RECORD OF DECISION

ABEX CORPORATION SUPERFUND SITE
PORTSMOUTH, VIRGINIA

PREPARED BY
THE U.S. ENVIRONMENTAL PROTECTION AGENCY
AND
THE VIRGINIA DEPARTMENT OF WASTE
MANAGEMENT

SEPTEMBER 1992
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RECORD OF DECISION
ABEX CORPORATION SITE
DECLARATION

I. SITE NAME AND LOCATION
Abex Corporation Site
Portsmouth, Virginia
Operable Unit One

II. STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the final remedial action selected for Operable Unit One of the Abex Corporation Site (Site), located in Portsmouth, Virginia. This remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. §§ 9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision document explains the factual and legal basis for selecting the remedial action and is based on the Administrative Record for this Site. An index of documents for the Administrative Record is included in Appendix A.

The Commonwealth of Virginia concurs on the selected remedy.

III. ASSESSMENT OF THE SITE

Pursuant to duly delegated authority, I hereby determine, pursuant to Section 106 of CERCLA, 42 U.S.C. § 9606; that actual or threatened releases of hazardous substances from this Site, as discussed in Section VI (Summary of Site Risks) of this ROD, if not addressed by implementing the remedial action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

IV. DESCRIPTION OF THE SELECTED REMEDY

The EPA, in consultation with the Virginia Department of Waste Management (VDWM), has selected the following remedial action for the Abex Corporation Site. This ROD addresses the first of two operable units for the Site. This operable unit (OU1) addresses contaminated soil and waste material present within approximately a 700-foot radius of the Abex foundry facility (See Figure 2). The former foundry buildings will also be addressed as part of OU1. The second operable unit (OU2) will further investigate ground water, offsite ecological impacts, and
the need for additional remediation of soil beyond the 700-foot radius. The selected remedial action for OU1 addresses the principal threat at the Site by excavating and treating the highly contaminated soils and waste material and by demolishing the buildings associated with the former foundry operation. Treated material, soil containing low levels of contamination that do not require treatment, and building debris will be disposed of offsite in an approved Resource Conservation and Recovery Act (RCRA) landfill.

Response actions began at this Site in 1986 when EPA identified high lead concentrations in the Abex foundry waste within the Abex Lot and in soil of neighboring residential lots. Pursuant to a Consent Order signed with EPA in August of 1986, Abex excavated and removed contaminated soil at varying depths (generally 6 to 12 inches) from residential areas around the Abex Lot, primarily in portions of the Washington Park Housing Project, the Effingham Playground, and around the Seventh Street Homes.

Additional high lead concentrations in soil of residential areas were identified in the Remedial Investigation and Feasibility Study (RI/FS) for OU1 completed in February of 1992. Pursuant to a Unilateral Order issued by EPA in March of 1992, Abex excavated and removed additional contaminated soil to a depth of approximately twelve inches in portions of the Washington Park Housing Project and the Effingham Playground. Excavation and removal of surface soil contamination in the Effingham residential area as called for under the March 1992 Order has not been completed because the home owners in the two-block residential area south of the Effingham Playground have not allowed access to their properties. Residents expressed a desire to know the full extent of cleanup that would be required in this remedial action before allowing a portion of the work to proceed on their properties.

The major components of the selected remedy include:

- Excavation in residential areas of surface soil not addressed under the March 1992 Order and subsurface soil in residential areas, including the Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, and the Effingham Playground, where lead concentrations exceed 500 milligrams per kilogram (mg/kg); excavation will extend to the depth of the water table (approximately three to six feet below the surface).

- Excavation of contaminated soil around the foundations and beneath homes and residential units (i.e., Washington Park Housing Project units); geotechnical investigations will be performed during the Remedial Design to determine the appropriate measures to be taken during excavation to maintain the structural integrity of each home or residential unit; residents
will be temporarily relocated while excavation is underway in the immediate vicinity of their home or residential unit; sampling of the interior of homes will be performed before, during, and after excavation to ensure that dust control measures have been effective.

- Excavation of soil from non-residential properties, including soil beneath areas currently covered with asphalt (e.g., the Abex and McCready Lots) where lead concentrations either exceed 500 mg/kg in the surface (0 - 12") or exceed 1000 mg/kg in the subsurface (> 12"); excavation of subsurface soil will extend to the depth of the water table (approximately three to six feet below the surface).

- Placement of clean backfill in all excavated areas; restoration of formerly vegetated areas to the conditions existing prior to excavation, to the extent practicable.

- Stabilization by mixing excavated soil and waste material that exhibit toxicity using the Toxicity Characteristic Leaching Procedures (TCLP) with chemicals/reagents; mixing will be contained in above-ground equipment onsite to create a final product that encapsulates and immobilizes lead and other metals; specific chemicals to be used in the process will be determined in a treatability study during the Remedial Design phase of this project; treated material will be tested using TCLP to ensure it no longer exhibits toxic characteristics.

- Transportation of treated soils and waste material and disposal offsite in an approved Resource Conservation and Recovery Act (RCRA) Subtitle D landfill; contaminated soils that do not exhibit toxicity using TCLP may be disposed of in an approved RCRA Subtitle D landfill, without treatment.

- Demolition of all structures associated with the foundry operations; debris exhibiting toxicity using TCLP will be decontaminated in accordance with current Land Disposal Restriction requirements; debris will be disposed of in approved RCRA landfill; decontamination of equipment stored by the current owner in contaminated structures may also be required.

- Air monitoring during onsite activity and implementation of dust control and other necessary abatement actions to prevent exposure of local residents to contamination during the remedial action.
V. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Because we do not anticipate that this remedy will result in hazardous substances remaining onsite above health-based cleanup levels (i.e., 500 mg/kg in residential areas, 500 mg/kg in the surface and 1,000 mg/kg in the subsurface soil in non-residential areas), the five-year review will not apply to this action. If hazardous substances are found in concentrations that exceed cleanup levels below the practicable limits of excavation at the water table and, therefore, cannot be excavated, the five-year review will apply to this action.

Edwin B. Erickson
Regional Administrator
Region III
Environmental Protection Agency

SEP 29 1992

Date
I. SITE NAME, LOCATION AND DESCRIPTION

The Abex Corporation Site (hereafter referred to as "the Site") is located in the eastern section of Portsmouth, Virginia, approximately 1.2 miles southwest of the confluence of the southern and eastern branches of the Elizabeth River (See Figure 1). The Site encompasses a several block area with numerous parcels of land (See Figure 2). The Site contains the former Abex brass and bronze foundry, which is comprised of five buildings (hereafter referred to as the Holland Property), and associated former waste sand disposal areas (hereafter referred to as the Abex Lot and the McCready Lot). Other areas within the approximate 700-foot Site radius that were found to have contamination associated, at least in part, with the former foundry operation will be addressed in this remedial action.

The Remedial Investigation (RI) for OU1 identified lead as the primary contaminant of concern at the Site. Lead was detected in soils on the Holland Property, under the asphalt-capped Abex and McCready Lots, and in surrounding residential and non-residential areas at levels that pose an actual or potential threat to human health and the environment.
FIGURE 1 - SITE LOCATION MAP

FOUNDRY SAND DISPOSAL AREA

FORMER LOCATION OF ABEX FOUNDRY

FIGURE 2 - MAP OF SITE FEATURES

LEGEND

III

GOVERNMENT BUILDINGS

III

GOVERNMENT BUILDINGS

SCALE: 1" = 300'
II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A brass and bronze foundry operated at the Site from 1928 to 1978. The foundry melted used railroad car journal bearings which were over 80% bronze and poured the molten material into sand molds to cast new railroad car bearings. These sand casts eventually became laden with heavy metals, such as lead, antimony, copper, tin, and zinc. During operation, the foundry also produced stack emissions of fine particulate material associated with facility processes.

The National Bearing Metal Corporation purchased the foundry property in May of 1927 and operated the foundry at the Site from 1928 until December of 1944. American Brake Shoe Company bought the foundry in December of 1944 and operated it until May of 1966. At that time, Abex purchased the facility and operated the foundry until it closed in 1978. During Abex's operation of the foundry, waste sand was disposed of in an approximately one acre area immediately north of the foundry building. When the foundry operation closed, Abex graded this disposal area, which is referred to as the Abex Lot, and secured it with a seven foot cyclone fence. Pneumo Abex Corporation, the successor of Abex Corporation, still owns most of the Abex Lot. In 1977, Runnymede Corporation, a real estate investment company, purchased a small parcel of the Abex Lot from Abex. Runnymede still owns this parcel, but no further development has occurred.

In 1984, Holland Investment and Manufacturing Corporation purchased the portion of the Site that contains the foundry building and several smaller associated structures. Holland Investment and Manufacturing Corporation allowed John C. Holland Enterprises, Inc., which is a trash hauling business, to conduct vehicle service and maintenance on the property.

During operation and following closure of the foundry, many of the parcels located nearby have changed ownership and have been redeveloped for other uses. These areas include the Washington Park Housing Project, the drug rehabilitation center, the Effingham Playground, and numerous private residences.

In January of 1983, an EPA contractor visited the Site to observe the conditions at the Abex Lot. No sampling was conducted during this preliminary assessment. EPA contractors returned to the Site in June of 1984 to perform a site inspection and collect several samples from the Abex Lot. Sample results detected high levels of lead (up to 10,400 mg/kg), zinc, copper, tin, and antimony. A sample, which was to serve as an indication of the background concentration of lead in the soil, was collected east of the Site and also had a lead concentration of 2,750 mg/kg.

In April of 1986, EPA collected additional soil samples from the Washington Park Housing Project and other properties adjoining the Abex Site. The analytical results found lead concentrations of up to 12,800 mg/kg in the samples collected.
Pursuant to the authority granted in Section 106 of CERCLA, 42 U.S.C. §9606, EPA entered into a Consent Order with Abex in August of 1986 for the excavation and removal of contaminated soil at varying depths (generally 6 to 12 inches) from certain residential areas around the Abex Lot. The areas to be addressed included portions of the Washington Park Housing Project, the Effingham Playground, and the Seventh Street row homes. All excavated areas were filled with clean soil and revegetated. Abex also paved and fenced the Abex Lot and the McCready Lot.

The analytical data collected at the Site were used to evaluate the relative hazards posed by the Abex Site using EPA’s Hazard Ranking System (HRS). EPA uses the HRS to calculate a score for hazardous waste sites based upon the presence of potential and observed hazards. If the final HRS score exceeds 28.5, the site is placed on the National Priorities List (NPL), making it eligible to receive Superfund monies for remedial cleanup. An HRS score of 36.53 was calculated for the Abex Site. As a result, EPA proposed the Abex Site for inclusion on the NPL on June 24, 1988 (53 FR 23988). The Site was placed on the list on August 28, 1990 (55 FR 35502).

On June 2, 1989, pursuant to Section 122 of CERCLA, 42 U.S.C. §9622, EPA issued Special Notice Letters to Abex Corporation and the Holland Investment and Manufacturing Corporation (hereafter referred to as "Holland Investment") offering them the opportunity to perform the RI/FS for the Site. On October 10, 1989, the VDWM, serving as the lead agency, entered into an Administrative Order on Consent with Abex pursuant to Section 106 of CERCLA, 42 U.S.C. §9606. Under the terms of the Order, Abex agreed to conduct the RI/FS at the Site to determine the nature and extent of Site contamination and to identify remedial alternatives for Site-related contamination of concern.

Based on the findings of the draft RI/FS report submitted in October of 1991 and the final RI/FS report dated February of 1992, EPA determined that lead contaminated surface soil exceeding 500 mg/kg within the Effingham residential area, and at a few additional locations in the Washington Park Housing Project and the Effingham Playground, presented a short-term threat to human health. As a result, pursuant to Section 106 of CERCLA, 42 U.S.C. §9606, EPA issued a Unilateral Administrative Order on March 30, 1992 to Abex requiring Abex to remove such soils from the Site. Abex agreed to perform the removal action and, to date, has excavated and removed additional contaminated surface soil in the Washington Park Housing Project and the Effingham Playground. Removal of soil in the Effingham residential area has been temporarily suspended because the impacted residents have not allowed access to their properties pending issuance of this document.
III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

EPA has several public participation requirements that are defined in Sections 113(k)(2)(B), 117, and 121(f)(1)(G) of CERCLA, 42 U.S.C. §§9613(k)(2)(B), 9617, and 9621(f)(1)(G), respectively. The documents which EPA used to develop, evaluate, and select a remedial alternative for the Abex Site have been made available to the public in the Administrative Record maintained at the Portsmouth Public Library (Reference Section) and at the EPA, Region III, Philadelphia Office. The Administrative Record is required by Section 113(k)(1) of CERCLA, 42 U.S.C. §9613(k)(1).

The RI/FS Report and the Proposed Plan for the Abex Corporation Site were released to the public in April of 1992. The Proposed Plan described remedial alternatives being considered by EPA and VDWM and identified EPA's preferred alternative at that time. The notice of the availability of the Proposed Plan and the Administrative Record was published in The Virginian-Pilot on April 28, 1992. This notice also invited the public to a meeting on May 7, 1992 to discuss the Proposed Plan with EPA and VDWM. The public was encouraged to review the Proposed Plan and the Administrative Record files and to submit comments on the proposed remedial alternatives to EPA and VDWM. The public comment period was initially scheduled to be open from April 29, 1992 through May 29, 1992, the statutorily required 30-day period. At the request of local citizens, EPA and VDWM extended the public comment period which formally closed on July 10, 1992.

A public meeting was held on May 7, 1992, during the public comment period. At this meeting, representatives from VDWM and EPA answered questions about the Site and discussed the remedial alternatives under consideration, as well as the short-term removal action that was about to proceed. Approximately 30 people, including residents from the impacted area, local government officials, a representative from Pneumo Abex, and VDWM and EPA representatives, attended the public meeting.

EPA and representatives from MaeCorp, Abex's contractor implementing the removal action, visited homes in the Effingham residential area after the public meeting to try to secure access for the removal work. During these visits, EPA also provided additional explanations about the remedial actions presented in the Proposed Plan. After these visits, members of the Madison Ward Civic League requested that EPA and VDWM meet with the Effingham residents to further discuss their concerns.

Representatives from EPA and VDWM met with approximately 30 Effingham residents on May 28, 1992 and June 9, 1992 to discuss the proposed removal and remedial actions and the health effects associated with lead contamination on their properties. During this period, community awareness and concern about the proposed cleanup activities were significantly heightened. On June 25, 1992, representatives from EPA, VDWM, the City of Portsmouth...
Health Department, and the Agency for Toxic Substances and Disease Registry (ATSDR), met with approximately 60 residents at the community center in the Washington Park Housing Project to provide an additional opportunity for impacted residents to gain information about the health effects of the lead contamination and to discuss the proposed removal and remedial actions. In addition to meetings with the local residents, VDWM and EPA met with local officials on several occasions during this period.

As a result of the June 25, 1992, meeting, the Portsmouth Health Department began offering free blood-lead testing to residents in the impacted area. During July and August of 1992, a total of 546 individuals were tested. Representatives from the Portsmouth Health Department notified families of the test results as they became available and advised families on appropriate follow-up measures, where warranted.

Although the public comment period was closed, EPA held a fifth meeting with the local community at the request of the City of Portsmouth Mayor and City Council. The meeting was held on August 26, 1992. Representatives from the City of Portsmouth Health Department, ATSDR, VDWM, and EPA addressed questions from approximately 150 local residents about health effects of lead contamination and the proposed cleanup of the Site.

Responses to the comments received during the public comment period are included in the Responsiveness Summary, which is part of this ROD. This decision document presents the selected remedial action for the Abex Corporation Site in Portsmouth, Virginia, chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the NCP. The decision for this Site is based on the Administrative Record. The index for the Administrative Record is included in Appendix A of the ROD. This decision is also based upon comments received by VDWM and EPA during the public comment period, which are included in the Administrative Record.

IV. SCOPE AND ROLE OF RESPONSE ACTION

As with many Superfund sites, the problems at the Abex Corporation Site are complex. As a result, EPA and VDWM have organized the work into two operable units (OUs). These OUs are:

- **OU1**: Contamination in the soil and waste sands on the Holland Property, the Abex Lot, the McCready Lot and in the surrounding properties within an approximate 700-foot radius of the foundry facility
- **OU2**: Potential contamination of the shallow and deep aquifers, ecological impacts, including further investigation and analysis of surface and sediment quality, and additional soil contamination that may exist beyond the approximate 700-foot radius being addressed in OU1.
The first OU, the subject of this ROD, addresses lead contamination in soil. The primary exposure pathway of concern at this Site is incidental ingestion of soil. Based on results of the EPA's Lead Uptake Biokinetic Model, children are exposed to an unacceptable health risk when the average lead concentrations in surface soil exceeds 400 mg/kg. The purpose of this response is to protect human health and the environment by preventing current or future exposure to the contaminated soil.

As part of OU2, additional RI/FS activity will be performed to fully characterize the nature and extent of ground water contamination. This OU will also include an investigation of additional soil contamination at distances greater than 700 feet from the foundry facility, as well as offsite ecological impacts.

V. SUMMARY OF SITE CHARACTERISTICS

GENERAL OVERVIEW

The Abex Site is located in the urban environment of Portsmouth, Virginia, approximately one-half mile to the west of the south branch of the Elizabeth River. The Site is relatively flat and is approximately 5 to 10 feet above mean sea level. A review of aerial photographs from 1937 reveals extensive surficial drainage surrounding the Site. However, by 1964, drainage was largely confined to Gander Creek, a channelized canal flowing from east to west just north of the Abex Lot. At the present, most drainage occurs through a network of catch basins and storm sewers.

The Abex Site is located in one of the oldest sections of the City of Portsmouth. The area was incorporated into the City's limits in 1784. The U.S. Naval Shipyard, located less than a mile to the southeast, commenced operation in 1767 and presently encompasses about 800 acres. The Portsmouth area experienced rapid growth during World Wars I and II when the Navy expanded its shipyard, hospitals, and docking facilities.

The population in the one-mile radius surrounding the Site varied during the period when the foundry was operating. From 1930 to 1950, the population in this area grew from 27,470 to 30,930. Subsequent to 1950, the population declined to 27,575 in 1960; 19,940 in 1970; and 15,117 in 1980.

The Elizabeth River Basin, which surrounds Norfolk, Portsmouth, and Chesapeake, drains approximately 300 square miles. The river basin is heavily industrialized and receives wastewater discharges from U.S. Naval facilities, heavy industry, major municipal treatment facilities, urban runoff, and boating and docking facilities.

Annual rainfall in the Site area is between 45 and 50 inches. Wind direction for the Portsmouth and the surrounding area is predominantly north-northeast and south-southwest.
Generally interpreted, the former foundry property and the surrounding 700-foot radius study area are underlain by a veneer of undistinguished fill material, sand, and fine grained sediments. Groundwater movement beneath the study area is largely confined to the sand-dominated strata.

Portsmouth lies in the Coastal Plain physiographic province and, in general, is underlain by a thick sequence of unconsolidated sediments consisting primarily of sand, gravel, silt, clay and some shell material. These sediments thicken from west to east in a wedge-like form and are immediately underlain by igneous and metamorphic bedrock. The depositional history of the unconsolidated sediments is complex and has resulted in what is generally an alternating sequence of sand and fine grain sediment layers.

In the vicinity of Portsmouth, large-scale groundwater movement occurs only within the confined aquifer formations. Except for the uppermost aquifer, the Columbia Group, each aquifer is separated from the underlying aquifer by a confining unit. Most of the ground water used in the area for potable purposes is withdrawn from the confined aquifers. At the present time, very little ground water withdrawn from the unconfined Columbia Group aquifer is utilized for potable purposes.

**SUMMARY OF RI FINDINGS**

The primary focus of the RI was to evaluate possible lead contamination in soil on and around the foundry property. In addition, the RI included a limited investigation of ground water, surface water, and sediments potentially impacted by the Site.

Soil contamination was investigated by sampling and testing over 1,000 samples for lead content. Of these samples, over 550 were also analyzed for fourteen other metals. Soil samples were collected either using a hand auger or through soil borings. A total of 206 locations were sampled using the hand auger. Sample locations were established primarily through use of a 100-foot grid system over the 700-foot radius study area. At each location, a minimum of two samples were collected - one at the 0 to 0.5 foot depth and a second at the 1.5 to 2 foot depth. Additional samples were collected to a maximum depth of 3 to 3.5 feet where elevated lead concentrations were observed.

Soil borings ranging in depth from 11 to 26 feet were performed at 34 locations primarily in the Abex lot and on and around the Holland Property. A minimum of five samples were collected at each location to characterize the stratigraphy of the water table aquifer. The number of samples analyzed varied depending on the location and the conditions encountered. Most analyses were for lead or for the primary pollutant list of fourteen metals.
Sweep samples for dust were also collected from the interior of the foundry building and from the attics of two Seventh Street row homes. A number of the dust and soil samples collected on the Holland Property and in the Abex Lot were analyzed for the complete list of priority pollutants.

The major finding of the RI at the Site was that both surface and subsurface soils are contaminated with lead in residential and non-residential areas. Soil ("floor dirt") and dust throughout the interior of the foundry building on the Holland Property was found to contain lead levels of up to 100,000 mg/kg. Outdoor soil on the Holland Property contains lead levels of up to 58,000 mg/kg within the top two feet. Waste sand beneath the asphalt cap on the Abex Lot has lead concentrations ranging up 24,000 mg/kg. Lead levels of up to 4,750 mg/kg occur within the top two feet of soil under asphalt within the McCready Lot.

Surrounding areas containing lead-contaminated soil associated with the Site include portions of the Washington Park Housing Project, the Effingham Playground, the Effingham residential area, the Seventh Street row homes, the drug rehabilitation center property, and vacant lots east of Seventh Street.

Lead levels of up to 46,500 mg/kg were detected in soil at depths of one to four feet in portions of the Washington Park Housing Project. Subsurface soil in the Effingham Playground contains lead levels up to 5,000 mg/kg. Contaminated surface soil (generally 6 to 12 inches) in both Washington Park and the Effingham Playground were previously excavated and removed by Abex pursuant to a Consent Order signed with EPA in August 1986. A few additional areas in the Washington Park Housing Project and the Effingham Playground were identified during the OU1 investigation as having surface soil contamination above 500 mg/kg. Soil in these areas was excavated and removed by Abex pursuant to a Unilateral Order issued by EPA in March of 1992.

Surface and subsurface soil within the Effingham residential area have lead concentrations of up to 8,000 mg/kg. Additional sampling performed as part of the 1992 removal action detected elevated levels of lead ranging up to 3,739 mg/kg in crawl spaces beneath eleven of sixteen homes sampled in this area.

Soil in lots associated with the Seventh Street row homes contain lead at levels up to 7,000 mg/kg at 0 to 2 feet in depth. Surface soil contamination in the row home lots was previously addressed by Abex under the 1986 Consent Order. Attics of two Seventh Street homes contain dust with lead levels of up to 7,030 mg/kg.

Surface soil within the drug rehabilitation center property contains lead at levels of up to 9,300 mg/kg. Lead has also been detected in surface soil of the vacant lots east of Seventh Street at levels of up to 1,200 mg/kg, with subsurface soils
containing lead of up to 6,000 mg/kg.

A limited hydrogeologic investigation was undertaken at the Site to assess the impact of contamination on the surficial aquifer. Four monitoring wells, three piezometers, and numerous soil borings were installed to gain an understanding of the materials and contaminant distribution in the upper aquifer. Two monitoring wells were located in the Abex Lot; one well was located in the McCready Lot; and one well was located immediately north of the Seventh Street row homes. The wells were drilled to approximately fourteen feet below ground surface; the piezometers were drilled to fifteen feet below ground surface. Groundwater was encountered from three to six feet below surface across the Site.

Groundwater data from the Abex property indicates that lead has entered the surficial groundwater in the source area either through migration or through past disposal practices. Elevated concentrations of lead were present in filtered samples collected in one of the monitoring wells in the Abex Lot (MW-1). Lead levels of 31 micrograms per liter (µg/l) and 24 µg/l were detected during two separate sampling events. EPA recommends a cleanup level of 15 µg/l for lead in ground water. Filtered samples collected in the other three wells did not exhibit elevated concentrations of lead. The surficial aquifer and the deeper aquifer are not currently used for drinking water supplies in the area of the Site. Further investigation of contamination in the deeper aquifer and the hydraulic relationship between the surface and deeper aquifers will be undertaken as part of OU2.

Surface water and sediment samples were collected from four catch basins within the 700-foot study area. Elevated metal concentrations were observed in both surface water and sediment samples. The significance of the metal concentrations detected and the relationship of these concentrations to the Abex Site is unclear. Further investigation and analysis of surface water and sediment quality at the Site, including potential ecological impacts, will be performed as part of OU2.

VI. SUMMARY OF SITE RISKS

An assessment of the potential risks posed to human health and the environment was completed in accordance with the NCP. Specifically, the baseline risk assessment provides the basis for taking action and indicates the exposure pathways that need to be addressed by the remedial action. It identifies the risks that could exist if no action were taken at the Site. The baseline risk assessment for the Abex Site was completed in February of 1992 and is part of the Administrative Record.

In general, a baseline risk assessment is performed in four steps: (1) data collection and evaluation, (2) the exposure assessment, (3) the toxicity assessment, and (4) risk characterization. This section of the ROD will summarize the
findings during each of these steps of the baseline risk assessment for the Abex Site.

IDENTIFICATION OF CONTAMINANTS OF CONCERN

Lead is the contaminant of principal concern at this Site due to its known health effects and its widespread presence in surface and subsurface soil in the residential areas, as well as the foundry properties. Other contaminants present, along with lead, at levels of concern in residential areas include antimony, nickel, tin, copper, and zinc. These contaminants are all known to be present in the waste sands from the foundry operation. Other contaminants present at levels of concern on the Holland Property, the Abex Lot, or the McCready Lot include cadmium, chromium, silver, and polynuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

The two media of primary concern at this Site are soil and ground water. An overview of the extent of contamination in the soil at the Site is presented in Table 1. The data are presented for the three residential areas - the Washington Park Housing Project, the Effingham residential area, and the Seventh Street row homes; for the Effingham Playground; for the foundry properties including the Holland Property, the Abex Lot, and the McCready Lot; and for the vacant lots. The number of samples collected (designated as "n"), the mean (or average) concentrations, and the upper 97.5 percentile confidence limit concentrations are presented in Table 1 for both surface soil (0 - 12") and subsurface soil (> 12") data. The term "upper 97.5 percentile confidence limit" is a statistical term used in describing how well the data collected reflect actual conditions. There is a 97.5% probability (i.e., 39 times out of 40) that the actual mean concentration for the contaminant of concern listed is below the upper confidence limit value.

Since lead is relatively immobile in the environment, the ground water investigation in the OU1 RI was limited to four wells in the surficial aquifer. Ground water in the surficial aquifer was found to exceed the EPA's recommended cleanup level for lead in one well which was located in the Abex Lot. The surficial aquifer and the deeper confined aquifer are not currently used for drinking water supply. Further investigation of potential ground water contamination will be performed as part of the OU-2 investigation to assess potential future risk and the need for possible remediation. The discussion of site risks presented below will focus on contamination in the soil media.
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<tr>
<td>Tin</td>
<td>25</td>
<td>152</td>
</tr>
<tr>
<td>Zinc</td>
<td>25</td>
<td>896</td>
</tr>
<tr>
<td>Seventh Street Row Homes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Antimony</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Copper</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Nickel</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Tin</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Zinc</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Effingham Playgrounds:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>36</td>
<td>267</td>
</tr>
<tr>
<td>Antimony</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Copper</td>
<td>5</td>
<td>407</td>
</tr>
<tr>
<td>Nickel</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>AREA: Contaminant</td>
<td>SURFACE SOIL</td>
<td>SUBSURFACE SOIL</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>MEAN (mg/kg)</td>
</tr>
<tr>
<td>Effingham Playground (Cont.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tin</td>
<td>5</td>
<td>63</td>
</tr>
<tr>
<td>Zinc</td>
<td>5</td>
<td>381</td>
</tr>
<tr>
<td>Holland Property/Abex Lot/McCready Lot:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>41</td>
<td>33,000</td>
</tr>
<tr>
<td>Antimony</td>
<td>33</td>
<td>590</td>
</tr>
<tr>
<td>Cadmium</td>
<td>33</td>
<td>15</td>
</tr>
<tr>
<td>Chromium</td>
<td>33</td>
<td>185</td>
</tr>
<tr>
<td>Copper</td>
<td>33</td>
<td>54,000</td>
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<td>Nickel</td>
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<td>255</td>
</tr>
<tr>
<td>Silver</td>
<td>33</td>
<td>18</td>
</tr>
<tr>
<td>Tin</td>
<td>33</td>
<td>2,872</td>
</tr>
<tr>
<td>Zinc</td>
<td>33</td>
<td>8,400</td>
</tr>
<tr>
<td>Total PAHs</td>
<td>340</td>
<td>29</td>
</tr>
<tr>
<td>Total PCBs</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Vacant Lots/Drug Rehabilitation Center:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>86</td>
<td>609</td>
</tr>
<tr>
<td>Antimony</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td>Copper</td>
<td>22</td>
<td>619</td>
</tr>
<tr>
<td>Nickel</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>Tin</td>
<td>22</td>
<td>100</td>
</tr>
<tr>
<td>Zinc</td>
<td>22</td>
<td>549</td>
</tr>
</tbody>
</table>

**KEY:**
- n = the number of samples collected
- mean = the average concentration of the samples collected; units are milligram per kilogram
- 97.5% UCL = Upper Confidence Limit; the concentration at which there is a 97.5% probability that the actual mean concentration is below
The purpose of the exposure assessment in the baseline risk assessment is to determine exposure pathways that exist at a site and to quantify the exposure associated with each pathway. An exposure pathway exists if there are: (1) contaminants at a site at levels of concern; (2) individuals that may come in contact with those contaminants; and (3) mechanisms by which contamination can enter the body.

The potentially exposed populations for OU1 consist principally of residents (children and adults) within approximately 700 feet of the foundry who are exposed to soil containing the contaminants of concern discussed above. The risk assessment also considered the potential exposure to adults working in the former foundry building, although this type of exposure is not presently occurring.

Actions at Superfund sites should be based on an estimate of the reasonable maximum exposure expected to occur under both the current and future land-use conditions. The reasonable maximum exposure is defined as the highest exposure that is reasonably expected to occur at a site. The risk assessment for the Abex Site was based on the assumption that current and future land use in the area are not expected to change significantly.

The current land use at the Site is a mixture of residential and commercial/light-industrial. The Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, and the Effingham Playground are currently zoned for residential use (See Figure 3). The Abex Lot, Holland Property, and McCready Lot, the drug rehabilitation center, and the vacant lots are zoned for use as commercial/light-industrial purposes. Future use is expected to remain the same for the residential properties. The Holland Property, the Abex Lot, and the McCready Lot are expected to be used for commercial or light industrial purposes in the future. The drug rehabilitation center is expected to continue operation at its current location. The properties with the greatest uncertainty as to their future use are the vacant lots east of Seventh Street. Most of the vacant lot area is located outside of the 700-foot study area for OU1. The City of Portsmouth had originally planned a 60-acre PortCentre Business Park in this area, however, a GSA project which was the cornerstone of this development was awarded to another city. The City of Portsmouth is currently considering other options for this 60-acre parcel located just outside of the 700-foot radius, including construction of a new high school.

Routes of exposure considered in the risk assessment include soil ingestion, dermal contact, food ingestion, dust inhalation, inhalation of vapors. These pathways are described briefly below:

Soil ingestion
Eating soil and dust, usually inadvertently and probably arising
mostly from the soil being transferred from hand to mouth

Dermal contact  Skin contact with soil and dust

Food ingestion  Eating locally grown foods not thoroughly washed to remove contaminated soil

Dust inhalation  Breathing dust; no industrial dusts are currently being generated through active operations, nor are any expected to be generated in future; dust may come from disturbed contaminated soil in the area

Inhalation of vapors  Breathing vapors from ground water and soil; route of exposure was found to be negligible

To quantitatively evaluate the exposure associated with pathways identified at the Site, assumptions were made concerning the reasonable maximum exposure for an individual living in the impacted area. Table 2 presents the activity pattern for exposed residents and the assumptions made as part of the risk assessment. This table was designed to reflect potential activities for a resident that would result in relatively high exposure to the contaminants of concern in the soil. Different activities were assigned reasonable average weekly times. All activities were assumed to take place for 350 days per year.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>HOURS/WEEK (By Age Category)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-1</td>
</tr>
<tr>
<td>At home indoors</td>
<td>130</td>
</tr>
<tr>
<td>At home outdoors</td>
<td>35</td>
</tr>
<tr>
<td>Foundry site</td>
<td>0</td>
</tr>
<tr>
<td>At school off-site</td>
<td></td>
</tr>
<tr>
<td>Activities off-site</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: Baseline Risk Assessment for the Abex Site, Table 3.7
FIGURE 3 - SITE ZONING MAP

RM-60 - Single family residential detached homes (6,000 sq ft).
M-1 - Industrial district for wholesale, warehouses, light industrial, etc.
C-2 - General commercial district (large scale stores, strip malls, department stores, etc);
C-1 - Neighborhood commercial retail trade
OR-75 - Office residential district (doctors, dentist, etc)
M-2 - Heavy Industrial district
As part of the process to quantify exposure, standard assumptions are made concerning factors such as the intake rate for soil ingestion, the ability of soil to adhere to skin, inhalation and consumption rates, the average lifetime, and maximum periods of exposure. Table 3 summarizes the exposure factors used in the risk assessment for the Abex Site.

The final consideration in quantifying exposure is the concentration of the contaminant of concern to be used in the calculation. The risk assessment for the Site used data from soil samples collected in the top six inches to calculate exposure concentrations. Surface soil data was used since residents are exposed to these soils at a much greater frequency than subsurface soil. The mean concentration and the upper 97.5 percentile confidence limit were calculated for each contaminant of concern in each area of the Site, as presented in Table 1. The upper confidence limit values were used to quantify individual exposure.

HUMAN HEALTH TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to weigh available evidence regarding the potential for particular contaminants to cause adverse effects in an exposed individual. Where possible, the toxicity assessment provides an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. The first step in the process is to determine whether exposure to the contaminant can cause an increase in the incidence of either a cancer-related (carcinogenic) or non-cancer-related (noncarcinogenic) adverse health effect. EPA gathers evidence from a variety of sources regarding these health effects including controlled epidemiologic investigations, clinical studies, and experimental animal studies.

The second step in the toxicity assessment is to quantitatively evaluate the health effects associated with the contaminant of concern on the exposed population. For contaminants that are known or suspected of causing cancer, Cancer Slope Factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group in order to estimate the adverse health effect. Carcinogenic effects are measured as the additional risk of an individual contracting cancer as a result of exposure to potentially carcinogenic chemicals. CPFs are multiplied by the estimated exposure rates to provide an upper-bound estimate of the excess lifetime cancer risk associated with that exposure. The term "upper bound" reflects the conservative estimate of the risks and makes underestimation of the actual cancer risk highly unlikely. Table 4 lists the CPFs for the chemicals treated in this risk assessment.

For contaminants that are not known to cause cancer, reference doses (RfDs) have been developed by EPA for quantifying the potential for adverse health effects from exposure. RfDs are
<table>
<thead>
<tr>
<th>Exposure Pathway</th>
<th>0-1</th>
<th>1-4</th>
<th>4-7</th>
<th>7-11</th>
<th>11-15</th>
<th>15-18</th>
<th>18-70</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ingestion of soil and dust</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake rate mg/day</td>
<td>100</td>
<td>200</td>
<td>200</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Exposure frequency days/year</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td><strong>Dermal absorption of soil</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil to skin adherence factor mg/cm² (f)</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
</tr>
<tr>
<td>Total limb area m² (g)</td>
<td>0.203</td>
<td>0.286</td>
<td>0.406</td>
<td>0.537</td>
<td>0.81</td>
<td>0.997</td>
<td>1.95</td>
</tr>
<tr>
<td><strong>Inhalation of contaminants (c)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indoor intake rate m³/day</td>
<td>1.645</td>
<td>4.168</td>
<td>6.636</td>
<td>7.267</td>
<td>7.952</td>
<td>9.845</td>
<td>15</td>
</tr>
<tr>
<td>Total intake rate m³/day</td>
<td>2.194</td>
<td>5.558</td>
<td>8.868</td>
<td>9.689</td>
<td>10.603</td>
<td>13.126</td>
<td>20</td>
</tr>
<tr>
<td><strong>Body weight kg (b)</strong></td>
<td>9</td>
<td>13.2</td>
<td>19.7</td>
<td>29.9</td>
<td>46</td>
<td>59.4</td>
<td>70</td>
</tr>
<tr>
<td><strong>Consumption of home grown produce (d)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homegrown vegetables g/day</td>
<td>0</td>
<td>9.175</td>
<td>9.175</td>
<td>15.263</td>
<td>18.350</td>
<td>18.350</td>
<td>22.930</td>
</tr>
<tr>
<td>Homegrown fruit g/day</td>
<td>0</td>
<td>1.660</td>
<td>1.660</td>
<td>2.762</td>
<td>3.320</td>
<td>3.320</td>
<td>4.151</td>
</tr>
<tr>
<td>Fraction of adult consumption</td>
<td>0</td>
<td>0.4</td>
<td>0.4</td>
<td>0.665</td>
<td>0.8</td>
<td>0.8</td>
<td>1</td>
</tr>
<tr>
<td><strong>Exposure constants</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Potential Exposure</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>52</td>
</tr>
<tr>
<td>Lifetime fraction (for cancer risks)</td>
<td>0.014</td>
<td>0.043</td>
<td>0.043</td>
<td>0.057</td>
<td>0.057</td>
<td>0.043</td>
<td>0.742</td>
</tr>
<tr>
<td>Concentration of particulates in the air g/m³ (h)</td>
<td>5E-05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifetime</td>
<td>70 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum period of exposure</td>
<td>30 years</td>
<td></td>
<td></td>
<td></td>
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</tr>
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</table>

Source: Baseline Risk Assessment for the Abex Site, Table 3.8
<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>SLOPE FACTORS (mg/kg-day)^{-1}*</th>
<th>ORAL</th>
<th>INHALATION</th>
<th>DERMAL</th>
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</thead>
<tbody>
<tr>
<td><strong>Metals:</strong></td>
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<td></td>
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</tr>
<tr>
<td>Antimony</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Cadmium</td>
<td>**</td>
<td>6.1</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Chromium (VI)</td>
<td>**</td>
<td>41.0</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Copper</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Nickel</td>
<td>**</td>
<td>0.84</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Silver</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Tin</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Zinc</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td><strong>PAHSs:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acanaphthene</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Anthracene</td>
<td>1.85</td>
<td>1.95</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Benzo(a)-anthracene</td>
<td>0.84</td>
<td>0.88</td>
<td>0.03</td>
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</tr>
<tr>
<td>Benzo(a)-pyrene</td>
<td>5.79</td>
<td>6.10</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>Benzo(b)-fluoranthe</td>
<td>0.81</td>
<td>0.85</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Benzo(ghi)-perylen</td>
<td>0.13</td>
<td>0.13</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>Chrysene</td>
<td>0.03</td>
<td>0.03</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>Dibenz(o,p)-anthracene</td>
<td>6.43</td>
<td>6.77</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>Fluoranthe</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Fluorene</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Indeno(1,2,3-c,d)pyrene</td>
<td>1.34</td>
<td>1.42</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Naphthalene</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Pyrene</td>
<td>0.47</td>
<td>0.49</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td><strong>PCBs:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCB-1248</td>
<td>7.70</td>
<td>**</td>
<td>**</td>
<td>2.91</td>
</tr>
<tr>
<td>PCB-1254</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* risk per milligram per kilogram per day
** Factors not available or not appropriate for these chemicals
Source: Baseline Risk Assessment for the Abex Site, Table 4.3
estimates of lifetime daily exposure levels for humans, including sensitive individuals, who are likely to be without an appreciable risk of adverse effects during a lifetime. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated soil) can be compared to the RfD. Table 5 lists values of RfD (for chronic exposure) and RfD (for subchronic exposure), where they are available. The toxicity profiles discussing the possible effects of the contaminants of concern are included at the end of this section.

EPA does not currently recommend using the standard risk assessment methods described thus far for evaluating lead contamination. EPA recommends, and the Abex risk assessment used, the Uptake/Biokinetic (UBK) Model to assess the hazards associated with lead contamination at the Abex Site. The UBK Model estimates a range of blood lead levels for children that can result from the overall exposure to the variety of lead sources in the environment. The model considers possible exposure from air, diet, drinking water, soil/dust, paint chips/dust, and maternal blood lead sources. Table 6 presents the standard assumptions used in the UBK model in the Abex risk assessment. Lead exposure was evaluated for children up to four years old, the group most sensitive to potential adverse health effects from lead.

TOXICITY PROFILES FOR CONTAMINANTS OF CONCERN

Lead is a heavy metal that exists in one of three oxidation states, 0, +2, and +4. Primarily, lead is used in equipment where pliability and corrosion resistance are required, for example, in solder, paints and varnishes, storage batteries, and alloys. Occupational exposure to lead dust and fumes can occur during mining, refining, smelting, and welding. Children exhibiting pica (placing non-food items in the mouth), as well as children exhibiting normal hand-to-mouth activities, who are exposed to lead-contaminated paint chips, dust, or soil can experience elevated blood lead levels, sometimes at elevations significant enough to cause clinical illness. Some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at low blood levels. The fetus may also be impacted by blood levels below 10 micrograms per deciliter (ug/dL). Lead has been classified as a Group B2 probable human carcinogen. Oral exposure to lead salts, primarily phosphates and acetates, has caused kidney tumors in laboratory animals.

(Note: Additional details on the health effects of lead are presented in response to questions in Section I of the Responsiveness Summary.)
<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>CHRONIC (mg/kg-d)</th>
<th>SUBCHRONIC (mg/kg-d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oral</td>
<td>Inhalation</td>
</tr>
<tr>
<td>Antimony</td>
<td>0.0004</td>
<td>**</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.001</td>
<td>**</td>
</tr>
<tr>
<td>Chromium (VI)</td>
<td>0.005</td>
<td>5.7E-07</td>
</tr>
<tr>
<td>Copper</td>
<td>0.037</td>
<td>**</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.02</td>
<td>**</td>
</tr>
<tr>
<td>Silver</td>
<td>0.003</td>
<td>**</td>
</tr>
<tr>
<td>Tin</td>
<td>0.6</td>
<td>**</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.2</td>
<td>**</td>
</tr>
<tr>
<td>Aacenaphthene</td>
<td>0.06</td>
<td>**</td>
</tr>
<tr>
<td>Anthracene</td>
<td>0.3</td>
<td>**</td>
</tr>
<tr>
<td>Benzo(a)anthracene</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Benzo(b)fluoranthen</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Benzo(ghi)perylene</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Chrysene</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Dibenzo(a,h)anthracene</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Fluoranthen</td>
<td>0.04</td>
<td>**</td>
</tr>
<tr>
<td>Fluorene</td>
<td>0.04</td>
<td>**</td>
</tr>
<tr>
<td>Indeno(1,2,3-c,d)pyrene</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>0.004</td>
<td>**</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Pyrene</td>
<td>0.03</td>
<td>**</td>
</tr>
<tr>
<td>PCB-1248 &amp; PCB-1254</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

* milligrams per kilograms per day
** RfDs not available or not appropriate for this chemical
Source: Baseline Risk Assessment for the Abex Site, Table 4.2
**TABLE 6 - STANDARD ASSUMPTIONS FOR UBK MODEL**

<table>
<thead>
<tr>
<th>Parameters that vary with age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Exposure from air</td>
</tr>
<tr>
<td>Background concentration in air: 0.2 µg/m³</td>
</tr>
<tr>
<td>Indoor air concentration (% of outdoors): 30%</td>
</tr>
<tr>
<td>Time spent outdoors (hours/day):</td>
</tr>
<tr>
<td>Ventilation rate (m³/hr):</td>
</tr>
<tr>
<td>Percent absorption in lung: 32%</td>
</tr>
<tr>
<td>Exposure from diet</td>
</tr>
<tr>
<td>Background dietary exposure to lead (µg/day):</td>
</tr>
<tr>
<td>Percent absorption in gastrointestinal tract: 50%</td>
</tr>
<tr>
<td>Exposure from drinking water</td>
</tr>
<tr>
<td>Lead concentration in drinking water: 4 µg/l</td>
</tr>
<tr>
<td>Daily ingestion rate of drinking water (l/day):</td>
</tr>
<tr>
<td>Percent absorption in gastrointestinal tract: 50%</td>
</tr>
<tr>
<td>Exposure from soil/dust</td>
</tr>
<tr>
<td>Rate of soil/dust exposure (mg/day): 100</td>
</tr>
<tr>
<td>Percentage exposure to soil: 45%</td>
</tr>
<tr>
<td>Percentage exposure to dust: 55%</td>
</tr>
<tr>
<td>Percent absorption in gastrointestinal tract: 30%</td>
</tr>
<tr>
<td>Exposure from paint chips</td>
</tr>
<tr>
<td>Rate of exposure to lead in paint (mg/day): 0</td>
</tr>
</tbody>
</table>

*Source: Baseline Risk Assessment for the Abex Site, Table 4.4*
Antimony is a soft metal which is insoluble in water and organic solvents. It is widely used in the production of alloys. Oral exposure to antimony has been shown to cause burning stomach pains, colic, nausea and vomiting in humans. Long-term occupational inhalation exposure is associated with heart disease in both human and laboratory animals. Decreased longevity and altered cholesterol levels have been observed in rats. Antimony has not been tested for carcinogenicity.

Copper is a reddish-brown metal which occurs alone or in ores. It is insoluble in water but soluble in acid. Metallic copper is used as a conductor of electricity and in all gauges of wire for circuitry, as well as in coil and high conductivity tubes. Copper is used in many important alloys, such as brass and bronze. Copper is also used in insecticides, fungicides, catalysts, analytical reagents, and paints. Acute exposure to copper salts may cause eye and skin irritation. Acute industrial exposure to copper may occur from fumes generated during welding copper-containing metals. This type of exposure may cause upper respiratory tract and stomach irritation. The effect of chronic exposure to copper are rarely seen, except in individuals with Wilson's disease. Wilson's disease is a genetic condition where abnormal amounts of copper are absorbed and stored by the body. Chronic exposure to copper may result in anemia. Copper is not classifiable as to human carcinogenicity.

Cadmium is a bluish-white metal. Small amounts of cadmium are found in zinc, copper, and lead ores. Cadmium is insoluble in water but insoluble in acids. Cadmium dust includes dust of various cadmium compounds. Cadmium is used as a protective coating for iron, steel, and copper because it is resistant to corrosion. Cadmium alloys (copper, nickel) may be used as coatings for other materials, welding electrodes, solders, and in pigments and paints. Cadmium is used as an amalgam in dentistry. Various cadmium compounds are used as fungicides and insecticides. Exposure to cadmium can occur through inhalation and ingestion. Short and long-term inhalation exposure to cadmium dust or fumes is associated with swelling of the lung tissue, pain in the chest, difficulty in breathing and emphysema. Long-term ingestion of cadmium is associated with changes and damages to the kidneys in laboratory animals. The EPA has classified cadmium as a Group B1 probable human carcinogen. Cadmium may be associated with an increased risk of prostate and lung cancer in humans occupationally exposed to this contaminant.

Chromium is a heavy metal that generally exists in either a trivalent or hexavalent oxidation state. Hexavalent chromium is soluble and mobile in ground water and surface water. Trivalent chromium is in the reduced form and is generally found adsorbed to soil, therefore, it is less mobile. Hexavalent chromium is used in chrome plating, copper photography, copper stripping, aluminum anodizing, as a catalyst, in organic synthesis, and photography. Exposure to chromium compounds can occur through
ingestion, inhalation and skin contact. Hexavalent chromium may have a direct corrosive effect on the skin and may cause upper respiratory distress, headache, fever, and loss of weight. Long-term occupational inhalation exposure to dust and fumes of hexavalent chromium has been shown to cause lung cancer in humans, especially those in the chromate-producing industry. In addition, a number of salts of hexavalent chromium are carcinogenic in rats. The EPA has classified hexavalent chromium as a Group A human carcinogen. Trivalent chromium is an essential nutrient and has low toxicity; however, at high levels, it may cause skin irritation.

Nickel is a hard white, ferromagnetic metal that is a naturally-occurring element in the earth’s crust and is stable in the atmosphere at ambient temperatures. Nickel forms alloys with a variety of metals including copper, manganese, zinc, chromium and iron. Elemental nickel is used in electroplating and casting operations, magnetic tapes, surgical and dental instruments, nickel-cadmium batteries, and colored ceramics. Occupational exposure to nickel compounds has been associated with an increased incidence of nasal cavity and lung cancers. For this reason, nickel refinery dust has been classified by the EPA as a Group A - Human Carcinogen via the inhalation route of exposure. The most common reaction to nickel exposure is skin sensitization. Nickel and its compounds also irritate the conjunctiva of the eye and the mucous membranes of the upper respiratory tract.

Polychlorinated biphenyls (PCBs) are complex mixtures of the products of the chlorination of biphenyl. The mixtures contain isomers of chlorobiphenyls with different chlorine content. PCBs may contain other chlorinated mixtures (e.g., chlorinated naphthalenes and chlorinated dibenzofurans). PCBs are stable and nonflammable. They are used chiefly in insulation for electric cables and wires. PCBs are persistent in the environment and bioaccumulate in food chains, with possible adverse effects on animals and man. Prolonged skin contact may cause the formation of chloracne which is characterized by blackheads, fat containing cysts and pustules. Irritation of eyes, nose and throat may also occur. Systemic toxic effects are dependent upon the degree of chlorination of the biphenyls. Short and long-term exposure may cause liver damage. PCBs may cause embryo toxicity leading to stillbirth. Some PCBs are carcinogenic in animals. The EPA has classified PCBs as Group B2 probable human carcinogens. Oral exposure to PCBs has been shown to cause liver tumors in laboratory animals.

Polycyclic aromatic hydrocarbons (PAHs) constitute a class of contaminants consisting of substituted and unsubstituted polycyclic aromatic rings formed by the incomplete combustion of organic materials. Their physical, chemical, and biological properties vary with their size and shape. PAHs are persistent in the environment. Benzo (a) pyrene is one of the most common and most hazardous PAH. Some PAHs are classified by the EPA as a Group B2 probable human carcinogens. Benzo (a) pyrene is the
most potent of the carcinogenic PAHs. Oral exposure to benzo (a) pyrene has been shown to produce stomach tumors in mice and rats and mammary tumors in rats. Dermal exposure to benzo (a) pyrene has been shown to produce skin cancer in mice, rats, and rabbits. Oral and inhalation exposure to benzo (a) pyrene has been shown to cause lung tumors in mice and rats. Long-term exposure to PAHs may cause birth defects.

Silver is a white metal insoluble in water and soluble in sulfuric and nitric acids. Alloys or silver (e.g., copper, aluminum, cadmium, lead or antimony) are used in the manufacture of silverware, jewelry, coins, films, in mirrors, as a bactericide for sterilizing water, fruit juices, etc. Some silver compounds are also of medical importance as antiseptics or astringents. Exposure to silver can occur through inhalation of fumes or dust, ingestion of solutions or dust, eye and skin contact. Eye and skin contact with metallic silver may produce local permanent discoloration of the skin similar to tattooing. This process is referred to as argyria. Argyria is characterized by a dark, slate-gray color pigmentation of the skin. Generalized argyria can also develop through exposure to silver oxides or salts through ingestion and inhalation of dust. Silver is not classifiable as to carcinogenicity.

Tin is a soft, silvery-white metal which is insoluble in water. It is used as a protective coating for other metals such as in household utensils, as soft solders, and in the packaging industry. Exposure to tin may occur in mining, smelting, and refining, and in the production and use of tin alloys and solders. Inorganic tin salts are mild skin irritants. Exposure to dust or fumes of inorganic tin is known to cause lung disease. Tin is not classifiable as to human carcinogenicity.

Zinc is a bluish-white metal that is stable in dry air, but becomes covered with a white coating on exposure to moist air. Zinc is present in abundance in the earth's crust. Zinc chloride is used as a wood preservative, in dry battery cells, in oil refining operations, and in the manufacture of dyes, activated carbon, deodorants, and disinfecting solutions. Zinc chromate and zinc oxide are used primarily as pigments. Exposure to zinc compounds can cause skin sensitization, irritation of the nose and throat, fever, and fatigue. Zinc is not classifiable as to human carcinogenicity.

HUMAN HEALTH RISK CHARACTERIZATION

The risk characterization section in a risk assessment summarizes the results of the exposure and toxicity assessments to describe the baseline risk for the Site. In general, risk is characterized as being unacceptable when (1) existing levels of contaminants present at the site may cause cancer or some other adverse health effect; (2) there is a route or pathway through which a receptor may be exposed (e.g., ingestion of contaminated soil); and (3) there is a receptor which may be exposed (e.g., a
child ingesting soil). For cancer-causing contaminants, risk is measured as the number of additional incidences of cancer that can be expected in a population exposed to that contaminant. For example, one additional incident of cancer estimated to occur in a population of 10,000, as a result of exposure to contamination at a site, would quantitatively be described as a $1 \times 10^{-4}$ cancer risk. EPA recommends that remedial actions be taken to address risk greater than a $1 \times 10^{-4}$ cancer risk. EPA may recommend action in situations where the risk is in the range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$ (one additional incident of cancer in a population of 1,000,000).

For noncarcinogenic contaminants, risk is considered unacceptable when the concentration of the contaminant that an individual is exposed to (i.e., the intake rate) exceeds the RfD concentration for that contaminant. The noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ). To assess the overall potential for noncarcinogenic effects posed by more than one contaminant, the HQs are added to determine the Hazard Index (HI). The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposure within a single medium or across media. EPA may recommend action in situations where the HI exceeds one.

Table 7 summarizes the quantitative results of the risk assessment for residents and workers exposed to contaminants of concern other than lead at the site. In the case of residential exposure, risks to different age groups were determined.

EPA does not recommend characterizing the health effects associated with lead using the risk assessment procedures discussed above. EPA currently believes that the best available approach for characterizing risks associated with lead in residential areas is the UBK Model. The UBK Model was used at the Abex Site to predict the percentage of highly exposed children that would have a level of lead in their blood exceeding 10 ug/dL, the level recommended as safe by the Center for Disease Control (CDC), at various levels of contamination. Based on the exposure assumptions presented earlier, the model predicts that approximately 95 percent of the children exposed to soil/dust with an average lead concentration of 400 mg/kg would have blood lead levels below 10 ug/dL.

The baseline risk assessment for the Abex Site has determined that contamination at the site currently presents unacceptable risks to residents and would pose unacceptable risks to workers within the former foundry building. The average lead concentration exceeds 400 mg/kg in surface soil in the Effingham residential area, on the Holland Property, and in the vacant lots. Average lead concentrations also exceed 400 mg/kg in subsurface soil in the Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, the Holland Property, the Abex Lot, the drug rehabilitation center, and the vacant lots.
The baseline risk assessment also indicates that children between the ages of one and seven and future workers at the former foundry building would be exposed to unacceptable risks associated with other noncarcinogenic contaminants of concern. This is indicated in Table 7 where the total HI values are greater than one. It should be noted, however, that the HI calculations may overestimate the potential for adverse health effects at the Site since not all contaminants of concern induce the same health effect by the same mechanism of action.

The total lifetime cancer risks associated with the Site are $3.0 \times 10^{-5}$ for residents (i.e., one additional incident of cancer in an exposed population of 33,333) and $8.97 \times 10^{-4}$ for future workers at the former foundry facility (i.e., one additional incident of cancer in an exposed population of 1,115).

<p>| TABLE 7 - BASELINE RISKS FOR THE ABEJX SITE |</p>
<table>
<thead>
<tr>
<th>EXPOSED POPULATION</th>
<th>HAZARD INDEX</th>
<th>CANCER RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residents: (by age group)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1</td>
<td>0.83</td>
<td>$1.20 \times 10^{-8}$</td>
</tr>
<tr>
<td>1-4</td>
<td>1.21</td>
<td>$1.29 \times 10^{-8}$</td>
</tr>
<tr>
<td>4-7</td>
<td>1.35</td>
<td>$3.34 \times 10^{-6}$</td>
</tr>
<tr>
<td>7-11</td>
<td>0.70</td>
<td>$2.36 \times 10^{-6}$</td>
</tr>
<tr>
<td>11-15</td>
<td>0.57</td>
<td>$1.59 \times 10^{-6}$</td>
</tr>
<tr>
<td>15-18</td>
<td>0.50</td>
<td>$1.35 \times 10^{-6}$</td>
</tr>
<tr>
<td>18-70</td>
<td>0.51</td>
<td>$2.09 \times 10^{-5}$</td>
</tr>
<tr>
<td>Total lifetime risk: (for carcinogens)</td>
<td>----</td>
<td>$3.0 \times 10^{-5}$</td>
</tr>
<tr>
<td>Future Workers: (chronic/subchronic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation</td>
<td>43.9/43.8</td>
<td>$4.10 \times 10^{-4}$</td>
</tr>
<tr>
<td>Ingestion</td>
<td>2.42/2.38</td>
<td>$1.46 \times 10^{-4}$</td>
</tr>
<tr>
<td>Dermal</td>
<td>4.49/4.37</td>
<td>$3.41 \times 10^{-4}$</td>
</tr>
<tr>
<td>Total lifetime risk: (for carcinogens)</td>
<td>----</td>
<td>$8.97 \times 10^{-4}$</td>
</tr>
</tbody>
</table>

FUTURE RISKS ASSOCIATED WITH SUBSURFACE SOIL

The risk assessment that was performed for the Abex Site does not specifically address the issue of human health risks that may exist if contaminated subsurface soil is brought to the surface by future activity. The risk assessment only briefly
discusses this subject in conjunction with current and future land use and states that highly contaminated subsurface soils could be brought to the surface if large scale development occurs.

In addition to large scale development, EPA and VDWM have considered other possible mechanisms for exposure to subsurface soils either directly or by the transport of these soils to the surface. Routine activities by property owners or their children that could result in direct contact with subsurface soils include, but are not limited to: gardening of fruits, vegetables and other plants; children playing in soil (e.g. digging holes, making mudpies, etc.); and installing fence posts, decks, and playground equipment. Construction activities that could result in human exposure to contaminated subsurface soil and the recontamination of surface soil include, but are not limited to, construction of housing additions, maintenance and addition/replacement of subsurface utilities, demolition of existing buildings/structures, construction of new buildings/structures, and construction of in-ground pools.

EPA and VDWM are unaware of any research or models that can be used as a basis for estimating the potential future exposure of residents to subsurface soil contamination. Since future activities in the residential areas of OU1, unless restricted, could reasonably result in either direct exposure to contaminated subsurface soil or exposure to contaminated soil reintroduced to the surface, EPA and VDWM believe surface and subsurface soil are of equal concern. Since this ROD identifies the final remedial action for contaminated soil in OU1, EPA and VDWM believe a conservative approach to determining the extent of cleanup is appropriate.

ECOLOGICAL RISK

The OU1 RI focused on the area within a 700-foot radius of the foundry which is a predominantly urban area. A formal ecological risk assessment that qualitatively and/or quantitatively appraises the actual or potential effects of the Site on plants and animals was not performed as part of this OU. An investigation of the ecological impacts that may be associated with this Site, particularly with regard to the Elizabeth River and offsite environmental receptors, will be evaluated in OU2.

LEAD CLEANUP LEVELS

After completion of the baseline risk assessment at a site, appropriate cleanup levels are considered during the feasibility study in order to evaluate the effectiveness of the remedial alternatives. For sites dealing with lead contamination, EPA recommends, as a matter of policy (OSWER Directive §9355.4-02), that soil cleanup levels in the range of 500 to 1,000 mg/kg lead be used to trigger a remedial action in residential areas. The
use of a specific level to trigger an action has proved to be an effective method for implementing cleanup activities. After cleanup has been completed, confirmatory sampling is performed to ensure that unacceptable risks identified in the baseline risk assessment have been addressed. Since other contaminants of concern identified at the Abex Site are found in close association with lead, actions taken to achieve the lead cleanup levels will also be effective in addressing unacceptable risks from these contaminants.

VII. DESCRIPTION OF ALTERNATIVES

Engineering technologies were screened in the FS report to determine which ones could be applied to clean up contamination identified at the Site. The technologies were evaluated based on their effectiveness, cost, and implementability. Those technologies determined to be most appropriate were then developed into remedial alternatives. Table 8 presents the alternatives evaluated in this ROD, their present worth cost, and the time required for implementation. These alternatives are for work to be performed in addition to that already performed under the Removal Action.

COMMON ELEMENTS OF ALL ALTERNATIVES:

Except for Alternative 1, the No-Action Alternative, all of the remedial alternatives include the following common elements:

Demolition of Former Foundry Facility Buildings

All buildings associated with the former foundry operation would be demolished in Alternatives 2-7. Building debris would be disposed of offsite in an approved RCRA landfill in accordance with RCRA Land Disposal Restrictions. Equipment maintained within these buildings by the current property owner would have to be removed and may require decontamination.

Solid residuals generated by any decontamination activities would be handled in the same manner as contaminated soil. Any contaminated soil beneath the buildings would be addressed in the same manner as surrounding non-residential soil on the Holland Property, the Abex Lot, and the McCready Lot.

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1 This represents a change from the Proposed Plan which indicated that building would be decontaminated. Section XI (Documentation of Significant Changes) provides further explanation.
<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>DESCRIPTION</th>
<th>TOTAL COST (Present Worth)</th>
<th>TIME TO CONSTRUCT (Weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Action</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Surface soil excavation; Offsite treatment and disposal; Capping Abex Lot, McCready Lot, and Holland Property; Institutional Controls</td>
<td>4,888,930</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Surface and subsurface soil excavation; Offsite treatment and disposal</td>
<td>37,895,000</td>
<td>57</td>
</tr>
<tr>
<td>4</td>
<td>Surface and subsurface soil excavation; Onsite treatment; Offsite disposal</td>
<td>28,891,243</td>
<td>55</td>
</tr>
<tr>
<td>5</td>
<td>Surface and subsurface soil excavation, Onsite treatment; Offsite disposal, Capping Abex Lot, McCready Lot, and Holland Property; Institutional Controls</td>
<td>22,074,430</td>
<td>44</td>
</tr>
<tr>
<td>6</td>
<td>Surface and subsurface soil excavation; Onsite treatment; Offsite disposal; In-situ treatment and capping of Abex Lot; McCready Lot, and Holland Property, Institutional Controls</td>
<td>23,654,430</td>
<td>45</td>
</tr>
<tr>
<td>7</td>
<td>Surface and limited subsurface soil excavation; Onsite treatment; Offsite disposal; Institutional Controls²</td>
<td>16,169,450</td>
<td>40</td>
</tr>
</tbody>
</table>

² The Proposed Plan did not identify institutional controls as part of Alternative 7. Upon further consideration, EPA and VDWM have determined that institutional controls would be necessary for Alternative 7 to be protective of human health and the environment. Section XI (Documentation of Significant Changes) provides further discussion.
Soil Excavation, Offsite Disposal, and Temporary Relocation

Soil excavation and offsite soil disposal is required to various extents under all of the alternatives. TCLP testing would be conducted to determine whether excavated soil is a RCRA characteristic hazardous waste. Soil which is determined to be a RCRA hazardous waste would be treated prior to land disposal. Soil which is not a RCRA hazardous waste may still require treatment prior to disposal in a solid waste facility within Virginia or another state. Conventional earth moving equipment would be used to excavate and load the contaminated soil. Contaminated soil beneath homes and residential units may be removed using vacuum-type equipment. Dust suppression measures would be used to ensure that unacceptable releases on air-borne contamination do not occur. All excavated areas would be backfilled with clean fill and revegetated to achieve former conditions, to the extent practicable. Temporary relocation would be provided to residents while excavation is occurring around or beneath their homes or residential units.

Soil Treatment By Stabilization and/or Solidification

Where treatment is included, the treatment would be stabilization by mixing excavated soil and waste materials from the Site that exhibit toxicity using the TCLP test with chemicals/reagents. The mixing would be contained in above-ground equipment onsite to create a final product that encapsulates and immobilizes lead and other metals. Specific chemicals to be used in the process would be determined in a treatability study during the Remedial Design phase of the project. Treated material would be tested using TCLP to ensure it no longer exhibits toxic characteristics.

Discharge of Contaminated Water

Discharge of decontamination water and any other water generated during remedial activities will meet Virginia Pollution Discharge Elimination System (VPDES) requirements developed pursuant to the Federal Clean Water Act, 31 U.S.C. §§1251 et seq., and the Virginia State Water Control Law, Code of Virginia §§ 62.1-44.2 et seq.

Air Emissions Monitoring During Remedial Activities

Air will be monitored for both dust and lead levels during the remedial activities to protect the health of onsite workers and the community. Sampling of the interior of homes in the vicinity of excavation will also be performed before, during, and after excavation to assure that there is no significant release of contaminated dust into homes during the remedial activity. Air will be monitored to ensure that the National Emission Standards for Hazardous Air Pollutants (NESHAPs) developed under the Federal Clean Air Act, 40 C.F.R. § 50.12 and 50.6, and the Virginia Regulations for the Control and Abatement of Air Pollution (VRCAAP), VR 0401-0101, are not exceeded.
Transportation, Storage, Treatment and Disposal of Soil and Debris in Conformance with State Requirements

In all cases, transportation, storage, treatment and disposal of soil and debris will be in compliance with applicable with Virginia Hazardous Waste Management Regulations (VHWMR) or Virginia Solid Waste Management Regulations.

DESCRIPTION OF EACH ALTERNATIVE:

A description and the estimated cost of each alternative are summarized below. Present Worth includes an estimate of operation and maintenance (O & M) costs over a thirty (30) year period.

Alternative 1: No Action

Pursuant to the National Contingency Plan (NCP), 40 C.F.R. Section 300.430(e)(6), the "no action" alternative is considered to provide a baseline for comparison to other remedial alternatives. Under this alternative, no action beyond the removal actions would be performed.

Surface soil (0-12" in depth) with lead levels exceeding 500 mg/kg would remain at the drug rehabilitation center property and the vacant lots. Subsurface soil (> 12" in depth) with lead levels exceeding 500 mg/kg would remain in the Washington Park Housing Project, the Effingham Playground, the Effingham residential area, and the Seventh Street row homes. Subsurface soil exceeding 1,000 mg/kg lead would remain at the Abex and McCready Lots, the Holland Property, the drug rehabilitation center property, and in the vacant lots. Certain areas of lead contamination, including the Abex and McCready lots, and areas of the Holland Property, are currently capped and fenced, minimizing exposure to underlying lead at this time. However, these caps would not be permanently maintained under this alternative. This action would not reduce the risks to the public health and the environment outlined in Section VI above.

Since no action is proposed, there are no costs.

Alternative 2: Surface Soil Excavation, Offsite Treatment/Disposal, Capping, and Institutional Controls

Under this alternative, remaining surface soil (0-12" in depth) exceeding 500 mg/kg lead, except soil currently capped, would be excavated. Areas of excavation would include the drug rehabilitation center property, the Effingham Residential area and the vacant lots. The excavated soils would be transported in accordance with RCRA requirements to an approved RCRA Treatment Facility. The soils would be treated at the offsite facility, tested using TCLP to ensure RCRA Land Disposal Restriction
requirements are met, and disposed of in an approved RCRA Subtitle D landfill. Excavated areas would be backfilled with clean soil, graded, and revegetated. Institutional land use controls (e.g., deed restrictions) restricting activity below one foot in depth would be required on all properties where lead concentrations in subsurface soil exceed 500 mg/kg in residential areas and 1,000 mg/kg in non-residential areas.

Existing caps (i.e., pavement) on the Abex Lot, McCready Lot and the Holland Property would be permanently maintained under this alternative. Institutional controls would be required to control future exposure to the capped soils on these lots.

A CERCLA five-year review would be required under this alternative because hazardous substances would be left onsite. This alternative is designated as Alternative II, Case 1, in the FS and additional information developed in response to public comments.

Estimated Capital Cost: $4,865,430
Estimated O & M Cost: $23,500
Present Worth: $4,888,930
Time to Construct: 12 weeks

(Note: O & M costs are presented for a 30-year period. Since maintenance on capped areas would need to continue beyond 30 years, O & M costs would actually exceed this amount.)

Alternative 3: Surface and Subsurface Soil Excavation, Offsite Treatment/Disposal

Surface and subsurface soil exceeding 500 mg/kg lead in residential areas, including contaminated soil adjacent to home foundations and beneath homes\(^3\), would be excavated to the depth of the water table. Since the water table in the project area fluctuates and has been observed at depths from three to six feet below the surface, excavation would occur during the period when the water table is at the seasonally low elevation, to the extent practicable. Geotechnical investigations would be performed during the Remedial Design to determine appropriate construction techniques to be used to maintain the structural integrity of the homes during excavation. Temporary relocation would be provided to residents while excavation is occurring around or beneath their homes or residential units.

In non-residential areas, surface soil (0-12" in depth) exceeding 500 mg/kg lead and subsurface soil (>12" in depth)

\(^3\) This clarification on the extent of excavation was not included in the Proposed Plan. Section XI (Documentation of Significant Changes) provides further discussion.
exceeding 1,000 mg/kg lead would be excavated to the depth of the water table. To the extent practicable, excavation would occur during the period when the water table is at the seasonally low level.

All excavated areas would be backfilled with clean soil. Formerly vegetated areas would be graded and reestablished to original conditions, to the extent practicable.

The excavated soils would be transported in accordance with RCRA requirements to an approved RCRA Treatment Facility. The soils would be treated at the offsite facility, tested using TCLP to ensure RCRA Land Disposal Restriction requirements are met, and disposed of in an approved RCRA Subtitle D landfill.

Prior to the excavation of contaminated soil on the Abex Lot, the McCready Lot, and the Holland Property, existing asphalt and concrete would be removed and disposed as construction and demolition debris. This alternative is designated as Alternative II, Case 2, in the FS and additional information developed in response to public comments.

Estimated Capital Cost: $37,895,000
Estimated O & M Cost: 0
Present Worth: $37,895,000
Time to Construct: 57 weeks

Alternative 4: Surface and Subsurface Soil Excavation, Onsite Treatment, Offsite Disposal

Under this alternative, contaminated surface and subsurface soil in residential and non-residential areas would be excavated as described under Alternative 3.

Excavated soil and waste materials would be tested using TCLP to determine if it exhibits toxicity. Excavated soil and waste materials not exhibiting toxicity would be transported and disposed offsite in an approved RCRA Subtitle D landfill. Excavated soil and waste materials exhibiting toxicity using TCLP would be treated onsite using a stabilization process. Treated soil and waste materials would be retested using TCLP to ensure that it does not exhibit unacceptable toxicity and meets RCRA Land Disposal Restriction requirements. Treated soil and waste materials not exhibiting toxicity would be transported in accordance with RCRA requirements to an approved RCRA Subtitle D landfill.

The Proposed Plan indicated that subsurface soil in non-residential areas exceeding 500 mg/kg would be excavated, the same as in residential areas. Upon further consideration, EPA and VDWM have determined that 1,000 mg/kg is the appropriate cleanup level for subsurface soil in non-residential areas. Section XI (Documentation of Significant Changes) provides further discussion.
Prior to excavation of contaminated soil on the Abex Lot, the McCready Lot, and the Holland Property, existing asphalt and concrete would be removed and disposed of as construction and demolition debris. This alternative is based on Alternative III Case 2 in the FS and additional information developed in response to public comments.

Estimated Capital Cost: $28,891,243
Estimated O & M Cost: 0
Present Worth: $28,891,243
Time to Construct: 55 weeks

Alternative 5: Surface and Subsurface Soil Excavation, Onsite Treatment, Offsite Disposal, Capping, Institutional Controls

Under this alternative, contaminated surface and subsurface soil in residential and non-residential areas would be excavated, treated, and disposed of as described under Alternative 4, with the exception of the Holland Property, the Abex Lot, and the McCready Lot, which would be permanently capped with asphalt in accordance with RCRA Subtitle C requirements.

Operation and maintenance, institutional land use controls, and groundwater monitoring in accordance with RCRA requirements, would be necessary for areas that have been capped. A CERCLA five-year review would be required under this alternative because this remedy will leave hazardous substances on Site. This alternative is identified as Alternative V, Case 2 in the FS and additional information developed in response to public comments.

Estimated Capital Cost: $22,074,430
Estimated O & M Cost: $23,500
Present Worth: $22,097,930
Time to Construct: 44 weeks

(Note: O & M costs are presented for a 30-year period. Since maintenance on capped areas would need to continue beyond 30 years, O & M costs would actually exceed this amount.)

Alternative 6: Surface and Subsurface Soil Excavation, Onsite and In-Situ Treatment, Offsite Disposal, Capping, Institutional Controls

Under this alternative, contaminated surface and subsurface soil in residential and non-residential areas would be excavated, treated, and disposed of as described under Alternative 4, with the exception of the Holland Property, the Abex Lot, and the McCready Lot, which would be treated in-situ (in place) to immobilize the lead in the soil and waste material.

The in-situ treatment process utilizes augers and mixing
paddles to facilitate the injection and mixing of stabilizing agents into subsurface soils. Upon completion of this process, lead within the soil and waste material is expected to be stabilized. Pilot-scale treatability studies would be required to confirm the effectiveness of the in-situ treatment system.

Prior to the in-situ treatment, existing asphalt and concrete on the Abex Lot, McCready Lot and Holland Property would be removed and disposed of as construction and demolition debris. After the treatment is complete, these areas would capped in accordance with RCRA requirements. Operation and maintenance, institutional land use controls, and groundwater monitoring in accordance with RCRA requirements, would be necessary for areas that have been treated in-situ and capped. A CERCLA five-year review would be required. This alternative is identified as Alternative VII, Case 2, in the FS and additional information developed in response to public comments.

Estimated Capital Cost: $23,654,430
Estimated O & M Cost: $23,500
Present Worth: $23,677,930
Time to Construct: 45 weeks

(Note: O & M costs are presented for a 30-year period. Since maintenance on capped areas would need to continue beyond 30 years, O & M costs would actually exceed this amount.)

Alternative 7: Surface and Limited Subsurface Soil Excavation, Onsite Treatment, Offsite Disposal, Institutional Controls

Under this alternative, soil exceeding 500 mg/kg lead would be excavated from the surface to a depth of two feet. Subsurface soils below two feet with lead levels above 5,000 mg/kg would be excavated to the depth of the water table. Soil with lead levels between 500 and 5,000 mg/kg lead would remain below a depth of two feet. All excavated soil would be handled as described under Alternative 4.

Institutional land use controls preventing any disturbance of soil below two feet would be required in areas where lead concentrations in subsurface soil exceed 500 mg/kg. These controls would be necessary to prevent exposure to contaminated subsurface soil left in place and to ensure that surface soils are not recontaminated as a result of future construction activities. Activities that could be restricted to prevent

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5 Institutional controls were not included in Alternative 7 in the Proposed Plan. Upon further consideration, EPA and VDWM have determined that institutional controls would be necessary for Alternative 7 to be protective of human health and the environment. Section XI (Documentation of Significant Changes) provides further discussion.
recontamination of surface soil include, but are not limited to, construction of housing additions, maintenance, addition/replacement of subsurface utilities, demolition of exiting buildings/structures, construction of new buildings/structures and construction of in-ground pools.

A CERCLA five-year review would be required under this alternative because this remedy will leave hazardous substances on Site.

Estimated Capital Cost: $16,169,450
Estimated O & M Cost: $0
Present Worth: $16,169,450
Time to Construct: 40 weeks

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

EPA has developed a process to analyze remedial alternatives based on the statutory requirements of Section 121 of CERCLA, 42 U.S.C. §9621, and site-specific experience gained in the Superfund program. This process uses nine criteria as set forth in the NCP, 40 C.F.R. Section 300.430(e)(9)(iii), which encompass statutory requirements and technical, cost, and institutional considerations that EPA has determined are appropriate for a thorough evaluation. The nine criteria can be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. Brief descriptions of each of these criteria by category are presented below.

THRESHOLD CRITERIA: (relates to statutory requirements that each alternative must satisfy in order to be eligible for selection)

(1) Overall Protection of Human Health and the Environment:

Evaluation of the ability of each alternative to provide adequate protection of human health and the environment in the long and short-term; description of how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

(2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs):

Evaluation of the ability of each alternative to meet all ARARs of Federal and State environmental laws and/or justification for invoking a waiver; assessment of the ability of each alternative to comply with advisories, criteria, and guidance that EPA and VDWM have agreed to follow.
PRIMARY BALANCING CRITERIA: (technical criteria upon which the
detailed analysis is primarily based)

(3) Long-term Effectiveness and Permanence:
Evaluation of expected residual risk and the ability of each remedy to maintain reliable protection of human health and the environment over time after cleanup goals have been met.

(4) Reduction of Toxicity, Mobility, or Volume through Treatment:
Evaluation of the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances.

(5) Short-term Effectiveness:
Evaluation of the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

(6) Implementability:
Evaluation of the technical and administrative feasibility of each alternative, including the availability of materials and services.

(7) Cost:
Estimation of capital, O & M, and net present worth costs for each alternative.

MODIFYING CRITERIA: (criteria considered throughout the development of the preferred remedial alternative and formally assessed after the public comment period, which may modify to preferred alternative)

(8) State/Support Agency Acceptance:
Assessment of technical and administrative issues and concerns that the State may have regarding each alternative.

(9) Community Acceptance:
Assessment of issues and concerns the public may have regarding each alternative based on a review of public comments received on the Administrative Record and the Proposed Plan.
The alternatives were evaluated and compared in the FS and/or the Proposed Plan based on these nine criteria. This section summarizes EPA's comparison of alternatives based on the previous analyses with consideration of certain clarifications and modifications to some of the alternatives resulting from input received during the public comment process. Table 9 provides an overview of the comparison of alternatives.

**Overall Protection of Human Health and the Environment**

Although surface soil (0-12" in depth) contamination in the Washington Park Housing Project and the Effingham Playground has been addressed under the 1992 removal action, lead levels in the surface soil in the Effingham residential area presently exceed the residential health-based cleanup level of 500 mg/kg; surface soil on the Holland Property and in the vacant lots also exceeds 500 mg/kg lead; subsurface soil (> 12" in depth) in the residential areas including the Washington Park Housing Project, the Effingham residential area, and the Seventh Street row homes, exceeds the health-based cleanup level of 500 mg/kg; subsurface soil in the non-residential areas including the Holland Property, the Abex Lot, the McCready Lot, the drug rehabilitation center, and the vacant lots exceed 1,000 mg/kg lead. Alternative 1 (No Action) would not prevent current and/or future exposure to lead contaminated soil at the Abex Site and is not protective of human health. Therefore, Alternative 1 will not be considered further as a remedial alternative.

Alternative 2 provides a remedy for surface soil (0-12" in depth) within OU1 that exceeds 500 mg/kg lead by excavating and removing these soils. However, Alternative 2 does not excavate and remove subsurface soil (> 12" in depth) within OU1 with lead levels greater than 500 mg/kg. Exposure to subsurface soil exceeding 500 mg/kg lead in residential areas or 1,000 mg/kg lead in non-residential areas either directly or after contaminated soil has been reintroduced to the surface over time would result in an unacceptable human health risk. Routine activities by property owners or their children that could result in direct contact with subsurface soil include, but are not limited to, gardening of fruits, vegetables and other plants, children playing in soil (e.g. digging holes, making mudpies, etc.), and installing fence posts, decks, and playground equipment. Construction activities that could result in human exposure to contaminated subsurface soil and the recontamination of surface soil include, but are not limited to, construction of housing additions, maintenance and addition/replacement of subsurface utilities, demolition of existing buildings/structures, construction of new buildings/structures, and construction of in-ground pools.

Alternative 2 includes capping and institutional controls to control human exposure to soil exceeding 500 mg/kg during routine activities and construction activities. EPA and VDWM do not support the use of restrictions on residential property as a
Both Alternatives 3 and 4 would remove surface and subsurface soil above the water table in residential and non-residential areas to health-based cleanup levels. In residential areas, surface and subsurface soil with lead exceeding 500 mg/kg lead above the water table would be removed. In the non-residential areas, surface soil above 500 mg/kg lead and subsurface soil above 1,000 mg/kg lead would be removed to the depth of the water table. The Abex Lot is the only area where subsurface soil contamination above the cleanup level is expected to occur below the water table. The Abex Lot is zoned for commercial and/or light industrial use. Future activity is not expected to extend into the water table and quantity of soil exceeding 1,000 mg/kg lead below the water table is expected to be minimal. Alternatives 3 and 4 are both considered fully protective of human health and the environment.

Alternatives 5 and 6 would remove contaminated surface and subsurface soil in residential and non-residential areas within OU1 as described above for Alternatives 3 and 4, with the exception of soil within the Holland Property, the Abex Lot, and the McCready Lot. These areas would be permanently capped with asphalt under Alternative 5, and treated in-situ and then capped with asphalt in Alternative 6. Institutional controls would be required to assure permanent maintenance of the asphalt caps under both alternatives. Alternatives 5 and 6 are both considered protective of human health and the environment.

Alternative 7 would remove soil within OU1 exceeding 500 mg/kg lead between the surface and a depth of two feet. This removal would minimize unacceptable health risks associated with exposure to shallow soil during routine activities including, but not limited to, gardening of fruits, vegetables and other plants, children playing in soil (e.g. digging holes, making mudpies, etc.), and installing fence posts, decks, and playground equipment (assuming these activities do not extend beyond two feet in depth). However, under this alternative, lead levels between 500 mg/kg and 5,000 mg/kg would remain in soil below two feet in depth. As discussed in Alternative 2, construction activities could result in human exposure to contaminated subsurface soil and the recontamination of surface soil. Institutional controls would be required to restrict construction activities including, but not limited to, construction of housing additions, maintenance and addition/replacement of subsurface utilities, demolition of existing buildings/structures, construction of new buildings/structures, and construction of inground pools. As stated in Alternative 2, EPA and VDWM do not support the use of restrictions on residential property as a method to achieve protection of human health and the environment unless no other feasible alternatives are present.
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The ARARs associated with Alternatives 2 - 7 are the same. Under Alternatives 2, 5, and 7, however, some soil left in place may be a RCRA Characteristic Hazardous Waste (D008) due to high levels of leachable lead. In the event that such soil is excavated during some future activity, this soil would need to be treated and disposed of in accordance with RCRA Land Disposal Restrictions.

All alternatives would be in compliance with existing Federal and State ARARs.

Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time after cleanup levels have been met.

Alternative 2 would leave subsurface soil (> 12" in depth) contaminated with lead levels of up to 50,000 mg/kg in place and covered with soil and grass or asphalt within OU1, thereby resulting in the potential for a substantial residual risk.

Alternatives 3 and 4 provide minimal residual risk and, therefore, a high degree of long-term effectiveness since surface and subsurface soil that exceed 500 and 1,000 mg/kg lead in residential and non-residential areas of OU1, respectively, are excavated, treated as required, and disposed of offsite in an approved RCRA landfill.

Alternatives 5, 6, and 7 all leave contaminated soils and/or waste material in place, thereby allowing for potential residual risk. Alternatives 5 would leave soil and waste material contaminated with lead up to 58,000 mg/kg beneath asphalt caps on the Holland Property, the Abex Lot, and the McCready Lot. Alternative 6 would also leave contaminated soil and waste material in place, however, in-situ treatment would take place prior to capping and, therefore, reduce the potential residual risk. Alternative 7 would leave soil containing 500 to 5,000 mg/kg lead in place below two feet in depth within residential and non-residential areas. As with Alternative 2, Alternative 7 would result in the potential for a substantial residual risk at the Site.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Lead, the primary contaminant of concern at the Site, is a metallic element that cannot be destroyed to reduce its toxicity. Therefore, remedies addressing lead contamination in soil generally require either removal and/or stabilization by
immobilizing the lead within the soil structure, thereby reducing the mobility of the contaminant. Stabilization, however, results in an increase in the volume of material to be addressed and will not reduce the toxicity of the lead.

Under Alternative 2, only surface soil (0-12" in depth) within OU1 would be excavated and treated as appropriate (i.e., in accordance with RCRA Land Disposal Restriction requirements). Contaminated soil below this level would remain in place. Contaminated soil and waste material on the Holland Property, the Abex Lot, and McCready Lot would remain in place and be in accordance with RCRA requirements. This alternative, therefore, would not significantly reduce the mobility and volume of lead through treatment.

Under Alternatives 3 and 4, surface and subsurface soil above the water table within OU1 that is contaminated above health-based cleanup levels would be excavated and treated, as appropriate, to reduce the mobility of lead in the soil. In any case where the soil is treated, the volume of the lead-contaminated soil will increase due to the addition of stabilizing agents designed to reduce lead mobility.

Under Alternative 5, contaminated surface and subsurface soil above the water table within OU1 would be excavated and treated, as appropriate, to reduce the mobility of lead in the soil, with the exception of contaminated soil and waste material within the Holland Property, the Abex Lot, and the McCready Lot. These areas would not be treated, but would be contained with one foot of asphalt. As such, Alternative 5 would fail to treat the primary sources of lead contamination at the Site.

Alternative 6 is the same as Alternative 5, except that contaminated soil and waste material on the Holland Property, the Abex Lot, and the McCready Lot would be treated in-situ before capping. While in-situ treatment may significantly reduce the mobility of lead, treatability studies would need to be performed during the Remedial Design to determine the extent of the reduction in mobility that can be achieved.

Alternative 7 would excavate and treat, as appropriate, surface and subsurface soil within OU1 that exceeds 500 mg/kg lead within two feet of the ground surface, as well as soil exceeding 5,000 mg/kg between two feet in depth and the water table. Under Alternative 7, soil between 500 and 5,000 mg/kg lead within residential areas would remain in place below two feet in depth. Therefore, Alternative 7 would not reduce the mobility of lead to the extent accomplished under Alternatives 3 and 4, and perhaps under Alternative 6.

**Short-term Effectiveness**

The primary short-term effects associated with each alternative are possible exposure to contaminated dust generated
during excavation, and exposure to physical safety hazards that exist around heavy equipment. Air-borne dust containing elevated lead levels could be generated during soil excavation required in Alternatives 2 - 7. The extent of soil excavation is highest under Alternatives 3 and 4, and lowest under Alternative 2. Additional dust could be generated during soil handling and operation of treatment units onsite, particularly under Alternatives 4 and 7. However, measures would be taken to control dust during implementation of the various alternatives. These measures would be detailed in the Remedial Action Work Plan and the associated Health and Safety Plan which must be prepared and approved by EPA and VDWM prior to initiation of construction. Measures to be performed would include (1) dust suppression during excavation, handling, and treatment activities, (2) sampling the interior of homes for contaminated dust before, during, and after remedial activities to ensure dust suppression has been effectively implemented, and (3) air monitoring for both lead and dust before and during remedial activity.

Alternatives 3 - 7 would require temporary relocation of residents during excavation of contaminated surface and subsurface soil around or beneath their home or residential unit. This action is being taken to minimize the physical safety hazards associated with heavy equipment operating in close proximity to residential property. Details on the extent of excavation required for each home or residential unit and the arrangements for temporary relocation would be discussed with impacted residents during the Remedial Design process.

Alternatives 4 - 7 require onsite treatment of excavated soils. The Remedial Action Work Plan and Health and Safety Plan to be developed would detail measures to be taken to secure the area where soil is stockpiled and treated to prevent air or water-borne releases of contaminated soil and to prevent access by local children.

Implementability

Alternatives 3, 4, 5, and 6 require extensive excavation of contaminated surface and subsurface soil including contaminated soil that may exist adjacent to foundations and/or beneath homes or residential units. Due to the unstable nature of soil or fill material around or under many of the impacted residences and the proximity of the water table to the ground surface (estimated at 3 to 6 feet), strict engineering practices would need to be followed to prevent damage to the homes during excavation. Further geotechnical investigation would be required as part of the Remedial Design to determine appropriate construction techniques to be used to maintain the structural integrity of each home or residential unit requiring excavation. While additional costs would be incurred by implementing the necessary engineering controls, current engineering technology can be employed to safely remove contaminated soil around and beneath impacted residences.
In the case of Alternatives 4, 5, 6, and 7, implementation of onsite treatment will require careful planning and additional construction activities. In each case, treatability studies will be necessary to determine the appropriate mixture of reagents needed to effectively immobilize the lead in the soil. The implementation of these alternatives will require significantly more activity onsite than Alternatives 2 and 3, where treatment would be performed offsite at an RCRA-permitted facility.

Alternative 6 includes in-situ treatment of the Holland Property, the Abex Lot, and the McCready Lot, as well as treatment of excavated soil from other areas of the Site in an above-ground onsite treatment unit. The use of two separate onsite treatment units may further increase the time necessary to complete the remediation. Extensive pilot-scale treatment studies would be necessary to confirm the effectiveness of the in-situ treatment system. As a result, Alternative 6 would likely require a significantly longer time to complete the Remedial Design than the other alternatives.

As discussed under the criteria for Overall Protection of Human Health and the Environment and Long-term Effectiveness and Permanence, Alternatives 2, 5, 6, and 7 require effective implementation of institutional controls to fully satisfy these criteria. Of these alternatives, Alternative 2 relies most heavily on the use of institutional controls. All properties with subsurface soil (> 12" in depth) that exceeds 500 mg/kg in residential areas and 1,000 mg/kg in non-residential areas would require restrictions to limit activities that may occur below the one-foot depth. In terms of the residential areas, most of the privately-owned homes in the Effingham residential area, several of the units in the Washington Park Housing Project, and several of the Seventh Street row homes would be subject to these restrictions. EPA and VDWM prefer not to impose such restrictions on residential properties unless no other feasible alternatives are present.

Alternative 7 is second to Alternative 2 in its reliance on institutional controls to protect human health and the environment and to achieve long-term effectiveness. All properties with soil below two feet in depth that contains lead at 500 to 5,000 mg/kg in residential areas and at 1,000 to 5,000 mg/kg in non-residential areas would require restrictions to limit activities that may occur below the two-foot depth. Again, most of the privately-owned homes in the Effingham residential area, several of the units in the Washington Park Housing Project, and several of the Seventh Street row homes would be subject to these restrictions. At the time the Proposed Plan was issued, EPA and VDWM supported this alternative as the preferred remedy. However, during the initial analysis of alternatives, EPA and VDWM had not fully considered the implications of allowing contaminated soil between 500 and 5,000 mg/kg lead to remain below two feet. EPA and VDWM also became aware during the public comment period that many homes in the Effingham residential area had crawl spaces, many of which were found to be
contaminated with lead at levels exceeding 500 mg/kg. Upon further consideration, EPA and VDWM recognized that institutional controls would be required as part of this alternative. While restrictions would probably be required on fewer properties under Alternative 7 than under Alternative 2, and the restrictions on property use would be less severe, EPA and VDWM still prefer not to impose such restrictions on residential properties unless no other feasible alternatives are present.

The institutional controls required under Alternatives 5 and 6 are limited to restrictions needed to ensure capped areas on the Holland Property, the Abex Lot, and the McCready Lot are permanently maintained. EPA and VDWM consider these institutional controls to be implementable.

Cost

Alternative 2 has the lowest total present worth cost at $4,888,930. However, long-term cap maintenance and groundwater monitoring costs would actually be higher than estimated since these activities would need to continue well beyond the 30-year period used for estimation purposes. Administrative costs associated with implementing institutional controls have not been included. In addition, this cost does not reflect the fact that use of the Holland Property, the Abex Lot, and the McCready Lot would be permanently restricted.

Alternative 7 is the second least costly remedy with a total present worth of $16,169,450. As in Alternative 2, this total does not include administrative costs that would be associated with implementing institutional and does not reflect the impact of restricting the future use of residential and non-residential properties.

Alternatives 5 and 6 are similar in total present worth cost at $22,074,430 and $23,654,430, respectively. The limitations of these cost estimates are the same as discussed for Alternative 2.

Alternative 4 is second most costly remedy with a total present worth of $28,891,243. Alternative 3 is the most costly alternative with an estimated present worth of $37,895,000. There are no annual operation and maintenance costs or administrative costs for implementing institutional controls associated with either of these alternatives.

State Acceptance

VDWM served as the lead agency for the Abex Site during implementation of the RI/FS. VDWM has reviewed the remedial alternatives under consideration for the Abex Site and has provided EPA with technical and administrative requirements for the Commonwealth of Virginia. VDWM agrees with the analysis of alternatives presented in this ROD and concurs with EPA's selected remedy discussed below.
Community Acceptance

During the public comment period, the community expressed a strong desire to have a remedy that guarantees protection of human health and the environment in a manner that does not restrict their activities in the future. Many of the comments EPA and VDWM received from local residents expressed the concern that none of the alternatives being considered would restore their community to a safe level and they, therefore, preferred to be permanently relocated. Since EPA, in consultation with VDWM, has determined that Alternatives 3 and 4 would achieve the desire of local residents for a remedy that restores their community to a safe level without restricting their future activities, EPA is not recommending permanent relocation. EPA has included temporary relocation in the alternatives requiring excavation of contaminated surface and subsurface soil in residential areas. This measure will minimize the physical safety hazards associated with heavy equipment operating in close proximity to residential property.
### Table 9 - Comparison of Alternatives

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>ALTERNATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term Effectiveness and Permanence</td>
<td>1: Low</td>
</tr>
<tr>
<td>Reduction of toxicity, mobility, or volume through treatment</td>
<td>1: Low</td>
</tr>
<tr>
<td>Short-term Effectiveness</td>
<td>1: High</td>
</tr>
<tr>
<td>Implementability</td>
<td>1: Low</td>
</tr>
<tr>
<td>Cost</td>
<td>1: Low</td>
</tr>
<tr>
<td>State Acceptance</td>
<td>1: Low</td>
</tr>
<tr>
<td>Community Acceptance</td>
<td>1: Low</td>
</tr>
</tbody>
</table>

6 Since Alternative 1 (No Action) failed to meet this threshold criteria, it was not evaluated further.

7 "Low" indicates that significant contamination is left in place in residential and non-residential areas, and there is a high reliance on institutional controls for long-term effectiveness.

8 "Moderate" indicates that highly contaminated soil/waste material is left in place in non-residential areas, and there is some dependence on institutional controls for long-term effectiveness.
IX. SELECTED REMEDY AND PERFORMANCE STANDARDS

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives presented in the Proposed Plan using the nine criteria, and public comments, EPA, in consultation with VDWM, has determined that Alternative 4 is the most appropriate remedy for the Abex Superfund Site. The major components of the remedy and the required performance standards are listed below. Table 10 provides a detailed cost estimate for Alternative 4.

SOIL EXCAVATION

Performance Standards:

- Soil in residential areas within OU1, including the Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, and the Effingham Playground, where lead concentrations exceed 500 mg/kg shall be excavated; excavation shall extend to the depth of the water table and, to the extent practicable, shall be performed when the water table is at the seasonally low elevation.

- Contaminated soil exceeding 500 mg/kg lead around the foundations and beneath homes and residential units within OU1 shall be excavated; the structural integrity of each home or residential unit shall be maintained by performing geotechnical investigations during the Remedial Design to determine the appropriate construction measures to be taken during excavation.

- Soil from non-residential areas within OU1, including soil currently covered with material such as asphalt or concrete (i.e., the Holland Property, the Abex Lot, the McCready Lot, and the drug rehabilitation center) where lead concentrations either exceed 500 mg/kg at the surface (0-12" in depth) or exceed 1,000 mg/kg in the subsurface (> 12") shall be excavated; excavation of subsurface soil shall extend to the depth of the water table and, to the extent practicable, shall be performed when the water table is at the seasonally low elevation; asphalt, concrete, and other similar material that cover soil contaminated with lead above the cleanup levels shall be removed prior to excavation.

Additional Components:

- Residents shall be temporarily relocated while surface and subsurface soil is excavated around and/or beneath their particular home or residential unit; dust suppression measures shall be used to prevent contaminated dust from entering homes or adjacent areas; sampling of the interior of homes shall be performed before, during, and after excavation to ensure dust control measures have been
effective; air monitoring for lead and dust shall be performed in accordance with 40 C.F.R. Part 50, Appendix G, to ensure air emissions conform with the National Primary and Secondary Ambient Air Quality Standards for lead, 40 C.F.R. § 50.12, and particulate matter, 40 C.F.R. § 50.6, and for the control of fugitive dust emissions in accordance with Virginia Air Pollution Control Board Regulations, VR 04-0101.

- Erosion and sediment control measures shall be installed in accordance with the substantive requirements of the Virginia Erosion and Sediment Control Law, Code of Virginia § 10.1-560 et seq., the Virginia Erosion and Sediment Regulations, VR 625-02-00, and the City of Portsmouth's Erosion and Sediment Control Ordinance; an erosion and sediment control plan shall be prepared and submitted for review.

- All excavated areas shall be backfilled with clean fill; areas vegetated prior to excavation shall be restored to original conditions to the extent practicable.

- Additional sampling and analysis of soil shall be performed prior to excavation to determine the full extent of contamination. Sampling and analysis shall also be performed after excavation has been completed to confirm that cleanup goals set forth in the performance standards have been achieved; methods for determining that the cleanup goals have been reached shall be finalized during the Remedial Design and approved by EPA and VDWM based on EPA 230/02-89-042, Methods for Evaluating the Attainment of Cleanup Standards, Vol I.

- Excavated soil and waste materials shall be temporarily staged onsite prior to treatment and/or transportation to an offsite disposal facility; to the extent practicable, excavated soil and waste material shall be staged in areas of existing contamination, preferably on the Abex Lot, the Holland Property, and the McCready Lot; measures such as berms and temporary covers shall be used in areas with staged material to ensure that there are no unacceptable air or water-borne releases of contamination from these areas; these measures shall be sufficient to provide protection in the event of flooding; areas that are used to stage excavated material shall be secured with a fence to prevent trespassing.

- When the final areas of contamination are being addressed at the Site, excavated soil and waste materials may need to be staged in an area where cleanup has previously occurred. In all instances where soil and waste materials are staged in areas where cleanup has previously occurred or are otherwise not contaminated above levels requiring excavation, soil and waste material shall be staged in containers in accordance with RCRA regulations contained in 40 C.F.R. Part 268.50;
SOIL TREATMENT AND DISPOSAL

Performance Standards:

- Excavated soil and waste materials shall be tested using TCLP to determine if they exhibit toxicity as defined in 40 C.F.R. Part 261, Subpart C; contaminated soil that does not exhibit toxicity during testing shall be disposed of offsite at an approved RCRA Subtitle D landfill.

- Soil and waste material that exhibits toxicity due to the leaching of lead or other metals of concern shall be handled as a RCRA Characteristic Waste as defined in 40 C.F.R. Part 261, Subpart C. Such material shall be treated prior to disposal using a stabilization process that mixes the excavated soil and waste materials with chemicals/reagents to create a final product that encapsulates and immobilizes the lead and other metals; specific chemicals to be used in the process shall be determined in a treatability study during the Remedial Design phase of this project; mixing shall be contained in above-ground equipment onsite in accordance with VHWHR Section 10.9, Tanks.

- Treated material shall be tested using TCLP to ensure it no longer exhibits toxic characteristics; treated material that continues to exhibit toxicity shall either be subject to additional treatment to further reduce toxicity, or disposed of offsite in an approved RCRA Subtitle C landfill if RCRA Land Disposal Restriction requirements have been met; treated material that no longer exhibits toxicity using TCLP shall be disposed of offsite in an approved RCRA Subtitle D landfill; if a disposal facility in Virginia is used, the treated waste is considered a "Special Waste" under Part VIII of VSWMR and specific approval from VDWM's Director shall be obtained prior to disposal.

Additional Components:

- Air monitoring for lead and dust shall be performed in accordance with 40 C.F.R. Part 50, Appendix C, to ensure air emissions conform with the National Primary and Secondary Ambient Air Quality Standards for lead, 40 C.F.R. § 50.12, and particulate matter, 40 C.F.R. § 50.6, and for the control of fugitive dust emissions in accordance with Virginia Air Pollution Control Board Regulations, VR 04-0101.

- The onsite treatment unit shall be housed in a temporary structure to minimize exposure to the elements and the opportunity for air or water-borne releases.
• Treated material shall be staged onsite in accordance with the same requirements described above for staging untreated excavated soil and waste materials.

• Any transportation of hazardous waste from the Site shall be performed in accordance with VHWMR Part VII, Regulations Applicable to Transporters of Hazardous Waste, and RCRA requirements as defined in 40 C.F.R. Parts 262 and 263, and 49 C.F.R. Parts 107 and 171 - 179; any local roads damaged by the increased truck traffic associated with the remedial action shall be repaired in a timely manner following the conclusion of the onsite activity.

• Any offsite discharge of water generated from the onsite soil treatment system or from site decontamination activities shall be in compliance with the Virginia Surface Water Standards and the Virginia Pollution Discharge Elimination System (VPDES) requirements; any disposal of wastewater at a local Publicly-Owned Treatment Works (POTW) shall be in compliance with the POTW’s VPDES permit and pretreatment standards or requirements.

• Any treatment and/or storage units used during the remedial action (i.e., tanks or containers for storage or treatment) that are regulated under VHWMR/RCRA requirements shall meet the closure and post-closure care requirements of VHWMR Section 9.6.

**BUILDING DEMOLITION**

**Performance Standard:**

• All existing structures on the Holland Property associated with the former foundry operations shall be demolished; debris exhibiting toxicity using TCLP shall be decontaminated in accordance with RCRA Land Disposal Restriction requirements effective at the time when demolition occurs; debris shall be disposed of in an approved RCRA landfill.

**Additional Components:**

• Equipment stored by the current owner shall be sampled to determine if is contaminated; if analytical results find contamination, the equipment shall be decontaminated prior to removal from the Site.
<table>
<thead>
<tr>
<th>Action</th>
<th>Unit Cost</th>
<th>Quantity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Excavation (not including soil beneath homes)</td>
<td>$62.50/ton</td>
<td>59,542 tons</td>
<td>$3,721,375</td>
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<tr>
<td>Soil Removal Beneath Homes</td>
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<td>Soil Treatment</td>
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<td>Soil Disposal</td>
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<td>74,436 tons</td>
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<td>Asphalt Disposal</td>
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<td>Backfilling</td>
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<tr>
<td>Structure Stabilization</td>
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<tr>
<td>Utility Replacement:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Lines</td>
<td>$37.33/LF</td>
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<td>$219,310</td>
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<tr>
<td>Sewer Lines</td>
<td>$11.60/LF</td>
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<td>Air and Residence Monitoring</td>
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<tr>
<td>Temporary Relocation</td>
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<td>62 families</td>
<td>$124,000</td>
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<tr>
<td>Building Demolition</td>
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<td>Debris Decontamination</td>
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<td>Debris Disposal</td>
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<tr>
<td>Engineering and Management @ 10%</td>
<td></td>
<td></td>
<td>$1,926,083</td>
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<tr>
<td>Sampling and Testing @ 5%</td>
<td></td>
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<td>$963,041</td>
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<tr>
<td>Contingency @ 25%</td>
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<tr>
<td>Construction Monitoring @ 10%</td>
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<tr>
<td>TOTAL COST</td>
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<td></td>
<td>$28,891,243</td>
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</table>
EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C § 9621, establishes several other statutory requirements and preferences. Under this Section, the selected remedy for the Site, when completed, must comply with ARARs established under Federal and State laws unless a statutory waiver is justified. The selected remedy must also be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity or mobility of contamination as their principle element. This section discusses how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

The baseline risk assessment for the Abex Site determined that the Site currently presents unacceptable risks to residents through exposure to contaminated soil and would pose unacceptable risks to workers exposed to contamination in the former foundry building. The risk assessment, through use of the UBK Model, indicates that average lead concentrations exceeding 400 mg/kg present an unacceptable risk to children. Average lead concentrations in surface soil exceed this level in the Effingham residential area, on the Holland Property, and in the vacant lots. Average lead concentrations also exceed 400 mg/kg in subsurface soil in the Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, the Holland Property, the Abex Lot, the drug rehabilitation center, and the vacant lots.

The baseline risk assessment also indicates that children between the ages of one and seven and future workers at the former foundry building would be exposed to unacceptable risks associated with other noncarcinogenic contaminants of concern, including copper, antimony, tin, zinc, nickel, cadmium, chromium, PAHs, and PCBs. The total lifetime cancer risks associated with the Site are $3.0 \times 10^{-5}$ for residents (i.e., one additional incident of cancer in an exposed population of 33,333) and $8.97 \times 10^{-4}$ for future workers at the former foundry facility (i.e., one additional incident of cancer in an exposed population of 1,115).

Excavation, treatment, and offsite disposal of contaminated surface and subsurface soil at the Site and demolition of the former foundry buildings will virtually eliminate exposure to all contaminants of concern at the Site. By removing surface and subsurface soil contaminated above 500 mg/kg lead in the residential areas, EPA and VDWM expect the average lead concentration in the soil to be in the range of 100 to 300 mg/kg. This is below the average soil concentration of 400 mg/kg, which
the UBK Model estimates as the acceptable level for children. The risks associated with the other contaminants of concern will be within acceptable ranges as well through implementation of this remedy.

The short-term threats associated with the selected remedy can and will be readily controlled and no adverse cross-media impacts are expected from the remedy.

Compliance With Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Materials (TBCs)

Under Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), and EPA guidance, remedial actions at Superfund sites must attain legally applicable or relevant and appropriate Federal and state environmental standards, requirements, criteria, and limitations (collectively referred to as ARARs). Applicable requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address hazardous material found at the site, the remedial action to be implemented at the site, the location of the site, or other circumstances at the site. Relevant and appropriate requirements are those which, while not applicable to the site, nevertheless address problems or situations sufficiently similar to those encountered at the site that their use is well suited to that site.

The selected remedy will comply with ARARs and To Be Considered Materials (TBCs). The ARARs and TBCs are presented below.

CHEMICAL-SPECIFIC ARARs

- The Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 et seq. (40 C.F.R. Parts 261-270), the Virginia Waste Management Act, Code of Virginia § 10.1-1400 et seq., the Virginia Waste Management Regulations (VWHMR), VR 672-10-1, and the Virginia Solid Waste Management Regulations (VSWMR), VR 672-20-10 regulate the generation, transportation, storage, and disposal of hazardous wastes. Based on TCLP testing, some of the soil found during the RI exhibits toxicity for lead and would be regulated as a RCRA characteristic hazardous waste (40 C.F.R. Part 261, Subpart C and VWHMR Part III). As a result, RCRA and VWHMR are applicable to the treatment, transportation, and disposal of these soils.

(VPDES) and Virginia Pollution Abatement (VPA) Permit Program, VR 680-14-01, and the Virginia water Protection Permit, VR 680-15-02 regulate any discharge of wastewater to waters of the Commonwealth of Virginia.

- National Primary and Secondary Ambient Air Quality Standards for Lead (40 C.F.R. Part 50.12), and for Particulate Matter (40 C.F.R. Part 50.6), the Virginia Air Pollution Control Board, Code of Virginia § 10.1-1300 et seq., and the Virginia Department of Air Pollution Control regulations for the Control and Abatement of Air Pollution, VR 120-01-01 regulate air emissions and establish permissible levels of lead and particulate matter that can be released into the environment.

LOCATION-SPECIFIC ARARs

- Executive Order 11988, Floodplain Management, the National Flood Insurance Act of 1968, the Flood Disaster Act of 1973, and Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act regulate activities that take place in floodplains. The Site is located within a 500-year floodplain for the South Branch, Elizabeth River.

- Coastal Zone Management Act; the Coastal Management Plan for the City of Portsmouth; and the National Oceanic and Atmospheric Administration (NOAA) Regulations on Federal Consistency With Approved State Coastal Zone Management Programs regulate activities that take place in coastal areas. The Site lies within the Coastal Management Zone of the City of Portsmouth.

- Chesapeake Bay Preservation Act, Code of Virginia § 10.1-2100 and the Chesapeake Bay Preservation Area Designation and Management Regulations (CBPA Regulations), VR 173-02-01 regulate activities that take place in the Chesapeake Bay area. The City of Portsmouth Planning Department has designated the area in which the Site lies as a Resource Management Area of a Chesapeake Bay Preservation Area.

ACTION-SPECIFIC ARARs

- Virginia Erosion and Sediment Control Law, Code of Virginia § 10.1-560 et seq., and the Virginia Erosion and Sediment Control Regulations, VR 625-02-00 requires control measures during earth-moving activities to prevent erosion and transport of sediment in surface water runoff.

- 40 C.F.R. Part 264, Subpart I, and VHWMR Section 10.8 Use and Management of Containers regulate the use of containers for storing and/or treating hazardous wastes.

- 40 C.F.R. Part 264, Subpart J, and VHWMR Section 10.9, Tanks regulate the use of tanks for storing and/or treating hazardous wastes.


- Virginia Solid Waste Management Regulations (VSWMR) Part VIII, VR 672-10-1 regulates disposal of "Special Wastes" in Commonwealth of Virginia RCRA Subtitle D solid waste landfills. Treated soil that no longer exhibits toxic characteristics would be a special waste.

- Occupational Safety and Health Administration Act (29 C.F.R. Parts 1910, 1926, and 1904) regulates health and safety in the workplace.

Criteria, Advisories, or Guidance To Be Considered (TBCs):

- Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (EPA OSWER Directive 9355.4-02) recommends use of the UBK Model and appropriate assumptions to develop soil cleanup levels for lead.

- Methods for Evaluating the Attainment of Cleanup Standards, Vol. I (EPA 230/02-89-042) recommends statistical methods to confirm soil cleanup levels have been achieved.

Cost Effectiveness

EPA and VDWM considered less expensive alternatives during the remedy selection process, however, these alternatives did not provide the level of protection of human health, long-term effectiveness, reduction in mobility of contamination through treatment, or community acceptance that was provided by the selected remedy, Alternative 4. EPA and VDWM believe the selected remedy will eliminate unacceptable risks to human health at the Site at an estimated cost of $28,891,243 and, therefore, provides an overall benefit proportionate to its costs. The selected remedy also assures, with a much higher degree of certainty, that the remedy will be effective in the long-term because contaminated surface and subsurface soil in both residential and non-residential areas within OUI will be excavated, treated as appropriate, and disposed of offsite.
Utilisation of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

Section 121(b) of CERCLA, 42 U.S.C. § 9621(b), establishes a preference for remedial actions that permanently and significantly reduce toxicity, mobility, or volume of hazardous substances over remedial actions which will not. EPA, in consultation with VDWM, has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner to control contamination at the Abex Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA, in consultation with VDWM, has determined that this selected remedy, Alternative 4, provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost, while also considering the statutory preference for treatment as a principal element, and state and community acceptance.

The selected remedy treats lead-contaminated soil that exhibits toxicity, as determined using TCLP, thereby achieving significant reduction of the mobility of lead in soil. Alternatives 3 and 4 provide the most effective treatment of any of the alternatives considered, with Alternative 4 being the most cost effective. The selection of treatment of the contaminated soil is consistent with program expectations that indicate that highly toxic wastes are a priority for treatment and often necessary to ensure the long-term effectiveness of a remedy.

Preference for Treatment as Principal Element

By treating the contaminated soil at the Site that exhibits toxicity using TCLP, the selected remedy addresses the principal threats posed by the Site through the use of treatment technologies and satisfies the statutory preference for remedies that employ treatment as a principal element.

XI. DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan, released for public comment on April 28, 1992, identified Alternative 7 as the preferred alternative of VDWM and EPA. At that time, EPA and VDWM had not fully considered the implications of Alternative 7 with respect to allowing contaminated soil between 500 and 5,000 mg/kg lead to remain at depths below two feet in both residential and non-residential areas. During the public comment period, EPA and VDWM recognized that institutional controls would be required as part of this alternative. All properties with soil contaminated below two feet in depth at levels of 500 to 5,000 mg/kg in residential areas and at 1,000 to 5,000 mg/kg in non-residential areas would require restrictions to limit activities that may occur below the two-foot depth. These restrictions would
significantly impact the current residential areas. Most of the privately-owned homes in the Effingham residential area, several of the units in the Washington Park Housing Project, and several of the Seventh Street row homes would be subject to these restrictions. EPA, in consultation with VDWM, decided to select a remedy that includes excavation of contaminated soil below two feet (Alternative 4) rather than one that would impose restrictions on residential properties (Alternative 7). Section VIII (Summary of Comparative Analysis of Alternatives) of the ROD presents the full evaluation of the all alternatives based on the nine criteria identified in the NCP and provides the basis for the selection of Alternative 4.

Several additional changes and clarifications were made to the Common Elements associated with the alternatives after considering comments received during the public comment period. In the Proposed Plan, the former foundry facility was to be decontaminated. Based on comments received and further review of the condition of the former foundry building, and several associated structures, the ROD requires demolition.

Several residents raised questions about contamination in crawl spaces beneath their homes during the public comment period. Sampling performed as part of the recent removal action confirmed that lead contamination above 500 mg/kg exists beneath many of the homes. The ROD clarifies that excavation of contaminated soil adjacent to foundations and beneath homes is required as part of alternatives that include excavation of contaminated subsurface soil.

Due to the extent of excavation that may be required around and beneath homes and residential units, and in response to concerns raised by many local residents, temporary relocation was added as a Common Element for all alternatives requiring subsurface soil excavation. Temporary relocation would be provided to residents while excavation is occurring around and/or beneath their home or residential unit.

A final change made to the alternatives requiring subsurface excavation (> 12" in depth) in non-residential areas is a change in the lead cleanup level from 500 mg/kg to 1,000 mg/kg. This change was made: (1) to reflect the fact that nearby residents are not expected to be exposed to subsurface soil in the non-residential areas to the same extent they would be exposed in residential areas and (2) to be consistent with the lead cleanup levels used at other Superfund site for non-residential land use.
During the public comment period on the Proposed Plan for the Abex Corporation Site, VDWM and EPA received over 20 letters providing comments on the cleanup alternatives and various other aspects of Site activity. In addition, oral comments were recorded by a stenographer at the public meeting held on May 7, 1992, and tape recorded at the meetings held with local residents on May 28, 1992, June 9, 1992, and June 15, 1992. VDWM and EPA have carefully reviewed these comments and organized them into the following major categories:

- Health Effects of Lead Contamination
- Communication with Impacted Residents
- Compensation for Impacted Residents
- Proposed Cleanup Activities
  - Proposed Cleanup Levels
  - Excavation in Residential Areas
  - Soil Treatment and Disposal
  - Holland Property Buildings
  - Cleanup of the Abex Lot
- Future Site Investigation and Remedial Action
- Enforcement-Related Issues

Responses to public comments are presented below. Copies of the letters submitted to VDWM and EPA are included in the Administrative Record and identified in the index of documents for the Administrative Record in Appendix A.

I. Health Effects of Lead Contamination

(a) Several residents questioned how lead can enter the body and cause health problems. Specific concerns included the ability of lead to penetrate the skin, the possibility of inheriting problems associated with lead, possible exposure
The objective of a Feasibility Study (FS) is to identify and compare remedial alternatives for a hazardous substance release. The FS is not intended to "recommend" or "provide for" a particular remedial alternative. EPA, in consultation with VDWM, is responsible for selecting the appropriate remedial action for the Site based on an evaluation of the RI/FS prepared by Abex, other supporting documents in the Administrative Record (including information received during the public comment period), and the comments received during the public comment period. As part of this process, EPA and VDWM fully considered all recommendations and comments provided by Abex.

The Abex Corporation commented that EPA and VDWM failed to adequately justify the basis of their decision to select a new preferred remedial alternative.

Response: The basis for the selected remedy is included in the Administrative Record, Section VIII (Summary of Comparative Analysis of Remedial Alternatives) of the ROD, and further documentation concerning the change in preferred alternatives between the Proposed Plan and the ROD are included in Section XI (Documentation of Significant Changes).
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- Health Effects of Lead Contamination
- Communication with Impacted Residents
- Compensation for Impacted Residents
- Proposed Cleanup Activities
  - Proposed Cleanup Levels
  - Excavation in Residential Areas
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(a) Several residents questioned how lead can enter the body and cause health problems. Specific concerns included the ability of lead to penetrate the skin, the possibility of inheriting problems associated with lead, possible exposure
to lead from cutting grass, possible exposure to lead in the home, the effects of lead in the air, and the relationship between air-borne exposure and climate.

Response: Lead usually enters the body by two routes, by eating (ingestion) and by breathing (inhalation) materials that contain lead. At the Abex Site, the remedial investigation focused on the presence of foundry-related lead contamination within a 700-foot radius of the foundry facility. Lead was found at elevated levels in the soil of residential areas near the former foundry, including the Washington Park Housing Project, the Effingham residential area, the Seventh Street row home area, and the Effingham Playground. Contaminated surface soil in the Washington Park Housing Project, the Seventh Street row home area, and the Effingham Playground was excavated by Abex during removal actions performed in 1986 and 1992. As a result of these actions, the potential for exposure of local residents to lead-contaminated soil has been significantly reduced. EPA also required Abex to remove contaminated surface soil in the Effingham residential area as part of the 1992 removal action, however, local homeowners have, thusfar, denied access to their properties at this time.

In areas where surface soil contamination remains, local residents could be exposed to lead contamination through ingestion of soil or inhalation of contaminated dust. Ingestion is likely to be a more significant exposure route. A basic concept of risk assessment is that there is no risk unless there is exposure of an individual to a contaminant. If for some reason the contaminant does not come into contact with the individual, there is no exposure and, therefore, no risk. For instance, if activities (e.g., playing, moving grass) occur in grass-covered yards that contain lead-contaminated soil, the grass acts as a barrier between the lead-contaminated soil and the individual. The grass and its roots not only hold the soil in place, but act as a barrier which prevents much of the exposure to lead in soil. When bare patches of soil are encountered, exposure could occur. In the case of the child playing, exposure to lead contamination could present an unacceptable risk if the child spends a significant amount of time playing in soil that has elevated lead concentrations. For the adult mowing grass, small amounts of soil may be thrown up into the air and dispersed. However, the resulting exposure would not be sufficient to cause an unacceptable risk. In both instances, hand washing after such activities further reduces the possibility of exposure to the contaminated soils.

Where contaminated surface soil remains in yards of homes (i.e., the Effingham residential area), some
contamination could be carried indoors by routine activities. If residents play or walk in areas where the soil is bare, and if the soil in those particular areas is contaminated, contaminated soil could be carried indoors on their shoes. Pets could also carry small amounts of contaminated soils into the house on their fur. Toys and other items used in outdoor play activities may carry some contamination indoors if they have been used outside on bare soil areas and then brought back into the house. Since the yards in the areas where contaminated soil remain are, for the most part, grass covered, this is not expected to be a significant route of exposure for current residents.

Children under the age of seven would be the group most likely to experience adverse effects if exposed to lead-contaminated soil. Children in this age group most frequently ingest lead particles in the form of dusts during normal hand-to-mouth activities. The small lead particles get on their hands during play activities and are ingested when they put their hands in their mouths. For children exposed to lead contamination, blood lead levels have been shown to rise as they become more active. A child's blood lead level will tend to be quite low until his/her mobility begins to increase at approximately six months of age. At that point, children begin to come into contact with more surfaces that may be covered with fine dusts containing lead. Toddlers tend to be a particularly susceptible age group since they routinely experience increased contact with surfaces that may be contaminated and are prone to increased hand-to-mouth activity. Older children, as well as adults, exhibit much less hand-to-mouth activity than do small children, so their blood lead levels tend to be lower than those of small children when exposed to lead contamination.

Seasonal changes would likely result in differing exposures to lead-contaminated soil in children, and in some cases, adults. Children's blood lead levels tend to increase during the summer months due to their increased activity both indoors and outdoors. During the warmer seasons, children tend to be more active. With children coming into more frequent contact with various environmental surfaces, particularly with their hands, their exposure to lead hazards in the environment increases. Some adults may show a slight increase in blood lead during the warm months due to activities around the home such as gardening and yard work that require digging in soil and, therefore, an increased outdoor exposure to lead hazards.

Other sources of lead that may exist in the Site area, but which would not be related to the foundry operation, include finely crushed or powdered lead-based paint residues, dusts created through hobbies such as making
fishing sinkers and reloading bullets, food and beverages stored in improperly glazed ceramic vessels, and drinking water from home plumbing systems that used lead solder. There may be some exposure of children under seven through ingestion of lead contaminated food and drinking water, however, this contributes much less to their exposure than the hand-to-mouth-related activities. Older children may ingest lead by activities such as playing in contaminated soil, eating contaminated foods, drinking contaminated water, and being exposed to lead contaminants present in adult hobby work done at home.

Adult lead exposure generally occurs in occupational settings. Most adults are exposed to lead by inhalation of dusts or fumes in industrial activities such as battery breaking or recycling, lead foundry work, sand blasting, bridge and elevated storage tank painting, auto body work, burning and sanding of lead-based paint, stained glass-making, and supervising/cleaning indoor firing ranges. Occupational exposure in adults should not increase in the summer, although workers that fail to obey safe work practices such as using protective equipment because of the heat, may be affected. Adults can also be exposed to lead in the home through hobbies such as reloading bullets and producing fishing sinkers.

Lead exposure of pregnant women that results in elevated maternal blood lead levels may have an impact upon fetuses in utero. Since the maternal blood does pass across the placenta, the level of lead in the blood of a pregnant woman may affect developmental changes in the fetus as a result of her lead exposure. There is, however, no evidence to indicate that blood lead levels are inherited. There is no evidence that any genetic code allows for elevated blood lead levels.

A route of exposure often considered when evaluating effects of contamination is that of dermal contact. Lead, however, is generally found in inorganic forms that are not water or fat soluble, therefore, absorption through the skin does not occur. It is also important to note that lead particles are far too large to pass through the pores in the skin. Thus, this route of exposure is not considered significant. The only forms of lead that may be absorbed through the skin are those in organic lead compounds such as tetraethyl lead that was used in gasoline. The compounds at the Abex Site are inorganic and, therefore, will not pass through skin.

The total exposure to lead experienced by the residents impacted by the Site will be dependent upon their exposure to contaminated soils, as well as exposure to lead from the
other sources discussed above (e.g., lead leaching from solder into drinking water, lead-based paint, and occupational or recreational sources).

(b) Many residents from the impacted area questioned how the lead contamination could affect the health of their families, particularly their children. Specific concerns included the health effects to different age groups (e.g., children under six, older children, and adults), health effects at different blood lead levels, the permanence of health effects, the symptoms of lead poisoning that parents should look for in children, how parents can recognize cognitive or physical developmental impacts of lead in their children, health effects of lead in bones of children and adults, available studies on physical health problems caused by lead exposure, ability of lead to accumulate in the body, the teratogenic effects of lead, and the availability of a teratogen registry.

Response: As discussed in response to the previous question, residents in areas where lead contaminated soil is present would only experience a risk of possible adverse health effects if they are actually exposed to this soil. Cleanup actions performed in 1986 and 1992 have removed contaminated surface soil from the Washington Park Housing Project, the Seventh Street row home area, and the Effingham Playground. As part of the 1992 removal action, EPA also required Abex to remove contaminated surface soil in the Effingham residential area, however, local homeowners have not allowed access to their properties at this time. As part of the response actions being taken at the Site, additional sampling and analysis of surface soil will be performed to confirm that residents are not currently exposed to contaminated surface soil at levels that would pose an unacceptable risk to their health.

Residents currently exposed to surface soil contamination in the Effingham residential area, and residents exposed to other sources of lead (e.g., lead leaching from solder into drinking water, lead-based paint, and occupational or recreational sources) could experience adverse health effects if their blood lead levels become sufficiently elevated. Based on the results from the blood lead testing performed during July and August of 1992, some children are experiencing mildly elevated blood lead levels. (See responses I(d) and I(e).) The City of Portsmouth Health Department is working with these families to try to identify the source(s) of exposure to lead for these children.
The full range of health effects associated with lead are presented in some detail below. Children under the age of seven are the most sensitive to the effects of lead. The best way to determine if small children have been impacted by lead is to perform regular blood lead screening of children at risk. If children below seven years of age who may be at risk are screened on a yearly basis, potential problems can be identified and, with the help of health professionals, the sources of potential problems may be determined and proper treatment given when required. The recent blood lead testing performed for local residents indicates that some young children could be experiencing health effects associated with mildly elevated blood lead levels ranging from 10 to 19 ug/dL. The level established as safe by the Center for Disease Control is 10 ug/dL. At blood lead levels in the 10 to 19 ug/dL range, the recommended follow-up measures include repeat testing in one to three months, the performance of environmental and dietary history for the children to identify potential sources of exposure, and lead reduction education.

Young children tend to absorb larger amounts of lead than do older individuals and, due to their hand-to-mouth activities, generally ingest larger quantities of lead. The main target of lead's detrimental effects is the central nervous system. Since the organ systems in small children are still developing (the brain and other parts of the central nervous system, in particular), these children are at the greatest risk to the health effects of lead. Individuals impacted by the deleterious effects of lead early in life have a greater chance of experiencing significant adverse health effects. Learning disabilities and social and behavioral problems are associated with childhood lead poisoning. Studies have shown that decreased cognitive skill and motor skill development are associated with elevated blood lead levels. These effects were seen to progressively increase in severity as blood lead levels increase. At mildly elevated blood lead levels (10-19 ug/dL), lead may adversely affect IQ, hearing, and growth. Lead is implicated in decreased synthesis of a vitamin D metabolite and decreased nerve conduction velocity at slightly higher blood lead levels (20-30 ug/dL). At moderate blood lead levels (30-40 ug/dL) vitamin D metabolism and hemoglobin synthesis may be adversely affected. At high blood lead levels (60-80 ug/dL) lead anemia, lead colic, kidney damage, and brain damage may occur.

A recent evaluation of 24 major cross-sectional studies (Needleman and Gatsonis) provides strong support for the hypothesis that children with higher blood lead levels tend to have lower IQ scores than those with lower blood lead levels.
levels. In these studies, a number of learning related problems were seen to be associated with students having higher lead levels. Among the impacts cited were problems with attention and fine motor coordination, deficits in reading and vocabulary skills, increased absenteeism, and lower class ranking in school. A number of other investigators have also examined the effects of lead on cognitive skills and development. A number of other investigators have also examined the effects of lead on cognitive skills and development. Along with Needleman, work in this area has been done by Lansdown et al., Fulton et al., Bellenger, Fergusson et al., and a host of others. Schwartz et al., Mushak et al., Bornschein et al., and Chisholm are among other key investigators that have done research concerning childhood lead poisoning.

Older children are not as susceptible to the effects of lead as younger children since: (1) the hand-to-mouth activity patterns change in children over the age of six, (2) the target system for the toxic effects of lead is more completely formed, and (3) the absorption of lead decreases. However, if these older children are poisoned, they may be adversely affected. Lead will interfere with heme synthesis and may impact upon motor skills. Lead may effect the kidneys, may cause anemia, and may effect the brain at high blood lead levels (60-80 ug/dL).

As stated in the previous response, most adult exposure to lead is the result of inhalation of lead-bearing materials in occupational settings or during hobby-related activities. These individuals are exposed to lead at extremely high concentrations and are sometimes seen with blood lead levels in excess of 150 ug/dL. These workers may suffer lead anemia, lead colic, kidney damage, elevated blood pressure, neuromuscular problems, brain damage, and even death. These symptoms are associated with extremely high blood lead levels (greater than or equal to 80 ug/dL), and would not be characteristic of persons associated with the types and extent of exposure to lead contamination around the homes at the Abex Site.

As a general rule, the effects of lead are more serious and permanent the earlier the exposure occurs in the development of the central nervous system. Elevated blood lead levels will decrease over a period of time once the source of the exposure is eliminated. Some of the health effects due to lead exposure are reversible. The effects upon the kidneys due to blood lead elevations of short duration which are sufficient to cause kidney damage are reversible; however, when these elevated blood lead levels are sustained for long time periods the effects upon the kidneys are permanent. The effects upon hemoglobin
synthesis, vitamin D metabolism, lead colic, and lead anemia are reversible.

There are no symptoms which could be classified as being specific for lead poisoning. Individuals affected by lead may be hyperactive or listless, they may have diarrhea or be constipated, they may have headaches, develop severe stomach cramps, or any of a number of other general symptoms that could be characteristic of any number of conditions. It should be noted that many of these symptoms are contradictory of one another. One person may have diarrhea, while another may become constipated. These symptoms when associated with lead poisoning usually occur at blood lead levels $> 60$ ug/dL. At low blood lead levels ($< 20$ ug/dL), there are no distinctive symptoms.

When individuals are exposed to lead, it must be absorbed before adverse health effects are seen. Most lead to which individuals are exposed is not absorbed. The fraction that is absorbed will go to the target organs of the central nervous system, the hemopoietic system (blood-forming organs), and bone. The effects on the central nervous system have already been discussed. Lead may bind in place of iron in the heme group in hemoglobin, the oxygen-carrying protein in blood, and may effect hemoglobin synthesis. Lead may be stored in bone along with calcium. The bones then become a reservoir for the accumulation of lead in the human body. When the calcium in the bones is mobilized, stored lead may enter the blood stream and be incorporated into the hemoglobin in the red blood cells. No literature could be found which associates lead with bone deformities in children or adults.

Lead has been shown to have teratogenic effects in some studies. Lead may present a hazard to reproduction and exerts a toxic effect on conception, pregnancy, and the fetus in humans and experimental animals. Transplacental transfer of lead is thought to occur at blood lead levels of less than 10 ug/dL. Maternal and cord blood lead levels of 10-15 ug/dL seem to be associated with reduced gestational age and reduced weight at birth. At this time, the central nervous system effects upon the developing fetus appear to be the most significant of those listed since they occur at low levels. Inquiries were made concerning the existence of a registry for teratogens. No evidence was found of a registry of teratogens, however, it is common scientific knowledge that lead is considered to be teratogenic and information to that effect is found throughout the literature.
Several residents asked how to prevent their children from being affected by the contamination.

Response: Children would only be affected by contamination associated with the former foundry operation if they were exposed to contaminated soil or dust. Abex removed contaminated surface soil in residential areas, including the Washington Park Housing Project, the Seventh Street row home area, and the Effingham Playground, and placed asphalt caps on the Abex and McCready Lots during the 1986 and 1992 removal actions. Based upon the information currently available, children in areas where removal actions have been performed are not, therefore, currently exposed to lead-contaminated soil at levels that would pose an unacceptable risk. As part of the 1992 removal action, EPA also required Abex to remove contaminated surface soil in the Effingham residential area, however, local homeowners refused the request for access to complete this work. As part of the response actions being taken at the Site, additional sampling and analysis of surface soil will be performed to confirm that residents are not currently exposed to contaminated surface soil at levels that would pose an unacceptable risk to their health.

Risk due to lead exposure in areas where surface soil contamination remains (i.e., the Effingham residential area) may be minimized by: washing the hands of small children with soap and water frequently, especially before eating and drinking; cleaning surfaces that may become contaminated with soil or dust with a trisodium phosphate and water solution on a regular basis; and having children below the age of seven undergo regular blood lead screening. If soil thought to be contaminated with lead is covered with grass or some other ground cover, the chance of exposure is decreased. Foods placed on surfaces that may be contaminated with lead dusts should be rinsed with water before eating or preparation. Proper diet is also an important concern in regard to lead poisoning. Low fat diets are important for maintaining a good lead status. Persons eating fatty foods will absorb more lead than those maintaining low fat diets. Lead is also more readily absorbed if ingested when the stomach is empty. Additionally, small children that are iron deficient may have the lead they absorb substituted in place of the iron in the heme in their red blood cells, causing the red blood cells to have diminished oxygen transport capabilities.

Many residents expressed concern that testing had not been performed to determine if their families suffer from lead poisoning. Several generations of some families have lived in the impacted area. Residents requested that immediate blood testing for lead be made available at no charge to
anyone who may have been exposed to lead contamination in the impacted area. Residents also requested testing after the Site remediation is completed.

Response: The City of Portsmouth Health Department provided free blood lead testing to individuals in the impacted area during July and August of 1992. A total of 546 individuals were tested. At a public meeting held on August 26, 1992, the Director of Public Health for the City of Portsmouth presented a summary of the blood lead test results. All but four analyses had been received at that time. Of the available data, the City Health Department reported that 18 children had blood lead levels in the range of 10-14 ug/dL, and three children had blood lead levels in the range of 15-19 ug/dL. The highest blood level observed was 19 ug/dL.

The remedy selected for cleanup of the Site requires excavation of contaminated surface and subsurface soil in residential and non-residential areas, including the removal of contaminated soil adjacent to foundations and beneath homes and residential units, and beneath the asphalt on the Abex and McCready Lots. The remedy also requires implementation of dust suppression measures during excavation and air monitoring for dust and lead to ensure that dust suppression measures have been effective. The interior of homes will be sampled before, during, and after excavation to ensure that dust suppression measures have been effective. Residents will be temporarily relocated while excavation is occurring around or beneath their home or residential units.

Upon completion, the selected remedy will eliminate the unacceptable risks associated with lead at the Site. Measures will be taken during implementation to ensure that the remedial action is fully protective of human health. Therefore, EPA and VDWM did not include a requirement for additional blood lead testing as part of the final remedy.

Residents questioned what would happen if elevated levels of lead occur in blood test results. Residents also questioned if EPA investigates cases of lead poisoning.

Response: The City of Portsmouth Health Department has been notifying and advising families with children having elevated blood levels of appropriate follow-up measures. For children experiencing blood lead levels in the range of 10-14 ug/dL, follow-up activities include rescreening in three months, performing an environmental and dietary history for the child to identify potential sources of exposure, and lead reduction education. For children experiencing blood lead levels in the range of 15-19 ug/dL,
the same follow-up activities are performed, except rescreening will occur in one month and be repeated on 3-4 month intervals. If two consecutive venous blood tests fall in the range of 15-19 ug/dL, an environmental investigation to determine potential sources of lead and abatement to remove or minimize exposure to those sources will be conducted.

EPA does not investigate cases of lead poisoning. However, the Agency for Toxic Substances and Disease Registry (ATSDR) is responsible for addressing potential public health problems associated with exposure to hazardous substances from waste sites and releases of hazardous materials into the environment. On August 19, 1992, Portsmouth city officials asked ATSDR to review the results of the blood lead testing conducted for residents at the Abex Site. Upon completion of its review, ATSDR will be meeting with local residents to discuss the blood lead results and assist with follow-up activities.

Residents questioned how the health effects of lead change based on the length of time that an individual is exposed to the contamination. Several residents questioned whether children visiting the area and playing in contaminated soils could be affected. Residents also questioned whether former residents who have since moved from the area could still be affected. Other residents questioned the impact of long-term exposure to the contaminated soil.

Response: As discussed in previous responses, surface soil contamination has been removed from the Washington Park Housing Project, the Seventh Street row home area, and the Effingham Playground by Abex during the 1986 and 1992 removal actions. Contaminated surface soil remains in the Effingham residential area because homeowners have not allowed access for the removal activities to proceed. Current exposure to contaminated surface soil in the the Effingham residential area could result in an unacceptable health risk. The effects upon human health due to lead exposure are related to several factors including the concentration of the lead to which an individual is exposed and the duration of the exposure. Residents living in an area where there is a barrier that prevents exposure (e.g., grass covering contaminated soil) would be less likely to experience an unacceptable risk, and could live in an area for an extended period of time without experiencing adverse health effects. On the other hand, individuals exposed to elevated concentrations of lead (i.e., concentrations sufficient to elevate blood lead level above 10 ug/dL) are more likely to experience adverse health effects the longer they are exposed to these elevated lead levels. Since the
yards in the Effingham residential area are, for the most part, grass covered, the chance for exposure to contaminated soil is significantly reduced.

The length of time that an individual must be exposed to a given concentration of lead in the soil to experience an adverse health effect would vary considerably among individuals. Therefore, EPA and VDWM cannot predict the possible health effects, if any, that would be experienced by children visiting and playing in yards of the Effingham residential area. Since yards in this area are grass covered, the opportunity for exposure to contaminated soil is significantly reduced. Children playing in practically any urban environment will be exposed to some lead. In order for visiting children to possibly experience adverse health effects, they would need to be exposed to soil contaminated with lead at levels sufficient for their blood lead levels to become elevated. Generally, elevated blood levels will not be apparent for at least a month after exposure. If the blood lead level of a visiting child, or any child for that matter, was found to be elevated, it would not be appropriate to immediately assume that the elevated blood lead level resulted from exposure to contaminated soil. Lead is common in our environment and exposure to lead is widespread. A careful evaluation of possible lead sources, including drinking water, food, paint in and around the child’s home, dust from the hobbies and occupations of adults around the child, and soil and dust in and around the child’s own home, would have to be performed in order to accurately assess the appropriate steps needed to minimize future exposure. If the source of lead exposure can be accurately identified and that exposure is eliminated, blood lead levels should begin to decrease in one to two months.

The possible health effects experienced by former residents of the Washington Park Housing Project, the Effingham residential area, or the Seventh Street row homes would be difficult to predict. If former residents were exposed to lead-contaminated soil when they lived in the Site area, they may have experienced elevated blood levels. Upon moving from the area, their exposure to contaminated soil at the Site should have been reduced and elevated blood lead levels associated with this exposure should decrease. However, as discussed above in the situation of visiting children, many other sources of lead exist in the environment. A careful evaluation of all potential sources of exposure would need to be performed to accurately assess the cause of the elevated blood lead level. Generally, the body generates new red blood cells every 110 days. Therefore, if all sources of lead exposure have been eliminated, blood lead levels should return to normal levels.
within this timeframe.

(g) One resident questioned if health effects in children could go unnoticed by those around them.

Response: Health effects associated with blood lead levels of less than 20 ug/dL are not readily discernable, or attributable solely to lead, and could go unnoticed. For example, a decrease of 1 or 2 IQ points or the decreased synthesis of a vitamin D metabolite would not be noticeable. As blood lead levels increase, the associated health effects become increasingly more noticeable.

(h) Several residents questioned the impact over the years of eating fruit and vegetables grown in contaminated soil. One resident stated that conventional washing of vegetables would not remove lead contamination.

Response: EPA has assessed the risk likely to be posed to human health due to ingestion of home grown fruits and vegetables in the study area. Lead is not known to be readily translocated through the roots and shoots of plants, including fruits and vegetables, which contact subsurface soils. The low levels of lead that are retained by some plant roots are tightly bound to the cell wall of the roots with little lead passing through into the shoots and other plant parts (e.g., fruits). Although some root vegetables (e.g., carrots) have been shown to bioaccumulate trace amounts of lead, the levels reported are insignificant from a human health perspective.

While lead from subsurface soil is not readily translocated into the roots and tissues of fruits and vegetables, lead from surface deposition (e.g., atmospheric source, soil dust, paint chips, etc.) contributes to the vast majority of lead that is found in food (e.g., fruits and vegetables). This type of exposure can be eliminated by proper washing of fruits and vegetables before eating. Smooth skinned fruits and vegetables should be washed and wiped thoroughly with a clean paper towel after washing. Fruits and vegetables with irregular, hard to clean surfaces should be peeled and then washed and towel dried after peeling. However, the best method is to peel and then wash and dry all fruits and vegetables.

(i) Several residents expressed concern that the mental stress they were experiencing posed as much or more of a health threat than the lead contamination. Residents requested that a mental health team be provided to assist them.

Response: EPA and VDH are aware that local residents may be experiencing mental stress in having to deal with the
impacts of the Abex Superfund Site in their neighborhood. EPA and VDWM have been attempting to provide local residents with accurate information regarding the conditions at the Site to help alleviate fears that have arisen based on misinformation. EPA and VDWM will continue to work with the local community through the design and implementation of the remedy selected in the ROD. EPA does not have a mental health team to assist residents at Superfund Sites. However, ATDSR and the City of Portsmouth Health Department will be providing assistance to local residents.

Several residents expressed concern regarding the seriousness of the immediate threat to impacted residents and the need for immediate action. One individual commented that information from a variety of sources including requirements of the Occupational Health and Safety Act (OSHA) indicate that lead presents a more serious immediate threat than indicated by EPA’s toxicologist.

Response: EPA, as a matter of policy (OSWER Directive 9355.4-02), recommends that soil cleanup levels in the range of 500 to 1,000 mg/kg lead be used as the basis to trigger cleanup in residential areas. As a rule, if surface soil is contaminated above 500 mg/kg lead in an existing residential area, EPA will initiate a short-term removal action to eliminate exposure by local residents to such soil. Removal actions were performed in 1986 and 1992 in residential areas of the Site because data available at those times indicated surface soil contamination was present above 500 mg/kg lead. Contaminated surface soil was removed in the Washington Park Housing Project and the Effingham Playground. EPA directed Abex to remove contaminated surface soil in the Effingham residential area as part of the 1992 removal action, however, the impacted residents refused to provide access to their properties. Children could currently be exposed to contaminated surface soil in the Effingham residential area. Since the yards in this area are covered with grass, it is unlikely that exposure to contaminated soil would be sufficient to cause an unacceptable risk in the short term. However, even if children were to experience elevated blood lead levels, measures can be taken to reduce blood lead levels without completely removing the children and their families from their homes. Elevated blood lead levels are, in fact, not uncommon among children in most urban areas.

EPA and VDWM have determined that the lead concentrations in the soil in both residential and non-residential areas within OU1 of the Abex Site present a long-term threat to local residents. To minimize the chance for any adverse effects to the local community in the short-
term, EPA has required that removal actions be performed to eliminate the immediate exposure pathway, namely contact with contaminated surface soil in existing residential areas. EPA and VDWH would recommend that residents of the Effingham residential area who may be concerned about the short-term risks associated with surface soil in their yards, allow the removal action to be completed in this area.

As to the requirements of OSHA, standards have been established for workers in occupational settings where exposure to high levels of lead could occur routinely. OSHA establishes exposure levels above which workers must be protected through measures such as wearing protective clothing or respirators. EPA has formal risk assessment procedures which are used at Superfund sites to determine cleanup levels that will be protective, in this case, of individuals in a residential setting. These cleanup levels are much stricter than the OSHA requirement.

(k) One resident wanted to know the findings of the final risk assessment for current and future exposure scenarios at the site for the major contaminants of concern.

Response: This information is summarized in Section VI (Summary of Site Risks) of the ROD.

(l) Several residents questioned the meaning of the term "upper bound cancer risk" used by EPA.

Response: Cancer, unlike noncancer health effects, does not have a threshold at which it is safe to assume that adverse health effects will not occur. Therefore, EPA assumes that there is no level of exposure to a carcinogen that does not create the possibility, however small, of generating a carcinogenic response. EPA uses a two-part cancer risk evaluation in which the substance is first assigned a weight-of-evidence classification, and then a slope factor, as described below, is calculated. A chemical weight-of-evidence classification indicates the strength of the evidence that a chemical is a human carcinogen. EPA has the following classifications:

<table>
<thead>
<tr>
<th>Group</th>
<th>Classification</th>
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<tbody>
<tr>
<td>A</td>
<td>Human Carcinogen</td>
</tr>
<tr>
<td>B1 or B2</td>
<td>Probable Human Carcinogen – B1</td>
</tr>
<tr>
<td></td>
<td>indicates that limited human data are available; B2 indicates sufficient evidence in animals and inadequate or no evidence in humans</td>
</tr>
</tbody>
</table>
Group C  Possible human carcinogen
Group D  Not classifiable as to human carcinogenicity
Group E  Evidence of noncarcinogenicity for humans

EPA calculates a slope factor for both Group A and Group B carcinogens. A slope factor is a toxicity value that defines, quantitatively, the relationship between dose and the response of a carcinogen. The slope factor is an upper bound estimate of the probability of a response per unit intake of a chemical over a lifetime. It is used in the risk assessments to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. The term "upper bound" reflects the conservative estimate of the risks calculated from the slope factor.

The EPA currently regulates contaminants whose cancer risk exceeds an upper bound risk of one additional cancer in a population of 10,000 people (referred to as a $10^{-4}$ cancer risk). A contaminant whose upper bound risk level is between one additional cancer in a population of 10,000 (a $10^{-4}$ cancer risk) and one additional cancer in a population of one million (a $10^{-6}$ cancer risk) is within the target cancer risk range, as defined by the EPA.

The upper bound total cancer risk for residents at this Site is within EPA's target cancer risk range. The total lifetime cancer risk for a resident living 70 years in the study area is estimated to be one additional cancer in a population of 33,333 people (a $3.0 \times 10^{-3}$ cancer risk). If individuals were working in the former foundry building on the Holland Property eight hours a day, five days a week, fifty weeks a year for a total of 25 years, the total lifetime cancer risk estimate for these workers would be one additional cancer risk in a population of 1,115 (an $8.97 \times 10^{-4}$ cancer risk). This cancer risk level exceeds EPA's acceptable risk range.

A resident expressed concern that a well located in the Effingham residential area of the Site is used for watering plants and that children may drink this water.

Response: EPA and VDWM were unaware that any private wells were still in use in the immediate vicinity of the Site. The residential areas surrounding the former foundry facility obtain drinking water through public water.
supplies. EPA and VDWM are recommending that further investigation of this well be included as part of the OU2 RI/FS activity. Although a well in the Effingham residential area is expected to be upgradient of the Site, EPA and VDWM recommend that children not be permitted to drink this water until it has been tested. If elevated lead levels are present, use of this water should probably be discontinued.

(n) Several residents expressed concern that the quality of their drinking water may be affected by the Site.

Response: Residents in the vicinity of the Abex Site obtain drinking water through public water supplies. The City of Portsmouth does not have any water supply wells in the vicinity of the Site. Lead contamination could be present in drinking water if lead solder has been used in copper water lines in home plumbing systems, or as a result of the use of brass bathroom water fixtures, however, such contamination would not be related to any Site contamination.

II. Communication With the Impacted Residents

(a) Homeowners with properties impacted by the proposed cleanup expressed concern that they were not notified of known or suspected contamination at the time they purchased their properties.

Response: EPA and VDWM understand the concern and frustration that local residents are experiencing now that lead contamination has been identified on their properties. EPA and VDWM only became aware of contamination in the area of privately-owned homes (i.e., the Effingham residential areas) through the RI/FS that was submitted in draft in October of 1991 and completed in February of 1992. EPA and VDWM were not involved with the sale of these properties.

(b) Many residents questioned how VDWM and EPA compiled their mailing list for distributing Site information since many had not received Agency mailings. Some residents stated that they were first informed of the problem when they received a letter from the cleanup contractor requesting access to begin removal work. One resident did not believe the Agency used an effective method to notify residents of the public comment period.
Responses: VDWM and EPA compiled the mailing list for distributing site information from sign-in sheets of workshops held during the performance of the RI/FS at the site. This is a standard method used to develop mailing lists of interested parties at Superfund sites. However, EPA and VDWM have agreed to include all residents in the Washington Park Housing Project, the Effingham residential area, and the Seventh Street row homes on the site mailing list. All future mailings, including notification of the availability of this ROD, will be sent to all residents.

EPA and VDWM notified the public of the availability of the Proposed Plan and Administrative Record in accordance with procedures required by the NCP. A formal notice opening the public comment period and notifying the community of the May 7, 1992 public meeting was published in the local paper, The Virginian-Pilot, on April 28, 1992. EPA and VDWM will be updating the Community Relations Plan. Community relations interviews will be conducted at the Abex Site to identify additional steps that need to be taken to improve communication with the community. EPA and VDWM encourage local residents to contact the EPA or VDWM Community Relations Coordinator with any suggestions in this regard.

Several residents questioned the length of time required by VDWM and EPA to provide sampling results to residents. Residents questioned why the final results of data collected as early as 1984 were not completed until February 1992.

Response: Most of the residential soil sampling and analysis conducted at the site was performed during late 1990 and through 1991. The final RI/FS Report for the Site was completed in February of 1992 and was made available to the public as part of the Administrative Record supporting the Proposed Plan on April 28, 1992. Earlier sampling and analysis that was performed was limited to the Abex Lot and residential areas immediately adjacent to the Abex Lot. EPA collected several samples from the Abex Lot during the site inspection performed in 1984. This data was reported in the final Site Inspection Report dated March 25, 1986. EPA collected additional samples in April of 1986 in the Washington Park Housing Park and other properties adjoining the Abex Lot. This data was the basis for the removal action performed later that summer in the Washington Park Housing Project, the Effingham Playground, and the Seventh Street row homes. Subsequent to the site being proposed on the National Priorities List in 1988, VDWM, with the support of EPA, completed negotiations of a Consent Order with Abex to conduct the RI/FS in October of 1989. The complexities
associated with the Abex Site, as with all Superfund sites, from both the technical and legal standpoint make progress necessarily slow. However, when data has become available indicating the need for an immediate action, EPA has taken steps to ensure those actions were carried out quickly.

(d) Several residents expressed concern that the cleanup action was initiated before questions were answered.

Response: Under CERCLA, EPA has the ability to perform two types of response actions at Superfund sites. Removal response actions are performed when conditions warrant that an immediate action be taken. These actions are generally limited in scope and require immediate action, therefore, the public is not afforded the opportunity to comment on these actions prior to implementation. In this case, a public meeting was held prior to the initiation of the 1992 removal action due to issuance of the Proposed Plan for the upcoming remedial action. The other type of response is a remedial action and it addresses the long-term cleanup of a Superfund site. The public is given the opportunity to comment on the proposed remedial action in a formal public comment period. EPA was initiating a removal action to address surface contamination in residential areas of the site the same time that the Proposed Plan for the final remedial action for OU1 was issued. This created a considerable amount of confusion among local residents. EPA and VDWM were requesting comments from residents on the OU1 remedial alternatives and telling residents that a final decision had not been made while Abex's contractor was mobilizing onsite to perform the 1992 removal action. EPA and VDWM have attempted to address all questions raised by local residents during the public comment period for the remedial action in this Responsiveness Summary. In addition, EPA and VDWM have considered the concerns expressed with regard to the 1992 removal action in determining how to proceed with the remedial action.

(e) Residents questioned why they had not been notified of the potential danger at the site earlier and questioned what government agency is responsible for advising residents of such danger.

Response: EPA is responsible for the cleanup of hazardous contamination at Superfund sites, including the Abex Site. VDWM served as the primary point of contact in overseeing Abex's performance of the RI/FS at this site. EPA and VDWM became aware of the extent of additional lead-contaminated soil that was present in the Washington Park Housing Project, the Effingham residential area, and the Effingham
Playground in late October of 1991 when Abex submitted the draft RI/FS report. After reviewing this report during November and early December, EPA determined that the immediate threat posed by contaminated surface soil in the existing residential areas and the playground warranted an additional removal response action. Since exposure to contaminated surface soil during the winter months is limited, EPA and VDWM did not believe it was necessary to notify residents of any potential danger at that time. During January and February, EPA attempted to negotiate a Consent Order with Abex to perform the 1992 removal action. On March 30, 1992, after had negotiations failed, EPA issued a Unilateral Administrative Order to Abex to perform the work.

During the same period, Abex was also finalizing the RI/FS report based on comments provided by VDWM and EPA. The final RI/FS report was completed in late February of 1992. During March and April, EPA and VDWM developed the Proposed Plan presenting proposed remedial action alternatives for the final cleanup of OU1. At this point, EPA and VDWM issued the Proposed Plan and the Administrative Record in accordance with requirements of the NCP, thereby notifying residents of the contamination at the Site, as well as proposed remedial alternatives.

EPA and VDWM recognize the frustration that local residents are experiencing in confronting the fact that lead contamination is present around many of their homes. At Superfund sites where the health impacts of current exposure do not present an immediate risk to public health, EPA and VDWM prefer not to unduly alarm local communities with preliminary findings, but rather present complete information, including the proposed plan of action. This was the approach taken at the Abex Site.

Several residents questioned why warning signs had not been posted in contaminated areas.

Response: When contamination is identified at a Superfund site at levels that may present a threat to individuals currently being exposed, EPA and VDWM recommend taking an appropriate response action to eliminate that exposure pathway. EPA and VDWM do not routinely rely on the use of warning signs as a mechanism for preventing such exposure. In the case of the Abex Site, EPA required Abex to install asphalt caps on the Abex Lot and the McCready Lot and to secure these areas, as well as the Holland Property, with fencing to limit the access by trespassers. EPA and VDWM have taken into consideration the view of local residents that warning signs may deter individuals from trespassing on
these properties. Warning signs have been posted on the Holland Property, the Abex Lot, and the McCready Lot. In addition, access to the Holland Property has been secured by reinforcing fences, gates, and doors.

(g) One individual questioned why the Administrative Record was not organized in chronological order and stated that review of the material was difficult to follow and understand.

Response: The Administrative Record for Superfund sites include all documents relied upon by EPA in selecting the remedy at the site. This record provides technical information for public review and comment and establishes the basis for legal review of EPA's decision on the selection of a remedy. Because of the significance of Administrative Records at Superfund sites, EPA has established formal guidelines for their organization. Generally, the documents are organized into several sections based on types of activities that typically occur at a Superfund site (e.g., site identification, remedial enforcement planning, remedial response planning, removal response projects, and community involvement sections). The documents in each of these sections are presented in chronological order. EPA and VDWM recognize the difficulty that can exist in reviewing the Administrative Record. EPA and VDWM will investigate ways to better present the information in the Administrative Record for the site to the public. The Administrative Record will be re-indexed following issuance of the ROD.

III. Compensation for Impacted Residents

(a) Many residents expressed a strong desire to be permanently relocated. The affected homeowners specifically requested that an alternative be considered that would award them replacement value of their homes and land and a six to twelve month temporary housing allowance. Their proposed alternative would also include the cleanup requirements of the preferred alternative identified in the Proposed Plan.

Response: Permanent relocation is generally considered by EPA to be a remedy of last resort at Superfund sites. Permanent relocation is a remedy that seriously disrupts the local community which EPA is striving to protect and often presents difficulties during implementation. Section 101(24) of CERCLA, 42 U.S.C. § 9601(24), provides for including the cost of permanent relocation in remedial actions at Superfund sites when EPA determines that such relocation, either alone or in combination with other
measures, is more cost-effective and environmentally preferable to the transportation, storage, treatment, destruction, or secure disposition offsite of hazardous substances, or may otherwise be necessary to protect the public health or welfare. EPA, in consultation with VDWM, has determined that the selected remedy (Alternative 4) can be implemented to fully protect the health of impacted residents in a cost-effective manner. Therefore, permanent relocation is not recommended as part of the selected remedy.

In residential areas, the selected remedy requires excavation of soil exceeding 500 mg/kg lead to the depth of the water table, including excavation of contaminated soil adjacent to foundations and beneath homes or residential units. Upon completion of the required excavation, residents will no longer be subjected to unacceptable health risks from exposure to lead-contaminated soil and residents will have unrestricted use of their properties. During implementation of the remedy, the ROD requires a variety of activities to ensure that residents are not exposed to levels of contamination that may pose an unacceptable risk. The details of these measures will be developed during the Remedial Design phase of the project and will be documented in the Remedial Action Plan and the associated Health and Safety Plan. These documents must be prepared prior to initiation of construction at the Site and are subject to approval/acceptance by EPA and VDWM. These documents will be available to the public as part of the Administrative Record.

The ROD requires measures such as: dust suppression during excavation; air monitoring for lead and dust during the entire project; sampling of the interior of homes before, during, and after excavation to that ensure dust suppression measures have been effective; and berming and covering stockpiled soil to prevent air or water-borne releases of contamination. In addition, the ROD requires that residents be temporarily relocated while excavation is occurring around and/or beneath their individual home or residential unit. Additional soil sampling and geotechnical investigations will be performed during the Remedial Design to determine the extent of excavation required on each property and the appropriate construction measures that need to be employed to ensure the structural integrity of each home or residential unit. The details of the excavation and arrangements for temporary relocation will be discussed with the residents of each impacted home or residential unit prior to implementation. In the unlikely event that excavation cannot be performed on a particular property, EPA and VDWM will reevaluate the remedial options available at that time.
(b) Several residents requested compensation for possible health loss, including compensation for mental agony and stress.

Response: CERCLA does not provide for the inclusion of compensation for possible health loss, including compensation for mental agony and stress, in the cost of remedial actions at Superfund sites. EPA and VDWM understand that residents may have experienced mental agony and stress, and possibly other health effects, as a result of having to deal with the presence of lead contamination on their properties. However, compensation for such impacts can only be sought as a result of legal action brought by impacted residents against the responsible parties.

(c) Several homeowners expressed concern that the negative stigma of contamination in the area has left them with property they cannot sell.

Response: EPA and VDWM recognize that property associated with a Superfund site is likely to have a negative stigma and may be difficult to sell. These problems result from the fact that contaminated soil on these properties presents an unacceptable health risk to exposed residents. The remedy selected in the ROD (Alternative 4) requires removal of soil currently presenting an unacceptable risk to residents of these properties. Therefore, while restoration of property values is not an explicit objective of CERCLA or the NCP, this will likely be one of the benefits associated with implementation of the remedy.

(d) Several homeowners expressed concern that possible deed restrictions would limit what they or future owners can do on their properties without risking their health.

Response: Institutional controls, such as deed restrictions, would be required under several alternatives considered in the ROD, including Alternative 7, the remedy preferred by EPA and VDWM in the Proposed Plan. During the initial analysis of the alternatives, EPA and VDWM had not fully considered the implications of Alternative 7 in allowing contaminated soil between 500 and 5,000 mg/kg lead to remain below two feet. Upon further consideration, EPA and VDWM recognized that institutional controls would be required as part of this alternative to prevent direct exposure to contaminated soil below two feet by limiting activities that could reintroduce contamination to the surface. EPA and VDWM prefer not to impose such restrictions on residential properties unless no other feasible alternatives are present.
The selected remedy, Alternative 4, does not include any institutional controls. After implementation, the selected remedy will fully protect the health of residents and provide for unrestricted use of properties.

(e) A few homeowners expressed concern that they had been unable to secure home improvement loans because of the contamination on their properties.

Response: EPA and VDWM recognize that the presence of contaminated soil on residential properties may impact the ability of lending institutions to provide funds for activities such as home improvements. The remedy selected in the ROD (Alternative 4) will eliminate the presence of unacceptable levels of contamination in the soil of impacted properties within GUI.

IV. Proposed Cleanup Activities

LEAD CLEANUP LEVELS

(a) The Abex Corporation commented that VDWM failed to justify its classification of soils or wastes with concentrations of lead above 5,000 mg/kg as constituting a "principal threat". The Abex Corporation also asserted that VDWM misused the principal threat determination during the criteria evaluation process.

Response: The preamble to the NCP [40 C.F.R. § 300.430(a)(1)(iii)] states EPA's preference for treatment in addressing principal threats posed by a site wherever practicable. The NCP further states that principal threats are characterized as waste that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure). EPA and VDWM determined that the waste at the Abex Site could not be reliably controlled in place without significantly restricting future use of residential properties in the Effingham residential area, in the Seventh Street row homes, and the Washington Park Housing Project. Restrictions on future use would also be required in commercial and light industrial areas including the Holland Property, the Abex Lot, the McCready Lot, the drug rehabilitation center property, and the vacant lots east of Seventh Street. If only soil with lead concentrations exceeding 500 mg/kg in the surface soil (0 - 12" in depth) would be excavated, as proposed in Alternative 2, institutional controls that prevent any activity that
disturbs soil below twelve inches would be required on all properties with subsurface contamination above 500 mg/kg lead. These restrictions would be necessary to reliably control the contamination in place and ensure that lead levels above 500 mg/kg are not reintroduced into the surface soil.

At the time the Proposed Plan was issued, EPA and VDWM were balancing several factors in determining a preferred remedial alternative. EPA and VDWM considered the need to provide protection of human health over the long-term, the potential disruption to the community resulting from extensive excavation, and the limitations of institutional controls. In an effort to achieve a balance among these factors, EPA and VDWM defined soil or wastes with concentrations of lead above 5,000 mg/kg as a principal threat and used this concept in the development of Alternative 7. By requiring excavation of these highly contaminated soils, EPA and VDWM believed that the need for institutional controls could be significantly reduced. Upon further consideration, however, EPA and VDWM have determined that institutional controls, similar to those discussed above for Alternative 2, would be required to reliably control contamination between 500 and 5,000 mg/kg lead that would be left in place below two feet under Alternative 7. Therefore, after evaluating the alternatives against the nine criteria used for selecting remedies, EPA, in consultation with VDWM, selected Alternative 4 as the remedy for OU1. EPA and VDWM maintain that highly contaminated soils at the Site can be considered a principal threat.

(b) The Abex Corporation commented that there is no documentation in the record supporting the use of 500 mg/kg as a cleanup level in non-residential areas. The Abex Corporation further commented that the Abex Lot and the Holland Property have been designated for industrial/light commercial use for the last one hundred years and are unlikely to be redesignated as residential in the foreseeable future.

Response: Several alternatives presented in the Proposed Plan require excavation of contaminated surface and subsurface soil in non-residential areas. Non-residential areas of the Site, which include the Holland Property, the Abex Lot, the McCready Lot, the drug rehabilitation center property, and the vacant lots, are immediately adjacent to and, in some cases, readily accessible to individuals living in the residential areas. Therefore, EPA and VDWM have determined that it is appropriate to apply the residential cleanup standard of 500 mg/kg to surface soil in these areas. The final remedy selected in the ROD continues to
require excavation of surface soil (0 - 12" in depth) that exceeds the cleanup level of 500 mg/kg lead in areas within OU1 that are zoned as commercial or light industrial for the same reason.

EPA and VDWM agree with the Abex Corporation that the cleanup level of 500 mg/kg is not appropriate for subsurface soil of areas in OU1 zoned as commercial or light industrial. Nearby residents are not expected to be exposed to subsurface soil (> 12" in depth) in the non-residential areas to the same extent that they would be exposed in the residential areas. The final remedy requires excavation of subsurface soil to the depth of the water table if lead concentrations exceed 1,000 mg/kg. This is consistent with cleanup levels used at other Superfund Sites (e.g., the C & R Battery Site in Chesterfield County, VA) for non-residential land use.

(c) The Abex Corporation commented that there is no basis in the Administrative Record for concluding that lead above 500 mg/kg or greater than one foot in depth constitutes a threat to human health or the environment. The Abex Corporation further commented that excavating all lead-contaminated soil in excess of 500 mg/kg to the water table is not significantly more protective of human health and the environment than excavating to two feet.

Response: The Proposed Plan, which is part of the Administrative Record, stated the basis for concern regarding contaminated subsurface soil in the discussion of overall protection of human health and the environment (See Evaluation of Alternatives in Proposed Plan). EPA and VDWM, as well as many residents in the impacted area, are concerned that exposure to subsurface soil (> 12" in depth) that exceeds 500 mg/kg lead will occur either directly through routine activities such as gardening, children playing, and typical backyard construction or by exposure to surface soil recontaminated by future construction and/or earth-moving activities. The Abex Corporation asserts that only soil within one foot in depth is likely to be exposed to the surface at any time in the future. EPA and VDWM disagree with this assertion and contend that it is reasonable to assume that soil below one foot is likely to be exposed to the surface in significant quantities at some point in the future. The Abex Corporation further asserts that it is standard practice to segregate excavated topsoil and deeper soil in a manner which would prevent permanent placement of excavated deeper soil on the surface. However, the Abex Corporation does not present, and EPA and VDWM are not aware of, any mechanism for assuring that this practice is followed.
EPA and VDWM are unaware of any research or models that can be used as a basis for estimating the potential future exposure of residents to subsurface soil contamination. Since future activities in the OU1 area could reasonably result in either direct exposure to contaminated subsurface soil or exposure to contaminated soil reintroduced to the surface, EPA and VDWM believe surface and subsurface soil are of equal concern. Since this ROD identifies the final remedial action for contaminated soil in OU1, EPA and VDWM believe a conservative approach to determining the extent of cleanup is appropriate.

(d) The Abex Corporation commented that the memo from Candace J. Wingfield, Regional Coordinator of the CERCLA Enforcement Branch, OWPE (EPA, Washington, D.C.) stated that "redistribution of soils to the surface could result in a direct contact threat." However, the soil at the Site does not pose "a direct contact threat" since dermal absorption of lead is minuscule.

Response: While not explicitly stated, the memo of concern assumed incidental ingestion of soil to constitute part of a direct contact threat at the Site.

(e) The Abex Corporation commented that there is no basis in the Administrative Record for establishing the elimination of inhalation of dust which exceeds 500 mg/kg lead as a primary objective of the remedial action.

Response: EPA and VDWM agree that incidental soil ingestion is the primary exposure pathway of concern with regard to lead. Dust inhalation may be considered a secondary pathway relative to incidental ingestion.

(f) The Abex Corporation commented that through deed restrictions, permitting, or licensing, exposure of deeper contaminated soils to the surface could be controlled.

Response: As discussed in Section VIII (Summary of Comparative Analysis of Alternatives) in the ROD, Alternatives 2, 5, 6, and 7 would require institutional controls to be fully protective of human health and the environment. Of these alternatives, Alternative 2 and 7 would rely most heavily on the use of institutional controls. For Alternative 2, all properties with subsurface soil (> 12" in depth) that exceeds 500 mg/kg in residential areas and 1,000 mg/kg in non-residential areas would require restrictions to limit activities that may occur below the one-foot depth. In terms of the residential areas, most of
the privately-owned homes in the Effingham residential area, several of the units in the Washington Park Housing Project, and several of the Seventh Street row homes would be subject to these restrictions.

For Alternative 7, all properties with soil below two feet in depth that contains lead at 500 to 5,000 mg/kg in residential areas and at 1,000 to 5,000 mg/kg in non-residential areas would require restrictions to limit activities that may occur below the two-foot depth. Again, most of the privately-owned homes in the Effingham residential area, several of the units in the Washington Park Housing Project, and several of the Seventh Street row homes would be subject to these restrictions. While restrictions would probably be required on fewer properties under Alternative 7 than under Alternative 2, and the restrictions on property use would be less severe, EPA and VDWM would prefer not to impose such restrictions on residential properties in either case unless no other feasible alternatives were present.

The institutional controls required under Alternatives 5 and 6 are limited to restrictions needed to ensure capped areas on the Holland Property, the Abex Lot, and the McCready Lot are permanently maintained. EPA and VDWM consider these institutional controls to be implementable, although not preferable to removing the contamination.

The Abex Corporation commented that the cleanup concentration of 500 mg/kg lead should be strictly interpreted as an average over an area in which an individual might spend a large fraction of their time.

Response: The results of the UBK Model in the risk assessment for the Site discuss exposure of children to average concentrations of lead in soil. The model predicts that approximately 95 percent of the children exposed to soil/dust with an average lead concentration of 400 mg/kg would have blood lead levels below 10 µg/dL, the blood lead level established as safe by the Center for Disease Control. EPA has established the lead cleanup level at this Site for surface and subsurface soil in residential areas and surface soil in non-residential areas as 500 mg/kg. The cleanup level for subsurface soil in non-residential areas is 1,000 mg/kg. These cleanup levels are the concentrations not to be exceeded at any given sampling location. By removing surface and subsurface soil contaminated above 500 mg/kg lead in the residential areas, EPA and VDWM expect the average lead concentration in the soil to be in the range of 100 to 300 mg/kg. This is below the average soil concentration of 400 mg/kg, which the UBK Model estimates as
the acceptable level for children. Methods for determining that the cleanup goals have been reached will be finalized during the Remedial Design by EPA and VDWM based on EPA 230/02-89-042, Methods for Evaluating the Attainment of Cleanup Standards, Vol. 1.

EXCAVATION IN RESIDENTIAL AREAS

(h) Several homeowners expressed concern that excavation of contaminated soils around and beneath their homes could leave them structurally unsound.

Response: EPA has determined that construction techniques are available to allow for the safe excavation of contaminated soils around and under the homes and residential units. Additional geotechnical investigations will be required during the Remedial Design to determine the appropriate measures to be used at each impacted residence. Examples of generic construction options that will be considered are given in response to Question III(m), later in this Responsiveness Summary. The engineering details of the measures required during excavation will be included in the final plans and specifications for the remedial action. The final design will be incorporated into the Remedial Action Work Plan and the associated Health and Safety Plan prior to initiation of construction. These plans are subject to approval/acceptance by EPA and VDWM and will be made available to the public as part of the Administrative Record. Planned construction activity and arrangements for temporary relocation will be discussed with impacted residents prior to implementation. In the unlikely event that information obtained during the Remedial Design indicates that necessary excavation around or beneath a residence cannot be performed safely, EPA and VDWM will reevaluate remedial options available at that time.

(i) Several residents questioned how contamination in crawl spaces or otherwise found beneath their houses would be addressed.

Response: EPA collected samples of soil within crawl spaces of sixteen homes in the Effingham residential area in response to concerns raised by residents. Lead concentrations that exceeded 500 mg/kg were detected in eleven of these homes. These results confirm that contamination extends below homes as was assumed in the FS report based on soil sampling results available at the time. The selected remedy requires excavation of surface and subsurface soil in residential areas exceeding 500 mg/kg lead, including excavation of contaminated soil adjacent to
and beneath homes and residential units. The methods to be used for excavation will be determined during the Remedial Design following additional sampling to determine the full extent of contamination and geotechnical investigations to determine appropriate construction measures to be employed to ensure the structural integrity of the each residence. Several generic construction options are presented in response to Question III(m), later in the Responsiveness Summary. Excavation of contaminated soil beneath residences is expected to be performed using conventional earth-moving equipment or vacuum extraction techniques. The ROD requires that temporary relocation be provided for residents while excavation is occurring around and/or beneath their home or residential unit.

(j) Several residents expressed concern that contaminated dust and soil inside their homes could be a problem, particularly with the extensive excavation planned. Sampling and inspection of the inside of homes was requested.

Response: The selected remedy requires sampling of the interior of homes before, during, and after implementation of the remedial action to ensure that dust suppression measures have been effective. The details of dust suppression, air monitoring, and home sampling activities to be performed as part of the remedy will be included in the Remedial Action Work Plan and associated Health and Safety Plan. If results from samples collected from the interior of homes before, during, or after the remedial action indicate the presence of an unacceptable health risk, EPA and VDWM will take the action necessary to reduce this risk to acceptable levels.

(k) Many residents expressed concern that the proposed cleanup would not be a permanent solution to the problem. Some residents were opposed to leaving elevated lead levels in place at depths over two feet as recommended in the Proposed Plan preferred Alternative 7 because there would be no assurance that unacceptable levels of lead would not reoccur near the surface. Other residents requested that they be given a written guarantee that all lead would be removed and/or that it was safe to live in their homes.

Response: EPA and VDWM agree that Alternative 7, the preferred remedy in the Proposed Plan, would not be effective in the long term unless institutional controls (e.g., deed restrictions) were imposed on properties with soil contamination exceeding 500 mg/kg below two feet in depth. These controls would be needed to prevent residents from being exposed to contaminated soil below two feet and
to ensure that activities do not occur that would reintroduce contaminated soil to the surface. Alternative 4, the remedy selected in the ROD, requires the excavation of surface and subsurface soil in residential areas of OU1 with lead levels exceeding 500 mg/kg to the depth of the water table (approximately three to six feet). By removing surface and subsurface soil contaminated above 500 mg/kg lead in the residential areas, EPA and VDWM expect the average lead concentration in the soil to be in the range of 100 to 300 mg/kg. This is below the average soil concentration of 400 mg/kg, which the UBK Model estimates as the acceptable level for children. Confirmatory sampling will be performed after excavation is performed to ensure acceptable levels have been achieved.

(1) One resident questioned how her property could be contaminated when she had covered her property with four feet of topsoil from outside the area. She expressed concern that lead contamination in the deeper soils had seeped up into the clean soils. Several residents with similar concerns recommended using concrete to provide a barrier between clean and contaminated areas. A specific alternative was proposed calling for placement of a 6-10" layer of concrete below two feet of clean soil.

Response: Topsoil obtained from outside sources may have been contaminated with lead carried by stormwater or by wind from nearby contaminated surface soils (e.g. the Abex Lot prior to capping). In addition, topsoil may have been mixed with contaminated soil during placement or the topsoil may have had elevated lead levels prior to placement in the area of concern. As discussed previously, an evaluation of available soil sampling data does not indicate that lead contamination from deeper soils has "seeped up" into overlying clean soils. While the water table does rise and fall according to season and during major rain events, this water table movement is not expected to deposit significant levels of lead in soils in an upward direction. Sampling has confirmed that within residential areas there is generally a layer of soil above the water table where lead is well below health-based levels. Available information (including historical aerial photographs) indicates that contamination in deeper soils is likely to be the result of placement of lead-laden waste sand from the former foundry operation. Since contaminant migration from deeper soils to surface soils is not considered likely, placement of a containment layer of concrete as proposed is unnecessary. Furthermore, a layer of concrete at the proposed depth in these circumstances is not recommended since it would interfere with natural surface and ground water distribution and flow and would be difficult to maintain.
The Abex Corporation commented that the Proposed Plan failed to define the required depth of excavation. The Abex Corporation further commented through an affidavit from their contractor, GEO Engineering, Inc., that excavation to the water table could pose significant risks to structures.

Response: To clarify, the remedy selected in the ROD requires excavation of subsurface soil (> 12" in depth) to the depth of the water table in both residential areas where lead concentrations exceed 500 mg/kg and in non-residential areas where lead concentrations exceed 1000 mg/kg. The ROD further requires that, to the extent practicable, excavation occur during the period when the water table is at a seasonally low elevation.

EPA and VDWM generally agree with the assertion in the Geo Engineering affidavit that excavating soil around and beneath homes, without taking any precautionary measures, would likely result in structural damage and that specific investigations near each structure will be required to reduce these risks. As part of the selected remedy, geotechnical investigations will be required as part of the Remedial Design to determine appropriate construction techniques to be used to maintain the structural integrity of each home or residential unit requiring excavation. Generic construction options that will be considered include, but are not limited to:

1. **Sloping the Excavation Away from the Foundations** - If the soil strength beneath the house is adequate to withstand excavation (as determined by a geotechnical engineer) and if the contamination next to the house is not extensive, a potential option includes removing soil down to the base of the foundation footing and then sloping the excavation away from the footing on a 1:1 angle.

2. **Underpinning the Foundations** - If the soil conditions are adequate to withstand excavation (as determined by a geotechnical engineer) and if contamination is present below the base of the footing, a potential option includes excavating the soil to the required depth in small sections from beneath the footing, filling the void beneath the footing with concrete, and repeating the process in the next section after the concrete has achieved adequate strength.

3. **Deep Foundations** - If the soil conditions beneath the foundation are inadequate to withstand excavation (as determined by a geotechnical engineer) or if extensive contamination is present around and beneath the impacted residence, a potential option includes driving
or drilling piles or caissons to a depth with adequate bearing (possibly 20 feet or more) at appropriate intervals around the footing and connecting the piles or caissons to the footing to transfer support of the foundations to the deeper soil.

The Abex Corporation commented that VDWM failed to take into account the potential effects of the proposed remedy, particularly with regard to the impacts of the extensive excavation that would be necessary, as compared with the effects of alternative remedies. The Abex Corporation further commented that Alternatives 3 and 4 will cause a significant disruption of the daily routine of residents.

Response: EPA and VDWM have carefully considered the short-term effects associated with the selected remedy, Alternative 4. All of the alternatives considered, with the exception of Alternative 1 (No Action), would require earth-moving operations and the use of heavy equipment. EPA and VDWM agree that the extent of earth-moving activity associated with Alternative 4 is greater than that associated with all the other alternatives except Alternative 3, which requires the same level of excavation. EPA and VDWM do not agree with the Abex Corporation's assertion that the short-term effects of implementing Alternative 4 are greater than the risks to human health and the environment associated with this Site.

Measures will be taken during implementation of the remedy to ensure that the local community is protected from exposure to contamination. The generation of dust during earth-moving activities will be controlled through the use of dust suppression measures. Air monitoring and sampling of the interior of homes before, during, and after remedial activities will be performed to ensure planned dust control measures have been effective. The details of the measures to be employed will be detailed in the Remedial Action Work Plan and associated Site Health and Safety Plan. These plans must be approved/accepted by EPA and VDWM prior to initiation of construction. Approved plans will be made available to the public as part of the Administrative Record for the Site.

EPA and VDWM agree that extensive excavation may be required around and, in some cases, beneath the homes in the Effingham residential area and several residential units in the Washington Park Housing Project. The selected remedy requires that temporary relocation be provided to residents while excavation is occurring around and/or beneath their individual home or residential unit. During the Remedial Design, additional soil sampling and geotechnical
investigations will be required at each impacted residence to determine the full extent of excavation that will be required. The details of the excavation and arrangements for temporary relocation will be discussed with residents of each home or residential unit prior to implementation.

(o) Several residents expressed concern that the measures included in the health and safety plan for the removal action to guard against air and water-borne releases of contamination were not effective.

Response: EPA and VDWM recognize that residents were not satisfied with several aspects of the 1992 removal action. While EPA and VDWM do not believe that unacceptable releases of contaminants occurred during performance of that removal action, the concerns of local residents will be taken into consideration during the design of the remedial action.

(p) Several residents questioned whether the selected remedy would require removal of lead-contaminated soil from areas within OU1 which were not sampled during the RI/FS. Residents also questioned how they would be assured that sampling will be adequate to detect all elevated lead in the soils within areas addressed by the ROD.

Response: The sampling performed during the RI/FS was based on a 100' by 100' grid system. This sampling was designed to provide a representative analysis of the extent of contamination at the Site. The RI/FS sampling was not intended to be the final basis for actual excavation during remedial action. Additional sampling of impacted areas will be performed during the Remedial Design to determine the full extent of contamination. The details of the sampling to be performed will be included as part of the Remedial Design Work Plan which will be approved by EPA and VDWM. In the same regard, confirmation sampling will be performed after the remedial action to ensure that the average concentrations of lead in the impacted areas are within the cleanup goals. The details of this confirmatory sampling will be based on EPA 230/02-89-042, Methods for Evaluating the Attainment of Cleanup Standards, Vol. I, and included in the final design for the remedial action.

SOIL TREATMENT AND DISPOSAL

(q) Several residents commented that treatment should be conducted offsite to eliminate the possibility of unacceptable lead exposure during remedial work.
Responses: EPA and VDWM carefully considered the advantages and disadvantages associated with onsite and offsite treatment and determined that onsite treatment can be performed in a manner which is fully protective of human health at a cost savings of approximately $12.5 million. Offsite treatment would eliminate possible exposure of local residents to any unlikely air or water-borne releases of contamination associated with treatment. However, onsite control measures can be readily implemented to achieve a similar level of protection to local residents. Excavated soil will be staged in areas of existing contamination, to the extent practicable, preferably on the Abex Lot, the McCready Lot, or the Holland Property. Surface water runoff from stockpile areas will be controlled by measures such as berms to prevent any release of contamination. Stockpiled soil will be covered to prevent air-borne releases of contamination and fenced to prevent trespassing. The onsite treatment unit will be housed in a temporary structure to minimize exposure to the elements and opportunity for air or water-borne releases. The area containing the treatment unit will be bermed and secured with fencing in the same manner as the stockpiled soil areas. Areas where treated soil will be staged will employ similar measures to ensure releases do not occur. The details of the control measures to be employed will be included in the final design plans and specifications and subject to approval of EPA and VDWM. The final design will be incorporated into the Remedial Action Work Plan and associated Health and Safety Plan prior to initiation of construction. These plans are subject to EPA and VDWM approval/acceptance and will be made available to the public as part of the Administrative Record.

HOLLAND PROPERTY BUILDINGS

Several residents commented that the buildings associated with the former foundry operation present a safety threat due to their dilapidated condition and would collapse if decontamination was performed as recommended in the Proposed Plan. Residents requested that these buildings be demolished. In addition, residents expressed concern that the foundry is not secured and is readily accessible to trespassers, including children, who may be exposed to the high levels of lead that exist in the buildings.

Response: EPA and VDWM have further reviewed the condition of the former foundry building and associated structures on the Holland Property and agree that these structures should be demolished. The selected remedy requires demolition of the former foundry buildings and offsite disposal of the construction debris in an approved RCRA landfill. Abex has secured the Holland Property to restrict access to the
former foundry buildings by reinforcing fences, gates, and doors.

CLEANUP OF THE ABEX LOT

\( s \) The Abex Corporation commented that the Abex Lot is not contributing to unacceptable levels of lead in the underlying aquifer and that ground water contamination should not be a basis for rejecting a remedy of capping and institutional controls for the Abex Lot.

Response: During the RI, levels of 24 and 31 ug/l of dissolved lead were detected during two separate sampling events in a monitoring well (MW-1) located in the surficial aquifer beneath the Abex Lot. Four monitoring wells were installed in the surficial aquifer at the Site to a depth of approximately fourteen feet. Ground water was encountered at depths of three to six feet below the surface. This surficial aquifer is designated a Class III aquifer under the Safe Drinking Water Act because of its saline content and is not considered drinkable. EPA's recommended cleanup level for lead in ground water usable for drinking water is 15 ug/l. Since, as the Proposed Plan stated, the surface aquifer is not utilized for drinking water purposes, EPA is not recommending ground water remediation as part of the OU1 cleanup. EPA is recommending further investigation of the ground water as part of OU2 to more fully characterize the nature of the surficial aquifer and its relationship to both underlying aquifers and the Elizabeth River. Although not presently used in the vicinity of the Site, the deeper confined aquifer is a potential source for drinking water and is, therefore, of concern. Data from the OU1 RI clearly indicates that lead from the Abex Lot has migrated into the surficial aquifer. EPA and VDWM do not consider capping the Abex Lot to be an effective remedy over the long term.

\( t \) The Abex Corporation commented that the surface aquifer underlying Abex is not hydraulically connected to other aquifers and that this should not be a basis for rejecting a remedy of capping and institutional controls for the Abex Lot.

Response: EPA and VDWM have reviewed the RI technical data in the Administrative Record and determined that a conclusion concerning the hydraulic connection between the surficial and underlying aquifers cannot be drawn at this time. EPA and VDWM are recommending that additional information be collected as part of the OU2 RI to confirm whether there is a hydraulic connection between the
surficial aquifer and potable aquifers and/or the Elizabeth River, and (2) determine whether the underlying potable aquifer(s) or the Elizabeth River has elevated lead levels due to the Site or could potentially be impacted by the Site in the future.

V. Future Site Investigation and Remedial Action

(a) Several residents questioned how elevated lead in soil outside of areas targeted by the Proposed Plan would be addressed. The City of Portsmouth further commented that the OU1 remedy should be expanded to include additional lead-contaminated soils located in the vacant lots east of Seventh Street.

Response: The RI/FS for OU1 focused primarily on areas within a 700-foot radius of the former foundry facility. The study area was expanded in the southwest direction to include the entire two blocks of privately-owned homes south of the Effingham Playground. In addition, some additional sampling was performed in the vacant lots east of Seventh Street. The remedial action selected in the ROD will address contaminated soil identified during the OU1 RI/FS. Due to the extent of contamination identified within OU1, EPA and VDWH are recommending that additional RI/FS work be performed, as part of OU2, in areas beyond the 700-foot radius. If additional areas of lead contamination are identified and determined to be associated with the former foundry operation, additional remedial action will be taken.

(b) Several residents questioned whether there would be any additional Superfund actions addressing the Site after implementation of removal work and the remedy selected in this ROD are completed.

Response: The ROD identifies the final remedial action required to address contaminated soil within OU1. Therefore, no further cleanup action should be required to remediate contaminated soil within OU1 upon completion of the selected remedy. EPA and VDWH are recommending that OU2 RI/FS activities for the Site include: (1) identification of potential soil contamination beyond the OU1 700-foot study radius that may be related to the former foundry operation, (2) full characterization of groundwater at the Site, including an analysis of the hydraulic connection between the surficial and deep aquifers and the Elizabeth River, and (3) an evaluation the ecological impacts of the Site to potential receptors beyond OU1, particularly with regard to the surface water and sediment pathways extending to the...
Elizabeth River. Upon completion of the OU2 RI/FS activities, EPA and VDWM anticipate issuing a Proposed Plan and ROD for OU2 identifying any further remedial action that would be required for the Site.

VI. Enforcement-Related Issues

(a) The Abex Corporation commented that the Proposed Plan failed to include a definition of "Site-related" lead. Without this definition, the Abex Corporation asserts that it is likely that the company will be required to excavate lead-contaminated soil that is unrelated to the former foundry activities and then, by necessity, be forced to submit a claim to the Fund for compensation. The City of Portsmouth commented that the "fingerprint" (canonical) analysis included in the RI/FS report by Abex may have drawn incorrect conclusions regarding the source of lead at particular locations.

Response: The 700-foot radius study area for the OU1 RI was determined primarily through an interpretation of aerial photographs that depicted areas likely to have been impacted by activities associated with the Abex foundry operation. During the RI, the Abex Corporation conducted a statistical analysis of the soil data (see Appendix J of the RI report) in an effort to determine if the lead present was related to the former foundry operation or other possible sources including lead-based paint from homes, demolition fill and debris, sand blasting, and auto emissions. Through this analysis, Abex concluded that many points of lead contamination within the OU1 study area are not attributable to the foundry. EPA evaluated this analysis and concluded that additional work would be required to identify the sources of lead contamination with certainty. EPA and VDWM consider the issue of the source of lead contamination to be more significant as it relates to OU2 and recommend additional analysis be performed as part of the subsequent RI activity. Since the areas being addressed in OU1 are within approximately 700 feet of the former foundry operations and aerial photographs show evidence of foundry-related activity (See response the Question VI(b), below), EPA and VDWM believe it is reasonable to assume that the foundry contributed, either through disposal of waste sand or through air deposition, to lead contamination found in these areas. The reference to "Site-related" lead has been eliminated in the ROD.

(b) The Abex Corporation commented that the analysis of foundry operations indicates that foundry sand disposal occurred...
only on the Abex Lot north of Brighton Street. The Abex Corporation further asserts that aerial photographs depict structures to the east of the foundry until the mid-1970s and to the west and south of the foundry which would eliminate the possibility of foundry sand deposition in these areas.

Response: An evaluation of aerial photographs by the EPA Environmental Photographic Interpretation Center (EPIC) indicates potential foundry-related activities and/or foundry waste handling activities associated with Abex in the following areas:

1. An area north of the "Abex Lot" (currently part of Washington Park) (See aerial photograph dated 4/9/49 and 10/11/54)

2. An area west of the "Abex Lot" (currently part of Washington Park) (See aerial photograph dated 4/9/49 and 10/11/54)

3. An area west of the former Abex Foundry (currently the Effingham Playground) (See aerial photograph dated 9/4/37, 4/9/49, 10/11/54 and 10/26/64)

4. An area currently bounded by Effingham Playground and Effingham, Henry and Green Streets (part of Effingham residential area) (See aerial photographs dated 4/9/49, 10/11/54 and 10/26/64)

5. An area currently bounded by Effingham, Lincoln, Green and Henry Streets (also part of the Effingham residential area) (See aerial photograph dated 4/9/49)

6. An area south of the former Abex foundry facility property (currently occupied by Randolph Street and the drug rehabilitation center) (See aerial photographs dated 4/9/49 and 10/11/54)

In addition to the above, fill material was placed within an area immediately east of the former foundry sometime between 9/4/37 and 4/9/49. In the case of all areas referenced above, including the fill area east of the Site, Abex has concluded that at least part of the lead detected is attributable to their facility (See RI report).

(c) The Abex Corporation commented that aerial photographs and discussion with local residents suggest the presence of rail tracks running west from the southwest corner of the former foundry and following a route now occupied by Randolph Street. The Abex Corporation discussion with former
residents revealed that "slag piles" existed near the bed of the former railway that serviced the foundry.

Response: Aerial photographs in the EPIC report discussed in the previous response indicate that railroad tracks did at one time extend into the Abex facility. These tracks appear to be present from at least 9/4/37 to 10/26/64. The aerial photograph of 10/26/64 appears to indicate a railroad car within the Abex facility property. Ground stains (See 4/9/49 aerial photograph), ground scars (See 10/11/54 aerial photograph), stacked material (See 10/11/54 aerial photograph), and mounded material (See 10/26/64 aerial photograph) all appeared adjacent to apparent former railroad tracks after 9/4/37 and are likely to be associated with the Abex foundry and/or the railway, which apparently was providing service for Abex.

(d) The Abex Corporation commented that EPA and VDWM failed to give adequate notice of the basis of their decision to select a new preferred remedial alternative.

Response: The remedy selected in this ROD was identified as one of the remedial alternatives in the Proposed Plan issued on May 28, 1992 (with one modification changing the lead cleanup level for subsurface soil in non-residential areas from 500 mg/kg to 1,000 mg/kg), and was also identified as a remedial alternative in the Feasibility Study prepared by Abex. The Proposed Plan specifically stated that "VDWM and EPA encourage the public and interested parties to review and comment on the preferred alternative, other alternatives considered in the Proposed Plan, and other documents comprising the Administrative Record for the Site". Furthermore, the Proposed Plan stated that "VDWM and the EPA may modify the preferred proposed alternative or select another alternative presented in this Proposed Plan or select remedial action is documented in this ROD and based on the Administrative Record, which includes comments received during the public comment period and new information obtained during the comment period.

(e) The Abex Corporation commented that EPA and VDWM disregarded the recommended remedial alternative provided for in the RI/FS prepared by Pneumo Abex Corporation for the Abex Corporation Site.
ABEX CORPORATION
ADMINISTRATIVE RECORD FILE * **
INDEX OF DOCUMENTS

I. SITE IDENTIFICATION


* Administrative Record File available 4/28/92, updated 9/10/92 and 9/28/92.

** For additional information concerning the Abex Site, please refer to the Abex Removal Administrative Record located in the U.S. EPA Region III Office in Philadelphia, PA.
III. REMEDIAL RESPONSE PLANNING


5. Letter to Mr. Darius Ostrauskas, U.S. EPA, from Mr. Stephen Mihalco, Virginia Department of Waste Management (VDWM), re: Response to request for additional information from the meeting of January 9, 1992 with Abex, 1/22/92. P. 300531-300567. A memorandum regarding soil ingestion valves and the Biokinetic Uptake Model, an article entitled, "Development of a Model to Estimate the Soil Ingestion Detection Level of Soil Ingestion Studies," and an article entitled, "Qualitative and Quantitative Evidence of Soil Ingestion," are attached.


20. Memorandum to file from Mr. Darius Ostrauskas, U.S. EPA, re: Proposed Plan for Abex Site, 4/27/92. P. 303212-303215. Attachment 1, Vacant Lots (approximate location), Attachment 2, Effingham Residences, and Attachment 3, Drug Rehabilitation Center/Shopping Center Area, are attached.


27. Composite soil samples taken from the crawl space of residents' houses, prepared by Wayne Analytical & Environmental Services, Inc., 6/29/92. P. 303292-303293.

29. Letter to Mr. Ron Davis, U.S. EPA, from Mr. Mark diFeliciantonio, CDM Federal Programs Corporation, re: Revised geotechnical recommendations letter, 9/14/92. P. 303336-303350. The following are attached:

   a) a letter regarding geotechnical recommendations;

   b) Figure 1, Option #1: Sloped Excavation;

   c) Figure 2, Option #2: Concrete Underpinning;

   d) Figure 3, Option #2: Concrete Underpinning;

   e) Figure 4, Option #3: Pier Supports;

   f) Figure 5, Option #3: A.B. Chance Auger Foundation System.

IV. REMOVAL RESPONSE PROJECTS


V. COMMUNITY INVOLVEMENT/CONGRESSIONAL CORRESPONDENCE/IMAGERY


2. Transcript of public meeting, Abex Superfund Site, 5/7/92. P. 500032-500136.


4. Handwritten letter to Abex Superfund, U.S. EPA, and all other waste agencies [sic], from Mr. Allen E. Dillard [sic], re: Request for relocation and compensation funding due to lead concentrations is yard, 5/28/92. P. 500312-500312.

5. Handwritten letter from Mr. & Mrs. Ernest & Regina Hinton, re: Disagreement with method of cleanup and request that their home be bought, 5/28/92. P. 500313-500313.


10. Letter to Ms. Jamie Walters, VDWM, from Mr. Tyrone Riddick, re: Disappointment with EPA and VDWM's handling of the situation and other areas of concern, 6/6/92. P. 500321-500323.


13. Letter to Ms. Ann Troutman, VDWM, from Mr. & Mrs. Ernest Hinton, Sr., re: Frustrations with the city's actions towards the community, 6/16/92. P. 500417-500417.


18. Newspaper article entitled "Residents want to relocate out of contaminated area," The Virginian-Pilot, 6/26/92. P. 500431-500431.


22. Letter to Ms. Jamie Walters, VDWM, from Mr. Martin V. Williams and Ms. Clara Williams, re: Concerns over lead contamination and request for relocation and monetary compensation, 7/3/92. P. 500441-500442.


24. Letter to Ms. Jamie Walters and Mr. Stephen Mihalko, and Ms. Leanne S. Nurse, U.S. EPA, from Ms. Carolyn Cotton, re: Concerns over the Abex Superfund Site, 7/6/92. P. 500446-500451. Figure 2, Abex Superfund Site, and an envelope are attached.


BIBLIOGRAPHY OF SITE SPECIFIC GUIDANCE DOCUMENTS

1. Regulating Status of Soil Contaminated with Toluene, prepared by David Friedman, 4/5/85. 9445.01(85)

2. RCRA Regulatory Status of Contaminated Ground Water, prepared by OSWER, 11/13/86.

3. Determining When Land Disposal Restrictions (LDR's) Are Applicable to CERCLA Response Actions, prepared by OSWER, 7/89. OSWER 9347.3-05FS

4. Implementing The Land Disposal Restrictions, Question and Answer Document, prepared by OSWER, 10/89.

5. CERCLA Compliance with Other Laws Manual, RCRA ARARs: Focus on Closure Requirements, prepared by OSWER, 10/89. OSWER 9234.2-04FS

6. Replacement of Contaminated Soil and Debris Treated Under a Treatability Variance, prepared by OSWER, 10/9/90.

7. EPA's Contained-In Policy, Background Information, prepared by U.S. EPA, 2/5/92.
GLOSSARY

of Superfund Terms

This glossary defines terms often used by the U.S. Environmental Protection Agency (EPA) staff when describing activities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly called Superfund), as amended in 1986. The definitions apply specifically to the Superfund program and may have other meanings when used in different circumstances. Underlined words included in various definitions are defined separately in the glossary.

Administrative Order on Consent (AOC): A legal agreement between EPA and potentially responsible parties (PRPs) whereby PRPs agree to perform or pay the cost of a site cleanup. The agreement describes actions to be taken at a site and may be subject to a public comment period. Unlike a consent decree, an administrative order on consent does not have to be approved by a judge.

Administrative Record: A file which is maintained and contains all information used by the lead agency to make its decision on the selection of a response action under CERCLA. This file is to be available for public review and a copy is to be established at or near the site, usually at one of the information repositories. Also, a duplicate file is held in a central location, such as a Regional or State office.

Aquifer: An underground rock formation composed of materials such as sand, soil, or gravel that can store and supply groundwater to wells and springs. Most aquifers used in the United States are within a thousand feet of the earth's surface.

Carcinogen: A substance that causes cancer.

Cleanup: Actions taken to deal with a release or threatened release of hazardous substances that could affect public health and/or the environment. The term "cleanup" is often used broadly to describe various response actions or phases of remedial responses such as the remedial investigation/feasibility study.

Comment Period: A time period during which the public can review and comment on various documents and EPA actions. For example, a comment period is provided when EPA proposes to add sites to the National Priorities List. Also, a minimum 3-week comment period is held to allow community members to review and comment on a draft EI/FS and proposed plan.

Community Relations (CR): EPA's program to inform and involve the public in the Superfund process and respond to community concerns.

Community Relations Plan (CRP): Formal Plan for EPA community
relations activities at a Superfund site.

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. The Acts created a special tax that goes into a Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, EPA can either:

- Pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work; or
- Take legal action to force parties responsible for site contamination to clean up the site or pay back the Federal government for the cost of the cleanup.

Consent Decree (CD): A legal document, approved and issued by a judge, that formalizes an agreement reached between EPA and potentially responsible parties (PRPs) where PRPs will perform all or part of a Superfund site cleanup. The consent decree describes actions that PRPs are required to perform and is subject to a public comment period.

Contract Lab Program: Laboratories under contract to EPA which analyze soil, water, and waste samples taken from areas at or near Superfund sites.

Cost-Effective Alternative: The cleanup alternative selected for a site on the National Priorities List based on technical feasibility, permanence, reliability, and cost. The selected alternative does not require EPA to choose the least expensive alternative. It requires that if there are several cleanup alternatives available that deal effectively with the problems at a site, EPA must choose the remedy on the basis of permanence, reliability, and cost.

Cost Recovery: A legal process where potentially responsible parties can be required to pay back the Federal government for money it spends on any cleanup actions.

Emergency: Those releases or threats of releases requiring initiation of on-site activity within hours of the lead agency's determination that a removal action is appropriate.

Enforcement: EPA's efforts, through legal action if necessary, to force potentially responsible parties to perform or pay for a Superfund site cleanup.

Engineering Evaluation/Cost Analysis (EE/CA): An analysis of removal alternatives for a site, similar to a remedial program feasibility study. The EE/CA must be made available for a 30 calendar day public comment period prior to the signing off of the Action Memorandum.

Environmental Response Team (ERT): EPA hazardous waste experts who provide 24-hour technical assistance to EPA Regional Offices and
States during all types of emergencies involving releases at hazardous waste sites and spills of hazardous substances.

Explanation of Differences: After adoption of a final remedial action plan, if any remedial action is taken, or any enforcement action under Section 106 is taken, or if any settlement or consent decree under Sections 106 or 122 is entered into, and if such action, settlement, or decree differs in any significant respects from the final plan, the lead agency is required to publish an explanation of the significant differences and the reasons the changes were made. See Guidance on Preparing Superfund Decision Documents: the Proposed Plan and Record of Decision for further information.

Feasibility Study (FS): See Remedial Investigation/Feasibility Study.

Ground Water: Water found beneath the earth’s surface that fills pores between materials such as sand, soil, or gravel. In aquifers ground water occurs in sufficient quantities that it can be used for drinking water, irrigation and other purposes.

Hazard Ranking System (HRS): A scoring system used to evaluate potential relative risks to public health and the environment from releases or threatened releases of hazardous substances. EPA and States use the HRS to calculate a site score, from 0 to 100, based on the actual or potential release of hazardous substances from a site through air, surface water, or ground water to affect people. This score is the primary factor used to decide if a hazardous waste site should be placed on the National Priorities List.

Hazardous Substance: Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.

Hydrology: The science dealing with the properties, movement, and effects of water on the earth’s surface, in the soil and rocks below, and in the atmosphere.

Information Repository: A file containing current information, technical reports, and reference documents regarding a Superfund site. The information repository is usually located in a public building that is convenient for local residents -- such as a public school, city hall, or library.

Monitoring Wells: Special wells drilled at specific locations on or off a hazardous waste site where ground water can be sampled at selected depths and studied to determine such things as the direction in which ground water flows and the types and amounts of contaminants present.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The Federal regulation that guides the Superfund program.

National Priorities List (NPL): EPA’s list of the most serious
uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial response using money from the Trust Fund. The list is based primarily on the score a site receives on the Hazard Ranking System (HRS). EPA is required to update the NPL at least once a year.

National Response Center (NRC): The center operated by the U.S. Coast Guard that receives and evaluates reports of oil and hazardous substance releases into the environment and notifies the appropriate agency(ies). The NRC can be contacted 24-hours a day, toll-free at (800) 424-8802.

National Response Team (NRT): Representatives of twelve Federal agencies that coordinate Federal responses to nationally significant pollution incidents and provide advice and technical assistance to the responding agency(ies).

Non-Time-Critical Removals: Those releases or threats of releases not requiring initiation of on-site activity within 6 months after the lead agency’s determination, based on the site evaluation, that a removal action is appropriate.

On-Scene Coordinator: The Federal official who coordinates and directs Superfund removal actions.

Operable Unit: An action taken as one part of an overall site cleanup. For example, a carbon adsorption system could be installed to halt rapidly spreading ground-water contaminants while a more comprehensive and long-term remedial investigation/feasibility study is underway. A number of operable units can be used in the course of a site cleanup.

Operation and Maintenance (O&M): Activities conducted at a site after a response action occurs, to ensure that the cleanup or containment system is functioning properly.

Potentially Responsible Party (PRP): An individual(s) or company(ies) (such as owners, operators, transporters, or generators) potentially responsible for, or contributing to, the contamination problems at a Superfund site. Whenevver possible, EPA requires PRPs, through administrative and legal actions, to clean up hazardous waste sites they have contaminated.

Preliminary Assessment: The process of collecting and reviewing available information about a known or suspected hazardous waste site or release. EPA or States use this information to determine if the site requires further study. If further study is needed, a site inspection is undertaken.

Proposed Plan: A public participation requirement of SARA in which EPA summarizes for the public the preferred cleanup strategy, the rationale for the preference, reviews the alternatives presented in the detailed analysis of the remedial investigation/feasibility study, and presents any waivers to cleanup standards of §121(d)(4) may be proposed. This may be prepared either as a fact sheet or as a separate document. In either case, it must actively solicit public
review and comment on all alternatives under Agency consideration.

Quality Assurance/Quality Control (QA/QC): A system of procedures, checks, audits, and corrective actions used to ensure that field work and laboratory analysis during the investigation and cleanup of Superfund sites meet established standards.

Record of Communication: A register of all verbal communications between EPA and citizens regarding site concerns.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will be used at National Priorities List sites. The record of decision is based on information and technical analysis generated during the remedial investigation/feasibility study and consideration of public comments and community concerns.

Regional Response Team (RRT): Representatives of Federal, State, and local agencies who may assist in coordination of activities at the request of the On-Scene Coordinator or Remedial Project Manager before and during response actions.

Remedial Action (RA): The actual construction or implementation phase that follows the remedial design of the selected cleanup alternative at a site on the National Priorities List.

Remedial Design (RD): An engineering phase that follows the record of decision when technical drawings and specifications are developed for the subsequent remedial action at a site on the National Priorities List.

Remedial Investigation/Feasibility Study: Investigative and analytical studies usually performed at the same time in an interactive, iterative process, and together referred to as the "RI/FS." They are intended to:

- Gather the data necessary to determine the type and extent of contamination at a Superfund site;
- Establish criteria for cleaning up the site;
- Identify and screen cleanup alternatives for remedial action; and
- Analyze in detail the technology and costs of the alternatives.

Remedial Project Manager (RPM): The EPA or State official responsible for overseeing remedial response activities.

Remedial Response: A long-term action that stops or substantially reduces a release or threatened release of hazardous substances that is serious, but does not pose an immediate threat to public health and/or the environment.
Removal Action: An immediate action taken over the short-term to address a release or threatened release of hazardous substances.

Resource Conservation and Recovery Act (RCRA): A Federal law that established a regulatory system to track hazardous substances from the time of generation to disposal. The law requires safe and secure procedures to be used in treating, transporting, storing, and disposing of hazardous substances. RCRA is designed to prevent new, uncontrolled hazardous waste sites.

Response Action: A CERCLA-authorized action at a Superfund site involving either a short-term removal action or a long-term remedial response that may include, but is not limited to, the following activities:

- Removing hazardous materials from a site to an EPA-approved, licensed hazardous waste facility for treatment, containment, or destruction.
- Containing the waste safely on-site to eliminate further problems.
- Destroying or treating the waste on-site using incineration or other technologies.
- Identifying and removing the source of ground water contamination and halting further movement of the contaminants.

Responsiveness Summary: A summary of oral and/or written public comments received by EPA during a comment period on key EPA documents, and EPA’s responses to those comments. The responsiveness summary is a key part of the ROD, highlighting community concerns for EPA decision-makers.

Site Inspection (SI): A technical phase that follows a preliminary assessment designed to collect more extensive information on a hazardous waste site. The information is used to score the site with the Hazard Ranking System to determine whether response action is needed.

Superfund: The common name used for the Comprehensive Environmental Response, Compensation, and Liability Act, also referred to as the Trust Fund.

Superfund Amendments and Reauthorization Act (SARA): Modifications to CERCLA enacted on October 17, 1986.

Surface Water: Bodies of water that are above ground, such as rivers, lakes, and streams.

Time Critical Removals: Including emergencies lasting longer than 30 calendar days, those releases requiring initiation of on-site activity within 6 months of the lead agency’s determination, based on the site evaluation that a removal action is appropriate.
Treatment, Storage, and Disposal Facility (TSD Facility): Any building, structure, or installation where a hazardous substance has been treated, stored, or disposed. TSD facilities are regulated by EPA and States under the Resource Conservation and Recovery Act.

Trust Fund: A Fund set up under the Comprehensive Environmental Response, Compensation, and Liability Act to help pay for cleanup of hazardous waste sites and to take legal action to force those responsible for the sites to clean them up.

Volatile Organic Compound: An organic (carbon-containing) compound that evaporates (volatilizes) readily at room temperature.

Water Purveyor: A public utility mutual water company, county water district, or municipality that delivers drinking water to customers.