0	0
2,4-Dichlorophenol	1,800	2004 PRG Industrial	0	0
2,4-Dimethylphenol	1,500	2005 ESL Industrial (inhalation)	0	0
2,4-Dinitrophenol	1,200	2004 PRG Industrial	0	0
2,4-Dinitrotoluene	5.6	2005 ESL Industrial (direct exp)	0	0
2,6-Dinitrotoluene	620	2004 PRG Industrial	0	0
2-Chloronaphthalene	23,000	2004 PRG Industrial	0	0
2-Chlorophenol	10	2005 ESL Industrial (inhalation)	0	0
2-Methylnaphthalene	550	2005 ESL Industrial (inhalation)	0	0
2-Methylphenol	31,000	2004 PRG Industrial	0	0
2-Nitroaniline	1,800	2004 PRG Industrial	0	0
2-Nitrophenol	--		--	--
3,3'-Dichlorobenzidine	1.4	2005 ESL Industrial (direct exp)	0	0
3-Nitroaniline	82	2004 PRG Industrial	0	0
4,6-Dinitro-2-methylphenol	--		--	--
4-Bromophenyl-phenylether	--		--	--
4-Chloro-3-methylphenol	--		--	--
4-Chloroaniline	2,500	2004 PRG Industrial	0	0
4-Chlorophenyl-phenylether	--		--	--
4-Methylphenol	3,100	2004 PRG Industrial	0	0
4-Nitroaniline	82	2004 PRG Industrial	0	0
4-Nitrophenol	7,000	SDGI Industrial Criteria	0	0
Acenaphthene	650	2005 ESL Industrial (inhalation)	0	0
Acenaphthylene	18,000	2005 ESL Industrial (direct exp)	0	0
Aniline	300	2004 PRG Industrial	0	0
Anthracene	31	2005 ESL Industrial (inhalation)	0	0
Azobenzene	16	2004 PRG Industrial	0	0
Benzidine	--		--	--
Benzo(a)anthracene	2.1	2005 ESL Industrial (direct exp)	1	0
Benzo(a)pyrene	0.33	2004 PRG Industrial	1	0
Benzo(b)fluoranthene	2.1	2005 ESL Industrial (direct exp)	1	0
Benzo(e)pyrene	--		--	--
Benzo(g,h,i)perylene	22,000	2005 ESL Industrial (direct exp)	0	0
Benzo(k)fluoranthene	15	2005 ESL Industrial (direct exp)	0	0
Benzoic acid	100,000	2004 PRG Industrial	0	0
Benzyl alcohol	100,000	2004 PRG Industrial	0	0
Biphenyl	18,000	2005 ESL Industrial (direct exp)	0	0
Bis(2-chloroethoxy)methane	--		--	--
Bis(2-chloroethyl)ether	0.012	2005 ESL Industrial (inhalation)	0	0
Bis(2-ethylhexyl)phthalate	120	2004 PRG Industrial	0	0
Butylbenzylphthalate	100,000	2004 PRG Industrial	0	0
Carbazole	86	2004 PRG Industrial	0	0

Table 4-14. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Semivolatile Organic Compounds *(continued)*				
Chrysene	13	2005 ESL Industrial (direct exp)	0	0
Dibenz(a,h)anthracene	0.33	SDGI Industrial Criteria	0	0
Dibenzofuran	1,600	2004 PRG Industrial	0	0
Diethylphthalate	100,000	2004 PRG Industrial	0	0
Dimethylphthalate	100,000	2004 PRG Industrial	0	0
Di-n-butylphthalate	62,000	2004 PRG Industrial	0	0
Di-n-octylphthalate	25,000	2004 PRG Industrial	0	0
Fluoranthene	22,000	2004 PRG Industrial	0	0
Fluorene	800	2005 ESL Industrial (inhalation)	0	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Hexachlorocyclopentadiene	3,700	2004 PRG Industrial	0	0
Hexachloroethane	44	2005 ESL Industrial (direct exp)	0	0
Indeno(1,2,3-cd)pyrene	2.1	2005 ESL Industrial (direct exp)	1	0
Isophorone	510	2004 PRG Industrial	0	0
Naphthalene	1.5	2005 ESL Industrial (inhalation)	3	0
Nitrobenzene	100	2004 PRG Industrial	0	0
n-Nitrosodimethylamine	0.034	2004 PRG Industrial	0	0
n-Nitroso-di-n-propylamine	0.25	2004 PRG Industrial	0	0
n-Nitrosodiphenylamine	350	2004 PRG Industrial	0	0
Pentachlorophenol	9	2004 PRG Industrial	0	0
Phenacetin	--		--	--
Phenanthrene	18,000	2005 ESL Industrial (direct exp)	0	0
Phenol	100,000	2004 PRG Industrial	0	0
Pyrene	425	2005 ESL Industrial (inhalation)	0	0
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	6.9	2005 ESL Industrial (direct exp)	0	0
1,1,1-Trichloroethane	230	2005 ESL Industrial (inhalation)	0	0
1,1,2,2-Tetrachloroethane	0.025	2005 ESL Industrial (inhalation)	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	--		--	--
1,1,2-Trichloroethane	0.089	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethane	0.89	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethene	105	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloropropene	--		--	--
1,2,3-Trichlorobenzene	--		--	--
1,2,3-Trichloropropane	--		--	--
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dibromo-3-chloropropane	0.067	2005 ESL Industrial (direct exp)	0	0
1,2-Dibromoethane	0.02	2005 ESL Industrial (inhalation)	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethane	0.07	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethene (Total)	150	SDGI Industrial Criteria	0	0
1,2-Dichloropropane	0.14	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,3-Dichloropropane	--		--	--
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2-Dichloropropane	--		--	--
2-Butanone	6,500	2005 ESL Industrial (inhalation)	0	0
2-Chloroethyl vinyl ether	--		--	--
2-Chlorotoluene	--		--	--
2-Hexanone	--		--	--
4-Chlorotoluene	--		--	--
4-Methyl-2-pentanone	1,550	2005 ESL Industrial (inhalation)	0	0
Acetone	16,500	2005 ESL Industrial (inhalation)	0	0
Benzene	0.38	2005 ESL Industrial (direct exp)	0	0
Bromobenzene	--		--	--
Bromochloromethane	--		--	--
Bromodichloromethane	0.039	2005 ESL Industrial (inhalation)	0	0
Bromoform	220	2004 PRG Industrial	0	0
Bromomethane	2.6	2005 ESL Industrial (inhalation)	0	0
Carbon disulfide	720	2004 PRG Industrial	0	0
Carbon tetrachloride	0.034	2005 ESL Industrial (inhalation)	0	0
Chlorobenzene	31	2005 ESL Industrial (inhalation)	0	0
Chloroethane	1.8	2005 ESL Industrial (inhalation)	0	0
Chloroform	0.47	2004 PRG Industrial	0	0
Chloromethane	0.2	2005 ESL Industrial (inhalation)	0	0
cis-1,2-Dichloroethene	18	2005 ESL Industrial (inhalation)	0	0

Table 4-14. Summary of Detected Exceedances of Evaluation Criteria in the Panhandle Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Volatile Organic Compounds *(continued)*				
cis-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Dibromochloromethane	0.054	2005 ESL Industrial (inhalation)	0	0
Dibromomethane	--		--	--
Dichlorodifluoromethane	310	2004 PRG Industrial	0	0
Ethylbenzene	5	2008 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Isopropylbenzene	2,000	2004 PRG Industrial	0	0
Methylcyclohexane	2,600	2004 PRG Industrial	0	0
Methylene chloride	1.5	2005 ESL Industrial (inhalation)	0	0
n-Butylbenzene	240	2004 PRG Industrial	0	0
o-Xylene	210	SDGI Industrial Criteria	0	0
para-Isopropyl toluene	--		--	--
Propylbenzene	240	2004 PRG Industrial	0	0
sec-Butylbenzene	220	2004 PRG Industrial	0	0
Styrene	1,100	2005 ESL Industrial (inhalation)	0	0
tert-Butyl methyl ether	5.6	2005 ESL Industrial (inhalation)	0	0
tert-Butylbenzene	390	2004 PRG Industrial	0	0
Tetrachloroethene	0.24	2005 ESL Industrial (inhalation)	0	0
Toluene	520	2004 PRG Industrial	0	0
trans-1,2-Dichloroethene	37	2005 ESL Industrial (inhalation)	0	0
trans-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Trichloroethene	0.11	2004 PRG Industrial	0	0
Trichlorofluoromethane	2,000	2004 PRG Industrial	0	0
Vinyl acetate	1,400	2004 PRG Industrial	0	0
Vinyl chloride	0.019	2005 ESL Industrial (inhalation)	0	0
Xylene (Total)	420	2004 PRG Industrial	0	0
Petroleum Hydrocarbons				
Gasoline-range organics	750	2005 ESL Industrial (direct exp)	0	0
Diesel-range organics	750	2005 ESL Industrial (direct exp)	0	0
Motor oil-range organics	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-extractable unknown hydrocarbons	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-purgeable unknown hydrocarbons	750	2005 ESL Industrial (direct exp)	0	0
Total TPH	3,500	HPS TPH source criterion	1	0
Total oil and grease	3,500	HPS TPH source criterion	4	0

Notes:

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical
bgs below ground surface
BHC benzene hexachloride
Conc. concentration
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethene
DDT dichlorodiphenyltrichloroethane
ESL environmental screening level
HPAL Hunters Point ambient level
HpCDD heptachlorodibenzo-p-dioxin
HpCDF heptachlorodibenzofuran
HPS Hunters Point Shipyard
HxCDD hexachlorodibenzo-p-dioxin
HxCDF hexachlorodibenzofuran
mg/kg milligrams per kilogram
NE not established
OCDD octachlorodibenzo-p-dioxin
OCDF octachlorodibenzofuran
PCB polychlorinated biphenyl
PeCDD pentachlorodibeno-p-dioxin
PeCDF pentachlorodibenzofuran
PRG preliminary remediation goal
RIEC remedial investigation evaluation criteria
SDGI standard data gaps investigation
TEQ toxicity equivalent quotient
TPH total petroleum hydrocarbon

Table 4-15. Summary of Analyses and Detections in the East Adjacent Area (0-2 feet bgs)
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Metals					
Aluminum	42 / 42	1.4 - 240	1,200 - 32,900	NA	--
Antimony	41 / 55	0.34 - 6.6	0.21J - 409.44J	9.05	13
Arsenic	50 / 55	0.26 - 3	1.3 - 22	11.1	5
Barium	55 / 55	0.02 - 21.5	12 - 650	314.4	7
Beryllium	23 / 55	0.01 - 0.54	0.04J - 1.1	0.71	5
Cadmium	19 / 55	0.04 - 0.76	0.13 - 11.82	3.14	7
Calcium	42 / 42	1.4 - 220	950 - 120,000J	NA	--
Chromium	55 / 55	0.09 - 2.4	15.3 - 860J	a	3
Chromium VI	2 / 34	0.05 - 0.06	1.005 - 1.5	NA	--
Cobalt	55 / 55	0.09 - 5.4	2.9 - 102	a	4
Copper	55 / 55	0.11 - 23	5.1J - 5,500	124.3	28
Cyanide	0 / 5	0.51 - 0.55	--	NA	--
Iron	42 / 42	0.73 - 210	6,100 - 140,000	NA	--
Lead	55 / 55	0.15 - 28	2.6J - 11,215.9	8.99	52
Magnesium	42 / 42	0.78 - 14.47	630J - 175,000	NA	--
Manganese	42 / 42	0.01 - 2.2	78 - 2,400	1431.2	2
Mercury	42 / 55	0.01 - 0.5	0.05 - 46.67	2.28	10
Molybdenum	20 / 54	0.13 - 2.2	0.64 - 46.83	2.68	15
Nickel	53 / 55	0.15 - 4.3	16 - 1,500	a	--
Potassium	39 / 42	1.4 - 411	182J - 5,300J	NA	--
Selenium	11 / 55	0.26 - 2.3	0.14J - 3.9	1.95	1
Silver	14 / 55	0.07 - 2.56	0.11J - 1.51	1.43	1
Sodium	26 / 42	4.7 - 39	94 - 4,510	NA	--
Thallium	6 / 55	0.13 - 3.1	0.21J - 6.9	0.81	6
Tin	0 / 0	--	--	NA	--
Vanadium	54 / 55	0.09 - 5.4	4.1 - 209	117.2	1
Zinc	55 / 55	0.21 - 21	40J - 4,100	109.9	34
Pesticides					
4,4'-DDD	2/52	0.0034 - 1.7	0.3 - 1.2	NA	-
4,4'-DDE	8/52	0.0034 - 1.7	0.0064 - 0.99	NA	--
4,4'-DDT	15/52	0.0034 - 2.3	0.0071 - 5.8	NA	--
Aldrin	1/52	0.0018 - 0.21	0.0017	NA	--
Alpha-BHC	1/52	0.0018 - 0.21	0.0051	NA	--
Alpha-chlordane	1/39	0.0018 - 11	0.01	NA	--
Beta-BHC	0/52	0.0018 - 0.21	--	NA	--
Delta-BHC	0/52	0.0018 - 0.21	--	NA	--
Dieldrin	10/52	0.0034 - 1.7	0.0018 - 0.25J	NA	--
Endosulfan I	1/52	0.0018 - 0.85	0.0018	NA	--
Endosulfan II	5/52	0.0034 - 1.7	0.0037 - 4.8	NA	--
Endosulfan sulfate	10/52	0.0034 - 2.3	0.0081 - 13	NA	--
Endrin	6/52	0.0018 - 1.7	0.0064 - 0.14	NA	--
Endrin aldehyde	0/35	0.0034 - 0.35	--	NA	--
Endrin ketone	4/52	0.0034 - 2.3	0.45 - 0.99	NA	--
Gamma-BHC (lindane)	0/52	0.0018 - 0.21	--	NA	--
gamma-Chlordane	0/13	0.15 - 3.2	--	NA	--
Heptachlor	1/52	0.0018 - 0.21	0.0046	NA	--
Heptachlor epoxide	9/52	0.0018 - 0.21	0.0032 - 3.2	NA	--
Methoxychlor	9/52	0.0068 - 11	0.0088 - 3.3	NA	--
Toxaphene	0/48	0.167 - 23	--	NA	--
trans-Chlordane	1/38	0.0018 - 11	0.013	NA	--
Polychlorinated Biphenyls					
Aroclor-1016 (low risk PCB)	0/55	0.01 - 10	0 - 0	NA	--
Aroclor-1221 (high risk PCB)	0/55	0.02 - 20	0 - 0	NA	--
Aroclor-1232 (high risk PCB)	0/55	0.01 - 10	0 - 0	NA	--
Aroclor-1242 (high risk PCB)	0/55	0.01 - 11	0 - 0	NA	--
Aroclor-1248 (high risk PCB)	1/55	0.01 - 11	3.8 - 3.8	NA	--
Aroclor-1254 (high risk PCB)	3/55	0.01 - 23	0.45 - 1.5	NA	--
Aroclor-1260 (high risk PCB)	39/55	0.01 - 23	0.035 - 450	NA	--
Total (high risk) PCBs	39/55	0.01 - 23	0.035 - 450	NA	--

Table 4-15. Summary of Analyses and Detections in the East Adjacent Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds					
1,2,4-Trichlorobenzene	1 / 39	0.14 - 21	0.12J	NA	--
1,2-Dichlorobenzene	0 / 39	0.14 - 21	--	NA	--
1,3-Dichlorobenzene	0 / 39	0.14 - 21	--	NA	--
1,4-Dichlorobenzene	0 / 39	0.14 - 21	--	NA	--
11H-Benzo(a)fluorene	1 / 1	0.13 - 0.13	0.13J	NA	--
17-Pentatriacontene	1 / 1	0.45 - 0.45	0.45J	NA	--
1-Docosene	0 / 0	--	--	NA	--
1-Methylpyrene	2 / 2	0.63 - 0.78	0.63 - 0.78J	NA	--
2-(2-Butoxyethoxy)-ethanol	1 / 1	0.11 - 0.11	0.11J	NA	--
2,2'-Oxybis(1-chloropropane)	0 / 0	0.68 - 14	--	NA	--
2,3-Dimethylphenanthrene	0 / 0	--	--	NA	--
2,4,5,7-Tetramethylphenanthrene	0 / 0	--	--	NA	--
2,4,5-Trichlorophenol	0 / 27	0.36 - 110	--	NA	--
2,4,6-Trichlorophenol	0 / 27	0.34 - 21	--	NA	--
2,4-Dichlorophenol	0 / 27	0.34 - 21	--	NA	--
2,4-Dimethylphenol	0 / 39	0.14 - 21	--	NA	--
2,4-Dinitrophenol	0 / 27	0.85 - 110	--	NA	--
2,4-Dinitrotoluene	0 / 30	0.34 - 21	--	NA	--
2,6,10,14-Tetramethylhexadecane	0 / 0	--	--	NA	--
2,6,10,14-Tetramethylpentadecane	1 / 1	0.27 - 0.27	0.27	NA	--
2,6,10-Trimethyl-dodecane	1 / 1	0.31 - 0.31	0.31	NA	--
2,6,11,15-Tetramethylhexadecane	2 / 2	0.14 - 0.36	0.14J - 0.36J	NA	--
2,6,11-Trimethyl-dodecane	0 / 0	--	--	NA	--
2,6-Dinitrotoluene	0 / 39	0.14 - 21	--	NA	--
2-Chloronaphthalene	0 / 39	0.14 - 21	--	NA	--
2-Chlorophenol	0 / 30	0.34 - 21	--	NA	--
2-Methylnaphthalene	3 / 39	0.072 - 21	0.075J - 3.5	NA	--
2-Methylphenol	0 / 39	0.14 - 21	--	NA	--
2-Nitroaniline	0 / 39	0.14 - 110	--	NA	--
2-Nitrophenol	0 / 27	0.34 - 21	--	NA	--
3,3'-Dichlorobenzidine	0 / 39	0.14 - 42	--	NA	--
3,6-Dimethylphenanthrene	1 / 1	0.5 - 0.5	0.5	NA	--
3-Nitroaniline	0 / 27	0.72 - 110	--	NA	--
4,4-Dimethylbiphenyl	1 / 1	0.24 - 0.24	0.24J	NA	--
4,6-Dinitro-2-methylphenol	0 / 27	0.85 - 110	--	NA	--
4-Bromophenyl-phenylether	0 / 27	0.34 - 21	--	NA	--
4-Chloro-3-methylphenol	0 / 30	0.34 - 21	--	NA	--
4-Chloroaniline	0 / 27	0.34 - 21	--	NA	--
4-Chlorophenyl-phenylether	0 / 27	0.34 - 21	--	NA	--
4H-Cyclopenta(def)phenanthrene	1 / 1	0.089 - 0.089	0.089J	NA	--
4-Methylphenol	1 / 39	0.14 - 21	0.1J	NA	--
4-Nitroaniline	0 / 27	0.72 - 110	--	NA	--
4-Nitrophenol	0 / 39	0.35 - 110	0.83J	NA	--
7H-Benzo[c]fluorene	0 / 0	--	--	NA	--
9,10-Anthracenedione	1 / 1	0.17 - 0.17	0.17J	NA	--
9-Methylanthracene	1 / 1	0.13 - 0.13	0.13	NA	--
Acenaphthene	6 / 52	0.07 - 21	0.067J - 0.44J	NA	--
Acenaphthylene	3 / 43	0.07 - 21	0.038J - 0.088J	NA	--
Aniline	0 / 3	0.351 - 3.546	--	NA	--
Anthracene	14 / 52	0.07 - 21	0.0043J - 0.39J	NA	--
Azobenzene	0 / 1	0.36 - 14	--	NA	--
Benzidine	0 / 3	0.351 - 3.546	--	NA	--
Benzo(a)anthracene	26 / 52	0.07 - 21	0.019J - 2.3J	NA	--
Benzo(a)pyrene	26 / 52	0.07 - 21	0.018J - 3.4J	NA	--
Benzo(b)fluoranthene	26 / 52	0.07 - 21	0.03J - 6.6J	NA	--
Benzo(e)pyrene	0 / 0	--	--	NA	--
Benzo(g,h,i)perylene	21 / 52	0.07 - 21	0.015J - 2.2J	NA	--
Benzo(k)fluoranthene	13 / 52	0.07 - 21	0.015J - 2.1	NA	--
Benzoic acid	0 / 18	1.6 - 110	--	NA	--
Benzyl alcohol	0 / 18	0.34 - 21	--	NA	--

Table 4-15. Summary of Analyses and Detections in the East Adjacent Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Bis(2-chloroethoxy)methane	0 / 27	0.34 - 21	--	NA	--
Bis(2-chloroethyl)ether	0 / 27	0.34 - 21	--	NA	--
Bis(2-chloroisopropyl)ether	0 / 27	0.34 - 21	--	NA	--
Bis(2-ethylhexyl)phthalate	3 / 39	0.14 - 21	0.16 - 4.1	NA	--
Butylbenzylphthalate	0 / 39	0.14 - 21	--	NA	--
Carbazole	0 / 21	0.14 - 10	--	NA	--
Chrysene	33 / 52	0.07 - 21	0.082J - 5.8	NA	--
Cyclopenta(cd)pyrene	0 / 0	--	--	NA	--
Dibenz(a,h)anthracene	6 / 52	0.07 - 21	0.071J - 0.23J	NA	--
Dibenzofuran	2 / 39	0.14 - 21	0.068J - 0.11J	NA	--
Diethylphthalate	0 / 39	0.14 - 21	--	NA	--
Dimethylphthalate	0 / 27	0.34 - 21	--	NA	--
Di-n-butylphthalate	1 / 39	0.14 - 21	0.63	NA	--
Di-n-octylphthalate	0 / 39	0.14 - 21	--	NA	--
Docosane	0 / 0	--	--	NA	--
Dodecane	0 / 0	--	--	NA	--
Dotriacontane	1 / 1	0.54 - 0.54	0.54J	NA	--
Eicosane	4 / 4	0.11 - 0.86	0.11 - 0.86	NA	--
Fluoranthene	31 / 39	0.14 - 21	0.051J - 5.5J	NA	--
Fluorene	7 / 52	0.07 - 21	0.063J - 0.86J	NA	--
Heneicosane	2 / 2	0.8 - 0.81	0.8 - 0.81	NA	--
Heptacosane	0 / 0	--	--	NA	--
Heptadecane	5 / 5	0.087 - 0.63	0.087J - 0.63	NA	--
Hexachlorobenzene	0 / 39	0.14 - 21	--	NA	--
Hexachlorobutadiene	0 / 27	0.34 - 21	--	NA	--
Hexachlorocyclopentadiene	0 / 27	0.34 - 70	--	NA	--
Hexachloroethane	0 / 27	0.34 - 21	--	NA	--
Hexacosane	0 / 0	--	--	NA	--
Hexadecane	4 / 4	0.36 - 8.2	0.36J - 8.2	NA	--
Hexadecanoic acid	1 / 1	0.28 - 0.28	0.28J	NA	--
Hexatriacontane	4 / 4	0.11 - 0.58	0.11 - 0.58J	NA	--
Indeno(1,2,3-cd)pyrene	17 / 52	0.07 - 21	0.012 - 0.81	NA	--
Isophorone	0 / 39	0.14 - 21	--	NA	--
m-Terphenyl	0 / 0	--	--	NA	--
Naphthalene	10 / 52	0.14 - 21	0.034J - 1.3	NA	--
Nitrobenzene	0 / 27	0.34 - 21	--	NA	--
n-Nitrosodimethylamine	0 / 4	0.351 - 14	--	NA	--
n-Nitroso-di-n-propylamine	0 / 39	0.14 - 21	--	NA	--
n-Nitrosodiphenylamine	0 / 39	0.14 - 21	--	NA	--
Nonacosane	0 / 0	--	--	NA	--
Nonadecane	3 / 3	0.25 - 0.6	0.25 - 0.6	NA	--
Octacosane	1 / 1	0.18 - 0.18	0.18J	NA	--
Octadecane	2 / 2	0.32 - 0.7	0.32 - 0.7	NA	--
o-Terphenyl	0 / 0	--	--	NA	--
PCB-153	0 / 0	--	--	NA	--
Pentachlorophenol	0 / 39	0.35 - 110	--	NA	--
Pentacosane	0 / 0	--	--	NA	--
Pentadecane	0 / 0	--	--	NA	--
Pentatriacontane	0 / 0	--	--	NA	--
Perylene	0 / 0	--	--	NA	--
Phenanthrene	26 / 52	0.07 - 21	0.038J - 2.1	NA	--
Phenol	4 / 39	0.14 - 21	0.074J - 1J	NA	--
p-Terphenyl	0 / 0	--	--	NA	--
Pyrene	37 / 52	0.07 - 21	0.059 - 6.9	NA	--
Tetracosane	2 / 2	0.16 - 0.61	0.16 - 0.61	NA	--
Tetradecane	1 / 1	0.81 - 0.81	0.81	NA	--
Tetratetracontane	0 / 0	--	--	NA	--
Triacontane	1 / 1	0.61 - 0.61	0.61	NA	--
Tricosane	0 / 0	--	--	NA	--
Tridecane	1 / 1	0.1 - 0.1	0.1J	NA	--

Table 4-15. Summary of Analyses and Detections in the East Adjacent Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Tri-m-cresyl phosphate	0 / 0	--	--	NA	--
Triphenylene	1 / 1	0.16 - 0.16	0.16J	NA	--
Tri-p-tolyl phosphate	0/0	--	--	NA	--
Volatile Organic Compounds					
1,1,1-Trichloroethane	0 / 20	0.005 - 0.011	--	NA	--
1,1,2,2-Tetrachloroethane	2 / 22	0.005 - 0.011	0.24 - 0.74J	NA	--
1,1,2-Trichloroethane	0 / 20	0.005 - 0.011	--	NA	--
1,1-Dichloroethane	1 / 20	0.005 - 0.011	0.00329J	NA	--
1,1-Dichloroethene	0 / 20	0.005 - 0.011	--	NA	--
1,2,3,5-Tetramethylbenzene	1 / 1	0.017 - 0.017	0.017	NA	--
1,2,4-Trimethylbenzene	1 / 1	0.005 - 0.005	0.005J	NA	--
1,2-Dichloroethane	0 / 20	0.005 - 0.011	--	NA	--
1,2-Dichloroethene (Total)	1 / 20	0.005 - 0.011	0.0064	NA	--
1,2-Dichloropropane	0 / 20	0.005 - 0.011	--	NA	--
1-Ethyl-2,3-dihydro-1H-indene	0 / 0	0.013 - 0.013	--	NA	--
1-Ethyl-2,4-dimethyl benzene	1 / 1	0.005 - 0.005	0.005	NA	--
1-Ethyl-2-methylbenzene	1 / 1	0.005 - 0.006	1.005	NA	--
2-Butanone	2 / 20	0.01 - 0.014	0.003J - 0.0083J	NA	--
2-Hexanone	0 / 20	0.01 - 0.014	--	NA	--
4-Ethyl-1,2-dimethylbenzene	1 / 1	0.008 - 0.008	0.008	NA	--
4-Methyl-2-pentanone	1 / 20	0.01 - 0.014	0.021	NA	--
Acetone	0 / 20	0.01 - 0.014	--	NA	--
Benzene	0 / 24	0.0048 - 0.011	--	NA	--
Bicyclo[3.3.1]nonane	0 / 0	--	--	NA	--
Bromodichloromethane	0 / 20	0.005 - 0.011	--	NA	--
Bromoform	0 / 20	0.005 - 0.011	--	NA	--
Bromomethane	0 / 20	0.01 - 0.014	--	NA	--
Carbon disulfide	0 / 20	0.005 - 0.011	--	NA	--
Carbon tetrachloride	0 / 20	0.005 - 0.011	--	NA	--
Chlorobenzene	0 / 20	0.005 - 0.011	--	NA	--
Chloroethane	0 / 20	0.01 - 0.014	--	NA	--
Chloroform	0 / 20	0.005 - 0.011	--	NA	--
Chloromethane	0 / 20	0.01 - 0.014	--	NA	--
cis-1,2-Dichloroethene	0 / 20	--	--	NA	--
cis-1,3-Dichloropropene	0 / 0	0.005 - 0.011	--	NA	--
cis-Bicyclo[4.3.0]nonane	0 / 0	--	--	NA	--
Dibromochloromethane	0 / 20	0.005 - 0.011	--	NA	--
Ethylbenzene	3 / 24	0.0048 - 0.011	0.0031J - 0.012	NA	--
Methylcyclohexane	0 / 0	--	--	NA	--
Methylene chloride	0 / 20	0.005 - 0.011	--	NA	--
o-Xylene	1 / 4	0.0048 - 0.0084	0.0072J	NA	--
Styrene	0 / 20	0.005 - 0.011	--	NA	--
Tert-butyl methyl ether	0 / 4	0.0048 - 0.0084	--	NA	--
Tetrachloroethene	2 / 20	0.005 - 0.011	0.001J - 0.0073	NA	--
Toluene	8 / 24	0.0048 - 0.011	0.00054J - 0.12	NA	--
trans-1,3-Dichloroethene	0 / 20	--	--	NA	--
trans-1,3-Dichloropropene	0 / 0	0.005 - 0.011	--	NA	--
Trichloroethene	3 / 20	0.005 - 0.011	0.001J - 0.013	NA	--
Vinyl acetate	0 / 17	0.01 - 0.014	--	NA	--
Vinyl chloride	0 / 20	0.01 - 0.014	--	NA	--
Xylene (Total)	4 / 24	0.0048 - 0.011	0.0039J - 0.056	NA	--
Petroleum Hydrocarbons					
Gasoline-range organics	12 / 52	0.18 - 11	0.02J - 84J	NA	--
Diesel-range organics	44 / 53	1 - 5,100	4.2 - 110,00D	NA	--
Motor oil-range organics	36 / 36	5.1 - 5,300	8.5J - 77,000Y	NA	--
TPH-extractable unknown hydrocarbon	1 / 4	10 - 11	46	NA	--
TPH-purgeable unknown hydrocarbon	0 / 3	0.2 - 5.2	--	NA	--
Total recoverable petroleum hydrocarbon	9 / 10	11 - 2,100	7.3J - 62,000	NA	--
Total TPH	46 / 51	--	14.6 - 83,500.64	NA	--
Total oil and grease	17 / 17	26 - 92	78J - 8,100J	NA	--

Table 4-15. Summary of Analyses and Detections in the East Adjacent Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Notes:

(1)	rejected data are not included in detection frequency
(a)	PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.
–	No criteria available for this chemical
bgs	below ground surface
BHC	Benzene hexachloride
D	pattern resembles diesel
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
HPAL	Hunters Point ambient level
J Estimated	value
mg/kg	milligrams per kilogram
NA not	available
PCB	polychlorinated biphenyl
R Rejected	
TPH	total petroleum hydrocarbons
Y	Chromatogram indicates the presence of petroleum fuel

Table 4-16. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (0-2 feet bgs)
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Metals				
Aluminum	100,000	2004 PRG Industrial	0	0
Antimony	380	2005 ESL Industrial (direct exp)	1	0
Arsenic	11.1	HPAL	5	0
Barium	63,000	2005 ESL Industrial (direct exp)	0	0
Beryllium	36	2005 ESL Industrial (direct exp)	0	0
Cadmium	7.4	2005 ESL Industrial (direct exp)	2	0
Calcium	--		--	--
Chromium (total)	a	See note	2	0
Chromium VI	37	2005 ESL Industrial (direct exp)	0	0
Cobalt	a	See note	0	0
Copper	38,000	2005 ESL Industrial (direct exp)	0	0
Cyanide (free)	12,000	2004 PRG Industrial	0	0
Iron	100,000	2004 PRG Industrial	2	0
Lead	800	2004 PRG Industrial	9	0
Magnesium	--		--	--
Manganese	19,000	2004 PRG Industrial	0	0
Mercury	180	2005 ESL Industrial (direct exp)	0	0
Molybdenum	4,800	2005 ESL Industrial (direct exp)	0	0
Nickel	a	See note	0	0
Potassium	--		--	--
Selenium	4,800	2005 ESL Industrial (direct exp)	0	0
Silver	4,800	2005 ESL Industrial (direct exp)	0	0
Sodium	--		--	--
Thallium	63	2005 ESL Industrial (direct exp)	0	0
Tin	100,000	2004 PRG Industrial	0	0
Vanadium	1,000	2004 PRG Industrial	0	0
Zinc	100,000	2004 PRG Industrial	0	0
Pesticides				
2,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
2,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
2,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
4,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
Aldrin	0.1	2004 PRG Industrial	0	0
alpha-BHC	0.36	2004 PRG Industrial	0	0
Alpha-chlordane	2.9	SDGI Industrial Criteria	0	0
beta-BHC	1.3	2004 PRG Industrial	0	0
Chlordane	1.7	2005 ESL Industrial (direct exp)	0	0
cis-Nonachlor	--		--	--
delta-BHC	0.59	SDGI Industrial Criteria	0	0
Dieldrin	0.11	2004 PRG Industrial	4	0
Endosulfan I	3,700	2004 PRG Industrial	0	0
Endosulfan II	3,700	2004 PRG Industrial	0	0
Endosulfan sulfate	5300	SDGI Industrial Criteria	0	0
Endrin	180	2004 PRG Industrial	0	0
Endrin aldehyde	260	SDGI Industrial Criteria	0	0
Endrin ketone	260	SDGI Industrial Criteria	0	0
Gamma-BHC (lindane)	1.7	2004 PRG Industrial	0	0
Gamma-chlordane	2.9	SDGI Industrial Criteria	0	0
Heptachlor	0.38	2004 PRG Industrial	0	0
Heptachlor epoxide	0.19	2004 PRG Industrial	2	0
Heptachlor epoxide A	--		--	--
Heptachlor epoxide B	--		--	--
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Methoxychlor	3,100	2004 PRG Industrial	0	0
Mirex	--		--	--
Oxychlordane	--		--	--
Toxaphene	1.6	2004 PRG Industrial	0	0
trans-Nonachlor	21	2004 PRG Industrial	0	0

Table 4-16. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Polychlorinated Biphenyls				
Aroclor-1016 (low risk PCB)	21	2004 PRG Industrial	0	0
Aroclor-1221 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1232 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1242 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1248 (high risk PCB)	0.74	2004 PRG Industrial	1	0
Aroclor-1254 (high risk PCB)	0.74	2004 PRG Industrial	1	0
Aroclor-1260 (high risk PCB)	0.74	2004 PRG Industrial	30	2
Total (high risk) PCBs	0.74	2004 PRG Industrial	30	0
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	0	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2'-Oxybis(1-chloropropane)	7.4	2004 PRG Industrial	0	0
2,4,5-Trichlorophenol	61	2005 ESL Industrial (inhalation)	0	0
2,4,6-Trichlorophenol	25	2005 ESL Industrial (direct exp)	0	0
2,4-Dichlorophenol	1,800	2004 PRG Industrial	0	0
2,4-Dimethylphenol	1,500	2005 ESL Industrial (inhalation)	0	0
2,4-Dinitrophenol	1,200	2004 PRG Industrial	0	0
2,4-Dinitrotoluene	5.6	2005 ESL Industrial (direct exp)	0	0
2,6-Dinitrotoluene	620	2004 PRG Industrial	0	0
2-Chloronaphthalene	23,000	2004 PRG Industrial	0	0
2-Chlorophenol	10	2005 ESL Industrial (inhalation)	0	0
2-Methylnaphthalene	550	2005 ESL Industrial (inhalation)	0	0
2-Methylphenol	31,000	2004 PRG Industrial	0	0
2-Nitroaniline	1,800	2004 PRG Industrial	0	0
2-Nitrophenol	--		--	--
3,3'-Dichlorobenzidine	1.4	2005 ESL Industrial (direct exp)	0	0
3-Nitroaniline	82	2004 PRG Industrial	0	0
4,6-Dinitro-2-methylphenol	--		--	--
4-Bromophenyl-phenylether	--		--	--
4-Chloro-3-methylphenol	--		--	0
4-Chloroaniline	2,500	2004 PRG Industrial	0	0
4-Chlorophenyl-phenylether	--		--	--
4-Methylphenol	3,100	2004 PRG Industrial	0	0
4-Nitroaniline	82	2004 PRG Industrial	0	0
4-Nitrophenol	7,000	SDGI Industrial Criteria	0	0
Acenaphthene	650	2005 ESL Industrial (inhalation)	0	0
Acenaphthylene	18,000	2005 ESL Industrial (direct exp)	0	0
Aniline	300	2004 PRG Industrial	0	0
Anthracene	31	2005 ESL Industrial (inhalation)	0	0
Azobenzene	16	2004 PRG Industrial	0	0
Benzidine	--		--	--
Benzo(a)anthracene	1.3	2005 ESL Industrial (direct exp)	2	0
Benzo(a)pyrene	0.33	SDGI Industrial Criteria	10	0
Benzo(b)fluoranthene	1.3	2005 ESL Industrial (direct exp)	5	0
Benzo(e)pyrene	--		--	--
Benzo(g,h,i)perylene	22,000	2005 ESL Industrial (direct exp)	0	0
Benzo(k)fluoranthene	1.3	2005 ESL Industrial (direct exp)	2	0
Benzoic acid	100,000	2004 PRG Industrial	0	0
Benzyl alcohol	100,000	2004 PRG Industrial	0	0
Biphenyl	18,000	2005 ESL Industrial (direct exp)	0	0
Bis(2-chloroethoxy)methane	--		--	--
Bis(2-chloroethyl)ether	0.012	2005 ESL Industrial (inhalation)	0	0
Bis(2-ethylhexyl)phthalate	120	2004 PRG Industrial	0	0
Butylbenzylphthalate	100,000	2004 PRG Industrial	0	0
Carbazole	86	2004 PRG Industrial	0	0

Table 4-16. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Semivolatile Organic Compounds *(continued)*				
Chrysene	13	2005 ESL Industrial (direct exp)	0	0
Dibenz(a,h)anthracene	0.33	SDGI Industrial Criteria	0	0
Dibenzofuran	1,600	2004 PRG Industrial	0	0
Diethylphthalate	100,000	2004 PRG Industrial	0	0
Dimethylphthalate	100,000	2004 PRG Industrial	0	0
Di-n-butylphthalate	62,000	2004 PRG Industrial	0	0
Di-n-octylphthalate	25,000	2004 PRG Industrial	0	0
Fluoranthene	22,000	2004 PRG Industrial	0	0
Fluorene	800	2005 ESL Industrial (inhalation)	0	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Hexachlorocyclopentadiene	3,700	2004 PRG Industrial	0	0
Hexachloroethane	44	2005 ESL Industrial (direct exp)	0	0
Indeno(1,2,3-cd)pyrene	1.3	2005 ESL Industrial (direct exp)	0	0
Isophorone	510	2004 PRG Industrial	0	0
Naphthalene	1.5	2005 ESL Industrial (inhalation)	0	0
Nitrobenzene	100	2004 PRG Industrial	0	0
n-Nitrosodimethylamine	0.034	2004 PRG Industrial	0	0
n-Nitroso-di-n-propylamine	0.25	2004 PRG Industrial	0	0
n-Nitrosodiphenylamine	350	2004 PRG Industrial	0	0
Pentachlorophenol	9	2004 PRG Industrial	0	0
Phenacetin	--		--	--
Phenanthrene	18,000	2005 ESL Industrial (direct exp)	0	0
Phenol	100,000	2004 PRG Industrial	0	0
Pyrene	425	2005 ESL Industrial (inhalation)	0	0
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	6.9	2005 ESL Industrial (direct exp)	0	0
1,1,1-Trichloroethane	230	2005 ESL Industrial (inhalation)	0	0
1,1,2,2-Tetrachloroethane	0.025	2005 ESL Industrial (inhalation)	2	0
1,1,2-Trichloro-1,2,2-trifluoroethane	--		--	--
1,1,2-Trichloroethane	0.089	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethane	0.89	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethene	105	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloropropene	--		--	--
1,2,3-Trichlorobenzene	--		--	--
1,2,3-Trichloropropane	--		--	--
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dibromo-3-chloropropane	0.067	2005 ESL Industrial (direct exp)	0	0
1,2-Dibromoethane	0.02	2005 ESL Industrial (inhalation)	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethane	0.07	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethene (Total)	150	SDGI Industrial Criteria	0	0
1,2-Dichloropropane	0.14	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,3-Dichloropropane	--		--	--
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2-Dichloropropane	--		--	--
2-Butanone	6,500	2005 ESL Industrial (inhalation)	0	0
2-Chloroethyl vinyl ether	--		--	--
2-Chlorotoluene	--		--	--
2-Hexanone	--		--	--
4-Chlorotoluene	--		--	--
4-Methyl-2-pentanone	1,550	2005 ESL Industrial (inhalation)	0	0
Acetone	16,500	2005 ESL Industrial (inhalation)	0	0
Benzene	0.38	2005 ESL Industrial (direct exp)	0	0
Bromobenzene	--		--	--
Bromochloromethane	--		--	--
Bromodichloromethane	0.039	2005 ESL Industrial (inhalation)	0	0

Table 4-16. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (0-2 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Volatile Organic Compounds *(continued)*				
Bromoform	220	2004 PRG Industrial	0	0
Bromomethane	2.6	2005 ESL Industrial (inhalation)	0	0
Carbon disulfide	720	2004 PRG Industrial	0	0
Carbon tetrachloride	0.034	2005 ESL Industrial (inhalation)	0	0
Chlorobenzene	31	2005 ESL Industrial (inhalation)	0	0
Chloroethane	1.8	2005 ESL Industrial (inhalation)	0	0
Chloroform	0.47	2004 PRG Industrial	0	0
Chloromethane	0.2	2005 ESL Industrial (inhalation)	0	0
cis-1,2-Dichloroethene	18	2005 ESL Industrial (inhalation)	0	0
cis-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Dibromochloromethane	0.054	2005 ESL Industrial (inhalation)	0	0
Dibromomethane	--		--	--
Dichlorodifluoromethane	310	2004 PRG Industrial	0	0
Ethylbenzene	5	2008 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Isopropylbenzene	2,000	2004 PRG Industrial	0	0
Methylcyclohexane	2,600	2004 PRG Industrial	0	0
Methylene chloride	1.5	2005 ESL Industrial (inhalation)	0	0
n-Butylbenzene	240	2004 PRG Industrial	0	0
o-Xylene	210	SDGI Industrial Criteria	0	0
para-Isopropyl toluene	--		--	--
Propylbenzene	240	2004 PRG Industrial	0	0
sec-Butylbenzene	220	2004 PRG Industrial	0	0
Styrene	1,100	2005 ESL Industrial (inhalation)	0	0
tert-Butyl methyl ether	5.6	2005 ESL Industrial (inhalation)	0	0
tert-Butylbenzene	390	2004 PRG Industrial	0	0
Tetrachloroethene	0.24	2005 ESL Industrial (inhalation)	0	0
Toluene	520	2004 PRG Industrial	0	0
trans-1,2-Dichloroethene	37	2005 ESL Industrial (inhalation)	0	0
trans-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Trichloroethene	0.11	2004 PRG Industrial	0	0
Trichlorofluoromethane	2,000	2004 PRG Industrial	0	0
Vinyl acetate	1,400	2004 PRG Industrial	0	0
Vinyl chloride	0.019	2005 ESL Industrial (inhalation)	0	0
Xylene (Total)	420	2004 PRG Industrial	0	0
Petroleum Hydrocarbons				
Gasoline-range organics	750	2005 ESL Industrial (direct exp)	0	0
Diesel-range organics	750	2005 ESL Industrial (direct exp)	8	0
Motor oil-range organics	4,600	2005 ESL Industrial (direct exp)	3	0
TPH-extractable unknown hydrocarbon	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-purgeable unknown hydrocarbon	750	2005 ESL Industrial (direct exp)	0	0
Total TPH	3,500	HPS TPH source criterion	7	0
Total oil and grease	3,500	HPS TPH source criterion	6	0

Notes:

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

--	No criteria available for this chemical	HPS	Hunters Point Shipyard
bgs	below ground surface	mg/kg	milligrams per kilogram
BHC	benzene hexachloride	NE	not established
Conc.	concentration	PCB	polychlorinated biphenyl
DDD	dichlorodiphenyldichloroethane	PRG	preliminary remediation goal
DDE	dichlorodiphenyldichloroethene	RIEC	remedial investigation evaluation criteria
DDT	dichlorodiphenyltrichloroethane	SDGI	standard data gaps investigation
ESL	environmental screening level	TPH	total petroleum hydrocarbons
HPAL	Hunters Point ambient level		

Table 4-17. Summary of Analyses and Detections in the East Adjacent Area (2-10 feet bgs)
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Metals					
Aluminum	72 / 72	1.4 - 250	871.46 - 42,652.9	NA	--
Antimony	87 / 126	0.36 - 6.9	0.26J - 976.27J	9.05	26
Arsenic	97 / 126	0.22 - 3.4	0.6 - 106	11.1	14
Barium	126 / 126	0.02 - 20.6	5.71 - 985	314.4	10
Beryllium	72 / 126	0.01 - 1.1	0.03J - 1.28	0.71	9
Cadmium	61 / 126	0.04 - 1.1	0.2J - 7.16	3.14	4
Calcium	72 / 72	1.31 - 330	278.04 - 131,000	NA	--
Chromium	126 / 126	0.09 - 2.5	33.16 - 924	a	4
Chromium VI	2 / 69	0.05 - 0.07	0.3 - 0.97	NA	--
Cobalt	126 / 126	0.09 - 5.2	1.8J - 225	a	2
Copper	125 / 126	0.11 - 23	2.7 - 7700	124.3	57
Cyanide	5 / 17	0.12 - 1	0.37 - 1.2	NA	--
Iron	72 / 72	0.72 - 210	4,011.52 - 100,000	NA	--
Lead	117 / 126	0.13 - 29	1.6 - 255,684	8.99	95
Magnesium	72 / 72	0.79 - 100	630J - 212,000	NA	--
Manganese	72 / 72	0.01 - 3.4	43.22 - 2,550	1431.2	3
Mercury	102 / 126	0.01 - 2.3	0.01J - 51	2.28	35
Molybdenum	45 / 123	0.14 - 2.3	0.56 - 14.61	2.68	15
Nickel	121 / 126	0.16 - 5.2	10J - 2,970	a	2
Potassium	55 / 72	1.4 - 413.09	107 - 5,640	NA	--
Selenium	39 / 126	0.22 - 5.2	0.09J - 6.2	1.95	4
Silver	26 / 126	0.09 - 10.4	0.14J - 17.8	1.43	4
Sodium	54 / 72	4.8 - 330	70 - 7,520	NA	--
Thallium	11 / 126	0.16 - 3.1	0.14J - 5.6	0.81	5
Tin	0 / 0	--	--	NA	--
Vanadium	125 / 126	0.09 - 5.2	3.7 - 520	117.2	2
Zinc	126 / 126	0.23 - 45	20.4 - 3,100	109.9	65
Pesticides					
4,4'-DDD	9 / 128	0.0034 - 27	0.0026J - 0.059J	NA	--
4,4'-DDE	37 / 128	0.0034 - 27	0.0016J - 24J	NA	--
4,4'-DDT	47 / 128	0.0034 - 27	0.0036J - 110J	NA	--
Aldrin	8 / 128	0.0017 - 14	0.0053J - 0.039J	NA	--
Alpha-BHC	2 / 128	0.0017 - 14	0.0029 - 0.0037J	NA	--
Alpha-chlordane	0 / 74	0.0017 - 87	--	NA	--
Beta-BHC	11 / 128	0.0017 - 14	0.0027J - 0.065	NA	--
Delta-BHC	2 / 128	0.0017 - 14	0.0027J - 0.0093J	NA	--
Dieldrin	25 / 128	0.0034 - 27	0.0047J - 7.9	NA	--
Endosulfan I	12 / 128	0.0017 - 14	0.0015J - 0.01J	NA	--
Endosulfan II	16 / 128	0.0034 - 27	0.0075J - 4.8	NA	--
Endosulfan sulfate	44 / 128	0.0034 - 27	0.0057J - 250	NA	--
Endrin	19 / 128	0.0017 - 27	0.0063J - 2.3J	NA	--
Endrin aldehyde	15 / 79	0.0034 - 27	0.0095J - 49J	NA	--
Endrin ketone	17 / 126	0.0034 - 27	0.011J - 3J	NA	--
Gamma-BHC (lindane)	0 / 128	0.0017 - 14	--	NA	--
Gamma-chlordane	9 / 56	0.024 - 240	0.001 - 0.0097	NA	--
Heptachlor	7 / 128	0.0017 - 14	0.0031J - 0.048J	NA	--
Heptachlor epoxide	35 / 128	0.0017 - 14	0.0038J - 86	NA	--
Methoxychlor	25 / 128	0.0068 - 140	0.012J - 85J	NA	--
Toxaphene	0 / 125	0.069 - 490	--	NA	--
Trans-chlordane	0 / 72	0.0017 - 87	--	NA	--
Polychlorinated Biphenyls					--
Aroclor-1016 (low risk PCB)	1 / 232	0.01 - 780	0.22	NA	--
Aroclor-1221 (high risk PCB)	0 / 232	0.021 - 1,600	--	NA	--
Aroclor-1232 (high risk PCB)	0 / 232	0.01 - 780	--	NA	--
Aroclor-1242 (high risk PCB)	3 / 232	0.01 - 780	0.016V - 1.2	NA	--
Aroclor-1248 (high risk PCB)	0 / 232	0.01 - 780	--	NA	--
Aroclor-1254 (high risk PCB)	8 / 232	0.01 - 780	0.62 - 5.9	NA	--
Aroclor-1260 (high risk PCB)	157 / 232	0.01 - 780	0.004J - 12,000	NA	--
Total (high risk) PCBs	157 / 232	0.01 - 780	0.008 - 12,000	NA	--

Table 4-17. Summary of Analyses and Detections in the East Adjacent Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds					
1,2,4-Trichlorobenzene	3 / 76	0.15 - 640	0.49J - 280	NA	--
1,2-Dichlorobenzene	1 / 76	0.15 - 640	2.7	NA	--
1,3-Dichlorobenzene	1 / 76	0.15 - 640	6.3	NA	--
1,4-Dichlorobenzene	1 / 76	0.15 - 640	5.8	NA	--
11H-Benzo(a)fluorene	0 / 0	--	--	NA	--
17-Pentatriacontene	0 / 0	--	--	NA	--
1-Docosene	1 / 1	0.24 - 0.24	0.24J	NA	--
1-Methylpyrene	0 / 0	--	--	NA	--
2-(2-Butoxyethoxy)-ethanol	0 / 0	--	--	NA	--
2,2'-Oxybis(1-chloropropane)	0 / 2	0.71 - 9.9	--	NA	--
2,3-Dimethylphenanthrene	0 / 0	--	--	NA	--
2,4,5,7-Tetramethylphenanthrene	1 / 1	0.098 - 0.098	0.098	NA	--
2,4,5-Trichlorophenol	0 / 71	0.48 - 1,600	--	NA	--
2,4,6-Trichlorophenol	0 / 71	0.34 - 640	--	NA	--
2,4-Dichlorophenol	0 / 71	0.34 - 640	--	NA	--
2,4-Dimethylphenol	0 / 76	0.15 - 640	--	NA	--
2,4-Dinitrophenol	0 / 71	0.86 - 1,600	--	NA	--
2,4-Dinitrotoluene	0 / 73	0.34 - 640	--	NA	--
2,6,10,14-Tetramethylhexadecane	0 / 0	--	--	NA	--
2,6,10,14-Tetramethylpentadecane	2 / 2	0.25 - 0.34	0.25 - 0.34J	NA	--
2,6,10-Trimethyl-dodecane	1 / 1	0.089 - 0.089	0.089	NA	--
2,6,11,15-Tetramethylhexadecane	1 / 1	0.084 - 0.084	0.084J	NA	--
2,6,11-Trimethyl-dodecane	1 / 1	0.12 - 0.12	0.12	NA	--
2,6-Dinitrotoluene	0 / 76	0.15 - 640	--	NA	--
2-Chloronaphthalene	0 / 76	0.15 - 640	--	NA	--
2-Chlorophenol	0 / 73	0.34 - 640	--	NA	--
2-Methylnaphthalene	7 / 73	0.14 - 640	0.046J - 25J	NA	--
2-Methylphenol	0 / 76	0.15 - 640	--	NA	--
2-Nitroaniline	0 / 76	0.15 - 1,600	--	NA	--
2-Nitrophenol	0 / 71	0.34 - 640	--	NA	--
3,3'-Dichlorobenzidine	0 / 76	0.15 - 640	--	NA	--
3,6-Dimethylphenanthrene	0 / 0	--	--	NA	--
3-Nitroaniline	0 / 71	0.86 - 1,600	--	NA	--
4,4-Dimethylbiphenyl	0 / 0	--	--	NA	--
4,6-Dinitro-2-methylphenol	0 / 71	0.86 - 1,600	--	NA	--
4-Bromophenyl-phenylether	0 / 71	0.34 - 640	--	NA	--
4-Chloro-3-methylphenol	0 / 73	0.34 - 640	--	NA	--
4-Chloroaniline	0 / 71	0.34 - 640	--	NA	--
4-Chlorophenyl-phenylether	0 / 71	0.34 - 640	--	NA	--
4H-Cyclopenta(def)phenanthrene	0 / 0	--	--	NA	--
4-Methylphenol	0 / 76	0.15 - 640	--	NA	--
4-Nitroaniline	0 / 71	0.86 - 1,600	--	NA	--
4-Nitrophenol	1 / 76	0.37 - 1,600	0.24J	NA	--
7H-Benzo[c]fluorene	1 / 1	0.19 - 190	0.19J	NA	--
9,10-Anthracenedione	0 / 0	--	--	NA	--
9-Methylanthracene	0 / 0	--	--	NA	--
Acenaphthene	4 / 127	0.073 - 44	0.26J - 2.3J	NA	--
Acenaphthylene	3 / 124	0.073 - 44	0.035J - 0.086J	NA	--
Aniline	0 / 9	0.351 - 3.623	--	NA	--
Anthracene	18 / 127	0.073 - 44	0.005J - 1.5	NA	--
Azobenzene	0 / 2	0.71 - 9.9	--	NA	--
Benzidine	0 / 9	0.351 - 3.623	--	NA	--
Benzo(a)anthracene	38 / 127	0.073 - 44	0.013J - 7.3	NA	--
Benzo(a)pyrene	37 / 127	0.073 - 44	0.016J - 13	NA	--
Benzo(b)fluoranthene	43 / 127	0.073 - 44	0.025J - 5.9	NA	--
Benzo(e)pyrene	1 / 1	9.1 - 640	9.1 - 9.1	NA	--
Benzo(g,h,i)perylene	19 / 127	0.073 - 44	0.017J - 4.3	NA	--
Benzo(k)fluoranthene	33 / 127	0.073 - 44	0.0092J - 6.6	NA	--
Benzoic acid	0 / 51	1.6 - 220	--	NA	--

Table 4-17. Summary of Analyses and Detections in the East Adjacent Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Benzyl alcohol	0 / 51	0.34 - 44	--	NA	--
Bis(2-chloroethoxy)methane	0 / 71	0.34 - 640	--	NA	--
Bis(2-chloroethyl)ether	0 / 71	0.34 - 640	--	NA	--
Bis(2-chloroisopropyl)ether	0 / 69	0.34 - 640	--	NA	--
Bis(2-ethylhexyl)phthalate	0 / 76	0.15 - 640	--	NA	--
Butylbenzylphthalate	0 / 76	0.15 - 640	--	NA	--
Carbazole	1 / 24	0.15 - 640	0.24J	NA	--
Chrysene	58 / 127	0.073 - 44	0.029J - 15	NA	--
Cyclopenta(cd)pyrene	1 / 1	0.14 - 140	0.14J	NA	--
Dibenz(a,h)anthracene	4 / 127	0.073 - 44	0.046J - 0.71	NA	--
Dibenzofuran	2 / 76	0.15 - 640	0.075J - 0.083J	NA	--
Diethylphthalate	0 / 76	0.15 - 640	--	NA	--
Dimethylphthalate	0 / 71	0.34 - 640	--	NA	--
Di-n-butylphthalate	0 / 76	0.15 - 640	--	NA	--
Di-n-octylphthalate	0 / 76	0.15 - 640	--	NA	--
Docosane	0 / 0	--	--	NA	--
Dodecane	2 / 2	0.1 - 0.12	0.1 - 0.12J	NA	--
Dotriacontane	6 / 6	0.11 - 1	0.11 - 1	NA	--
Eicosane	7 / 7	0.076 - 230	0.076 - 0.83	NA	--
Fluoranthene	49 / 127	0.073 - 44	0.026J - 11	NA	--
Fluorene	9 / 127	0.073 - 44	0.0067J - 3.2J	NA	--
Heneicosane	2 / 2	0.25 - 0.56	0.25J - 0.56	NA	--
Heptacosane	1 / 1	0.28 - 0.28	0.28J	NA	--
Heptadecane	4 / 4	0.088 - 0.26	0.088 - 0.26	NA	--
Hexachlorobenzene	0 / 76	0.15 - 640	--	NA	--
Hexachlorobutadiene	0 / 71	0.34 - 640	--	NA	--
Hexachlorocyclopentadiene	0 / 71	0.34 - 640	--	NA	--
Hexachloroethane	0 / 71	0.34 - 640	--	NA	--
Hexacosane	0 / 0	--	--	NA	--
Hexadecane	4 / 4	0.083 - 0.45	0.083 - 0.45J	NA	--
Hexadecanoic acid	0 / 0	--	--	NA	--
Hexatriacontane	5 / 5	0.098 - 0.57	0.098 - 0.57	NA	--
Indeno(1,2,3-cd)pyrene	16 / 127	0.073 - 44	0.014J - 5.1	NA	--
Isophorone	0 / 73	0.15 - 640	--	NA	--
m-Terphenyl	1 / 1	0.32 - 0.32	0.32	NA	--
Naphthalene	13 / 127	0.073 - 44	0.008J - 7.9	NA	--
Nitrobenzene	0 / 71	0.34 - 640	--	NA	--
n-Nitrosodimethylamine	0 / 11	0.351 - 9.9	--	NA	--
n-Nitroso-di-n-propylamine	0 / 76	0.15 - 640	--	NA	--
n-Nitrosodiphenylamine	0 / 76	0.15 - 640	--	NA	--
Nonacosane	1 / 1	0.15 - 0.15	0.15	NA	--
Nonadecane	1 / 1	0.09 - 0.09	0.09	NA	--
Octacosane	0 / 0	--	--	NA	--
Octadecane	1 / 1	2.5 - 2,500	2.5	NA	--
o-Terphenyl	0 / 0	--	--	NA	--
PCB-153	1 / 1	0.22 - 0.22	0.22	NA	--
Pentachlorophenol	0 / 76	0.37 - 1,600	--		--
Pentacosane	1 / 1	0.11 - 0.11	0.11J	NA	--
Pentadecane	2 / 2	0.11 - 0.12	0.11 - 0.12J	NA	--
Pentatriacontane	5 / 5	0.093 - 0.4	0.093J - 0.4J	NA	--
Perylene	1 / 1	7.8 - 7,800	7.8J	NA	--
Phenanthrene	54 / 127	0.073 - 44	0.025J - 10	NA	--
Phenol	3 / 76	0.15 - 640	0.56J - 3.2J	NA	--
p-Terphenyl	0 / 0	--	--	NA	--
Pyrene	63 / 127	0.073 - 44	0.036J - 14	NA	--
Tetracosane	1 / 1	0.59	0.59	NA	--
Tetradecane	1 / 1	0.21	0.21	NA	--
Tetratetracontane	1 / 1	0.085	0.085	NA	--
Triacontane	1 / 1	0.35	0.35J	NA	--

Table 4-17. Summary of Analyses and Detections in the East Adjacent Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Tricosane	1 / 1	0.54 - 0.54	0.54	NA	--
Tridecane	0 / 0	--	--	NA	--
Tri-m-cresyl phosphate	1 / 1	0.23 - 0.23	0.23J	NA	--
Triphenylene	0 / 0	--	--	NA	--
Tri-p-tolyl phosphate	1 / 1	0.21 - 0.21	0.21	NA	--
Volatile Organic Compounds					
1,1,1-Trichloroethane	5 / 69	0.005 - 1.1	0.004J - 0.03028	NA	--
1,1,2,2-Tetrachloroethane	7 / 76	0.005 - 1.2	0.19 - 1.2	NA	--
1,1,2-Trichloroethane	0 / 69	0.005 - 1.1	--	NA	--
1,1-Dichloroethane	2 / 69	0.005 - 1.1	0.05878 - 0.15047	NA	--
1,1-Dichloroethene	2 / 69	0.005 - 1.1	0.00582 - 0.01053	NA	--
1,2,3,5-Tetramethylbenzene	0 / 0	--	--	NA	--
1,2,4-Trimethylbenzene	0 / 0	0.12 - 0.12	--	NA	--
1,2-Dichloroethane	0 / 69	0.005 - 1.1	--	NA	--
1,2-Dichloroethene (Total)	0 / 66	0.005 - 1.1	--	NA	--
1,2-Dichloropropane	0 / 69	0.005 - 1.1	--	NA	--
1-Ethyl-2,3-dihydro-1H-indene	0 / 0	--	--	NA	--
1-Ethyl-2,4-dimethyl benzene	0 / 0	--	--	NA	--
1-Ethyl-2-methylbenzene	0 / 0	--	--	NA	--
2-Butanone	5 / 69	0.006 - 2.2	0.0031J - 0.01445	NA	--
2-Hexanone	0 / 69	0.01 - 2.2	--	NA	--
4-Ethyl-1,2-dimethylbenzene	0 / 0	--	--	NA	--
4-Methyl-2-pentanone	0 / 69	0.01 - 2.2	--	NA	--
Acetone	3 / 69	0.01 - 2.2	0.009J - 0.068J	NA	--
Benzene	1 / 69	0.005 - 1.1	0.0018J	NA	--
Bicyclo[3.3.1]nonane	0 / 0	--	--	NA	--
Bromodichloromethane	0 / 69	0.005 - 1.1	--	NA	--
Bromoform	0 / 69	0.005 - 1.1	--	NA	--
Bromomethane	0 / 69	0.01 - 2.2	--	NA	--
Carbon disulfide	3 / 66	0.005 - 1.1	0.006J - 0.04129J	NA	--
Carbon tetrachloride	0 / 69	0.005 - 1.1	--	NA	--
Chlorobenzene	1 / 69	0.005 - 1.1	0.094J	NA	--
Chloroethane	1 / 69	0.01 - 2.2	0.008J	NA	--
Chloroform	0 / 69	0.005 - 1.1	--	NA	--
Chloromethane	0 / 69	0.01 - 2.2	--	NA	--
cis-1,2-Dichloroethene	0 / 3	0.0067 - 0.0078	--	NA	--
cis-1,3-Dichloropropene	0 / 69	0.005 - 1.1	--	NA	--
cis-Bicyclo[4.3.0]nonane	0 / 0	--	--	NA	--
Dibromochloromethane	0 / 69	0.005 - 1.1	--	NA	--
Ethylbenzene	3 / 69	0.005 - 1.1	0.0017J - 1.11324	NA	--
Methylcyclohexane	0 / 0	--	--	NA	--
Methylene chloride	1 / 69	0.005 - 1.1	0.076	NA	--
o-Xylene	0 / 0	--	--	NA	--
Styrene	0 / 69	0.005 - 1.1	--	NA	--
Tert-butyl methyl ether	0 / 3	0.0067 - 0.0078	--	NA	--
Tetrachloroethene	3 / 69	0.005 - 1.1	0.02339 - 0.204	NA	--
Toluene	7 / 69	0.005 - 1.1	0.0011J - 0.064	NA	--
trans-1,3-Dichloroethene	0 / 3	0.0067 - 0.0078	--	NA	--
trans-1,3-Dichloropropene	0 / 69	0.005 - 1.1	--	NA	--
Trichloroethene	6 / 69	0.005 - 1.1	0.002J - 0.02414	NA	--
Vinyl acetate	0 / 52	0.01 - 2.2	--	NA	--
Vinyl chloride	0 / 69	0.01 - 2.2	--	NA	--
Xylene (Total)	9 / 69	0.005 - 1.1	0.0012J - 3.34324	NA	--
Petroleum Hydrocarbons					
Gasoline-range organics	88 / 228	0.16 - 590	0.02J - 4,800	NA	--
Diesel-range organics	193 / 229	1.1 - 990	2.8 - 15,000	NA	--
Motor oil-range organics	178 / 180	5.4 - 340	9.7J - 24,000	NA	--
TPH-extractable unknown hydrocarbon	1 / 6	10 - 12	110	NA	--
TPH-purgeable unknown hydrocarbon	1 / 8	0.19 - 150	0.35H - 290H	NA	--

Table 4-17. Summary of Analyses and Detections in the East Adjacent Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Petroleum Hydrocarbons *(continued)*					
Total recoverable petroleum hydrocarbon	11 / 14	10 - 26	31J - 720	NA	--
Total TPH	205 / 231	--	9.7 - 34,120	NA	--
Total oil and grease	43 / 49	26 - 94	29 - 9,700J	NA	--

Notes:

(1) rejected data are not included in detection frequency

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical

bgs below ground surface

BHC benzene hexachloride

DDD dichlorodiphenyldichloroethane

DDE dichlorodiphenyldichloroethene

DDT dichlorodiphenyltrichloroethane

H pattern is heavier hydrocarbon end of the chemical's range in the standard

HPAL Hunters Point ambient level

J estimated value

mg/kg milligrams per kilogram

NA not available

PCB polychlorinated biphenyl

R rejected

TPH total petroleum hydrocarbons

Table 4-18. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (2-10 feet bgs)
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Metals				
Aluminum	100,000	2004 PRG Industrial	0	0
Antimony	380	2005 ESL Industrial (direct exp)	2	0
Arsenic	11.1	HPAL	14	0
Barium	63,000	2005 ESL Industrial (direct exp)	0	0
Beryllium	36	2005 ESL Industrial (direct exp)	0	0
Cadmium	7.4	2005 ESL Industrial (direct exp)	0	0
Calcium	--		--	--
Chromium (total)	a	See note	1	0
Chromium VI	37	2005 ESL Industrial (direct exp)	0	0
Cobalt	a	See note	0	0
Copper	38,000	2005 ESL Industrial (direct exp)	0	0
Cyanide (free)	12,000	2004 PRG Industrial	0	0
Iron	100,000	2004 PRG Industrial	0	0
Lead	800	2004 PRG Industrial	11	2
Magnesium	--		--	--
Manganese	19,000	2004 PRG Industrial	0	0
Mercury	180	2005 ESL Industrial (direct exp)	0	0
Molybdenum	4,800	2005 ESL Industrial (direct exp)	0	0
Nickel	a	See note	0	0
Potassium	--		--	--
Selenium	4,800	2005 ESL Industrial (direct exp)	0	0
Silver	4,800	2005 ESL Industrial (direct exp)	0	0
Sodium	--		--	--
Thallium	63	2005 ESL Industrial (direct exp)	0	0
Tin	100,000	2004 PRG Industrial	0	0
Vanadium	1,000	2004 PRG Industrial	0	0
Zinc	100,000	2004 PRG Industrial	0	0
Pesticides				
2,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
2,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
2,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
4,4'-DDE	6.3	2005 ESL Industrial (direct exp)	1	0
4,4'-DDT	6.3	2005 ESL Industrial (direct exp)	3	0
Aldrin	0.1	2004 PRG Industrial	0	0
alpha-BHC	0.36	2004 PRG Industrial	0	0
Alpha-chlordane	2.9	SDGI Industrial Criteria	0	0
beta-BHC	1.3	2004 PRG Industrial	0	0
Chlordane	1.7	2005 ESL Industrial (direct exp)	0	0
cis-Nonachlor	--		--	--
delta-BHC	0.59	SDGI Industrial Criteria	0	0
Dieldrin	0.11	2004 PRG Industrial	9	0
Endosulfan I	3,700	2004 PRG Industrial	0	0
Endosulfan II	3,700	2004 PRG Industrial	0	0
Endosulfan sulfate	5,300	SDGI Industrial Criteria	0	0
Endrin	180	2004 PRG Industrial	0	0
Endrin aldehyde	260	SDGI Industrial Criteria	0	0
Endrin ketone	260	SDGI Industrial Criteria	0	0
Gamma-BHC (lindane)	1.7	2004 PRG Industrial	0	0
Gamma-chlordane	2.9	SDGI Industrial Criteria	0	0
Heptachlor	0.38	2004 PRG Industrial	0	0
Heptachlor epoxide	0.19	2004 PRG Industrial	11	1
Heptachlor epoxide A	--		--	--
Heptachlor epoxide B	--		--	--
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Methoxychlor	3,100	2004 PRG Industrial	0	0
Mirex	--		--	--
Oxychlordane	--		--	--
Toxaphene	1.6	2004 PRG Industrial	0	0
trans-Nonachlor	21	2004 PRG Industrial	0	0

Table 4-18. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Polychlorinated Biphenyls				
Aroclor-1016 (low risk PCB)	21	2004 PRG Industrial	0	0
Aroclor-1221 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1232 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1242 (high risk PCB)	0.74	2004 PRG Industrial	1	0
Aroclor-1248 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1254 (high risk PCB)	0.74	2004 PRG Industrial	5	0
Aroclor-1260 (high risk PCB)	0.74	2004 PRG Industrial	79	18
Total (high risk) PCBs	0.74	2004 PRG Industrial	81	0
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	1	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	1	0
2,2'-Oxybis(1-chloropropane)	7.4	2004 PRG Industrial	0	0
2,4,5-Trichlorophenol	61	2005 ESL Industrial (inhalation)	0	0
2,4,6-Trichlorophenol	25	2005 ESL Industrial (direct exp)	0	0
2,4-Dichlorophenol	1,800	2004 PRG Industrial	0	0
2,4-Dimethylphenol	1,500	2005 ESL Industrial (inhalation)	0	0
2,4-Dinitrophenol	1,200	2004 PRG Industrial	0	0
2,4-Dinitrotoluene	5.6	2005 ESL Industrial (direct exp)	0	0
2,6-Dinitrotoluene	620	2004 PRG Industrial	0	0
2-Chloronaphthalene	23,000	2004 PRG Industrial	0	0
2-Chlorophenol	10	2005 ESL Industrial (inhalation)	0	0
2-Methylnaphthalene	550	2005 ESL Industrial (inhalation)	0	0
2-Methylphenol	31,000	2004 PRG Industrial	0	0
2-Nitroaniline	1,800	2004 PRG Industrial	0	0
2-Nitrophenol	--		--	--
3,3'-Dichlorobenzidine	1.4	2005 ESL Industrial (direct exp)	0	0
3-Nitroaniline	82	2004 PRG Industrial	0	0
4,6-Dinitro-2-methylphenol	--		--	--
4-Bromophenyl-phenylether	--		--	--
4-Chloro-3-methylphenol	--		--	--
4-Chloroaniline	2,500	2004 PRG Industrial	0	0
4-Chlorophenyl-phenylether	--		--	--
4-Methylphenol	3,100	2004 PRG Industrial	0	0
4-Nitroaniline	82	2004 PRG Industrial	0	0
4-Nitrophenol	7,000	SDGI Industrial Criteria	0	0
Acenaphthene	650	2005 ESL Industrial (inhalation)	0	0
Acenaphthylene	18,000	2005 ESL Industrial (direct exp)	0	0
Aniline	300	2004 PRG Industrial	0	0
Anthracene	31	2005 ESL Industrial (inhalation)	0	0
Azobenzene	16	2004 PRG Industrial	0	0
Benzidine	--		--	--
Benzo(a)anthracene	1.3	2005 ESL Industrial (direct exp)	7	0
Benzo(a)pyrene	0.33	SDGI Industrial Criteria	14	0
Benzo(b)fluoranthene	1.3	2005 ESL Industrial (direct exp)	13	0
Benzo(e)pyrene	--		--	--
Benzo(g,h,i)perylene	22,000	2005 ESL Industrial (direct exp)	0	0
Benzo(k)fluoranthene	1.3	2005 ESL Industrial (direct exp)	5	0
Benzoic acid	100,000	2004 PRG Industrial	0	0
Benzyl alcohol	100,000	2004 PRG Industrial	0	0
Biphenyl	18,000	2005 ESL Industrial (direct exp)	0	0
Bis(2-chloroethoxy)methane	--		--	--
Bis(2-chloroethyl)ether	0.012	2005 ESL Industrial (inhalation)	0	0
Bis(2-ethylhexyl)phthalate	120	2004 PRG Industrial	0	0
Butylbenzylphthalate	100,000	2004 PRG Industrial	0	0
Carbazole	86	2004 PRG Industrial	0	0
Chrysene	13	2005 ESL Industrial (direct exp)	1	0
Dibenz(a,h)anthracene	0.33	SDGI Industrial Criteria	2	0

Table 4-18. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Semivolatile Organic Compounds *(continued)*				
Dibenzofuran	1,600	2004 PRG Industrial	0	0
Diethylphthalate	100,000	2004 PRG Industrial	0	0
Dimethylphthalate	100,000	2004 PRG Industrial	0	0
Di-n-butylphthalate	62,000	2004 PRG Industrial	0	0
Di-n-octylphthalate	25,000	2004 PRG Industrial	0	0
Fluoranthene	22,000	2004 PRG Industrial	0	0
Fluorene	800	2005 ESL Industrial (inhalation)	0	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Hexachlorocyclopentadiene	3,700	2004 PRG Industrial	0	0
Hexachloroethane	44	2005 ESL Industrial (direct exp)	0	0
Indeno(1,2,3-cd)pyrene	1.3	2005 ESL Industrial (direct exp)	2	0
Isophorone	510	2004 PRG Industrial	0	0
Naphthalene	1.5	2005 ESL Industrial (inhalation)	3	0
Nitrobenzene	100	2004 PRG Industrial	0	0
n-Nitrosodimethylamine	0.034	2004 PRG Industrial	0	0
n-Nitroso-di-n-propylamine	0.25	2004 PRG Industrial	0	0
n-Nitrosodiphenylamine	350	2004 PRG Industrial	0	0
Pentachlorophenol	9	2004 PRG Industrial	0	0
Phenacetin	--		--	--
Phenanthrene	18,000	2005 ESL Industrial (direct exp)	0	0
Phenol	100,000	2004 PRG Industrial	0	0
Pyrene	425	2005 ESL Industrial (inhalation)	0	0
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	6.9	2005 ESL Industrial (direct exp)	0	0
1,1,1-Trichloroethane	230	2005 ESL Industrial (inhalation)	0	0
1,1,2,2-Tetrachloroethane	0.025	2005 ESL Industrial (inhalation)	7	0
1,1,2-Trichloro-1,2,2-trifluoroethane	--		--	--
1,1,2-Trichloroethane	0.089	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethane	0.89	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethene	105	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloropropene	--		--	--
1,2,3-Trichlorobenzene	--		--	--
1,2,3-Trichloropropane	--		--	--
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dibromo-3-chloropropane	0.067	2005 ESL Industrial (direct exp)	0	0
1,2-Dibromoethane	0.02	2005 ESL Industrial (inhalation)	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethane	0.07	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethene (Total)	150	SDGI Industrial Criteria	0	0
1,2-Dichloropropane	0.14	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,3-Dichloropropane	--		--	--
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2-Dichloropropane	--		--	--
2-Butanone	6,500	2005 ESL Industrial (inhalation)	0	0
2-Chloroethyl vinyl ether	--		--	--
2-Chlorotoluene	--		--	--
2-Hexanone	--		--	--
4-Chlorotoluene	--		--	--
4-Methyl-2-pentanone	1,550	2005 ESL Industrial (inhalation)	0	0
Acetone	16,500	2005 ESL Industrial (inhalation)	0	0
Benzene	0.38	2005 ESL Industrial (direct exp)	0	0
Bromobenzene	--		--	--
Bromochloromethane	--		--	--
Bromodichloromethane	0.039	2005 ESL Industrial (inhalation)	0	0
Bromoform	220	2004 PRG Industrial	0	0
Bromomethane	2.6	2005 ESL Industrial (inhalation)	0	0
Carbon disulfide	720	2004 PRG Industrial	0	0

Table 4-18. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (2-10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Volatile Organic Compounds *(continued)*				
Carbon tetrachloride	0.034	2005 ESL Industrial (inhalation)	0	0
Chlorobenzene	31	2005 ESL Industrial (inhalation)	0	0
Chloroethane	1.8	2005 ESL Industrial (inhalation)	0	0
Chloroform	0.47	2004 PRG Industrial	0	0
Chloromethane	0.2	2005 ESL Industrial (inhalation)	0	0
cis-1,2-Dichloroethene	18	2005 ESL Industrial (inhalation)	0	0
cis-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Dibromochloromethane	0.054	2005 ESL Industrial (inhalation)	0	0
Dibromomethane	--		--	--
Dichlorodifluoromethane	310	2004 PRG Industrial	0	0
Ethylbenzene	5	2008 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Isopropylbenzene	2,000	2004 PRG Industrial	0	0
Methylcyclohexane	2,600	2004 PRG Industrial	0	0
Methylene chloride	1.5	2005 ESL Industrial (inhalation)	0	0
n-Butylbenzene	240	2004 PRG Industrial	0	0
o-Xylene	210	SDGI Industrial Criteria	0	0
para-Isopropyl toluene	--		--	--
Propylbenzene	240	2004 PRG Industrial	0	0
sec-Butylbenzene	220	2004 PRG Industrial	0	0
Styrene	1,100	2005 ESL Industrial (inhalation)	0	0
tert-Butyl methyl ether	5.6	2005 ESL Industrial (inhalation)	0	0
tert-Butylbenzene	390	2004 PRG Industrial	0	0
Tetrachloroethene	0.24	2005 ESL Industrial (inhalation)	0	0
Toluene	520	2004 PRG Industrial	0	0
trans-1,2-Dichloroethene	37	2005 ESL Industrial (inhalation)	0	0
trans-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Trichloroethene	0.11	2004 PRG Industrial	0	0
Trichlorofluoromethane	2,000	2004 PRG Industrial	0	0
Vinyl acetate	1,400	2004 PRG Industrial	0	0
Vinyl chloride	0.019	2005 ESL Industrial (inhalation)	0	0
Xylene (Total)	420	2004 PRG Industrial	0	0
Petroleum Hydrocarbons				
Gasoline-range organics	750	2005 ESL Industrial (direct exp)	0	0
Diesel-range organics	750	2005 ESL Industrial (direct exp)	36	0
Motor oil-range organics	4,600	2005 ESL Industrial (direct exp)	18	0
TPH-extractable unknown hydrocarbons	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-purgeable unknown hydrocarbons	750	2005 ESL Industrial (direct exp)	0	0
Total TPH	3,500	HPS TPH source criterion	27	0
Total oil and grease	3,500	HPS TPH source criterion	6	0

Notes:

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical
bgs below ground surface
BHC benzene hexachloride
Conc. concentration
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethene
DDT dichlorodiphenyltrichloroethane
ESL environmental screening level
HPAL Hunters Point ambient level
HPS Hunters Point Shipyard
mg/kg milligrams per kilogram
NE not established
PCB polychlorinated biphenyl
PRG preliminary remediation goal
RIEC remedial investigation evaluation criteria
SDGI standard data gaps investigation
TPH total petroleum hydrocarbons

Table 4-19. Summary of Analyses and Detections in the East Adjacent Area (greater than 10 feet bgs)
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Metals					
Aluminum	59/59	1.6 - 11.4	2,682.99 - 5,9232.3	NA	--
Antimony	26/60	0.7 - 7.7	1.4J - 14.69J	9.05	5
Arsenic	46/60	0.32 - 4.3	0.68 - 25.98	11.1	12
Barium	60/60	0.07 - 2.1	11.3 - 512	314.4	1
Beryllium	19/60	0.02 - 1.1	0.19 - 1.25	0.71	6
Cadmium	8/60	0.05 - 1.5	0.5 - 2.6	3.14	0
Calcium	59/59	1.29 - 43	525J - 90,625.9	NA	--
Chromium	60/60	0.12 - 2.1	40.89 - 983.67	a	3
Chromium VI	0/85	0.05 - 0.05	-	NA	--
Cobalt	60/60	0.12 - 2.6	5.39 - 150.25	a	1
Copper	59/60	0.19 - 4.3	7.88 - 2,910J	124.3	8
Cyanide	4/19	0.12 - 1	0.14J - 1.1	NA	--
Iron	59/59	0.79 - 5.3	1,0815.2 - 65,095.9	NA	--
Lead	57/60	0.22 - 11.5	0.45 - 24,600	8.99	37
Magnesium	59/59	0.88 - 43	1,984.29 - 245,000	NA	--
Manganese	60/60	0.01 - 3.2	62.77 - 2,110.98	1,431.20	3
Mercury	18/60	0.03 - 0.5	0.11J - 8.8	2.28	4
Molybdenum	10/55	0.28 - 2.1	0.84 - 2.77	2.68	1
Nickel	60/60	0.3 - 6.8	22.74 - 2,250	a	0
Potassium	51/59	11.7 - 195	114 - 6,150	NA	--
Selenium	1/60	0.4 - 4.28	0.75J	1.95	0
Silver	9/60	0.16 - 2.1	0.42J - 1.1	1.43	0
Sodium	57/59	5.9 - 43	115 - 9,300	NA	--
Thallium	0/60	0.35 - 3.92	--	0.81	0
Tin	0/0	--	--	NA	--
Vanadium	60/60	0.19 - 2.8	18.39 - 116.65	117.2	0
Zinc	60/60	0.28 - 2.1	12.9 - 1,120	109.9	7
Pesticides					
4,4'-DDD	1/35	0.0039 - 0.21	0.0081J	NA	--
4,4'-DDE	1/35	0.0039 - 0.21	0.0075J	NA	--
4,4'-DDT	0/35	0.0039 - 0.21	--	NA	--
Aldrin	0/35	0.0019 - 0.11	--	NA	--
Alpha-BHC	0/35	0.0019 - 0.11	--	NA	--
Alpha-chlordane	0/34	0.0019 - 1.1	--	NA	--
Beta-BHC	1/35	0.0019 - 0.11	0.0018J	NA	--
Delta-BHC	0/35	0.0019 - 0.11	--	NA	--
Dieldrin	0/35	0.0039 - 0.21	--	NA	--
Endosulfan I	1/35	0.0019 - 0.11	0.0032J	NA	--
Endosulfan II	0/35	0.0039 - 0.21	--	NA	--
Endosulfan sulfate	1/35	0.0039 - 0.21	0.0043J	NA	--
Endrin	0/35	0.0039 - 0.21	--	NA	--
Endrin aldehyde	0/5	0.0039 - 0.019	--	NA	--
Endrin ketone	1/35	0.0039 - 0.21	0.0095J	NA	--
Gamma-BHC (lindane)	0/35	0.0019 - 0.11	--	NA	--
Gamma-chlordane	0/1	0.096 - 0.096	--	NA	--
Heptachlor	0/35	0.0019 - 0.11	--	NA	--
Heptachlor epoxide	1/35	0.0019 - 0.11	0.0015J	NA	--
Methoxychlor	0/35	0.019 - 1.1	--	NA	--
Toxaphene	0/35	0.051 - 2.1	--	NA	--
Trans-chlordane	0/34	0.0019 - 1.1	--	NA	--
Polychlorinated Biphenyls					
Aroclor-1016 (low risk PCB)	0/55	0.011 - 1.1	--	NA	--
Aroclor-1221 (high risk PCB)	0/55	0.022 - 1.1	--	NA	--
Aroclor-1232 (high risk PCB)	0/55	0.011 - 1.1	--	NA	--
Aroclor-1242 (high risk PCB)	0/55	0.011 - 1.1	--	NA	--
Aroclor-1248 (high risk PCB)	0/55	0.011 - 1.1	--	NA	--
Aroclor-1254 (high risk PCB)	0/55	0.011 - 2.1	--	NA	--
Aroclor-1260 (high risk PCB)	18/55	0.011 - 2.1	0.0042J - 8.6	NA	--
Total (high risk) PCBs	18/55	0.011 - 2.1	0.004 - 8.6	NA	--

Table 4-19. Summary of Analyses and Detections in the East Adjacent Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds					
1,2,4-Trichlorobenzene	1/62	0.35 - 26	0.044J	NA	--
1,2-Dichlorobenzene	0/62	0.35 - 26	--	NA	--
1,3-Dichlorobenzene	0/62	0.35 - 26	--	NA	--
1,4-Dichlorobenzene	0/62	0.35 - 26	--	NA	--
11H-Benzo(a)fluorene	0/0	--	--	NA	--
17-Pentatriacontene	0/0	--	--	NA	--
1-Docosene	0/0	--	--	NA	--
1-methylpyrene	0/0	--	--	NA	--
2-(2-Butoxyethoxy)-ethanol	0/0	--	--	NA	--
2,2'-Oxybis(1-chloropropane)	0/0	--	--	NA	--
2,3-Dimethylphenanthrene	1/1	3.9	3.9	NA	--
2,4,5,7-Tetramethylphenanthrene	0/0	--	--	NA	--
2,4,5-Trichlorophenol	0/62	0.93 - 130	--	NA	--
2,4,6-Trichlorophenol	0/62	0.35 - 26	--	NA	--
2,4-Dichlorophenol	0/62	0.35 - 26	--	NA	--
2,4-Dimethylphenol	0/62	0.35 - 26	--	NA	--
2,4-Dinitrophenol	0/62	0.93 - 130	--	NA	--
2,4-Dinitrotoluene	0/62	0.35 - 26	--	NA	--
2,6,10,14-Tetramethylhexadecane	1/1	0.19	0.19J	NA	--
2,6,10,14-Tetramethylpentadecane	1/1	3.2	3.2	NA	--
2,6,10-Trimethyl-dodecane	0/0	--	--	NA	--
2,6,11,15-Tetramethylhexadecane	1/1	0.4	0.4J	NA	--
2,6,11-Trimethyl-dodecane	1/1	0.15	0.15J	NA	--
2,6-Dinitrotoluene	0/62	0.35 - 26	--	NA	--
2-Chloronaphthalene	0/62	0.35 - 26	--	NA	--
2-Chlorophenol	0/62	0.35 - 26	--	NA	--
2-Methylnaphthalene	1/61	0.35 - 26	0.085J	NA	--
2-Methylphenol	0/62	0.35 - 26	--	NA	--
2-Nitroaniline	0/62	0.93 - 130	--	NA	--
2-Nitrophenol	0/62	0.35 - 27	--	NA	--
3,3'-Dichlorobenzidine	0/62	0.38 - 53	--	NA	--
3,6-Dimethylphenanthrene	0/0	--	--	NA	--
3-Nitroaniline	0/62	0.93 - 130	--	NA	--
4,4-Dimethylbiphenyl	0/0	--	--	NA	--
4,6-Dinitro-2-methylphenol	0/62	0.93 - 130	--	NA	--
4-Bromophenyl-phenylether	0/62	0.35 - 26	--	NA	--
4-Chloro-3-methylphenol	0/62	0.35 - 26	--	NA	--
4-Chloroaniline	0/62	0.35 - 26	--	NA	--
4-Chlorophenyl-phenylether	0/62	0.35 - 26	--	NA	--
4H-Cyclopenta(def)phenanthrene	0/0	--	--	NA	--
4-Methylphenol	0/62	0.35 - 26	--	NA	--
4-Nitroaniline	0/62	0.93 - 130	--	NA	--
4-Nitrophenol	0/62	0.93 - 130	--	NA	--
7H-Benzo[c]fluorene	0/0	--	--	NA	--
9,10-Anthracenedione	0/0	--	--	NA	--
9-Methylanthracene	0/0	--	--	NA	--
Acenaphthene	0/62	0.35 - 26	--	NA	--
Acenaphthylene	0/62	0.35 - 26	--	NA	--
Aniline	0/16	0.375 - 0.565	--	NA	--
Anthracene	0/62	0.35 - 26	--	NA	--
Azobenzene	0/0	--	--	NA	--
Benzidine	0/16	0.375 - 0.565	--	NA	--
Benzo(a)anthracene	1/62	0.35 - 26	0.33711J	NA	--
Benzo(a)pyrene	3/62	0.35 - 26	0.086J - 0.26206J	NA	--
Benzo(b)fluoranthene	2/62	0.35 - 26	0.15J - 0.3432J	NA	--
Benzo(e)pyrene	0/0	--	--	NA	--
Benzo(g,h,i)perylene	1/62	0.35 - 26	0.13J	NA	--
Benzo(k)fluoranthene	2/62	0.35 - 26	0.078J - 0.26289J	NA	--
Benzoic acid	0/57	1.7 - 130	--	NA	--

Table 4-19. Summary of Analyses and Detections in the East Adjacent Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Benzyl alcohol	0/57	0.35 - 26	--	NA	--
Bis(2-chloroethoxy)methane	0/62	0.35 - 26	--	NA	--
Bis(2-chloroethyl)ether	0/62	0.35 - 26	--	NA	--
Bis(2-chloroisopropyl)ether	0/62	0.35 - 26	--	NA	--
Bis(2-ethylhexyl)phthalate	0/62	0.35 - 26	--	NA	--
Butylbenzylphthalate	0/62	0.35 - 26	--	NA	--
Carbazole	0/4	0.38 - 7.6	--	NA	--
Chrysene	2/62	0.35 - 26	0.12J - 0.40961	NA	--
Cyclopenta(cd)pyrene	0/0	--	--	NA	--
Dibenz(a,h)anthracene	0/62	0.35 - 26	--	NA	--
Dibenzofuran	2/62	0.35 - 26	0.089J - 0.20677J	NA	--
Diethylphthalate	0/62	0.35 - 26	--	NA	--
Dimethylphthalate	0/62	0.35 - 26	--	NA	--
Di-n-butylphthalate	0/62	0.35 - 26	--	NA	--
Di-n-octylphthalate	0/62	0.35 - 26	--	NA	--
Docosane	1/1	6	6	NA	--
Dodecane	0/0	--	--	NA	--
Dotriacontane	1/1	1.9	1.9	NA	--
Eicosane	2/2	0.27 - 0.48	0.27 - 0.48	NA	--
Fluoranthene	2/62	0.35 - 26	0.25J - 0.83414	NA	--
Fluorene	2/62	0.35 - 26	0.16 - 0.74448	NA	--
Heneicosane	1/1	3.5	3.5J	NA	--
Heptacosane	0/0	--	--	NA	--
Heptadecane	1/1	0.16	0.16	NA	--
Hexachlorobenzene	0/62	0.35 - 26	--	NA	--
Hexachlorobutadiene	0/62	0.35 - 26	--	NA	--
Hexachlorocyclopentadiene	0/62	0.35 - 27	--	NA	--
Hexachloroethane	0/62	0.35 - 26	--	NA	--
Hexacosane	1/1	4.6	4.6J	NA	--
Hexadecane	0/0	--	--	NA	--
Hexadecanoic acid	0/0	--	--	NA	--
Hexatriacontane	1/1	7.2	7.2	NA	--
Indeno(1,2,3-cd)pyrene	0/62	0.35 - 26	--	NA	--
Isophorone	0/61	0.35 - 26	--	NA	--
m-Terphenyl	1/1	7.3	7.3	NA	--
Naphthalene	0/62	0.35 - 26	--	NA	--
Nitrobenzene	0/62	0.35 - 26	--	NA	--
n-Nitrosodimethylamine	0/16	0.375 - 0.565	--	NA	--
n-Nitroso-di-n-propylamine	0/62	0.35 - 26	--	NA	--
n-Nitrosodiphenylamine	0/62	0.35 - 26	--	NA	--
Nonacosane	0/0	--	--	NA	--
Nonadecane	1/1	0.49	0.49J	NA	--
o-Terphenyl	1/1	2.3	2.3	NA	--
Octacosane	1/1	1.3	1.3	NA	--
Octadecane	0/0	--	--	NA	--
p-Terphenyl	2/2	0.36 - 2.7	0.36J - 2.7	NA	--
PCB-153	0/0	--	--	NA	--
Pentachlorophenol	0/62	0.93 - 130	--	NA	--
Pentacosane	0/0	--	--	NA	--
Pentadecane	0/0	--	--	NA	--
Pentatriacontane	1/1	2.1	2.1J	NA	--
Perylene	0/0	--	--	NA	--
Phenanthrene	3/62	0.35 - 26	0.46 - 1.45217	NA	--
Phenol	0/62	0.35 - 26	--	NA	--
Pyrene	3/62	0.35 - 26	0.34J - 0.62724	NA	--
Tetracosane	1/1	6.3	6.3J	NA	--
Tetradecane	1/1	0.16	0.16J	NA	--
Tetratetracontane	1/1	2.7	2.7J	NA	--
Triacontane	0/0	--	--	NA	--

Table 4-19. Summary of Analyses and Detections in the East Adjacent Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Semivolatile Organic Compounds *(continued)*					
Tricosane	1/1	7.2	7.2J	NA	--
Tridecane	2/2	0.17 - 0.39	0.17J - 0.39	NA	--
Triphenylene	0/0	--	--	NA	--
Tri-m-cresyl phosphate	0/0	--	--	NA	--
Tri-p-tolyl phosphate	0/0	--	--	NA	--
Volatile Organic Compounds					
1,1,1-Trichloroethane	2/61	0.005 - 0.028	0.05042 - 0.35719	NA	--
1,1,2,2-Tetrachloroethane	0/61	0.005 - 0.028	--	NA	--
1,1,2-Trichloroethane	0/61	0.005 - 0.028	--	NA	--
1,1-Dichloroethane	1/61	0.005 - 0.028	0.39584	NA	--
1,1-Dichloroethene	2/61	0.005 - 0.028	0.00955 - 0.14717	NA	--
1,2,3,5-Tetramethylbenzene	0/0	--	--	NA	--
1,2,4-Trimethylbenzene	0/0	--	--	NA	--
1,2-Dichloroethane	0/61	0.005 - 0.028	--	NA	--
1,2-Dichloroethene (Total)	0/61	0.005 - 0.028	--	NA	--
1,2-Dichloropropane	0/61	0.005 - 0.028	--	NA	--
1-Ethyl-2,3-dihydro-1H-indene	1/1	0.015	0.015	NA	--
1-Ethyl-2,4-dimethyl benzene	0/0	--	--	NA	--
1-Ethyl-2-methylbenzene	1/1	0.008	0.008	NA	--
2-Butanone	3/61	0.006 - 0.056	0.0043J - 0.0072J	NA	--
2-Hexanone	0/61	0.011 - 0.056	--	NA	--
4-Ethyl-1,2-dimethylbenzene	0/0	--	--	NA	--
4-Methyl-2-pentanone	0/61	0.011 - 0.056	--	NA	--
Acetone	0/61	0.011 - 0.056	--	NA	--
Benzene	0/61	0.005 - 0.028	--	NA	--
Bicyclo[3.3.1]nonane	1/1	0.007	0.007	NA	--
Bromodichloromethane	0/61	0.005 - 0.028	--	NA	--
Bromoform	0/61	0.005 - 0.028	--	NA	--
Bromomethane	0/61	0.011 - 0.056	--	NA	--
Carbon disulfide	11/61	0.005 - 0.028	0.0016J - 0.04772	NA	--
Carbon tetrachloride	0/61	0.005 - 0.028	--	NA	--
Chlorobenzene	0/61	0.005 - 0.028	--	NA	--
Chloroethane	0/61	0.011 - 0.056	--	NA	--
Chloroform	0/61	0.005 - 0.028	--	NA	--
Chloromethane	0/61	0.011 - 0.056	--	NA	--
cis-1,2-Dichloroethene	0/61	0.005 - 0.028	--	NA	--
cis-1,3-Dichloropropene	0/0	--	--	NA	--
cis-Bicyclo[4.3.0]nonane	1/1	0.014	0.014	NA	--
Dibromochloromethane	0/61	0.005 - 0.028	--	NA	--
Ethylbenzene	0/61	0.005 - 0.028	--	NA	--
Methylcyclohexane	1/1	0.008	0.008	NA	--
Methylene chloride	0/61	0.005 - 0.028	--	NA	--
o-Xylene	0/0	--	--	NA	--
Styrene	0/61	0.005 - 0.028	--	NA	--
Tert-butyl methyl ether	0/0	--	--	NA	--
Tetrachloroethene	2/61	0.005 - 0.028	0.09973 - 0.1569	NA	--
Toluene	3/61	0.005 - 0.028	0.0014J - 0.028	NA	--
trans-1,3-Dichloroethene	0/0	--	--	NA	--
trans-1,3-Dichloropropene	0/61	0.005 - 0.028	--	NA	--
Trichloroethene	3/61	0.005 - 0.028	0.002J - 0.05328	NA	--
Vinyl acetate	0/57	0.011 - 0.056	--	NA	--
Vinyl chloride	0/61	0.011 - 0.056	--	NA	--
Xylene (Total)	3/61	0.005 - 0.028	0.01154 - 0.0587	NA	--
Petroleum Hydrocarbons					
Gasoline range organics	16/54	0.19 - 12	0.04J - 130J	NA	--
Diesel range organics	31/61	0.005 - 0.028	2 - 1,300	NA	--
Motor oil range organics	24/25	5.7 - 58	7.6 - 1,500	NA	--
TPH-extractable unknown hydrocarbon	0/2	11 - 12	--	NA	--

Table 4-19. Summary of Analyses and Detections in the East Adjacent Area (greater than 10 feet bgs) *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	Detection Frequency[1]	Range of Detection Limits (mg/kg)	Range of Results (mg/kg)	Ambient Level (mg/kg)	Detections Exceeding Ambient Level
Petroleum Hydrocarbons *(continued)*					
TPH-purgeable unknown hydrocarbon	0/2	1.1 - 1.2	--	NA	--
Total recoverable petroleum hydrocarbon	1/2	12 - 12	210	NA	--
Total TPH	32/55	0.005 - 58	9.6 - 2,480	NA	--
Total oil and grease	0/0	--	--	NA	--

Notes:

(1) rejected data are not included in detection frequency

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

-- No criteria available for this chemical

bgs below ground surface

BHC benzene hexachloride

DDD dichlorodiphenyldichloroethane

DDE dichlorodiphenyldichloroethene

DDT dichlorodiphenyltrichloroethane

HPAL Hunters Point ambient level

J estimated value

mg/kg milligrams per kilogram

NA not available

PCB polychlorinated biphenyl

TPH total petroleum hydrocarbons

Table 4-20. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (greater than 10 feet bgs)

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Metals				
Aluminum	100,000	2004 PRG Industrial	0	0
Antimony	380	2005 ESL Industrial (direct exp)	0	0
Arsenic	11.1	HPAL	12	0
Barium	63,000	2005 ESL Industrial (direct exp)	0	0
Beryllium	36	2005 ESL Industrial (direct exp)	0	0
Cadmium	38	2005 ESL Industrial (direct exp)	0	0
Calcium	--		--	--
Chromium (total)	a	See note	1	0
Chromium VI	37	2005 ESL Industrial (direct exp)	0	0
Cobalt	a	See note	0	0
Copper	38,000	2005 ESL Industrial (direct exp)	0	0
Cyanide (free)	12,000	2004 PRG Industrial	0	0
Iron	100,000	2004 PRG Industrial	0	0
Lead	800	2004 PRG Industrial	1	0
Magnesium	--		--	--
Manganese	19,000	2004 PRG Industrial	0	0
Mercury	180	2005 ESL Industrial (direct exp)	0	0
Molybdenum	4,800	2005 ESL Industrial (direct exp)	0	0
Nickel	a	See note	0	0
Potassium	--		--	--
Selenium	4,800	2005 ESL Industrial (direct exp)	0	0
Silver	4,800	2005 ESL Industrial (direct exp)	0	0
Sodium	--		--	--
Thallium	63	2005 ESL Industrial (direct exp)	0	0
Tin	100,000	2004 PRG Industrial	0	0
Vanadium	1,000	2004 PRG Industrial	0	0
Zinc	100,000	2004 PRG Industrial	0	0
Pesticides				
2,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
2,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
2,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDD	9	2005 ESL Industrial (direct exp)	0	0
4,4'-DDE	6.3	2005 ESL Industrial (direct exp)	0	0
4,4'-DDT	6.3	2005 ESL Industrial (direct exp)	0	0
Aldrin	0.1	2004 PRG Industrial	0	0
alph-BHC	0.36	2004 PRG Industrial	0	0
Alph-chlordane	2.9	SDGI Industrial Criteria	0	0
bet-BHC	1.3	2004 PRG Industrial	0	0
Chlordane	1.7	2005 ESL Industrial (direct exp)	0	0
ci-Nonachlor	--		--	--
delt-BHC	0.59	SDGI Industrial Criteria	0	0
Dieldrin	0.11	2004 PRG Industrial	0	0
Endosulfan I	3,700	2004 PRG Industrial	0	0
Endosulfan II	3,700	2004 PRG Industrial	0	0
Endosulfan sulfate	5,300	SDGI Industrial Criteria	0	0
Endrin	180	2004 PRG Industrial	0	0
Endrin aldehyde	260	SDGI Industrial Criteria	0	0
Endrin ketone	260	SDGI Industrial Criteria	0	0
Gamm-BHC (lindane)	1.7	2004 PRG Industrial	0	0
Gamm-chlordane	2.9	SDGI Industrial Criteria	0	0
Heptachlor	0.38	2004 PRG Industrial	0	0
Heptachlor epoxide	0.19	2004 PRG Industrial	0	0
Heptachlor epoxide A	--		--	--
Heptachlor epoxide B	--		--	--
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Methoxychlor	3,100	2004 PRG Industrial	0	0
Mirex	--		--	--
Oxychlordane	--		--	--
Toxaphene	1.6	2004 PRG Industrial	0	0
tran-Nonachlor	21	2004 PRG Industrial	0	0

Table 4-20. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (greater than 10 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Polychlorinated Biphenyls				
Aroclor-1016 (low risk PCB)	21	2004 PRG Industrial	0	0
Aroclor-1221 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1232 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1242 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1248 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1254 (high risk PCB)	0.74	2004 PRG Industrial	0	0
Aroclor-1260 (high risk PCB)	0.74	2004 PRG Industrial	3	0
Total (high risk) PCBs	0.74	2004 PRG Industrial	3	0
Semivolatile Organic Compounds				
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	0	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2'-Oxybis(1-chloropropane)	7.4	2004 PRG Industrial	0	0
2,4,5-Trichlorophenol	61	2005 ESL Industrial (inhalation)	0	0
2,4,6-Trichlorophenol	25	2005 ESL Industrial (direct exp)	0	0
2,4-Dichlorophenol	1,800	2004 PRG Industrial	0	0
2,4-Dimethylphenol	1,500	2005 ESL Industrial (inhalation)	0	0
2,4-Dinitrophenol	1,200	2004 PRG Industrial	0	0
2,4-Dinitrotoluene	5.6	2005 ESL Industrial (direct exp)	0	0
2,6-Dinitrotoluene	620	2004 PRG Industrial	0	0
2-Chloronaphthalene	23,000	2004 PRG Industrial	0	0
2-Chlorophenol	10	2005 ESL Industrial (inhalation)	0	0
2-Methylnaphthalene	550	2005 ESL Industrial (inhalation)	0	0
2-Methylphenol	31,000	2004 PRG Industrial	0	0
2-Nitroaniline	1,800	2004 PRG Industrial	0	0
2-Nitrophenol	--		--	--
3,3'-Dichlorobenzidine	1.4	2005 ESL Industrial (direct exp)	0	0
3-Nitroaniline	82	2004 PRG Industrial	0	0
4,6-Dinitro-2-methylphenol	--		--	--
4-Bromophenyl-phenylether	--		--	--
4-Chloro-3-methylphenol	--		--	--
4-Chloroaniline	2,500	2004 PRG Industrial	0	0
4-Chlorophenyl-phenylether	--		--	--
4-Methylphenol	3,100	2004 PRG Industrial	0	0
4-Nitroaniline	82	2004 PRG Industrial	0	0
4-Nitrophenol	7,000	SDGI Industrial Criteria	0	0
Acenaphthene	650	2005 ESL Industrial (inhalation)	0	0
Acenaphthylene	18,000	2005 ESL Industrial (direct exp)	0	0
Aniline	300	2004 PRG Industrial	0	0
Anthracene	31	2005 ESL Industrial (inhalation)	0	0
Azobenzene	16	2004 PRG Industrial	0	0
Benzidine	--		--	--
Benzo(a)anthracene	2.1	2005 ESL Industrial (direct exp)	0	0
Benzo(a)pyrene	0.33	2004 PRG Industrial	0	0
Benzo(b)fluoranthene	2.1	2005 ESL Industrial (direct exp)	0	0
Benzo(e)pyrene	--		--	--
Benzo(g,h,i)perylene	22,000	2005 ESL Industrial (direct exp)	0	0
Benzo(k)fluoranthene	15	2005 ESL Industrial (direct exp)	0	0
Benzoic acid	100,000	2004 PRG Industrial	0	0
Benzyl alcohol	100,000	2004 PRG Industrial	0	0
Biphenyl	18,000	2005 ESL Industrial (direct exp)	0	0
Bis(2-chloroethoxy)methane	--		--	--
Bis(2-chloroethyl)ether	0.012	2005 ESL Industrial (inhalation)	0	0
Bis(2-ethylhexyl)phthalate	120	2004 PRG Industrial	0	0
Butylbenzylphthalate	100,000	2004 PRG Industrial	0	0
Carbazole	86	2004 PRG Industrial	0	0

Table 4-20. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (greater than 10 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Semivolatile Organic Compounds *(continued)*				
Chrysene	13	2005 ESL Industrial (direct exp)	0	0
Dibenz(a,h)anthracene	0.33	SDGI Industrial Criteria	0	0
Dibenzofuran	1,600	2004 PRG Industrial	0	0
Diethylphthalate	100,000	2004 PRG Industrial	0	0
Dimethylphthalate	100,000	2004 PRG Industrial	0	0
Di-n-butylphthalate	62,000	2004 PRG Industrial	0	0
Di-n-octylphthalate	25,000	2004 PRG Industrial	0	0
Fluoranthene	22,000	2004 PRG Industrial	0	0
Fluorene	800	2005 ESL Industrial (inhalation)	0	0
Hexachlorobenzene	0.96	2005 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Hexachlorocyclopentadiene	3,700	2004 PRG Industrial	0	0
Hexachloroethane	44	2005 ESL Industrial (direct exp)	0	0
Indeno(1,2,3-cd)pyrene	2.1	2005 ESL Industrial (direct exp)	0	0
Isophorone	510	2004 PRG Industrial	0	0
Naphthalene	1.5	2005 ESL Industrial (inhalation)	0	0
Nitrobenzene	100	2004 PRG Industrial	0	0
n-Nitrosodimethylamine	0.034	2004 PRG Industrial	0	0
n-Nitroso-di-n-propylamine	0.25	2004 PRG Industrial	0	0
n-Nitrosodiphenylamine	350	2004 PRG Industrial	0	0
Pentachlorophenol	9	2004 PRG Industrial	0	0
Phenacetin	--		--	--
Phenanthrene	18,000	2005 ESL Industrial (direct exp)	0	0
Phenol	100,000	2004 PRG Industrial	0	0
Pyrene	425	2005 ESL Industrial (inhalation)	0	0
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	6.9	2005 ESL Industrial (direct exp)	0	0
1,1,1-Trichloroethane	230	2005 ESL Industrial (inhalation)	0	0
1,1,2,2-Tetrachloroethane	0.025	2005 ESL Industrial (inhalation)	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	--		--	--
1,1,2-Trichloroethane	0.089	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethane	0.89	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloroethene	105	2005 ESL Industrial (inhalation)	0	0
1,1-Dichloropropene	--		--	--
1,2,3-Trichlorobenzene	--		--	--
1,2,3-Trichloropropane	--		--	--
1,2,4-Trichlorobenzene	5	2005 ESL Industrial (inhalation)	0	0
1,2,4-Trimethylbenzene	170	2004 PRG Industrial	0	0
1,2-Dibromo-3-chloropropane	0.067	2005 ESL Industrial (direct exp)	0	0
1,2-Dibromoethane	0.02	2005 ESL Industrial (inhalation)	0	0
1,2-Dichlorobenzene	21	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethane	0.07	2005 ESL Industrial (inhalation)	0	0
1,2-Dichloroethene (Total)	150	SDGI Industrial Criteria	0	0
1,2-Dichloropropane	0.14	2005 ESL Industrial (inhalation)	0	0
1,3,5-Trimethylbenzene	70	2004 PRG Industrial	0	0
1,3-Dichlorobenzene	600	2004 PRG Industrial	0	0
1,3-Dichloropropane	--		--	--
1,4-Dichlorobenzene	0.13	2005 ESL Industrial (inhalation)	0	0
2,2-Dichloropropane	--		--	--
2-Butanone	6,500	2005 ESL Industrial (inhalation)	0	0
2-Chloroethyl vinyl ether	--		--	--
2-Chlorotoluene	--		--	--
2-Hexanone	--		--	--
4-Chlorotoluene	--		--	--
4-Methyl-2-pentanone	1,550	2005 ESL Industrial (inhalation)	0	0
Acetone	16,500	2005 ESL Industrial (inhalation)	0	0
Benzene	0.38	2005 ESL Industrial (direct exp)	0	0
Bromobenzene	--		--	--
Bromochloromethane	--		--	--

Table 4-20. Summary of Detected Exceedances of Evaluation Criteria in the East Adjacent Area (greater than 10 feet bgs) *(continued)*

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Chemical	RIEC Conc. (mg/kg)	RIEC Comments	Detections Exceeding RIEC	Detections Exceeding 100x RIEC
Volatile Organic Compounds *(continued)*				
Bromodichloromethane	0.039	2005 ESL Industrial (inhalation)	0	0
Bromoform	220	2004 PRG Industrial	0	0
Bromomethane	2.6	2005 ESL Industrial (inhalation)	0	0
Carbon disulfide	720	2004 PRG Industrial	0	0
Carbon tetrachloride	0.034	2005 ESL Industrial (inhalation)	0	0
Chlorobenzene	31	2005 ESL Industrial (inhalation)	0	0
Chloroethane	1.8	2005 ESL Industrial (inhalation)	0	0
Chloroform	0.47	2004 PRG Industrial	0	0
Chloromethane	0.2	2005 ESL Industrial (inhalation)	0	0
ci-1,2-Dichloroethene	18	2005 ESL Industrial (inhalation)	0	0
ci-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Dibromochloromethane	0.054	2005 ESL Industrial (inhalation)	0	0
Dibromomethane	--		--	--
Dichlorodifluoromethane	310	2004 PRG Industrial	0	0
Ethylbenzene	5	2008 ESL Industrial (direct exp)	0	0
Hexachlorobutadiene	22	2004 PRG Industrial	0	0
Isopropylbenzene	2,000	2004 PRG Industrial	0	0
Methylcyclohexane	2,600	2004 PRG Industrial	0	0
Methylene chloride	1.5	2005 ESL Industrial (inhalation)	0	0
n-Butylbenzene	240	2004 PRG Industrial	0	0
o-Xylene	210	SDGI Industrial Criteria	0	0
par-Isopropyl toluene	--		--	--
Propylbenzene	240	2004 PRG Industrial	0	0
sec-Butylbenzene	220	2004 PRG Industrial	0	0
Styrene	1,100	2005 ESL Industrial (inhalation)	0	0
tert-Butyl methyl ether	5.6	2005 ESL Industrial (inhalation)	0	0
tert-Butylbenzene	390	2004 PRG Industrial	0	0
Tetrachloroethene	0.24	2005 ESL Industrial (inhalation)	0	0
Toluene	520	2004 PRG Industrial	0	0
tran-1,2-Dichloroethene	37	2005 ESL Industrial (inhalation)	0	0
tran-1,3-Dichloropropene	0.093	2005 ESL Industrial (inhalation)	0	0
Trichloroethene	0.11	2004 PRG Industrial	0	0
Trichlorofluoromethane	2,000	2004 PRG Industrial	0	0
Vinyl acetate	1,400	2004 PRG Industrial	0	0
Vinyl chloride	0.019	2005 ESL Industrial (inhalation)	0	0
Xylene (Total)	420	2004 PRG Industrial	0	0
Petroleum Hydrocarbons				
Gasoline-range organics	750	2005 ESL Industrial (direct exp)	0	0
Diesel-range organics	750	2005 ESL Industrial (direct exp)	0	0
Motor oil-range organics	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-extractable unknown hydrocarbons	4,600	2005 ESL Industrial (direct exp)	0	0
TPH-purgeable unknown hydrocarbons	750	2005 ESL Industrial (direct exp)	0	0
Total TPH	3,500	HPS TPH source criterion	0	0
Total oil and grease	3,500	HPS TPH source criterion	0	0

Notes:

(a) PRC Environmental Management, Inc. 1995a. "Draft Calculation of Hunters Point Ambient Levels, Hunters Point Shipyard, San Francisco, California." April 11. HPALs for chromium, cobalt, and nickel were determined on a location-specific basis.

--	No criteria available for this chemical	HPS	Hunters Point Shipyard
bgs	below ground surface	mg/kg	milligrams per kilogram
BHC	benzene hexachloride	NE	not established
Conc.	concentration	PCB	polychlorinated biphenyl
DDD	dichlorodiphenyldichloroethane	PRG	preliminary remediation goal
DDE	dichlorodiphenyldichloroethene	RIEC	remedial investigation evaluation criteria
DDT	dichlorodiphenyltrichloroethane	SDGI	standard data gaps investigation
ESL	environmental screening level	TPH	total petroleum hydrocarbons
HPAL	Hunters Point ambient level		

Table 4-21. Resolution of Data Quality Objectives, Lateral Extent of Landfill Waste
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Decision Questions	Decision Inputs	Resolution of Decision Questions
Investigation of Lateral Extent of Landfill Waste		
The following decision questions associated with the lateral extent of landfill waste were initially presented in the Parcel E NDGI FSP/QAPP: 1. Are there areas where the lateral extent of the Industrial Landfill located in IR Site 01/21 are not adequately delineated? 2. Are there areas along the northern border where waste thickness will be required for possible future remedial actions?	▪ Results from previous investigations at the Parcel E-2 Landfill. Data inputs are to include existing and available boring and test pit logs, geophysical surveys, scintillation surveys, and data from the soil gas survey. ▪ Maps that depict the spatial locations of previous soil borings, the known locations for the lateral extent of the landfill, and the limits of the multilayer cover. ▪ Results of test pits and borings.	Based on the results of previous investigations conducted at the Landfill, the answer to the decision questions are as follows: 1. The lateral extent of waste at the Landfill has been adequately defined and is shown on Figure 3-1. The presence of solid waste was defined as a 6-inch (minimum) thickness of solid waste in a test pit (TtEMI, 2004f). The first test pit where no waste was encountered was considered to be the limit of the solid waste. The Panhandle and East Adjacent Areas both contain isolated solid waste locations where a continuous 6-inch layer of waste was encountered. These isolated locations are outside the landfill footprint, are noncontiguous, and contain predominantly inert construction debris or sandblast waste. 2. The vertical extent of waste along the northern boundary has been adequately defined through test pits and borings drilled during the NDGI. The vertical extent of waste is shown on Figures 2-3 through 2-8. Data are adequate to answer the decision questions and to support the RI/FS.

Notes:

FS	Feasibility Study
FSP	Field Sampling Plan
IR	Installation Restoration
NDGI	nonstandard data gaps investigation
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
TtEMI	Tetra Tech EM Inc.

Reference:

TtEMI. 2002a. "Draft Final Field Sampling Plan/Quality Assurance Project Plan (FSP/QAPP) for Parcel E Nonstandard Data Gaps Investigation (Industrial Landfill and Wetlands Delineation), Hunters Point Shipyard, San Francisco, California." January 8.
TtEMI. 2004f. "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Lateral Extent Evaluation, Hunters Point Shipyard, San Francisco, California." October 29.

Table 4-22. Resolution of Data Quality Objectives, Landfill Gas Characterization
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Decision Questions	Decision Inputs	Resolution of Decision Questions
Investigation of Nature and Extent of Landfill Gas		
The following decision questions associated with the nature and extent of landfill gas were initially presented in the NDGI FSP/QAPP for Parcel E (TtEMI, 2002a): 1. Is methane gas present outside the landfill boundary (the outer limit of the industrial landfill in IR Site 01/21) in ambient air of buildings or subterranean structures at concentrations greater than 1.25 percent by volume in air (25 percent of the LEL.)? 2. Are landfill gases other than methane present outside the landfill boundary (the outer limit of the industrial landfill in IR Site 01/21) in ambient air of buildings or subterranean structures at concentrations greater than 5 ppm above background? (Note: the basis of comparison for NMOC concentrations in buildings and subterranean structures was subsequently changed, in the Landfill Gas Characterization Study Report [TtEMI, 2003e], to the 2004 EPA Region 9 PRGs for ambient air.) 3. Are there locations on the periphery of the industrial landfill in IR Site 01/21 where concentrations of methane in soil gas are greater than the lower quantitation limit of the instrument (0.5 percent LEL)? 4. Are there areas of local topographic highs, cap penetrations, or visually stressed vegetation on the interim landfill cap where concentrations of methane and other landfill gas surface emissions in ambient air immediately above the interim landfill cap exceed 25 percent of the LEL and 5 ppm above background, respectively? 5. Is landfill gas present in areas located outside the defined lateral extent of landfill waste and farther from the landfill than the 300-foot zone of monitoring?	▪ Analytical results from previous investigations at Parcel E. ▪ Information on historical use from previous studies for Parcel E. ▪ Readings obtained from a methane monitor calibrated according to manufacturer's instructions taken during a soil gas survey performed around the periphery of the landfill in IR Site 01/21. ▪ Readings obtained from a CGI and a PID calibrated according to manufacturer's instructions taken during a building and subterranean ambient air survey conducted in the area within 300 feet of the limit of waste fill. ▪ Readings obtained from a CGI and a PID calibrated according to manufacturer's instructions taken during a surface ambient air survey conducted at areas of local topographic high points, cap penetrations, or areas of visually distressed vegetation on the interim landfill cap. ▪ Laboratory analytical results from the gaseous organic analysis (samples collected in Summa canisters) performed during soil gas sampling at five locations at the landfill in IR Site 01/21.	Based on the results of landfill gas investigation, the answers to the decision questions are as follows: 1. During the April 2002 survey, methane gas was not detected in ambient air of buildings or subterranean structures at concentrations greater than 1.25 percent. Methane gas was detected at concentrations greater than 1.25 percent at two outdoor locations (light pole and Location B) shown on Figure 4-2; however, methane was not detected at these locations during subsequent air monitoring in May 2002. As an additional precaution, surface monitoring was continued at these locations under the Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c). The results of the ongoing monitoring are summarized in Table 4-23. 2. During the April 2002 survey, NMOCs were not detected in ambient air of buildings at concentrations greater than the EPA Region 9 PRGs. Several NMOCs were detected in the crawlspace of Building 830 at concentrations greater than the EPA Region 9 PRGs; however, no NMOCs were detected at concentrations greater than PRGs in samples collected at these locations in November 2002 (after active landfill gas extraction was initiated in the area). 3. The extent of methane in soil gas was delineated through a series of probes installed in April 2002. As shown on Figure 4-3, methane concentrations within (and due east of) the UCSF compound ranged from 25 percent of the LEL to greater than 100 percent of the LEL. As a result of this delineation, the Navy initiated a TCRA to (1) remove landfill gas and reduce subsurface methane concentrations at the UCSF compound to below the LEL (5 percent by volume in air); and (2) control future migration of landfill gas to off-site areas. The TCRA activities are described in the Landfill Gas TCRA Closeout Report (TtEMI, 2004a) (Appendix **F**). Performance of the gas control system is currently being monitored under the Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c). The results of the ongoing monitoring are summarized in Table 4-23. 4. Outdoor air monitoring performed on the landfill surface (consisting of breathing zone measurements at cap penetrations and a surface transect over and around the cap surface) did not detect methane at concentrations exceeding 25 percent of the LEL. Methane was detected at the top of several well casings within the Landfill Area at concentrations exceeding 25 percent of LEL (Figure 4-2); however, these concentrations were not representative of outdoor air within the Landfill Area. As an additional precaution, surface monitoring was continued at several of these locations under the Landfill Gas Monitoring and Control Plan (TtEMI and ITSI, 2004c). The results of the ongoing monitoring are summarized in Table 4-23. 5. Subsurface landfill gas (specifically methane greater than the LEL) was detected within (and due east of) the UCSF compound. This finding prompted the Navy to initiate a TCRA (as described in item 3 above) that is effectively controlling landfill gas migration. The performance of the gas control system is summarized in Table 4-23. Methane was not detected at concentrations exceeding 25 percent of the LEL along the east, south, and west sides of the landfill (Figure 4-3). There are adequate data to answer the decision questions and to support the RI/FS.

Notes:

CGI	combustible gas indicator	LEL	lower explosive limit (for methane = 5 percent by volume)	QAPP	Quality Assurance Project Plan
EPA	U.S. Environmental Protection Agency	NDGI	nonstandard data gaps investigation	RI	Remedial Investigation
FS	Feasibility Study	NMOCs	nonmethane organic compounds	TCRA	time-critical removal action
FSP	Field Sampling Plan	PID	photoionization detector	TtEMI	Tetra Tech EM Inc.
IR	Installation Restoration	ppm	parts per million	UCSF	University of California, San Francisco
ITSI	Innovative Technical Solutions, Inc.	PRG	preliminary remediation goal		

Sources:

TtEMI. 2002a. "Draft Final Field Sampling Plan/Quality Assurance Project Plan (FSP/QAPP) for Parcel E Nonstandard Data Gaps Investigation (Industrial Landfill And Wetlands Delineation), Hunters Point Shipyard, San Francisco, California. January 8.
TtEMI. 2003e. "Final Parcel E Nonstandard Data Gaps Investigation, Landfill Gas Characterization, Hunters Point Shipyard, San Francisco, California." December 23.
TtEMI and ITSI. 2004a. "Draft Removal Action Closeout Report, Parcel E Landfill Gas Time-Critical Removal Action, Hunters Point Shipyard, San Francisco, California." March 19.
TtEMI and ITSI. 2004c. "Final Interim Landfill Gas Monitoring and Control Plan, Parcel E Industrial Landfill, Hunters Point Shipyard, San Francisco, California." August 13.

Table 4-23. Resolution of Data Quality Objectives, Landfill Gas Monitoring and Control System Operation
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Decision Questions	Decision Inputs	Resolution of Decision Questions
Landfill Gas Monitoring of the Fence Line and UCSF Compound, Building 830 Crawlspace, UCSF Surface Locations, and On-Site Utilities		
To ensure consistency with Title 27 CCR and the adequacy of the gas control system, the Navy has developed the following decisions for the fence line GMPs, the UCSF GMPs, the Building 830 crawlspace, UCSF surface locations, and on-site utilities: 1. Is migration of methane from the landfill controlled below explosive levels (5 percent by volume) at the site boundary (northern fence line) and the UCSF compound? Is the migration of NMOCs from the landfill controlled below levels that pose a potential health threat (500 ppmv)? 2. Are concentrations of methane in the Building 830 crawlspace greater than 1.25 percent by volume? Are concentrations of NMOCs in the Building 830 crawlspace a potential health threat (5 ppmv above background)? 3. Are concentrations of methane at the UCSF surface locations greater than 1.25 percent by volume? Are concentrations of NMOCs in the breathing zone above the UCSF surface locations posing a potential health threat (5 ppmv above background)? Do the UCSF surface locations warrant continued monitoring? 4. Are concentrations of methane in on-site utilities greater than 1.25 percent by volume? Are concentrations of NMOCs in the breathing zone at on-site utilities posing a potential health threat (5 ppmv above background)? The Navy has established action levels shown in the Interim Monitoring and Control Plan (TtEMI and ITSI, 2004c) to inhibit exceedances of the regulatory limits.	▪ The landfill gas control system is operated passively and actively. ▪ Percent methane and NMOC readings collected at the GMPs along the fence line and on the UCSF compound using a methane monitor and PID calibrated according to manufacturer's instructions. ▪ Percent methane and NMOC readings collected from the Building 830 crawlspace using a methane monitor and PID calibrated according to manufacturer's instructions. ▪ Percent methane and NMOC readings collected from the UCSF surface locations and the breathing zone, respectively, using a methane monitor and PID calibrated according to manufacturer's instructions. ▪ Percent methane and NMOC readings collected within the on-site utilities and in the breathing zone of the on-site utilities, respectively, using a methane monitor and PID calibrated according to manufacturer's instructions.	Based on the data collected through June 2010, the answers to the decision questions are: 1. Yes. The migration of methane from the landfill is being controlled below explosive levels and the migration of NMOCs from the landfill is being controlled below levels that pose a potential health threat (ITSI, 2004a through 2004g, 2005a through 2005n, 2006a through 2006g, 2006i through 2006m, 2007a through 2007c, 2007e through 2007g, 2008a through 2008c, 2008e, 2009a through 2009d, and 2010a through 2010c). 2. No. Concentrations of methane in the Building 830 crawlspace are not greater than 1.25 percent by volume and concentrations of NMOCs in the Building 830 crawlspace are not a potential health threat (ITSI, 2004a through 2004g, 2005a through 2005n, 2006a through 2006g, 2006i through 2006m, 2007a through 2007c, 2007e through 2007g, 2008a through 2008c, 2008e, 2009a through 2009d, and 2010a through 2010c). 3. No. Concentrations of methane at the UCSF surface locations are not greater than 1.25 percent by volume and NMOCs have not been detected in the breathing zone; therefore, they do not pose a potential health threat. Methane has not been detected above 1 percent and NMOCs have not been detected above 5 ppmv for more than 18 consecutive months (ITSI, 2004a through 2004g, 2005a through 2005n, 2006a through 2006g, 2006i through 2006m, 2007a through 2007c, 2007e through 2007g, and 2008a through 2008d); therefore, the UCSF surface locations can be removed from the monitoring program. 4. No. Concentrations of methane in the on-site utilities are not greater than 1.25 percent by volume and concentrations of NMOCs in the breathing zone at these locations do not pose a potential health threat (ITSI, 2004a through 2004g, 2005a through 2005n, 2006a through 2006g, 2006i through 2006m, 2007a through 2007c, 2007e through 2007g, 2008a through 2008c, 2008e, 2009a through 2009d, and 2010a through 2010c). Data are adequate to answer the decision questions and to support the RI/FS.
Landfill Gas Monitoring at GMPs along Crisp Avenue		
To ensure that landfill gas is not migrating north from the landfill into Parcel A, the Navy has developed the following decisions for GMPs along Crisp Avenue: 1. Is methane migrating across Crisp Avenue toward Parcel A at concentrations greater than 5 percent by volume? 2. Are concentrations of NMOCs exceeding levels that would pose a potential health threat to future residents on the former Parcel A? The Navy has established action levels shown in the Interim Monitoring and Control Plan (TtEMI and ITSI, 2004c) to inhibit landfill gas from affecting the former Parcel A.	▪ The landfill gas control system operated passively and actively. ▪ Percent methane and NMOC readings collected at GMPs along Crisp Avenue using a methane monitor and PID calibrated according to manufacturer's instructions.	Based on the data collected through June 2010, the answers to the decision questions are: 1. No. Methane is not migrating across Crisp Avenue toward adjacent non-Navy property. Methane has not been detected in the Crisp Avenue GMPs. 2. No. NMOC concentrations do not pose a health threat to residents of the adjacent non-Navy property. Data are adequate to answer the decision questions and to support the RI/FS.

Table 4-23. Resolution of Data Quality Objectives, Landfill Gas Monitoring and Control System Operation *(continued)*
Remedial Investigation/Feasibility Study for Parcel E-2, Hunters Point Shipyard

Decision Questions	Decision Inputs	Resolution of Decision Questions
Landfill Gas Control System		
The following decisions were identified to determine when to initiate and terminate extraction: 1. Is extraction from the gas control system effectively controlling gas migration? 2. Do monitoring data indicate the potential for a landfill fire? 3. Is the HDPE barrier sufficiently submerged in groundwater to prevent migration of gas under the barrier? 4. Do monitoring data results indicate that extraction is no longer needed? 5. Is the system operating correctly? Is extraction occurring from the correct location? The Navy developed the following decision to ensure the gas control system is maintained appropriately: 6. Do data indicate that treatment units need to be replaced?	▪ The landfill gas control system operated passively and actively. ▪ Percent methane and NMOC readings collected from the sample ports located on the extraction unit using a methane monitor and PID calibrated according to manufacturer's instructions. ▪ Water levels recorded at monitoring wells and GMPs upgradient and downgradient of the gas control system using a water-level meter in accordance with manufacturer's instructions. ▪ Pressure readings collected at the vents while actively extracting gas from the gas control system to check for flow restrictions. Pressure readings will be taken at the outlet sample port of the last canister (three treatment canisters in series), while applying a vacuum at the first canister to check for flow restrictions within the NMOC treatment units. ▪ Temperature readings for landfill gas collected during monitoring before and after the NMOC treatment units vent locations. ▪ Treatment units installed at the vents of the interceptor trench visually inspected for moisture. ▪ Meteorological data collected from the monitoring station.	Based on the data collected through June 2010, the answers to the decision questions are: 1. Yes. Extraction from the gas control system is effectively controlling gas migration. Data indicate that landfill gas is currently being collected in the passive vents located along the barrier wall and is not migrating past the gas control system into the perimeter GMPs. Methane concentrations have been below explosive levels in all GMPs. 2. No. Monitoring data do not indicate the potential for a landfill fire. Temperatures above 55°C (131°F) within the gas collection trench indicate a potential fire risk (Appendix G). Temperature measurements from locations within the gas collection trench have been below 55°C (131°F) (ITSI, 2005j). 3. Yes. According to monthly water level measurements collected around the barrier wall, Yes. The HDPE barrier is sufficiently submerged in groundwater, thus preventing migration of gas under the barrier (ITSI, 2004a through 2004g, 2005a through 2005n, 2006a through 2006g, 2006i through 2006m, 2007a through 2007c, 2007e through 2007g, 2008a through 2008c, 2008e, 2009a through 2009d, and 2010a through 2010c). 4. No. Monitoring data indicate that gas extraction is needed to continue to prevent the migration of methane onto non-Navy property. When operated only passively, landfill gas will build up in the gas collection trench and will eventually migrate north across the barrier wall. Because of this, the control system is operated both passively and actively on an intermittent basis. 5. Yes. Passive extraction occurs throughout the perforated pipe along the barrier wall and is vented through treatment units at the five passive vent locations (Figure 3-6). Active extraction is performed at PV-02, which is located near the center of the barrier wall. Data have shown that active extraction from this location sufficiently controls migration of landfill gas. 6. No. Current data indicate the treatment units do not need to be replaced. However, constant operation of the gas control system can possibly cause NMOC concentrations to exceed 100 ppmv (project action level for treatment units) at the outlet of a treatment unit. When this occurs for 2 consecutive days, the treatment unit is replaced with a new unit (ITSI, 2005j). Data are adequate to answer the decision questions and to support the RI/FS.

Notes:

CCR	California Code of Regulations
GMP	gas monitoring probe
FS	Feasibility Study
HDPE	high-density polyethylene
ITSI	Innovative Technical Solutions, Inc.
Navy	Department of the Navy
NMOC	nonmethane organic compound
PID	photoionization detector
ppmv	parts per million by volume
RI	Remedial Investigation
TtEMI	Tetra Tech EM Inc.
UCSF	University of California, San Francisco

Sources:

ITSI. 2004 to 2010. Monthly and Quarterly Gas Monitoring Reports for Parcel E-2, Hunters Point Shipyard, San Francisco, California (various dates).

TtEMI and ITSI, 2004c. "Final Interim Landfill Gas Monitoring and Control Plan, Parcel E Industrial Landfill, Hunters Point Shipyard, San Francisco, California." August 13.

Table 4-24. Exceedance Frequency of Soil Evaluation Criteria

Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

	Landfill Area			Panhandle Area			East Adjacent Area		
Chemical	**0-2**	**2-10**	**10+**	**0-2**	**2-10**	**10+**	**0-2**	**2-10**	**10+**
Maximum depth (feet bgs)	1.91	10	52.66	2	10	42.75	2	10	46.82
Metals									
Antimony		4 / 113		1 / 77			1 / 55	2 / 126	
Arsenic		5 / 113	21 / 97	12 / 77	12 / 64	6 / 40	5 / 55	14 / 126	12 / 60
Cadmium		8 / 113	2 / 97	3 / 77	4 / 64		2 / 55		
Chromium		8 / 113	17 / 97			1 / 40	2 / 55	1 / 126	1 / 60
Copper		3 / 113							
Iron		4 / 87	2 / 96	3 / 68	2 / 38		2 / 42		
Lead	1 / 22	16 / 113	7 / 97	16 / 77	13 / 64	5 / 40	9 / 55	11 / 126	1 / 60
Mercury				1 / 77					
Vanadium		1 / 113		1 / 77					
Zinc					1 / 64				
Pesticides									
4,4'-DDE				1 / 77				1 / 128	
4,4'-DDT								3 / 128	
Dieldrin		7 / 112		2 / 77			4 / 52	9 / 128	
Heptachlor epoxide	1 / 22	5 / 112					2 / 52	11 / 128	
Polychlorinated Biphenyls									
Total PCBs (high risk)	2 / 23	45 / 122	31 / 103	8 / 70	7 / 64		30 / 55	81 / 232	3 / 55
Total PCBs (low risk)		2 / 122	1 / 103						
Dioxins and Furans									
1,2,3,4,7,8-HxCDF					1 / 10	1 / 2			
1,2,3,7,8,9-HxCDF					1 / 10	1 / 2			
1,2,3,7,8-PeCDD					1 / 10	1 / 2			
2,3,4,6,7,8-HxCDF					1 / 10	1 / 2			
2,3,4,7,8-PeCDF					8 / 10	2 / 2			
2,3,7,8-TCDD					1 / 10	1 / 2			
2,3,7,8-TCDF						1 / 2			
Semivolatile Organic Compounds									
1,4-Dichlorobenzene		8 / 62	9 / 81		1 / 50			1 / 76	
1,2,4-Trichlorobenzene								1 / 76	
2-Methylnapthalene		1 / 61							
Anthracene		1 / 113							
Benzo(a)anthracene	2 / 24	5 / 113	1 / 97	5 / 61		1 / 40	2 / 52	7 / 127	
Benzo(a)pyrene	9 / 24	10 / 113	6 / 97	10 / 61	6 / 52	1 / 40	10 / 52	14 / 127	
Benzo(b)fluoranthene	2 / 24	7 / 113	1 / 97	7 / 61		1 / 40	5 / 52	13 / 127	
Benzo(k)fluoranthene		6 / 113		9 / 61			2 / 52	5 / 127	
Bis(2-ethylhexyl)phthalate				1 / 61					
Chrysene		2 / 113		1 / 61				1 / 127	
Dibenz(a,h)anthracene		2 / 113		1 / 61				2 / 127	
Indeno(1,2,3-cd)pyrene	2 / 24	4 / 113		4 / 61		1 / 40		2 / 127	
Naphthalene	1 / 24	11 / 113	13 / 98	2 / 62	7 / 52	3 / 40		3 / 127	
n-Nitroso-di-n-propylamine			1 / 97						
Volatile Organic Compounds									
1,1,2,2-Tetrachloroethane							2 / 22	7 / 76	
Carbon tetrachloride			1 / 78						
Tetrachloroethene			1 / 78						
Total xylenes			1 / 77						
Petroleum Hydrocarbons									
Total TPH		13 / 107	9 / 89	3 / 16		1 / 33	7 / 51	27 / 231	

Table 4-24. Exceedance Frequency of Soil Evaluation Criteria *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Notes: Text denotes the number of samples above the RIEC over the total number of samples analyzed (e.g., 2 / 26 = 2 exceedances out of 26 analys
Bold text (in shaded cells) denotes chemicals that are not fully delineated.

bgs	below ground surface
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
PCB	polychlorinated biphenyl
PeCDD	pentachlorodibenzo-p-dioxin
PeCDF	pentachlorodibenzofuran
RIEC	remedial investigation evaluation criteria
TPH	total petroleum hydrocarbons
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran

Table 4-25. Resolution of Data Quality Objectives, Parcel E-2 Soil and Sediment
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Decision Questions	Decision Inputs	Resolution of Decision Questions
Nature and Extent of Contamination in Onshore Soil		
The primary decision questions associated with onshore soil within Parcel E-2 are: 1. Do potential source areas identified by additional review of site-related documents, aerial photographs, and other historical information have chemical concentrations that exceed criteria? 2. Have all identified source areas been sufficiently characterized to estimate the approximate spatial extent of contamination? 3. Does contamination extend beyond the boundaries of single-point sampling locations? 4. Do actual concentrations of PAHs or PCBs exceed screening criteria at locations where existing samples yielded nondetect results but where detection limits were above screening criteria? 5. Do potential source areas, known source areas, and single-point locations suspected of being within TPH plumes or locations where PCBs have been detected in groundwater have soil concentrations of TPH that exceed criteria (greater than 3,500 mg/kg of total TPH)?	▪ Historical use information from previous Parcels E and E-2 studies ▪ Aerial photographs of HPS ▪ GIS maps that depict the locations of previous sampling locations and their analytical results ▪ Existing data from the NDGI ▪ Validated analytical results for data collected during the SDGI ▪ SDGI screening criteria (updated with RIEC for RI/FS) ▪ HPALs for metals of potential concern	Based on the data presented in the Parcels E and E-2 SDGI Data Summary Report (Revision 01) (TtEMI, 2005c), the answer to the decision questions are: 1. Yes. Source areas have chemical concentrations that exceed criteria, such as PCBs within the southeast portion of Parcel E-2 (referred to as the PCB Hot Spot Area). 2. No. Some but not all identified source areas have been sufficiently characterized to estimate the spatial extent of contamination. This finding is attributed to the heterogeneous nature of the Parcel E-2 soil contamination. Additional delineation is not effective in defining the nature and extent of such heterogeneous soil contamination. Enough data are available to support the HHRA and SLERA and the focused set of remedial alternatives. 3. Yes. Some (but not all) single-point sampling locations, at which further delineation was attempted during the SDGI, were found to have contamination that extends beyond the boundaries of single-point locations. Similar to the resolution of question 2 above, this finding is attributed to the heterogeneous nature of Parcel E-2 soil contamination. Enough data are available to support the HHRA and SLERA and the focused set of remedial alternatives. 4. Yes. Concentrations of PAHs or PCBs detected during the SDGI exceed screening criteria at locations where previous samples yielded nondetect results (but where detection limits were above the screening criteria). Results with elevated detection limits are shown as triangles on the Section 4 figures. 5. Yes. Some (but not all) sampling locations within potential TPH plumes or areas with PCBs were detected in groundwater contain total TPH concentrations exceeding the soil source criteria (3,500 mg/kg). Adequate information has been collected to identify primary source areas, most notably the PCB hot spot in the East Adjacent Area; however, not all identified source areas have been sufficiently characterized to estimate the spatial extent of contamination. This finding is attributed to the heterogeneous nature of the Parcel E-2 soil contamination. Additional delineation is not effective in defining the nature and extent of such heterogeneous soil contamination. Enough data are available to support the HHRA and SLERA and the focused set of remedial alternatives. There are adequate data to answer the decision questions and to support the RI/FS.
Nature and Extent of Contamination in Parcel E-2 Shoreline Sediment		
The primary decision questions associated with shoreline sediment within Parcel E-2 are: 1. Are copper, lead, and PCBs present in shoreline sediment at concentrations sufficient to pose a threat to offshore areas and does the proposed offshore Parcel F FS footprint (identified in the Parcel F validation study [Battelle, Entrix, Inc., and Neptune and Company, 2002]) have corresponding source areas in the Parcel E-2 shoreline area? 2. Are metals, hexavalent chromium, pesticides, PCBs, and SVOCs present at identified or potential source areas along the Parcel E-2 shoreline at concentrations sufficient to pose a threat to wildlife?	▪ Historical use information from previous Parcels E and E-2 studies ▪ Aerial photographs of HPS ▪ Observations from the March 3, 2001, and April 9, 2002, site walkthroughs and reconnaissance studies ▪ GIS maps that depict the locations of previous sampling locations and their analytical results ▪ Validated analytical results for data collected during this SDGI ▪ Information on chemical concentrations that exceed screening criteria within the Parcel F validation study area ▪ Parcel E shoreline ecological screening criteria (SulTech, 2007)	Based on the data presented in the Shoreline Characterization Technical Memorandum (SulTech, 2007; Appendix G to this report), the answer to the decision questions are: 1. Concentrations of copper, lead, and PCBs in sediments along the Parcel E-2 shoreline exceed ambient concentrations for San Francisco Bay sediments, and are considered a potential source of contamination to Parcel F (SulTech, 2007; Appendix G to this report). 2. Benthic invertebrates, birds, and mammals are at risk from exposure to PCBs in surface and subsurface sediment along the Parcels E and E-2 shoreline. Benthic invertebrates in surface and subsurface sediment may be adversely affected by exposure to copper, lead, zinc, and DDTs. In subsurface sediment, mercury may pose an additional risk to benthic invertebrates. Ingestion of sediment and prey that contain cadmium, copper, molybdenum, zinc, and PCBs may pose a risk to the house mouse (SulTech, 2007; Appendix G to this Report). There are adequate data to answer the decision questions and to support the RI/FS.

Table 4-25. Resolution of Data Quality Objectives, Parcel E-2 Soil and Sediment *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

Notes:

DDT	dichlorodiphenyltrichloroethane
FS	Feasibility Study
GIS	Geographic Information System
HHRA	human health risk assessment
HPALs	Hunters Point ambient levels
HPS	Hunters Point Shipyard
IR	Installation Restoration
mg/kg	milligrams per kilogram
NDGI	Nonstandard Data Gaps Investigation
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
RI	Remedial Investigation
RIEC	Remedial Investigation Evaluation Criteria
SDGI	Standard Data Gaps Investigation
SLERA	screening-level ecological risk assessment
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
TtEMI	Tetra Tech EM Inc.

Sources:

Battelle, Entrix, Inc., and Neptune and Company. 2002. "Draft Parcel F Validation Study Report, Hunters Point Shipyard, San Francisco, California."
SulTech. 2007. "Draft Parcels E and E-2 Shoreline Characterization Technical Memorandum, Hunters Point Shipyard, San Francisco, California." June 29.
TtEMI. 2002d. "Revised Draft Final Sampling and Analysis Plan (Field Sampling Plan/Quality Assurance Project Plan) for Parcel E Standard Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California." August 22.
TtEMI. 2005c. "Parcels E and E-2 Standard Data Gaps Investigation, Data Summary Report (Revision 01), Hunters Point Shipyard, San Francisco, California." March 24.

Table 4-26. Exceedances of Remedial Investigation Evaluation Criteria Adjacent to Parcel Boundary
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

	Panhandle Area			East Adjacent Area		
Chemical	**0–2**	**2–10**	**10+**	**0–2**	**2–10**	**10+**
Maximum depth (feet bgs):	*2*	*10*	*42.75*	*2*	*10*	*46.82*
Metals						
Antimony	IR01B038					
Arsenic	IR01B366, IR01B367, IR01B368, IR01B369, IR01MW58A	IR01MW58A	IR01B365	IR01MW09B, IR02B452, GRID 128 SIDEWALL	GRID 139 SIDEWALL, IR02B452, GRID 65 SIDEWALL, IR01MW09B, IR04B002, IR72B037	IR01MW07A, IR04B002, IR01MW09B, IR02B249
Cadmium	IR01B368	IR01MW58A				
Chromium			IR01B015		IR12B041	
Iron	IR01B368, IR01B369	IR01MW58A		IR02B452		
Lead	IR01B366, IR01B367, IR01B368, IR01B369	IR01MW58A	IR01MW58A, IR01MW62A	IR04B015, IR04B017, IR04B028, IR04B047, IR04MW13A, IR12B042	IR01TA07B, IR04B019, IR72B037	
Zinc		IR01MW58A				
Volatile Organic Compounds						
1,1,2,2-Tetrachloroethane				IR72B038, IR72B026	IR72B025, IR72B026, IR72B027, IR72B039, IR01MW367A	

Table 4-26. Exceedances of Soil Evaluation Criteria Adjacent to Parcel Boundary *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

	Panhandle Area			East Adjacent Area		
Chemical	**0–2**	**2–10**	**10+**	**0–2**	**2–10**	**10+**
Maximum depth (feet bgs):	*2*	*10*	*42.75*	*2*	*10*	*46.82*
Semivolatile Organic Compounds						
Benzo(a)anthracene			IR01MW58A	GRID 139 SIDEWALL	IR72B038, GRID 138 SIDEWALL	
Benzo(a)pyrene			IR01MW58A	IR12SS19, IR02TA11A, IR12B037, GRID 128 SIDEWALL, IR02B434, GRID 139 SIDEWALL, IR72B038	IR72B038, GRID 138 SIDEWALL	
Benzo(b)fluoranthene			IR01MW58A	IR02TA11A, IR12B037, GRID 139 SIDEWALL	IR72B038, GRID 138 SIDEWALL	
Benzo(k)fluoranthene	IR01B366, IR01B368			GRID 139 SIDEWALL	IR72B038, GRID 138 SIDEWALL	
Dibenz(a,h)anthracene					GRID 138 SIDEWALL	
Indeno(1,2,3-cd)pyrene			IR01MW58A		GRID 138 SIDEWALL	
Naphthalene	IR01B368, IR01B369	IR01B366, IR01B367, IR01B368, IR01B369, IR01MW58A, IR01MW63A	IR01MW58A, IR01MW63A			

Table 4-26. Exceedances of Soil Evaluation Criteria Adjacent to Parcel Boundary *(continued)*
Remedial Investigation/Feasibility Study Report for Parcel E-2, Hunters Point Shipyard

	Panhandle Area			East Adjacent Area		
Chemical	**0–2**	**2–10**	**10+**	**0–2**	**2–10**	**10+**
Maximum depth (feet bgs):	*2*	*10*	*42.75*	*2*	*10*	*46.82*
Pesticides						
Dieldrin				IR12B041		
Polychlorinated Biphenyls						
Total PCBs (high risk)	IR01B368, IR01B372	WE20B		IR01SS350, IR04B030, IR04B015, IR04B047, IR04B028, IR04MW13A, IR04B017, IR12B042, IR12B041, IR12SS19, IR12B038, IR02TA11A, IR12B037, GRID 66 SIDEWALL, GRID 138 SIDEWALL, GRID 139 SIDEWALL, IR02B434, GRID 128 SIDEWALL	IR01MW367A, IR04B019, IR01TA07B, GRID 65 SIDEWALL, GRID 65 BOTTOM, GRID 66 BOTTOM, GRID 74 BOTTOM, GRID 104 BOTTOM, GRID 116 BOTTOM, GRID 131 BOTTOM, GRID 130 BOTTOM, GRID 138 SIDEWALL, GRID 139 SIDEWALL, GRID 128 BOTTOM, IR02B434, IR02B452	
Petroleum Hydrocarbons						
Total TPH	IR01B366, IR01B368, IR01B369		IR01MW63A	GRID 139 SIDEWALL, IR12B042, IR72B037, IR72SS22, IR72SS24	GRID 128 BOTTOM	

Notes:
bgs below ground surface PCBs polychlorinated biphenyls TPH total petroleum hydrocarbons