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PROPOSED PLAN FOR OPERABLE UNIT 4 NSB NEW LONDON CT
4/12/2012
NSB NEW LONDON

Naval Submarine Base - New London
Lower Subase, Operable Unit 4
Proposed Plan

This Proposed Plan identifies the Preferred Alternatives for cleaning up soil and sediment in the Lower Subase (Operable Unit (OU) 4) at the Naval Submarine Base–New London. No cleanup is required for groundwater or surface water. This plan was prepared to satisfy the public participation requirements of Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP) Section 300.43(f)(2). The plan explains the history of the Lower Subase and the type and extent of contamination found. The primary purpose of this plan is to describe the remedial alternatives evaluated and to identify those preferred by the Navy. Community involvement is critical for selecting final remedies. Public comment is invited and encouraged on the preferred and other alternatives. Information on how to participate in this decision making process is provided toward the end of this plan.

Introduction

This is the Proposed Plan for the Lower Subase (OU4). The Navy has identified preferred alternatives, based on evaluations presented in the Feasibility Study (FS) and FS Addendum. This plan provides:

- Background information on the Lower Subase (OU4)
- A discussion of the scope and role of the response actions
- A summary of site risks
- A discussion of remedial methods and alternatives as developed in the FS and FS Addendum

What Do You Think?

The Navy, United States Environmental Protection Agency (EPA), and Connecticut Department of Energy and Environmental Protection (CTDEEP) are accepting public comments on the Proposed Plan for the Lower Subase from April 5, 2012 to May 4, 2012. If you have a comment or concern, the Navy wants to hear from you before making a final decision. There are two ways to formally register a comment:

1. Offer oral comments during the April 12, 2012 formal public hearing, or
2. Send written comments postmarked no later than May 4, 2012, following the instructions provided at the end of this Proposed Plan.

To the extent possible, the Navy will respond to your oral comments during the April 2012 public meeting. The Navy will review the transcript of the comments received at the meeting, and all written comments received during the formal comment period, before making a final decision and providing a written response to the comments in a Responsiveness Summary. The Responsiveness Summary will be included in the Record of Decision (ROD) for the Lower Subase and will be publicly available.

Section 404 of the Clean Water Act and Executive Orders 11990 (Protection of Wetlands) and 11988 (Protection of Floodplains), as incorporated under Federal Emergency Management Agency regulations that are relevant and appropriate to the cleanup, require a determination that there is no practical alternative to taking federal actions affecting federal jurisdictional wetlands, aquatic habitats, and floodplains. EPA and the Navy are requesting public comment concerning the finding that the proposed cleanup alternative for sediments is the least environmentally damaging, practicable alternative for protecting wetlands and aquatic habitats, and that the proposed alternatives for soil are protective of coastal floodplain resources and the adjacent Thames River. EPA and the Navy are also proposing a finding under the Toxic Substances Control Act (TSCA) that the risk-based polychlorinated biphenyl (PCB) cleanup level and the capping of sediments containing low levels of PCBs would not pose an unreasonable risk of injury to health or the environment.

Learn More About the Proposed Plan

- The Navy will describe this Proposed Plan and listen to your questions at an informational public meeting. A formal public hearing will immediately follow this meeting.
- For further information regarding the proposed cleanup plan or upcoming meeting, please contact the Navy or regulators listed at the end of this Proposed Plan.

April 12 **Public Meeting**

Meeting: 6:30 pm
Hearing: 7:00 pm
Date: April 12, 2012
Location: Best Western Olympic Inn
Route12
Groton, Connecticut

INTRODUCTION (CONTINUED)

- Rationale for recommending the preferred alternatives
- Opportunities for public participation
- A glossary that defines technical terms, which is provided at the end of this document

The FS and FS Addendum presented detailed remedial alternatives that would remove or manage the source of contamination and reduce or eliminate human health and environmental risks associated with contamination. The alternatives considered in the FS and FS Addendum were developed by the Navy, with EPA providing primary regulatory oversight, and CTDEEP providing regulatory support. The Navy will finalize the remedy selection after evaluating comments received from the public.

OU4 has been divided into seven zones, based on specific sites and potential sources of contamination. The seven zones contain a total of nine sites (Sites 10, 11, 13, 17, 19, 21, 22, 24, and 25) and Outer Pier 1, as summarized in Table 1. The locations of the zones and sites are shown on Figure 1. This Proposed Plan describes remedies only for those chemicals regulated by CERCLA. Some areas are contaminated solely with total petroleum hydrocarbons (TPHs), which are addressed under CTDEEP's Remediation Standard Regulations (RSR), a non-CERCLA program. A small area of Zone 4 is contaminated with both TPH and lead, and because lead is regulated under CERCLA, the contamination in that area is covered by this plan.

Preliminary Remediation Goals (PRGs) have been developed to identify the levels of chemicals above which cause potentially unacceptable risk to human health and the environment. This Proposed Plan recommends no further action (NFA) in zones or media with concentrations below PRGs or where it has been determined that there is no CERCLA risk. Recommended actions for zones exceeding PRGs will include either removal of the soil/sediment or land use controls (LUCs) (engineering controls, institutional controls, and inspections) and monitoring. LUCs are designed to reduce the risk of human and ecological exposure to contamination and may include regular maintenance and inspection of building foundations and pavement, erosion controls, and monitoring wells. The Cleanup Proposal (Table 1) presents a summary, by zone, of the contaminants associated with potentially unacceptable human health and ecological risks, the medium through which they present the risk, and the proposed CERCLA cleanup actions.

This Proposed Plan is presented in eight sections. The first section provides general information on the Lower Subase and information applicable to all zones. The remaining sections provide information specific to each of the seven zones that require CERCLA action.

BASE BACKGROUND AND CHARACTERISTICS

The Lower Subase includes approximately 33 acres of land along the Thames River that extends from just south of Pier 2 to just north of Pier 33 (Figure 1). A quay (retaining) wall runs along the Thames River for the entire length of the Lower Subase. The Lower Subase contains piers and berths for submarine docking; facilities for submarine maintenance, repair, and overhaul; and administrative buildings. The seven zones being addressed by this Proposed Plan are in a highly developed portion of the Lower Subase, with 90 to 100 percent of the surfaces of each zone covered with pavement or buildings. Lead-acid battery maintenance and overhaul activities were conducted at the Lower Subase until the mid-1950s and a classified materials incinerator was operated in the Lower Subase until 1967. It is possible that the resulting ash was disposed of in portions of the Lower Subase. Petroleum products were used by the Navy throughout the Lower Subase, and releases of these products to the environment may have occurred because of leaks from underground storage tanks (USTs) and fuel distribution lines, vehicle and locomotive maintenance operations and associated waste disposal practices, and marine fueling activities. Other ship and submarine maintenance activities (e.g., sandblasting and painting) were also conducted in the Lower Subase and adjacent Thames River.

TABLE 1: THE CLEANUP PROPOSAL

MEDIUM	ZONE 1—SITES 10 AND 11		ZONE 2		ZONE 3—SITE 17		ZONE 4—SITES 13 AND 19 AND OUTER PIER 1		ZONE 5—SITE 2		ZONE 6—SITE 24		ZONE 7—SITES 21 AND 25	
	CHEMICALS OF CONCERN (COCS)	PROPOSED CERCLA ACTION	COCS	PROPOSED CERCLA ACTION	COCS	PROPOSED CERCLA ACTION	COCS	PROPOSED CERCLA ACTION	COCS	PROPOSED CERCLA ACTION	COCS	PROPOSED CERCLA ACTION	COCS	PROPOSED CERCLA ACTION
Soil - Residential Exposure	PAHs, Lead, Mercury	LUCs and Monitoring	None	NFA	PAHs, Lead	LUCs and Monitoring	PAHs, Lead	Excavation, LUCs, and Monitoring	None	NFA	None	NFA	PAHs, Metals	LUCs and Monitoring
Soil - Industrial/ Commercial Exposure	None	NFA	None	NFA	Lead		Lead		None	NFA	None	NFA	Antimony, Lead	
Sediment - Ecological Risk	None	NFA	None	NFA	None	NFA	PCBs, Pesticides, PAHs, & Metals	Dredging, LUCs and Monitoring (Zone 4); LUCs and Monitoring (Outer Pier 1)	None	NFA	None	NFA	None	NFA
Groundwater Human Health and Ecological Risk	There are no unacceptable human health risks for the residential or industrial/commercial scenarios or unacceptable ecological risks for any of the Lower Subase zones.													
Surface Water Human Health and Ecological Risk	There are no unacceptable human health risks for the residential or industrial/commercial scenarios or unacceptable ecological risks for any of the Lower Subase zones.													
Soils Ecological Risk	There are no unacceptable ecological risks for any of the Lower Subase zones.													
Sediments Human Health Risk	There are no unacceptable human health risks for the residential or industrial/commercial scenarios for any of the Lower Subase zones.													

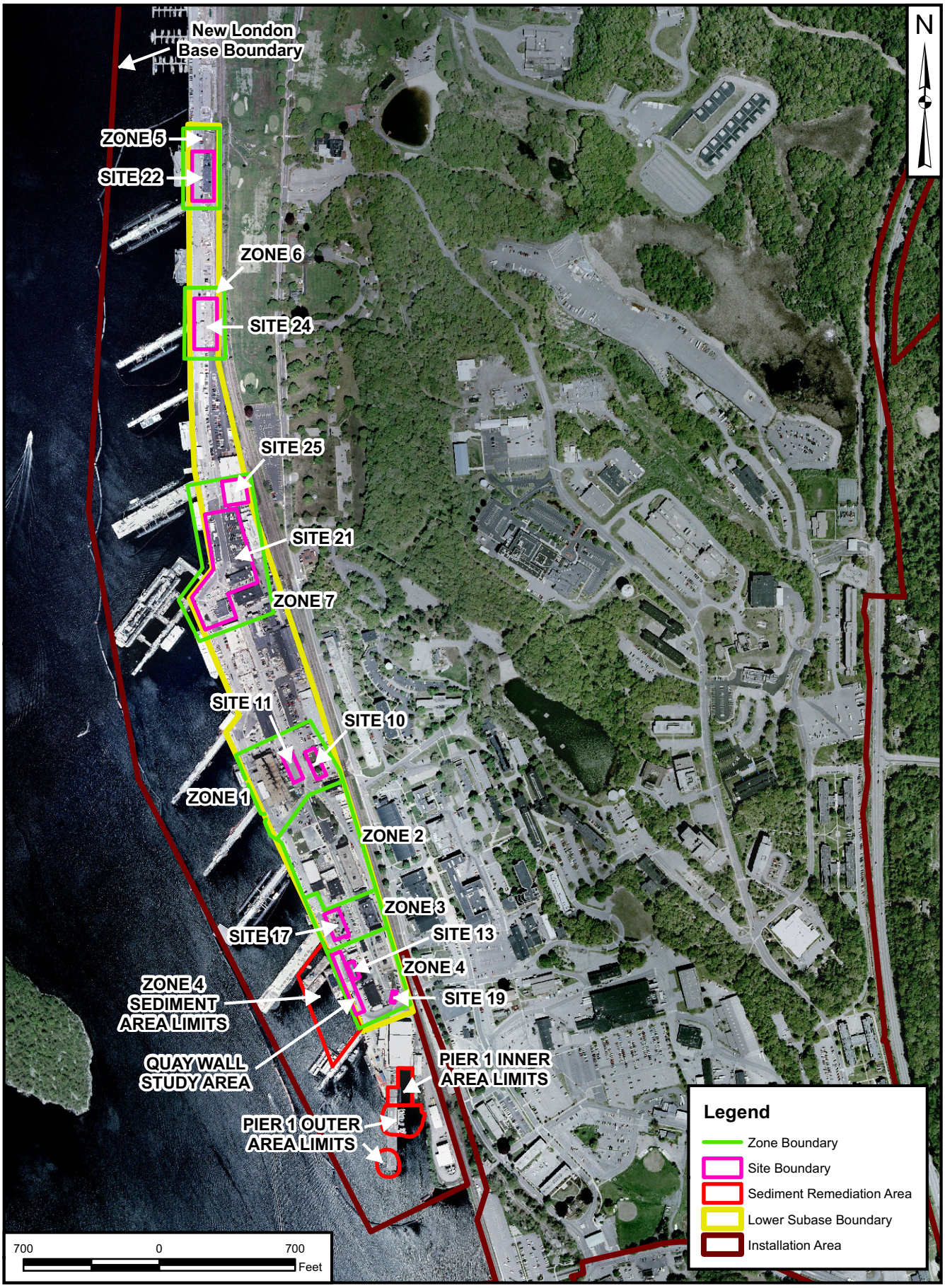

Figure 1. Lower Subase Site Location Map

The soils of the Lower Subase are classified as Urban Land and are underlain by 5 to 20 feet of sand and gravel backfill overlying natural deposits of sand or silt. Bedrock is estimated to be approximately 70 feet below ground surface (bgs) in Zones 1 through 4; 6 to 12 feet bgs along the Thames River in Zone 5; 40 feet bgs in Zone 6; and 50 feet bgs in Zone 7. The depth to groundwater increases from west to east across the Lower Subase. Depths to groundwater commonly range from approximately 4 to 6 feet bgs; however, depth to groundwater in the easternmost part of some zones can be as deep as 27 feet bgs. Groundwater flow is generally west toward the Thames River at low tide; however, in some zones, a groundwater flow reversal occurs during high tide and flow is to the east. Site characteristics and a summary of the extent of contamination for each zone are provided later in this document.

Figures showing the horizontal extent of soil contamination were developed using sample results and commonly used statistical techniques. Figures are presented in this plan for soil in Zones 1 through 4 and Zone 7. These figures display the concentrations of polycyclic aromatic hydrocarbons (PAHs), lead exceeding screening levels for direct contact hazards only, and TPH commingled (mixed) with lead-contaminated soil (Zone 4 only). Sediment contamination is shown for Zone 4, the only zone with sediment COCs. Figures have not been included for other contaminants identified as COCs because the locations where they were detected were within the areas of PAHs or lead. In addition, there are no contaminant maps for Zones 5 and 6, or for any other media, because there are no related COCs. In most locations, samples contained multiple chemicals that are all known as PAHs. To simplify the figures, PAHs are all represented by one concentration, called a benzo(a)pyrene (BaP) equivalent (EQ) concentration. This one BaPEQ concentration is used to help the Navy and EPA understand the combined hazard of multiple PAHs more easily than evaluating each PAH separately. The contaminant figures are color coded, with different colors used to represent various concentration ranges; the meanings of specific colors are shown in the figure legends.

The FS describes chemicals identified in Thames River surface water and sediments and Zones 2, 3, and 6 groundwater. Detailed descriptions of chemicals found in Zones 1 through 7 soil and Zones 1, 4, 5, and 7 groundwater can be found in the FS Addendum.

Thames River

In addition to soil and groundwater in Zones 1 through 7, this Proposed Plan addresses surface water and sediment in the Thames River adjacent to the Lower Subase (Figure 2). The Thames River is a tidally influenced, stratified estuary with a width that varies from 1,700 to 3,500 feet wide at the Lower Subase. A 600 to 900 feet wide dredged channel runs north to south in the Thames River, adjacent to the Lower Subase area. Outside the channel, water depths are relatively shallow (2 to 10 feet). Non-point discharges occur throughout the river's drainage basin and account for a significant amount of water, sediment, and chemical constituents in the river. In 2007, a Watershed Contaminated Source Document indicated that near-shore contaminated sediment adjacent to the Lower Subase was related to Navy activities in Zones 1 through 7, as well as from off-site (non-Navy) sources, although the contribution for all potential sources could not be established.

Investigations have determined that Thames River surface water quality is similar upstream and downstream of the Lower Subase, which indicates that Subase activities do not significantly affect chemical concentrations in surface water. Investigations have also shown that Thames River sediment adjacent to Zones 1, 2, 3, 5, 6, and 7 is not a concern for ecological receptors (finfish, sediment invertebrates, shellfish, and fish-eating birds) but Thames River sediment adjacent to Zone 4 and Outer Pier 1 has been determined to be a concern to certain ecological receptors (sediment invertebrates and fish-eating birds in Zone 4 and sediment invertebrates in Outer Pier 1) (Thames River Validation Study, 2008).

Ship maintenance activities from 1930 to 1960 at the former marine railway at Pier 1 may have contributed metals, PAHs, and PCBs to sediment. Pier 1 was divided into two subareas (Inner and Outer) based on contaminant distribution in sediment to support a CERCLA non-time critical removal action (Figure 3, shown in red). Clamshell dredging, completed in March 2010, removed the majority of the contaminated sediment. Hydraulic dredging will be completed in spring 2012 to remove the remaining contaminated sediment. A small area of contaminated sediment covered by several feet of clean sediment currently remains in place in Outer Pier 1 (Figure 3, shown in purple). Alternatives for this area were developed in the Lower Subase FS and are summarized in the Zone 4 and Outer Pier 1 sections below.

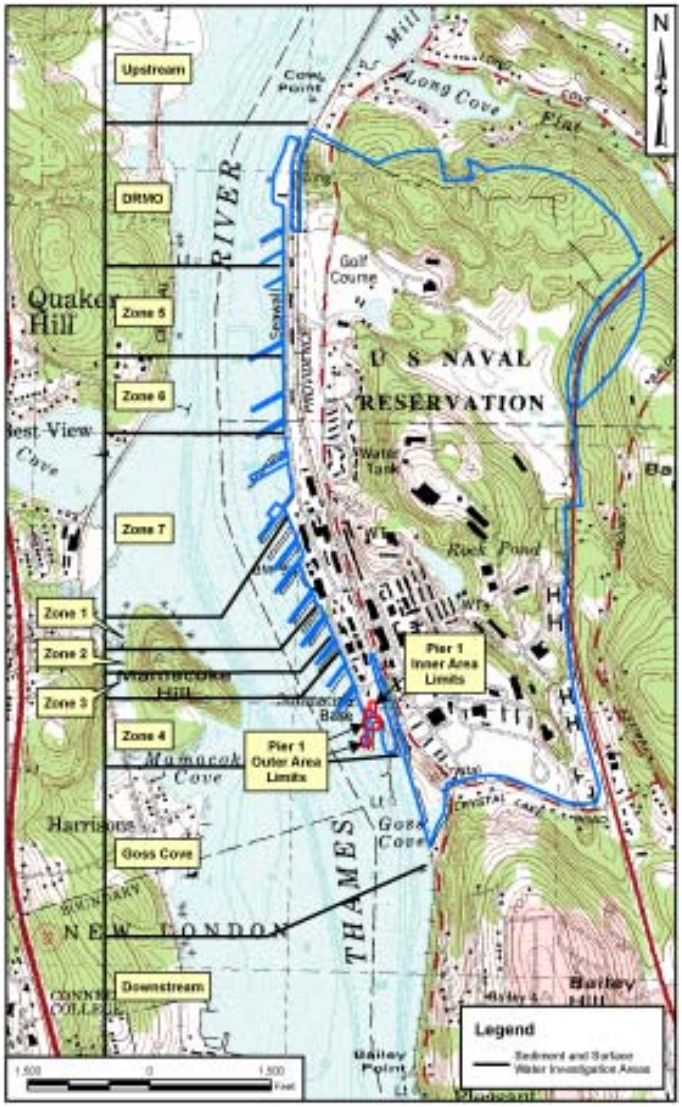

Figure 2. Thames River Sediment Investigation Zones

SCOPE AND ROLE OF RESPONSE ACTION

The FS Addendum for the Lower Subase was finalized in January 2012. It details the characterization and evaluation of the associated Installation Restoration (IR) Program sites and potential alternatives for remediation. This Proposed Plan summarizes the Navy's preferred remedial alternatives for addressing soil in the Lower Subase (OU4) and sediment in the Thames River adjacent to the Lower Subase at New London. No CERCLA action is required for groundwater or surface water. The ROD for OU4 will reflect the final remedial actions. A total of 12 OUs have been defined at New London to address the 23 sites included in the IR Program. Nine of these sites are addressed in this Proposed Plan; the remaining 14 IR Program sites were addressed in RODs for the other 11 OUs at New London. NFA has been documented or a remedy has been implemented at the other 11 OUs. OU4 is the last remaining OU for which a remedy has not been selected. However, soil at Sites 9 and 23, which has not been defined as an OU to date, is still being evaluated to determine whether further investigation under CERCLA will be required. If appropriate, the soil at these sites will be defined as OU13 and further evaluated under CERCLA.

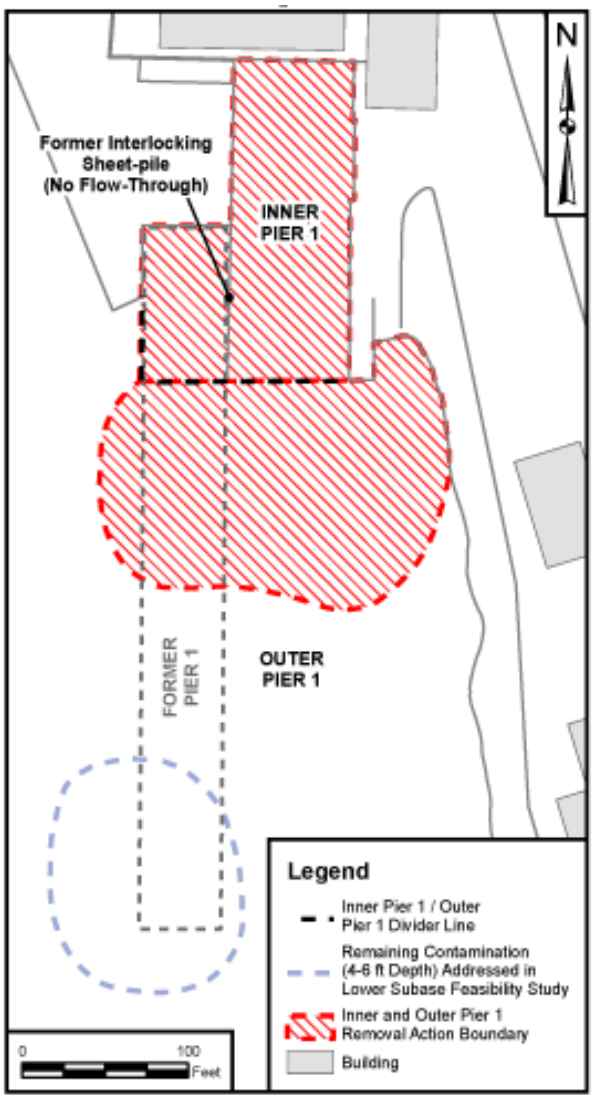

Figure 3. Inner and Outer Pier I Removal Action Locations

SUMMARY OF LOWER SUBASE SITE RISKS

This section summarizes results of the human health risk assessments (HHRAs) and ecological risk assessment (ERA) conducted during the Remedial Investigation (RI), which are applicable to the entire Lower Subase, and describes how human health and ecological risks are evaluated. The HHRA completed for an adult recreational user exposed to surface water, shellfish, and finfish and the associated uncertainty analysis, in combination, indicate no unacceptable risks to the receptor. Although they were not considered in the risk evaluation, other factors, including the significant depth of the river adjacent to NSB-NLON, CTDEEP's existing ban on recreational shellfish harvesting from the Thames River near the Lower Subase, and the physical boundaries installed by the Navy to prevent public access, all minimize human exposure to these media. A screening-level ERA indicated no unacceptable risks to sediment invertebrates posed by contaminants in Zones 1, 2, 3, 5, and 6 sediment; thus, sediment in these zones was not evaluated further. The ERA completed as part of the Thames River Validation Study, included an evaluation of Thames River sediment data in Zone 4, Zone 7, and a small area near Outer Pier 1 not included in the non-time-critical removal action. The results of the ERA are summarized in the following zone-specific sections.

Human Health Risks

HHRAs were performed for Zones 1 through 7 of the Lower Subase to characterize the potential risks to people likely to come into contact with soil and groundwater at the sites under current and potential future land use scenarios. The results of the HHRAs are summarized in the zone-specific sections. The Lower Subase is used strictly for industrial purposes and future residential development of the Lower Subase is not anticipated; however, a future residential scenario was evaluated for decision-making purposes. Groundwater beneath the Lower Subase is brackish and has been classified GB, which means it is not suitable for human consumption without treatment, and a public water supply service is available; thus, only exposure via direct contact (not human consumption) was considered when evaluating human health risk associated with contaminants in groundwater. Potential receptors under current land use are construction workers and full-time employees, and potential receptors under future land use are construction workers, full-time employees, and hypothetical residents (adults and children). Lead exposure was evaluated using residential and non-residential lead models, which predict the average blood-lead concentration in adult and child receptors.

Ecological Risks

Because Zones 1 through 7 contain a substantial amount of paved area and very little maintained lawn, they do not provide suitable habitat for wildlife. The only potential ecological habitat near the Lower Subase is the Thames River; thus, an ERA was only conducted for this area of the Lower Subase. A screening-level ERA was completed for sediment adjacent to each zone of the Lower Subase. The RI determined that potential unacceptable risks to fish-eating birds and/or sediment invertebrates exist in Outer Pier 1, Zone 4, and Zone 7 and that further evaluation in the Thames River Validation Study was necessary to determine ecological risks in these zones. The RI determined that ecological risks for other receptors (e.g., shellfish, finfish) and risks in Zones 1, 2, 3, 5, and 6 were acceptable and that further evaluation was not necessary.

The ERA conducted during the Thames River Validation Study (2008) focused on risks to fish-eating birds and sediment invertebrates in three areas of the Thames River adjacent to the Lower Subase (Zone 4, Zone 7, and Outer Pier 1). The results of this ERA are summarized in the zone-specific sections.

How are Human Health Risks Evaluated?

An HHRA estimates "baseline risk," which is an estimate of the likelihood of health problems occurring if no cleanup action is taken at a site. To estimate baseline risk at a site, the Navy undertakes a four-step process in accordance with EPA guidance:

Step 1: Analyze Contamination

Step 2: Estimate Exposure

Step 3: Assess Potential Health Dangers

Step 4: Characterize Site Risk

In Step 1, the Navy looks at the concentrations of chemicals found at a site as well as past scientific studies on the effects these chemicals have had on people (or animals when human studies are unavailable). Comparisons between site-specific concentrations and concentrations reported in past studies help determine which chemicals are most likely to pose the greatest threat to human health.

In Step 2, the Navy considers the different ways that people might be exposed to the chemicals identified in Step 1, the concentrations to which people might be exposed, and the potential frequency and duration of exposure. Using this information, the Navy calculates a "reasonable maximum exposure" (RME) scenario, which represents the highest level of human exposure that could reasonably be expected to occur.

In Step 3, the Navy uses the information from Step 2, combined with information on the toxicity of each chemical, to assess potential health risks. The likelihood of any kind of cancer resulting from exposure to a site is generally expressed as an upper bound probability, for example, a "1 in 10,000 chance." In other words, for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure to site chemicals. An extra cancer case means that one more person could get cancer than would normally be expected from all other causes. For non-cancer health effects, the Navy calculated a "hazard index (HI)," where a "threshold level" (measured usually as a hazard index of less than 1) exists, below which non-cancer health effects are no longer predicted.

In Step 4, the Navy determines whether site risks are great enough to cause health problems for people at or near the site. The results of the three previous steps are combined, evaluated, and summarized. The Navy adds the potential risks from the individual chemicals to determine the total risk resulting from the site.

How are Ecological Risks Evaluated?

An ERA is defined as a process that evaluates the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to one or more stressors. ERAs under the Superfund program typically focus on chemical stressors, but biological and physical stressors often need to be considered during evaluation of data as part of the ERA. The ERA process under Superfund consists of the following eight-steps:

Step 1. Screening-Level Problem Formulation and Ecological Effects Evaluation

Step 2. Screening-Level Preliminary Exposure Estimate and Risk Calculation

Step 3. Baseline Risk Assessment Problem Formulation

Step 4. Study Design and Data Quality Objectives

Step 5. Field Verification of Sampling Design

Step 6. Site Investigation and Analysis of Exposure and Effects

Step 7. Risk Characterization

Step 8. Risk Management

The first two steps in the process include screening chemicals to select chemicals of potential concern (COPCs), and determining whether the risk assessment process can stop, or needs to be continued to Step 3. These two steps comprise what is termed the screening level ERA.

Steps 3 through 7 comprise what is termed the baseline ERA. The first part of Step 3 is sometimes conducted as part of the screening ERA, and includes refining the list of COPCs from the screening ERA and determining which ecological receptors are at greatest risk so that the baseline ERA can focus on the COPCs and receptors that are of greatest concern. Site-specific studies (i.e., toxicity tests) typically are conducted as part of these steps to determine with more certainty whether the COPCs are impacting ecological receptors at the site, and the data can often be used to develop site-specific cleanup goals or PRGs. Step 8, Risk Management, is ultimately the responsibility of the site risk managers, who must balance risk reductions associated with cleanup of contaminants with the potential ecological impacts of implementing the remedial actions themselves, comprising the total risk resulting from the site.

REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) provide a general description of what the cleanup will accomplish. The RAOs are medium-specific goals that define the objectives of conducting cleanups to protect receptors that are at risk from contaminated media. The RAOs developed for Lower Subase soil and sediment, after considering current and potential future land use and receptors, are summarized in the zone-specific sections below. For zones in which COCs were identified, PRGs for both industrial/commercial (I/C) and residential land use were calculated and used to develop remedial alternatives. Human health risk-based PRGs for direct exposure were developed using a combination of the HHRA results and chemical-specific applicable or relevant and appropriate requirements (ARARs) (CTDEEP RSRs). Soils that have concentrations of contaminants at or greater than the direct exposure PRGs have the potential to cause health problems for individuals who have direct contact with the soil over an extended period of time. This is referred to as a direct contact concern. Direct contact concerns can occur in both residential and industrial settings.

When contaminated soil comes in contact with groundwater, there is a possibility that some of the contaminants will migrate into the groundwater. CTDEEP RSRs required an evaluation of the migration of contaminants from soil to groundwater for the Lower Subase. CTDEEP RSRs contain Pollutant Mobility Criteria (PMCs), which are contaminant concentrations in soil at which migration of contaminants from the soil to groundwater could cause future levels of chemicals in groundwater to exceed regulatory standards. The PMC were used to develop pollutant mobility standards for the Lower Subase. PMC values depend on the specific contaminant detected and the groundwater classification at the site. Site-specific PMCs, called Alternative PMCs, were calculated using a GB groundwater classification and assuming future land use as either residential or I/C. When the Alternative PMC was determined to meet CTDEEP RSR protectiveness standards for site conditions, although greater than the CTDEEP RSR PMC, it was used as the PRG. These criteria are referred to as the Alternative GB PMC PRGs for either residential or I/C site use. When the Alternative PMC was determined not to meet CTDEEP RSR protectiveness standards for site conditions, the CTDEEP RSR PMC was used as the PRG. To calculate PMCs under I/C land use, it was assumed that pavement with low permeability would be maintained on the site. To calculate PMCs under future residential land use, it was assumed that most of the site would be covered with grass and landscaping. More water was assumed to percolate through unsaturated soil to the water table under future residential land use than under I/C land use. Future residential land use was assumed to result in higher concentrations of groundwater contaminants than I/C land use. Additionally, site-specific Alternative PMCs are only allowed to be used in areas that do not contain light non-aqueous phase liquid (LNAPL). LNAPL is not present in any of the areas at OU4 that require CERCLA action.

As outlined in the Connecticut RSRs, the PMCs for PAHs are defined in terms of the concentration of the chemical in mass concentrations, such as micrograms per kilogram (µg/kg) (parts per billion). To evaluate pollutant mobility for metals in soil, the Connecticut RSRs stipulate that samples must be tested in a laboratory to measure how readily a particular metal can be leached into a solution. For the test, a portion of the soil sample is mixed with a standard solution for a set period of time. The concentration of the chemical in the solution is measured and reported in units of milligrams per liter (mg/L) (parts per million), which is then compared to the applicable PMC. Ecological PRGs were developed using the results of the baseline ERA completed in the Thames River Validation Study. Tables summarizing the COCs and PRGs for industrial and residential land use and ecological receptors are included in the zone-specific sections below.

The following RAOs were developed for human receptors exposed to surface/subsurface soil considering industrial and residential land use:

- **Soil RAO No.1:** Prevent exposure of current and future full-time employees and construction workers to surface/subsurface soil containing concentrations of COCs greater than I/C PRGs.
- **Soil RAO No. 2:** Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than PRGs.
- **Soil RAO No. 3:** Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.
- **Soil RAO No. 4:** Prevent exposure of hypothetical future residents to surface/subsurface soil containing concentrations of COCs greater than residential PRGs.

In addition, the following RAOs were developed for ecological receptors exposed to sediment adjacent to Zone 4 and Outer Pier 1 of the Lower Subase:

- **Sediment RAO No. 1:** Reduce risks to sediment invertebrates from exposure to bioavailable/bioaccessible COCs in Thames River sediment at Zone 4 and Outer Pier 1 to acceptable levels.
- **Sediment RAO No. 2:** Reduce risks to fish-eating birds from food-chain exposure to bioavailable/bioaccessible COCs in Thames River sediment at Zone 4 and Outer Pier 1 to acceptable levels.
- **Sediment RAO No. 3:** Mitigate the potential for bioavailable/bioaccessible COCs in Thames River sediment at Zone 4 and Outer Pier 1 to migrate to less impacted areas of the Thames River and cause adverse effects to receptors.

No contaminants were present in surface water in the Thames River at levels that exceed regulatory standards, and chemical concentrations in groundwater do not present unacceptable risks or exceed migration-to-surface water regulatory standards in any of the seven zones. Therefore, NFA is recommended for surface water and groundwater to ensure protection of human health and the environment.

SUMMARY OF REMEDIAL ALTERNATIVES

Remedial alternatives for the Lower Subase were originally presented in the FS. Data collected during the Soil and Groundwater Pre-Design Investigation (PDI) were used to update the estimated volumes of contaminated soil, costs, and remedial alternative evaluations for soil in Zones 1, 3, 4, and 7 in the FS Addendum. Remedial alternatives were also re-evaluated for sediment at Zone 4 and Outer Pier 1 in the FS Addendum. Information presented in

both the FS and FS Addendum was used to summarize the remedial alternatives for soil in Zones 1, 3, 4, and 7 and sediment in the Thames River. Estimated costs presented in the FS and FS Addendum include capital, operation and maintenance, and net present worth (NPW) costs. With the exception of Alternative 1 (No Action) and Alternatives S-4.2 and S-4.5A, all alternatives would attain the RAOs. NFA under CERCLA is recommended in Zones 2, 5, and 6 soil, Zones 1 through 7 groundwater, Thames River surface water, and Thames River sediment adjacent to Zones 1, 2, 3, 5, 6, and 7; thus, remedial alternatives were not developed for these media and zones. Alternatives for remediation were originally presented in the FS, but because of the results of the soil and groundwater PDI, many of the alternatives were not included in the FS Addendum. However, the alternative numbers were kept the same to make comparisons easier, so, in some instances, the alternative numbers discussed in the zone-specific sections are not consecutive.

For each alternative in which concentrations of COCs greater than residential PRGs remain, LUCs would establish institutional controls to restrict unauthorized disturbance of soil/sediment and prevent residential development. CERCLA risk-based engineering controls, including regular inspections and maintenance of building foundations and pavement (if applicable) already covering some areas of contaminated soil, are required when concentrations of COCs greater than the residential PRGs remain. CTDEEP RSRs require the CERCLA risk-based engineering controls to be comprised of a minimum of 3 inches of bituminous concrete or concrete, or be an existing building or another existing permanent structure. Under I/C site use, CTDEEP RSRs, which are CERCLA ARARs, allow low permeability pavement to be a CTDEEP RSR engineered control. A CTDEEP RSR engineered control is required in an area classified as I/C site use when concentrations of COCs are greater than the CTDEEP I/C direct exposure criteria (DECs) in top 2 feet of soil beneath paved areas, and/or where COCs are greater than the Alternative GB PMC PRGs for I/C site use in soil above the water table. By establishing CTDEEP RSR engineered controls, one type of LUC, in accordance with CERCLA ARARs (*i.e.*, CTDEEP RSRs), the Navy would meet the CTDEEP RSR requirements for managing exceedances of the State's numeric DEC and PMC standards. A draft LUC Remedial Design (RD) would be developed 90 days from the signing of the ROD to document the LUC requirements. Five-year reviews to evaluate the continued protectiveness of the remedy would be required for all alternatives in which contamination would remain in excess of levels that allow for unrestricted use and unlimited exposure. Long-term groundwater monitoring programs would be developed for all alternatives where soil with COC concentrations exceeding PRGs remains on site, including alternatives containing treatment of COCs to reduce pollutant mobility. Groundwater monitoring programs would be implemented and modified as necessary, based on the groundwater monitoring results.

Evaluation of Alternatives

Nine criteria are used to compare alternatives and select a final cleanup plan. The comparative analysis of the cleanup alternatives developed for soil in Zones 1, 3, 4, and 7 and sediment in Zone 4 and Outer Pier 1 of the Lower Subase are discussed in the zone-specific sections below. After comments from the State of Connecticut and the community are received and evaluated, the Navy and EPA will select the final cleanup plan.

Evaluation Criteria for Superfund Remedial Alternatives

Threshold Criteria:

1. Overall Protection of Human Health and the Environment: Will it protect you and the plant and animal life on and near the site? EPA and the Navy will not choose a plan that does not meet this basic criterion.
2. Compliance with ARARs: Does the alternative meet all federal environmental, state environmental, and facility siting statutes, regulations and requirements? The chosen cleanup plan must meet this criterion.

Primary Balancing Criteria:

3. Long-Term Effectiveness and Permanence: Will the effects of the cleanup plan last or could contamination cause future risk?
4. Reduction of Toxicity, Mobility or Volume through Treatment: Using treatment, does the alternative reduce the harmful effects of the contaminants, the spread of contaminants, and the amount of contaminated material?
5. Short-Term Effectiveness: How soon will site risks be adequately reduced? Could the cleanup cause short-term hazards to workers, residents, or the environment?
6. Implementability: Is the alternative technically feasible? Are the right goods and services (e.g., treatment machinery) available for the plan?
7. Cost: What is the total cost of an alternative over time? EPA and the Navy must find a plan that gives necessary protection for a reasonable cost.

Modifying Criteria:

8. State Acceptance: Does the state agree with the proposal?
9. Community Acceptance: What objections, suggestions, or modifications do the public offer during the comment period?

Preferred Alternatives

The Preferred Alternatives for contaminated media in each zone are described in detail in the zone-specific sections below. The Preferred Alternatives meet the threshold criteria and provide the best balance of tradeoffs among the alternatives. The Preferred Alternatives satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; and (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Although the alternatives do not satisfy the preference for treatment as a principal element, based on the cost

of treating the contaminated soil and the slight risk reduction that treatment would provide over the Preferred Alternatives, treatment was determined not to be a viable option.

It is the Navy's current judgment that the Preferred Alternatives identified in this Proposed Plan for Zones 1, 3, 4, and 7 soil and Thames River sediment adjacent to Outer Pier 1 and Zone 4 are necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from these sites that may present an imminent and substantial endangerment to public health or welfare. Further CERCLA action is not necessary for soil in Zones 2, 5, and 6, groundwater in Zones 1 through 7, surface water in the Thames River, or sediment in the Thames River adjacent to Zones 1, 2, 3, 5, 6, and 7.

PROPOSED PLAN BY ZONE

This section includes the site background and characteristics, human and ecological risks, RAOs, description of remedial alternatives, and the Preferred Alternative for each of the seven zones (when applicable) of the Lower Subase.

PROPOSED PLAN – ZONE 1

SITE BACKGROUND – ZONE 1

Zone 1 extends from Darter Road, south of Building 89, to the southern side of Corvina Road (Figure 4). The Providence and Worcester Railroad runs along the eastern border of the zone, and the Thames River forms the western border of the zone. The two

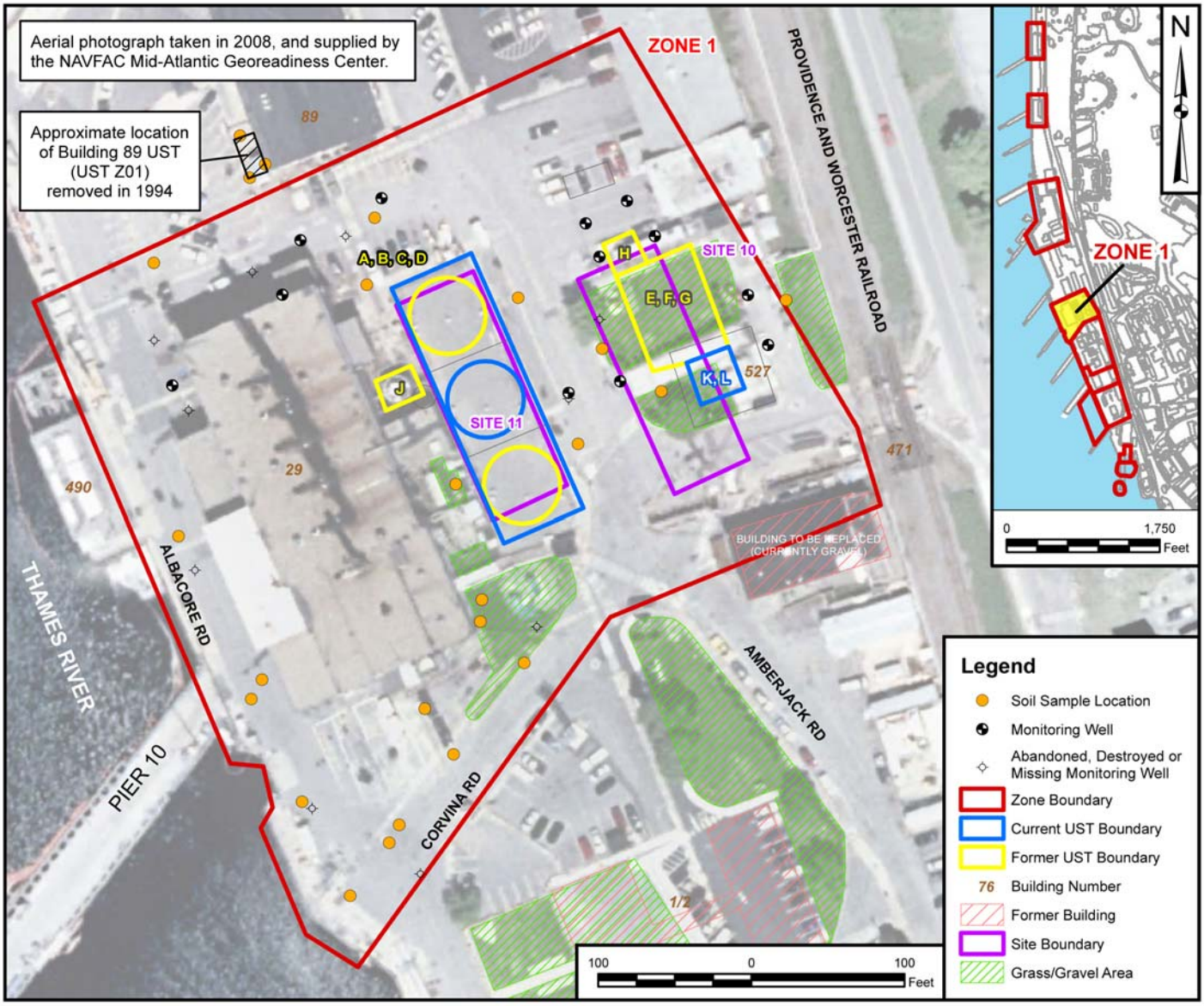

Figure 4. Zone 1 Location Map

Table 2: Zone 1 Site Description and Summary of Actions

Source	Description	Summary of Actions
Site 10: Fuel Storage Tanks and Tank 54-H	Five concrete USTs placed into service during World War II. Three were used to store diesel fuel and two stored lubrication and hydraulic oils. A sixth tank (54-H) was used as a reclamation tank for the others.	• Tanks E, F, G, and 54-H were decommissioned in 1987. • Tanks K and L were decommissioned in 1989 and the shells were used to provide secondary containment for newly installed steel tanks.
Site 11: Power Plant Oil Tanks	Tanks A, B, C, and D were USTs that had been in place in place since World War II and used to store No. 6 fuel oil, diesel oil, and waste from the bilge-water oil recovery system.	• Oil leakage was observed during tank cleaning. Tanks A, B, C, and D were repaired and used as containment structures for three 150,000-gallon steel USTs. • Two of the steel tanks were abandoned in 2011.
Tank J	Tank J held waste oil.	• Removed in 1943.
Building 89 UST (located North of Site 11)	Building 89 UST (UST Z01) was installed in 1982 and used to store No. 2 fuel oil.	• The tank failed testing in 1993 and was drained of its contents. In early 1994, the tank and associated piping were excavated and removed from the site. • In 1996, the Navy replaced a section of pipe that failed pressure testing.

IR Program sites in Zone 1 include Site 10 – Fuel Storage Tanks and Tank 54-H and Site 11 – Power Plant Oil Tanks. The major suspected sources of contamination at Zone 1 include leaks or spills associated with on-site USTs. Table 2 contains descriptions of Zone 1 sources and a summary of actions that have occurred at Zone 1.

SITE CHARACTERISTICS – ZONE 1

Figure 5 shows the locations in Zone 1 in which high concentrations of PAHs have been found in surface and subsurface soil. As noted previously, the BaPEQ concentrations represent a combination of several PAHs found in soil. Soil with BaPEQ concentrations at or above 1,000 µg/kg exceed regulatory residential direct contact standards. Soil with BaPEQ concentrations exceeding these standards could cause health problems for individuals who have direct contact with the soil over an extended period of time. The area with the high BaPEQ concentrations extends from east of Site 11 to the Thames River in the northern half of Zone 1. BaPEQ concentrations were generally greater in surface (0 to 2 feet bgs) than subsurface soil (greater than 2 feet bgs). In some portions of the contaminated areas, concentrations of individual PAHs in soil exceed pollutant mobility residential regulatory standards and could cause future levels of chemicals in groundwater to exceed acceptable concentrations for residential use. PAH concentrations that exceed pollutant mobility regulatory standards depend on the specific PAHs detected but range from 2,600 to 40,000 µg/kg.

In addition to PAHs, mercury was detected in three of 11 subsurface soil samples at a maximum concentration of 83.4 milligrams per kilogram (mg/kg) (parts per million) at test boring TB2-1RI. Lead concentrations in Zone 1 surface and subsurface soil were below residential regulatory standards (400 mg/kg). Leachate tests were performed on Zone 1 soil samples to evaluate pollutant mobility in Zone 1. Leachate test results were below residential regulatory standards except for a result from a subsurface sample of 0.194 mg/L.

It is important to understand that although PAH and lead concentrations in Zone 1 soil exceed the residential regulatory pollutant mobility standard, the results of groundwater sampling completed during the Lower Subase Soil and Groundwater PDI indicated that these contaminants have not migrated from the soil into groundwater. If no action is taken to address PAH and lead contamination in Zone 1 soil, migration of PAHs and lead may occur in the future.

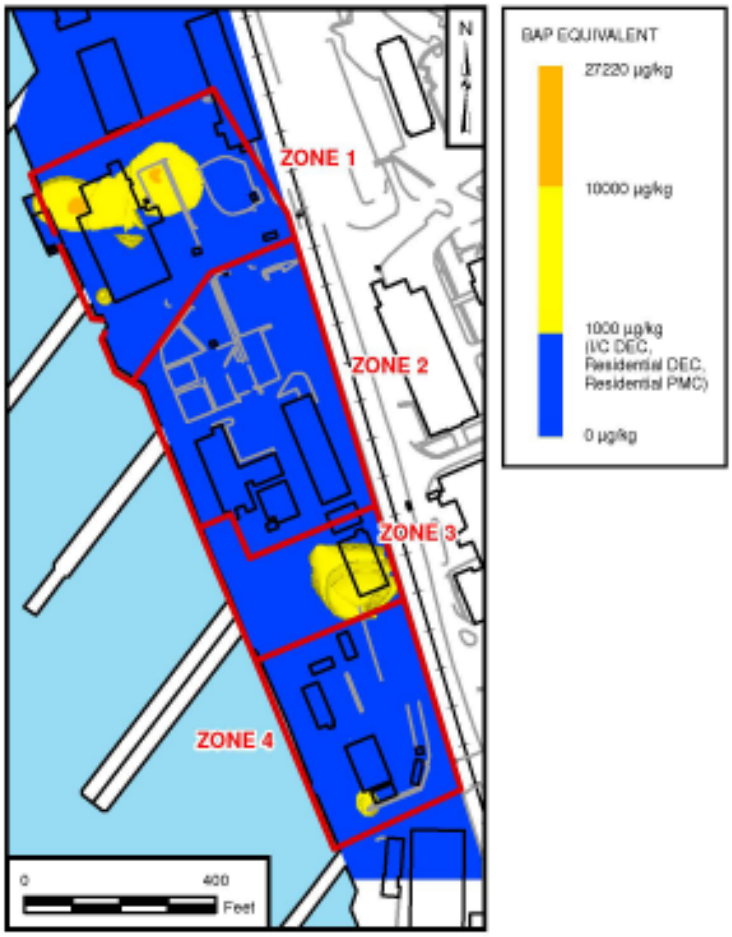

Figure 5. Zones 1 Through 4 BAP Equivalent Concentrations

No contaminants regulated under CERCLA were detected in Zone 1 groundwater, surface water, or sediment at concentrations that cause a concern.

Based on these results, soil was carried forward as a medium of concern for Zone 1; groundwater, surface water, and sediment were determined not to be media of concern for Zone 1.

TABLE 3: ZONE 1 HUMAN HEALTH RISK ASSESSMENT SUMMARY

	INDUSTRIAL LAND USE				RESIDENTIAL LAND USE					
	CONSTRUCTION WORKERS		FULL-TIME EMPLOYEES		FUTURE RESIDENTS					
	CURRENT/FUTURE		CURRENT	FUTURE	CHILD		ADULT	LIFE-LONG		LIFE-LONG
RISK MEASURE	SURFACE/ SUBSURFACE SOIL DIRECT EXPOSURE	GROUNDWATER DIRECT EXPOSURE	SURFACE SOIL DIRECT EXPOSURE	SURFACE/ SUBSURFACE SOIL DIRECT EXPOSURE	SURFACE/ SUBSURFACE SOIL DIRECT EXPOSURE	RISK DRIVERS	SURFACE/ SUBSURFACE SOIL DIRECT EXPOSURE	SURFACE/ SUBSURFACE SOIL DIRECT EXPOSURE	RISK DRIVERS	VAPOR INTRUSION
Cancer Risk[1]	3 per 1,000,000	8 per 100,000,000	5 per 100,000	6 per 100,000	7 per 10,000	PAHs, arsenic	1 per 10,000	8 per 10,000	PAHs, arsenic	3 per 1,000,000
Hazard Index[2]	1	0.04	No COPCs	0.3	4	Mercury	0.4	NA	NA	0.01

Notes

1	> 1 per 10,000 considered unacceptable cancer risk
2	Hazard Index > 1 is considered unacceptable
NA	Not applicable for this receptor
COPCs	chemicals of potential concern

SUMMARY OF SITE RISKS – ZONE 1

Human Health Risks – Zone 1

Table 3 summarizes the cumulative HIs and cancer risks for current and future receptors for Zone 1.

There are unacceptable human health risks for soil in Zone 1 for residential land use only. Arsenic was only a minor contributor to the unacceptable cancer risk for future residents; risk associated with arsenic alone is considered acceptable. There are no unacceptable risks to humans exposed to groundwater, surface water, or sediment in Zone 1. A conceptual site model illustrates the receptors and exposure pathways in Zone 1 and is included as Figure 6.

Ecological Risks – Zone 1

Ecological risks for Zone 1 are acceptable. The conceptual site model for Zone 1 shows the ecological receptors and exposure pathways evaluated during the ERA (Figure 6).

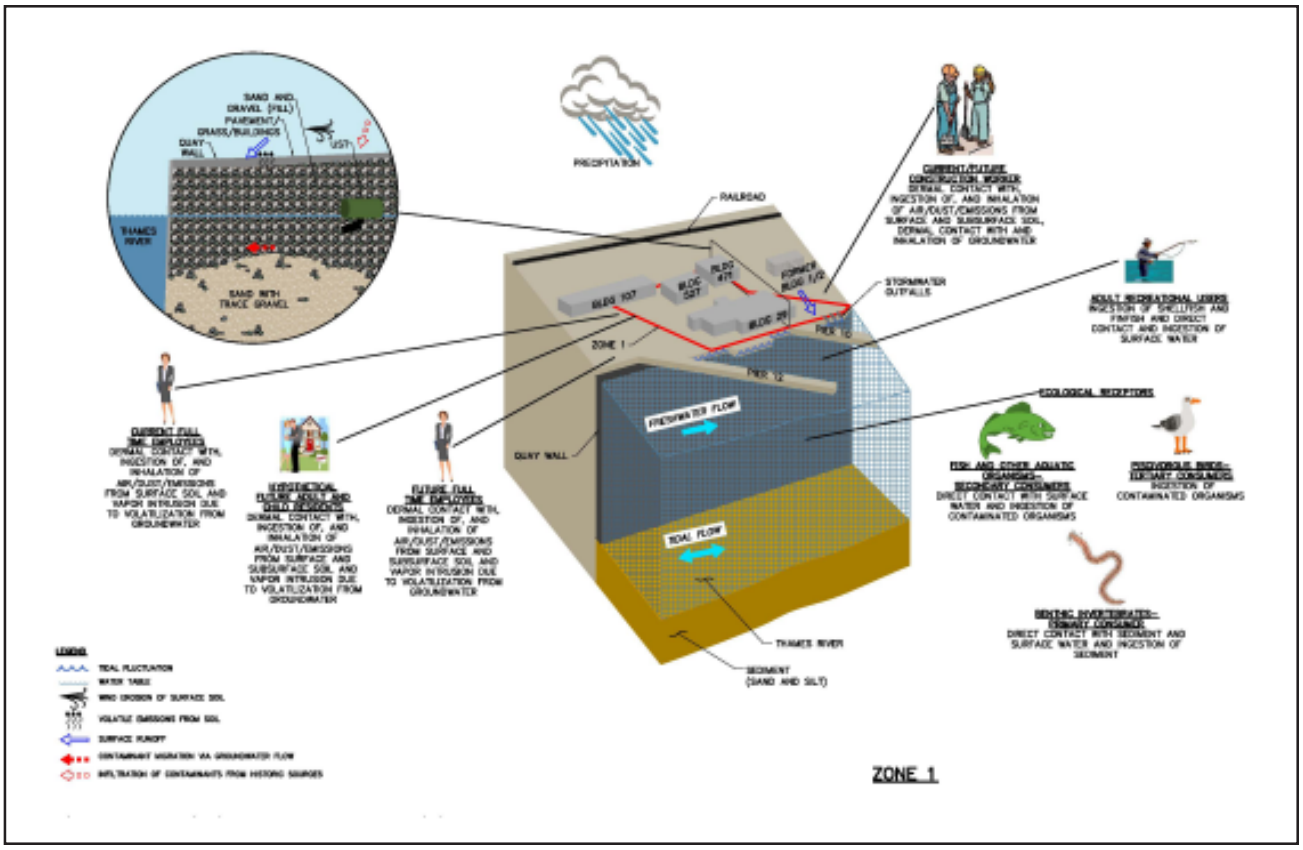

Figure 6. Exposure Pathways for Zone 1

Table 4: Zone 1 Chemicals of Concern and Preliminary Remediation Goals

Chemical of Concern	Preliminary Remediation Goals			
	Direct Exposure Criteria for Industrial Land Use+	Direct Exposure Criteria for Residential Land Use(1)	Pollutant Mobility Criteria for Industrial Land Use+	Pollutant Mobility Criteria for Residential Land Use (1,2)
Benzo(a)anthracene	Not a concern	1,000 µg/kg	Not a concern	4,000* µg/kg
Benzo(a)pyrene	Not a concern	1,000 µg/kg	Not a concern	6,000* µg/kg
Benzo(b)fluoranthene	Not a concern	1,000 µg/kg	Not a concern	2,600* µg/kg
Benzo(k)fluoranthene	Not a concern	Not a concern	Not a concern	6,500* µg/kg
Chrysene	Not a concern	Not a concern	Not a concern	6,800* µg/kg
Dibenzo(a,h)anthracene	Not a concern	1,000 µg/kg	Not a concern	5,100* µg/kg
Indeno(1,2,3-cd)pyrene	Not a concern	1,000 µg/kg	Not a concern	6,000* µg/kg
Phenanthrene	Not a concern	Not a concern	Not a concern	40,000 µg/kg
Lead	Not a concern	Not a concern	Not a concern	0.15 mg/L
Mercury	Not a concern	24 mg/kg*	Not a concern	Not a concern

+ Based on the existing site covers (soil and building foundations).

* Calculated site-specific criterion. See Note (1).

1 Pollutant Mobility Criteria and Direct Exposure Criteria are Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations criteria, except where flagged with an asterisk (*). Flagged values are calculated site-specific criteria, referred to as Alternative GB PMCs.

2 Pollutant Mobility Criteria for areas of Zone 1 where no light non-aqueous phase liquid is present and Alternative Pollutant Mobility Criteria are allowable.

RAOs for Zone 1 Soil

The following RAOs were developed for surface/subsurface soil in Zone 1 for residential land use and receptors:

- **Soil RAO No. 1**: Does not apply to Zone 1.
- **Soil RAO No. 2**: Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than PRGs.
- **Soil RAO No. 3**: Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.
- **Soil RAO No. 4**: Prevent exposure of hypothetical future residents to surface/subsurface soil containing concentrations of COCs greater than residential PRGs.

Table 4 summarizes the human health COCs and PRGs for Zone 1 that were calculated as acceptable levels of COCs in soil under the residential land use scenario.

Summary of Remedial Alternatives for Zone 1 Soil

Descriptions of Zone 1 soil remedial alternative are summarized in Table 5.

TABLE 5: ZONE 1 DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS
PAGE 1 OF 2

ALTERNATIVE DESCRIPTION/EVALUATION CRITERION	ALTERNATIVE S-1.1 NO ACTION	ALTERNATIVE S-1.2 LUCS (ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND INSPECTIONS) AND MONITORING	ALTERNATIVE S-1.5 EXCAVATION TO MEET RESIDENTIAL PRGS, ON-SITE DEWATERING, AND OFF-SITE DISPOSAL
Description	Evaluated as required by CERCLA as a baseline for comparison to other alternatives. Under this alternative, the Navy would take no action in Zone 1.	Instituting CERCLA LUCs and inspections to prohibit soil disturbance and future residential development. LUCs would include CERCLA risk-based engineering controls (maintenance and inspection of building foundations and pavement), institutional controls to meet residential PRGs, and maintenance of monitoring wells. Upon implementation, this alternative would allow I/C site use only.	Excavation and off-site disposal of soil with concentrations of COCs greater than residential PRGs. Upon implementation, this alternative would allow unrestricted site use.
Area Addressed (square feet [sf])	NA	An implementable LUC boundary was created to encompass the 44,800 sf of soil where residential PRGs were exceeded (Figure 7a). The LUC boundary contains approximately 65,300 sf. Within this area, building foundations and approximately 48,000 sf of pavement would be maintained through CERCLA risk-based engineering controls to meet residential PRGs.	Excavation over approximately 44,800 sf up to 15 feet deep (Figure 7b).
Volume Addressed (cubic yards [cy])	NA	NA	Excavation and off-site disposal of approximately 12,600 cy.
Comments	Because contamination would remain in excess of levels that allow for unrestricted use and unlimited exposure, five-year reviews would be required under this alternative.	A long-term groundwater monitoring program for all COCs that exceed the residential soil PRGs would be implemented. Monitoring frequency would be quarterly for the first 2 years, semi-annually for the next 2 years, annually the fifth year, and every 5 years thereafter. Five-year reviews would be required under this alternative.	Groundwater monitoring and LUCs would not be required because all soil with COC concentrations greater than PRGs would be removed. After excavation, confirmation samples would be collected to verify that all contaminated soil has been removed. Excavation areas would be backfilled with clean soil.
EVALUATION CRITERION			
Overall Protection of Human Health and Environment	Not protective.	Protective.	Protective.
Compliance with ARARs and TBCs	Would not comply.	Would comply.	Would comply.
Long-Term Effectiveness and Permanence	Not effective.	Effective. LUCs would ensure protection but LUCs are not as effective as Alternative S-1.5 because soil with concentrations greater than residential PRGs would remain onsite.	Most effective. All soil with concentrations greater than PRGs would be removed from the site.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Would not include treatment.	Would not include treatment.	There would be no treatment, except the treatment of water generated from the dewatering process prior to discharge to the Thames River. A very small mass of COCs would be treated by this process.

TABLE 5: ZONE 1 DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS
PAGE 2 OF 2

ALTERNATIVE DESCRIPTION/EVALUATION CRITERION	ALTERNATIVE S-1.1 NO ACTION	ALTERNATIVE S-1.2 LUCS (ENGINEERING CONTROLS, INSTITUTIONAL CONTROLS, AND INSPECTIONS) AND MONITORING	ALTERNATIVE S-1.5 EXCAVATION TO MEET RESIDENTIAL PRGS, ON-SITE DEWATERING, AND OFF-SITE DISPOSAL
Short-Term Effectiveness	No short-term risks. Would not achieve soil RAOs.	Minimal potential for short-term risks from worker exposure during groundwater sampling or utility excavation activities; no impacts to environment or community. Three months to implement and achieve soil RAOs. Residential PRGs would be met through CERCLA risk-based engineering controls and institutional controls.	High potential for short-term risks from worker exposure during excavation; transport of contaminated soil through community; dust from excavation. Four months to implement and achieve soil RAOs. Residential PRGs would be met through excavation and off-site disposal. .
Implementability	Requires only five-year reviews.	Easy to implement; resources are readily available. No base construction approval would be needed; LUC RD can be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than Alternative S-1.2 because the remedy involves more complex actions, but the resources are readily available. Sheet piles would be installed for excavation support and to protect buildings; dewatering system would be required; water treatment and disposal system would be required; base construction approval would be needed.
Costs:			
Capital	$0	$23,000	$6,157,000
Annual O&M Cost	$25,000	$42,000 Years 1 and 2; $28,000 Years 3 and 4; $46,000 every fifth year $5,000 annually all other years	$0
NPW	$104,000	$420,000	$6,157,000

NOTES:

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chemicals of concern
cy	Cubic yard
LUC	Land use control
LUC RD	Land use control remedial design
NPW	Net present worth
O&M	Operation and maintenance
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RD	Remedial Design
sf	Square Feet
TBC	To be considered (criteria)

Blue font indicates Preferred Alternative

Table 6: Summary of Zone 1 Preferred Alternative			
Alternative Number	**Alternative Name (Cost)**	**Why this Alternative is the Best Balance of Trade-offs**	**Reason for Choice of Alternative**
S-1.2	LUCs (Engineering Controls, Institutional Controls, and Inspections) and Monitoring (30-Year NPW $420,000) (Figure 7a)	• Is protective and provides long-term effectiveness and permanence to ensure protection. • Easy and straightforward to implement • Lowest short-term risk • Most cost-effective approach that ensures protection	• Zone 1 has soil exceeding residential PRGs; therefore, a remedy is needed. • Building foundations and pavement already covering most of Zone 1 act as CERCLA risk-based engineering controls to prevent exposure to contaminated soil. These covers must be maintained for continued protectiveness. • Soil in Zone 1 has relatively low concentrations (no I/C COCs). • Other alternatives are more expensive without significantly more human health protectiveness. • Other alternatives have greater potential short-term human health risks associated with implementation activities.

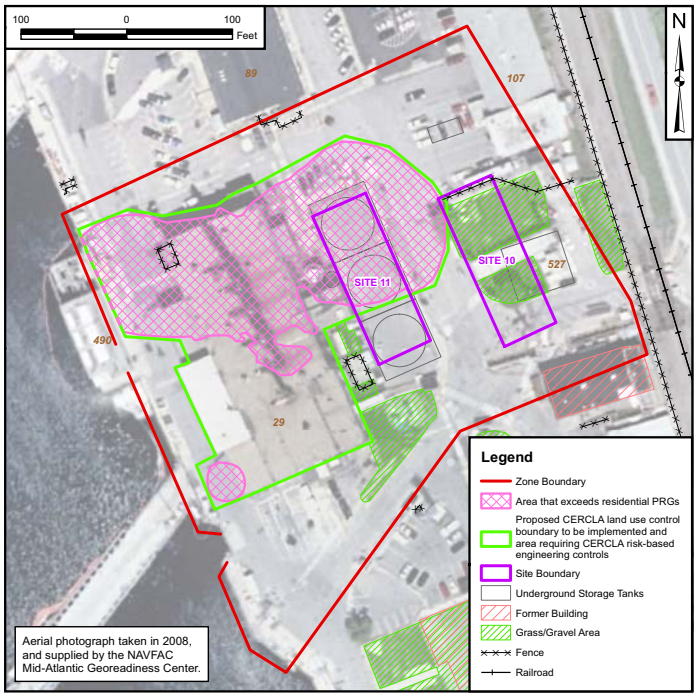

Figure 7a. Zone 1 Alternative S-1.2 Components

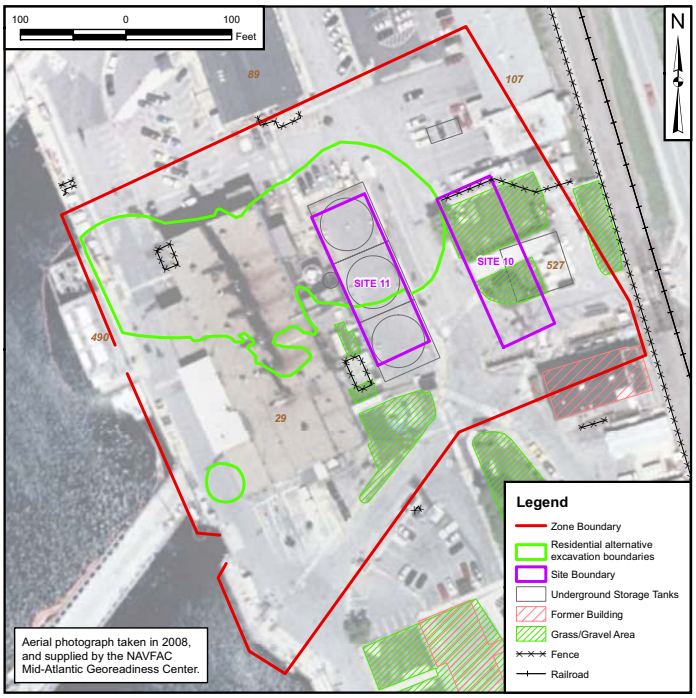

Figure 7b. Zone 1 Alternative S-1.5 Components

EVALUATION OF ALTERNATIVES FOR ZONE 1 SOIL

Table 5 summarizes how well each of the cleanup alternatives developed for soil in Zone 1 meets the first seven criteria. After comments from the State and community are received and evaluated, the Navy and EPA will select the final cleanup plan.

PREFERRED ALTERNATIVE FOR ZONE 1 SOIL

Table 6 summarizes the Navy and EPA's Preferred Alternative for cleaning up Zone 1 Soil.

PROPOSED PLAN – ZONE 2

SITE BACKGROUND AND CHARACTERISTICS – ZONE 2

Zone 2 extends from the southern boundary of Zone 1 along Corvina Road south to Capelin Road (Figure 8). With the exception of the former subsurface fuel oil distribution lines and steam, condensate, and electrical ducts, no other suspected contaminant sources have been identified within Zone 2. Table 7 contains a description of Zone 2 sources and a summary of actions that have occurred at Zone 2.

No contaminants regulated under CERCLA were detected in Zone 2 soil, groundwater, surface water, or sediment at concentrations that cause a CERCLA risk.

SUMMARY OF SITE RISKS – ZONE 2

Table 8 summarizes the cumulative HIs and cancer risks for current and future receptors for Zone 2. No unacceptable human-health or ecological risks for chemicals regulated under CERCLA have been identified in Zone 2.

Human health risks from exposure to Zone 2 soil and groundwater and ecological risks from exposure to Zone 2 sediment are considered acceptable. A conceptual site model graphically illustrates the human and ecological receptors and exposure pathways in Zone 2 and is included as Figure 9.

RAOS FOR ZONE 2

Because there are no unacceptable CERCLA human health or ecological risks, there are no CERCLA COCs for Zone 2 media; thus, RAOs were not developed for Zone 2.

Figure 8. Zone 2 Location Map

Table 7: Zone 2 Site Description and Summary of Actions		
Source	**Description**	**Summary of Actions**
Oil distribution, steam, and condensate lines and electrical ducts.	Prior to their abandonment in 1996, subsurface fuel oil distribution lines ran throughout Zone 2.	Leak testing was performed on the lines and valves in the fuel oil distribution system within Zone 2 in 1996; all portions of the distribution system within Zone 2 passed the leak testing. The lines were subsequently abandoned in place.

Table 8: Zone 2 Human Health Risk Assessment Summary								
Risk Measure	Industrial Land Use				Residential Land Use			
	Construction Workers		Full-Time Employees		Future Residents			
	Current/Future		Current	Future	Child	Adult	Life-Long	Life-Long
	Surface/ Subsurface Soil Direct Exposure	Groundwater Direct Exposure	Surface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Vapor Intrusion
Cancer Risk[1]	2 per 10,000,000	1 per 100,000,000	2 per 1,000,000	3 per 1,000,000	3 per 100,000	6 per 1,000,000	4 per 100,000	1 per 1,000,000
Hazard Index[2]	0.3	0.001	No COPCs	0.009	0.1	0.01	NA	0.003

Notes

1 > 1 per 10,000 considered unacceptable cancer risk

2 Hazard Index > 1 is considered unacceptable

NA Not applicable for this receptor

COPCs chemicals of potential concern

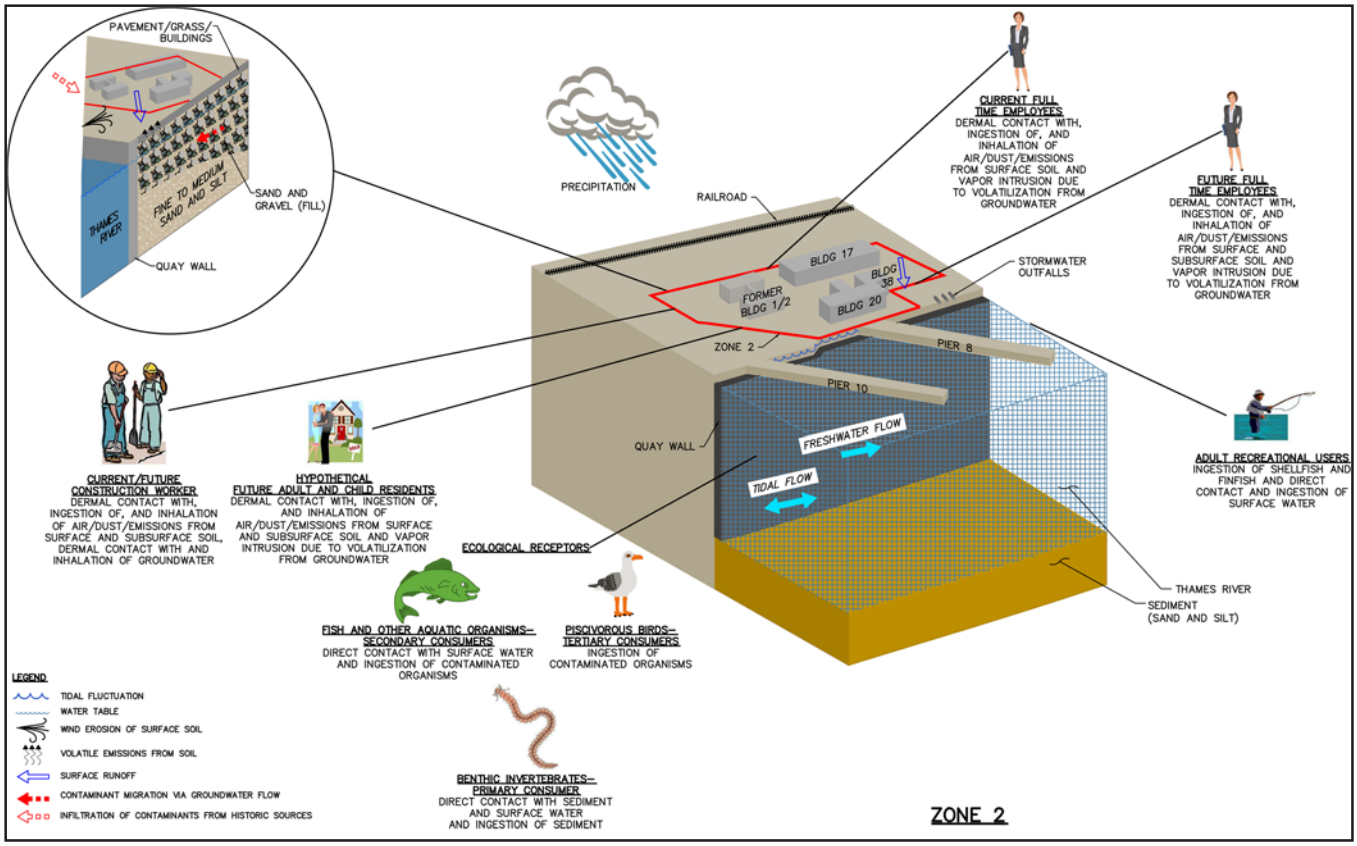

Figure 9. Exposure Pathways for Zone 2

SUMMARY OF REMEDIAL ALTERNATIVES FOR ZONE 2

No further CERCLA action is necessary for Zone 2 soil, groundwater, surface water, or sediment; thus, remedial alternatives were not developed for Zone 2.

PROPOSED PLAN – ZONE 3

SITE BACKGROUND – ZONE 3

Zone 3 extends from Capelin Road along the southern end of Zone 2 to the southern end of Bullhead Road (Figure 10). The one IR Program site in Zone 3 is Site 17 – Hazardous Materials/Solvent Storage Area (Former Building 31). Building 31 was used as a battery overhaul shop until the 1950s and then as a hazardous materials storage area from the 1970s to the 1990s. The major sources of contamination at Zone 3 include battery overhaul activities and leaks from the former fuel distribution line. Table 9 contains descriptions of Zone 3 sources and a summary of actions that have occurred at Zone 3.

Site Characteristics – Zone 3

Figure 5 shows the locations in Zone 3 at which high concentrations of PAHs have been found in surface and subsurface soil. As noted previously, the BaPEQ concentrations represent a combination of several PAHs found in the soil. Soil with BaPEQ concentrations above 1,000 µg/kg exceed regulatory residential direct contact standards. Soil with concentrations of BaPEQ exceeding these standards could cause health problems for individuals who have direct contact with the soil over an extended period of time. As shown on Figure 5, a small area of Zone 3 has high BaPEQ concentrations.

Lead was detected at mass concentrations greater than 4,000 mg/kg, which exceeds regulatory standards, in both surface and subsurface soil in the southwestern portion of Zone 3 (Figure 11). Additionally, lead leachate concentrations exceeded regulatory standards in soil from this area, with a maximum lead leachate concentration of 5.88 mg/L. In 1995, a CERCLA time-critical removal action was completed at former Building 31 in Zone 3 to cleanup soil with concentrations greater than 500 mg/kg of total lead and/or 5.0 mg/L leachate lead. The majority of contaminated soil at Building 31 was excavated and treated through solidification, which reduced the leachability of lead in the treated soil, but did not reduce the overall concentration of lead in the soil. Soil in three areas adjacent to Building 31 was excavated, disposed of off site, and then replaced with uncontaminated soil. In one of these areas, soil with concentrations greater than 500 mg/kg of total lead and/or 5.0 mg/L leachate lead was excavated to the mean high water table and replaced with clean fill. [Contamination remains in this area below the mean high water table (Figure 11).] The other two areas were excavated to 3 feet bgs (Figure 11). Soil with lead concentrations greater than 400 mg/kg remains in half of one of the areas that was excavated to 3 feet bgs, as shown on Figure 11. Additionally, some untreated soil in the vicinity of former Building 31 still contains elevated concentrations of mass and leachable lead.

High concentrations of mass lead in both treated and untreated soil could cause health problems for individuals who have direct contact with the soil over an extended period of time. High concentrations of leachable lead in untreated soil could cause future levels of chemicals in groundwater to exceed acceptable concentrations for residential and industrial use. Concentrations of leachable lead in treated soil do not exceed pollutant mobility regulatory standards because solidification reduced these concentrations to acceptable levels. Lead concentrations shown on Figure 11 represent the current concentrations at Zone 3.

It is important to understand that although lead concentrations in soil in untreated areas of Zone 3 exceed pollutant mobility standards, the results of groundwater sampling completed during the Lower Subase Soil and Groundwater PDI indicated that lead has not migrated from the soil into groundwater. If no action is taken to address lead contamination in Zone 3 soil, migration of PAHs and lead from soil to groundwater may occur in the future.

No contaminants regulated under CERCLA were detected in Zone 3 groundwater, surface water, or sediment at concentrations that cause a concern.

Based on these results, soil was carried forward as a medium of concern for Zone 3; groundwater, surface water, and sediment were determined not to be media of concern for Zone 3.

SUMMARY OF SITE RISKS – ZONE 3

Human Health Risks – Zone 3

Table 10 summarizes the cumulative HIs and cancer risks for current and future receptors for Zone 3, and Table 11 summarizes the results of lead modeling completed for Zone 3 soil.

The lead models showed that average concentrations of lead would not be a hazard to workers or residents. Lead concentrations in localized areas of Zone 3 present acute (short-term exposure) risks to both industrial and residential receptors. The Navy made a decision based on the acute toxicity risks presented by lead to address lead contamination in Zone 3 soil. The conceptual site model presented as Figure 12 illustrates the receptors and exposure pathways in Zone 3.

Ecological Risks – Zone 3

Ecological risks for Zone 3 are acceptable. The conceptual site model for Zone 3 includes ecological receptors and exposure pathways evaluated during the ERA (Figure 12).

RAOS FOR ZONE 3 SOIL

The following RAOs were developed for surface/subsurface soil in Zone 3 considering industrial land use and receptors:

- **Soil RAO No.1:** Prevent exposure of current and future full-time employees and construction workers to surface/subsurface soil containing concentrations of COCs greater than I/C PRGs.
- **Soil RAO No. 2:** Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than PRGs.
- **Soil RAO No. 3:** Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.

In addition, the following RAO was developed for surface/subsurface soil in Zone 3 considering residential land use and receptors:

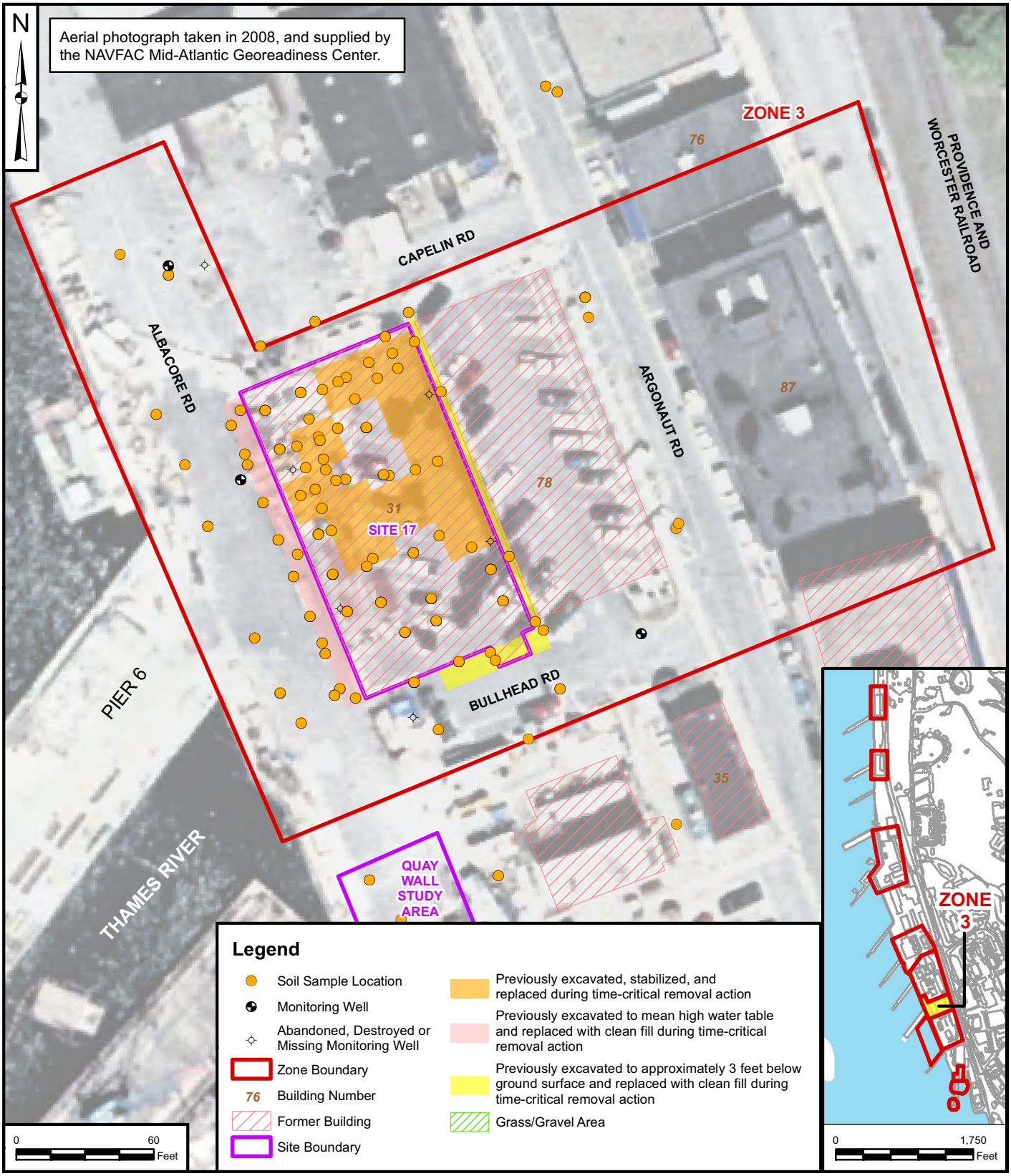

Figure 10. Zone 3 Location Map

Table 9: Zone 3 Site Description and Summary of Actions		
Source	Description	Summary of Actions
Site 17: Hazardous Materials/Solvent Storage Area (Building 31)	Former Battery Overhaul Shop (Former Building 31) was constructed in 1917 and used as a battery overhaul shop until the mid-1950s and was the main hazardous/flammable materials warehouse from the 1970s to late 1990s. Materials stored included acids, ketones, and hydroxides.	• In 1993, a time-critical removal action was completed in Building 31 to cleanup lead-contaminated soil through excavation and on-site solidification (mixing with a stabilizing agent to prevent leaching of lead from soil to groundwater). Figure 10 shows the area where cleanup of lead-contaminated soil occurred at Building 31. • Building 31 was demolished in 2001, and Building 78, located adjacent to Building 31, was demolished in 2005. The Building 31 foundation was left in place to act as a cap over lead-contaminated soil. A parking lot was constructed in the area formerly occupied by Buildings 31 and 78.
Subsurface Oil Distribution Lines	Oil distribution lines ran through Zone 3.	• Pressure leak testing was performed on the lines and valves in 1996; system within Zone 3 met testing criteria.

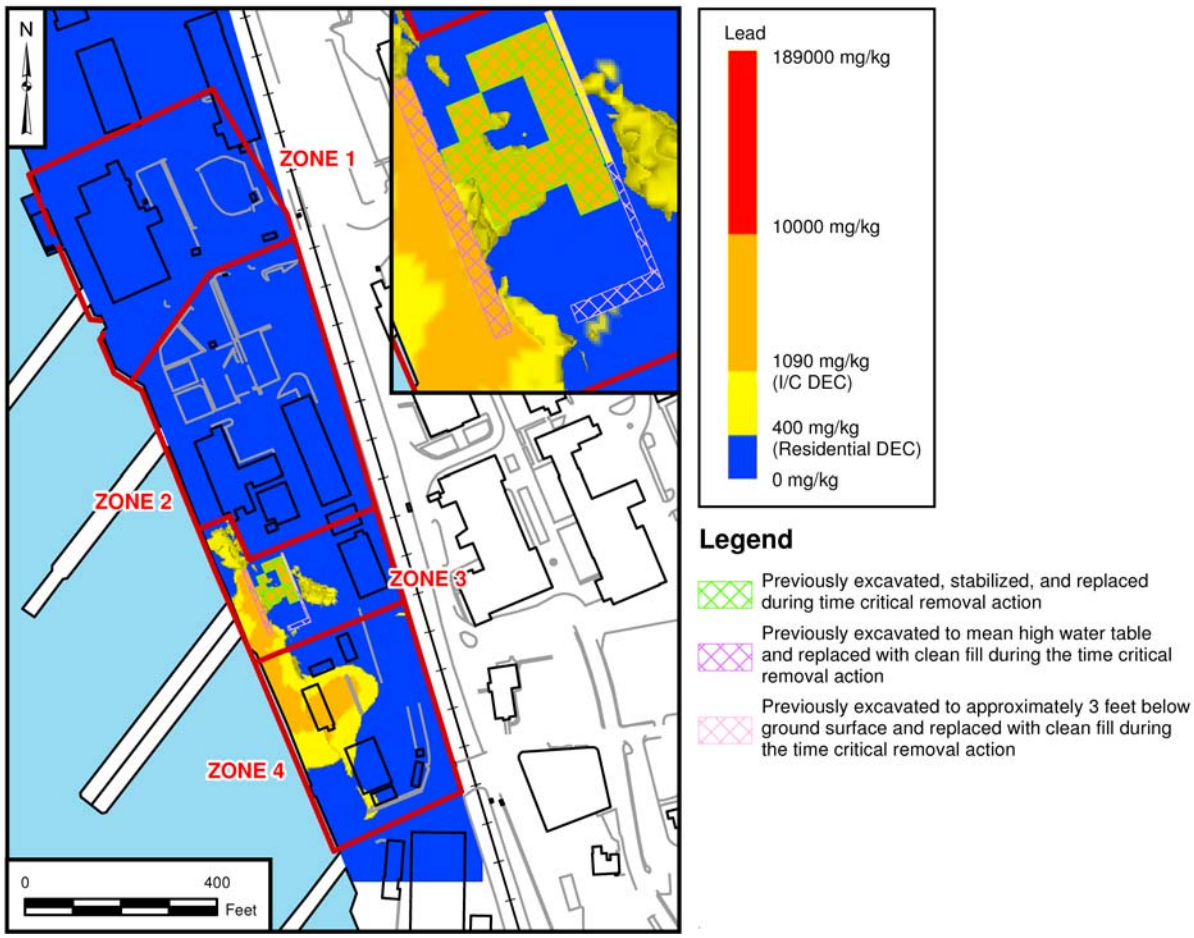

Figure 11. Zones 1 through 4 Lead Concentrations

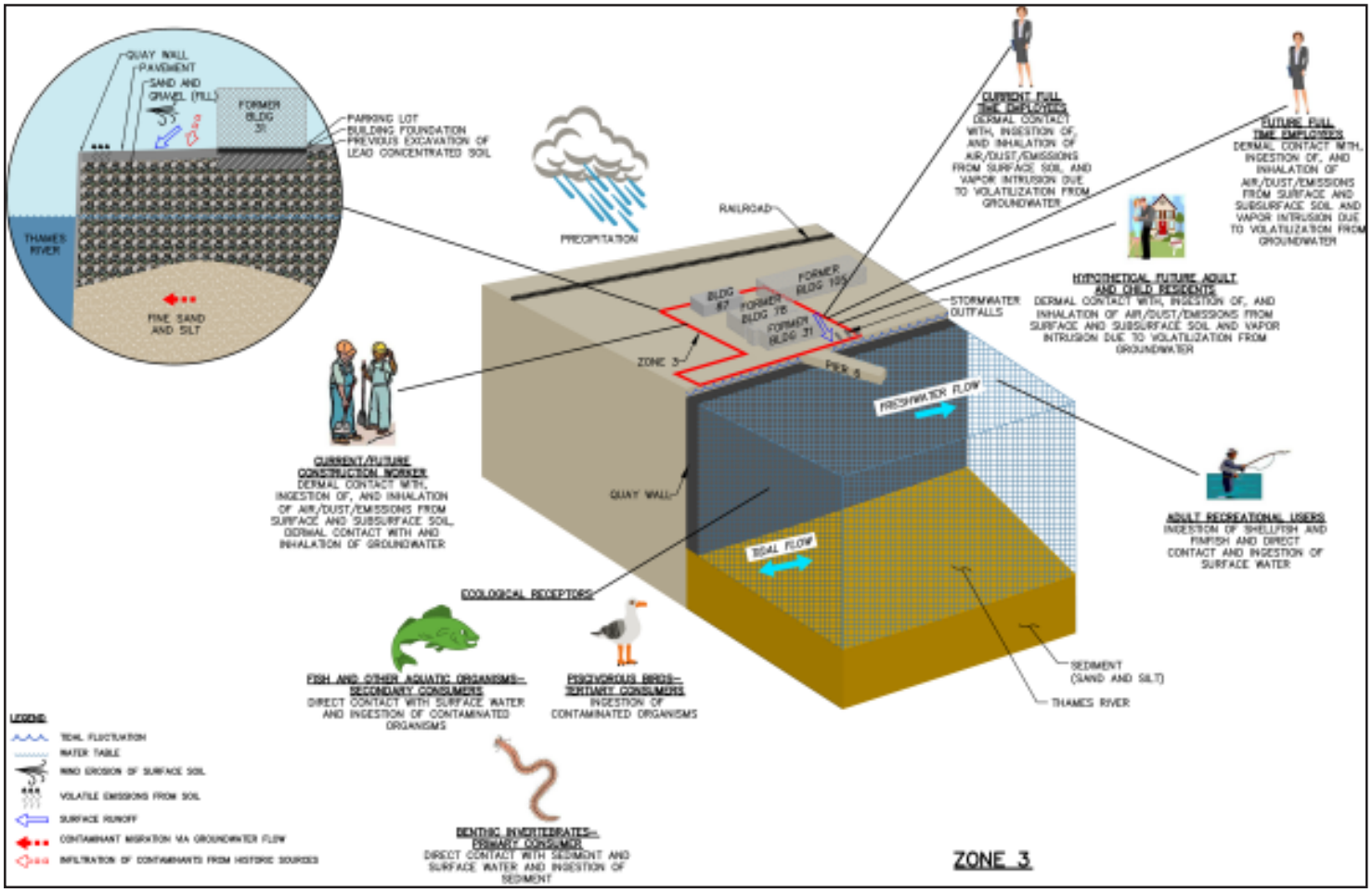

Figure 12. Exposure Pathways for Zone 3

Table 10: Zone 3 Human Health Risk Assessment Summary

Risk Measure	Industrial Land Use				Residential Land Use			
	Construction Workers		Full-Time Employees		Future Residents			
	Current/Future		Current	Future	Child	Adult	Life-Long	Life-Long
	Surface/ Subsurface Soil Direct Exposure	Groundwater Direct Exposure	Surface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Vapor Intrusion
Cancer Risk[1]	3 per 10,000,000	1 per 1,000,000,000	1 per 1,000,000	6 per 1,000,000	6 per 100,000	1 per 100,000	7 per 100,000	NA
Hazard Index[2]	0.3	0.006	0.009	0.01	0.1	0.01	NA	NA

Notes

1 > 1 per 10,000 considered unacceptable cancer risk

2 Hazard Index > 1 is considered unacceptable

NA Not applicable for this receptor

Table 11: Zone 3 Lead Models Summary				
Percentage of Estimated Fetal Blood Lead Level Greater than 10 microgram per deciliter (µg/dL)				
Risk Measure	Industrial Land Use			Residential Land Use
	Construction Workers	Full-Time Employees		Child
	Current/Future	Current	Future	Future
Blood Lead Level (%)[1]	0.04	0.03	0.02	1

Notes

1 Blood lead levels exceeding 10 µg/dL for more than 5% of fetuses or children are considered unacceptable.

Table 12: Zone 3 Chemicals of Concern and Preliminary Remediation Goals				
	Preliminary Remediation Goals			
Chemical of Concern	Direct Exposure Criteria for Industrial Land Use (1, 2)	Direct Exposure Criteria for Residential Land Use (1)	Pollutant Mobility Criteria for Industrial Land Use (1,2)	Pollutant Mobility Criteria for Residential Land Use (1)
Benzo(a)anthracene	Not a concern	1,000 µg/kg	Not a concern	Not a concern
Lead	1,090 mg/kg*	400 mg/kg	0.47 mg/L	0.15 mg/L

* Calculated site-specific criterion. See Note (1).

[1] Pollutant Mobility Criteria and Direct Exposure Criteria are Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations criteria, except where flagged with an asterisk (*). Flagged value is a site-specific criterion

[2] Based on existing site covers (soil and building foundations)

- **Soil RAO No. 4:** Prevent exposure of hypothetical future residents to surface/subsurface soil containing concentrations of COCs greater than residential PRGs.

Table 12 summarizes the human health COCs and PRGs for Zone 3 that were calculated as acceptable levels of COCs in soil under both industrial and residential land use scenarios.

There are no human health groundwater, surface water, or sediment CERCLA COCs or ecological COCs for Zone 3; thus, no PRGs were calculated for human or ecological receptors for these media.

SUMMARY OF REMEDIAL ALTERNATIVES FOR ZONE 3 SOIL

Descriptions of remedial alternatives for Zone 3 soil are summarized in Table 13.

TABLE 13: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 3 SOIL REMEDIAL ALTERNATIVES
PAGE 1 OF 5

	Alternative S-3.1 No Action	Alternative S-3.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-3.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.4 In-Situ Treatment (Stabilization/ Solidification) to Meet Alternative GB PMCs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5A Excavation to Meet I/CDirect Exposure PRGs, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5B Excavation to Meet I/CPRGs, Off-Site Disposal LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.6 Excavation to Meet Residential PRGs, On-Site Dewatering, and Off-Site Disposal
Description	Evaluated as required by CERCLA as a baseline for comparison to other alternatives. Under this alternative, the Navy would take no action in Zone 3.	Instituting CERCLA LUCs and inspections to prohibit soil disturbance and future residential development and meet PRGs. CERCLA LUCs would include CERCLA risk-based engineering controls (maintenance of building foundations and pavement) and institutional controls to meet residential PRGs, and maintenance of monitoring wells. CTDEEP RSR engineered controls would be implemented in a small area of Zone 3 where COC concentrations exceed I/C DEC and PMC PRGs. These controls would include a higher level of pavement maintenance to ensure that pavement prevents infiltration and direct exposure. Upon implementation, this alternative would allow I/C site use only.	Excavation and off-site disposal of soil with lead concentrations greater than the I/C direct exposure PRG to a depth of 2 feet bgs in paved areas to allow installation of the cap; soil with lead concentrations above the Alternative GB PMC PRG for I/C site use between 2 feet bgs and the mean high water table would be capped with an impervious cover system to prevent lead migration from soil to groundwater. After installation of the cap, the area would be backfilled with clean soil and site pavement would be restored. CERCLA LUCs and CTDEEP RSR engineered controls similar to Alternative S-3.2 would be required. Upon implementation, this alternative would allow I/C site use only.	This alternative would include removal of asphalt pavement and in-place mixing of soil in the unsaturated zone (above the water table) with lead concentrations greater than the I/C PRGs with Portland cement to chemically stabilize the lead and prevent migration from soil to groundwater. This process would also reduce the direct exposure risk by changing the characteristics of the soil. After treatment, asphalt pavement would be restored. CERCLA LUCs similar to Alternative S-3.2 would be required. CTDEEP RSR engineered controls would not be required. Upon implementation, this alternative would allow I/C site use only.	This alternative would include excavation and off-site disposal of soil with lead concentrations greater than the I/C direct exposure PRG to a depth of 2 feet bgs. After excavation, the area would be backfilled with clean soil and site pavement restored. CERCLA LUCs and CTDEEP RSR engineered controls similar to Alternative S-3.2 would be required. Upon implementation, this alternative would allow I/C site use only.	This alternative is similar to Alternative S-3.5A, except soil with lead concentrations greater than both the I/C direct exposure PRGs and Alternative GB PMC PRGs for I/C site use would be excavated to a depth of 2 feet bgs for soil greater than the I/C direct exposure PRG, and to the water table for soil greater than the Alternative GB PMC PRGs for I/C site use. CERLCA LUCs similar to Alternative S-3.2 would be required. CTDEEP RSR engineered controls would not be required. Upon implementation, this alternative would allow I/C site use only.	Excavation and off-site disposal of soil with concentrations of COCs greater than residential and I/C PRGs. Upon implementation, this alternative would allow unrestricted site use.

TABLE 13: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 3 SOIL REMEDIAL ALTERNATIVES
PAGE 2 OF 5

	Alternative S-3.1 No Action	Alternative S-3.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-3.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.4 In-Situ Treatment (Stabilization/ Solidification) to Allow I/C Site Use and Meet Alternative GB PMCs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5A Excavation to Meet I/CDirect Exposure PRGs, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5B Excavation to Meet I/CPRGs, Off-Site Disposal LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.6 Excavation to Meet Residential PRGs, On-Site Dewatering, and Off-Site Disposal
Area Addressed (sf)	NA	An implementable LUC boundary was created to encompass the 52,700 sf of soil where residential PRGs were exceeded (Figure 13a). The LUC boundary contains approximately 60,900 sf. Within this area, building foundations and approximately 46,600 sf of pavement would be maintained through CERCLA risk-based engineering controls to meet residential PRGs. A 6,200 sf area contains soil with concentrations of COCs greater than the I/C PRGs and would be maintained through CTDEEP RSR engineered controls.	Soil in a 6,200 sf area would be excavated to a depth of 2 feet bgs; soil in a 4,800 sf area beneath that would be capped (Figure 13b). Within the LUC area, building foundations and 46,600 sf of pavement would be maintained through CERCLA risk-based engineering controls and 4,800 would be maintained through CTDEEP RSR engineered controls. Lead-contaminated soil beneath buildings/already treated is considered environmentally isolated and inaccessible and would not be capped.	Soil in a 6,200 sf area to a depth of 4 feet bgs would be treated in place (Figure 13c), Within the LUC area, building foundations and 46,600 sf of pavement would be maintained through CERCLA risk-based engineering controls. CTDEEP RSR engineered controls are not required because all soil with COC concentrations greater than the Alternative GB PMC PRGs would be treated to reduce pollutant mobility to levels below the PRGs. In addition, all soil with concentrations of COCs greater than the I/C direct exposure PRGs would be treated. The treatment process would change the soil characteristics and would reduce the direct exposure risks to levels below the I/C PRGs. Lead-contaminated soil beneath buildings/already treated is considered environmentally isolated and inaccessible and would not be treated.	Soil in a 5,120 sf area to a depth of 2 feet bgs would be excavated (Figure 13d). Within the LUC area, building foundations and 46,600 sf of pavement would be maintained through CERCLA risk-based engineering controls and 6,200 sf of pavement would be maintained through CTDEEP RSR engineered controls. Lead-contaminated soil beneath buildings/already treated is considered environmentally isolated and inaccessible and would not be excavated.	Soil in a 6,200 sf area, to a depth of up to 4 feet bgs, would be excavated (Figure 13c). Within the LUC area, building foundations and 46,600 sf of pavement would be maintained through CERCLA risk-based engineering controls. CTDEEP RSR engineered controls are not required because all soil with COC concentrations greater than I/C PRGs would be excavated. Lead-contaminated soil beneath buildings/already treated is considered environmentally isolated and inaccessible and would not be excavated.	Soil in a 52,700 sf area with COC concentrations greater than residential and I/C PRGs to a depth up to 15 feet bgs would be excavated (Figure 13e).
Volume Addressed (cy)	NA	NA	Approximately 290 cy of soil addressed through excavation and off-site disposal; unknown volume addressed through capping.	Approximately 750 cy would be treated and mixed in place; treatment/mixing would result in an increase in volume of 75 cy, which would be disposed of off site after testing confirms it is non-hazardous.	Approximately 240 cy of excavated soil would be transported off site for disposal.	Approximately 750 cy of excavated soil would be transported off site for disposal.	Approximately 12,000 cy of excavated soil would be transported off site for disposal.

TABLE 13: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 3 SOIL REMEDIAL ALTERNATIVES
PAGE 3 OF 5

	Alternative S-3.1 No Action	Alternative S-3.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-3.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.4 In-Situ Treatment (Stabilization/ Solidification) to Allow I/C Site Use and Meet Alternative GB PMCs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5A Excavation to Meet I/CDirect Exposure PRGs, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5B Excavation to Meet I/CPRGs, Off-Site Disposal LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.6 Excavation to Meet Residential PRGs, On-Site Dewatering, and Off-Site Disposal
Comments	Because contamination would remain in excess of levels that allow for unrestricted use and unlimited exposure, five-year reviews would be required under this alternative.	Long-term groundwater monitoring for all COCs that exceed residential soil PRGs would be implemented. For cost estimating purposes, the monitoring frequency was assumed to be quarterly for the first 2 years, semi-annually for the next 2 years, annually the fifth year, and every 5 years thereafter. Final details for the monitoring program will be documented in a long-term monitoring plan developed after the ROD is signed.	LUCs and monitoring similar to Alternative S-3.2 would be implemented, in addition to regular cap inspections and maintenance. Confirmation samples would be collected to verify that soil with COC concentrations greater than the I/C direct exposure PRGs has been removed.	LUCs and monitoring similar to Alternative S-3.2 would be implemented to ensure that building foundations and pavement are maintained and the remedy was effective in decreasing the concentrations of COCs to levels below the I/C PRGs. Following treatment, confirmation samples would be collected beneath and around the treated area to verify that all contaminated soil has been treated. Additional confirmation samples would be collected from the treated area within 1 month and tested to verify the treated soil contains COC concentrations below the I/C PRGs.	LUCs and monitoring similar to Alternative S-3.2 would be implemented to ensure that building foundations/pavement are maintained and COCs are not migrating from soil to groundwater. Following excavation, confirmation samples would be collected from the walls of the excavated area to verify that soil with concentrations greater than I/C direct exposure PRGs has been removed.	LUCs, monitoring, and confirmation sampling similar to Alternative S-3.5A would be implemented.	Excavation beyond a depth of approximately 6 feet bgs would take place below the water table. No LUCs or monitoring would be required because the remaining soil would not contain concentrations of COCs above the residential PRGs.
Evaluation Criterion							
Overall Protection of Human Health and Environment	Not protective.	Protective.	Protective.	Protective.	Protective.	Protective.	Protective.
Compliance with ARARs and TBCs	Would not comply.	Would comply.	Would comply.	Would comply.	Would comply.	Would comply.	Would comply.
Long-Term Effectiveness and Permanence	Not effective.	Effective CTDEEP RSR engineered controls were determined to be effective to address lead concentrations that exceed the CTDEEP Alternative GB PMC PRGs. LUCs would ensure protection but LUCs are not as effective as Alternatives S-3.3 through S-3.6 because all soil with concentrations greater than PRGs would remain onsite.	More effective than Alternative S-3.2 and S-3.5A because all soil with concentrations greater than I/C direct exposure PRGs would be removed but soil with concentrations greater than the Alternative GB PMC PRGs for I/C site use would be capped and left in place.	Approximately as effective as Alternative S-3.3 but more effective than Alternatives S-3.2 and S-3.5A. Treatment would reduce both direct exposure and pollutant mobility but material would remain onsite.	More effective than Alternative S-3.2 but less effective than Alternatives S-3.3 and S-3.4. Soil that is not environmentally isolated and contains concentrations greater than I/C direct exposure PRGs would be removed, but soil with concentrations greater than Alternative GB PMC PRGs for I/C site use would be left in place, with asphalt pavement covering it (no engineered cap as in S-3.3).	More effective than Alternatives S-3.2, S-3.3, S-3.4, and S-3.5A. All soil that is not environmentally isolated and contains concentrations greater than the I/C PRGs would be removed from the site.	Most effective. All soil with concentrations greater than the residential PRGs would be removed.

TABLE 13: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 3 SOIL REMEDIAL ALTERNATIVES
PAGE 4 OF 5

	Alternative S-3.1 No Action	Alternative S-3.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-3.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.4 In-Situ Treatment (Stabilization/ Solidification) to Allow I/C Site Use and Meet Alternative GB PMCs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5A Excavation to Meet I/CDirect Exposure PRGs, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5B Excavation to Meet I/CPRGs, Off-Site Disposal LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.6 Excavation to Meet Residential PRGs, On-Site Dewatering, and Off-Site Disposal
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	There is no treatment.	There is no treatment.	There is no treatment.	Would reduce lead toxicity and mobility by in-situ chemical stabilization/solidification.	There is no treatment.	There is no treatment.	There is no treatment, except the treatment of water generated from the dewatering process prior to discharge to the Thames River. A very small mass of COCs will be treated by this process.
Short-Term Effectiveness	No short-term risks. Would not achieve soil RAOs or meet Zone 3 soil PRGs.	Minimal potential for short-term risks from worker exposure during groundwater sampling. No impacts to environment or community. Three months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C PRGs would be met through CTDEEP RSR engineered controls.	Moderate potential for short-term risks from worker exposure during cap installation and groundwater sampling; transport of contaminated soil through the community; dust from excavation. After planning, 1 month to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C direct exposure PRGs would be met through excavation and off- site disposal, and Alternative GB PMC PRGs for I/C site use would be met through CTDEEP RSR engineered controls and capping.	Moderate potential short-term risks from worker exposure during treatment and groundwater sampling; no impacts to environment or community. After planning, 1 month to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C PRGs would be met through in-situ treatment.	Moderate potential short-term risks from worker exposure during excavation; transport of contaminated soil through the community; dust from excavation. After planning, 1 month to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C direct exposure PRGs would be met through excavation and off-site disposal and Alternative GB PMC PRGs for I/C site use would be met through CTDEEP engineered controls.	Moderate potential short-term risks from worker exposure during excavation; transport of contaminated soil through the community; dust from excavation. After planning, 1.5 months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C PRGs would be met through excavation and off-site disposal.	High potential for short-term risks from worker exposure during excavation; transport of contaminated soil through the community; dust from excavation. After planning, 6 months to implement and achieve soil RAOs. Residential and I/C PRGs would be met through excavation and off-site disposal.

TABLE 13: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 3 SOIL REMEDIAL ALTERNATIVES
PAGE 5 OF 5

	Alternative S-3.1 No Action	Alternative S-3.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-3.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.4 In-Situ Treatment (Stabilization/ Solidification) to Allow I/C Site Use and Meet Alternative GB PMCs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5A Excavation to Meet I/CDirect Exposure PRGs, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.5B Excavation to Meet I/CPRGs, Off-Site Disposal LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-3.6 Excavation to Meet Residential PRGs, On-Site Dewatering, and Off-Site Disposal
Implementability	Requires only five-year reviews.	Easy to implement; resources are readily available. No base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-3.2 because the remedy involves more complex actions, but the resources are readily available. Excavation and construction may interfere with base activities; underground utilities may interfere with construction; maintaining paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-3.2 and S-3.3 because the remedy involves more complex actions, but the resources are readily available. Treatment may interfere with base activities; underground utilities may interfere with treatment; treatability tests needed; maintaining paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-3.2 because the remedy involves more complex actions; less difficult to implement than S-3.3 and S-3.4. Resources are readily available. Excavation may interfere with base activities; underground utilities may interfere with excavation; maintaining paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-3.2 because the remedy involves more complex actions; approximately as difficult to implement as S-3.5A. Resources are readily available. Excavation may interfere with base activities; underground utilities may interfere with excavation; maintaining paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	Most difficult to implement because the remedy involves excavation below the groundwater table; resources are readily available. Sheet piles for excavation support, dewatering system, water treatment and disposal system would be required; base construction approval needed.
Costs:							
Capital	$0	$26,000	$373,000	$641,000	$319,000	$563,000	$7,749,000
Annual O&M	$25,000	$45,000 Years 1 and 2; $32,000 Years 3 and 4; $51,000 every fifth year $11,000 annually all other years	$45,000 Years 1 and 2; $32,000 Years 3 and 4 $51,000 every fifth year $10,000 annually all other years	$44,000 Years 1 and 2; $31,000 Years 3 and 4 $50,000 every fifth year $10,000 annually all other years	$45,000 Years 1 and 2; $32,000 Years 3 and 4; $51,000 every fifth year; $11,000 annually all other years	$44,000 Years 1 and 2 $31,000 Years 3 and 4; $50,000 every fifth year; $10,000 annually all other years	$0
NPW	$104,000 (30)	$525,000	$867,000	$1,096,000	$819,000	$1,039,000	$7,749,000

ARAR Applicable or Relevant and Appropriate Requirement
cy Cubic yard
CTDEEP Connecticut Department of Energy and Environmental Protection
DEC Direct Exposure Criteria
I/C Industrial/commercial
LTTD Low-temperature thermal desorption
LUC Land use control
LUC RD Land Use Control Remedial Design
NPW Net present worth
O&M Operation and maintenance
PAH Polycyclic aromatic hydrocarbon
PMC Pollutant Mobility Criteria
PRG Preliminary Remediation Goal
RAO Remedial Action Objective
sf Square feet
TBC To Be Considered (criteria)

Blue font indicates Preferred Alternative

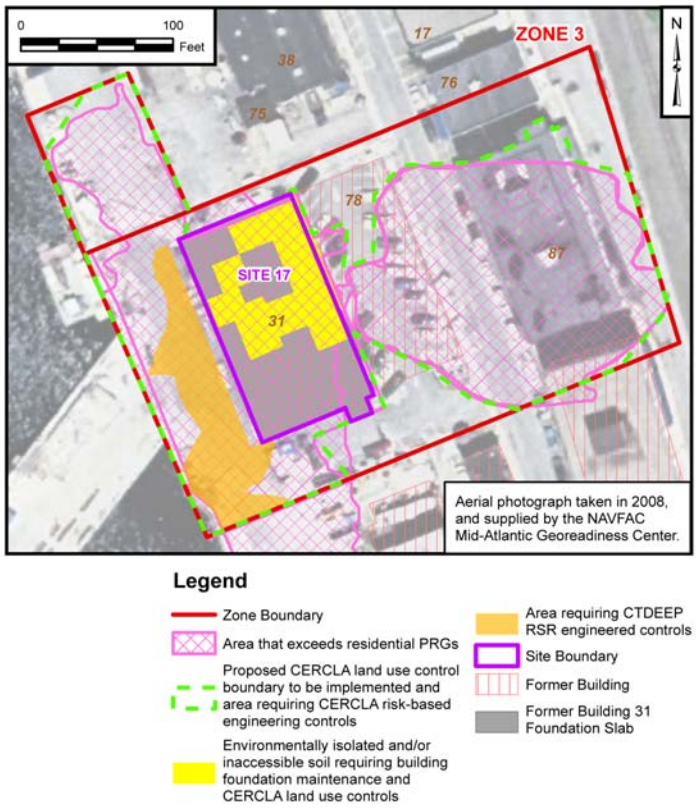

Figure 13a. Zone 3 Alternative S-3.2 Components

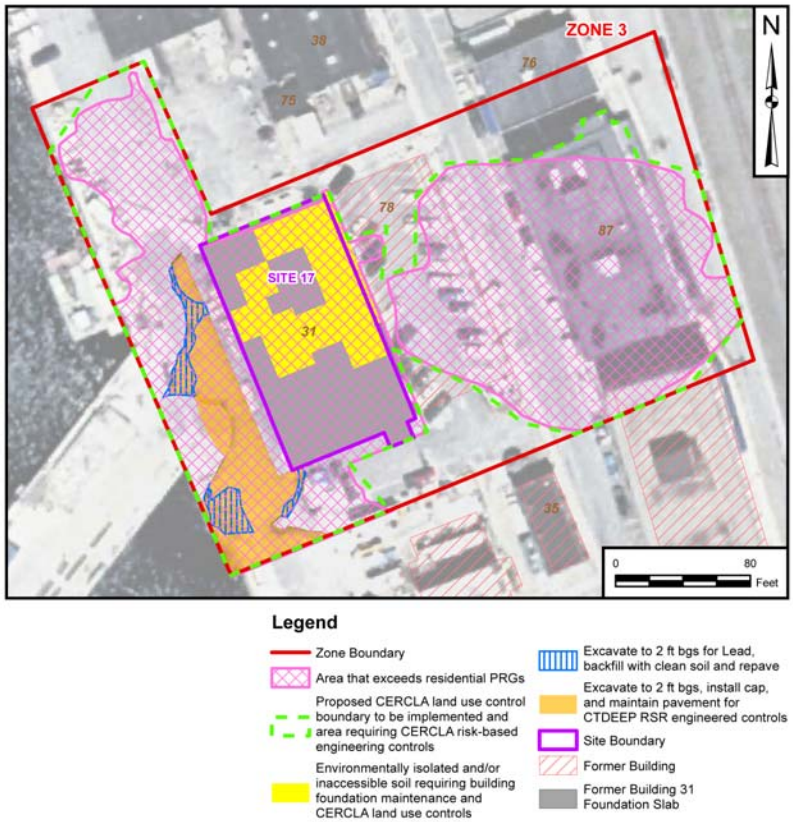

Figure 13b. Zone 3 Alternative S-3.3 Components

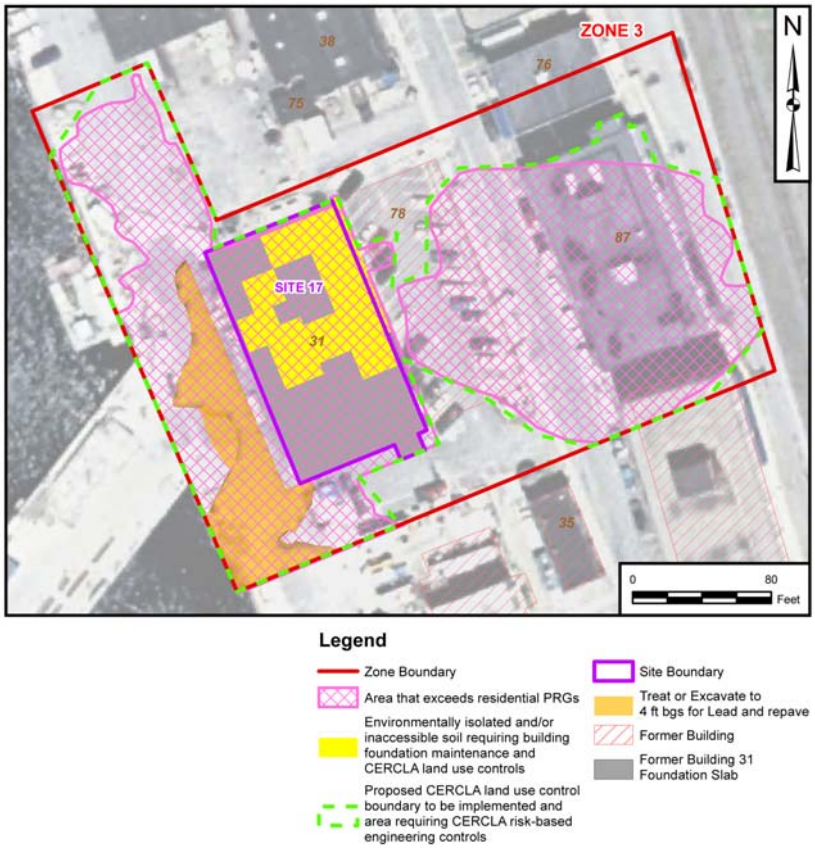

Figure 13c. Zone 3 Alternative S-3.4 and S-3.5B Components

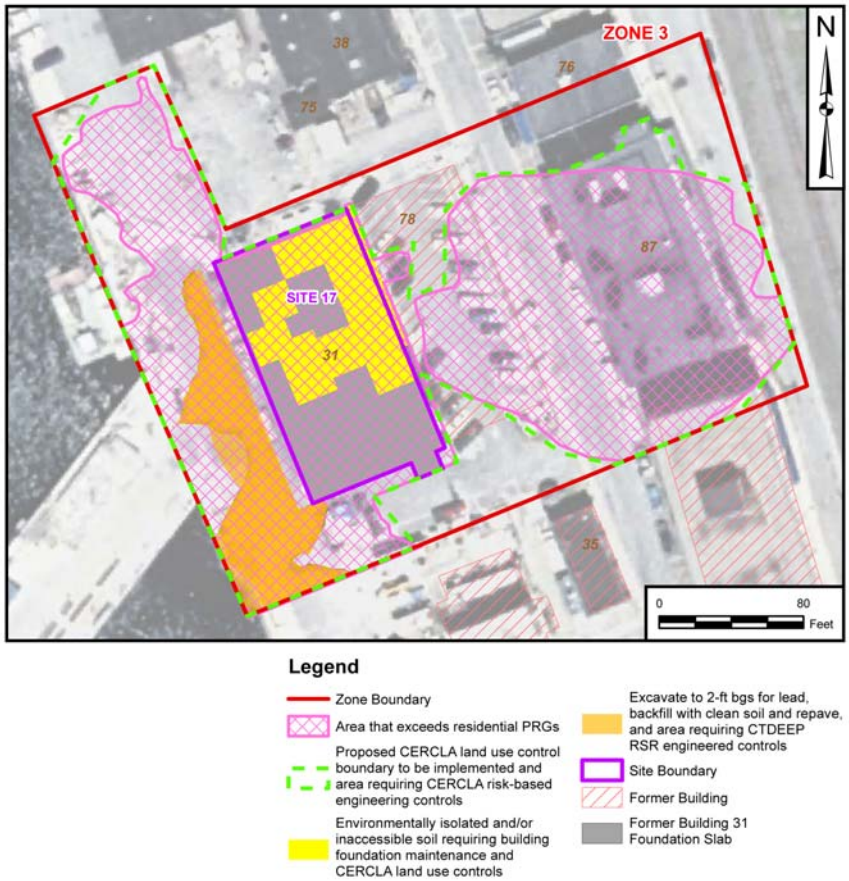

Figure 13d. Zone 3 Alternative S-3.5A Components

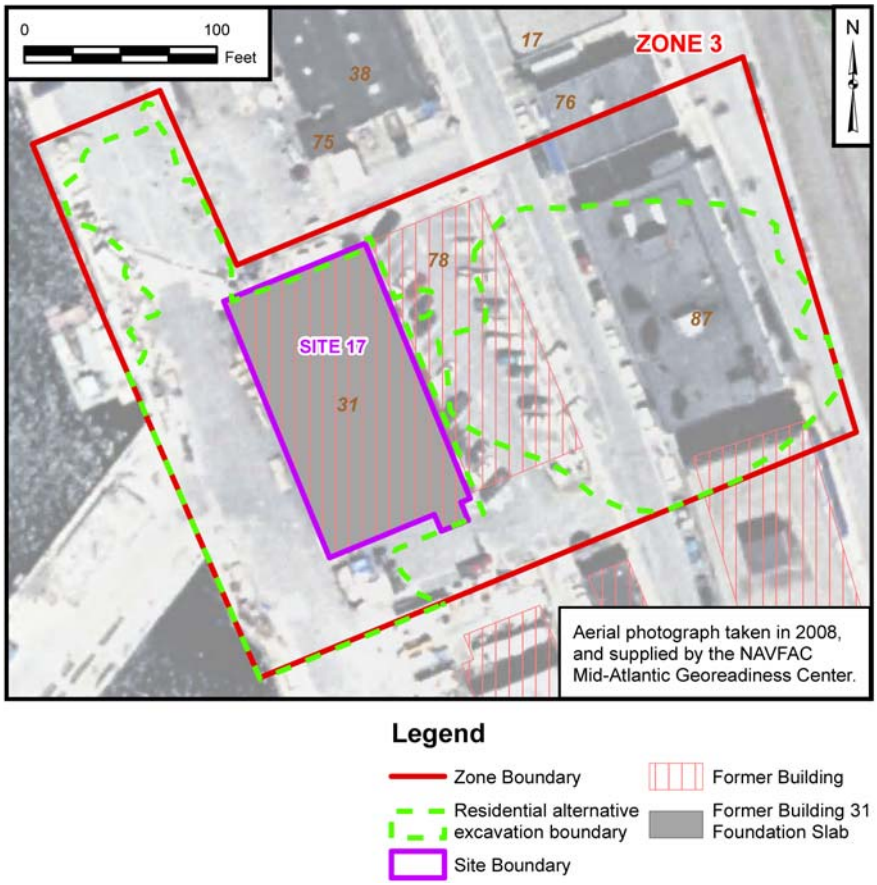

Figure 13e. Zone 3 Alternative S-3.6 Components

Table 14: Summary of Zone 3 Preferred Alternative			
Alternative Number	**Alternative Name (Cost)**	**Why this Alternative is the Best Balance of Trade-offs**	**Reason for Choice of Alternative**
S-3.2	LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring (30-Year NPW $525,000) (Figure 13a)	• Is protective and provides long-term effectiveness and permanence to ensure protection. • Easy and straightforward to implement • Lowest short-term risk • Most cost effective approach that ensures protection	• Zone 3 has soil exceeding residential and industrial PRGs; therefore, a remedy is needed. • Building foundations and pavement already covering Zone 3 act as CERCLA risk-based engineering controls to prevent exposure to contaminated soil. • Low permeability pavement also acts as a CTDEEP RSR engineered control to reduce the infiltration rate allowing Navy to meet the CTDEEP requirements for managing exceedances of the State's numeric DEC and PMC standards. • Other alternatives are more expensive without substantially more human health protectiveness. • Other alternatives have potential short-term human health risks associated with implementation activities.

EVALUATION OF ALTERNATIVES FOR ZONE 3 SOIL

Table 13 summarizes how well each of the cleanup alternatives developed for soil in Zone 3 meets the first seven criteria. After comments from the state and the community are received and evaluated, the Navy and EPA will select the final cleanup plan.

PREFERRED ALTERNATIVES FOR ZONE 3 SOIL

Table 14 summarizes the Navy and EPA's Preferred Alternative for cleaning up Zone 3 Soil.

PROPOSED PLAN – ZONE 4 AND OUTER PIER 1

SITE BACKGROUND – ZONE 4 AND OUTER PIER 1

Zone 4 extends from the southern end of Bullhead Road to the southern end of the Lower Subase along the Thames River (Figure 14). Zone 4 includes Site 13 – Building 79 Former Waste Oil Pit and Site 19 – Former Solvent Storage Area (Building 316). Fuel oil distribution lines formerly ran throughout Zone 4; however, they have been abandoned. In addition, prior to abandonment, the gate valve to the Tank Farm was previously located in this zone in Building 332. Table 15 contains descriptions of Zone 4 sources and a summary of actions that have occurred at Zone 4.

Former Pier 1 is located in the Thames River, southeast of Pier 2 adjacent to Zone 4 (Figure 14). The Pier 1 site was divided into two subareas (Inner and Outer), based on the distribution of contamination, and a non-time critical removal action was conducted to remove the majority of the contaminated sediment from Inner and Outer Pier 1 (Figure 3). A small area of contaminated sediment remains in Outer Pier 1 that was not removed during the non-time critical removal action. Alternatives were developed in the FS to address the remaining contamination in Outer Pier 1 and are summarized in this Proposed Plan.

SITE CHARACTERISTICS – ZONE 4 AND OUTER PIER 1

Elevated concentrations of PAHs, lead, and TPH commingled (mixed) with lead have been found in surface and subsurface soils in Zone 4. Figure 5 shows that a small area in the southwestern portion of Zone 4 has PAH concentrations, (represented on the figure as BaPEQ) greater than 1,000 µg/kg that exceed regulatory standards. Soil with concentrations of BaPEQ exceeding regulatory standards could cause health problems for individuals who have direct contact with the soil over an extended period of time.

Figure 11 shows the areas within Zone 4 that are contaminated with lead. This plan only addresses TPH-contaminated soil where it is commingled with lead, because TPH itself is not regulated under CERCLA. Lead was detected at concentrations exceeding the regulatory standard for I/C site use (greater than 1,090 mg/kg), with a maximum concentration of 10,600 mg/kg, in a large area in the northwestern portion of Zone 4 (Figure 11). Lead leachate concentrations exceed regulatory standards in this area with a maximum lead leachate concentration of 150 mg/L. Concentrations of leachable lead in soil could cause future levels of chemicals in groundwater to exceed regulatory standards for residential and industrial use.

Table 15: Zone 4 Site Description and Summary of Actions

Source	Description	Summary of Actions
Site 13: Building 79 - Waste Oil Pit	Included a rail spur to allow servicing of diesel engines inside Building 79 in the 1940s and 1950s. Service area included a pit in the northwestern corner of the building into which waste oil and solvents were reportedly drained.	• The waste oil pit is no longer in use and has been filled with concrete. • Building 79 is slated to be demolished and the area subsequently paved and used for parking.
Site 19: Solvent Storage Area (Building 316)	Former Solvent Storage Area (Building 316). Equipment cleaning solvents were stored in Building 316 until approximately 10 years ago.	• The roof and doors of Building 316 were demolished leaving only the side walls.
Quay Wall Study Area	A wooden platform and quay wall were constructed in 1940 in this Zone. Petroleum contaminants were identified in the soil above the platform in 1994.	• A two-phase removal action was completed to address the petroleum. The stormwater pipe leading to the outfall was abandoned and plugged in December 1994. Free-product recovery wells were installed in December 1994, and 18,300 gallons of oily waste water were recovered.
Oil Distribution Lines	Oil distribution lines ran throughout the zone.	• In 1996, pressure leak testing identified valves that failed test criteria. Unacceptable valves were replaced. The remainder of the distribution system passed the tests and all lines were abandoned in place.

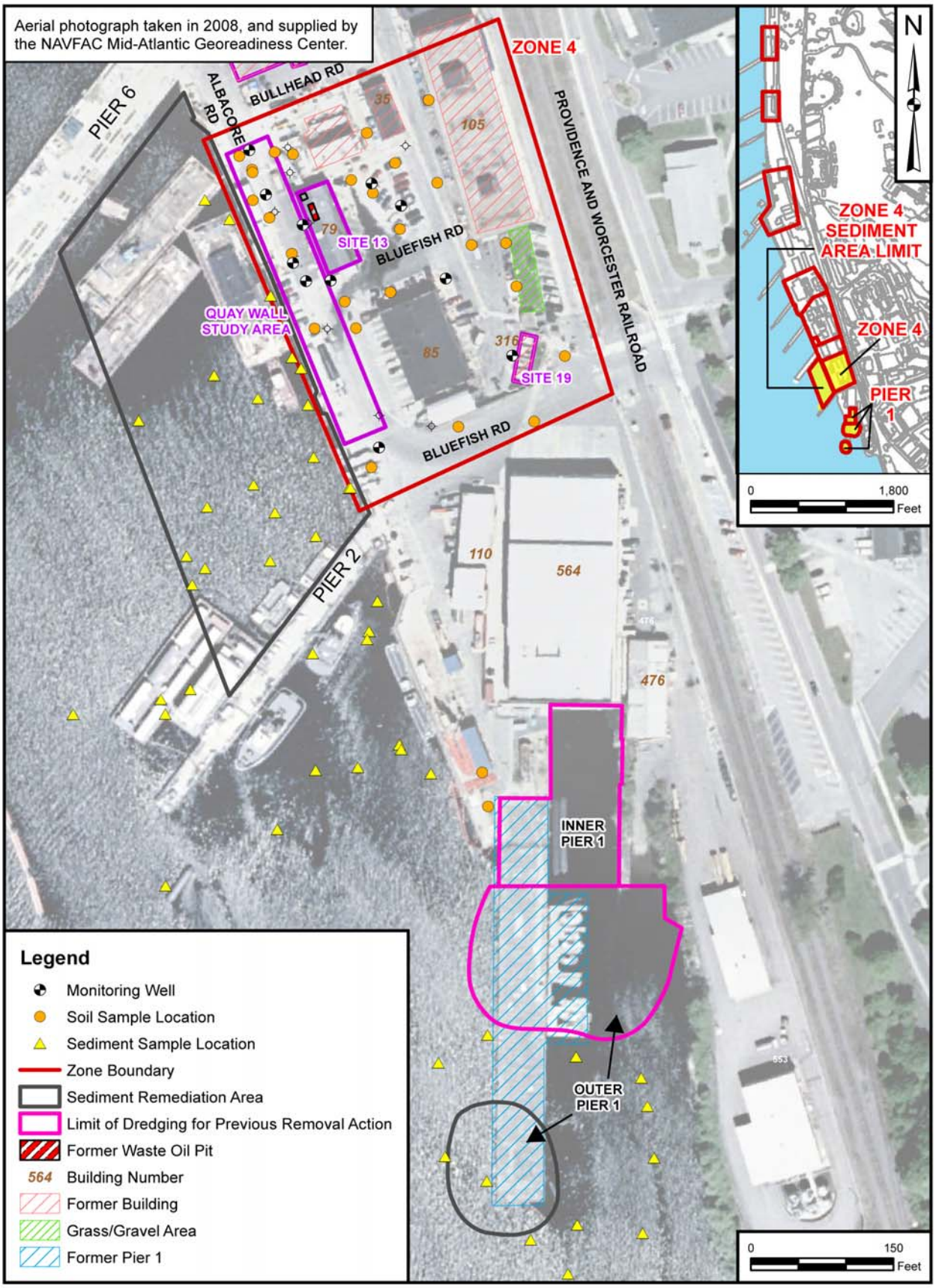

Figure 14. Zone 4 Location Map

It is important to understand that although PAH and lead concentrations in Zone 4 soil exceed pollutant mobility regulatory standards, the results of groundwater sampling completed during the Lower Subase Soil and Groundwater PDI did not indicate that these contaminants have actually migrated from the soil into groundwater. If no action is taken to address PAH and lead contamination in Zone 4 soil, migration of PAHs and lead from soil to groundwater may occur in the future.

No contaminants regulated under CERCLA were detected in Zone 4 groundwater or surface water at concentrations that exceed regulatory standards.

Metals, PAHs, pesticides, and PCBs were detected at elevated concentrations in Zone 4 sediments. To simplify the determination of the ecological effects of these chemicals, a composite value, called the effects range-median quotient (ERM-Q), was calculated to represent all of these chemicals together. In addition to being included in the calculation of the ERM-Q, total PCB contamination is also measured separately. Figure 16 shows the locations of Zone 4 sediment samples and the total PCB and ERM-Q sample results. Additional Zone 4 sediment samples will be collected during a pre-design investigation. These additional results will be used to refine the extent of contamination of metals, PAHs, pesticides, and PCBs required for the RD. The horizontal and vertical limits of contamination have been estimated, but will be revised as necessary for the design, based on the information available from the pre-design investigation.

For all of the contaminants, concentrations were generally lower in surface sediment samples (0 to 1 foot below sediment surface [bss]) compared to subsurface samples (greater than 2 feet bss). For total PCBs, the maximum surface sediment concentration was 1 mg/kg, whereas the concentrations in three subsurface sediment samples exceeded 1 mg/kg, with a maximum concentration in the subsurface of 1.4 mg/kg. Eight surface samples exceeded an ERM-Q of 1.17, with a maximum surface sediment concentration of 2.7. Ten subsurface sediment samples had ERM-Qs exceeding 1.17, with a maximum value in subsurface sediment of 2.8. Total PCB concentrations generally decreased with distance from the Quay Wall Study Area (Figure 15). One sediment sample location in the area of Outer Pier 1 not included in the non-time-critical removal action had elevated concentrations of PCBs, pesticides, metals, and PAHs and a subsurface sediment ERM-Q of 1.43 (Figure 15).

Based on these results, soil and sediment were carried forward as media of concern for Zone 4 and sediment was carried forward as a medium of concern for Outer Pier 1; groundwater and surface water were determined not to be media of concern for Zone 4.

SUMMARY OF SITE RISKS – ZONE 4

Human Health Risks – Zone 4

Table 16 summarizes the cumulative HIs and cancer risks for current and future receptors for Zone 4, and Table 17 summarizes the results of lead modeling completed, based on average lead concentration, in Zone 4 soil.

Table 16 shows unacceptable human health risks from PAHs and arsenic in Zone 4 soil for residential land use only. Arsenic was only a minor contributor to the unacceptable cancer risk for future residents; risk associated with arsenic alone is considered acceptable. The lead models summarized in Table 17 showed that average concentrations of lead would present a hazard to potential child residents. There are no unacceptable risks to humans exposed to groundwater, surface water, or sediment in Zone 4. The conceptual site model presented as Figure 16 illustrates the receptors and exposure pathways in Zone 4.

Ecological Risks – Zone 4 and Outer Pier 1

The Thames River Validation Study determined that zinc, in a small area of Zone 4 sediment, poses low, potentially unacceptable, risk to fish-eating birds; and PCBs, PAHs, metals, and pesticides in Zone 4 sediment, and PCBs in Outer Pier 1 sediment pose potentially unacceptable risks to sediment invertebrates. The conceptual site model for Zone 4 and Outer Pier 1 includes ecological receptors and exposure pathways evaluated in the ERA (Figure 16).

RAOS FOR ZONE 4 SOIL

The following RAOs were developed for surface/subsurface soil in Zone 4 considering industrial land use and receptors:

- **Soil RAO No.1:** Prevent exposure of current and future full-time employees and construction workers to surface/subsurface soil containing concentrations of COCs greater than I/C PRGs.
- **Soil RAO No. 2:** Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than PRGs.
- **Soil RAO No. 3:** Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.

In addition, the following RAO was developed for surface/subsurface soil in Zone 4 considering residential land use and receptors:

- **Soil RAO No. 4:** Prevent exposure of hypothetical future residents to surface/subsurface soil containing concentrations of COCs greater than residential PRGs.

Table 18 summarizes the human health COCs and PRGs for Zone 4 that were calculated as acceptable levels in soil under both industrial and residential land use scenarios.

There are no human health surface water, groundwater, or sediment CERCLA COCs for Zone 4 or Outer Pier 1; thus, no PRGs were calculated for human receptors for these media.

RAOS FOR ZONE 4 AND OUTER PIER 1 SEDIMENT

The following RAOs were developed for sediment adjacent to Zone 4 and Outer Pier 1 of the Lower Subase:

- **Sediment RAO No. 1:** Reduce risks to sediment invertebrates from exposure to bioavailable/bioaccessible COCs in Thames River sediment at Zone 4 and Outer Pier 1 to acceptable levels.
- **Sediment RAO No. 2:** Reduce risks to fish-eating birds from food-chain exposure to bioavailable/bioaccessible COCs in Thames River sediment at Zone 4 and Outer Pier 1 to acceptable levels.
- **Sediment RAO No. 3:** Mitigate the potential for bioavailable/bioaccessible COCs in Thames River sediment at Zone 4 and Outer Pier 1 to migrate to less impacted areas of the Thames River and cause adverse effects to receptors.

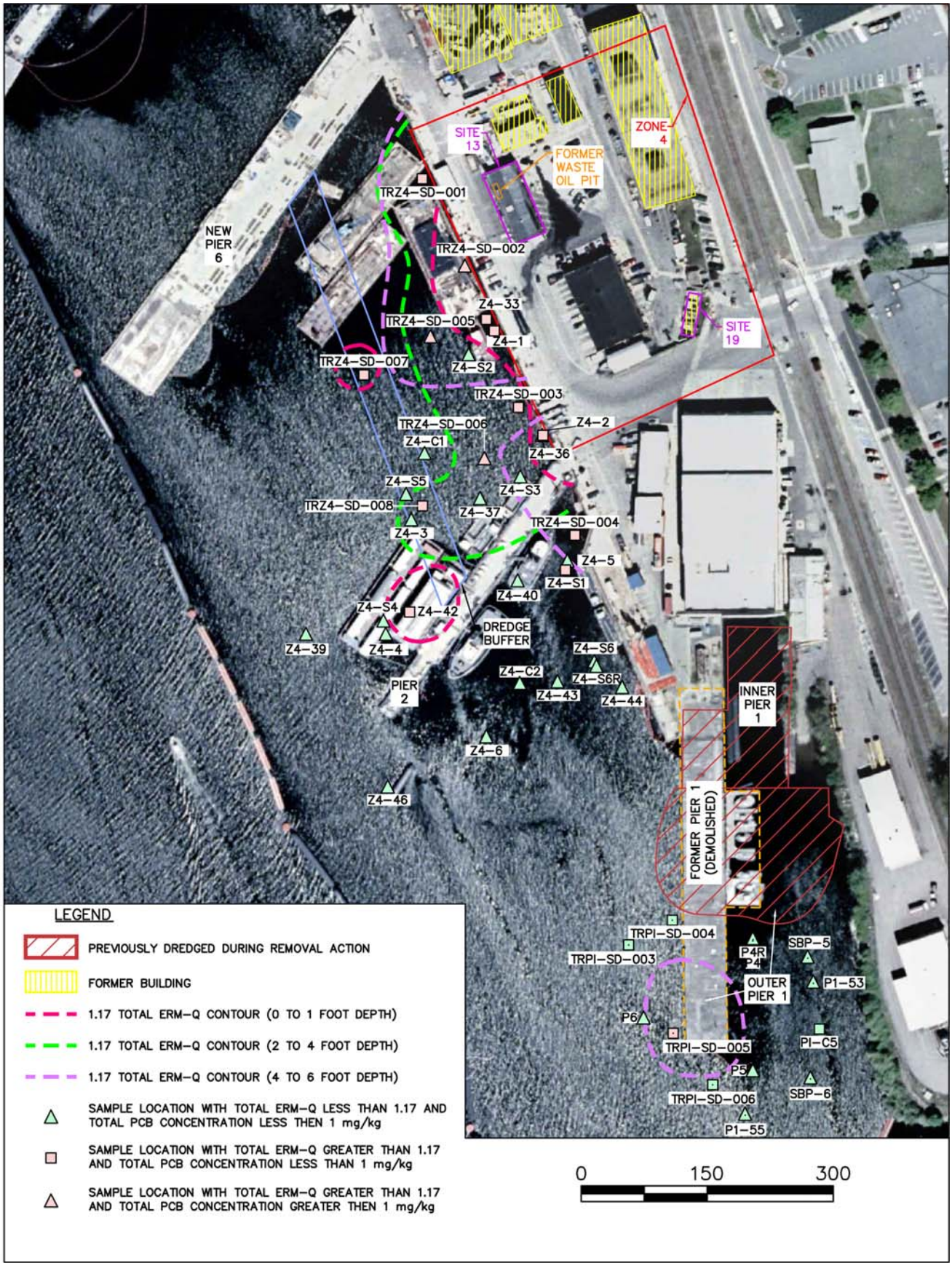

Figure 15. Thames River Sediment Sample Results

Table 16: Zone 4 Human Health Risk Assessment Summary

	Industrial Land Use				Residential Land Use					
	Construction Workers		Full-Time Employees		Future Residents					
	Current/Future		Current	Future	Child		Adult	Life-Long		Life-Long
Risk Measure	Surface/ Subsurface Soil Direct Exposure	Groundwater Direct Exposure	Surface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Risk Drivers	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Risk Drivers	Vapor Intrusion
Cancer Risk	1 per 1,000,000	2 per 10,000,000	4 per 100,000	2 per 100,000	3 per 10,000	PAHs, arsenic	4 per 100,000	3 per 10,000	PAHs, arsenic	4 per 100,000
Hazard Index	0.3	0.04	0.02	0.02	0.2	NA	0.02	NA	NA	0.1

> 1 per 10,000	Indicates unacceptable human health risk
NA	Not Applicable for this receptor
1	Hazard Index > 1 is considered unacceptable

Table 17: Zone 4 Lead Models Summary

Percentage of Estimated Fetal Blood-Lead Levels Greater than 10 µg/dL

Risk Measure	Industrial Land Use			Residential Land Use
	Construction Workers	Full-Time Employees		Child
	Current/Future	Current	Future	Future
Blood Lead Level (%)	3	2.9	1	55

> 5 %	Unacceptable blood lead level. Blood lead levels exceeding 10 µg/dL for more than 5% of fetuses or children are considered unacceptable.

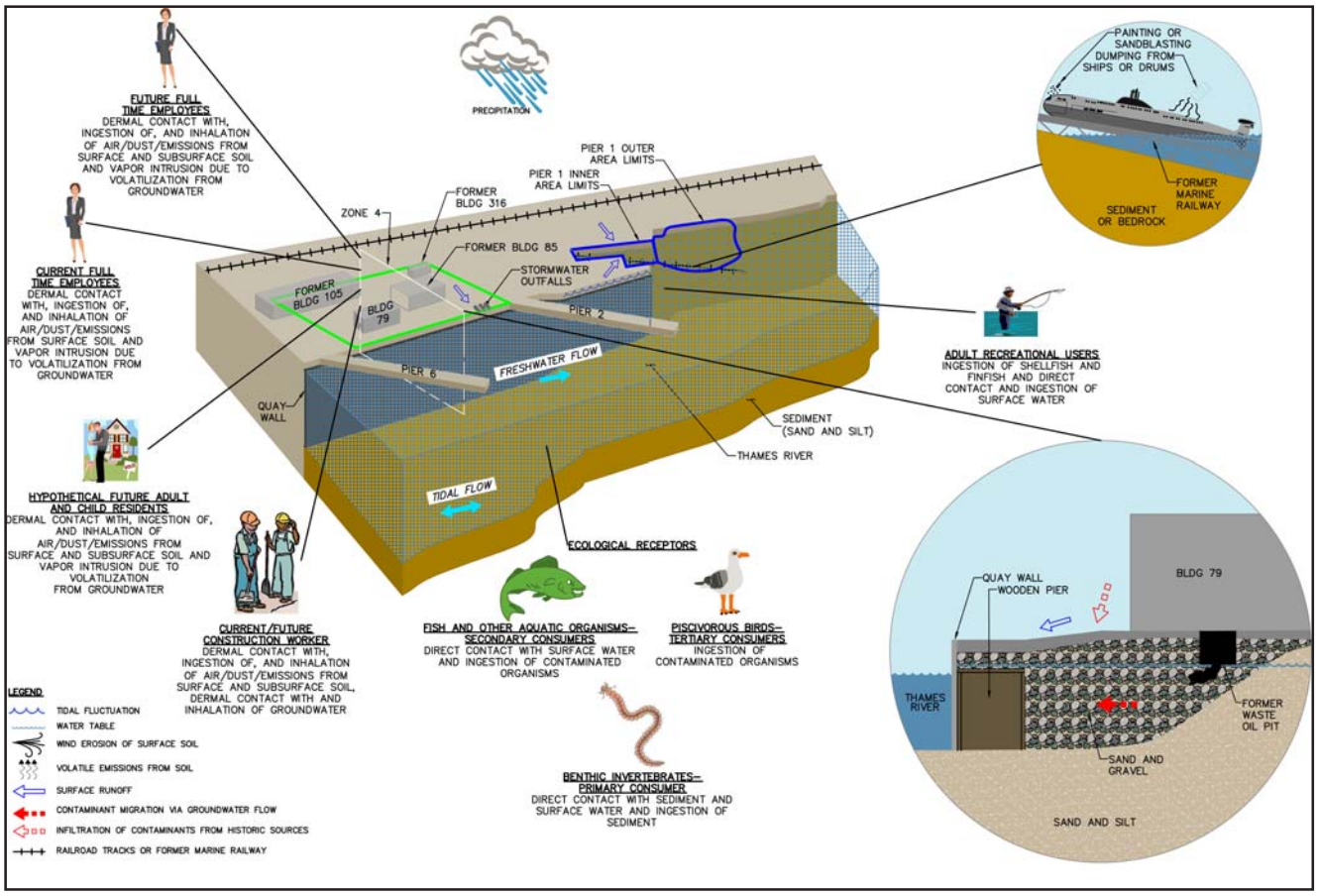

Figure 16. Exposure Pathways to Zone 4 and Outer Pier I

The following PRGs will be used as acceptable levels to meet the sediment RAOs:

- **PCB Congeners** – TSCA risk-based level of 1,000 µg/kg (or 1 mg/kg)
- **Composite Value Addressing Applicable Contaminants, referred to as the ERM-Q** – 1.17

The ERM-Q is a composite value addressing applicable contaminants (metals, PAHs, PCBs, and pesticides) that, when considered together, pose ecological risk to sediment invertebrates. The ERM-Q PRG of 1.17 was chosen for sediment as a conservative cleanup goal to prevent unacceptable risk to ecological receptors. Sediment posing a low risk to fish-eating birds is addressed by using the ERM-Q of 1.17 for sediment invertebrates. There are no ecological COCs for surface water for Zone 4 or Outer Pier 1; thus, no PRGs were calculated for ecological receptors for surface water.

Summary of Remedial Alternatives for Zone 4 and Outer Pier 1

Zone 4 Soil

Descriptions of remedial alternatives for Zone 4 soil are summarized in Table 19.

Zone 4 and Outer Pier 1 Sediment

Descriptions of remedial alternatives for Zone 4 and Outer Pier 1 sediment are summarized in Table 20

Evaluation of Alternatives – Zone 4 and Outer Pier 1

Tables 19 and 20 summarize how well each of the cleanup alternatives developed for soil in Zone 4 and sediment in Zone 4 and Outer Pier 1, respectively, meets the first seven criteria. After comments from the State and community are received and evaluated, the Navy and EPA will select the final cleanup plan.

Preferred Alternatives – Zone 4 and Outer Pier 1

Table 21 summarizes the Navy and EPA's Preferred Alternative for cleaning up soil in Zone 4 and sediment in Zone 4 and Outer Pier 1.

Table 18: Zone 4 Human Health Chemicals of Concern and Preliminary Remediation Goals

Chemical of Concern	Preliminary Remediation Goals			
	Direct Exposure Criteria for Industrial Land Use (1,2)	Direct Exposure Criteria for Residential Land Use (1)	Pollutant Mobility Criteria for Industrial Land Use (1,2)	Pollutant Mobility Criteria for Residential Land Use (1)
Benzo(a)anthracene	Not a concern	1,000 µg/kg	Not a concern	3,400* µg/kg
Benzo(a)pyrene	Not a concern	1,000 µg/kg	Not a concern	Not a concern
Benzo(b)fluoranthene	Not a concern	1,000 µg/kg	Not a concern	2,200* µg/kg
Dibenzo(a,h)anthracene	Not a concern	1,000 µg/kg	Not a concern	Not a concern
Indeno(1,2,3-cd)pyrene	Not a concern	1,000 µg/kg	Not a concern	Not a concern
Lead	1,090 mg/kg*	400 mg/kg	0.24* mg/L	0.15 mg/L

* Calculated site-specific criterion. See Note (1).

1 Pollutant Mobility Criteria and Direct Exposure Criteria are Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations, except where flagged with an asterisk (*). Flagged values are calculated site-specific criteria. Site-specific PMCs are referred to as Alternative GB PMCs.

2 Based on existing site covers (soil and building foundations).

TABLE 19: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 4 SOIL REMEDIAL ALTERNATIVES
1 OF 4

	Alternative S-4.1 No Action	Alternative S-4.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-4.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.4 In-Situ Treatment (Enhanced Bioremediation or Stabilization/Solidification) to Meet Alternative GB PMC PRGs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.5A Excavation to Meet I/C Direct Exposure PRGs, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.5B Excavation to Meet I/CPRGs, Off-Site Disposal (LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.6 Excavation to Meet Residential PRGs, On-Site Dewatering, and Off-Site Disposal
Description	Evaluated, as required by CERCLA, as a baseline for comparison to other alternatives. Under this alternative, the Navy would take no action in Zone 4.	Instituting CERCLA LUCs and inspections to prohibit soil disturbance and future residential development and meet PRGs. CERCLA LUCs would include institutional controls and CERCLA risk-based engineering controls (maintenance of building foundations and pavement) to meet residential PRGs, and maintenance of monitoring wells. CTDEEP RSR engineered controls would be implemented in a small area of Zone 4 where COC concentrations exceed I/C DEC and PMC PRGs. These controls would include a higher level of pavement maintenance to ensure that pavement prevents infiltration and direct exposure. Upon implementation, this alternative would allow I/C site use only.	Excavation and off-site disposal of soil with lead concentrations greater than the I/C PRGs to a depth of 2 feet bgs in paved areas to allow installation of the cap. Soil with lead concentrations above the Alternative GB PMC PRGs for I/C site use between 2 feet bgs and the mean high water table would be capped with an impervious cover system to prevent lead migration from soil to groundwater. After installation of the cap, the area would be backfilled with clean soil and site pavement would be restored. CERCLA LUCs and CTDEEP RSR engineered controls similar to Alternative S-4.2 would be required. Upon implementation, this alternative would allow I/C site use only.	This alternative would include removal of asphalt pavement and in-place mixing of soil in the unsaturated zone (above the water table) with lead concentrations greater than I/C PRGs with Portland cement to chemically stabilize the lead and prevent migration from soil to groundwater. This process would also reduce the direct exposure risk by changing the characteristics of the soil. After treatment, asphalt pavement would be restored. To address the small amount of soil containing TPH mixed with lead, TPH-contaminated soil would be treated using an in-place bioremediation technique that utilizes an oxygen-releasing compound (ORC), such as magnesium peroxide, to enhance the growth of natural microorganisms that will break down TPH in soil. CERCLA LUCs similar to Alternative S-4.2 would be required. CTDEEP RSR engineered controls would not be required. Upon implementation, this alternative would allow I/C site use only.	This alternative would include excavation and off-site disposal of soil with lead concentrations greater than the I/C direct exposure PRG to a depth of 2 feet bgs. After excavation, the area would be backfilled with clean soil and site pavement restored. CERCLA LUCs and CTDEEP RSR engineered controls similar to Alternative S-4.2 would be required. Upon implementation, this alternative would allow I/C site use only.	This alternative is similar to Alternative S-4.5A, except soil with lead concentrations greater than the I/C PRGs would be excavated to a depth of 2 feet bgs for soil with concentrations greater than the I/C direct exposure PRG, and to 5 feet bgs for soil with concentrations greater than the Alternative GB PMC PRG for I/C site use. CERLCA LUCs similar to Alternative S-4.2 would be required. CTDEEP RSR engineered controls would not be required. Upon implementation, this alternative would allow I/C site use only.	Excavation and off-site disposal of soil with concentrations of COCs greater than residential and I/C PRGs. Upon implementation, this alternative would allow unrestricted site use.
Area Addressed (sf)	NA	An implementable LUC boundary was created to encompass the 46,680 sf of soil where residential PRGs were exceeded (Figure 17a). The LUC boundary contains approximately 61,100 sf. Within this area, building foundations and approximately 36,000 sf of pavement would be maintained through CERCLA risk-based engineering controls to meet residential PRGs. A 13,100 sf area contains soil with concentrations of COCs	Soil in an 11,600 sf area that exceeds I/C direct exposure PRGs would be excavated to 2 ft bgs. Soil in an 8,720 sf area from 2 feet bgs to the mean high water table that exceeds the Alternative GB PMCPRGs for I/C site use would be capped. Soil in a 1,500 sf area that exceeds the Alternative GB PMC PRGs for I/C site use would be excavated to 2 feet bgs but no cap would be required in that area because there would be no remaining pollutant mobility issues after excavation is completed. Within the LUC area, building foundations and 36,000 sf of	Soil in a 13,100 sf area to a depth of 5 feet bgs has concentrations of lead greater than the I/C PRGs and would be treated. Within the LUC area, building foundations and 36,000 sf of pavement would be maintained through CERCLA risk-based engineering controls (Figure 17c). CTDEEP RSR engineered controls are not required because all soil with COC concentrations greater than the Alternative GB PMC PRGs would be treated to reduce pollutant mobility to levels below the PRGs. In addition, all soil with concentrations of COCs greater than the I/C direct exposure PRGs would be	Soil in an 11,600 sf area with lead concentrations greater than the I/C direct exposure PRGs to a depth of 2 feet bgs would be excavated and disposed of off site. Within the LUC area, building foundations and approximately 36,000 sf of pavement would be maintained through CERCLA risk-based engineering controls and 13,100 sf would be maintained through CTDEEP RSR engineered controls (Figure 17d). Lead-contaminated soil beneath buildings is considered environmentally isolated and inaccessible and would not be excavated.	Soil in a 13,100 sf area with lead concentrations greater than the I/C PRGs to a depth of up to 5 feet bgs would be excavated. Within the LUC area, building foundations and 36,000 sf of pavement would be maintained through CERCLA risk-based engineering controls. CTDEEP RSR engineered controls are not required because all soil with COC concentrations greater than Alternative GB PMC PRGs would be excavated (Figure 18c). Lead-contaminated soil beneath buildings is considered environmentally isolated and inaccessible and would not be excavated.	Soil in a 46,680 sf area with concentrations of COCs greater than the residential and I/C PRGs to a depth up to 15 feet bgs would be excavated (Figure 17e).

TABLE 19: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 4 SOIL REMEDIAL ALTERNATIVES
2 OF 4

	Alternative S-4.1 No Action	Alternative S-4.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-4.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.4 In-Situ Treatment (Enhanced Bioremediation or Stabilization/Solidification) to Meet Alternative GB PMC PRGs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.5A Excavation to Meet I/C Direct Exposure PRGs, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.5B Excavation to Meet I/CPRGs, Off-Site Disposal (LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.6 Excavation to Meet Residential PRGs, On-Site Dewatering, and Off-Site Disposal
		greater than the I/C PRGs and would be maintained through CTDEEP RSR engineered controls.	pavement would be maintained through CERCLA risk-based engineering controls and 8,700 sf would be maintained through CTDEEP RSR engineered controls (Figure 17b). Lead-contaminated soil beneath buildings is considered environmentally isolated and inaccessible and would not be capped.	treated. The treatment process would change the soil characteristics and reduce the direct exposure risks to levels below the I/C PRGs. Lead-contaminated soil beneath buildings is considered environmentally isolated and inaccessible and would not be treated.			
Volume Addressed (cy)	NA	NA	Approximately 730 cy of excavated soil would be transported off site for disposal.	Approximately 1,780 cy of soil would be treated for lead only; approximately 20 cy of TPH-contaminated soil would be treated; treatment/mixing would result in an increase in volume of 120 cy, which would be disposed of off site after testing confirms it is non-hazardous.	Approximately 645 cy of excavated soil would be transported off site for disposal.	Approximately 1,780 cy of excavated soil would be disposed of off site.	Approximately 11,480 cy of contaminated soil would be transported off site for disposal.
Comments	Because contamination would remain in excess of levels that allow for unrestricted use and unlimited exposure, five-year reviews would be required under this alternative.	Long-term groundwater monitoring for all COCs that exceed residential soil PRGs would be implemented. For cost estimating purposes, the monitoring frequency was assumed to be quarterly for the first 2 years, semi-annually for the next 2 years, annually the fifth year, and every 5 years thereafter. Final details for the monitoring program will be documented in a long-term monitoring plan developed after the Record of Decision is signed.	LUCs and monitoring similar to Alternative S-4.2 would be implemented, in addition to regular cap inspections and maintenance. Confirmation samples would be collected to verify soil with COC concentrations greater than the I/C direct exposure PRGs has been removed.	LUCs and monitoring similar to Alternative S-4.2 would be implemented to ensure that building foundations and pavement are maintained and the remedy was effective in decreasing the concentrations of COCs to levels below the I/C PRGs. Following treatment, confirmation samples would be collected beneath and around the treated area to verify that all contaminated soil has been treated. Areas treated with Portland cement would be sampled both right after and within 1 month from treatment; areas treated with ORC would be sampled within 1 year from treatment.	LUCs and monitoring similar to Alternative S-4.2 would be implemented to ensure that building foundations/pavement are maintained and COCs are not migrating from soil to groundwater. Following excavation, confirmation samples would be collected from the walls of the excavated area to verify that soil with concentrations greater than I/C direct exposure PRGs has been removed.	LUCs, monitoring, and confirmation sampling similar to Alternative S-4.5A would be implemented.	It is assumed that excavation beyond a depth of 6 feet bgs would take place below the water table. No LUCs or monitoring would be required because the remaining soil would not contain concentrations of COCs that exceed the residential PRGs.
Evaluation Criterion							
Overall Protection of Human Health and Environment	Not protective.	Not protective.	Protective.	Protective.	Not protective.	Protective.	Protective.
Compliance with ARARs and TBCs	Would not comply.	Would not comply; therefore, will not be implemented.	Would comply.	Would comply.	Would not comply; therefore, will not be implemented.	Would comply.	Would comply.

TABLE 19: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 4 SOIL REMEDIAL ALTERNATIVES
3 OF 4

	Alternative S-4.1 No Action	Alternative S-4.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-4.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.4 In-Situ Treatment (Enhanced Bioremediation or Stabilization/Solidification) to Meet Alternative GB PMC PRGs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.5A Excavation to Meet I/C Direct Exposure PRGs, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.5B Excavation to Meet I/CPRGs, Off-Site Disposal (LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.6 Excavation to Meet Residential PRGs, On-Site Dewatering, and Off-Site Disposal
Long-Term Effectiveness and Permanence	Not effective.	May not be effective. CTDEEP RSR engineered controls were not found to effectively address soil lead concentrations that exceeded the Alternative GB PMC PRG. LUCs would meet PRGs for direct exposure COCs but not COCs for Alternative GB PMC PRGs for I/C site use.	More effective than Alternatives S-4.2 and S-4.5A because all soil with concentrations greater than I/C direct exposure PRGs would be removed but soil with concentrations greater than Alternative GB PMC PRGs for I/C site use would be capped and left in place.	Approximately as effective as Alternative S-4.3 but more effective than Alternative S-4.2 and S-4.5A. Treatment would reduce both direct exposure and pollutant mobility but material would remain onsite.	May not be effective. The I/C direct exposure PRG would be met through excavation; however, Alternative GB PMC PRGs for I/C site use would not be fully met through CTDEEP RSR engineered controls.	More effective than Alternatives S-4.2, S-4.3, S-4.4, and S-4.5A. All soil that is not environmentally isolated that contains concentrations greater than the I/C PRGs would be removed from the site. Remaining soil exceeding residential PRGs will be controlled by LUCs.	Most effective. All soil with concentrations greater than the residential PRGs would be removed.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	There is no treatment.	There is no treatment.	There is no treatment.	Would reduce lead toxicity and mobility in 1,780 cy of soil by in-situ chemical stabilization/ solidification. Would reduce toxicity, mobility, and volume of commingled TPH in 20 cy by in-situ enhanced bioremediation.	There is no treatment.	There is no treatment.	There is no treatment, except the treatment of water generated from the dewatering process prior to discharge to the Thames River. A very small mass of COCs will be treated by this process.
Short-Term Effectiveness	No short-term risks. Would not achieve soil RAOs or meet Zone 4 soil PRGs.	Minimal potential for short-term risks from worker exposure during groundwater sampling. No impacts to environment or community. Three months to implement and achieve most soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C direct exposure PRGs would be met through CTDEEP RSR engineered controls. Alternative GB PMC PRGs for I/C site use would not be completely met through CTDEEP RSR engineered controls.	Moderate potential for short-term risks from worker exposure during cap installation and groundwater sampling; transport of contaminated soil through the community; dust from excavation. After planning, 2 months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C direct exposure PRGs would be met through excavation and off- site disposal, and Alternative GB PMC PRGs for I/C site use would be met through CTDEEP RSR engineered controls and capping.	Moderate potential for short-term risks from worker exposure during treatment and groundwater sampling; no impacts to environment or community. After planning, 16 months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C PRGs would be met through in-situ treatment. For commingled TPH, direct exposure and pollutant mobility CTDEEP RSRs would be met within 1 year through treatment.	Moderate potential for short-term risks from worker exposure during excavation and groundwater sampling; transport of contaminated soil through the community; dust from excavation. After planning, 1.5 months to implement and achieve most soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C direct exposure PRGs would be met through excavation and off-site disposal. Alternative GB PMC PRGs for I/C site use would not be completely met through CTDEEP RSR engineered controls.	Moderate potential for short-term risks from worker exposure during excavation and groundwater sampling; transport of contaminated soil through the community; dust from excavation. After planning, 3 months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C PRGs would be met through excavation and off-site disposal.	High potential for short-term risks from worker exposure during excavation; transport of contaminated soil through the community; dust from excavation. After planning, 4 months to implement and achieve soil RAOs. Residential and I/C PRGs would be met through excavation and off-site disposal.

TABLE 19: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 4 SOIL REMEDIAL ALTERNATIVES
4 OF 4

	Alternative S-4.1 No Action	Alternative S-4.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-4.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.4 In-Situ Treatment (Enhanced Bioremediation or Stabilization/Solidification) to Meet Alternative GB PMC PRGs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.5A Excavation to Meet I/C Direct Exposure PRGs, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.5B Excavation to Meet I/CPRGs, Off-Site Disposal (LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-4.6 Excavation to Meet Residential PRGs, On-Site Dewatering, and Off-Site Disposal
Implementability	Requires only five-year reviews.	Easy to implement; resources are readily available. No base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-4.2 because the remedy involves more complex actions, but the resources are readily available. Excavation and construction may interfere with base activities; underground utilities may interfere with construction; must maintain paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-4.2 and S-4.3 because the remedy involves more complex actions, but the resources are readily available. Treatment may interfere with base activities; underground utilities may interfere with treatment; treatability tests needed; must maintain paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-4.2 because the remedy involves more complex actions; less difficult to implement than S-4.3 and S-4.4. Resources are readily available. Excavation may interfere with base activities; underground utilities may interfere with excavation; must maintain paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-4.2 because the remedy involves more complex actions; approximately as difficult to implement as S-4.5A. Resources are readily available. Excavation may interfere with base activities; underground utilities may interfere with excavation; must maintain paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	Most difficult to implement because the remedy involves excavation below the groundwater table; resources are readily available. Sheet piles would be required for excavation support; dewatering system required; water treatment and disposal system required; base construction approval needed.
Costs:							
Capital	$0	$70,000	$774,000	$953,000	$629,000	$1,296,000	$5,001,000
Annual O&M Cost	$25,000	$51,000 Years 1 and 2; $37,000 Years 3 and 4; $68,000 every fifth year; $11,000 annually all other years;	$50,000 Years 1 and 2; $36,000 Years 3 and 4; $68,000 every fifth year; $10,000 annually all other years	$48,000 Year 1; $45,000 Year 2; $31,000 Years 3 and 4; $50,000 every fifth year; $9,000 annually all other years	$51,000 Years 1 and 2; $37,000 Years 3 and 4; $68,000 every fifth year; $11,000 annually all other years	$45,000 Years 1 and 2; $31,000 Years 3 and 4; $50,000 every fifth year; $9,000 annually all other years	$0
NPW	$104,000	$666,000	$1,354,000	$1,424,000	$1,225,000	$1,763,000	$5,001,000

ARAR Applicable or Relevant and Appropriate Requirement
cy Cubic yard
CTDEEP Connecticut Department of Energy and Environmental Protection
DEC Direct Exposure Criteria
I/C Industrial/commercial
LTTD Low-temperature thermal desorption
LUC Land use control
LUC RD Land Use Control Remedial Design
NPW Net present worth
O&M Operation and maintenance
PAH Polycyclic aromatic hydrocarbon
PMC Pollutant Mobility Criteria
PRG Preliminary Remediation Goal
RAO Remedial Action Objective
sf Square feet
TBC To Be Considered (criteria)

Blue font indicates Preferred Alternative

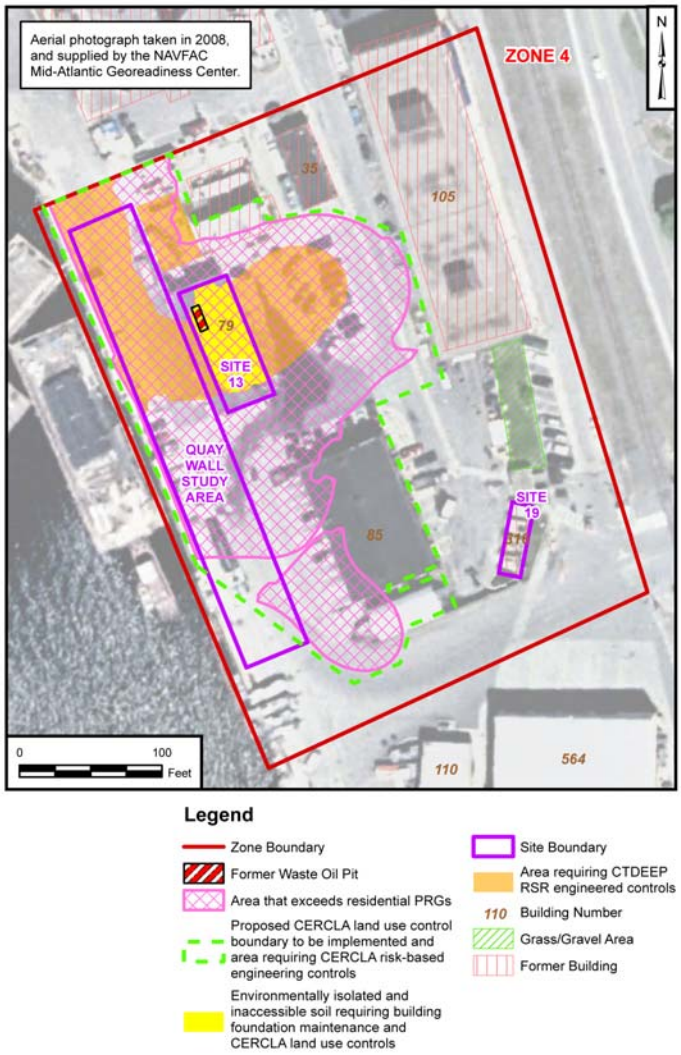

Figure 17a. Zone 4 Alternative S-4.2 Components

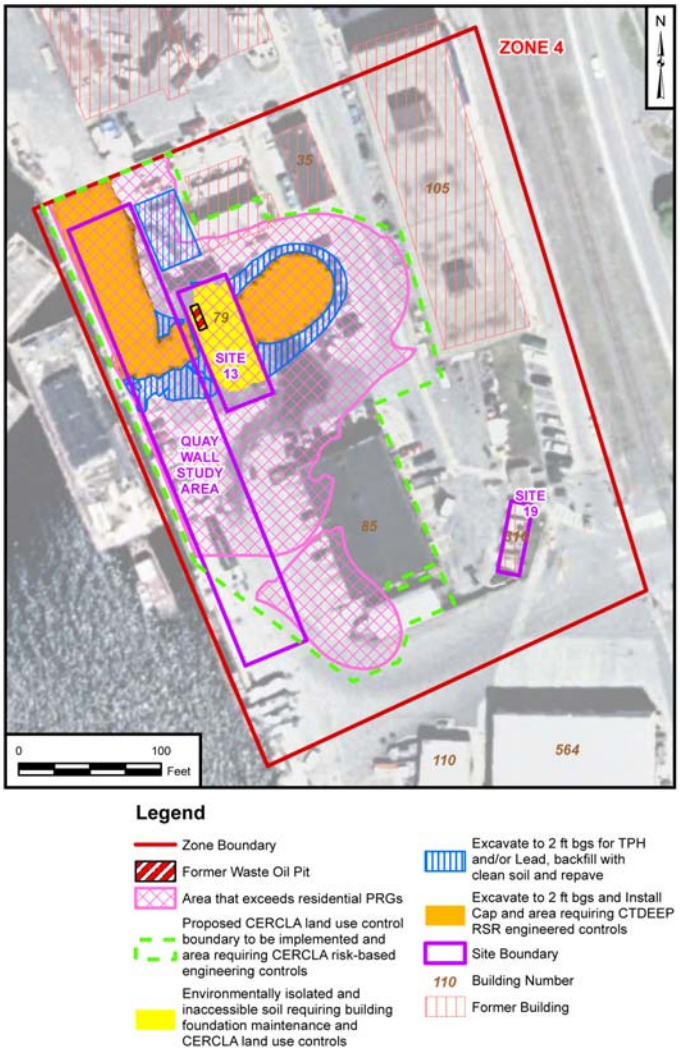

Figure 17b. Zone 4 Alternative S-4.3 Components

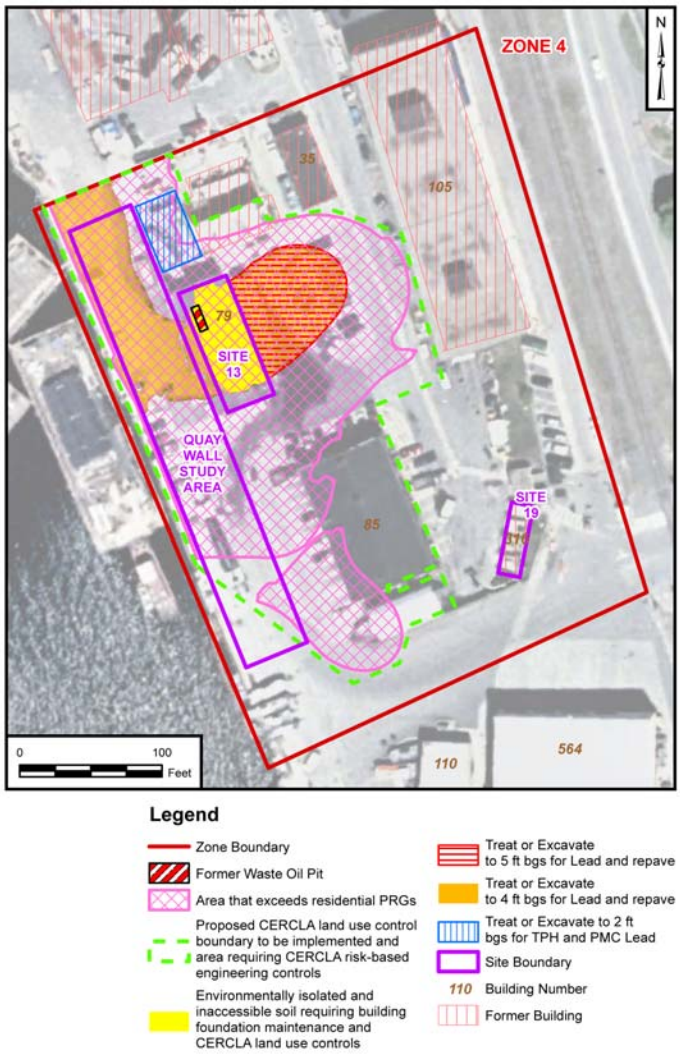

Figure 17c. Zone 4 Alternative S-4.4 and S4.5B Components

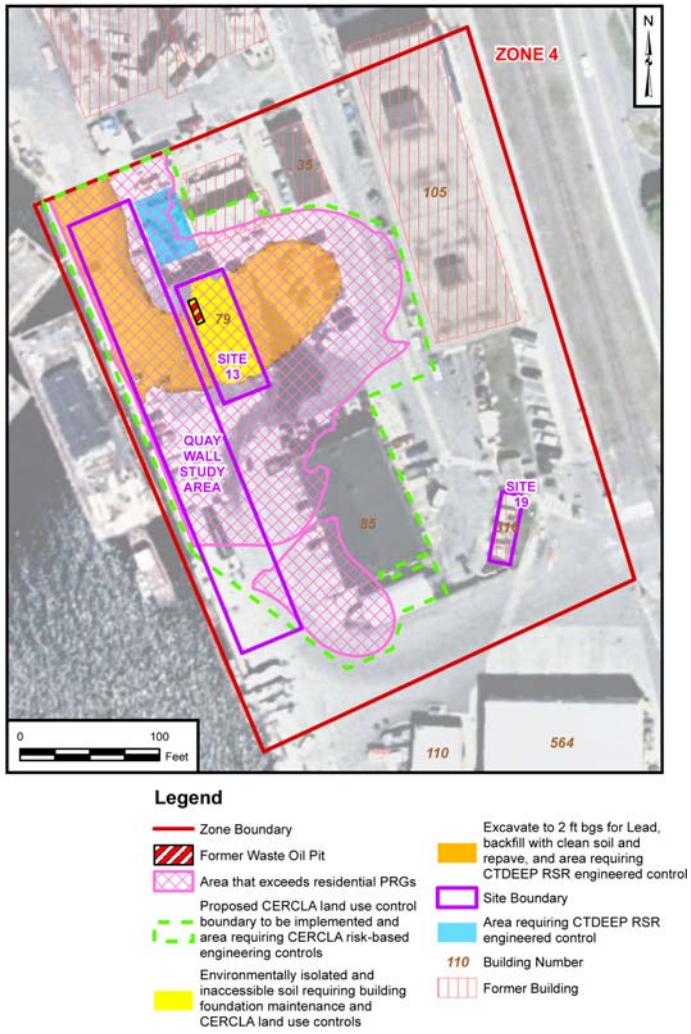

Figure 17d. Zone 4 Alternative S-4.5A Components

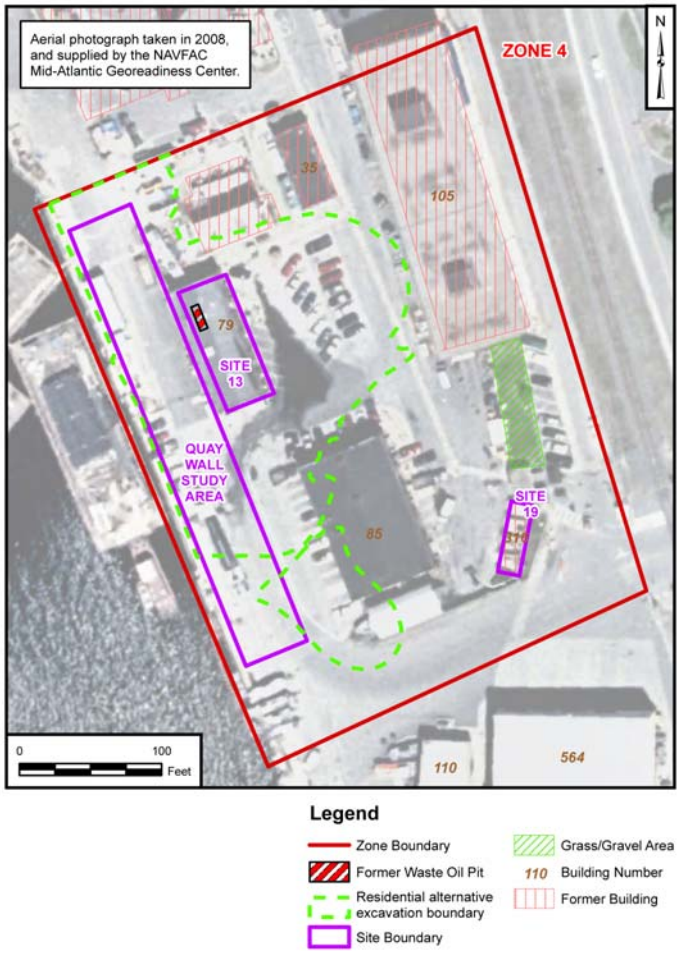

Figure 17e. Zone 4 Alternative S-4.6 Components

TABLE 20: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 4 AND OUTER PIER 1 SEDIMENT REMEDIAL ALTERNATIVES
1 OF 3

	Alternative SD-1 No Action	**Alternative SD-3 Capping with Pre-Dredging to Meet RAOs, Dewatering, On-Site Treatment and Discharge of Dewatering Fluid, Off-Site Disposal of Dewatered Sediment, LUCs (Institutional Controls and Inspections), and Monitoring**	**Alternative SD-4 Capping with Pre-Dredging to Meet RAOs, Dewatering, Off-Site Disposal of Dewatered Sediment and Dewatering Fluid, LUCs (Institutional Controls and Inspections), and Monitoring**	**Alternative SD-6 Dredging to Meet PRGs, Dewatering, On-Site Treatment and Discharge of Dewatering Fluid, and Off-Site Disposal of Dewatered Sediment, LUCs (Institutional Controls and Inspections), and Monitoring**	**Alternative SD-7 Dredging to Meet PRGs, Dewatering, and Off-Site Disposal of Dewatered Sediment and Dewatering Fluid, LUCs (Institutional Controls and Inspections), and Monitoring**	**Alternative SD-8 Zone 4 – Dredging to Meet PRGs, Dewatering, and Off-Site Disposal of Dewatered Sediment and Dewatering Fluid, LUCs (Institutional Controls and Inspections), and Monitoring and Outer Pier 1 – Capping to Meet RAOs, LUCs (Institutional Controls) and Monitoring**
Description	Evaluated, as required by CERCLA, as a baseline for comparison to other alternatives. Under this alternative, the Navy would take no action in Zone 4.	Surface sediment with concentrations of COCs greater than PRGs would be capped, including an area where maintenance dredging may have exposed contaminated sediment. Prior to capping, a 2-foot-thick layer of sediment would be dredged from a portion of the area to be capped. A portion of both Zone 4 and Outer Pier 1 contains an uncontaminated layer of sediment that covers the contaminated sediment at depths greater than 2 feet below the sediment surface; the uncontaminated sediment layers will be maintained in these areas. LUCs and monitoring would be implemented to ensure that the uncontaminated sediment layers/caps remain effective. Capping would consist of placing a layer of sand or sand and gravel with a minimum thickness of 3 feet over the contaminated sediment. Dredged sediment would be dewatered on site; a small portion would be treated on site. All dewatering fluid would be discharged to the Thames River.	Similar to Alternative SD-3, except rather than using an on-site treatment facility, dewatering fluid would be disposed of off site.	Areas of sediment with concentrations of COCs greater than PRGs would be dredged. Figure 18b shows all areas containing contaminated sediment that would be dredged. A pre-design investigation would be completed to refine the extent of contamination prior to completing the remedial design. Dewatering would be similar to Alternative SD-3. LUCs and monitoring would be implemented because of the potential for contaminated sediment remaining under the existing quay wall and pier structure to recontaminate clean sediment in the dredged area of Zone 4.	Similar to Alternative SD-6 except rather than using an on-site treatment facility, dewatering fluid would be disposed of off site.	Areas of sediment in Zone 4 with concentrations of COCs greater than PRGs would be dredged; area of sediment in Outer Pier 1 with concentrations of COCs greater than PRGs would remain in place beneath the current cover of uncontaminated sediment. A pre-design investigation would be completed to refine the extent of contamination prior to completing the remedial design. Dewatering fluid would be disposed of off site. LUCs and monitoring for Zone 4 would be similar to those included in Alternative SD-6. LUCs and monitoring for Outer Pier 1 would be implemented to ensure the cap remains effective.
Area Addressed (sf)	NA	Areas 1 and 3 in the Thames river adjacent to Zone 4 would be capped (Figure 18a). Area 1 would be both dredged and capped and Area 3, where maintenance dredging was conducted, would be capped (Figure 18a). Existing cover over contaminated sediment in Area 2 would be maintained to prevent exposure. No capping or dredging would be done in Outer Pier 1, but existing cover would be maintained to prevent exposure. Approximately 97,300 sf in Zone 4 and 13,500 sf in Outer Pier 1 would have either a maintained cover or a cap.	Identical to Alternative SD-3	The areas of contaminated sediment to be dredged in the Thames River adjacent to Zone 4 cover an estimated 97,200 sf. The area of contaminated sediment to be dredged in Outer Pier 1 covers an estimated 13,500 sf (Figure 18b).	Identical to Alternative SD-6	The areas of contaminated sediment to be dredged in the Thames River adjacent to Zone 4 cover an estimated 97,200 sf. The area of contaminated sediment with the current cover of uncontaminated sediment in Outer Pier 1 covers an estimated 13,500 sf (Figure 18b).
Volume Addressed (sf)	NA	Total in-place volume of 1,330 cy of contaminated sediment would be removed using a barge-mounted excavator. An estimated 1,463 cy of contaminated sediment would be disposed at an off-site municipal solid waste landfill. An estimated total volume of 3,660 cy of capping material would be required.	Identical to Alternative SD-3	An estimated total volume of approximately 23,160 cy of contaminated sediment would be removed. An estimated total volume of 10,250 cy of backfill material would be required. An estimated 25,470 cy of of treated sediment would be disposed off site at a municipal solid waste landfill.	Identical to Alternative SD-6	An estimated total volume of approximately 19,700 cy of contaminated sediment would be removed. An estimated total volume of 10,250 cy of backfill material would be required. An estimated 21,660 cy of contaminated sediment amended with fly ash would be disposed off site at a municipal solid waste landfill.

TABLE 20: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 4 AND OUTER PIER 1 SEDIMENT REMEDIAL ALTERNATIVES
2 OF 3

	Alternative SD-1 No Action	Alternative SD-3 Capping with Pre-Dredging to Meet RAOs, Dewatering, On-Site Treatment and Discharge of Dewatering Fluid, Off-Site Disposal of Dewatered Sediment, LUCs (Institutional Controls and Inspections), and Monitoring	Alternative SD-4 Capping with Pre-Dredging to Meet RAOs, Dewatering, Off-Site Disposal of Dewatered Sediment and Dewatering Fluid, LUCs (Institutional Controls and Inspections), and Monitoring	Alternative SD-6 Dredging to Meet PRGs, Dewatering, On-Site Treatment and Discharge of Dewatering Fluid, and Off-Site Disposal of Dewatered Sediment, LUCs (Institutional Controls and Inspections), and Monitoring	Alternative SD-7 Dredging to Meet PRGs, Dewatering, and Off-Site Disposal of Dewatered Sediment and Dewatering Fluid, LUCs (Institutional Controls and Inspections), and Monitoring	Alternative SD-8 Zone 4 – Dredging to Meet PRGs, Dewatering, and Off-Site Disposal of Dewatered Sediment and Dewatering Fluid, LUCs (Institutional Controls and Inspections), and Monitoring and Outer Pier 1 – Capping to Meet RAOs, LUCs (Institutional Controls) and Monitoring
Comments	Because contamination would remain in excess of levels that allow for unrestricted use and unlimited exposure, five-year reviews would be required under this alternative.	Pre-dredging would remove the typically lighter and softer top layer of sediment to provide better support for the cap and prevent unacceptably shallow conditions. Monitoring would be completed prior to, during, and after construction to verify that no migration of COCs occurred. LUCs would be implemented to prevent disturbance of the maintained cover/ capped areas, and yearly site inspections to verify the continued implementation of the LUCs would be performed. A long-term sediment and surface water monitoring program would be developed and implemented to verify the continued effectiveness of the cap/ maintained cover. Final details for the monitoring program will be documented in a monitoring plan developed after the ROD is signed.	Similar to Alternative SD-3, with the addition of sampling the dewatering fluid prior to off-site disposal.	Monitoring would be completed prior to, during, and after construction to verify that no migration of COCs occurred. Following dredging, confirmation samples would be collected to verify that contaminated sediment has been adequately removed. Even though the goal is to dredge all contaminated sediment with concentrations above the PRGs, LUCs and monitoring similar to Alternative SD-3 would be implemented in Zone 4 because of the potential for contaminated sediment to remain beneath the existing Quay wall and pier structure in Zone 4. They will remain in place until it can be shown the potentially contaminated sediment no longer presents a risk to the environment. No LUCs or monitoring would be required in Outer Pier 1 because all contaminated sediment containing COCs with concentrations greater than the PRGs would be removed from Outer Pier 1.	Similar to Alternative SD-6, with the addition of sampling the dewatering fluid prior to off-site disposal.	In Zone 4, LUCs and monitoring identical to SD-6, with the addition of sampling the dewatering fluid prior to off-site disposal, would be completed. In Outer Pier 1, LUCs would be implemented to prevent disturbance of the maintained cover, and yearly site inspections to verify the maintenance of the LUCs would be performed. A long-term sediment and surface water monitoring program will be developed and implemented to verify the continued effectiveness of the maintained cover.
Evaluation Criterion						
Overall Protection of Human Health and Environment	Not protective.	Protective.	Protective	Protective	Protective	Protective
Compliance with ARARs and TBCs	Would not comply.	Would comply.	Would comply.	Would comply.	Would comply.	Would comply. The alternative is the least environmentally damaging, practicable alternative under Section 404 of the Federal Clean Water Act.
Long-Term Effectiveness and Permanence	Not effective.	Effective. Cap and maintained cover would ensure protection but capping/maintaining cover is not as effective as Alternatives SD-6, SD-7, and SD-8 because most sediment with concentrations greater than PRGs would remain onsite.	Slightly less effective than Alternative SD-3. On-site treatment of dewatering fluid, as in Alternative SD-3, is slightly more effective.	Most effective. Nearly all sediment containing concentrations of COCs greater than the PRGs would be removed from the site. Only contaminated sediment beneath the existing Quay wall and pier structure may remain on site after dredging.	More effective than Alternatives SD-3, SD-4, and SD-8; slightly less effective than SD-6 because dewatering fluid would not be treated on-site.	More effective than Alternatives SD-3 and SD-4 because of the removal of a majority of the contaminated sediment; slightly less effective than SD-6 and SD-7 because more contaminated sediment would be left on site in Outer Pier 1.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	There is no treatment.	Would treat on site 26,900 gallons of dewatering fluid with subsequent discharge to the Thames River.	There is no treatment.	Would treat on site 468,000 gallons of dewatering fluid with subsequent discharge to the Thames River.	There is no treatment.	There is no treatment.

TABLE 20: DESCRIPTIONS AND SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 4 AND OUTER PIER 1 SEDIMENT REMEDIAL ALTERNATIVES
3 OF 3

	Alternative SD-1 No Action	Alternative SD-3 Capping with Pre-Dredging to Meet RAOs, Dewatering, On-Site Treatment and Discharge of Dewatering Fluid, Off-Site Disposal of Dewatered Sediment, LUCs (Institutional Controls and Inspections), and Monitoring	Alternative SD-4 Capping with Pre-Dredging to Meet RAOs, Dewatering, Off-Site Disposal of Dewatered Sediment and Dewatering Fluid, LUCs (Institutional Controls and Inspections), and Monitoring	Alternative SD-6 Dredging to Meet PRGs, Dewatering, On-Site Treatment and Discharge of Dewatering Fluid, and Off-Site Disposal of Dewatered Sediment, LUCs (Institutional Controls and Inspections), and Monitoring	Alternative SD-7 Dredging to Meet PRGs, Dewatering, and Off-Site Disposal of Dewatered Sediment and Dewatering Fluid, LUCs (Institutional Controls and Inspections), and Monitoring	Alternative SI-8 Zone 4 – Dredging to Meet PRGs, Dewatering, and Off-Site Disposal of Dewatered Sediment and Dewatering Fluid, LUCs (Institutional Controls and Inspections), and Monitoring and Outer Pier 1 – Capping to Meet RAOs, LUCs (Institutional Controls) and Monitoring
Short-Term Effectiveness	No short-term risks. Would not achieve sediment RAOs or meet sediment PRGs.	Moderate potential for short-term risks from worker exposure during dredging, capping, monitoring, dewatering, and treatment; transport of contaminated sediment through the community; solids in surface water from dredging; effect of dredging and cap on benthic organisms. Two months to implement and achieve sediment RAOs and meet sediment PRGs.	Moderate potential for short-term risks from worker exposure during dredging, capping, monitoring, and dewatering; transport of contaminated sediment and dewatering fluid through the community; solids in surface water from dredging; effect of dredging and cap on benthic organisms. Two months to implement and achieve sediment RAOs and meet sediment PRGs.	Moderate to high potential for short-term risks from worker exposure during dredging, monitoring, dewatering, and treatment; transport of contaminated sediment through the community; solids in surface water from dredging; effect of dredging on benthic organisms. Risks would be properly mitigated. Three months to implement and achieve sediment RAOs and meet sediment PRGs.	Moderate to high potential for short-term risks from worker exposure during dredging, monitoring, and dewatering; transport of contaminated sediment and dewatering fluid through the community; solids in surface water from dredging; effect of dredging on benthic organisms. Three months to implement and achieve sediment RAOs and meet sediment PRGs.	Moderate to high potential for short-term risks from worker exposure during dredging, monitoring, and dewatering; transport of contaminated sediment and dewatering fluid through the community; solids in surface water from dredging; effect of dredging on benthic organisms. Three months to implement and achieve sediment RAOs and meet sediment PRGs
Implementability	Requires only five-year reviews.	More difficult to implement than SD-4 because dewatering fluid would be treated on site; less difficult than the dredging alternatives. Resources are readily available. Dredging depth and cap placement are difficult to control; base construction approval needed; LUC RD could be readily developed and implemented. If the property were transferred LUCs, would need to be coordinated with the State (owner of the subtidal property).	Least difficult to implement; nearly as difficult to implement as SD-3 but dewatering fluid would be disposed off site. Resources readily available. Dredging depth and cap placement are difficult to control; base construction approval needed; LUC RD could be readily developed and implemented. If the property were transferred, LUCs would need to be coordinated with the State (owner of the subtidal property).	More difficult to implement than SD-7 and SD-8 because all contaminated sediment would be dredged and dewatering fluid would be treated on site. Resources readily available. Dredging depth difficult to control; base construction approval needed; LUC RD could be readily developed and implemented. If the property were transferred LUCs, would need to be coordinated with the State (owner of the subtidal property).	More difficult to implement than SD-8 because all contaminated sediment would be dredged; less difficult to implement than SD-6 because dewatering fluid would be disposed off site. Resources readily available. Dredging depth difficult to control; base construction approval needed; LUC RD could be readily developed and implemented. If the property were transferred LUCs, would need to be coordinated with the State (owner of the subtidal property).	More difficult to implement than SD-3 and SD-4 because the majority of contaminated sediment would be dredged; less difficult to implement than SD-6 and SD-7 because contaminated sediment would not be dredged from Outer Pier 1 and dewatering fluid would be disposed off site. Resources readily available. Dredging depth difficult to control; base construction approval needed; LUC RD could be readily developed and implemented. If the property were transferred LUCs, would need to be coordinated with the State (owner of the subtidal property).
Costs: Capital Annual O&M Costs	$0 $25,000	$1,384,000 $45,000 Year 1; $40,000 Year 2; $28,000 Year 3; $166,000 every fifth year; $23,000 annually all other years;	$1,222,000 $45,000 Year 1; $40,000 Year 2; $28,000 Year 3; $166,000 every fifth year; $23,000 annually all other years;	$8,147,000 $22,000 Years 1 through 4, 7, and 9; $48,000 every fifth year; $1,000 Years 6 and 8; $26,000 Year 10;	$7,340,000 $22,000 Years 1 through 4, 7, and 9; $48,000 every fifth year; $1,000 Years 6 and 8; $26,000 Year 10;	$6,276,000 $40,000 Year 1; $34,000 Year 2; $28,000 Year 3; $22,000 Years 4, 7, and 9; $125,000 every fifth year; $19,000 all other years;
NPW	$104,000	$2,514,000	$2,352,000	$8,334,000	$7,527,000	$7,154,000

NOTES:

ARAR Applicable or Relevant and Appropriate Requirement
COC Chemicals of concern
cy Cubic yard
LUC Land use control
LUC RD Land use control remedial design
NPW Net present worth
Blue font indicates Preferred Alternative

O&M Operation and maintenance
PRG Preliminary Remediation Goal
RAO Remedial Action Objective
TBC To be considered (criteria)

Figure 18a. Zone 4 and Outer Pier I Alternatives SD-3 and SD-4 Components

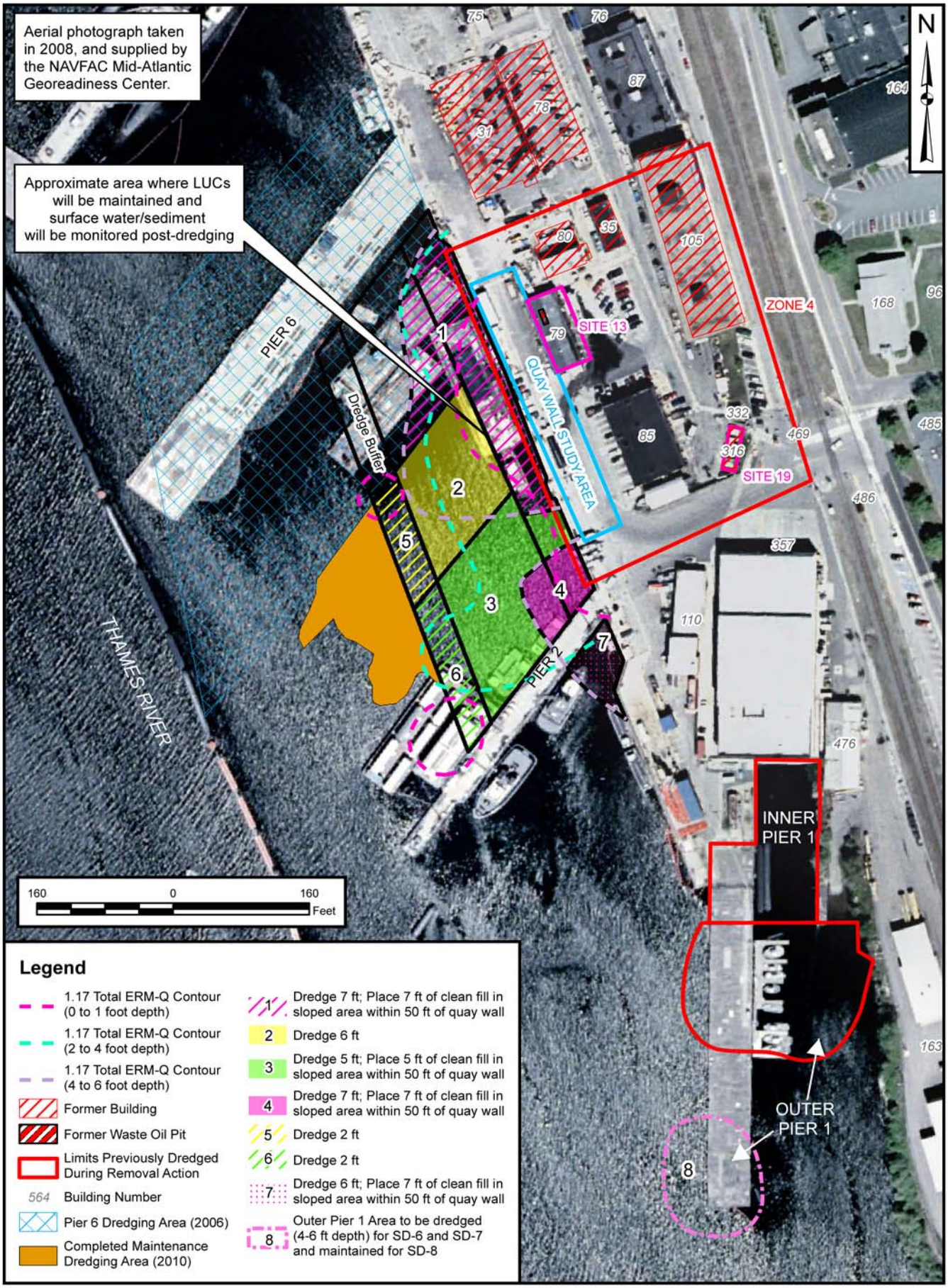

Figure 18b. Zone 4 and Outer Pier I Alternatives SD-6, SD-7, and SD-8 Components

Table 21: Summary of Zone 4 and Outer Pier 1 Preferred Alternatives

Zone	Alternative Number	Alternative Name (Cost)	Why this Alternative is the Best Balance of Trade-offs	Reason for Choice of Alternative
SOIL				
4	S-4.5B	Excavation to Meet I/C PRGs, Off-Site Disposal, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring (Capital/30-Year NPW $1,763,000) (Figure 17c)	• Is protective and provides long-term effectiveness and permanence to ensure protection • Moderately difficult to implement but resources are readily available • Moderate short-term risk • Most cost effective approach that ensures protection	• Zone 4 has soil exceeding residential and industrial PRGs; therefore, a remedy is needed. • Alternative S-4.2 does not adequately ensure protection because pavement does not adequately reduce the infiltration rate, which means the concentration of lead in soil exceeds the Alternative GB PMC PRG for I/C site use. • Excavation will be completed in stages to minimize interference with base operations. • Provides the most long-term effectiveness of the I/C alternatives. • Less complicated to implement than other alternatives that are protective and comply with ARARs. • Excavation would reduce long-term human health risk in Zone 4. • LUCs will address residential PRG exceedances.
SEDIMENT				
4 and Outer Pier 1	SD-8	Zone 4 – Dredging to Meet PRGs, Dewatering, and Off-Site Disposal of Dewatered Sediment and Dewatering Fluid and Outer Pier 1 – Capping to Meet RAOs, LUCs (Institutional Controls and Inspections) and Monitoring (Capital/30-Year NPW $7,154,000) (Figure 18b)	• Is protective and provides long-term effectiveness and permanence to ensure protection • Moderately difficult to implement but resources are readily available • Moderate to high short-term risk • Most cost effective approach that ensures protection	• Zone 4 and Outer Pier 1 have sediment exceeding ecological PRGs. • Maintenance dredging completed in 2010 not able to access all of Zone 4 area because of CERCLA concerns. • Approximately 4 feet of clean sediment currently covers contaminated sediment in Outer Pier 1, so maintaining the current cover will meet PRGs and provide minor cost savings. • Dredging will remove the contaminated sediment that causes potential ecological risks in Zone 4. • LUCs and monitoring will be used to manage the risk from any residual contaminated sediment that may exist in inaccessible areas under the quay wall until it can be shown that the inaccessible sediment will not result in an unacceptable risk to the environment and to ensure that the Outer Pier 1 cap remains effective. • Is the least environmentally damaging practicable alternative for protecting wetland/aquatic resources under the federal Clean Water Act.

PROPOSED PLAN – ZONE 5

SITE BACKGROUND AND CHARACTERISTICS – ZONE 5

Zone 5 (Figure 19) consists of Site 22, which includes Pier 33, Building 175, and approximately 400 linear feet of riverfront property adjacent to these two structures. Table 22 contains descriptions of Zone 5 sources and a summary of actions that have occurred at Zone 5.

No contaminants regulated under CERCLA were detected in Zone 5 soil, groundwater, surface water, or sediment at concentrations that caused a CERCLA risk.

SUMMARY OF SITE RISKS – ZONE 5

Table 23 summarizes the cumulative HIs and cancer risks for current and future receptors for Zone 5. No unacceptable human-health or ecological risks for chemicals regulated under CERCLA have been identified in Zone 5.

Human health risks from exposure to Zone 5 soil, groundwater, surface water, and sediment, and ecological risks from exposure to Zone 5 sediment are considered acceptable. The conceptual site model presented as Figure 20 illustrates the human and ecological receptors and exposure pathways in Zone 5.

RAOS FOR ZONE 5

Because there are no unacceptable CERCLA human health or ecological risks, there are no CERCLA COCs for Zone 5 media; thus, RAOs were not developed for Zone 5.

SUMMARY OF REMEDIAL ALTERNATIVES FOR ZONE 5

No further CERCLA action is necessary for Zone 5 soil, groundwater, surface water, or sediment; thus, remedial alternatives were not developed for Zone 5.

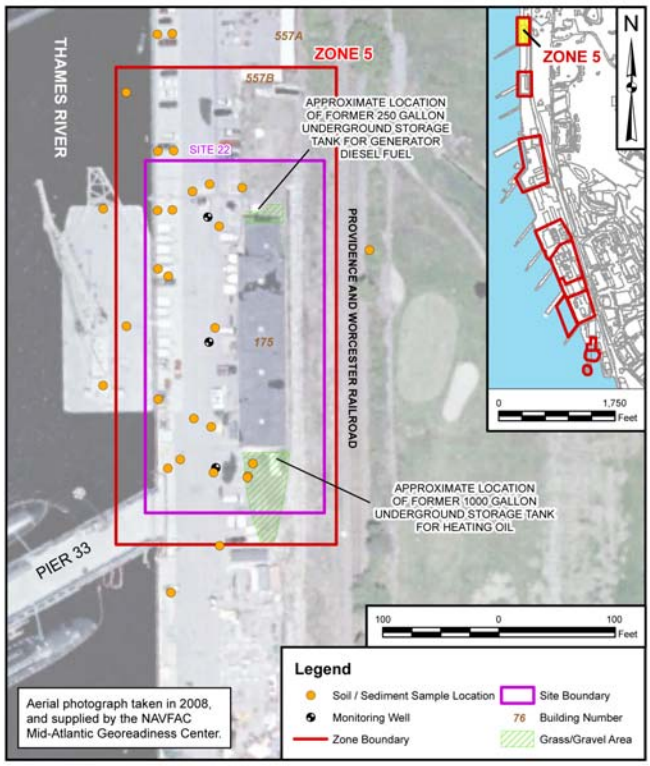

Figure 19. Zone 5 Location Map

Table 22: Zone 5 Site Description and Summary of Actions

Source	Description	Summary of Actions
Site 22: Pier 33 and Building 175	Building 175 originally used to house several above-ground battery acid storage tanks. Transfer lines from battery acid storage tanks extended in trenches to piers. A 1,000-gallon UST was located adjacent to the southern side of Building 175. Soil around the fill pipe was stained, and concentrations of petroleum compounds in soil exceeded federal and state criteria. A 250-gallon diesel fuel UST was also located adjacent to the building.	• The above-ground storage tanks and associated transfer piping were removed. • The 1,000-gallon UST was removed and replaced by an above-ground storage tank. • The 250-gallon UST was removed and replaced by an above-ground storage tank.

Table 23: Zone 5 Human Health Risk Assessment Summary

Risk Measure	Industrial Land Use				Residential Land Use			
	Construction Workers		Full-Time Employees		Future Residents			
	Current/Future		Current	Future	Child	Adult	Life-Long	Life-Long
	Surface/ Subsurface Soil Direct Exposure	Groundwater Direct Exposure	Surface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Vapor Intrusion
Cancer Risk[1]	4 per 10,000,000	2 per 100,000,000	1 per 1,000,000	3 per 1,000,000	3 per 100,000	5 per 1,000,000	3 per 100,000	7 per 10,000,000
Hazard Index[2]	0.4	0.1	0.009	0.01	0.1	0.02	NA	0.0006

Notes

1 > 1 per 10,000 considered unacceptable cancer risk
2 Hazard Index > 1 is considered unacceptable
NA Not applicable for this receptor

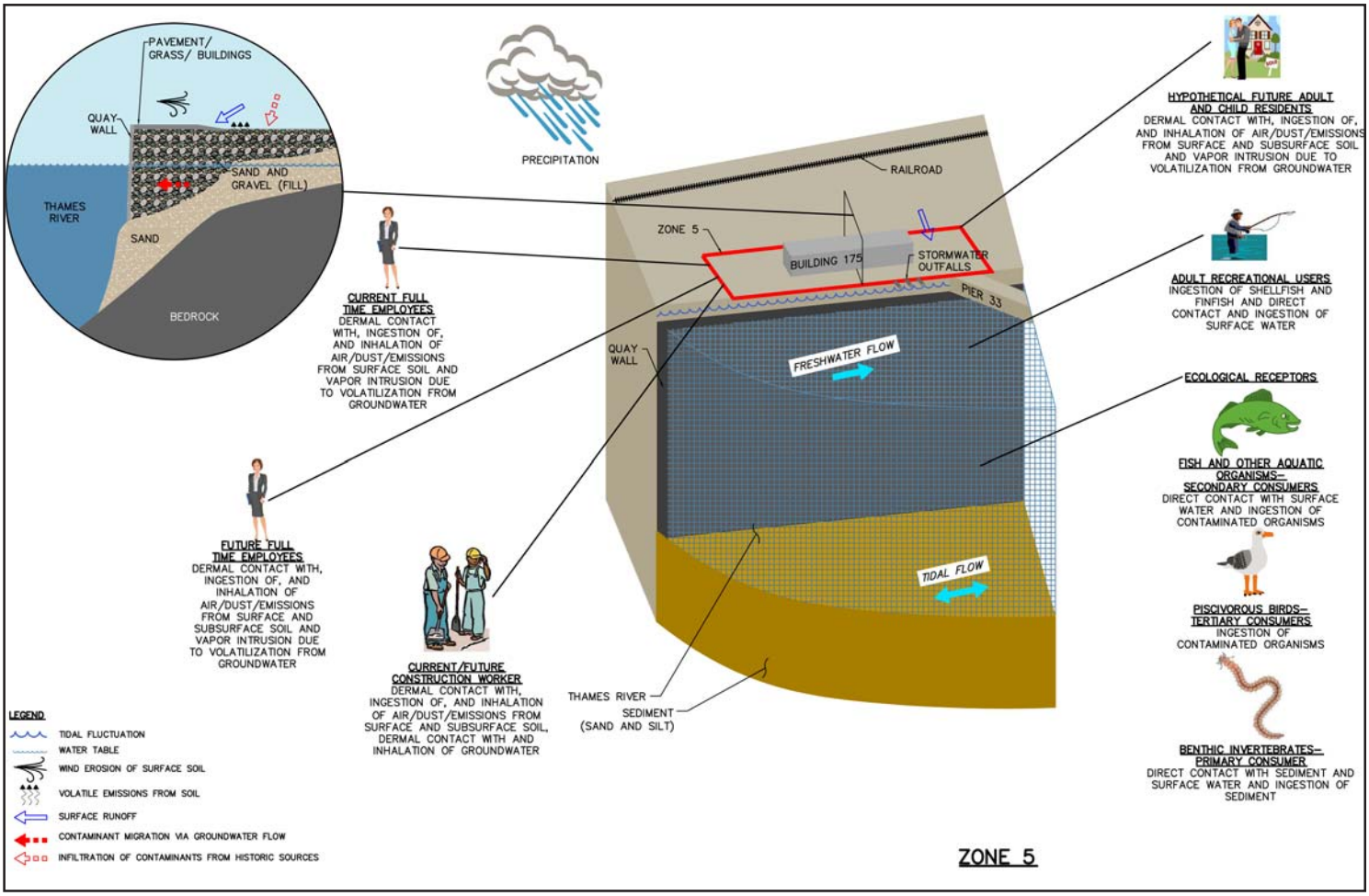

Figure 20. Exposure Pathway for Zone 5

PROPOSED PLAN – ZONE 6

SITE BACKGROUND AND CHARACTERISTICS – ZONE 6

Zone 6 (Figure 21) is located east of Pier 32 in the northern section of the Lower Subase. Zone 6 includes Building 174, which is designated Site 24 – Central Paint Accumulation Area. Table 24 contains descriptions of Zone 6 sources and a summary of actions that have occurred at Zone 6.

No contaminants regulated under CERCLA were detected in Zone 6 soil, groundwater, surface water, or sediment at concentrations that cause a concern.

SUMMARY OF SITE RISKS – ZONE 6

Table 25 summarizes the cumulative HIs and cancer risks for current and future Zone 6 receptors. No unacceptable human-health or ecological risks for chemicals regulated under CERCLA have been identified in Zone 6.

Human health risks from exposure to Zone 6 soil, groundwater, surface water, and sediment, and ecological risks from exposure to Zone 6 sediment are considered acceptable. The conceptual site model presented as Figure 22 illustrates the human and ecological receptors and exposure pathways in Zone 6.

RAOS FOR ZONE 6

Because there are no unacceptable CERCLA human health or ecological risks, there are no CERCLA COCs for Zone 6 media; thus, RAOs were not developed for Zone 6.

SUMMARY OF REMEDIAL ALTERNATIVES FOR ZONE 6

No further CERCLA action is necessary for Zone 6 soil, groundwater, surface water, or sediment; thus, remedial alternatives were not developed for Zone 6.

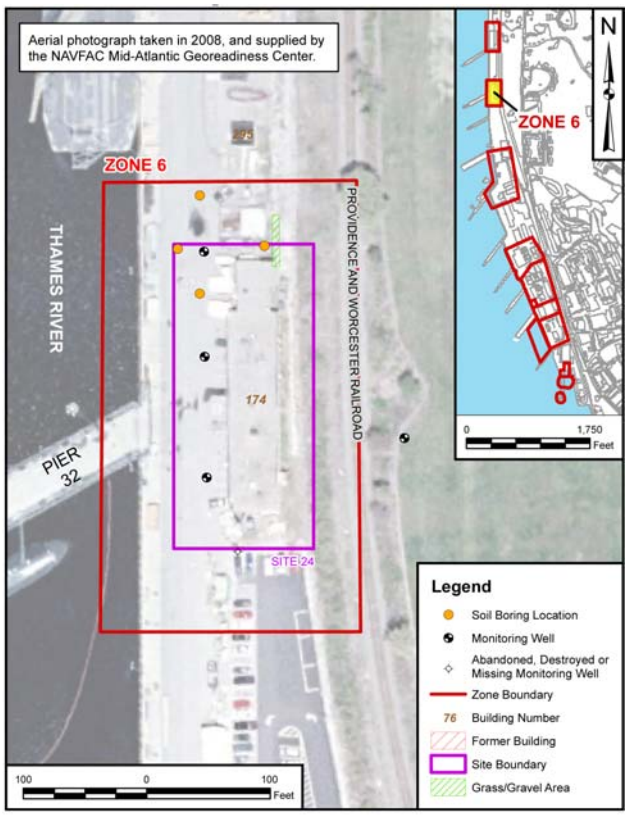

Figure 21. Zone 6 Location Map

Table 24: Zone 6 Site Description and Summary of Actions

Source	Description	Summary of Actions
Site 24: Central Paint Accumulation Area (Building 174)	Building 174 was used as the primary storage facility for paints used in boat maintenance.	• In 1982, Building 174 was refitted to allow boat anchor sandblasting and other paint activities.

Table 25: Zone 6 Human Health Risk Assessment Summary

Risk Measure	Industrial Land Use				Residential Land Use			
	Construction Workers		Full-Time Employees		Future Residents			
	Current/Future		Current	Future	Child	Adult	Life-Long	Life-Long
	Surface/ Subsurface Soil Direct Exposure	Groundwater Direct Exposure	Surface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Vapor Intrusion
Cancer Risk[1]	1 per 10,000,000	5 per 1,000,000,000	4 per 1,000,000	2 per 1,000,000	2 per 100,000	4 per 1,000,000	2 per 100,000	1 per 100,000
Hazard Index[2]	0.3	0.008	0.01	0.01	0.1	0.01	NA	0.01

Notes
1 > 1 per 10,000 considered unacceptable cancer risk
2 Hazard Index > 1 is considered unacceptable
NA Not applicable for this receptor

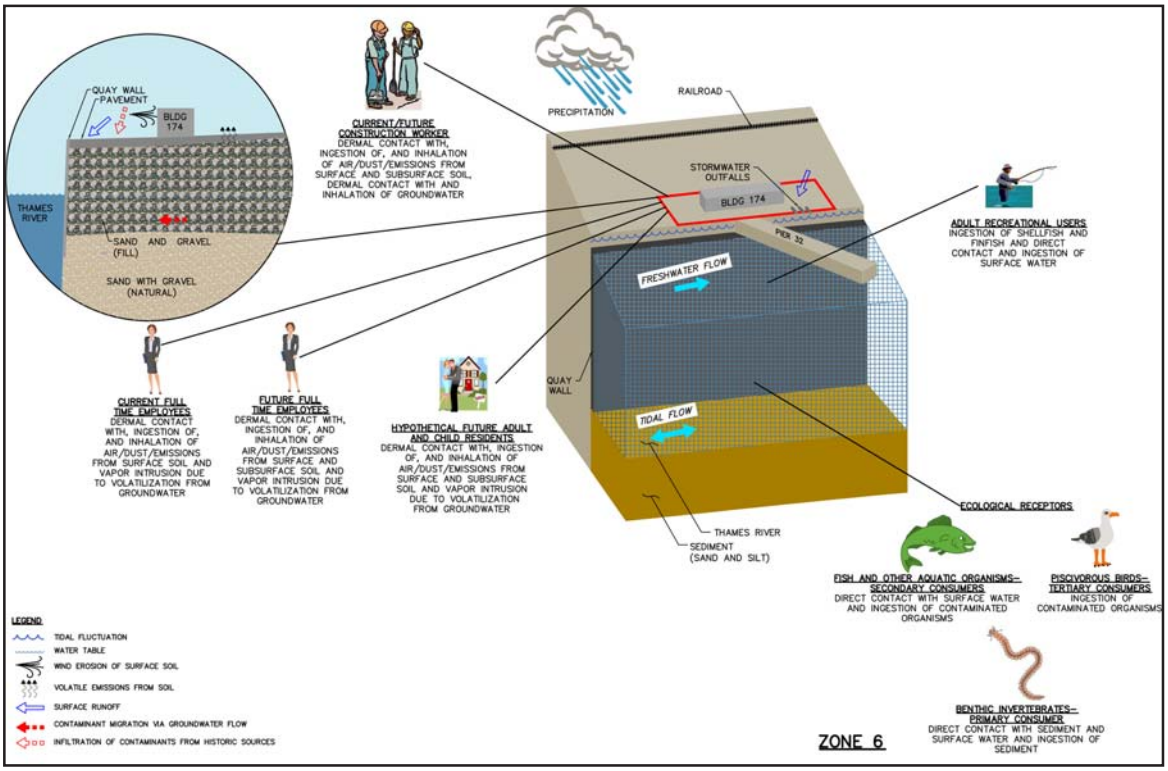

Figure 22. Exposure Pathway for Zone 6

PROPOSED PLAN – ZONE 7

SITE BACKGROUND – ZONE 7

Zone 7 (Figure 23) extends from just north of Building 478 to the southern side of Dorado Road. Zone 7 includes Site 21 (Berth 16), Site 25 (Classified Materials Incinerator), and transformers at Building 157, Vault 31. Subsurface fuel oil distribution lines were historically located in Zone 7 but have been abandoned. The following structures are present within Zone 7: Building 106, originally used for electronics and currently used for storage; Building 157, originally the Periscope Shop and currently the Optical Shop; Building 173, originally the Substation and currently used for electrical distribution; and Buildings 456 and 478, which were originally and are currently used to house maintenance shops. Table 26 contains descriptions of Zone 7 sources and a summary of actions that have occurred at Zone 7.

SITE CHARACTERISTICS – ZONE 7

An area of fill mixed with metal, brick, glass, plastic, concrete, ash, cinders, and other types of debris extends over a portion of Zone 7. Figure 24 shows that a large area of Zone 7 soil has high PAH concentrations exceeding residential regulatory standards, represented on the figure as BaPEQ. BaPEQ concentrations greater than 1,000 µg/kg exceed these standards. Soil with concentrations of BaPEQ exceeding regulatory standards could cause health problems for individuals who have direct contact with the soil over an extended period of time. In general, the concentrations are highest near the surface. In some portions of the contaminated areas, the concentrations of individual PAHs in the soil are high enough that they could cause future levels of chemicals in groundwater to exceed regulatory standards for residential and industrial use. Depending on the specific PAH detected, these levels range between 2,600 and 7,400 µg/kg.

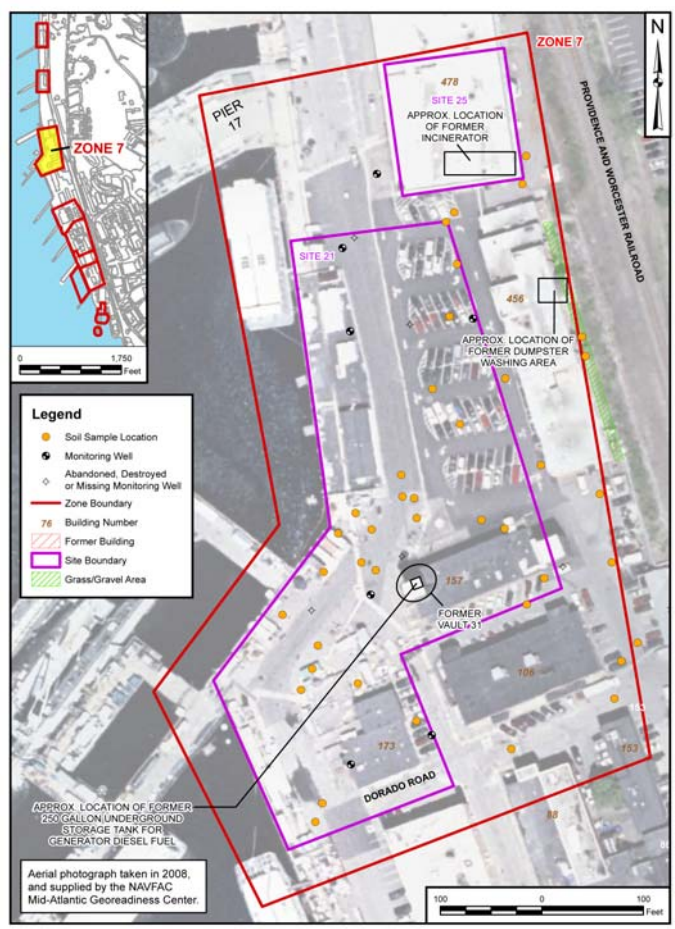

Figure 23. Zone 7 Location Map

Table 26: Zone 7 Site Description and Summary of Actions		
Source	**Description**	**Summary of Actions**
Site 21 (Berth 16)	Includes Berth 16 and Buildings 157 and 173. Berth 16 formerly included a UST containing diesel fuel, transformers that once contained PCB-based oils, and underground diesel fuel lines.	• PCB transformers were replaced with non-PCB transformers. Secondary containment was constructed around the vault. • All underground diesel distribution lines have been abandoned. The method of abandonment is unknown
Site 25: Classified Materials Incinerator (within former Building 97)	Between 1944 and 1963, the incinerator was used to burn classified materials and other non-salvageable wastes generated at the Subase. Residual ash was disposed of in the Goss Cove Landfill. Adjacent to the incinerator was a dumpster-cleaning operation.	• The incinerator was demolished in 1979, and Buildings 456 and 478 were constructed in the areas previously used for the dumpster-cleaning operation and incinerator, respectively.

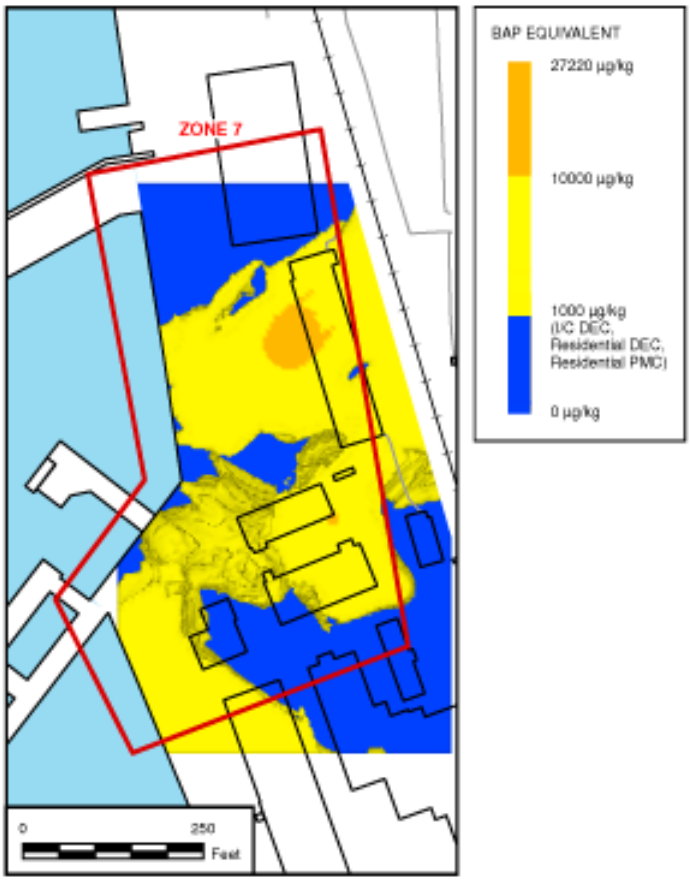

Figure 24. Zone 7 BAP Equivalent Concentrations

Concentrations of lead in soil within Zone 7 are greater than lead concentrations reported in soil in any of the other Lower Subase zones, with a maximum detected concentration of 31,400 in surface soil and 189,000 mg/kg in subsurface soil. Lead was detected at elevated concentrations over most of the eastern half of Zone 7. The areas with lead concentrations in soil that exceed regulatory standards are shown on Figure 25. Soil with concentrations of lead that exceed regulatory standards could cause health problems for individuals who have direct contact with the soil over an extended period of time, and in some cases present acute toxicity risks to individuals who have direct contact with the soil over a short period of time. Leachate tests were performed on soil samples to evaluate compliance with pollutant mobility standards. High lead leachate concentrations are also present in Zone 7, with a maximum lead leachate concentration of 45.9 mg/L. High concentrations of leachable lead in soil could cause future levels of chemicals in groundwater to exceed regulatory standards for residential and industrial use. Lead concentrations were generally higher at locations where ash and cinders were observed during sampling. The lead detected in Zone 7 soil may be associated with historical use or maintenance of batteries for submarines, historical use of lead ballast by the Navy, construction debris, or ash and cinders, possibly from the former incinerator.

Antimony was detected in surface and subsurface soil in Zone 7 at concentrations of both mass and leachable antimony exceeding regulatory standards, with maximum concentrations of 1,820 mg/kg and 0.627 mg/L, respectively. Antimony is commonly mixed (alloyed) with other metals such as lead to make the lead harder and stronger for use in lead-acid batteries. Therefore, it is possible that the antimony detected in Zone 7 may be associated with historical use or maintenance of batteries for submarines by the Navy at the Lower Subase. Arsenic (maximum concentration of 50 mg/kg), hexavalent chromium (maximum concentration of 0.78 mg/kg), and copper (maximum concentration of 9,010 mg/kg) were detected in Zone 7 soil at relatively high levels.

It is important to understand that although PAH, lead, and antimony concentrations in Zone 7 soil exceed pollutant mobility standards, the results of groundwater sampling completed during the Lower Subase Soil and Groundwater PDI did not indicate that these contaminants have migrated from the soil into groundwater. If no action is taken to address PAH, lead, and antimony in Zone 7 soil,

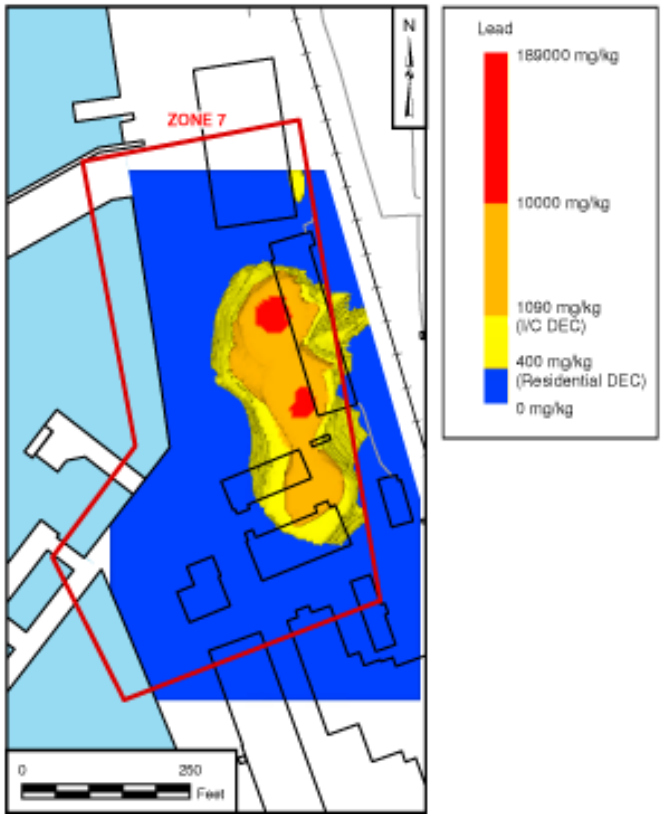

Figure 25. Zone 7 Lead Concentrations

these chemicals could migrate from soil to groundwater causing exceedances of groundwater standards in the future.

No contaminants regulated under CERCLA were detected in Zone 7 groundwater, surface water, or sediment at concentrations that exceed regulatory standards.

SUMMARY OF SITE RISKS – ZONE 7

Human Health Risks – Zone 7

Table 27 summarizes the cumulative HIs and cancer risks for current and future receptors for Zone 7 and Table 28 summarizes the results of the lead modeling completed for Zone 7 soil.

There are unacceptable human health risks for soil under both the residential and industrial scenarios; human health risks for groundwater are acceptable. The conceptual site model presented as Figure 26 illustrates the receptors and exposure pathways in Zone 7.

Ecological Risks – Zone 7

The Thames River Validation Study determined that ecological risks for Zone 7 are acceptable. The conceptual site model for Zone 7 includes ecological receptors and exposure pathways evaluated during the ERA (Figure 26).

Table 27: Zone 7 Human Health Risk Assessment Summary

Risk Measure	Industrial Land Use					Residential Land Use					
	Construction Workers			Full-Time Employees		Future Residents					
	Current/Future			Current	Future	Child		Adult	Life-Long		
	Surface/ Subsurface Soil Direct Exposure	Risk Drivers	Groundwater Direct Exposure	Surface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Risk Drivers	Surface/ Subsurface Soil Direct Exposure	Surface/ Subsurface Soil Direct Exposure	Risk Drivers	Vapor Intrusion
Cancer Risk	1 per 1,000,000	NA	7 per 1,000,000,000	3 per 100,000	2 per 100,000	2 per 10,000	PAHs, Arsenic	4 per 100,000	3 per 10,000	PAHs, Arsenic	1 per 1,000,000
Hazard Index	2	Antimony	0.04	0.05	1	14	Antimony	2	NA	NA	0.01

> 1 per 10,000	Indicates unacceptable human health risk
NA	Not applicable for this receptor
> 1	Indicates unacceptable hazard index
>1	Indicates risks are considered acceptable. Although the hazard index was greater than 1, the hazard index for the target organ is less than 1.

Table 28: Zone 7 Lead Models Summary

Percentage of Estimated Fetal Blood Lead Level Greater than 10 µg/dL				
Risk Measure	Industrial Land Use			Residential Land Use
	Construction Workers	Full-Time Employees		Child
	Current/Future	Current	Future	Future
Blood Lead Level (%)	58	6.3	34	99

> 5 %	Unacceptable blood lead level. Blood lead levels exceeding 10 µg/dL for more than 5% of fetuses or children are considered unacceptable.

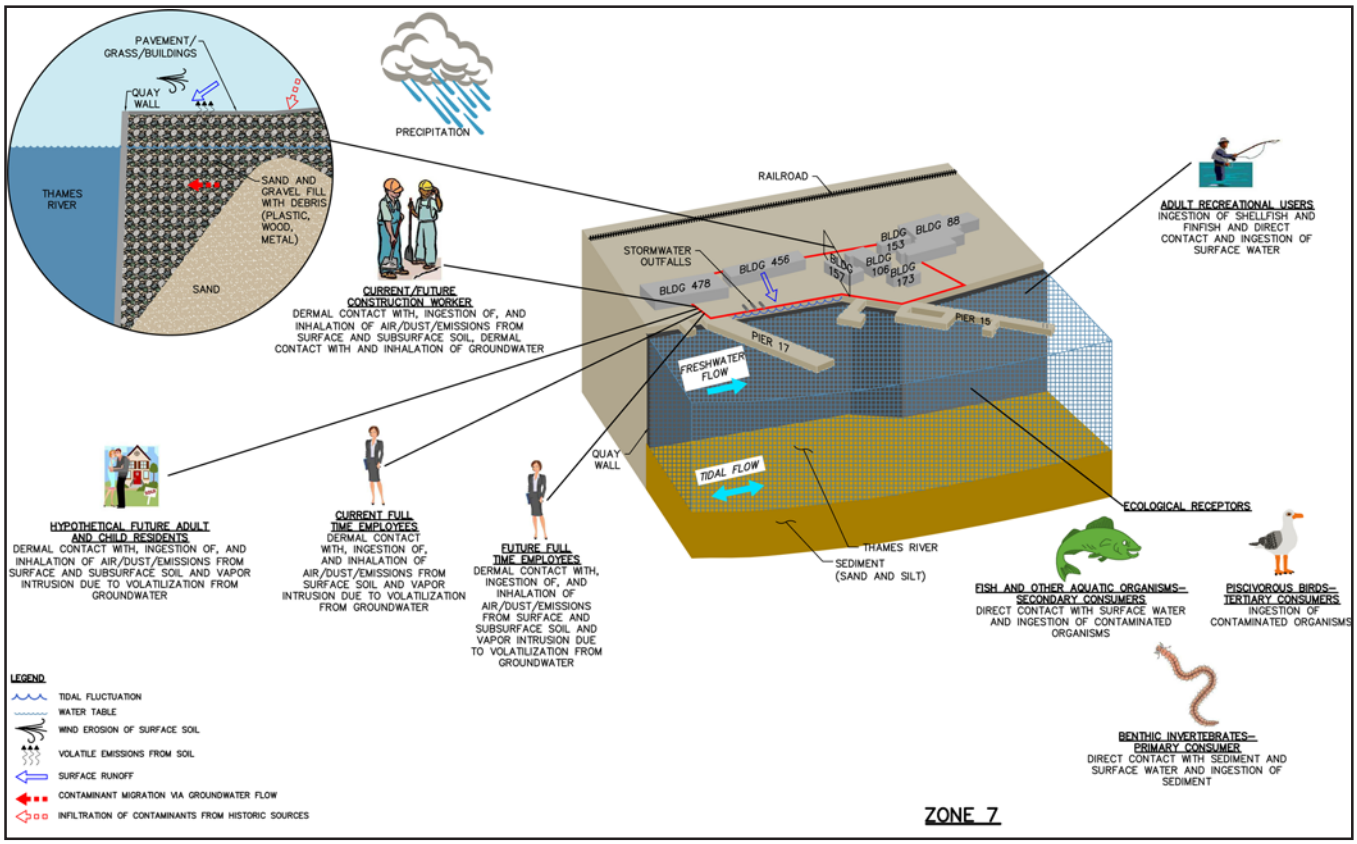

Figure 26. Exposure Pathways for Zone 7

RAOs for Zone 7 Soil

The following RAOs were developed for surface/subsurface soil in Zone 7 considering industrial land use and receptors:

- **Soil RAO No.1:** Prevent exposure of current and future full-time employees and construction workers to surface/subsurface soil containing concentrations of COCs greater than I/C PRGs.
- **Soil RAO No. 2:** Prevent migration of surface/subsurface soil COCs to groundwater that would result in concentrations greater than PRGs.
- **Soil RAO No. 3:** Prevent migration of surface/subsurface soil COCs as a result of erosion and sedimentation.

In addition, the following RAO was developed for surface/subsurface soil in Zone 7 considering residential land use and receptors:

- **Soil RAO No. 4:** Prevent exposure of hypothetical future residents to surface/subsurface soil containing concentrations of COCs greater than residential PRGs.

Table 29 summarizes the human health COCs and PRGs for Zone 7 that were calculated as acceptable levels of COCs in soil under both industrial and residential land use scenarios.

There are no human health groundwater, surface water, or sediment CERCLA COCs or ecological COCs for Zone 7; thus, no PRGs were calculated for these media or for ecological receptors.

Summary of Remedial Alternatives for Zone 7 Soil

The descriptions of each remedial alternative are summarized in Table 30.

Evaluation of Alternatives – Zone 7 Soil

Table 30 summarizes how well each of the cleanup alternatives developed for soil in Zone 7 meets the first seven criteria. After comments from the State and the community are received and evaluated, the Navy and EPA will select the final cleanup plan.

Preferred Alternatives – Zone 7 Soil

Table 31 summarizes the Navy and EPA's Preferred Alternatives for cleaning up soil in Zone 7.

Commitment to the Communities

The Navy is committed to keeping the communities informed of the environmental activities at Naval Submarine Base - New London. A Restoration Advisory Board, composed of the

Table 29: Zone 7 Chemicals of Concern and Preliminary Remediation Goals

Chemicals of Concern	Preliminary Remediation Goals			
	Direct Exposure Criteria for Industrial Land Use (1,2)	Direct Exposure Criteria for Residential Land Use (1)	Pollutant Mobility Criteria for Industrial Land Use (1,2)	Pollutant Mobility Criteria for Residential Land Use (1)
Benzo(a)anthracene	Not a concern	1,000 µg/kg	Not a concern	4,400* µg/kg
Benzo(a)pyrene	Not a concern	1,000 µg/kg	Not a concern	6,500* µg/kg
Benzo(b)fluoranthene	Not a concern	1,000 µg/kg	Not a concern	2,800* µg/kg
Benzo(k)fluoranthene	Not a concern	Not a concern	Not a concern	7,100* µg/kg
Chrysene	Not a concern	Not a concern	Not a concern	7,400* µg/kg
Dibenzo(a,h)anthracene	Not a concern	1,000 µg/kg	Not a concern	Not a concern
Indeno(1,2,3-cd)pyrene	Not a concern	1,000 µg/kg	Not a concern	Not a concern
Antimony	Not a concern	31 mg/kg*(3)	0.10 mg/L	0.06 mg/L(3)
Arsenic	Not a concern	10 mg/kg	Not a concern	Not a concern
Chromium, Hexavalent	Not a concern	0.29 mg/kg*(4)	Not a concern	Not a concern
Copper	Not a concern	3,130 mg/kg*	Not a concern	Not a concern
Lead	1,090 mg/kg*	400 mg/kg	0.32 mg/L	0.15 mg/L

*Calculated site-specific criterion. See Note (1).

1 Pollutant Mobility Criteria and Direct Exposure Criteria are Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations, except where flagged with an asterisk (*). Flagged values are calculated site-specific criteria, referred to as Alternative GB PMCs.
2 Based on existing site covers (soil and building foundations).
3 Antimony is co-located with lead in some Zone 7 soil.
4 USEPA Residential Regional Screening Level.

community and government agency representatives, meets regularly to discuss the environmental activities at New London. At these meetings, community Restoration Advisory Board members provide input and offer suggestions on program activities. Upcoming Restoration Advisory Board meetings are publicized in local news media and are open to the public. Past meeting minutes are available on the Naval Submarine Base New London website: https://portal.navfac.navy.mil/portal/page/portal/navfac

The Navy also maintains a community mailing list for distributing information about the environmental program. If you would like to be added to the mailing list, please contact Tracey McKenzie at the address provided at the end of this plan.

GLOSSARY OF TECHNICAL TERMS

Alternative Pollutant Mobility Criteria (PMC): Connecticut Department of Energy and Environmental Protection (CTDEEP) Remediation Standard Regulations (RSRs) provide a method to

TABLE 30: SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 7 SOIL REMEDIAL ALTERNATIVES
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	Alternative S-7.1 No Action	Alternative S-7.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-7.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.4 In-Situ Treatment (Stabilization/ Solidification) to Meet I/C Alternative GB PMC PRGs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.5A Excavation to Meet I/C DEC, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.5B Excavation to Meet I/CPRGs, Off-Site Disposal, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.6 Excavation to Meet ResidentialPRGs, On-Site Dewatering, and Off-Site Disposal
Description	Evaluated, as required by CERCLA, as a baseline for comparison to other alternatives. Under this alternative, the Navy would take no action in Zone 7.	Instituting CERCLA LUCs and inspections to prohibit soil disturbance and future residential development and meet PRGs. CERCLA LUCs would include institutional controls and CERCLA risk-based engineering controls (maintenance of building foundations and pavement) to meet residential PRGs, and maintenance of monitoring wells. Pavement would be installed to provide a CTDEEP RSR engineered controls for a small area of Zone 7 where COC concentrations exceed I/C DEC and PMC PRGs. This area would include a higher level of pavement maintenance to ensure that pavement prevents infiltration and direct exposure. Upon implementation, this alternative would allow I/C site use only.	Excavation and off-site disposal of soil with lead concentrations greater than the I/C direct exposure PRG to a depth of 2 feet bgs in paved areas to allow installation of the cap; soil with lead concentrations above the Alternative GB PMC PRG between 2 feet bgs and the mean high water table would be capped with an impervious cover system to prevent lead migration from soil to groundwater. After installation of the cap, the area would be backfilled with clean soil and site pavement would be restored. CERCLA LUCs and CTDEEP RSR engineered controls similar to Alternative S-7.2 would be required. Upon implementation, this alternative would allow I/C site use only.	This alternative would include removal of asphalt pavement and in-place mixing of soil in the unsaturated zone (above the water table) with COC concentrations greater than the I/C PRGs with Portland cement to chemically stabilize contaminants in soil and prevent migration from soil to groundwater. This process would also reduce the direct exposure risk by changing the characteristics of the soil. After treatment, asphalt pavement would be restored and pavement would be installed in a small unpaved area and maintained through CERCLA risk-based engineering controls. CERCLA LUCs similar to Alternative S-7.2 would be required. CTDEEP RSR engineered controls would not be required. Upon implementation, this alternative would allow I/C site use only.	This alternative would include excavation and off-site disposal of soil with COC concentrations greater than the I/C direct exposure PRG to a depth of 2 feet bgs. After excavation, the area would be backfilled with clean soil and site pavement restored. CERCLA LUCs and CTDEEP RSR engineered controls similar to Alternative S-7.2 would be required. Upon implementation, this alternative would allow I/C site use only.	This alternative is similar to Alternative S-7.5A, except soil with COC concentrations greater than the I/C PRGs would be excavated to a depth of 2 feet bgs for soil greater than the I/C direct exposure PRG, and to the water table for soil greater than the Alternative GB PMC PRGs for I/C site use. CERLCA LUCs similar to Alternative S-7.2 would be required. Pavement would be installed in a small unpaved area and maintained through CERCLA risk-based engineering controls. Upon implementation, this alternative would allow I/C site use only.	Excavation and off-site disposal of soil with concentrations of COCs greater than residential and I/C PRGs. Upon implementation, this alternative would allow unrestricted site use.
Area Addressed (sf)	NA	An implementable LUC boundary was created to encompass the 181,100 sf of soil where LUCs are required (Figure 27a). The LUC boundary is approximately 199,500 sf. Within this area, building foundations and approximately 121,000 sf of pavement would be maintained through CERCLA risk-based engineering controls to meet residential PRGs. Pavement would be installed and maintained as a CTDEEP RSR engineered control in a 1,960 sf area that contains soil with concentrations of COCs greater than the Alternative GB PMC PRGs for I/C site use. A total of 22,400 sf of pavement	Soil in a 22,400 sf area that exceeds I/C direct exposure PRGs would be excavated to a depth of 2 feet bgs and capped (Figure 27b). Within the LUC area, building foundations and 121,000 sf of pavement would be maintained through CERCLA risk-based engineering controls and 22,400 would be maintained through CTDEEP RSR engineered controls. Contaminated soil beneath buildings is considered environmentally isolated and would not be capped.	Soil in a 22,400 sf area to a depth of 5 feet bgs would be treated in place (Figure 27c). Within the LUC area, 1,090 sf of pavement would be installed and building foundations and 121,000 sf of pavement would be maintained through CERCLA risk-based engineering controls. CTDEEP RSR engineered controls are not required because all soil with COC concentrations greater than the Alternative GB PMC PRGs would be treated to reduce pollutant mobility to levels below the PRGs. In addition, all soil with concentrations of COCs greater than the I/C direct exposure PRGs would be treated. The treatment process would change the soil characteristics and would reduce the direct exposure risks to levels below the I/C PRGs. Contaminated soil beneath buildings is considered	Soil in a 13,100 sf area to a depth of 2 feet bgs would be excavated (Figure 27d). Within the LUC area, building foundations and 121,000 sf of pavement would be maintained through CERCLA risk-based engineering controls, 1,090 sf of pavement would be installed, and 22,400 sf of pavement would be maintained through CTDEEP RSR engineered controls. Contaminated soil beneath buildings is considered environmentally isolated and would not be excavated.	Soil in a 22,400 sf area, to a depth of up to 5 feet bgs, would be excavated (Figure 27c). Within the LUC area, 1,090 sf of pavement would be installed and building foundations and 121,000 sf of pavement would be maintained through CERCLA risk-based engineering controls. CTDEEP RSR engineered controls are not required because all soil with COC concentrations greater than I/C PRGs would be excavated. Contaminated soil beneath buildings is considered environmentally isolated and would not be excavated.	Soil in a 181,100 sf area with COC concentrations greater than residential and I/C PRGs to a depth up to 15 feet bgs would be excavated (Figure 27e).

TABLE 30: SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 7 SOIL REMEDIAL ALTERNATIVES
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	Alternative S-7.1 No Action	Alternative S-7.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-7.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.4 In-Situ Treatment (Stabilization/ Solidification) to Meet I/C Alternative GB PMC PRGs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.5A Excavation to Meet I/C DEC, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.5B Excavation to Meet I/CPRGs, Off-Site Disposal, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.6 Excavation to Meet ResidentialPRGs, On-Site Dewatering, and Off-Site Disposal
		contains soil with concentrations of COCs greater than the I/C PRGs and would be maintained through CTDEEP RSR engineered controls.		environmentally isolated and would not be treated.			
Volume Addressed (sf)	NA	NA	Approximately 1,285 cy of soil addressed through excavation and off-site disposal; unknown volume addressed through capping.	Approximately 3,020 cy would be treated and mixed in place; treatment/mixing would result in an increase in volume of 300 cy, which would be disposed of off site after testing confirms it is non-hazardous. An additional 240 cy of soil would be excavated and disposed of off site to allow for a 9-inch-thick pavement system to replace the existing 6-inch-thick asphalt.	Approximately 730 cy of excavated soil would be transported off site for disposal.	Approximately 3,020 cy of excavated soil would be transported off site for disposal.	Approximately 59,300 cy of excavated soil would be transported off site for disposal.
Comments	Because contamination would remain in excess of levels that allow for unrestricted use and unlimited exposure, five-year reviews would be required under this alternative.	Long-term groundwater monitoring for all COCs that exceed residential soil PRGs would be implemented. For cost estimating purposes, the monitoring frequency was assumed to be quarterly for the first 2 years, semi-annually for the next 2 years, annually the fifth year, and every 5 years thereafter. Final details for the monitoring program will be documented in a long-term monitoring plan developed after the Record of Decision is signed.	LUCs and monitoring similar to Alternative S-7.2 would be implemented, in addition to regular cap inspections and maintenance. Confirmation samples would be collected to verify soil with COC concentrations greater than the I/C direct exposure PRGs has been removed.	LUCs and monitoring similar to Alternative S-7.2 would be implemented to ensure that building foundations and pavement are maintained and the remedy was effective in decreasing the concentrations of COCs to levels below the I/C PRGs. Following treatment, confirmation samples would be collected beneath and around the treated area to verify that all contaminated soil has been treated. Additional confirmation samples would be collected from the treated area within 1 month and tested to verify the treated soil contains COC concentrations below the I/C PRGs.	LUCs and monitoring similar to Alternative S-7.2 would be implemented to ensure that building foundations/pavement are maintained and COCs are not migrating from soil to groundwater. Following excavation, confirmation samples would be collected from the walls of the excavated area to verify that soil with concentrations greater than I/C direct exposure PRGs has been removed.	LUCs, monitoring, and confirmation sampling similar to Alternative S-7.5A would be implemented.	Excavation beyond a depth of approximately 6 feet bgs would take place below the water table. No LUCs or monitoring would be required because the remaining soil would not contain concentrations of COCs above the residential PRGs. .
Evaluation Criterion							
Overall Protection of Human Health and Environment	Not protective.	Protective.	Protective.	Protective.	Protective.	Protective.	Protective.
Compliance with ARARs and TBCs	Would not comply.	Would comply.	Would comply.	Would comply.	Would comply.	Would comply.	Would comply.

TABLE 30: SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 7 SOIL REMEDIAL ALTERNATIVES
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	Alternative S-7.1 No Action	Alternative S-7.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-7.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.4 In-Situ Treatment (Stabilization/ Solidification) to Meet I/C Alternative GB PMC PRGs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.5A Excavation to Meet I/C DEC, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.5B Excavation to Meet I/CPRGs, Off-Site Disposal, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.6 Excavation to Meet ResidentialPRGs, On-Site Dewatering, and Off-Site Disposal
Long-Term Effectiveness and Permanence	Not effective.	Effective. CTDEEP RSR engineered controls were determined to be effective to address COC concentrations that exceed CTDEEP Alternative GB PMC PRGs. LUCs would ensure protection but LUCs are not as effective as alternatives S-7.3 through S-7.6 because all soil with concentrations greater than PRGs would remain onsite.	More effective than Alternative S-7.2 and Alternative S-7.5A. because all soil with concentrations greater than I/C direct exposure PRGs would be removed but soil with concentrations greater than Alternative GB PMC PRGs for I/C site use would be capped and left in place.	More effective than Alternative S-7.2 and approximately as effective as Alternative S-7.3. Treatment would reduce both direct exposure and pollutant mobility but material would remain onsite.	More effective than Alternative S-7.2 but not as effective as Alternatives S-7.3 and S-7.4. Soil that is not environmentally isolated that contains concentrations greater than I/C direct exposure PRGs would be removed, but soil with concentrations greater than Alternative GB PMC PRGs for I/C site use would be left in place, with asphalt pavement covering it (no engineered cap as in S-7.3).	More effective than Alternatives S-7.2, S-7.3, S-7.4, and S-7.5A. All soil that is not environmentally isolated that contains concentrations greater than the I/C PRGs would be removed from the site.	Most effective. All soil with concentrations greater than the residential and I/C PRGs would be removed.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	There is no treatment.	There is no treatment.	There is no treatment.	Would reduce toxicity and mobility of antimony and lead by in-situ chemical stabilization/ solidification.	There is no treatment.	There is no treatment.	There is no treatment, except the treatment of water generated from the dewatering process prior to discharge to the Thames River. A very small mass of COCs will be treated by this process.
Short-Term Effectiveness	No short-term risks. Would not achieve soil RAOs.	Minimal potential short-term risks to workers from exposure during groundwater sampling; no impacts to environment or community. Three months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C PRGs would be met through CTDEEP RSR engineered controls.	Moderate potential short-term risks to workers from exposure during cap installation and groundwater sampling; transport of contaminated soil through community; dust from excavation. After planning, 2 months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C direct exposure PRGs would be met through excavation and off- site disposal, and Alternative GB PMC PRGs would be met through CTDEEP RSR engineered controls and capping.	Moderate potential short-term risks to workers from exposure during cap installation and groundwater sampling; transport of contaminated soil through community; dust from excavation. After planning, 3 months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C PRGs would be met through in-situ treatment.	Moderate potential short-term risks to workers from exposure during excavation and groundwater sampling; transport of contaminated soil through community; dust from excavation. After planning, 2 months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C direct exposure PRGs would be met through excavation and off-site disposal and Alternative GB PMC PRGs for I/C site use would be met through CTDEEP RSR engineered controls.	Moderate potential short-term risks to workers from exposure during excavation and groundwater sampling; transport of contaminated soil through community; dust from excavation. After planning, 4.5 months to implement and achieve soil RAOs. Residential PRGs would be met through institutional controls and CERCLA risk-based engineering controls. I/C PRGs would be met through excavation and off-site disposal.	High potential short-term risks to workers from exposure during excavation; transport of contaminated soil through community; dust from excavation. After planning, 10 months to implement and achieve soil RAOs. Residential and I/C PRGs would be met through excavation and off-site disposal.

TABLE 30: SUMMARY OF COMPARATIVE ANALYSIS OF ZONE 7 SOIL REMEDIAL ALTERNATIVES
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	Alternative S-7.1 No Action	Alternative S-7.2 LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring	Alternative S-7.3 Capping to Allow I/C Site Use and Prevent Leaching, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.4 In-Situ Treatment (Stabilization/ Solidification) to Meet I/C Alternative GB PMC PRGs for I/C Site Use, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.5A Excavation to Meet I/C DEC, Off-Site Disposal, LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.5B Excavation to Meet I/CPRGs, Off-Site Disposal, LUCs (Engineering Controls, Institutional Controls, and Inspections), and Monitoring	Alternative S-7.6 Excavation to Meet ResidentialPRGs, On-Site Dewatering, and Off-Site Disposal
Implementability	Requires only five-year reviews.	Easy to implement; resources are readily available. No base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-7.2 because the remedy involves more complex actions, but the resources are readily available. Excavation and construction may interfere with base activities; underground utilities may interfere with construction; maintaining paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-7.2 and S-7.3 because the remedy involves more complex actions, but the resources are readily available. Treatment may interfere with base activities; underground utilities may interfere with treatment; treatability tests needed; maintaining paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-7.2 because the remedy involves more complex actions; less difficult to implement than S-7.3 and S-7.4. Resources are readily available. Excavation may interfere with base activities; underground utilities may interfere with excavation; maintaining paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	More difficult to implement than S-7.2 because the remedy involves more complex actions; approximately as difficult to implement as S-7.5A. Resources are readily available. Excavation may interfere with base activities; underground utilities may interfere with excavation; maintaining paved areas and monitoring wells; base construction approval needed; LUC RD could be readily developed and implemented; inspections and reviews readily performed; property transfer (if needed) could be readily accomplished.	Most difficult to implement because the remedy involves excavation below the groundwater table; resources are readily available. Sheet piles for excavation support, a dewatering system, and a water treatment and disposal system would be required; base construction approval needed.
Costs:							
Capital	$0	$75,000	$1,353,000	$1,325,000	$837,000	$2,275,000	$22,508,000
Annual O&M	$25,000	$69,000 Years 1 and 2; $56,000 Years 3 and 4; $91,000 every fifth year; $30,000 annually all other years;	$69,000 Years 1 and 2; $56,000 Years 3 and 4; $91,000 every fifth year; $30,000 annually all other years;	$61,000 Years 1 and 2; $48,000 Years 3 and 4; $66,000 every fifth year; $26,000 annually all other years;	$69,000 Years 1 and 2; $56,000 Years 3 and 4; $91,000 every fifth year; $30,000 annually all other years;	$61,000 Years 1 and 2; $48,000 Years 3 and 4; $66,000 every fifth year; $26,000 annually all other years;	$0
NPW	$104,000	$1,087,000	$2,365,000	$2,151,000	$1,849,000	$3,101,000	$22,508,000

ARAR	Applicable or Relevant and Appropriate Requirement	O&M	Operation and maintenance
cy	Cubic yard	PAH	Polycyclic aromatic hydrocarbon
DEC	Direct Exposure Criteria (Connecticut)	PMC	Pollutant Mobility Criteria (Connecticut)
I/C	Industrial/commercial	PRG	Preliminary Remediation Goal
LTTD	Low-temperature thermal desorption	RAO	Remedial Action Objective
LUC	Land use control	sf	Square feet
LUC RD	Land Use Control Remedial Design	TBC	To Be Considered (criteria)
NPW	Net present worth	TPH	Total petroleum hydrocarbons

Blue font indicates Preferred Alternative

Figure 27a. Zone 7 Alternate S-7.2 Components

Figure 27b. Zone 7 Alternate S-7.3 Components

Figure 27c. Zone 7 Alternate S-7.4 and S-7.5B Components

Figure 27d. Zone 7 Alternate S-7.5A Components

Figure 27e. Zone 7 Alternate S-7.6 Components

Table 31: Zone 7 Preferred Alternative			
Alternative Number	**Alternative Name (Cost)**	**Why this Alternative is the Best Balance of Trade-Offs**	**Reason for Choice of Alternative**
S-7.2	LUCs (Engineering and Engineered Controls, Institutional Controls, and Inspections) and Monitoring (30-Year NPW $1,087,000) (Figure 27a)	• Is protective and provides long-term effectiveness and permanence to ensure protection. • Easy and straightforward to implement • Lowest short-term risk • Most cost effective approach that ensures protection	• Zone 7 has soil exceeding residential and industrial PRGs; therefore, a remedy is needed. • Building foundations and pavement already covering Zone 7 act as CERCLA risk-based engineering controls to prevent exposure to contaminated soil. • Low permeability pavement also act as a CTDEEP RSR engineered control to reduce the infiltration rate allowing the Navy to meet the CTDEEP requirements for managing exceedances of the State's numeric DEC and PMC standards. • Other alternatives are more expensive without substantially more human health protectiveness and have potential short-term human health risks.

develop alternative soil PMCs in areas with GB classified groundwater. Alternative PMCs are prohibited where light non-aqueous phase liquid (LNAPL) is present.

Applicable or Relevant and Appropriate Requirements (ARARs): The federal and state environmental rules, regulations, and criteria that must be met by the selected remedy under CERCLA.

Benzo(a)pyrene (BaP) equivalent (EQ) (BaPEQ): Concentrations of multiple carcinogenic PAHs are represented by one concentration referred to as a BaPEQ concentration. The calculated concentration of cancer-causing PAHs relative to the toxicity associated with an equivalent concentration of the PAH benzo(a)pyrene.

Bioavailable/bioaccessible: the physiological availability of a chemical. A bioavailable chemical is absorbed by human or ecological receptors and can cause risks to these receptors.

Brackish: water that has more salinity than fresh water, but not as much as seawater.

Carcinogenic: cancer-causing.

Chemical of concern (COCs): Site-related chemicals that are found to be risk drivers in the baseline risk assessment. COCs may pose unacceptable human health or ecological risks.

Chemical of potential concern (COPCs): Site-related chemicals that are found to exceed screening values and may pose risks to human health receptors. COPCs are evaluated in the Human Health Risk Assessment (HHRA).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA). The act created a special tax that goes into a trust fund to investigate and clean up abandoned or uncontrolled hazardous waste sites.

Connecticut Department of Energy and Environmental Protection (CTDEEP) Remediation Standard Regulations (RSRs): State of Connecticut Regulations that contain numeric and narrative standards for the remediation of soil and groundwater. The remediation of a polluted property must consider the criteria for both these environmental media.

Contamination: Any physical, biological, or radiological substance or matter that, at a certain concentration, could have an adverse effect on human health and the environment.

Direct exposure criterion (DEC): A chemical concentration above which a chemical may pose potential health risks if humans come into direct contact with the chemical.

Ecological Risk Assessment (ERA): Evaluation and estimation of current and future potential for adverse ecological effects from exposure to chemicals.

Engineering Controls: physical mechanisms to contain or stabilize contamination while ensuring the effectiveness of a remedial action over time. Examples include caps, covers, fences, and signs.

Effects Range-Median Quotient (ERM-Q): a composite value addressing applicable contaminants that pose ecological risk to sediment invertebrates.

Feasibility Study (FS): A report that presents the development, analysis, and comparison of remedial alternatives.

Formal Public Hearing: A formal hearing at which the public has the opportunity to submit comments and testimony on the proposed action for the public record.

Groundwater: Water found beneath the earth's surface in the pores of the soil or the cracks in the bedrock. Groundwater may transport substances that have percolated downward from the ground surface as it flows towards its point of discharge.

Hazard Index (HI): value calculated to represent non-cancer health effects. An HI of less than 1 means that non-cancer health effects are not predicted.

Hexavalent chromium: refers to chemical compounds that contain the element chromium in the +6 oxidation state, or degree of oxidation of an atom in a substance. Hexavalent chromium is recognized as a human carcinogen via inhalation.

Human Health Risk Assessment (HHRA): Evaluation and estimation of current and future potential for adverse human health effects from exposure to chemicals.

Informational Public Meeting: A meeting that is open to the public to present information about the Proposed Plan for cleaning up the site. At the meeting, the public will have an opportunity to ask questions and provide comments about the cleanup.

Installation Restoration (IR) Program: The purpose of the program is to identify, investigate, assess, characterize, and clean up or control releases of hazardous substances, and to reduce the risk to human health and the environment from past waste disposal operations and hazardous material spills at Navy activities in a cost-effective manner.

Institutional Controls: engineered or physical controls and/or administrative or legal mechanisms designated to protect public health and the environment from contamination.

Land use controls (LUCs): legal and/or administrative measures formulated and enforced to regulate current and future land use options. LUCs include engineered controls, institutional controls, and inspections.

Leachate: a liquid that contains dissolved concentrations of environmentally harmful substances due to passing through a solid material that contains these substances.

Lead ballast: used to provide distribution of weight, counteract buoyancy, and provide stability in Navy ships because of its high density and resistance to corrosion.

Mean high water table: the average plane in the ground at which all pore spaces are filled with water at atmospheric pressure.

Metals: naturally occurring elements in the earth. Some metals, such as arsenic and mercury, can have toxic effects. Other metals, such as iron, are essential to the metabolism of humans and animals.

Monitoring: Collection of environmental information that helps to track changes in the magnitude and extent of contamination at a site or in the environment.

National Contingency Plan (NCP): the federal government's blueprint for responding to both oil spills and hazardous substance releases. The National Contingency Plan is the result of our country's efforts to develop a national response capability and promote overall coordination among the hierarchy of responders and contingency

plans.

Net Present Worth (NPW): A present-worth analysis is used to evaluate costs that occur over different time periods by discounting future costs to a common base year. It represents the amount of money that, if invested in the base year and dispersed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life. NPW considers both capital (construction) costs and costs for annual operation and maintenance.

Operable Unit (OU): Term for each of a number of separate remedial activities undertaken as part of a Superfund site cleanup. Sites with similar characteristics or in near proximity may also be grouped as one OU.

Operational Depths: depth of a water body at which the Navy can use the water body for operations.

Oxygen-releasing compound (ORC): a compound, such as magnesium peroxide, used to enhance the growth of natural microorganisms that will break down TPH in soil.

PCB Congener: any single, unique well-defined chemical compound in the PCB category. The name of a congener specifies the total number of chlorine substituents and the position of each chlorine.

Polycyclic aromatic hydrocarbons (PAHs): High molecular weight, relatively immobile, and moderately toxic organic chemicals featuring multiple benzenic (aromatic) rings in their chemical formula. Typical examples of PAHs are naphthalene and phenanthrene.

Polychlorinated biphenyls (PCBs): High molecular weight, moderately immobile, and moderately to highly toxic organic chemicals featuring two benzene rings and multiple chlorine atoms in their chemical formula. Aroclor is the commonly known trade name for PCBs. In the past, PCBs were commonly used in dielectric fluid in electrical equipment and as plasticizers.

Pollutant Mobility Criterion (PMC): a chemical concentration above which a chemical may pose soil to groundwater migration concerns.

Preliminary Remediation Goals (PRGs): Chemical-specific goals for site contaminants that when achieved will result in site concentrations that pose acceptable risk for the targeted receptor.

Proposed Plan: a public participation requirement of SARA in which the lead agency summarizes for the public the preferred cleanup strategy and rationale for preference and reviews the alternatives presented in the detailed analysis of the FS. The Proposed Plan must actively solicit public review and comment on all alternatives under consideration.

Reasonable Maximum Exposure (RME): the highest level of human exposure that could reasonably be expected to occur.

Record of Decision (ROD): An official document that describes the selected remedial action for a site under CERCLA. The ROD for OU4 will describe the factors that were considered in selecting the remedy and will be issued by the Navy and EPA following consideration of public comments on the Proposed Plan.

Remedial Action: The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

Remedial Action Objectives (RAOs): Describes what the proposed site cleanup is expected to accomplish.

Remedial Investigation (RI): A report which describes the site, documents the nature and extent of contaminants detected at the site, and presents the results of the risk assessment.

Remedial Design (RD): the phase in Superfund site cleanup where the technical specifications for cleanup remedies and technologies are designed. Remedial action follows the RD phase. The RD is based on the specifications described in the ROD.

Responsiveness Summary: A summary of written and oral comments received during the public comment period, together with the Navy's and EPA's responses to these comments.

Risk assessment: Evaluation and estimation of the current and future potential for adverse human health or environmental effects from exposure to contaminants.

Sediment: Soil, sand, and minerals typically transported by erosion from soil to the bottom of surface water bodies such as streams, rivers, ponds, and lakes.

Sediment invertebrates: Small invertebrates (e.g., insect larvae, worms, mollusks, crustaceans) that live in or on the sediment.

Solidification: a process by which lead-contaminated soil is treated with a chemical (usually Portland cement) to make the lead in the soil less mobile and prevent it from leaching.

Source(s): Area(s) of a site where contamination originated.

Stratified estuary: a partly enclosed coastal body of water in which saline seawater circulates in at the bottom, mixes with fresh riverine water, and then flows out at the top (salinity thus increases with depth and out toward the sea).

Stressor: is a chemical or biological agent, environmental condition, an external stimulus or an event that causes stress to an organism.

Surface water: Water that collects on the ground surface in a stream, pond, wetland, or other water body.

Total petroleum hydrocarbons (TPH): a term used to describe a mixture of hydrocarbons that are found in crude oil.

Underground storage tank (UST): A tank buried underground, usually used to store petroleum and other chemicals. The greatest potential threat from a leaking UST is contamination of groundwater.

Vapor Intrusion: migration of volatile chemicals from the subsurface into overlying buildings.

Watershed Contaminated Source Document: documents potential sources of contamination in a water body and is required if there is a potential for non-Navy sources to have contributed to sediment contamination in a water body adjacent to Navy property. The Navy is only responsible for remediating areas contaminated by a Navy release.

THE PUBLIC'S ROLE IN ALTERNATIVE SELECTION

Community input is integral to the selection process. The Navy and regulatory agencies will consider all comments in selecting the remedial actions before signing the ROD. The public is encouraged

to participate in the decision-making process. This Proposed Plan for the Lower Subase—OU4 is available for review, along with supplemental documentation, at the following Information Repositories during normal business hours:

Groton Public Library
52 Newtown Road
Groton, CT 06340
(860) 441-6750

Bill Library
718 Colonel Ledyard Highway
Ledyard, CT 06339
(860) 464-9912

For further information, please contact:

Public Affairs Office
Naval Submarine Base New London
NAVSUBASE NL
Box 44
Groton, CT 06349-5044
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USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Proposed Plan for the Lower Subase—OU4 at Naval Submarine Base – New London is important to the Navy and EPA. Comments provided by the public are valuable in helping to select the remedy for this site.

You may use the space below to write your comments, then fold and mail. Comments must be postmarked by May 4, 2012. Comments can be submitted via mail or e-mail and should be sent to either of the following address:

Public Affairs Office
Naval Submarine Base New London
NAVSUBASE NL
Box 44
Groton, CT 06349-5044
paosubasenlon@navy.mil

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