Public Summary: **Final Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California, September 30, 2010**

The Department of Navy has prepared this final record of decision (ROD) to address remaining contamination at Parcel C at Hunters Point Shipyard in San Francisco, California. The remedial action selected in this ROD is necessary to protect the public health, welfare, and the environment from actual or potential releases of contaminants from this parcel. The selected remedial action for Parcel C addresses metals (especially arsenic, lead, zinc and manganese), polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOC), polychlorinated biphenyls (PCB), and pesticides in soil, VOCs, PAHs and metals (especially chromium VI and zinc) in groundwater, and radionuclides in structures (such as buildings) and in soil.

In 2009, the Navy divided the former Parcel C into two new parcels: UC-2 and C. One overall remedy was selected for Parcels UC-2 and C. The Navy considered the following remedial alternatives for contaminants in soil: (1) no action; (2) institutional controls (IC) and maintained landscaping; (3) ICs, limited excavation and off-site disposal; (4) ICs and covers; and (5) a combination of ICs, covers, excavation, soil vapor extraction (SVE) and disposal. The Navy considered the following remedial alternatives for contaminants in groundwater: (1) no action; (2) long-term monitoring and ICs; (3) *in situ* treatment of VOCs and metals using biological compounds or zero-valent iron (ZVI), monitored natural attenuation (MNA) and ICs; and (4) *in situ* treatment of VOCs and metals using biological compounds plume-wide and ZVI, MNA and ICs. The Navy considered the following remedial alternatives for radiologically impacted structures (buildings, storm drains and sanitary sewers) and the soil associated with these structures: (1) no action; and (2) surveying radiologically impacted areas that may include structures and former building sites, decontaminating (and demolishing if necessary) buildings, excavating storm drain and sanitary sewer lines and soils in impacted areas, decontamination or removal of structures below Building 205 (pump house) and screening, separating, and disposing of radioactive sources and contaminated excavated soil at an off-site, low-level radioactive waste facility. The selected remedy for Parcel C is Alternative S-5 for soil; Alternative GW-3B for groundwater; and Alternative R-2 for radiologically impacted structures (buildings, storm drains and sanitary sewers) and the soil associated with these structures. Implementation of the remedy at Parcel C will consist of excavation and off-site disposal, SVE, durable covers, and ICs to address soil contamination; treatment of VOCs with ZVI or a biological substrate, MNA, and ICs to address groundwater contamination; and decontamination of buildings, removal of storm drains and sewer lines, decontamination or removal of structures below Building 205, and excavation of soil to address radiologically impacted structures and soil.

Information Repositories: A complete copy of the "Final Record of Decision for Parcel C" dated September 30, 2010, 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

Anna E. Waden Bayview Library
5075 Third Street
San Francisco, CA 94124
Phone: (415) 355-5757

The report is also available to community members on request to the Navy. For more information about environmental investigation and cleanup at Hunters Point Shipyard, contact Robert Hunt, remedial project manager for the Navy, at:

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Final

Record of Decision for Parcel C

Hunters Point Shipyard
San Francisco, California

September 30, 2010

Prepared by:
Department of the Navy
Base Realignment and Closure
Program Management Office West
San Diego, California

Prepared under:
Naval Facilities Engineering Command
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CHAD-3213-0029-0008.R1

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ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per liter
§	Section
ARAR	Applicable or relevant and appropriate requirement
ARIC	Area requiring institutional controls
BCT	BRAC Cleanup Team
bgs	Below ground surface
BHC	Benzene hexachloride
BRAC	Base Realignment and Closure
CAA	Corrective action area
CCSF	City and County of San Francisco
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	Chemical of concern
CSM	Conceptual site model
cy	Cubic yard
DNAPL	Dense non-aqueous phase liquid
dpm	Disintegrations per minute
DTSC	Department of Toxic Substances Control
ELCR	Excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	Feasibility study
F-WBZ	Bedrock water-bearing zone
GRA	General response action
HGAL	Hunters Point groundwater ambient level
HHRA	Human health risk assessment
HI	Hazard index
HPAL	Hunters Point ambient level
HPS	Hunters Point Shipyard
HRA	Historical Radiological Assessment
IC	Institutional control
IR	Installation Restoration
LUC RD	Land use control remedial design

ACRONYMS AND ABBREVIATIONS (Continued)

MCL	Maximum contaminant level
mg/kg	Milligrams per kilogram
millirem	One thousandth of a rem (10^{-3})
MNA	Monitored natural attenuation
MOA	Memorandum of Agreement
mrem/yr	Millirems per year
NA	Not available
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Not detected
NPL	National Priorities List
NRDL	Naval Radiological Defense Laboratory
O&M	Operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
PA	Preliminary assessment
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
pCi/g	Picocuries per gram
pCi/L	Picocuries per liter
PQL	Practical quantitation limit
RACR	Removal action completion report
RAO	Remedial action objective
RBC	Risk-based concentration
RD	Remedial design
RI	Remedial investigation
RME	Reasonable maximum exposure
RMP	Risk management plan
RMR	Risk management review
ROD	Record of Decision
RU	Remedial unit
SARA	Superfund Amendments and Reauthorization Act
SFPUC	San Francisco Public Utility Commission
SI	Site inspection
SVE	Soil vapor extraction
SVOC	Semivolatile organic compound
SWC	Surface water criterion

ACRONYMS AND ABBREVIATIONS (Continued)

TCE	Trichloroethene
TCRA	Time-critical removal action
TPH	Total petroleum hydrocarbon
UST	Underground storage tank
UWMP	Urban Water Management Plan
VOC	Volatile organic compound
Water Board	San Francisco Bay Regional Water Quality Control Board
ZVI	Zero-valent iron

1. DECLARATION

This Record of Decision (ROD) presents the selected remedy for Parcel C at Hunters Point Shipyard (HPS) in San Francisco, California. HPS was included on the National Priorities List (NPL) in 1989 (U.S. Environmental Protection Agency [EPA] ID: CA1170090087). The remedy was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 (Title 42 *United States Code* Section [§] 9601, et seq.), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Title 40 *Code of Federal Regulations* [CFR] Part 300). This decision is based on information contained in the administrative record[1] (Attachment 4) for the site. Information not specifically summarized in this ROD or its references but contained in the administrative record has been considered and is relevant to the selection of the remedy at Parcel C. Thus, the ROD is based on and relies on the entire administrative record file.

The Department of the Navy (Navy) and EPA jointly selected the remedy for Parcel C. The California Department of Toxic Substances Control (DTSC) and the San Francisco Bay Regional Water Quality Control Board (Water Board) concur on the remedy for Parcel C. The Navy, as the lead federal agency, provides funding under the Base Realignment and Closure (BRAC) program for site cleanups at HPS. The Federal Facility Agreement (FFA) for HPS documents how the Navy intends to meet and implement CERCLA in partnership with EPA, DTSC, and the Water Board.

Parcel C is one of six parcels (Parcels A through F) originally designated for environmental restoration. In 1997 and 2002, the boundaries of Parcels B and C were redefined, and Installation Restoration (IR) 06 (2002) and IR-25 (1997) were moved from Parcel B to Parcel C. In 2008, the Navy divided the former Parcel C into two new parcels: Parcel C and Parcel UC-2. Parcel UC-2 is not part of this ROD. Long-term uses in specified areas within Parcel C identified in the Hunters Point Shipyard Redevelopment Plan (July 14, 1997) include uses that are educational/cultural, maritime/industrial, mixed use (residential and industrial), open space, and research and development.

Environmental investigations began at Parcel C in 1984. A Draft Final Remedial Investigation (RI) Report for Parcel C was completed in 1997; the Draft Final RI for Parcel B (covers IR-06 and IR-25) was completed in 1996. The revised Final Feasibility Study (FS) Report for Parcel C was completed in 2008. This ROD documents the final remedial action selected for Parcel C and does not include or affect any other sites at HPS.

[1] **Bold blue text** identifies detailed site information available in the Administrative Record and listed in the References Table (Attachment 3). This ROD is also available on CD, whereby **bold blue text** serves as a hyperlink to reference information. The hyperlink will open a text box at the top of the screen. A blue box surrounds applicable information in the hyperlink. To the extent that inconsistencies may be or seem evident between the referenced information attached to the ROD via hyperlinks and the information in the basic ROD itself, the language in the basic ROD takes precedence.

1.1 SELECTED REMEDY

The CERCLA remedial action selected in this ROD is necessary to protect the public health, welfare, and the environment from actual or potential releases of contaminants from the site. The remedial action for Parcel C addresses metals, polycyclic aromatic hydrocarbons (PAH), other semivolatile organic compounds (SVOC), volatile organic compounds (VOC), polychlorinated biphenyls (PCB), and pesticides in soil; and radionuclides in structures (such as buildings) and in soil. The remedial action also addresses VOCs, PAHs, and other SVOCs found in groundwater in both the A- and B-aquifers, and metals and pesticides found in groundwater in the B-aquifer. The remedy consists of excavation and off-site disposal, soil vapor extraction (SVE), durable covers, and institutional controls (IC) to address soil contamination; treatment of VOCs with zero-valent iron (ZVI) or a biological substrate, monitored natural attenuation (MNA), and ICs to address groundwater contamination; and decontamination of buildings, removal of storm drains and sewer lines, decontamination or removal of structures below Building 205, and excavation of soil to address radiologically impacted structures and soil.

The remedial action is protective of human health and the environment, complies with federal and state statutes and regulations that are applicable or relevant and appropriate to the remedial action, and is cost-effective. The selected remedial action (1) uses permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and (2) satisfies the statutory preference for remedies employing treatment that reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element. A statutory review will be conducted within 5 years after the ROD is signed to ensure that the remedy is, or will be, protective of human health and the environment.

1.2 DATA CERTIFICATION CHECKLIST

The following information is included in Section 2 of this ROD. Additional information can be found in the administrative record file for this site:

- Chemicals of concern (COC) and their concentrations (Sections 2.3 and 2.5).
- Baseline risk represented by the COC (Section 2.5).
- Remediation goals established for COCs and the basis for these goals (Sections 2.5 and 2.7).
- Principal threat wastes (Section 2.6).
- Current and reasonably anticipated future land use assumptions, and current and potential future beneficial uses of groundwater (Section 2.4).
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Section 2.9.3).
- Estimated capital costs, annual operation and maintenance (O&M), and total present-worth costs; discount rate; and the number of years over which the remedy cost estimate is projected (Table 6).
- Key factors that led to selecting the remedy (for example, a description of how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.9.1).

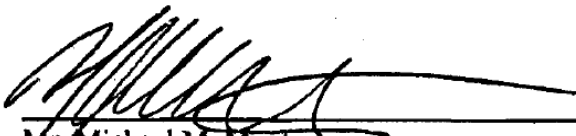
1.3 AUTHORIZING SIGNATURES

This signature sheet documents the Navy's and EPA's co-selection of the remedy in this ROD. This signature sheet also documents the State of California's (DTSC and Water Board) concurrence with this ROD.

09/02/10

Mr. Keith S. Forman
Base Realignment and Closure Environmental Coordinator
Base Realignment and Closure Program Management
Office West
Department of the Navy

Date



9/20/10

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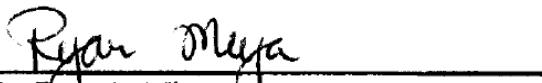

9/30/10

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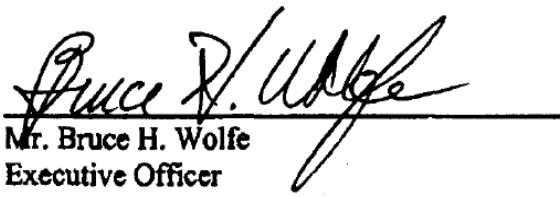


9/28/10

Mr. Bruce H. Wolfe
Executive Officer
California Environmental Protection Agency
San Francisco Bay Regional Water Quality Control Board

Date

2. DECISION SUMMARY

2.1 SITE DESCRIPTION AND HISTORY

HPS is located in southeastern San Francisco on a peninsula that extends east into San Francisco Bay (see Figure 1). HPS encompasses 866 acres: 420 acres on land and 446 acres under water in the San Francisco Bay. In 1940, the Navy obtained ownership of HPS for shipbuilding, repair, and maintenance. After World War II, activities at HPS shifted to submarine maintenance and repair. HPS was also the site of the Naval Radiological Defense Laboratory (NRDL). HPS was deactivated in 1974 and remained relatively unused until 1976. Between 1976 and 1986, the Navy leased most of HPS to Triple A Machine Shop, Inc., a private ship repair company. In 1987, the Navy resumed occupancy of HPS.

HPS property was placed on the NPL in 1989 pursuant to CERCLA, as amended by SARA, because past shipyard operations had left hazardous substances on site. In 1991, HPS was designated for closure pursuant to the Defense Base Closure and Realignment Act of 1990. Closure at HPS involves conducting environmental remediation and making the property available for nondefense use.

Parcel C$_{(1)}$ historically included about 79 acres in the central portion of the shipyard (see Figure 1), was formerly part of the industrial support area, and was used for shipping, ship repair, and office and commercial activities. Industrial support facilities for ship repair dominated the land use at Parcel C and included a foundry, a power plant, a sheet manufacturing shop, a paint shop, and various machine shops. Seventy buildings are located within the boundaries of Parcel C. The main buildings at Parcel C are shown on Figure 2. The docks at Parcel C were formerly part of the industrial production area. Portions of Parcel C were also used by NRDL. In 1997 and 2002, the boundaries of Parcels B and C were redefined, and IR-06 and IR-25 became part of Parcel C. In 2008, the Navy divided the former Parcel C into two new parcels: Parcel C and Parcel UC-2. Parcel UC-2 is not part of this ROD; the final ROD for Parcel UC-2 was signed in December 2009. The current Parcel C encompasses about 73 acres.

The original redevelopment plan developed by the San Francisco Redevelopment Agency in 1997 divided Parcel C into reuse areas. The reuse areas include educational/cultural, maritime/industrial, mixed use, open space, and research and development. To facilitate discussion of all areas of the parcel in the context of contamination and cleanup issues, the area was divided into redevelopment blocks. Figure 3 presents the planned reuses and redevelopment blocks in Parcel C. Figure 4 presents the associated **IR sites**$_{(2)}$ that are within Parcel C. Fourteen IR sites are in Parcel C, but four of these (IR-45, IR-49, IR-50, and IR-51) are facility-wide sites consisting of utilities that cut across other IR sites or are the locations of former transformer storage areas. As shown on Figure 3, the redevelopment blocks (and associated reuses) for Parcel C are 20B, 22, and 25 (educational/cultural); CMI-1 (maritime/industrial); 10, 11, 13, and 26 (mixed use); COS-1, COS-2, and COS-3 (open space); and 18, 20A, 23, and 24 (research and development).

Figure 1. Facility Location Map with the Boundary of Parcel C

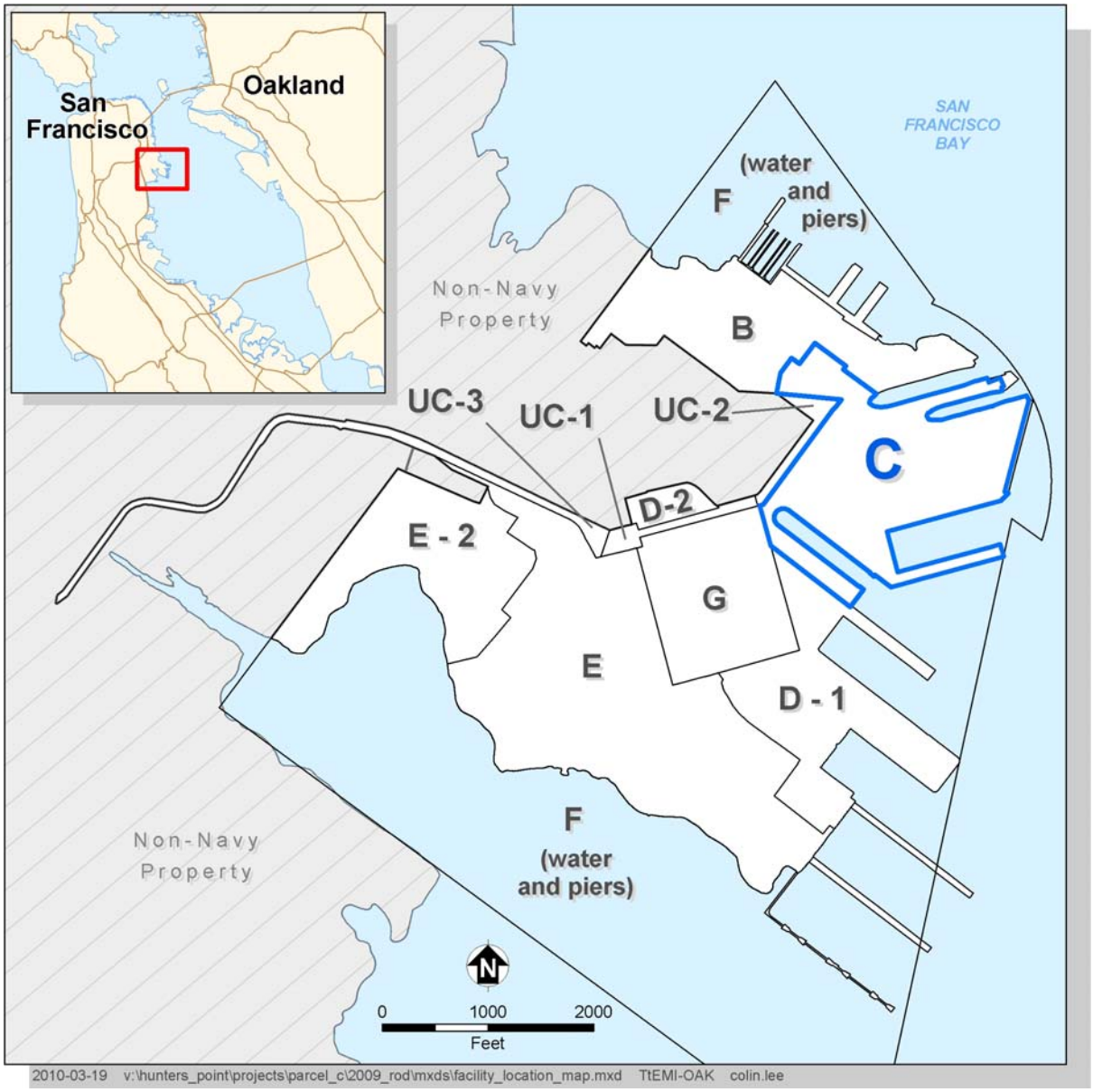


Figure 2. Parcel C Location Map

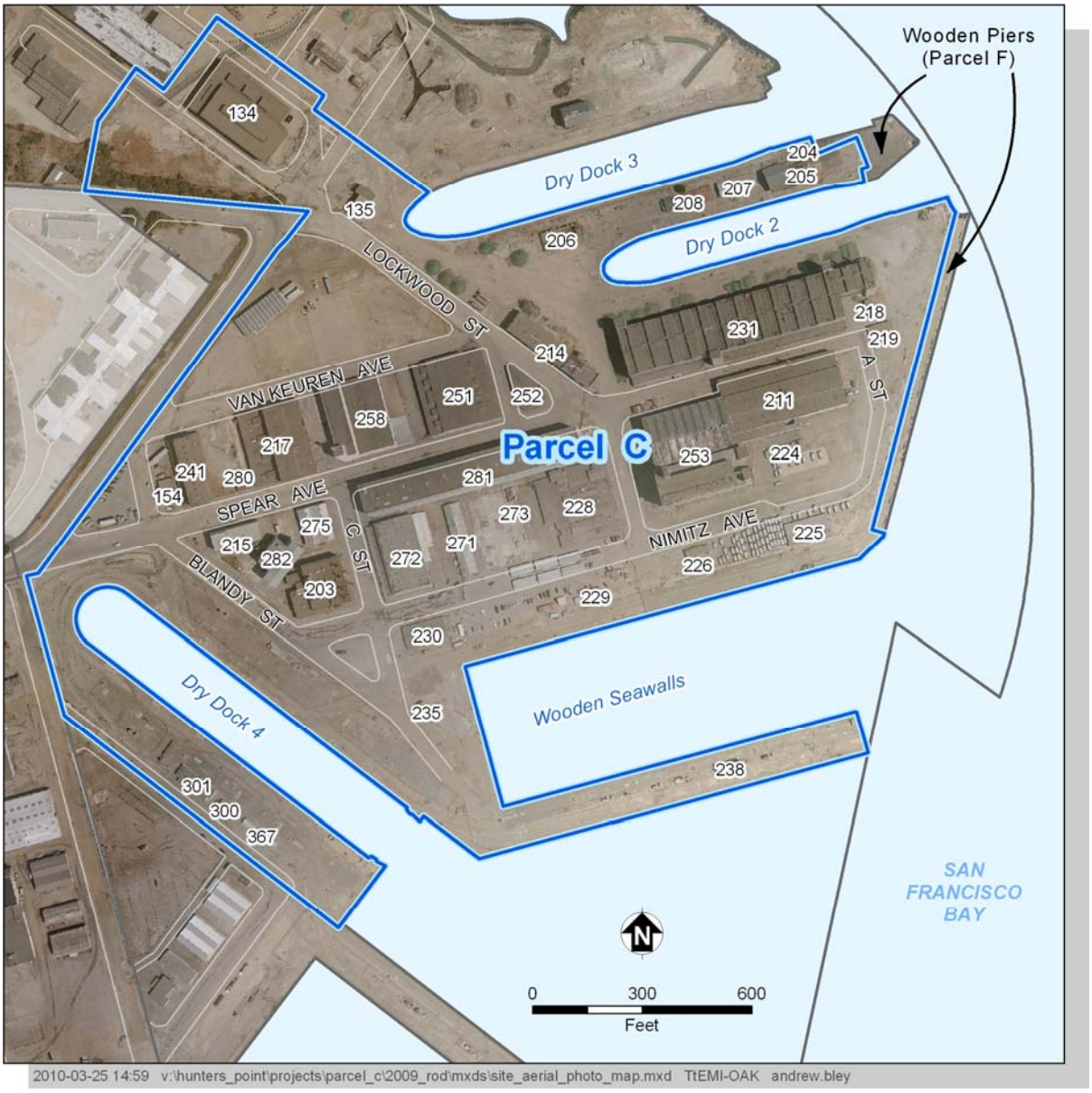


Figure 3. Reuse Areas and Associated Redevelopment Blocks

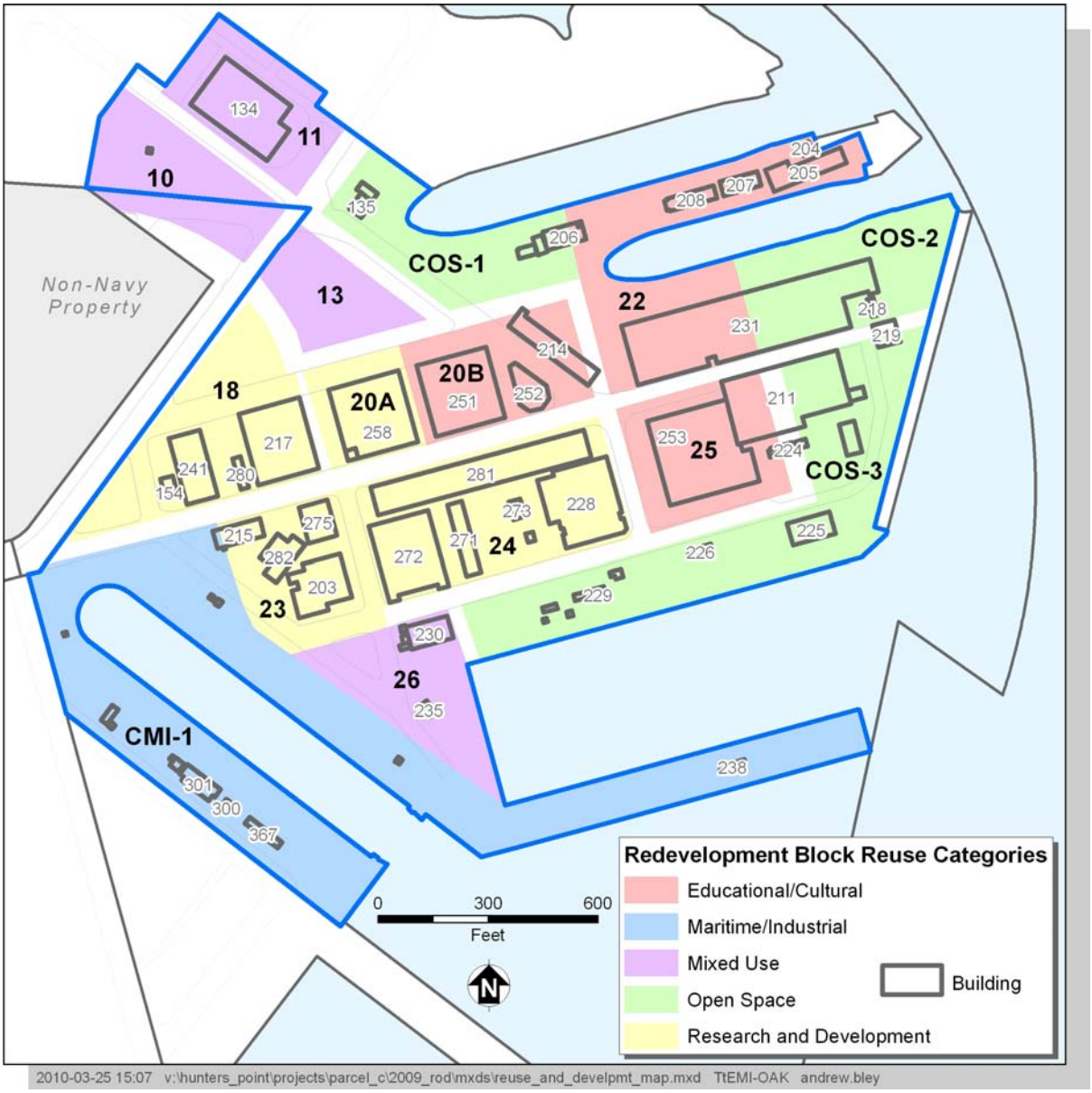
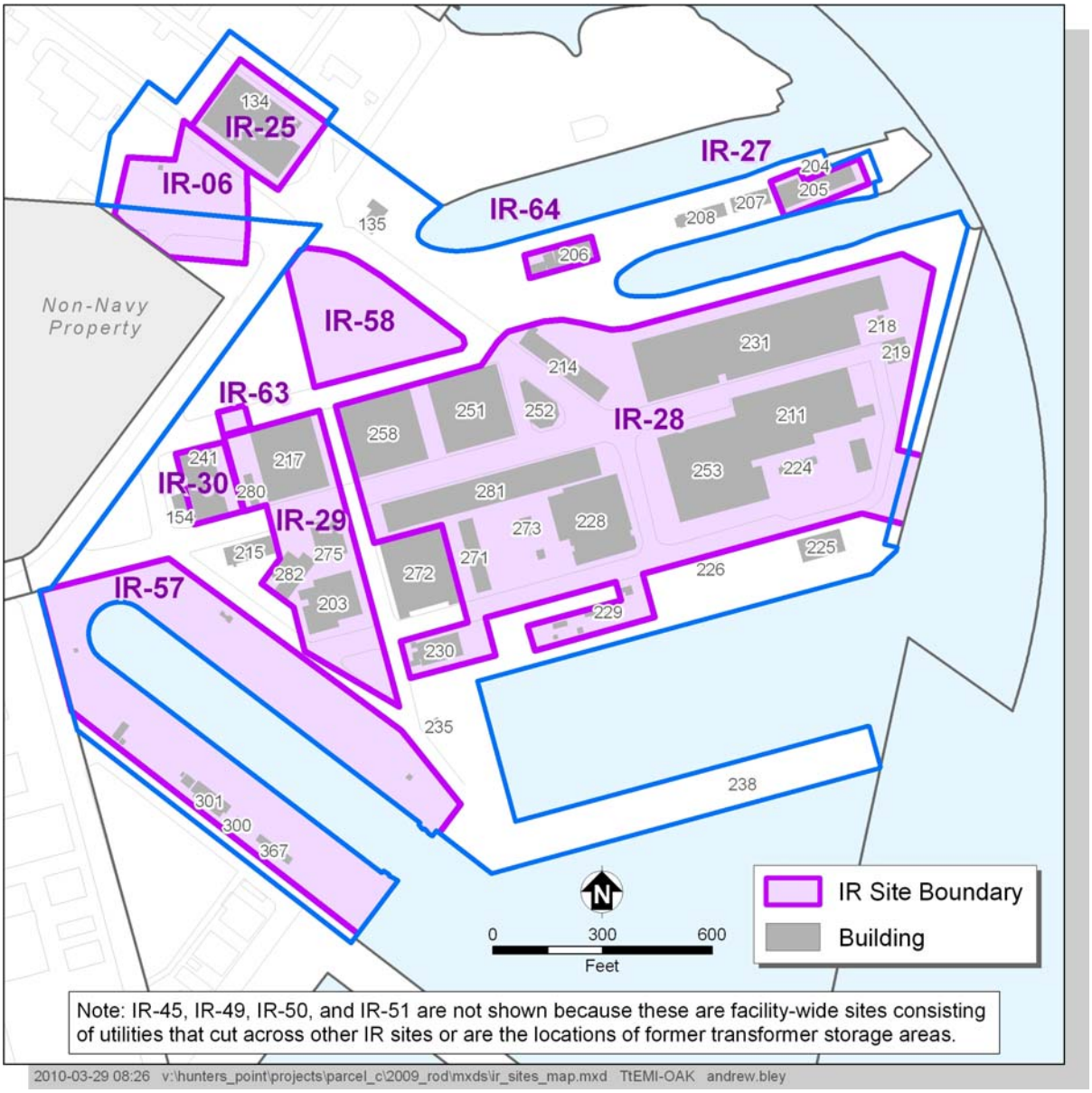


Figure 4. IR Sites within Parcel C



2.2 SITE CHARACTERISTICS

The western portion of Parcel C comprises the original promontory, with native soil over shallow bedrock, while most of the parcel consists of flat lowlands. The lowlands were constructed by placing borrowed fill material from various sources, including crushed serpentinite bedrock from the adjacent highland, construction debris, and waste materials (such as used sandblast materials). Most surface elevations in Parcel C are between 0 to 10 feet above mean sea level. The serpentinite bedrock and serpentine bedrock-derived fill material consist of minerals that naturally contain asbestos and relatively high concentrations of arsenic, manganese, nickel, and other ubiquitous metals.

The **hydrostratigraphic units**(3) present at Parcel C include the shallow A-aquifer, the aquitard zone, the B-aquifer, and a bedrock water-bearing zone. The bedrock water-bearing zone is designated as F-WBZ in this report. Depth to the top of the A-aquifer occurs at approximately 8 to 10 feet below ground surface (bgs) across most of Parcel C. Groundwater is not currently used for any purpose at Parcel C. On September 25, 2003, the Water Board concurred with the Navy that A-aquifer groundwater at HPS meets the exception criteria in the State Water Resources Control Board Sources of Drinking Water Resolution No. 88-63. Therefore, the groundwater in the A-aquifer is not suitable as a potential source of **drinking water**(4). On July 29, 2008, the Water Board concurred with the Navy that the B-aquifer groundwater in the central area of Parcel C also meets the Resolution 88-63 exception criteria, and clarified that the exception for the A- and B-aquifer applies to F-WBZ where the F-WBZ is in direct contact with or hydrogeologically connected to the overlying A- and B-aquifers. The B-aquifer in the area of Building 134 is distinct and separate from the B-aquifer in the central area of Parcel C, and the Water Board considers the B-aquifer in the area of Building 134 as part of the B-aquifer in Parcel B. However, based on the low permeability of the B-aquifer in the area of Building 134, the B-aquifer groundwater in this area has a low potential as a future source of drinking water.

The City and County of San Francisco (CCSF) regulates the installation and use of water wells within city boundaries under Article 12B of the CCSF Health Code. Under the Health Code, the withdrawal and use of groundwater within the City and County is administrated by the San Francisco Public Utilities Commission (SFPUC). SFPUC water policies are administrated as provided in the 2005 North Westside Groundwater Basin Management Plan, and in the 2005 Urban Water Management Plan (UWMP) for CCSF. San Francisco overlies all or part of seven groundwater basins. HPS Parcel C lies within the Islais Valley Basin. The UWMP identified the Islais Valley Basin as generally inadequate to supply a significant amount of groundwater for municipal supply due to low yield. As such, the SFPUC does not provide for the use of groundwater from the Islais Valley Basin. CCSF currently obtains its municipal water supply from the Hetch Hetchy watershed in the Sierra Nevada and plans to continue using the Hetch Hetchy watershed as a drinking water source in the future.

The general pattern of groundwater flow is radially away from the former Parcel A topographic high (west of Parcel C) and toward the shoreline. At Parcel C, the general direction of groundwater flow is to the east, where groundwater discharges into the bay. Locally, the groundwater flow direction is southeast or northeast, directly toward the bay or dry dock, at bayside perimeter locations of the parcel. Leaking storm drains, sewer lines, and water supply

lines also influence groundwater movement across Parcel C. The principal sources of groundwater recharge for the A-aquifer at Parcel C are considered to be the horizontal flow from the F-WBZ from areas upgradient of Parcel C, precipitation infiltration, and leaking sections of water lines. Discharge from the A-aquifer occurs principally as lateral flow of groundwater to the bay at the shore or through ruptured utility corridors. The principal sources of groundwater recharge for the B-aquifer at Parcel C are considered to be the horizontal flow from the upgradient F-WBZ and recharge from the overlying A-aquifer, particularly through infiltration of precipitation, in places where the two aquifers are in direct contact. Based on the limited extent of the B-aquifer in the central area of Parcel C and its lack of hydraulic connection to other aquifers, there is no potential for groundwater in the Parcel C central area B-aquifer to flow to the B-aquifer in adjacent parcels.

Parcel C ecology[5] is limited to those plant and animal species adapted to the industrial environment. More than 90 percent of Parcel C is covered by pavement and former industrial buildings. With little open space for flora and fauna, Parcel C is considered to have insignificant habitat value and poses an insignificant risk to terrestrial ecological receptors. No threatened or endangered species are known to inhabit Parcel C or its immediate vicinity.

Although fuel and steam lines at Parcel C were removed or closed in 2002, the storm drains and sanitary sewer lines beneath the parcel remain key site characteristics (Figure 5). The HPS storm and sanitary combined sewer system was installed in the 1940s and underwent a series of separation projects (1958 to 1976), but was never completely separated. Based on gamma surveys of key manholes in the Historical Radiological Assessment (HRA), the determination was made that potential contamination of the storm and sanitary sewer system was likely near former NRDL sites or sites associated with radium use. Therefore, the Navy also recommended removal of sanitary and storm sewers at Parcels B, C, D, E, and E-2. Radionuclides that may be present include cesium-137, cobalt-60, plutonium-239, radium-226, strontium-90, and thorium-232. Some of the storm drain and sanitary sewer lines in IR-06 and IR-25 (Survey Units 5, 7, 15, 16, 17, 18, and portions of 56) were removed in 2007 as part of the Parcel B radiological time-critical removal action (TCRA). The remaining lines in Parcel C are scheduled to be removed during 2010 through 2012.

2.3 PREVIOUS INVESTIGATIONS

Potential contamination at Parcel C is associated with metals, VOCs, PAHs, and PCBs in soil; VOCs, PAHs, SVOCs, and metals in groundwater; and radiologically impacted structures and soil. Assessment of contamination and risk for Parcel C is based on the Final FS Report for Parcel C (July 31, 2008), including the revised human health risk assessment (HHRA) and the radiological addendum to the FS Report. The Final FS Report for Parcel C considered new information associated with a Parcel C interim removal action and groundwater data gaps investigation. Both the FS and HHRA are detailed in the Final FS Report for Parcel C. The FS Report and radiological addendum (June 20, 2008) summarize the most recent information available on Parcel C and provide the basis for the ROD for Parcel C. Table 1 summarizes the previous studies, investigations, and removal actions conducted at Parcel C, including IR-06 and IR-25 (formerly in Parcel B) that became part of Parcel C in 1997 and 2002.

Figure 5. Parcel C Site Features

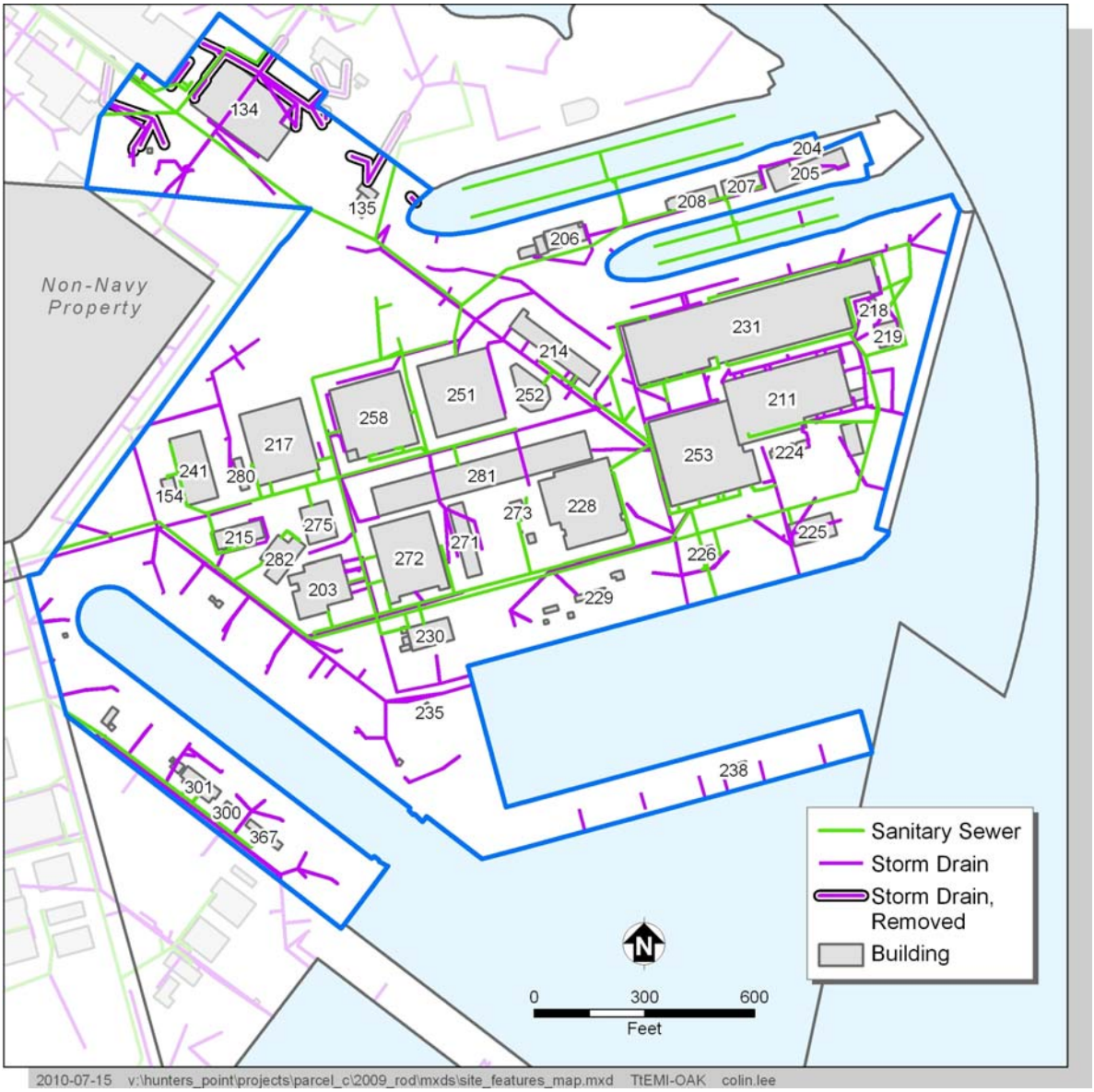


Table 1. Previous Investigations and Removal Actions

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Previous Investigation/ Removal Action[a]	Date	Investigation/Removal Action Activities
Investigations and Studies		
Preliminary Assessment (PA)	1984-1990	The PA for former Parcel C involved record searches, on-site surveys, interviews, and limited field investigations. The PA report concluded that portions of former Parcel C, including areas within Parcel B (IR-06 and IR-25) that were later added to former Parcel C, warranted further investigation because of the potential for contamination of soil and groundwater from past site activities.
Site Inspection (SI)	1994	Evaluated whether contamination was present and whether a release to the environment had occurred, evaluated each site for inclusion in the Navy's IR Program, and eliminated sites that posed no significant threats to public health or the environment. Additional field data were obtained, including geophysical surveys of suspected subsurface fuel lines; collection of soil and groundwater samples from borings; installation of monitoring wells and collection of groundwater samples; collection of shallow soil samples; trenching, mapping, inspection, and sample collection from the steam lines and sanitary sewers; video surveys of the sanitary sewers; and sump and floor scrape sampling. Based on the results of the SI, nine sites were recommended for inclusion in RI activities.
Remedial Investigation (RI)	1993-1997	Site conditions were further assessed through literature searches; interviews with former on-site employees; geophysical, radiological, and aerial map surveys; installation of soil borings and monitoring wells; aquifer testing; indoor air testing; and storm drain inspection. The following **samples**$_{(6)}$ were collected: 1,173 soil, 570 groundwater, and 129 source samples. Samples were analyzed for one or a combination of the following chemicals: metals, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), pesticides and polychlorinated biphenyls (PCB), and petroleum-related products. Removal actions were conducted, including aboveground storage tanks, tank farm, sandblast grit, and storm drain sediment, as well as asbestos and lead abatement. Based on the RI results, the 12 sites in former Parcel C (plus IR-06 and IR-25) were recommended for further evaluation in a FS.

Table 1. Previous Investigations and Removal Actions (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Previous Investigation/ Removal Action[a]	Date	Investigation/Removal Action Activities
Feasibility Study (FS) – Initial Phase	1996-1998	Results and analysis in the RI Report were used to identify, screen, and evaluate remedial alternatives and to define areas for proposed remedial action. Three different cleanup scenarios and associated cleanup goals were considered: cleanup to the industrial land use scenario (10^{-5} excess lifetime cancer risk [ELCR]); cleanup to the industrial land use scenario (10^{-6} ELCR); and cleanup to the residential land use scenario (10^{-6} ELCR). Each scenario also considered cleanup of soils representing a hazard index (HI) greater than 1 and lead concentrations greater than 1,000 milligrams per kilogram (mg/kg). Areas exceeding various cleanup goals for each reuse scenario and cleanup level were delineated, risk drivers were identified, and the extents of the cleanup areas were defined. Five IR sites and parts of two additional IR sites had cleanup areas based on residential use, one IR site and parts of two more IR sites had cleanup areas based on industrial use, and one IR site and parts of two more IR sites had areas based on recreational use. All soil cleanup areas exceeding at least one of the various cleanup criteria under each reuse scenario were identified.
Risk Management Review (RMR) Process	1999	The RMR process was developed and conducted during a series of meetings held by the Navy and the regulatory agencies from January through April 1999. The process used various criteria and decision rules to reevaluate whether remedial actions were required at all of the 14 IR sites in former Parcel C that had been originally identified as requiring remedial actions for soil. After the review was complete, all sites were grouped into one of the following three categories: (1) sites where the team agreed no response action was required, (2) sites where the team agreed response action was required, and (3) sites where the team did not yet agree on the course of action. Of the 14 IR sites in former Parcel C, six were recommended for action after the RMR process. Based on the **RMR results**(7), the sites and chemicals requiring further evaluation and remedial action were revised.

Table 1. Previous Investigations and Removal Actions (Continued)
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Previous Investigation/ Removal Action[a]	Date	Investigation/Removal Action Activities
Groundwater Data Gaps Investigation	2002-2008	A data gaps investigation was completed in three phases to provide additional understanding of the groundwater conditions underlying the parcel. To better define the vertical and horizontal extents of plumes, 17 monitoring wells were installed and groundwater samples were collected from these wells and 120 additional monitoring wells. To better understand the groundwater conceptual model, groundwater levels in 73 monitoring wells were measured, aquifer testing was conducted, and tidal influence and mixing studies were completed.
Historical Radiological Assessment (HRA)	2004	The HRA evaluated and designated sites as radiologically **impacted or non-impacted**$_{(8)}$. A radiologically impacted site has potential for radioactive contamination based on historical information, or is known to contain or have contained radioactive contamination. A non-impacted site, based on historical documentation or results of previous radiological survey information, has no reasonable possibility for residual radioactive contamination. Based on the results of the assessment, nine sites along with the sanitary sewer and storm drain lines at Parcel C have potential for radiological contamination, and further investigation is required to determine whether these sites and lines are not contaminated.
Contaminant Delineation at Remedial Unit (RU)-C5	2005-2006	This investigation involved collecting passive soil gas samples, soil cores from borings, and groundwater samples using Hydropunch and existing groundwater monitoring wells to better determine the extent of dissolved-phase VOCs in the groundwater, and to evaluate the extent of dense non-aqueous phase liquids (DNAPL) at RU-C5.

Table 1. Previous Investigations and Removal Actions (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Previous Investigation/ Removal Action[a]	Date	Investigation/Removal Action Activities
FS – Revised	2008	Existing RI data were combined with new data obtained after completion of the 1996 (Parcel B - IR-06 and IR-25) and 1997 (former Parcel C) RI Reports. The revised FS considered new information associated with several cleanup actions completed within former Parcel C and at other adjacent parcels at Hunters Point Shipyard (HPS). New information considered and incorporated into the revised FS included (1) quarterly monitoring of groundwater, (2) updates to toxicity criteria used in the 1997 human health risk assessment (HHRA), and (3) the findings from removal actions conducted to address chemicals identified by the RMR process and radiological contaminants that had been identified by the HRA. Data were summarized and evaluated to refine the site conceptual model, further define the nature and extent of contamination, assess potential risks based on existing site conditions, and develop and evaluate revised alternatives. Data evaluation included (1) a comparison of new and existing data with updated screening criteria, (2) a revised evaluation of groundwater beneficial uses and exposure pathways, and (3) a revised assessment of potential risk posed by exposure to soil and groundwater at former Parcel C. Revised remedial action objectives (RAO) were developed, which included a risk range rather than specific concentrations for contaminants. Remedial alternatives were developed, and a detailed and comparative analysis of alternatives was performed.
Radiological Addendum	2008	The primary purpose of this addendum was to provide decision makers with the information necessary to select a final remedy for radiologically impacted buildings, former building sites, outdoor areas, and soils and piping associated with remediated storm drains and sanitary sewers. This information was obtained by developing and evaluating appropriate remedial alternatives. After general response actions and process options were screened, two remedial alternatives were identified: no action, and a combination of surveys, decontamination, excavation, disposal, and release. The two alternatives were analyzed against the nine Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) evaluation criteria and against each other.
Proposed Plan	2009	The Proposed Plan was open to the public for review and comment on the Preferred Alternatives for addressing environmental contamination at former Parcel C before the final remedy was selected.

Table 1. Previous Investigations and Removal Actions (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Previous Investigation/ Removal Action[a]	Date	Investigation/Removal Action Activities
Soil Beneath Buildings 134, 203, 214, and 231, Data Gap Investigation	2009-2010	Additional evaluation of chemicals of concern (COC) in soil adjacent to and beneath buildings in Parcel C was conducted to ensure that the soil under building cover had been sufficiently characterized. The evaluation identified the need for adjusting soil excavation areas 20A-1 (east of Building 258) and 24-4 (north of Building 272), and collecting additional soil samples within the footprint of existing Buildings 134, 203, 214, and 231. The soil data gap investigation found that PAHs and lead exceeded goals at Building 214, and lead exceeded goals at Building 231. Soil samples collected at Buildings 134 and 203 contained no COCs that exceeded goals. As a result of the evaluation and soil data gap investigation, the footprints of Buildings 134, 214, 231, 272, and 281 were identified as areas requiring institutional controls (ARIC) that will need further action if the building foundation is removed.
Removal Actions		
Phase I and II Underground Storage Tank (UST) Removal Action	1991-1993	Twenty-one USTs were removed and seven USTs were closed in place. The USTs at former Parcel C ranged in size from 122 to 210,000 gallons, and tank contents included gasoline, diesel, waste oil, hydraulic fluids, solvents, or fuel oils.
Sandblast Grit Removal Action	1991-1995	A total of 4,665 tons of discarded sandblast grit was removed throughout HPS. An estimated 101 tons of grit was generated from Dry Dock 4, located in former Parcel C.
Storm Drain Sediment Removal Action	1996-1997	A total of 1,200 tons of contaminated sediment was removed from storm drain lines and appurtenances; approximately 800 feet of drainage culverts under Dry Dock 4 was cleaned.
Parcel B Remedial Action (IR-06)	1997-1998	Soil was removed at 19 excavation sites at the former tank farm in IR-06; the excavations were sampled and the sites were backfilled.
Facility-wide Exploratory Excavations	1997-1999	Soil was removed at 18 sites facility-wide, the excavations were sampled, and the sites were backfilled.
Soil Vapor Extraction Treatability Study	2000-2001	A soil vapor extraction treatability study was conducted at Building 134 in IR-25.
Time-critical Removal Action (TCRA)	2000-2002	Steam and fuel lines were closed in place or removed. Soil was removed at 46 of the 121 sites, contamination was delineated at 38 sites, and the remaining sites met the cleanup goals established for this action.

Table 1. Previous Investigations and Removal Actions (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Previous Investigation/ Removal Action[a]	Date	Investigation/Removal Action Activities
Parcel B Remedial Action – addendum	2000-2004	An industrial drain line between Buildings 123 and 134 was excavated, about 2,050 cubic yards (cy) of soil was removed, the excavation was sampled, and the site was backfilled.
Degreaser Pit/Separator Demolition at RU-C5	2004	Removal of the degreaser pit and oil-water separator occurred from Building 134.
Groundwater Treatability Study (RU-C5)	2004-2005	A groundwater treatability study using in-situ bioremediation was conducted at RU-C5 using sequential use of bio-additives to facilitate anaerobic followed by aerobic conditions to enhance degradation of chlorinated organic compounds.
Groundwater Treatability Study (RU-C4)	2004-2005	A groundwater treatability study was conducted using zero-valent iron (ZVI) at Building 272.
Emergency Removal Action Closeout Report Encapsulation of Drainage Culvert Sediment at Dry Dock 4	2003	Contaminated sediment in two culverts under Dry Dock 4 was successfully encapsulated.
Total Petroleum Hydrocarbon (TPH) Program Corrective Action Implementation Soil Removal	2005	Soil was removed at two Parcel C sites located in IR-28 (corrective action area [CAA] 3R in Block 20B and CAA 2R in Block 24); at CAA 2R, the excavation was 2 feet deep and 12 cy was removed; at CAA 3R, the excavation was 4 feet deep and 12 cy was removed.
Parcel B Storm Drain and Sanitary Sewer Removal Action	2007	A total of 1,892 linear feet of pipeline was removed at IR-06 and IR-25 in Parcel C; about 3,086 cy of material was removed. The concrete, clay, and cement pipelines were tested for radiological contamination and disposed of appropriately off site.
Groundwater Treatability Studies at RU-C1 and RU-C5	2008-ongoing	Groundwater treatability studies using ZVI injection points are ongoing at RU-C1 and RU-C5. Completion of these studies is expected in 2010 (RU-C1) and in 2011 (RU-C5).
Radiological TCRA	2010-ongoing	Initial design work for Parcel C started in 2010. Field work is scheduled for 2010 and 2011, with reports following in 2012.

Note:

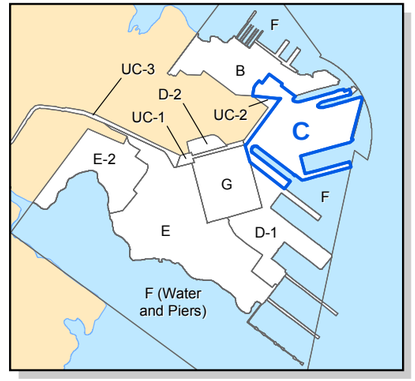
[a] The documents listed are available in the Administrative Record and provide detailed information used to support remedy selection at Parcel C.

The Navy has completed a number of removal actions and treatability studies at Parcel C. Two key soil removal actions reduced or eliminated certain risks to human health and ecological receptors. More than 3,000 samples were collected and approximately 9,600 cubic yards (cy) of soil was excavated during the exploratory excavations and the steam and fuel lines TCRA. Past and ongoing treatability studies at Parcel C have focused on technologies to reduce VOCs in groundwater and soil, including ZVI injection and sequential anaerobic/aerobic bioremediation. Based on these removal actions and studies, the sources and extent of the remaining contamination in soil and groundwater have been well characterized.

Industrial operations, former fuel lines, and underground storage tanks (UST) are the significant sources of chemicals in soil at Parcel C. The predominant chemicals in Parcel C soil are **VOCs(9)**, **PAHs(10)**, and **metals (11)** (Figure 6). The 28 former USTs (either removed or closed in place) stored various liquids, including boiler oil, diesel fuel, gasoline, solvents, waste oil, and brine and water. Metal contamination is associated with the pickling operation at Building 258, the former foundry at Building 241, and with fuel additives. Pickling is the acid treatment of metallic surfaces to remove any surface impurities before further processing. Elevated concentrations of ubiquitous metals, such as arsenic and manganese, may be related to the bedrock fill quarried to build the shipyard in the 1940s. The fill may have contained elevated concentrations of select ubiquitous metals from the bedrock. Therefore, the Navy has worked with the regulatory agencies to identify remedial alternatives that address metals in soil, regardless of their source. SVOCs other than PAHs, pesticides, and PCBs were detected in localized areas in Parcel C soil.

The sources of contamination in groundwater have been detected at four groundwater remedial units (RU), referred to as RU-C1, RU-C2, RU-C4, and RU-C5. The sources include dip tanks, sumps, former paint spray and cleaning rooms, industrial machining, USTs, solvent tanks, a pickling and degreasing area, floor drains and sewer lines, a former tank farm, and a former oil-water separator. The predominant chemicals present in Parcel C groundwater are **VOCs(12)**, and discrete VOC plumes are found in each RU (Figure 7). DNAPL has been detected at RU-C5; however, it is currently believed to exist on site only as distributed pockets of immobile liquid. Viscous light nonaqueous phase liquid is present, but limited to one well in RU-C1 (IR28MW129A). Areas of concern for metals also have been identified in groundwater at RU-C1 (**chromium VI and zinc(13)**) and RU-C5 (chromium VI) (Figure 7).

The plumes shown on Figure 7 are based on groundwater monitoring information obtained before 2004. Recent findings from a treatability study and ongoing groundwater monitoring suggest a reduction in contaminant concentrations and the extent of the plumes since 2004. The current groundwater sample data will be reviewed during the remedial design (RD) to focus future groundwater remediation.



Sampling Locations Where COCs Exceed Remediation Goals

- VOCs (Except Benzene)
- Benzene
- PAHs
- Pesticides and SVOCs (Except PAHs)
- PCBs (Aroclor-1254 and Aroclor-1260)
- Metals
- Total TPH ≥ 3,500 mg/kg where commingled within 50 feet of other contaminants

Parcel C

Building

mg/kg	milligrams per kilogram
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
SVOC	Semivolatile organic compound
TPH	Total petroleum hydrocarbon
VOC	Volatile organic compound

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

FIGURE 6
CHEMICALS IN SOIL
ABOVE REMEDIAL GOALS

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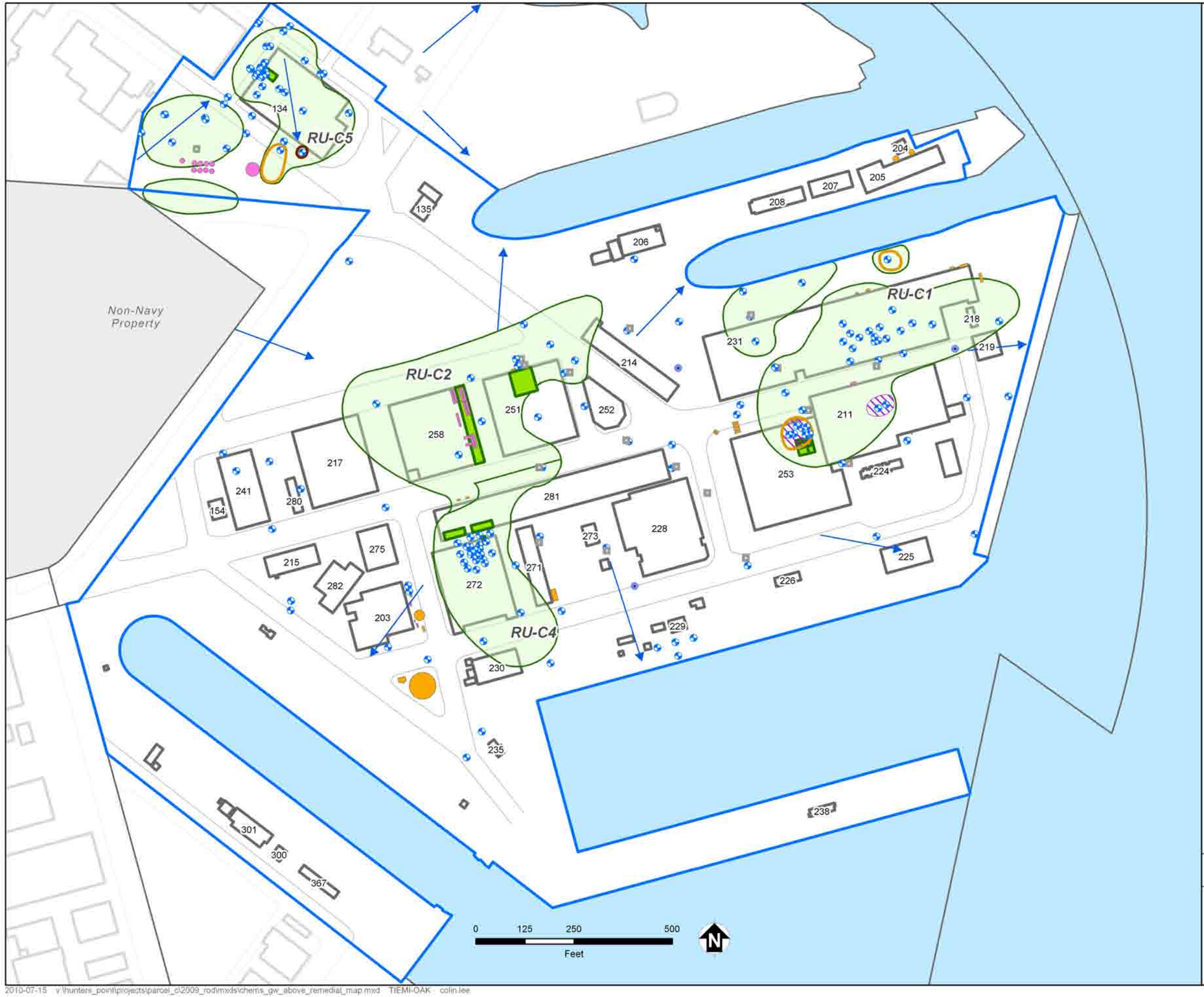

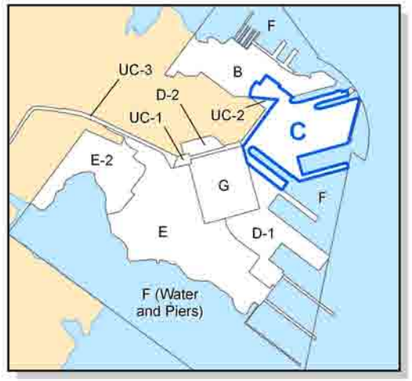

Monitoring Wells

- A-Aquifer Monitoring Well
- A-Aquifer Piezometer
- B-Aquifer Monitoring Well
- Groundwater Flow Direction
- Area of Elevated VOCs
- Area of Elevated Naphthalene
- Approximate Area of Concern for Chromium VI (exceeds surface water criterion 50 µg/L)
- Approximate Area of Concern for Zinc (exceeds surface water criterion 81 µg/L)

Former Storage Tanks

- Former Aboveground Storage Tank
- Former Underground Storage Tank
- Potential Source Area
- Parcel C
- Other Parcel
- Building

VOC Volatile organic compound
µg/L Micrograms per liter

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

FIGURE 7
CHEMICALS IN GROUNDWATER ABOVE REMEDIAL GOALS

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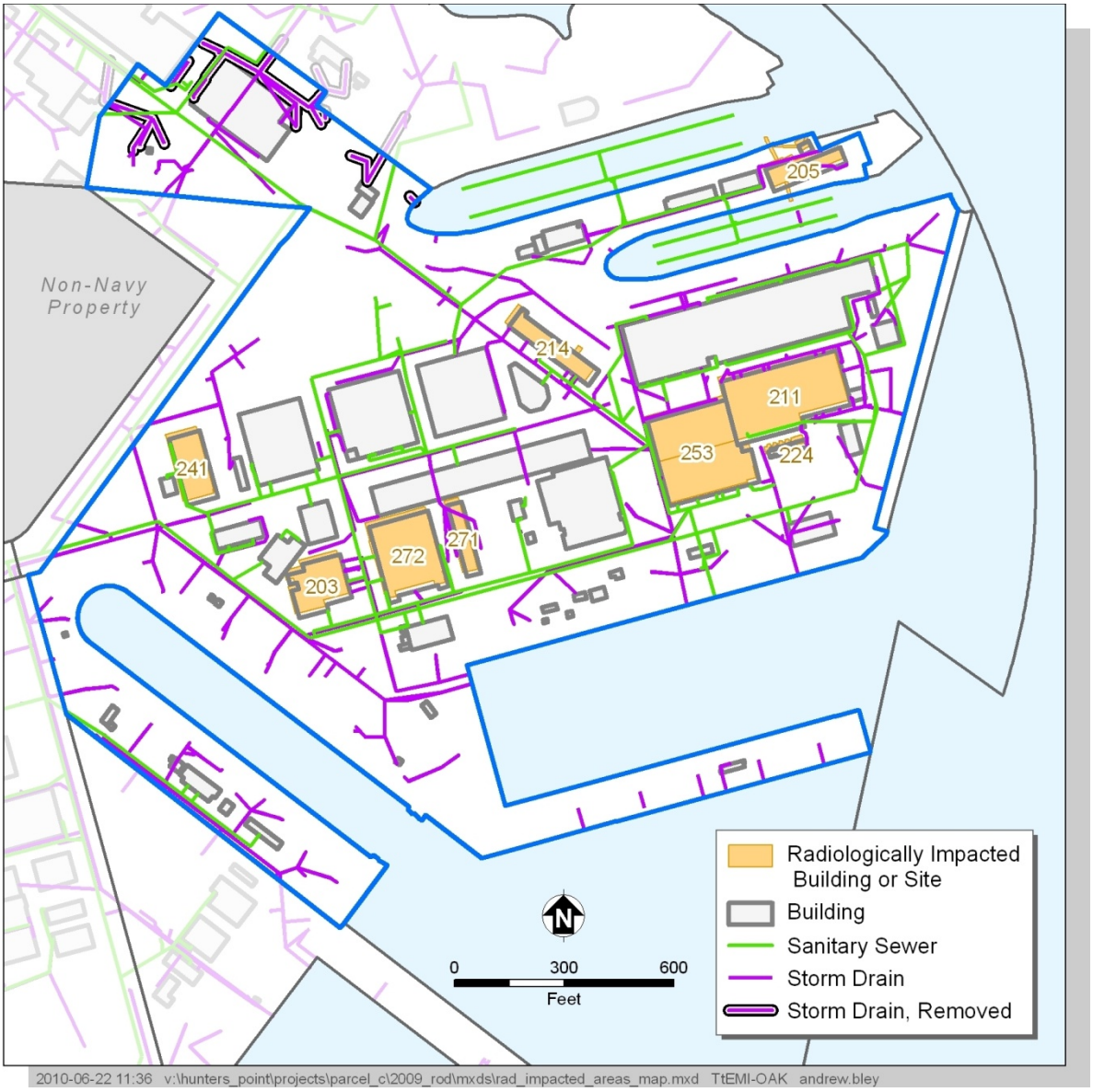
The Navy identified **radiologically impacted sites**(14)—including buildings, equipment, and infrastructure—at Parcel C associated with former use of general radioactive materials and decontamination of ships used during the 1946 atomic weapons testing in the South Pacific. Radiologically impacted buildings (203, 205 and discharge tunnel, 211, 214, 224, 241, 253, 271, and 272), storm drains, and sanitary sewers are all of concern in Parcel C (Figure 8). Storm drains and sewer lines were removed in 2007 at portions of IR-06 and IR-25 in Parcel C to address radiological concerns. Storm drains and sewer lines were addressed in these locations because they were connected to lines in Parcel B. The TCRA to address the remaining radiologically impacted sites in Parcel C began in 2010 and is scheduled for completion in 2012. All interim reports will be summarized in a final removal action completion report (RACR) which will be reviewed and approved by the BRAC Cleanup Team (BCT). Although the TCRA will not be completed by the time the ROD is signed, the TCRA is intended to achieve cleanup goals identical to the remedial action objectives (RAO) specified in this ROD. If the TCRA does not achieve its cleanup goals, cleanup will continue in accordance with the remedial action selected in this ROD until the RAOs are achieved.

2.4 CURRENT AND POTENTIAL FUTURE SITE USES

No tenants currently are at Parcel C; the parcel is a former industrial use area with restricted access that is undergoing remediation. The **reuses**(15) defined in the San Francisco Redevelopment Agency's 1997 reuse plan were evaluated by the following exposure scenarios: residential (mixed-use and research and development blocks), industrial (maritime/industrial and educational/cultural blocks), and recreational (open space blocks). In 2010, the SFRA issued an amendment to the 1997 reuse plan which revised the reuses in Parcel C to show "Land Use Districts" within the area corresponding to the current Parcel C, as "HPS Shoreline Open Space" which is open space reuse scenario; and "Shipyard North Residential," Shipyard Village Center Cultural," and "Shipyard Research and Development," which are residential reuses. While the ROD was not revised to reflect the **2010 amended land use**(16), the most up-to-date land use and associated human health risk exposure scenario will be evaluated at the time of the RD. The groundwater in the A-aquifer and upper F-WBZ, as discussed in the revised FS, is not suitable for use as drinking water. Exposures to the A-aquifer were evaluated based on indoor air inhalation and transport to the bay. The groundwater in the B-aquifer (RU-C5 only) was evaluated as a source of drinking water, though it has low potential for use as drinking water. The B-aquifer in the central area of Parcel C has been granted a Resolution No. 88-63 exception by the Water Board and is not suitable for use as a drinking water supply. Use of the B-aquifer groundwater at HPS is controlled by the CCSF, and the SFPUC does not provide for use of groundwater in this area of the City, as described in Section 2.2.

Figure 8. Radiologically Impacted Areas



2.5 SUMMARY OF SITE RISKS

The source of potential contamination at Parcel C is attributed to industrial and radiological research activities by the Navy or other tenants, except for ubiquitous metals such as arsenic and manganese found at levels consistent with ambient concentrations in the local serpentine bedrock. Most of the contamination is from identified IR sites with associated spills and leaks. The primary fate and transport mechanisms include volatilization, wind suspension, migration of contaminants via infiltration and percolation into subsurface soil and groundwater, transport and discharge of metals in groundwater to the bay, and root uptake. A general conceptual site model (CSM) for Parcel C is shown on Figure 9. Based on the CSM, Parcel C was evaluated for potential risks to human health and the environment in the Revised FS Report and its radiological addendum. The risk assessment results can be applied by focusing on the redevelopment blocks in the parcel. Results of the HHRA are presented in Section 2.5.1.

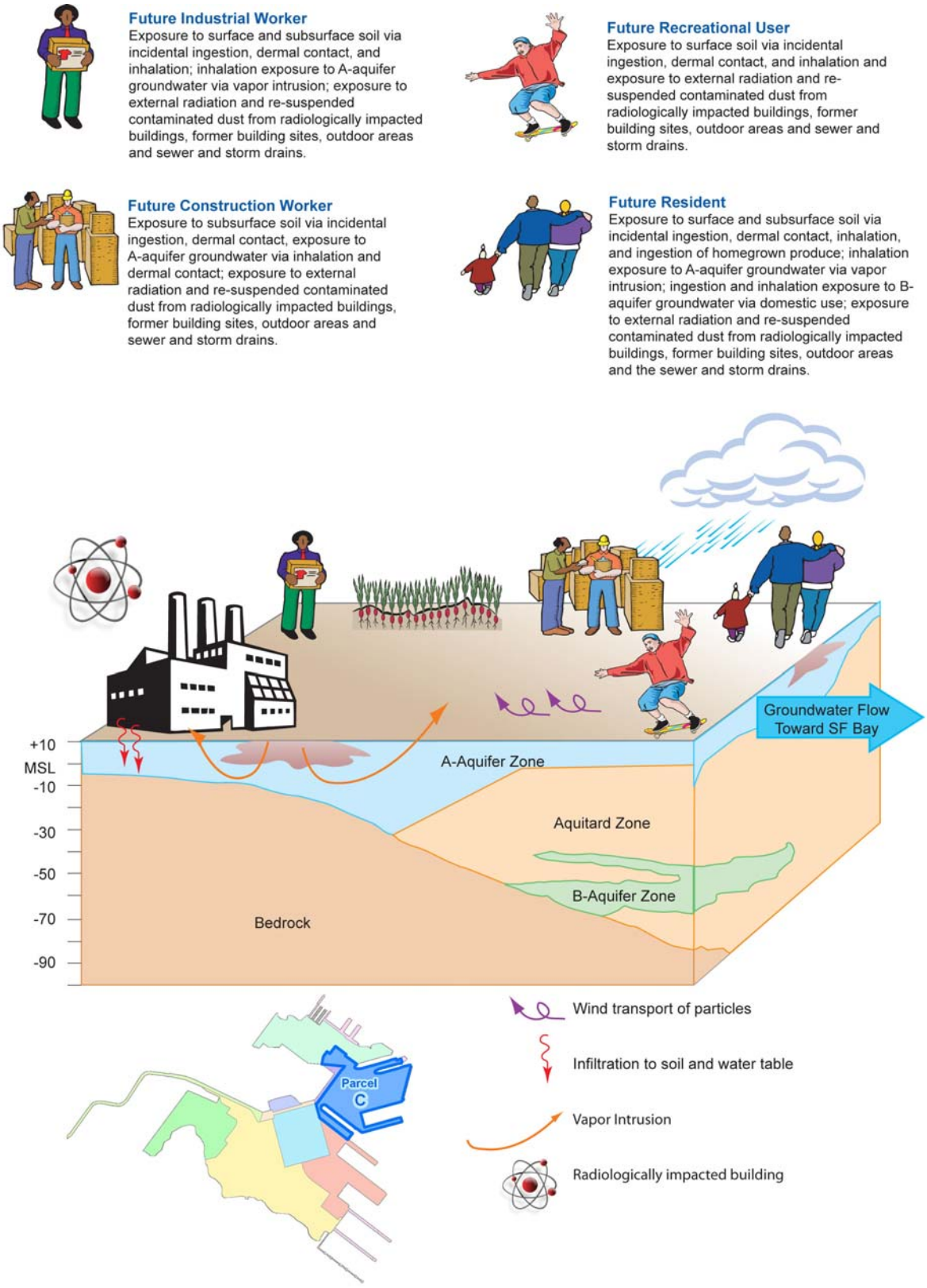
During the RI, the Navy concluded that limited viable habitat is available for terrestrial wildlife at Parcel C because most of the site is covered with pavement. Therefore, ecological risk associated with exposure to soil was not evaluated further. Furthermore, even if the future reuse of Parcel C were to change to open space/recreational, soil covers would protect terrestrial wildlife from risks posed by exposure to contaminants left below the cover. A screening evaluation of groundwater was conducted in the revised Final FS Report to evaluate potential risks to aquatic wildlife in San Francisco Bay. Results of that evaluation are summarized in Section 2.5.2.

2.5.1 Human Health Risk Assessment

Based on a **human health CSM(17)**, a quantitative **HHRA(18)** was completed for Parcel C and UC-2 for exposure to surface soil, subsurface soil, groundwater, and vapor intrusion from groundwater. Potential **cancer risks and noncancer hazards(19)** were calculated based on reasonable maximum exposure (RME) assumptions recommended by EPA and DTSC. These assumptions are based on a RME rather than an average or medium-range exposure assumption, and lead to conservative, protective estimates of the highest health risks reasonably expected at a site. Actual risks from exposures to chemicals in soil and groundwater at Parcel C are likely to be lower.

To help characterize cancer risk, the Navy adopted a conservative approach at Parcel C and evaluated action for risks greater than 10^{-6}. Acceptable exposure levels for known or suspected carcinogens are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual between 10^{-4} (a 1 in 10,000 chance of developing cancer) and 10^{-6} (a 1 in 1,000,000 chance of developing cancer) using information on the relationship between dose and response. The 10^{-6} risk level is used as the point of departure for establishing cleanup goals for alternatives when applicable or relevant and appropriate requirements (ARAR) are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure.

Figure 9. Conceptual Site Model



Both **total and incremental risks(20)** were evaluated for exposure to soil. All detected chemicals, including naturally occurring ubiquitous metals from the serpentine bedrock-derived fill material, were included as chemicals of potential concern for the total risk evaluation, regardless of their concentration. Only the essential nutrients calcium, magnesium, potassium, and sodium were not included as chemicals of potential concern. The total risk evaluation estimates the risks posed by chemicals at the site, including those present at concentrations at or below ambient levels. The essential nutrients were excluded as chemicals of potential concern in soil for the incremental risk evaluation, as well as the detected ubiquitous metals with maximum measured concentrations below the Hunters Point ambient levels (HPAL). The incremental risk evaluation estimates risks posed by metals present at the site that are above the estimated ambient levels.

Potential unacceptable risks include cancer risks and noncancer hazards for future receptors from exposure to soil or groundwater, as discussed below. Potential unacceptable risk is defined as an excess lifetime cancer risk of greater than 10^{-6} or a segregated hazard index (HI) greater than 1, as calculated by the incremental risk evaluation.

Based on the **revised HHRA results(21)** for soil, chemical cancer risks within Parcel C are greater than 10^{-6} at all redevelopment blocks except COS-1, which was evaluated for recreational risk (see Table 2). Noncancer HIs were less than 1 for redevelopment blocks CMI-1, evaluated for industrial risk, and COS-1, COS-2, and COS-3, evaluated for recreational risk. Eight of these redevelopment blocks (10, 11, 13, 18, 20A, 23, 24, and 26) with the higher chemical cancer risks and noncancer HIs were evaluated against the more stringent residential exposure scenario (see Table 2). Potential cancer risks from soil are based on inhalation of chlorinated VOCs and other VOCs and on ingestion or contact with arsenic, lead, PAHs and other SVOCs, and PCBs. Potential noncancer hazards from soil are based on ingestion of or contact with organic lead and manganese. The risk from indoor air inhalation via vapor intrusion from soil was not evaluated in the HHRA; however, action levels for soil gas that are protective of indoor air exposure from vapor intrusion of soil and groundwater will be established during the RD to address exposure to volatile chemicals in the subsurface at concentrations that would pose unacceptable risk.

The risk assessment for groundwater estimated cancer risks greater than 10^{-6} or noncancer HIs greater than 1 in distinct areas within 11 of the 15 Parcel C redevelopment blocks for which data were available (see Table 2). Potential risks from groundwater are based on breathing VOC and SVOC vapors in indoor air that may have migrated through the subsurface from groundwater in the A-aquifer. In addition, the HHRA results for groundwater show that the risk to the construction worker from exposure to the A-aquifer groundwater via dermal exposure and inhalation exceeds the cancer risk threshold of 10^{-6} in areas with elevated concentrations of the COCs. The COCs from this exposure pathway are chlorinated VOCs, PAHs, and other SVOCs. Groundwater in the B-aquifer (RU-C5 only) was evaluated for all chemicals of potential concern through the domestic use of groundwater pathway. The COCs from this exposure pathway are chlorinated VOCs and other SVOCs.

Table 2. Cancer Risks and Noncancer Hazards

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Redevelopment Block	Exposure Scenario	Cancer Risk		Noncancer Hazard Index[c]
		Chemical[a]	Radiological[b]	
Soil				
10	Residential	2×10^{-4}	5×10^{-5}	6
11	Residential	2×10^{-4}	5×10^{-5}	5
13	Residential	7×10^{-5}	5×10^{-5}	4
18	Residential	4×10^{-4}	5×10^{-5}	5
20A	Residential	5×10^{-5}	5×10^{-5}	10
20B	Industrial	6×10^{-4}	5×10^{-5}	3
	Residential[d]	*6×10^{-3}*	*5×10^{-5}*	*67*
22	Industrial	1×10^{-4}	5×10^{-5}	10
	Residential[d]	*3×10^{-3}*	*5×10^{-5}*	*180*
23	Residential	2×10^{-3}	5×10^{-5}	10,000
24	Residential	2×10^{-3}	5×10^{-5}	1,000
25	Industrial	4×10^{-5}	5×10^{-5}	< 1
	Residential[d]	*5×10^{-4}*	*5×10^{-5}*	*14*
26	Residential	3×10^{-4}	5×10^{-5}	20
CMI-1	Industrial	4×10^{-4}	5×10^{-5}	< 1
	Residential[d]	*3×10^{-3}*	*5×10^{-5}*	*37*
COS-1	Recreational	3×10^{-6}	5×10^{-5}	< 1
	Residential[d,e]	*9×10^{-7}*	*5×10^{-5}*	*< 1*
COS-2	Recreational	4×10^{-5}	5×10^{-5}	< 1
	Residential[d]	*7×10^{-4}*	*5×10^{-5}*	*66*
COS-3	Recreational	6×10^{-5}	5×10^{-5}	< 1
	Residential[d]	*5×10^{-4}*	*5×10^{-5}*	*15*
		Groundwater[f]		
A-Aquifer: Risk Based on Vapor Intrusion				
10	Residential	1×10^{-1}	--	337
11	Residential	1×10^{-1}	--	337
18	Residential	1×10^{-2}	--	46
20A	Residential	2×10^{-2}	--	130
20B	Industrial	1×10^{-2}	--	130
	Residential[g]	*2×10^{-2}*	--	*130*
22	Industrial	6×10^{-3}	--	6
	Residential[g]	*1×10^{-2}*	--	*10*
23	Residential	1×10^{-2}	--	46
24	Residential	2×10^{-2}	--	130
25	Industrial	6×10^{-3}	--	6
	Residential[g]	*1×10^{-2}*	--	*10*
26	Residential	1×10^{-2}	--	46
CMI-1	Industrial	7×10^{-3}	--	46
	Residential[g]	*1×10^{-2}*	--	*66*

Table 2. Cancer Risks and Noncancer Hazards (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Redevelopment Block	Exposure Scenario	Cancer Risk		Noncancer Hazard Index[c]
		Chemical[a]	Radiological[b]	
B-Aquifer (RU-C5 only): Risk Based on Domestic Use				
10	Residential	5×10^{-1}	--	3,000
11	Residential	5×10^{-1}	--	3,000

Notes:

a For soil, the chemical cancer risk shown is the maximum incremental cancer risk from soil depths evaluated in each redevelopment block (Tables 3-8 and 3-9 of the "Final Feasibility Study Report for Parcel C (SulTech 2008)"). These blocks and their associated reuses are based on the "Hunters Point Shipyard Redevelopment Plan." Reuse areas and development blocks may change in the future. For groundwater, the maximum total cancer risk is shown (Tables 3-14 and 3-16 of SulTech 2008).

b The radiological risk shown is the maximum incremental radiological risk estimated for the redevelopment block and is based on residential exposure to storm water or sanitary sewer systems (Table 3-6 of the "Final Radiological Addendum to the Revised Feasibility Study Report For Parcel C [Tetra Tech 2008]"). The radiological risk for residential exposure to storm water or sanitary sewer systems exceeds residential, building-specific radiological risks for Parcel C. Radiological risk from exposure to groundwater was not evaluated in the Final Radiological Addendum. Radionuclides of concern were not detected above remediation goals (Table 5) in groundwater samples collected at Parcel C in 2008 and 2009 as part of the supplemental groundwater monitoring program (CE2 Kleinfelder Joint Venture, 2009a, 2009b and 2010).

c For soil, the HI shown is the maximum incremental segregated hazard index (HI) from soil depths evaluated in each redevelopment block (Tables 3-8 and 3-9 of SulTech 2008). For groundwater, the maximum total segregated HI is shown (Tables 3-14 and 3-18 of SulTech 2008).

d Maximum residential cancer risk and noncancer HI results are provided for this nonresidential redevelopment block for comparison purposes (Tables C2-17 and C2-18 of SulTech 2008). It should be noted that the size of the area evaluated for the residential scenario differs from the size of the area evaluated for nonresidential scenarios. Specifically, residential cancer risks and noncancer HIs are based on a 2,500-square-foot exposure area (or "residential grid"), while nonresidential cancer risks and noncancer HIs are based on a 0.5-acre exposure area (or "industrial grid") (SulTech 2008).

e The use of different exposure area sizes for evaluating residential and nonresidential exposures (see footnote d) results in a recreational cancer risk for this redevelopment block that is higher than the cancer risk for the residential exposure scenario.

f Groundwater risks and HIs are based on redevelopment blocks and exposure areas (grids) associated with plumes.

g Residential cancer risk and noncancer HI results are provided for this nonresidential redevelopment block for comparison purposes. Risks and HIs were obtained from Tables C3-17, C3-22, C3-28, and C3-33 of SulTech (2008).

-- None

Sources:

CE2 Kleinfelder Joint Venture (CE2 Kleinfelder JV). 2009a. "Semi-Annual Groundwater Monitoring Report (April-September 2008), Hunters Point Shipyard, San Francisco, California." February.

CE2 Kleinfelder JV. 2009b. "Semi-Annual Groundwater Monitoring Report (October 2008-March 2009), Hunters Point Shipyard, San Francisco, California." July.

CE2 Kleinfelder JV. 2010. "Semi-Annual Groundwater Monitoring Report (April-September 2009), Hunters Point Shipyard, San Francisco, California." February.

SulTech. 2008. "Final Feasibility Study Report for Parcel C, Hunters Point Shipyard, San Francisco, California." July 31.

Tetra Tech EC, Inc. (Tetra Tech). 2008. "Final Radiological Addendum to the Revised Feasibility Study Report for Parcel C, Hunters Point Shipyard, San Francisco, California." June 20.

.

Additionally, **radiological risk**(22) was calculated based on estimated concentrations of contamination at radiologically impacted sites, using remediation goals for each radionuclide of concern. Actual calculated risk will be based on field measurements after final status survey results have been received for each impacted site.

Potential risks were primarily based on exposure to VOC and SVOC vapors, PAHs as well as other SVOCs, metals (arsenic, lead, organic lead, and manganese), and PCBs in soil; chlorinated VOCs, PAHs, and other SVOCs in groundwater; and radionuclides in structures (such as buildings) and soil. **Combined chemical and radiological risk**(23) was also summed to estimate the overall potential risk to human health associated with a site.

The HHRA specifies the **assumptions and uncertainties**(24) inherent in the risk assessment process based on the number of samples collected or their location(s), the literature-based exposure and toxicity values used to calculate risk, and the risk characterization across multiple media and exposure pathways. The effects of uncertainties are overestimation or underestimation of the actual cancer risk or HI. In general, the risk assessment process is based on the use of conservative (health-protective) assumptions that, when combined, are intended to overestimate the actual risk.

2.5.2 Ecological Risk Assessment

As previously stated, the Navy concluded during the RI that limited viable habitat is available for terrestrial wildlife at former Parcel C because most of the site is covered with pavement. Specifically, the RI concluded that "Parcels C and D are almost entirely paved except for small pockets of vegetation which are not considered suitable habitat for animal life." Most of the terrestrial component of the shoreline at Parcel C is paved. The tidal area associated with the shoreline is considered part of Parcel F rather than Parcel C. Therefore, ecological risk associated with exposure to soil was not evaluated further in the Revised FS Report.

The Navy completed a screening evaluation of **surface water quality**(25) to assess potential exposure by aquatic wildlife to groundwater as it interacts with the surface water of San Francisco Bay. Results of the screening evaluation indicated two metals (**chromium VI and zinc**(26)) in groundwater may pose a potential risk to aquatic wildlife. However, groundwater monitoring data indicate metals migrate at a much slower rate than groundwater flows; thus, discharge of metals to the bay is not imminent.

Chemicals present in both the A-aquifer and the B-aquifer groundwater at Parcel C were evaluated to assess potential **environmental impacts to the bay**(27). This evaluation was completed as part of the derivation of **trigger levels**(28) for chemicals that present a potential impact to the bay. Based on the evaluation results, chromium VI and zinc in the A-aquifer were identified as COCs that originated in Parcel C. No chemicals were identified as COCs in the B-aquifer or in the bedrock water-bearing zone at Parcel C.

Chromium VI(29) was identified as a COC because it was detected at two locations (Dry Dock 2 and Building 253) at levels that were slightly higher than the trigger levels (50 micrograms per liter [µg/L] and 150 µg/L). The trigger levels are conservative, and exceedance of a trigger level does

not necessarily indicate an immediate risk, but a potential ecological risk if the plume migrates toward the bay. Monitoring of affected areas is necessary to determine whether the plume is migrating and if it will discharge to the bay at concentrations that exceed surface water criteria. **Zinc(30)** was identified as a COC because it had been historically detected at concentrations above surface water criteria in three RU-C1 wells.

2.5.3 Basis for Response Action

The response action selected in this ROD is necessary to protect the public health, welfare, or the environment from actual or potential releases of hazardous substances into the environment. The Navy, in partnership with EPA, DTSC, and the Water Board, considered all pertinent factors in accordance with CERCLA and NCP remedy selection criteria, and concluded that remedial action is necessary to clean up **soil(31)**, **groundwater(32)**, and **radiologically impacted structures and soil(33)** at Parcel C. This determination was made because:

- Based on the HHRA results for soil, excess chemical cancer risk exceeds 10^{-6} at all of the Parcel C redevelopment blocks (see Table 2). The majority of these blocks are evaluated against the more stringent residential exposure scenario.
- Excess radiological risks for soil, building structures, and sanitary and storm sewers are greater than 10^{-6} across Parcel C.
- The soil noncancer HI exceeded 1 for redevelopment blocks 10, 11, 13, 18, 20A, 20B, 22, 23, 24, and 26. Except for 20B and 22, these redevelopment blocks were evaluated against the more stringent residential exposure scenario.
- Numeric action levels for VOCs in soil gas were not established in the ROD, but rather will be set using COC identification information from soil gas surveys conducted in the future (based on an excess cumulative cancer risk of 10^{-6}).
- The risk assessment for groundwater estimated excess cancer risks greater than 10^{-6} or noncancer hazards greater than 1 in distinct areas within 11 of the 15 redevelopment blocks within Parcel C.
- Potential risks from groundwater are based on breathing VOC and SVOC vapors in indoor air that may have migrated through the subsurface from groundwater in the A-aquifer.
- HHRA results for groundwater show that the risk from exposure to the A-aquifer groundwater via dermal exposure and inhalation to the construction workers exceeds the excess cancer risk threshold of 10^{-6} in areas with elevated concentrations of the COCs.
- The ecological risk assessment determined that chromium VI and zinc in the A-aquifer groundwater may pose a potential risk to aquatic wildlife and should be monitored.

The concentrations of COCs for soil and groundwater that would require a response action are summarized in Table 3 and Table 4, respectively.

Table 3. Chemicals of Concern in Soil Requiring Response Action and Remediation Goals
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Exposure Scenario	Chemical	Unit	Number of Analyses	Number of Detections	Detections[1]	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Average Detected Concentration[1]	Detections Greater than Remediation Goal[1]	Remediation Goal[2]	Basis[2]
Residential	1,2-Dichloroethane	mg/kg	1,283	20	1.6%	0.002	12	1.27	15.0%	0.28	RBC
	1,4-Dichlorobenzene	mg/kg	1,124	48	4.3%	0.00309	94	6.37	31.3%	2	RBC
	2-Methylnaphthalene	mg/kg	1,827	337	18.5%	0.008	280	1.96	0.3%	150	RBC
	3,3'-Dichlorobenzidine	mg/kg	655	1	0.2%	0.036	0.036	0.036	0.0%	1.6	PQL
	Antimony	mg/kg	701	354	50.5%	0.23	30.1	4.68	10.5%	10	RBC
	Aroclor-1254	mg/kg	1,408	22	1.6%	0.023	0.87	0.19	50.0%	0.093	RBC
	Aroclor-1260	mg/kg	1,545	291	18.8%	0.006	270	4.18	30.2%	0.21	RBC
	Arsenic	mg/kg	1,821	1,289	70.8%	0.178	245	8.43	16.3%	11.1	HPAL
	Benzene	mg/kg	1,428	222	15.6%	0.00049	9.1	0.96	31.5%	0.18	RBC
	Benzo(a)anthracene	mg/kg	2,153	600	27.9%	0.008	32	0.55	17.7%	0.37	RBC
	Benzo(a)pyrene	mg/kg	2,144	548	25.6%	0.008	27	0.54	21.4%	0.33	PQL
	Benzo(b)fluoranthene	mg/kg	2,153	670	31.1%	0.008	27	0.48	16.4%	0.34	RBC
	Benzo(k)fluoranthene	mg/kg	2,114	385	18.2%	0.008	6.5	0.32	19.5%	0.34	RBC
	bis(2-Ethylhexyl)phthalate	mg/kg	669	20	3.0%	0.08	3.2	0.54	15.0%	1.1	RBC
	Cadmium	mg/kg	1,166	413	35.4%	0.04	31.5	1.63	10.9%	3.5	RBC
	Chrysene	mg/kg	2,154	746	34.6%	0.009	44	0.56	2.8%	3.3	RBC
	Copper	mg/kg	1,749	1,730	98.9%	0.93	7,600	112	12.8%	160	RBC
	Dibenz(a,h)anthracene	mg/kg	2,095	146	7.0%	0.009	3.9	0.21	11.6%	0.33	PQL
	Dieldrin	mg/kg	630	7	1.1%	0.002	0.045	0.009	14.3%	0.003	PQL
	gamma-BHC (Lindane)	mg/kg	629	2	0.3%	0.005	0.0089	0.007	100.0%	0.0026	RBC
	Heptachlor epoxide	mg/kg	618	8	1.3%	0.0007	0.03	0.006	50.0%	0.002	PQL
	Hexachlorobenzene	mg/kg	659	1	0.2%	0.082	0.082	0.082	0.0%	0.33	PQL
	Indeno(1,2,3-cd)pyrene	mg/kg	2,133	370	17.4%	0.008	14	0.35	14.1%	0.35	RBC
	Iron	mg/kg	706	706	100.0%	121	125,000	35,120	4.1%	58,000	HPAL
	Lead	mg/kg	1,468	1,249	85.1%	0.15	2,610	53	7.3%	155	RBC
	Manganese	mg/kg	1,865	1,865	100.0%	2.1	55,300	2,234	33.6%	1,431	HPAL
	Mercury	mg/kg	922	586	63.6%	0.025	124	1.99	9.7%	2.28	HPAL
	Naphthalene	mg/kg	2,279	384	16.9%	0.00278	110	0.98	5.5%	1.7	RBC
	Nickel	mg/kg	745	743	99.7%	3.1	5,080	599	0.5%	2,650	HPAL
	n-Nitroso-di-n-propylamine	mg/kg	671	1	0.2%	0.11	0.11	0.11	0.0%	0.33	PQL
	Organic Lead	mg/kg	312	25	8.0%	0.31	62	4.61	84.0%	0.5	PQL
	Tetrachloroethene	mg/kg	1,300	172	13.2%	0.0008	139	2.07	7.6%	0.48	RBC
	Thallium	mg/kg	1,148	153	13.3%	0.3	60.9	4.63	24.8%	5	RBC
	Trichloroethene	mg/kg	1,284	287	22.4%	0.001	120	2.11	8.7%	2.9	RBC
	Vanadium	mg/kg	739	738	99.9%	0.63	636	62	6.1%	117	HPAL
	Vinyl chloride	mg/kg	1,285	26	2.0%	0.002	1.5	0.11	42.3%	0.024	RBC
	Zinc	mg/kg	1,347	1,323	98.2%	8.8	36,000	161	5.8%	370	RBC

Table 3. Chemicals of Concern in Soil Requiring Response Action and Remediation Goals (Continued)
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Exposure Scenario	Chemical	Unit	Number of Analyses	Number of Detections	Detections[1]	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Average Detected Concentration[1]	Detections Greater than Remediation Goal[1]	Remediation Goal[2]	Basis[2]
Industrial	1,4-Dichlorobenzene	mg/kg	1,124	48	4.3%	0.00309	94	6.37	20.8%	4.5	RBC
	Aroclor-1260	mg/kg	1,545	291	18.8%	0.006	270	4.18	12.4%	1	RBC
	Arsenic	mg/kg	1,821	1,289	70.8%	0.178	245	8.43	16.3%	11.1	HPAL
	Benzene	mg/kg	1,428	222	15.6%	0.00049	9.1	0.96	27.9%	0.39	RBC
	Benzo(a)anthracene	mg/kg	2,153	600	27.9%	0.008	32	0.55	4.2%	1.8	RBC
	Benzo(a)pyrene	mg/kg	2,144	548	25.6%	0.008	27	0.54	21.4%	0.33	PQL
	Benzo(b)fluoranthene	mg/kg	2,153	670	31.1%	0.008	27	0.48	3.9%	1.8	RBC
	Benzo(k)fluoranthene	mg/kg	2,114	385	18.2%	0.008	6.5	0.32	3.6%	1.8	RBC
	Chrysene	mg/kg	2,154	746	34.6%	0.009	44	0.56	0.4%	18	RBC
	Dibenz(a,h)anthracene	mg/kg	2,095	146	7.0%	0.009	3.9	0.21	11.6%	0.33	PQL
	Indeno(1,2,3-cd)pyrene	mg/kg	2,133	370	17.4%	0.008	14	0.35	4.6%	1.8	RBC
	Lead	mg/kg	1,468	1,249	85.1%	0.15	2,610	53	1.2%	800	RBC
	Organic Lead	mg/kg	312	25	8.0%	0.31	62	4.61	84.0%	0.5	PQL
	Tetrachloroethene	mg/kg	1,300	172	13.2%	0.0008	139	2.07	4.1%	1.5	RBC
	Trichloroethene	mg/kg	1,284	287	22.4%	0.001	120	2.11	5.9%	6.6	RBC
	Vinyl chloride	mg/kg	1,285	26	2.0%	0.002	1.5	0.11	23.1%	0.055	RBC
Recreational	Arsenic	mg/kg	1,821	1,289	70.8%	0.178	245	8.43	16.3%	11.1	HPAL
	Benzo(a)pyrene	mg/kg	2,144	548	25.6%	0.008	27	0.54	21.4%	0.33	PQL
	Lead	mg/kg	1,468	1,249	85.1%	0.15	2,610	53	7.3%	155	RBC
Construction	Aroclor-1260	mg/kg	1,545	291	18.8%	0.006	270	4.18	NA	2.1	RBC
	Arsenic	mg/kg	1,821	1,289	70.8%	0.178	245	8.43	NA	11.1	HPAL
	Benzo(a)anthracene	mg/kg	2,153	600	27.9%	0.008	32	0.55	NA	6.5	RBC
	Benzo(a)pyrene	mg/kg	2,144	548	25.6%	0.008	27	0.54	NA	0.65	RBC
	Benzo(b)fluoranthene	mg/kg	2,153	670	31.1%	0.008	27	0.48	NA	6.5	RBC
	Benzo(k)fluoranthene	mg/kg	2,114	385	18.2%	0.008	6.5	0.32	NA	6.5	RBC
	Dibenz(a,h)anthracene	mg/kg	2,095	146	7.0%	0.009	3.9	0.21	NA	1.1	RBC
	Indeno(1,2,3-cd)pyrene	mg/kg	2,133	370	17.4%	0.008	14	0.35	NA	6.5	RBC
	Lead	mg/kg	1,468	1,249	85.1%	0.15	2,610	53	NA	800	RBC
	Manganese	mg/kg	1,865	1,865	100.0%	2.1	55,300	2,234	NA	6,900	RBC
	Organic Lead	mg/kg	312	25	8.0%	0.31	62	4.61	NA	0.5	PQL
	Thallium	mg/kg	1,148	153	13.3%	0.3	60.9	4.63	NA	20	RBC

Notes:

This table includes soil analytical data obtained at Parcel C from 0 to 10 feet bgs. Samples that have been excavated or otherwise removed were excluded from this data set.

Exposures in the residential, industrial, and construction worker scenarios consider exposure to soil from 0 to 10 feet below ground surface (bgs). The recreational exposure scenario considers exposure to soil from 0 to 2 feet bgs.

Remediation goals for volatile organic compounds to address exposure via indoor inhalation of vapors may be superseded based on chemicals of concern identification information from future soil gas surveys. These future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative excess cancer risk level of 10^{-6} using the accepted methodology for risk assessments at the Hunters Point Shipyard (HPS).

1 SulTech. 2008. "Final Feasibility Study Report for Parcel C, Hunters Point Shipyard, San Francisco, California." July 31. Table 2-10.

2 SulTech. 2008. "Final Feasibility Study Report for Parcel C, Hunters Point Shipyard, San Francisco, California." July 31. Table 4-1.

BHC Benzene hexachloride
HPAL Hunters Point ambient level
mg/kg Milligrams per kilogram
NA Not available
ND Not detected
PQL Practical quantitation limit
RBC Risk-based concentration

Table 4. Chemicals of Concern in Groundwater Requiring Response Action and Remediation Goals
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Exposure Scenario	Chemical	Unit	Number of Analyses	Number of Detections	Detections[1]	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Average Detected Concentration[1]	Detections Greater than Remediation Goal[1]	Remediation Goal[2]	Basis[2]
A-Aquifer											
Residential – Vapor Intrusion	1,1,2,2-Tetrachloroethane	µg/L	1,067	2	0.2%	6	120	63	100.0%	3	RBC
	1,1,2-Trichloroethane	µg/L	1,067	34	3.2%	0.2	170	24	41.2%	4	RBC
	1,1-Dichloroethane	µg/L	1,067	59	5.5%	0.17	38	5	17.0%	6.5	RBC
	1,2,3-Trichloropropane	µg/L	382	2	0.5%	1.5	16	9	100.0%	0.5	PQL
	1,2,4-Trimethylbenzene	µg/L	207	29	14.0%	0.2	220	45	37.9%	25	RBC
	1,2-Dichlorobenzene	µg/L	1,065	206	19.3%	0.09	62,000	3,577	20.4%	2,600	RBC
	1,2-Dichloroethane	µg/L	1,083	125	11.5%	0.17	150,000	8,263	79.2%	2.3	RBC
	1,2-Dichloroethene (Total)	µg/L	287	89	31.0%	0.3	57,000	2,304	25.8%	210	RBC
	1,2-Dichloropropane	µg/L	1,067	38	3.6%	0.2	350	53	63.2%	1.1	RBC
	1,3,5-Trimethylbenzene	µg/L	207	10	4.8%	0.79	28	9	20.0%	19	RBC
	1,4-Dichlorobenzene	µg/L	1,064	175	16.5%	0.12	15,000	983	72.6%	2.1	RBC
	Benzene	µg/L	1,076	223	20.7%	0.1	400	18	79.8%	0.5	PQL
	Bromodichloromethane	µg/L	1,067	11	1.0%	0.15	130	18	45.5%	1	RBC
	Carbon Tetrachloride	µg/L	1,083	95	8.8%	0.15	520	41	89.5%	0.5	PQL
	Chlorobenzene	µg/L	1,067	118	11.1%	0.13	9,900	456	21.2%	390	RBC
	Chloroethane	µg/L	1,066	44	4.1%	0.52	81	13	36.4%	6.5	RBC
	Chloroform	µg/L	1,083	246	22.7%	0.09	1,000	49	80.5%	0.7	RBC
	cis-1,2-Dichloroethene	µg/L	796	443	55.7%	0.12	58,000	1,342	26.0%	210	RBC
	cis-1,3-Dichloropropene	µg/L	1,067	2	0.2%	0.54	4	2	100.0%	0.5	PQL
	Dibromochloromethane	µg/L	1,067	5	0.5%	0.2	3	1	20.0%	2.6	RBC
	Isopropylbenzene	µg/L	393	34	8.7%	0.11	15	2	8.8%	7.8	RBC
	Methylene Chloride	µg/L	1,067	33	3.1%	0.3	270	40	33.3%	27	RBC
	Naphthalene	µg/L	603	103	17.1%	0.06	1,800	110	83.5%	3.6	RBC
	Tetrachloroethene	µg/L	1,083	334	30.8%	0.1	72,000	2,031	78.4%	0.54	RBC
	trans-1,2-Dichloroethene	µg/L	796	215	27.0%	0.14	2,400	60	6.5%	180	RBC
	trans-1,3-Dichloropropene	µg/L	1,067	1	0.1%	3	3	3	100.0%	0.5	PQL
	Trichloroethene	µg/L	1,082	578	53.4%	0.12	76,000	1,950	75.6%	2.9	RBC
	Trichlorofluoromethane	µg/L	628	82	13.1%	0.24	5,900	122	9.8%	180	RBC
	Vinyl Chloride	µg/L	1,083	318	29.4%	0.28	6,600	286	94.3%	0.5	PQL

Table 4. Chemicals of Concern in Groundwater Requiring Response Action and Remediation Goals (Continued)
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Exposure Scenario	Chemical	Unit	Number of Analyses	Number of Detections	Detections[1]	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Average Detected Concentration[1]	Detections Greater than Remediation Goal[1]	Remediation Goal[2]	Basis[2]
Industrial – Vapor Intrusion	1,1,2,2-Tetrachloroethane	µg/L	1,067	2	0.2%	6	120	63	100.0%	5.1	RBC
	1,1,2-Trichloroethane	µg/L	1,067	34	3.2%	0.2	170	24	41.2%	6.7	RBC
	1,1-Dichloroethane	µg/L	1,067	59	5.5%	0.17	38	5	13.6%	11	RBC
	1,2,3-Trichloropropane	µg/L	382	2	0.5%	1.5	16	9	100.0%	0.5	PQL
	1,2,4-Trimethylbenzene	µg/L	207	29	14.0%	0.2	220	45	37.9%	25	RBC
	1,2-Dichloroethane	µg/L	1,083	125	11.5%	0.17	150,000	8,263	73.6%	3.9	RBC
	1,2-Dichloroethene (Total)	µg/L	287	89	31.0%	0.3	57,000	2,304	25.8%	210	RBC
	1,2-Dichloropropane	µg/L	1,067	38	3.6%	0.2	350	53	57.9%	1.8	RBC
	1,3,5-Trimethylbenzene	µg/L	207	10	4.8%	0.79	28	9	20.0%	19	RBC
	1,4-Dichlorobenzene	µg/L	1,064	175	16.5%	0.12	15,000	983	68.0%	3.6	RBC
	Benzene	µg/L	1,076	223	20.7%	0.1	400	18	77.1%	0.63	RBC
	Bromodichloromethane	µg/L	1,067	11	1.0%	0.15	130	18	45.5%	1.7	RBC
	Carbon Tetrachloride	µg/L	1,083	95	8.8%	0.15	520	41	89.5%	0.5	PQL
	Chlorobenzene	µg/L	1,067	118	11.1%	0.13	9,900	456	21.2%	390	RBC
	Chloroform	µg/L	1,083	246	22.7%	0.09	1,000	49	67.9%	1.2	RBC
	cis-1,2-Dichloroethene	µg/L	796	443	55.7%	0.12	58,000	1,342	26.0%	210	RBC
	cis-1,3-Dichloropropene	µg/L	1,067	2	0.2%	0.54	4	2	100.0%	0.5	PQL
	Isopropylbenzene	µg/L	393	34	8.7%	0.11	15	2	8.8%	7.8	RBC
	Methylene Chloride	µg/L	1,067	33	3.1%	0.3	270	40	18.2%	46	RBC
	Naphthalene	µg/L	603	103	17.1%	0.06	1,800	110	75.7%	6	RBC
	Tetrachloroethene	µg/L	1,083	334	30.8%	0.1	72,000	2,031	70.4%	0.9	RBC
	trans-1,3-Dichloropropene	µg/L	1,067	1	0.1%	3	3	3	100.0%	0.5	PQL
	Trichloroethene	µg/L	1,082	578	53.4%	0.12	76,000	1,950	66.1%	4.8	RBC
	Trichlorofluoromethane	µg/L	628	82	13.1%	0.24	5,900	122	9.8%	180	RBC
	Vinyl Chloride	µg/L	1,083	318	29.4%	0.28	6,600	286	94.3%	0.5	PQL

Table 4. Chemicals of Concern in Groundwater Requiring Response Action and Remediation Goals (Continued)
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Exposure Scenario	Chemical	Unit	Number of Analyses	Number of Detections	Detections[1]	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Average Detected Concentration[1]	Detections Greater than Remediation Goal[1]	Remediation Goal[2]	Basis[2]
Construction Worker	1,1,2-Trichloroethane	µg/L	1,067	34	3.2%	0.2	170	24	NA	40	RBC
	1,2,3-Trichloropropane	µg/L	382	2	0.5%	1.5	16	9	NA	0.6	RBC
	1,2,4-Trichlorobenzene	µg/L	1,051	56	5.3%	0.32	200	18	NA	41	RBC
	1,2,4-Trimethylbenzene	µg/L	207	29	14.0%	0.2	220	45	NA	53	RBC
	1,2-Dichlorobenzene	µg/L	1,065	206	19.3%	0.09	62,000	3,577	NA	1700	RBC
	1,2-Dichloroethane	µg/L	1,083	125	11.5%	0.17	150,000	8,263	NA	22	RBC
	1,2-Dichloroethene (Total)	µg/L	287	89	31.0%	0.3	57,000	2,304	NA	270	RBC
	1,2-Dichloropropane	µg/L	1,067	38	3.6%	0.2	350	53	NA	30	RBC
	1,4-Dichlorobenzene	µg/L	1,064	175	16.5%	0.12	15,000	983	NA	52	RBC
	Benzene	µg/L	1,076	223	20.7%	0.1	400	18	NA	16	RBC
	Bromodichloromethane	µg/L	1,067	11	1.0%	0.15	130	18	NA	19	RBC
	Carbon Tetrachloride	µg/L	1,083	95	8.8%	0.15	520	41	NA	15	RBC
	Chlorobenzene	µg/L	1,067	118	11.1%	0.13	9,900	456	NA	450	RBC
	Chloroform	µg/L	1,083	246	22.7%	0.09	1,000	49	NA	26	RBC
	cis-1,2-Dichloroethene	µg/L	796	443	55.7%	0.12	58,000	1,342	NA	270	RBC
	Naphthalene	µg/L	603	103	17.1%	0.06	1,800	110	NA	16	RBC
	Tetrachloroethene	µg/L	1,083	334	30.8%	0.1	72,000	2,031	NA	18	RBC
	Trichloroethene	µg/L	1,082	578	53.4%	0.12	76,000	1,950	NA	290	RBC
	Vinyl Chloride	µg/L	1,083	318	29.4%	0.28	6,600	286	NA	5.4	RBC
	2,4-Dimethylphenol	µg/L	393	25	6.4%	0.6	16,000	1,225	NA	9800	RBC
	2,4-Dinitrotoluene	µg/L	403	1	0.3%	4900	4,900	4,900	NA	180	RBC
	3,4-Dimethylphenol	µg/L	13	2	15.4%	380	3,200	1,790	NA	700	RBC
	4-Methylphenol	µg/L	380	15	4.0%	0.7	9,100	703	NA	3500	RBC
	Benzo(a)anthracene	µg/L	417	10	2.4%	0.01	10	2	NA	0.67	RBC
	Benzo(a)pyrene	µg/L	415	3	0.7%	0.21	3	2	NA	0.05	RBC
	Benzo(b)fluoranthene	µg/L	415	3	0.7%	0.055	4	2	NA	0.45	RBC
	Benzo(k)fluoranthene	µg/L	415	2	0.5%	1	1	1	NA	0.45	RBC
	Chrysene	µg/L	418	7	1.7%	0.02	200	31	NA	6.7	RBC
	Pentachlorophenol	µg/L	393	4	1.0%	0.3	6,100	1,526	25.0%	50	PQL
Protection of the Environment	Chromium VI	µg/L	266	26	9.8%	5	260	86	65.4%	50	SWC
	Zinc	µg/L	337	97	28.8%	3	1,300	56	13.4%	81	SWC

Table 4. Chemicals of Concern in Groundwater Requiring Response Action and Remediation Goals (Continued)
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Exposure Scenario	Chemical	Unit	Number of Analyses	Number of Detections	Detections[1]	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Average Detected Concentration[1]	Detections Greater than Remediation Goal[1]	Remediation Goal[2]	Basis[2]
B-Aquifer (RU-C5 plume only)											
Residential – Domestic Use	Chromium VI	µg/L	10	0	0.0%	ND	ND	ND	0.0%	109	MCL
	Antimony	µg/L	12	2	16.7%	3.4	5.3	4.4	0.0%	6	MCL
	Arsenic	µg/L	12	2	16.7%	1.9	2.8	2.4	0.0%	10	MCL
	Iron	µg/L	21	5	23.8%	10.1	429	130.6	0.0%	10,950	RBC
	Manganese	µg/L	12	12	100.0%	30	1,480	823.2	0.0%	8,140	HGAL
	Thallium	µg/L	12	1	8.3%	3	3	3.0	NA	2	MCL
	1,1-Dichloroethane	µg/L	77	0	0.0%	ND	ND	ND	0.0%	5	MCL
	1,2,4-Trichlorobenzene	µg/L	77	3	3.9%	0.35	0.94	0.6	0.0%	70	MCL
	1,2,4-Trimethylbenzene	µg/L	14	7	50.0%	8	48	31.0	NA	12	RBC
	1,2-Dichlorobenzene	µg/L	77	12	15.6%	0.17	100	50.0	0.0%	600	MCL
	1,2-Dichloroethane	µg/L	77	0	0.0%	ND	ND	ND	0.0%	0.5	MCL
	1,2-Dichloroethene (Total)	µg/L	9	0	0.0%	ND	ND	ND	0.0%	6	MCL
	1,2-Dichloropropane	µg/L	77	0	0.0%	ND	ND	ND	0.0%	5	MCL
	1,3,5-Trimethylbenzene	µg/L	14	3	21.4%	1.8	3.7	2.5	0.0%	12	RBC
	1,3-Dichlorobenzene	µg/L	77	12	15.6%	0.2	84	29.9	0.0%	183	MCL
	1,4-Dichlorobenzene	µg/L	77	13	16.9%	0.37	180	62.3	NA	5	MCL
	Benzene	µg/L	77	4	5.2%	0.24	9	4.6	NA	1	MCL
	Bromodichloromethane	µg/L	77	0	0.0%	ND	ND	ND	0.0%	80	MCL
	Chlorobenzene	µg/L	77	11	14.3%	0.1	1,000	365.2	NA	70	MCL
	Chloroethane	µg/L	77	0	0.0%	ND	ND	ND	0.0%	4.6	MCL
	Chloroform	µg/L	77	17	22.1%	0.17	7.3	1.9	0.0%	80	MCL
	cis-1,2-Dichloroethene	µg/L	68	17	25.0%	0.15	870	217.0	NA	6	MCL
	Methylene Chloride	µg/L	77	2	2.6%	0.66	21	10.8	NA	5	MCL
	Naphthalene	µg/L	29	7	24.1%	2.6	42	21.9	NA	0.093	RBC
	Tetrachloroethene	µg/L	77	12	15.6%	1.7	55	12.2	NA	5	MCL
	trans-1,2-Dichloroethene	µg/L	68	2	2.9%	0.52	0.83	0.7	0.0%	10	MCL
	Trichloroethene	µg/L	77	23	29.9%	0.2	28	6.1	NA	5	MCL
	Trichlorofluoromethane	µg/L	58	10	17.2%	0.14	16	5.1	0.0%	1,288	RBC
	Vinyl Chloride	µg/L	77	13	16.9%	0.29	84	33.6	NA	0.5	MCL

Table 4. Chemicals of Concern in Groundwater Requiring Response Action and Remediation Goals (Continued)
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Exposure Scenario	Chemical	Unit	Number of Analyses	Number of Detections	Detections[1]	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Average Detected Concentration[1]	Detections Greater than Remediation Goal[1]	Remediation Goal[2]	Basis[2]
Residential – Domestic Use	2,4-Dimethylphenol	µg/L	15	0	0.0%	ND	ND	ND	0.0%	730	MCL
	2,4-Dinitrotoluene	µg/L	15	0	0.0%	ND	ND	ND	0.0%	10	MCL
	2-Methylnaphthalene	µg/L	15	0	0.0%	ND	ND	ND	0.0%	24	MCL
	2-Methylphenol	µg/L	15	0	0.0%	ND	ND	ND	0.0%	1,825	MCL
	4-Methylphenol	µg/L	15	0	0.0%	ND	ND	ND	0.0%	182	MCL
	Benzo(a)anthracene	µg/L	15	0	0.0%	ND	ND	ND	0.0%	0.2	MCL
	Benzo(a)pyrene	µg/L	15	0	0.0%	ND	ND	ND	0.0%	0.2	MCL
	Bis(2-ethylhexyl)phthalate	µg/L	15	0	0.0%	ND	ND	ND	0.0%	4	MCL
	Carbazole	µg/L	9	0	0.0%	ND	ND	ND	0.0%	10	MCL
	Chrysene	µg/L	15	0	0.0%	ND	ND	ND	0.0%	0.2	MCL
	Dibenzofuran	µg/L	15	0	0.0%	ND	ND	ND	0.0%	12	MCL
	Hexachloroethane	µg/L	15	0	0.0%	ND	ND	ND	0.0%	1.7	MCL
	Pentachlorophenol	µg/L	15	0	0.0%	ND	ND	ND	0.0%	1	MCL
	Aldrin	µg/L	9	0	0.0%	ND	ND	ND	0.0%	0.05	MCL
	alpha-BHC	µg/L	9	0	0.0%	ND	ND	ND	0.0%	1	MCL
	Dieldrin	µg/L	9	0	0.0%	ND	ND	ND	0.0%	0.02	MCL
	Heptachlor Epoxide	µg/L	9	0	0.0%	ND	ND	ND	0.0%	0.01	MCL

Notes:

Protection of the environment prevents or minimizes discharge that would be above the specified remediation goals; specific trigger levels are developed for each plume.

Groundwater remediation goals for chromium VI and zinc are at the point of discharge to the bay.

Remediation goals for volatile organic compounds to address exposure via indoor inhalation of vapors may be superseded based on chemicals of concern identification information from future soil gas surveys. These future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative excess cancer risk level of 10^{-6} using the accepted methodology for risk assessments at the Hunters Point Shipyard (HPS).

1 SulTech. 2008. "Final Feasibility Study Report for Parcel C, Hunters Point Shipyard, San Francisco, California." July 31. Table 2-14 (A-aquifer) and Table 2-15 (B-aquifer).

2 SulTech. 2008. "Final Feasibility Study Report for Parcel C, Hunters Point Shipyard, San Francisco, California." July 31. Table 4-5.

µg/L Micrograms per liter
BHC Benzene hexachloride
HGAL Hunters Point groundwater ambient level
MCL Maximum contaminant level
NA Not available
ND Not detected
PQL Practical quantitation limit
RBC Risk based concentration
SWC Surface water criterion

Radionuclides of concern(34) were identified by redevelopment block and by specific buildings within each block. Radiologically impacted buildings are present within Block 18 (Building 241), Block 20B (Building 214), Block 22 (Building 205 and discharge channel), Block 23 (Building 203), Block 24 (Buildings 271 and 272), Block 25 (Buildings 211, 224, and 253), and Block COS-3 (Building 211); as well, radiologically impacted sanitary sewers and storm drains are present in every redevelopment block. Radionuclides of concern in the buildings include cesium-137, cobalt-60, plutonium-239, radium-226, strontium-90, thorium-232, potassium-40, and naturally occurring radioactive materials found in firebrick (primarily thorium-232). Radionuclides of concern in the sanitary sewers and storm drains are cesium-137, radium-226, and strontium-90.

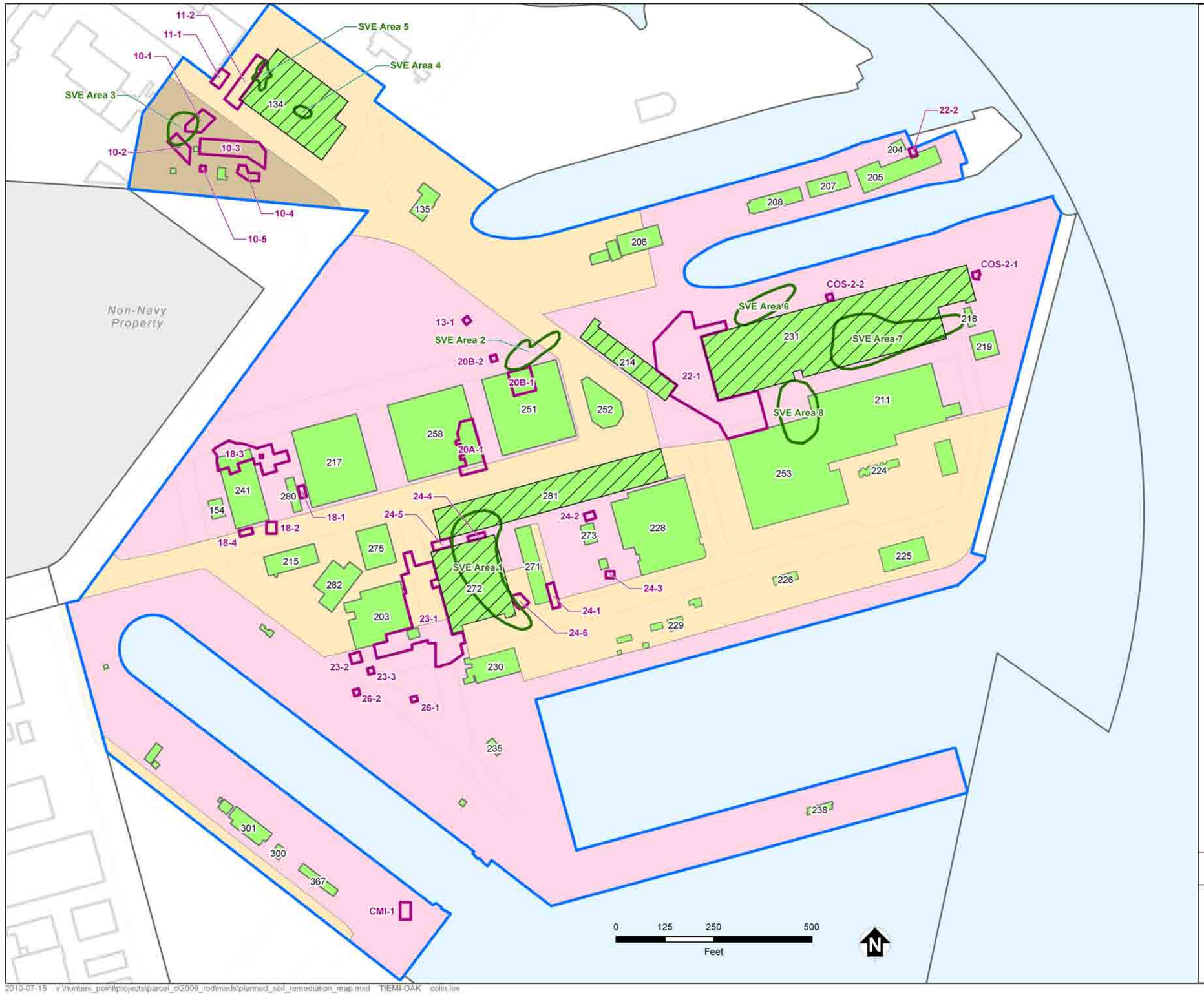
Figures 10 and 11 show the areas where remedial actions for soil and groundwater will occur. The footprints of the planned soil excavations adjacent north of Building 272 (Excavation 24-4) and within Building 258 (Excavation 20A-1) were expanded as a result of the meeting on May 19, 2009, attended by the Navy, EPA, DTSC, and CCSF.

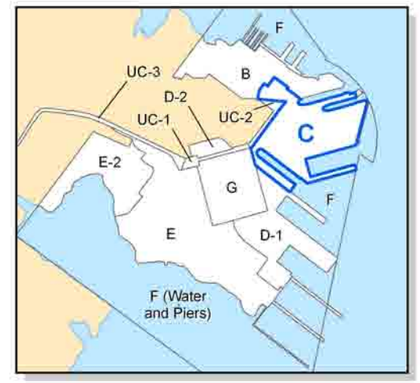
2.6 PRINCIPAL THREAT WASTE

Although a remedial response action is necessary (Section 2.5.3), no wastes in Parcel C constitute a "principal threat." Principal threat wastes are hazardous or highly toxic source materials that result in ongoing contamination to surrounding media, that generally cannot be reliably contained, or that present a significant risk to human health or the environment should exposure occur. Although elevated concentrations of VOCs, PAHs, some metals, PCBs, and radionuclides are present in soil and structures, the potential risks do not suggest a principal threat waste in soil at Parcel C. Contaminated groundwater is not generally considered source material unless its mobility is potentially extreme. Based on a review of the data, VOCs and metals in groundwater at Parcel C appear to be somewhat stable in that the associated plumes have expanded minimally over time. In addition, a variety of processes occur in the subsurface that reduce chemical concentrations in groundwater as groundwater migrates toward a discharge point such as the bay. These processes include hydrodynamic dispersion, sorption, chemical and biological transformation, dilution in the tidal mixing zone, and dilution on discharge to a surface water body. Therefore, VOCs (most significantly, 1,2-dichloroethane, 1,2-dichlorobenzene, carbon tetrachloride, chloroform, tetrachloroethene [PCE], trichloroethene [TCE], and vinyl chloride) and metals (chromium VI and zinc) in groundwater at Parcel C are not considered principal threat wastes individually or cumulatively.

2.7 REMEDIAL ACTION OBJECTIVES

RAOs(35) are established considering regulatory requirements, standards, and guidance; contaminated media; COCs; potential receptors and exposure scenarios; and human health and ecological risks. Ultimately, the success of a remedial action is measured by its ability to meet the RAOs. Planned future land use is an important component in developing RAOs, and the RAOs for Parcel C are based on the San Francisco Redevelopment Agency's 1997 reuse plan. However, the application of the RAOs may need to be revisited if significant changes would occur in planned reuse (for example, a recreational use area becomes a residential use area). The RAOs for Parcel C were developed in conjunction with the regulatory agencies and are listed below by medium.





Planned Soil Remedies

- Soil Vapor Extraction Area
- Excavation Area

Planned Surface Covers

- New Asphalt
- Repaired Asphalt
- Soil Cover
- Building Footprint (with building number)
- Building Area Requiring Institutional Controls Due to Contamination Under Foundation*
- Parcel C
- Other Parcel
- Non-Navy Property
- Road Edge

Note:
*Selected remedy for these areas is to maintain building footprints (foundations) to serve as surface covers through institutional controls. If the buildings are removed in the future, further action is required to address chemicals present in soil beneath the building footprint. Note that other institutional controls are required for the entire parcel.

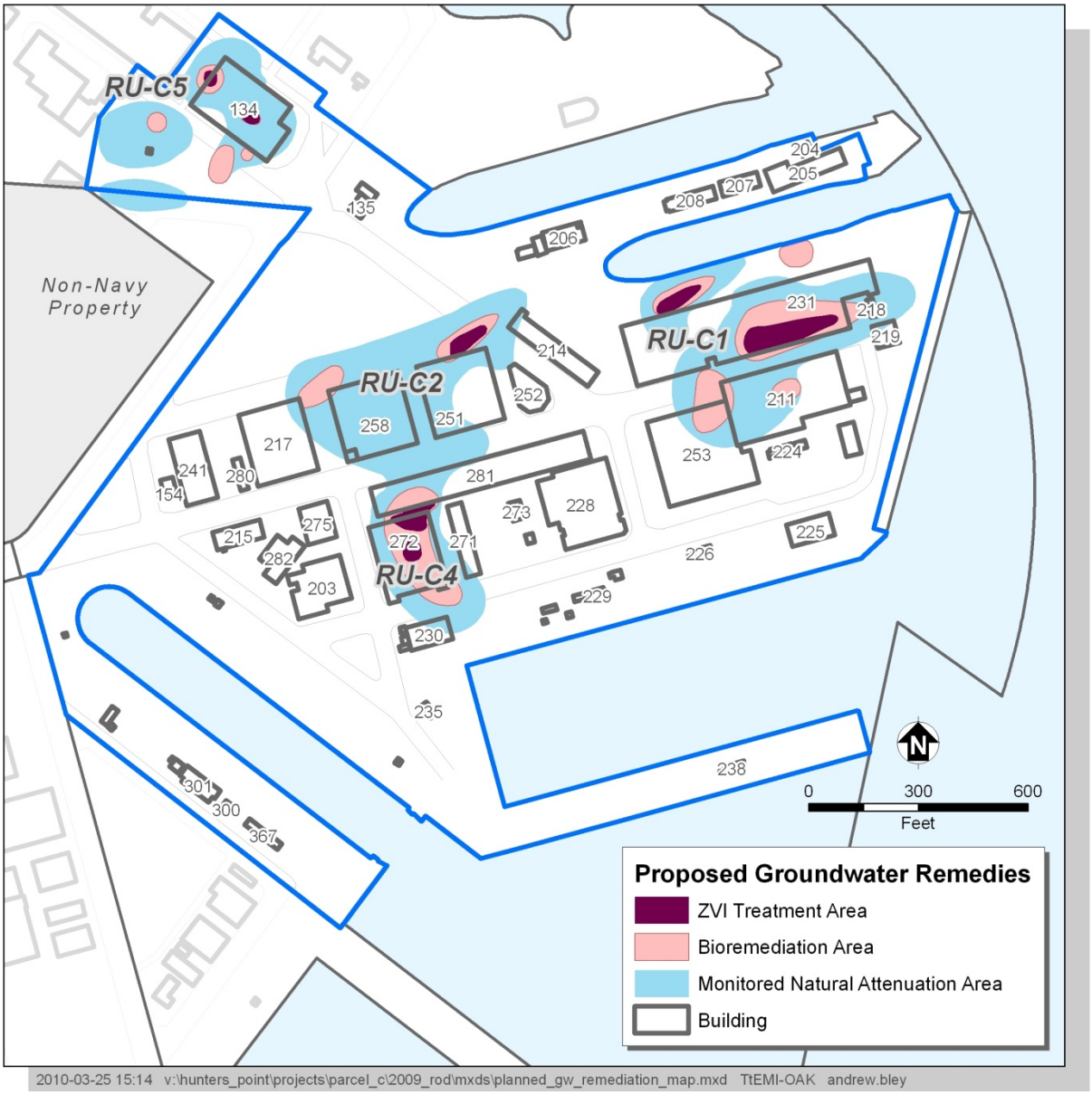
ChaduxTt JV

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

FIGURE 10
PLANNED SOIL REMEDIATION

2010-07-15 v:\hunters_point\projects\parcel_c\2009_rod\mxds\planned_soil_remediation_map.mxd TtEMI-OAK colin.lee

Figure 11. Planned Groundwater Remediation Areas



- **Soil RAOs:**

  1. Prevent or minimize exposure to organic and inorganic chemicals in soil at concentrations above remediation goals developed in the HHRA for the following exposure pathways:

     (a) Ingestion of, outdoor inhalation of, and dermal exposure to surface and subsurface soil.

     (b) Ingestion of homegrown produce in native soil.

  2. Prevent or minimize exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. **Table 7 of the final soil gas memorandum(36)** lists the volatile chemicals. This list includes SVOCs (such as pesticides and PAHs). Remediation goals for VOCs to address exposure via indoor inhalation of vapors may be superseded based on COC identification information from future soil gas surveys. Future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative excess cancer risk level of 10^{-6} using the accepted methodology for risk assessments at HPS.

- **Groundwater RAOs:**

  1. Prevent or minimize exposure to VOCs in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater.

  2. Prevent or minimize direct exposure to the groundwater that may contain COCs through the domestic use pathway in the B-aquifer, RU-C5 only (for example, drinking water or showering).

  3. Prevent or minimize exposure of construction workers to metals and VOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater.

  4. Prevent or minimize migration to the surface water of San Francisco Bay of chromium VI and zinc in A-aquifer groundwater that would result in concentrations of chromium VI above 50 µg/L and zinc above 81 µg/L at the point of discharge to the bay.

- **Radiologically Impacted Soil and Structures RAOs:**

  1. Prevent or minimize exposure to radionuclides of concern in concentrations that exceed remediation goals for all potentially complete exposure pathways (for example, external radiation, soil ingestion, and inhalation of resuspended radionuclides in soil or dust).

Remediation goals for soil and groundwater are listed in Table 3 and Table 4, respectively. Remediation goals for radiologically impacted sites are listed in Table 5.

Table 5. Remediation Goals for Radionuclides

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Radionuclide	Surfaces (dpm/100 cm^2)		Soil (pCi/g)[d]	Water (pCi/L)
	Equipment and Waste [a]	Structures [b]		
Cesium-137	5,000	5,000	0.113	119
Cobalt-60	5,000	5,000	0.0361	100
Plutonium-239	100	100	2.59	15
Radium-226	100	100	1[c]	5
Strontium-90	1,000	1,000	0.331	8
Thorium-232	1,000	36.5	1.69	15

Notes: Unless otherwise stated, the radiological remediation goals in this table are based on total activity per sample including the background.

a Limits for removable surface activity are 20 percent of these values.

b Remediation goals are consistent with those issued in the Radiological TCRA Action Memorandum. Remediation goals meet the 25 mrem/yr residual dose level consistent with 10 CFR Section 20.1402. Furthermore, for most radionuclides of concern, goals meet the 15 mrem/yr residual dose level for most radionuclides of concern, consistent with the 1997 EPA OSWER Directive (OSWER No. 9200.4-18). An exception is the goal for thorium-232 which, because of technical limitations in the detection limit, corresponds to a dose of 25 mrem/yr.

c Goal is 1 pCi/g above background per agreement with EPA.

d All radiologically impacted soils will be remediated according to Residential Remediation Goals.

CFR *Code of Federal Regulations*
dpm/100cm^2 Disintegration per minute per one hundred square centimeters
EPA U.S. Environmental Protection Agency
millirem One thousandth of a rem (10^{-3})
mrem/yr Millirems per year
OSWER Office of Solid Waste and Emergency Response
pCi/g Picocuries per gram
pCi/L Picocuries per liter
TCRA Time-Critical Removal Action

For nonradiological COCs, exposure scenario-specific risk-based concentrations (RBC) were calculated based on a target excess cancer risk level of 1×10^{-6} and target noncancer HI of 1, consistent with the exposure pathways and assumptions used in the HHRA to assess risks. The selection of these target risk levels is based on agreements with the BCT and the Conveyance Agreement for Parcel C. Remediation goals for nonradiological COCs were selected based on a comparison of the COC-specific RBC, the laboratory practical quantitation limit (PQL) based on standard EPA analytical methods, the HPAL (ubiquitous metals in soil only), and the drinking water ARARs (RU-C5 B-aquifer groundwater only).

For ubiquitous metals in soil, the RBC was also compared with the HPAL; if the HPAL exceeded the RBC, the HPAL was selected as the remediation goal. For organic COCs in the RU-C5 B-aquifer, the chemical-specific ARAR was used as the RAO, if established. In all other cases, the RBC was selected as the remediation goal, unless the RBC was below the laboratory PQL. The RBC is calculated based on target risk and hazard levels associated with

the toxicity of the COC, and scenario-specific exposure assumptions; however, these calculated levels cannot be practically achieved for all COCs. Certain pesticides, PAHs, and organic lead have a scenario-specific RBC that is below the PQL. In these cases, the laboratory PQL is selected as the remediation goal.

For radionuclide COCs, remediation goals were based on residential goals provided in the Radiological TCRA Action Memorandum.

2.8 DESCRIPTION AND EVALUATION OF REMEDIAL ALTERNATIVES

Preliminary screening of **general response actions (GRA)**(37) and process options was completed to refine the remedy selection process, as detailed in the revised Final FS Report, to address contamination in soil and groundwater and radiologically impacted structures and soil. The GRAs were also developed considering the planned future land use of each redevelopment block because the RAOs were developed based on the planned future land use. Five soil, five groundwater, and two radiological remedial approaches were retained as combinations of **preliminary remedial alternatives**(38) and were evaluated with respect to implementability, effectiveness, and relative cost (high, moderate, and low). Detailed cost analysis was not part of this preliminary screening.

Remedial alternatives retained for a detailed comparative analysis in accordance with the NCP are as follows:

- Five remedial alternatives for soil:
  - No action
  - ICs and maintained landscaping
  - Excavation, disposal, maintained landscaping, and ICs
  - Covers and ICs
  - Excavation, disposal, covers, SVE, and ICs
- Five remedial alternatives for groundwater:
  - No action
  - ICs and long-term monitoring
  - In situ bioremediation, MNA, and ICs
  - In situ ZVI reduction, bioremediation, MNA, and ICs
  - In situ ZVI reduction, plume-wide bioremediation, MNA, and ICs
- Two remedial alternatives for radiologically impacted structures and soil:
  - No action
  - Survey, decontamination, excavation, disposal, and release.

No significant changes were made to the ROD from the information presented in the proposed plan.

2.8.1 Description of Remedial Alternatives

Table 6 presents the major components, details, and cost of each remedial alternative identified for soil, groundwater, and radiologically impacted sites. The costs shown in Table 6 are from the final FS report for the combined Parcels C and UC-2. No adjustments were made to this original cost analysis because Parcel UC-2 represents a negligible portion of the combined parcels (5 percent). Thus the original cost estimate is valid for Parcel C.

2.8.2 Comparative Analysis of Alternatives

Table 7 presents a comparative analysis of the alternatives according to the **nine evaluation criteria**[39], and a relative ranking of the alternatives.

Threshold Criteria

Overall Protection of Human Health and the Environment. The no-action alternatives for soil, groundwater, and radiologically impacted structures and soil do not achieve RAOs; therefore, they do not protect human health and the environment and are not considered further in this ROD. For soil, Alternatives S-2 through S-5 are protective of human health and the environment under the anticipated future land use of the site. For groundwater, Alternatives GW-2, GW-3A, GW-3B, and GW-4 are also protective of human health and the environment, although the degree of protection varies among the alternatives. For radiologically impacted structures and soil, Alternative R-2 is protective of human health and the environment because it includes remediation that reduces exposure to radionuclides of concern.

Compliance with ARARs. ARARs do not apply to the no-action alternatives for soil, groundwater, and radiologically impacted structures and soil. An alternative for the remaining soil, groundwater, and radiological alternatives must either comply with ARARs or provide grounds for a waiver. Alternatives S-2 through S-5 comply with all ARARs. Alternative GW-4 meets all of the ARARs. Alternatives GW-2, GW-3A, and GW-3B also meet all the ARARs, but with potentially less certainty. Alternative R-2 fulfills all ARARs related to radiologically impacted structures or soil.

Primary Balancing Criteria

Criteria Long-Term Effectiveness and Permanence. Alternative S-5 is rated the highest with respect to long-term effectiveness and permanence because it includes the effective and permanent remedies of removal and disposal off site from Alternatives S-3 and the parcel-wide covers and ICs from Alternative S-4. The long-term permanence is lower for Alternative S-2, which relies more heavily on ICs to meet the RAOs for the chemicals left in place, and higher for Alternatives S-3, S-4, and S-5, which include excavations that would reduce the volume of on-site contaminants. Alternatives S-2 through S-5 would also provide long-term effectiveness in meeting the RAOs through reliance on continuous enforcement of covenants to restrict use of property to maintain covers and access restrictions. Alternative S-3 provides long-term effectiveness and permanence for contaminated soil that is excavated, but relies on access restrictions for other COCs until ICs are implemented. Alternative S-4 provides a permanent cover before development, but does not permanently remove any contamination. Because no action would be taken under Alternative S-1, it does not provide a long-term effective or permanent solution to the risks from soil present at the site.

Table 6. Remedial Alternatives

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Remedial Alternative	Components	Details	Cost
Soil Remedial Alternatives			
S-1: No Action *No action for contaminated soil with no restriction on activities.*	▪ Existing soil	▪ No action	No cost
S-2: ICs and Maintained Landscaping *Impose ICs to limit land use and maintain landscaping of bare or disturbed areas with no cover.*	▪ ICs ▪ Maintained landscaping	▪ ICs, including proprietary controls, restrictive covenants, restricted land use, restricted activities, and prohibited activities, would be implemented to prevent or minimize exposure to areas where potential unacceptable risk is posed by COCs in soil. Entire blocks would not be fenced, and areas within a block that are covered with a building footprint or existing cover (such as a parking lot) would not be fenced. ▪ Landscaping would be maintained for bare or minimally vegetated areas that have been disturbed by excavation or construction activities and not restored with a cover. ▪ Maintained landscaping would prevent exposure to asbestos that may be present in surface soil and transported by wind erosion.	Capital Cost: $461,000 O&M Cost: $475,000 **Present-Worth Cost: $1,580,000$_{(40)}$** Discount Rate: 3.0% Timeframe: 30 years

Table 6. Remedial Alternatives (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Remedial Alternative	Components	Details	Cost
Soil Remedial Alternatives (Continued)			
S-3: Excavation, Disposal, ICs, and Maintained Landscaping *Excavation of contaminated soil followed by off-site disposal, maintained landscaping, and ICs.*	▪ Excavation of soils ▪ Off-site disposal ▪ Maintained landscaping (S-2) ▪ ICs (S-2)	▪ Where feasible, excavate areas within Parcel C where soil contains organic chemicals, lead, and zinc above remediation goals. The combined volume of soil for all excavations is estimated to be 42,000 cy. ▪ Depth of excavations would be the maximum depth for human health exposure scenarios based on the proposed planned reuse (2 feet for recreational areas; 10 feet for industrial and residential areas). ▪ With few exceptions, excavation is not proposed beneath existing buildings, as the slab or foundation provides adequate cover. Excavation is proposed at Building 251 (foundation was disturbed) and Building 241 (remove benzene after radiological removal activities). ▪ Areas previously excavated to bedrock are not proposed for further excavation. ▪ CERCLA and TPH program work would be coordinated, but remediation would be handled separately.	Capital Cost: $12,833,000 O&M Cost: $854,000 **Present-Worth Cost: $16,430,000(41)** Discount Rate: 3.0% Timeframe: 30 years

Table 6. Remedial Alternatives (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Remedial Alternative	Components	Details	Cost
Soil Remedial Alternatives (Continued)			
S-4: Covers and ICs *Install physical barriers, such as covers, to block exposure pathways to contaminated soil, followed by ICs.*	▪ Install covers ▪ ICs (S-2)	▪ Install durable covers that will not break, erode, or deteriorate such that the underlying soil becomes exposed. Existing asphalt and concrete surfaces and buildings may be used as covers if they meet the durability requirement. ▪ All asphalt covers would be sealed at the start of construction and maintained by resealing once every 10 years or as needed to prevent or minimize possibility of opening an exposure pathway. ▪ Ground would be covered with a minimum of 4 inches of asphalt paving or 2 feet of new soil. ▪ Approximately 2 acres would be covered with soil and maintained landscaping, 35 acres would be covered with new asphalt, and 35.5 acres of existing asphalt and concrete surfaces (including buildings) would be used and repaired as necessary.	Capital Cost: $4,043,000 O&M Cost: $1,734,000 **Present-Worth Cost: $6,930,000(42)** Discount Rate: 3.0% Timeframe: 30 years

Table 6. Remedial Alternatives (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Remedial Alternative	Components	Details	Cost
Soil Remedial Alternatives (Continued)			
S-5: Excavation, Disposal, Covers, Soil Vapor Extraction, and ICs *Combination of soil excavation and off-site disposal followed by covers, SVE, and ICs.*	▪ Excavation of soil (S-3) ▪ Off-site disposal (S-3) ▪ Install covers (S-4) ▪ Remove and treat VOCs in soil using SVE ▪ ICs (S-2)	▪ Implement SVE as a source reduction method to address VOC-contaminated soil. SVE areas bound soil sampling locations where VOCs were detected above remediation goals. ▪ SVE would also be used to address soil vapor above the groundwater plumes. ▪ SVE would not be used as the sole remedy in areas where VOCs are commingled with chemicals that do not readily volatilize.	Capital Cost: $17,236,000 O&M Cost: $3,552,000 **Present-Worth Cost: $24,950,000(43)** Discount Rate: 3.0% Timeframe: 30 years
Groundwater Remedial Alternatives			
GW-1: No Action *No action for contaminated groundwater with no restriction on activities.*	▪ Existing groundwater	▪ No action	No cost

Table 6. Remedial Alternatives (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Remedial Alternative	Components	Details	Cost
Groundwater Remedial Alternatives (Continued)			
GW-2: Long-Term Monitoring and ICs *Implement monitoring to assess migration of chemicals and ambient conditions, followed by ICs.*	▪ Groundwater monitoring ▪ ICs	▪ Monitor VOCs and metals at strategically located monitoring wells to evaluate whether plumes are stable or mobile. Frequency and duration will be established at the RD stage. ▪ ICs — including proprietary controls, restrictive covenants, restricted land use, restricted activities, and prohibited activities — would be implemented to prevent exposure to groundwater where potential for unacceptable risk is posed by COCs in groundwater.	Capital Cost: $913,000 O&M Cost: $9,284,000 **Present-Worth Cost: $12,240,000 (44)** Discount Rate: 3.0% Timeframe: 30 years
GW-3 (A): Bioremediation, MNA, and ICs *Treat groundwater containing VOCs with biological substrate, followed by MNA and ICs.*	▪ Treatment ▪ Monitoring ▪ ICs (GW-2)	▪ Perform in situ pilot tests to confirm performance and support design and layout of the groundwater treatment system for VOCs. ▪ Treat groundwater with an in situ injection of a biological substrate to create conditions under which VOCs are reduced in groundwater. ▪ Monitor VOCs and metals at strategically located monitoring wells to evaluate whether plumes are stable or mobile. Frequency and duration would be determined in the RD stage. ▪ MNA and ICs would remain in place until remedial goals are achieved.	Capital Cost: $3,600,000 O&M Cost: $14,701,000 **Present-Worth Cost: $21,910,000 (45)** Discount Rate: 3.0% Timeframe: 30 years

Table 6. Remedial Alternatives (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Remedial Alternative	Components	Details	Cost
Groundwater Remedial Alternatives (Continued)			
GW-3 (B): In Situ ZVI Reduction, Bioremediation, MNA, and ICs *Treat groundwater containing VOCs with biological substrate or ZVI, followed by MNA and ICs.*	▪ Treatment ▪ Monitoring ▪ ICs (GW-2)	▪ Perform in situ pilot tests to confirm performance and support design and layout of the groundwater treatment system for VOCs. ▪ Treat groundwater with an in situ injection of a biological substrate or ZVI to create conditions under which VOCs are reduced in groundwater. ▪ Monitor VOCs and metals at strategically located monitoring wells to evaluate whether plumes are stable or mobile. Frequency and duration would be determined in the RD stage. ▪ MNA and ICs would remain in place until remedial goals are achieved.	Capital Cost: $4,573,000 O&M Cost: $18,985,000 **Present-Worth Cost: $28,290,000**(46) Discount Rate: 3.0% Timeframe: 30 years

Table 6. Remedial Alternatives (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Remedial Alternative	Components	Details	Cost
GW-4: In Situ ZVI Reduction, Plume-wide Bioremediation, MNA, and ICs *Treat groundwater containing VOCs and metals with biological substrate or ZVI followed by MNA and ICs.*	▪ Treatment ▪ Monitoring ▪ ICs (GW-2)	▪ Perform in situ pilot tests to confirm performance and support design and layout of the groundwater treatment system for VOCs and metals. ▪ Treat groundwater with an in situ injection of a biological substrate or ZVI to create conditions under which both VOCs and metals concentrations are reduced in groundwater to remedial goals. ▪ Monitor VOCs and metals at strategically located monitoring wells to evaluate whether plumes are stable or mobile. Frequency and duration would be determined in the RD stage. ▪ MNA and ICs would remain in place until remedial goals are achieved.	Capital Cost: $5,508,000 O&M Cost: $33,823,000 **Present-Worth Cost: $48,450,000**(47) Discount Rate: 3.0% Timeframe: 30 years

Table 6. Remedial Alternatives (Continued)

Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

Remedial Alternative	Components	Details	Cost
Radiologically Impacted Structures and Soil Remedial Alternatives			
R-1: No Action *No action for radiologically impacted structures and soil with no restriction on activities.*	▪ Existing structures ▪ Existing soil	▪ No action	No cost
R-2: Survey, Decontamination, Excavation, Disposal, and Release *Survey existing structures, followed by excavation and off-site disposal of contaminated materials and soil.*	▪ Survey ▪ Decontamination ▪ Excavation ▪ Disposal ▪ Release	▪ Survey structures, former building sites, and radiologically impacted areas. ▪ Decontaminate buildings. ▪ Excavate storm drain and sanitary sewer lines, and excavate at outdoor and radiologically impacted areas. ▪ Dispose of excavated materials and soils at off-site facilities. ▪ Conduct surveys to ensure that remediation goals are met for radiologically impacted sites scheduled for unrestricted release. ▪ Includes decontamination or removal of structures below Building 205.	Capital Cost: $24,749,000 O&M Cost: None **Present-Worth Cost: $29,698,000**$_{(48)}$ Discount Rate: Not applicable Timeframe: Approximately 1 year

Notes:

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chemical of concern
cy	Cubic yard
IC	Institutional control
MNA	Monitored natural attenuation
O&M	Operation and maintenance
RD	Remedial design
SVE	Soil vapor extraction
TPH	Total petroleum hydrocarbons
VOC	Volatile organic compound
ZVI	Zero-valent iron

Table 7. Relative Ranking of Remedial Alternatives
Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California

CERCLA Criteria	Soil					Groundwater					Radiologically Impacted Structures and Soil	
	S-1 No Action	S-2 ICs and Maintained Landscaping	S-3 Excavation, Disposal, Maintained Landscaping, and ICs	S-4 Covers and ICs	S-5*** Excavation, Disposal, Soil Vapor Extraction, Covers, and ICs	GW-1 No Action	GW-2 Groundwater Monitoring and ICs	GW-3A In Situ Biological Treatment, MNA, and ICs	GW-3B*** In Situ Zero-Valent Iron and Biological Treatment, MNA, and ICs	GW-4 In Situ Zero-Valent Iron and Plume-Wide Biological Treatment, MNA, and ICs	R-1 No Action	R-2*** Decontamination of Buildings, Removal of Storm Drains and Lines, Decontamination or Removal of Structures Below Building 205, and Excavation of Soil
Threshold Criteria												
Overall Protection of Human Health and the Environment	No	Yes	Yes	Yes	**Yes**	No	Yes	Yes	**Yes**	Yes	No	**Yes**
Compliance with ARARs	N/A	Yes	Yes	Yes	**Yes**	N/A	Yes	Yes	**Yes**	Yes	N/A	**Yes**
Balancing Criteria												
Long-Term Effectiveness and Permanence	○	◔	◕	◕	●	○	◕	●	●	●	○	◕
Reduction in Toxicity, Mobility, or Volume through Treatment	◕	◔	◕	◕	◑	◕	◕	◑	●	●	○	◔
Short-Term Effectiveness	◕	◑	◑	◕	◕	◕	●	◕	●	◕	◕	◕
Implementability	●	◔	◕	◕	◑	●	●	◕	◕	◑	◕	◕
Present-Worth Cost ($M)	$0	$1.6	$16	$7	$25	$0	$12	$22	$28	$48	$0	$30
Modifying Criteria												
State Acceptance	○	○	○	◑	◕	○	◕	◕	●	●	○	●
Community Acceptance[1]	○	◕	◕	◕	◕	○	◕	◑	◕	◕	○	●

Notes: Fill symbol by quarters from open (poor) to full (excellent).

*** Indicates preferred alternative

1 Community Acceptance ranking of the alternatives was based on feedback received during community and public meetings and public comments on Parcel C and other parcels at HPS.

$M Millions of dollars
ARAR Applicable or relevant and appropriate requirement
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
GW Groundwater
IC Institutional control
MNA Monitored natural attenuation
S Soil

Alternative GW-4 provides the highest level of long-term effectiveness and permanence because COCs would be degraded or immobilized. Alternative GW-2 would provide a moderate level of effectiveness and permanence because groundwater plumes would be addressed only through ICs and monitoring to assess the potential migration of contaminants. Alternatives GW-3A and GW-3B would provide a higher level of long-term effectiveness and permanence than Alternative GW-2 because VOCs would be degraded or immobilized. However, metals would be addressed through ICs and monitoring using the plume-specific attenuation factors and the chemical-specific trigger levels for metals. All alternatives, except for Alternative GW-1, provide an adequate and reliable level of controls.

Alternative R-2 would provide excellent long-term effectiveness and performance for radiologically impacted sites. Alternative R-1 provides very little long-term effectiveness and performance because it specifies no action.

Reduction in Toxicity, Mobility, or Volume through Treatment. None of the alternatives proposed for remediating soils at Parcel C includes treatment as a GRA; therefore, all of the alternatives (S-1 through S-5) are rated poor with respect to reducing mobility, toxicity, or volume through treatment.

Alternative GW-4 is rated the highest because it both reduces the toxicity and volume of contaminants by active treatment of VOCs, and the plumes of chromium VI and zinc. The treatment would also reduce the mobility of the chromium VI and zinc plumes by in situ precipitation of metals. Mobility of these contaminants would be monitored and human health exposure would be eliminated through ICs. Alternatives GW-3A and GW-3B would reduce the toxicity or volume of VOC contaminants through treatment, but would monitor the mobility of metals contamination through the groundwater monitoring program and eliminate exposure through use of ICs. Alternative GW-2 would not reduce the toxicity or volume of contaminants and would also monitor the mobility of the contamination through the groundwater monitoring program and eliminate exposure through use of ICs. Alternative GW-1 does not reduce the mobility, toxicity, or volume of contaminants in groundwater.

Alternatives R-1 and R-2 are both rated poor because they do not include treatment that would result in the destruction, transformation, or irreversible reduction in the mobility of the radionuclides of concern.

Short-Term Effectiveness. Alternative S-1 would least affect the community, remedial workers, or the environment because it specifies no actions. Alternatives S-2 and S-4 would introduce less risk to these receptors because these alternatives do not include excavation, hauling, and disposal of soil that contains contamination. Alternatives S-3 and S-5 include removing and hauling soils with contamination that would pose potential risk to these receptors, although this risk is considered low and mitigation measures would be implemented.

All of the alternatives for groundwater scored well in terms of short-term effectiveness according to the criteria. Alternatives GW-3A, GW-3B, and GW-4 pose a slightly greater risk to workers than Alternative GW-2 because these alternatives involve more aggressive field activities and would thus have a higher potential for construction-related injuries.

Alternatives GW-2, GW-3A, GW-3B, and GW-4 all pose a very low risk to workers during implementation of the groundwater monitoring program. Alternative GW-1 has an excellent short-term effectiveness rating, as no remedial actions would occur under this alternative.

Alternative R-1 would least affect the community, remedial workers, or the environment because it specifies no actions; therefore, it would not disturb the radionuclides of concern. Alternative R-2 includes removing and hauling contaminated soil and building materials from the site. This alternative would pose a potential risk to the community, remedial workers, or the environment, although this risk is considered low, and mitigation measures would be implemented.

Implementability. Distinctions among the alternatives for implementability are minimal. Alternatives S-2, S-3, and S-4 require implementation of ICs. Installing covers (Alternative S-4) and excavating soil (Alternatives S-3 and S-5) are standard technologies that are easy to implement. Alternative S-1 does not involve remedial technologies or ICs and requires no implementation.

Alternatives GW-1 and GW-2 have the highest rating and are technically the easiest to implement. Alternative GW-2 would require the most resources to conduct the long-term groundwater monitoring program; however, these resources are readily available. Alternatives GW-3A, GW-3B, and GW-4 are more complex to implement because of the injection treatment; however, this treatment is expected to be a one-time injection that would reduce the resources required for groundwater monitoring as compared with Alternative GW-2. Alternative GW-3A may be easier to implement because the injected substrates are slow-release compounds that continue to degrade or precipitate COCs over time, which increases the potential to react with contaminants as they disperse in the aquifer.

Alternative R-2 requires use of standard technologies that are easy to implement. Alternative R-1 does not involve remedial technologies and requires no implementation. Therefore, the distinction between these two alternatives regarding implementability is minimal.

Cost. Alternatives S-1 requires no action; therefore, no costs are associated with this alternative. Alternative S-2 is the least costly ($1.6 million) because it includes no active remediation before the property is transferred. Alternative S-4 has moderate cost (approximately $7 million), and Alternatives S-3 and S-5 that include significant amounts of off-site disposal have the greatest cost (approximately $16 million and $25 million).

Alternative GW-1 is rated the highest because it has no associated cost because no actions would be taken. The cost of Alternative GW-2 is moderate (approximately $12 million) because of the long-term groundwater monitoring. Alternatives GW-3A and GW-3B are more costly, as the in situ treatment would be added to a long-term MNA program ($22 million and $28 million). Alternative GW-4 has the highest capital cost because of the cost of the ZVI additive treatment for both the VOC and metal plumes, along with the long-term MNA program ($48 million).

Alternative R-1 requires no action; therefore, no costs are associated with this alternative. Alternative R-2 is costly ($30 million) but would effectively address all radiologically impacted sites.

Modifying Criteria

State Acceptance. State involvement has been solicited throughout the CERCLA process. The State of California concurs with the Navy's selected remedial alternatives.

Community Acceptance. Community acceptance is evaluated based on comments received from the public during the public comment period for the proposed plan. The proposed plan was presented to the community and discussed during a public meeting on February 11, 2009. Comments were also gathered during the public comment period from January 29 through February 27, 2009. Attachment 2, the responsiveness summary, of this ROD addresses the public's comments and concerns about the selected remedial alternatives at Parcel C.

2.9 SELECTED REMEDY

2.9.1 Rationale for Selected Remedy

The selected remedy for Parcel C is Alternative S-5 (excavation, disposal, SVE, covers, and ICs) for soil; Alternative GW-3B (treatment, MNA, and ICs) for groundwater; and Alternative R-2 (survey, decontamination, excavation, disposal, and release) for radiologically impacted structures and soil. The selected remedy provides the best balance of tradeoffs with respect to the nine criteria. The remedy for soil meets the RAOs by excavating and disposing of soils contaminated with arsenic, lead, and organic compounds such as chlorinated VOCs and PAHs at concentrations that exceed remediation goals, thus removing the source of contamination. Additionally, the entire parcel would be covered to cut off potential exposure pathways to arsenic, manganese, and any remaining COCs in soils. The remedy for groundwater meets the RAOs by treating groundwater to reduce concentrations of VOCs and metals to below remediation goals, thus removing the source of contamination. Monitoring would be implemented as needed for up to 30 years to confirm the treatment was successful. The remedy for radiologically impacted sites meets the RAOs by identifying and decontaminating any impacted structures. Additionally, remaining contaminated materials, storm drains and sewers, and soils would be excavated and disposed of off site, thereby removing the source of contamination.

ICs — including restrictive covenants regulating restricted land use, restricted activities, and prohibited activities — would be implemented to prevent or minimize exposure to areas where potential unacceptable risk is posed by COCs in soil and groundwater. ICs would remain in place until the concentrations of hazardous substances in soil and groundwater are at such levels that allow for unrestricted use and exposure.

2.9.2 Description of Selected Remedy

The selected remedy for soil consists of removing soil in selected areas where COCs exceed remediation goals, and disposing of excavated soil at an off-site facility. Excavations are planned at 32 areas within Parcel C, with a total removal of approximately 42,000 cy of soil. Soil in the areas selected for excavation is contaminated by arsenic, lead, and organic chemicals such as chlorinated VOCs and PAHs at concentrations that exceed remediation goals based on the planned reuse; excavations to remove zinc would focus on redevelopment block

20A, where zinc is likely present as a result of industrial activities. Excavations to remove arsenic are also included where concentrations significantly exceed the HPAL and are outside concentration ranges found in naturally occurring ubiquitous metals in the same geologic formations in the San Francisco area. The only excavations proposed beneath existing buildings would be at Building 251, where the foundation was disturbed during waste consolidation, and at Building 241 to remove benzene after radiological removal activities. The planned excavation 20A-1 on Figure 10 is not listed as an excavation beneath an existing building because it is located under an extended roof overhang area not under the building. The only excavations proposed to depths greater than 10 feet bgs would occur if light nonaqueous phase liquid is encountered, or at areas previously excavated to bedrock during removal activities, which include TCRA excavations 290301, 290302 (west of Building 203), and 290601 (south of Building 203). Open excavations would be backfilled with imported clean soil, and an appropriate durable cover would be installed.

In areas where total petroleum hydrocarbons (TPH) constituents are commingled with CERCLA contaminants in soil, the TPH constituents would be also cleaned up under the Navy's CERCLA program at Parcel C. For areas where TPH constituents in soil are not commingled with CERCLA contaminants or TPH remains after CERCLA cleanup is complete, the TPH cleanup would be conducted under the Navy's TPH Corrective Action Program for Parcel C, and would not be addressed by the Navy's CERCLA program.

SVE would be implemented as a source reduction measure to address VOC-contaminated soil; VOCs that migrate through the subsurface to indoor air (vapor intrusion) can pose an inhalation risk. The SVE areas bound soil sampling locations where VOCs were detected at concentrations above remediation goals and where soil characteristics are appropriate for SVE; SVE is also included to address soil vapor above the groundwater plumes. SVE would not be used as the sole remedy in areas where VOCs are commingled with chemicals that do not readily volatilize.

Across all of Parcel C, durable covers would be applied as physical barriers to cut off potential exposure to ubiquitous metals in soil. Existing asphalt and concrete surfaces (repaired as necessary to be durable) and buildings would act as covers. The type of new covers installed would be consistent with the redevelopment plan (for example, soil covers may be used for open space areas or asphalt for industrial areas). The cover design, including details on how the cover would be finished at the "improved shoreline," would be provided in the RD and would include plans for inspection and maintenance. Covers would be maintained to contain the soil at the "improved shoreline." Backfill for soil covers would be analyzed to confirm that the material does not contain chemicals above Parcel C remediation goals or contain greater than 0.25 percent asbestos. Modification of covers will be governed by the Risk Management Plan discussed below and its terms will be enforced by the regulatory agencies. Based on aerial photographs of Parcel C, an estimated 2 acres would be covered with soil and maintained landscaping, 35 acres would be covered with new asphalt, and 35.5 acres of existing asphalt and concrete surfaces (including buildings) would be used and repaired, as necessary. As a result of the meeting on May 19, 2009, attended by the Navy, EPA, DTSC, and CCSF, and results of the **2010 soil data gap investigation**[(49)], five existing buildings have been identified where further action would be needed if the building foundation is removed. The footprint of Buildings 134, 214, 231, 272, and 281 that serve as covers are identified on Figure 10 as areas

requiring institutional controls (ARIC). The Navy concluded that the soil beneath these buildings had been sufficiently characterized based on the result of the building-by-building evaluation of existing data under the buildings and the Navy's data gap investigation completed in 2010. The Navy further concluded that the building foundation cover is sufficiently protective of human health at Parcel C until such time as the building foundation would be removed or altered. Further action would be needed if the building foundations are removed or altered.

The selected remedy for groundwater consists of actively treating VOCs in groundwater using ZVI or an injected biological substrate to destroy the VOCs in the groundwater plumes at RU-C1, RU-C2, RU-C4, and RU-C5. ZVI would be used to target hotspot areas where concentrations of PCE exceed 15 µg/L and of TCE exceed 110 µg/L. Areas targeted for bioremediation have concentrations of select VOCs that exceed the remediation goal by factors ranging from 10 to 50. The treatment would also minimize migration of metals in the groundwater plumes within Parcel C (see Figure 7) and discharge of these metals into the bay at levels that exceed remediation goals. Groundwater monitoring would occur in and around the remediation areas and also in downgradient locations, as necessary. The locations of monitoring points and the monitoring frequency would be specified in the RD. The RD would use current information on the plume extent and concentration to select the actual injection parameters. The monitoring plan would be flexible to allow modifications as data are obtained.

At areas where TPH constituents are commingled with CERCLA contaminants in groundwater, the TPH constituents would be also cleaned up under the Navy's CERCLA program at Parcel C. At areas where TPH constituents in groundwater are not commingled with CERCLA contaminants or TPH remains after CERCLA cleanup is complete, the TPH cleanup would be conducted under the Navy's TPH Corrective Action Program for Parcel C, and would not be addressed by the Navy's CERCLA program.

Soil gas surveys would be conducted in consultation with regulatory agencies for the following purposes:

- Conduct a soil gas survey with regulatory approval in focused areas where concerns continue about residual VOCs in soil or where VOCs are present in groundwater.
- Use results of the soil gas survey to identify COCs for which risk-based numeric action levels for VOCs in soil gas would be established (based on a cumulative excess cancer risk of 10^{-6}).
- Once risk-based, numeric action levels are established, compare the results of the soil gas survey to the action levels to evaluate the need for remedial action or the reduction or retention of the ARIC for VOCs.
- At the groundwater remediation areas, conduct a soil gas survey following completion of the remedial action for groundwater (after the areas have re-equilibrated). The results of the survey would be used to evaluate potential vapor intrusion risks, determine whether the ARIC for VOCs can be reduced, and evaluate the need for additional remedial activities.

The selected remedy for radiologically impacted soil and structures consists of surveying radiologically impacted buildings and former building sites with documented radiological impacts for unrestricted release. Unrestricted release means that a property can be used for any residential or commercial purpose once regulatory requirements have been met. Decontamination would be performed and buildings would be dismantled if necessary. Radiologically impacted storm drains and sanitary sewer lines throughout Parcel C would be removed and disposed of off site while implementing appropriate **dust control measures(50)**. The following buildings at Parcel C were designated as radiologically impacted: Buildings 203, 205 and discharge tunnel, 211, 214, 224, 241, 253, 271, and 272.

The Navy would address the cleanup for radiologically impacted soil and structures at Parcel C under its ongoing Hunters Point Shipyard radiological removal action program. A RACR would summarize all building, storm drain, and sanitary sewer final status survey reports and survey unit package reports. After the agencies concur on the radiological RACR for Parcel C, unrestricted release would be granted. Should unrestricted release not be achieved, further remedial actions would occur to meet remedial goals established in the ROD.

Each radiologically impacted site would be investigated through the CERCLA process. If the final report of the site investigation is approved by the stakeholders and the site is determined to require no further action, the classification of "radiologically impacted" may be removed. The survey and removals would occur before any covers are installed as part of Alternative S-5. Buildings, former building sites, and excavated areas would be surveyed after cleanup is completed to ensure that no residual radioactivity is present at levels above the residential remediation goals. Excavated soil, building materials, and drain material from radiologically impacted sites would be screened, and radioactive sources and contaminated soil would be removed and disposed of at an off-site, low-level radioactive waste facility.

ICs(51) will be implemented to prevent or minimize exposure to areas where potential unacceptable risk is posed by COCs in soil and groundwater. ICs are legal and administrative mechanisms used to implement land use restrictions that are used to limit the exposure of future landowners or users of the property to hazardous substances present on the property, and to ensure the integrity of the remedial action. ICs are required on a property where the selected remedial cleanup levels result in contamination remaining at the property above levels that allow for unlimited use and unrestricted exposure. ICs will be maintained until the concentrations of hazardous substances in soil and groundwater are at such levels to allow for unrestricted use and exposure. Implementation of ICs includes requirements for monitoring and inspections, and reporting to ensure compliance with land use or activity restrictions.

The Navy has concluded that it will rely on proprietary controls in the form of environmental restrictive covenants as provided in the "Memorandum of Agreement between the United States Department of the Navy and the California Department of Toxic Substances Control" and attached covenant models (hereinafter referred to as the "Navy/DTSC MOA").

More specifically, land use and activity restrictions will be incorporated into two separate legal instruments as provided in the Navy/DTSC MOA:

1. Restrictive covenants included in one or more Quitclaim Deeds from the Navy to the property recipient.

2. Restrictive covenants included in one or more "Covenant(s) to Restrict Use of Property" entered into by the Navy and DTSC as provided in the Navy/DTSC MOA and consistent with the substantive provisions of *California Code of Regulations* Title 22 § 67391.1.

The "Covenant(s) to Restrict Use of Property" will incorporate the land use restrictions into environmental restrictive covenants that run with the land and that are enforceable by DTSC, and EPA, as a third party beneficiary, against future transferees and users. The Quitclaim Deed(s) will include the identical land use and activity restrictions in environmental restrictive covenants that run with the land and that will be enforceable by the Navy against future transferees.

The activity restrictions in the "Covenant(s) to Restrict Use of Property" and Quitclaim Deed(s) shall be addressed in the land use control remedial design (LUC RD) report that would be reviewed and approved by the FFA signatories. The LUC RD shall be referenced in the applicable Covenant(s) to Restrict Use of Property and Quitclaim Deed(s). The LUC RD shall be submitted in accordance with the FFA schedule. The LUC RD shall specify soil and groundwater management procedures for compliance with the remedy selected in the Parcel C ROD. The LUC RD shall identify the roles of local, state, and federal government in administering the LUC RD and shall include, but not be limited to, procedures for any necessary sampling and analysis requirements, worker health and safety requirements, and any necessary site-specific construction or use approvals that may be required.

Land use restrictions will be applied to specified portions of the facility and described in findings of suitability to transfer, findings of suitability for early transfer, "Covenant(s) to Restrict Use of Property" between the Navy and DTSC, and any Quitclaim Deed(s) conveying real property containing Parcel C at HPS.

A risk management plan (RMP) may be prepared by the CCSF and approved by the FFA signatories that may set forth certain requirements and protocols for implementing the activity restrictions specified in the ROD.

Access

The Deed and Covenant shall provide that the Navy and FFA signatories and their respective officials, agents, employees, contractors, and subcontractors shall have the right to enter upon HPS Parcel C for purposes consistent with the Navy IR Program or the FFA.

Implementation

The Navy shall address and describe IC implementation and maintenance actions including periodic inspections and reporting in the preliminary and final LUC RD reports to be developed and submitted to the FFA signatories for review and approval pursuant to the FFA (see "Navy Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Actions" attached to January 16, 2004, Department of Defense memorandum titled "Comprehensive Environmental Response, Compensation and

Liability Act [CERCLA] Record of Decision [ROD] and Post-ROD Policy"). The preliminary and final RD reports are primary documents as provided in Section 7.3 of the FFA.

The Navy is responsible for implementing, maintaining, reporting on, and enforcing land use controls. Although the Navy may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity.

Activity Restrictions that Apply throughout Parcel C

The following sections describe the IC objectives to be achieved through activity restrictions throughout Parcel C, as shown on Figure 2, to ensure that any necessary measures to protect human health and the environment and the integrity of the remedy have been undertaken.

Restricted Activities

The following restricted activities throughout HPS Parcel C must be conducted in accordance with the "Covenant(s) to Restrict Use of Property," Quitclaim Deed(s), the Parcel C RMP, the LUC RD report, and if required, any other work plan or document approved in accordance with these referenced documents, and must be further reviewed and approved by the FFA signatories:

a. "Land disturbing activity," which includes but is not limited to: (1) excavation of soil, (2) construction of roads, utilities, facilities, structures, and appurtenances of any kind, (3) demolition or removal of "hardscape" (for example, concrete roadways, parking lots, foundations, and sidewalks), (4) any activity that involves movement of soil to the surface from below the surface of the land, and (5) any other activity that causes or facilitates the movement of known contaminated groundwater.

b. Alteration, disturbance, or removal of any component of a response or cleanup action (including but not limited to pump-and-treat facilities and soil cap/containment systems); groundwater extraction, injection, and monitoring wells and associated piping and equipment; or associated utilities.

c. Extraction of groundwater and installation of new groundwater wells, with the exception of construction, operation, and maintenance responses or remedial actions as required or necessary under the CERCLA remedy.

d. Removal of or damage to security features (for example, locks on monitoring wells, survey monuments, fencing, signs, or monitoring equipment and associated pipelines and appurtenances).

Prohibited Activities

The following activities are prohibited throughout HPS Parcel C:

1. Growing vegetables, fruits, or any edible items in native soil for human consumption
2. Use of groundwater

Proposed Activity Restrictions Relating to VOC and SVOC Vapors at Specific Locations within Parcel C

Any proposed construction of enclosed structures must be approved in accordance with the "Covenant(s) to Restrict Use of the Property," Quitclaim Deed(s), LUC RD, and the RMP with approval of the FFA signatories prior to the conduct of such activity within the ARIC for VOC and SVOC vapors to ensure that the risks of potential exposures to VOC and SVOC vapors are reduced to acceptable levels that are adequately protective of human health. The reduction in potential risk can be achieved through engineering controls or other design alternatives that meet the specifications set forth in the ROD, RD reports, LUC RD report, and the RMP. Initially, the ARIC will include all of Parcel C. The ARIC for VOC and SVOC vapors may be modified by the FFA signatories as the soil contamination areas and groundwater contaminant plumes that are producing unacceptable vapor inhalation risks are reduced over time or in response to further soil, vapor, and groundwater sampling and analysis for VOCs and SVOCs that establishes that areas now included in the ARIC for VOC and SVOC vapors do not pose unacceptable potential exposure risk to VOC and SVOC vapors.

Additional Land Use Restrictions for Areas Designated for Open Space, Educational/Cultural, and Industrial Reuse

The following restricted land uses for property areas designated for open space, educational/cultural, and industrial land uses in the San Francisco Redevelopment Agency's reuse plan must be reviewed and approved by the FFA signatories in accordance with the "Covenants to Restrict Use of the Property," Quitclaim Deed(s), LUC RD, and the RMP for each parcel prior to use of the property for any of the following restricted uses:

a. A residence, including any mobile home or factory built housing, constructed or installed for use as residential human habitation,

b. A hospital for humans,

c. A school for persons under 21 years of age, or

d. A daycare facility for children.

2.9.3 Expected Outcomes of the Selected Remedy

The expected outcome for soil is that SVE would remove from soil VOCs that exceed remediation goals, and excavation would remove contaminated soil that exceeds remediation goals for arsenic, lead, and organic compounds such as chlorinated VOCs and PAHs. Remediation goals for soil are presented in Table 3. Residual risks from these and other COCs would be mitigated through use of durable covers and access restrictions to restrict exposure. After implementation of the remedy, the property would be suitable for the uses specified in the redevelopment plan (July 14, 1997).

The groundwater remedy is expected to achieve remediation goals presented in Table 4 via active treatment of VOCs in groundwater to restore the aquifer quality by reducing or immobilizing the mass of contaminants of concern in groundwater to levels that do not pose a threat to human health through the inhalation exposure pathway. Although treatment of groundwater is expected to reduce VOC and SVOC vapors released from groundwater,

ARICs for vapor intrusion may be needed at some locations at Parcel C. Furthermore, the Navy intends to permanently prohibit use of groundwater at Parcel C through implementation of ICs.

The remedy for radiological contamination includes surveys, decontamination, excavation, and off-site disposal. Removal of contaminants from radiologically impacted buildings and former building sites with documented radiological impacts, and removal of potential radiologically impacted sanitary and storm sewers and soils are expected to result in a reduction of the potential risks to levels below remediation goals presented in Table 5 associated with exposure to radionuclides of concern. The HRA classified buildings (203, 205 and discharge tunnel, 211, 214, 224, 241, 253, 271, and 272), storm drains, and sanitary sewers as "radiologically impacted" in Parcel C. Each of the radiologically impacted sites would be investigated through the CERCLA process. If the final report of the site investigation is approved by the stakeholders and the site is determined to require no further action, the classification of "radiologically impacted" may be removed.

The timeframe for achieving the uses specified in the redevelopment plan by implementing this remedy could vary from 3 to 10 years. This timeframe could be significantly impacted by funding and speed of regulatory concurrence on plans and completion of remediation.

2.9.4 Statutory Determinations

In accordance with the NCP, the selected remedy meets the following statutory determinations.

- **Protection of Human Health and the Environment** – The selected remedy for soil would protect human health and the environment through SVE, excavation of contaminated soil, prevention or minimization of exposure to remaining COCs by installing durable covers, and implementation of ICs. The selected remedy for groundwater would provide long-term protection by reducing concentrations of VOCs through treatment.
- **Compliance with ARARs** – CERCLA § 121(d)(1) states that remedial actions on CERCLA sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. Chemical-specific ARARs are health- or risk-based numerical values or methods that, when applied to site-specific conditions, establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the environment. Location-specific ARARs are restrictions on the concentrations of hazardous substances or on conducting activities solely because they are in specific locations. Specific locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats. Action-specific ARARs are technology- or activity-based requirements or limitations for remedial activities. These requirements are triggered by the particular remedial activities conducted at the site. The remedial alternatives selected by the Navy would meet all chemical-, location-, and action-specific ARARs. The ARARs that would be met by the preferred alternatives are summarized in Attachment 1.

- **Cost-Effectiveness** – The selected remedy would provide overall protectiveness proportional to its costs and is therefore considered cost-effective.

- **Utilization of Permanent Solution and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable** – Because soil contamination is widely dispersed across the installation, the Navy has concluded that a containment remedy, combined with excavation of more highly contaminated soil, represents the maximum extent to which permanent solutions can be used in a cost-effective manner. The in situ treatment of contaminated groundwater meets the preference for alternative treatment technologies. The selected remedy is expected to be permanent and effective in light of the anticipated land use.

- **Preference for Treatment as a Principal Element** – The selected remedy for soil does not satisfy the statutory preference for treatment as a principal element of the remedy because no cost-effective means of treating the large quantity of low-level soil contamination is available, and the quantities of soil to be excavated cannot be treated in a cost-effective manner. The soil remedy would not reduce the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants through treatment of the contaminated soil that would remain on site, but would provide for the off-site disposal of more highly contaminated soil at a facility ─ which would minimize the potential for those hazardous substances to migrate or otherwise pose a threat. The selected remedy for groundwater satisfies the statutory preference for treatment as a principal element of the remedy; that is, it would reduce the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment. The selected remedy for radiologically impacted soil and remediation of radiologically impacted building materials does not include treatment as a principal element of the remedy because no technology is available to reduce the toxicity or volume of radionuclides in contaminated soil or building materials.

- **Five-Year Review Requirements** –The selected remedy would result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unrestricted use. As a result, a statutory review would address Parcel C in accordance with the schedule established for HPS site-wide 5-year review after the remedial action is initiated to ensure the remedy is protective of human health and the environment.

2.10 COMMUNITY PARTICIPATION

Community participation at HPS includes public meetings, public information repositories, newsletters and fact sheets, public notices, and an IR Program website. The Community Involvement Plan for HPS provides detailed information on community participation for the IR Program, and documents interests, issues, and concerns raised by the community regarding ongoing investigation and cleanup activities at HPS. The Navy held a community meeting on February 2, 2010, to solicit community input on revising the Community Involvement Plan for HPS.

Starting in January 2010, the Navy is conducting bi-monthly Community Technical Meetings to discuss the technical aspects of CERCLA milestone documents with the community, with participation from the BCT. Documents and relevant information relied on in the remedy selection process will be made available for public review in the public information repositories listed below or on the **IR Program website**(52).

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

Anna E. Waden Bayview Library
5075 Third Street
San Francisco, California 94124
Phone: (415) 355-5757

For access to the administrative record or additional information on the IR Program, contact:

Mr. Keith Forman
Hunters Point Shipyard BRAC Environmental Coordinator
Base Realignment and Closure Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310
Phone: (619) 532-0913
e-mail: keith.s.forman@navy.mil

In accordance with CERCLA §§ 113 and 117, the Navy provided a public comment period from January 29, 2009, to February 27, 2009, for the proposed remedial action described in the Proposed Plan for Parcels C and UC-2. A public meeting to present the Proposed Plan was held from 6:00 to 8:00 p.m. on February 11, 2009. Public notice of the meeting and availability of documents was placed in the *San Francisco Examiner* on January 29, 2009.

3. RESPONSIVENESS SUMMARY

The responsiveness summary is the third component of a ROD; its purpose is to summarize information regarding the views of the public and support agency on both the remedial alternatives and general concerns about the site submitted during the public comment period. It documents in the record how public comments were integrated into the decision-making process. The participants in the public meeting, held on February 11, 2009, included community members and representatives of the Navy, EPA, DTSC, and the Water Board. Questions and concerns received during the meeting were addressed at the meeting and are documented in the meeting transcript. Responses to comments provided at the meeting and received during the public comment period by the Navy, EPA, DTSC, or the Water Board are included in the responsiveness summary (Attachment 2).