DRAFT REPORT

FEASIBILITY STUDY REPORT

IRONTON, OHIO

Prepared for:

HONEYWELL

Morristown, New Jersey

April 26, 2007

April 26, 2007

Ms. Brenda Jones
Remedial Project Manager
U.S. EPA Region V
Office of Superfund
SR-6J
77 West Jackson Blvd.
Chicago, Illinois 60640

Subject: **Feasibility Study Report**
Allied Chemical/Ironton Coke Facility
Operable Unit 3 – Tar Plant

Dear Ms. Jones:

On behalf of Honeywell International (Honeywell), MACTEC Engineering and Consulting, Inc. (MACTEC) is pleased to provide a Draft Feasibility Study for the above referenced Site. This Draft Feasibility Study includes the Remedial Action Objectives, Alternatives Screening, and Comparative Analysis of Alternatives Technical Memoranda and addresses comments from USEPA, OEPA and SulTRAC, Inc. on the previous memoranda.

Please feel free to contact Chuck Geadelmann at Honeywell (952-945-8017) or Garret Bondy at MACTEC (248-926-4008) if you have questions or need additional information.

Sincerely,

MACTEC Engineering and Consulting, Inc.

Garret E. Bondy, P.E.
Senior Principal Project Manager

Laura Stirban
Assistant Project Manager

cc: K. O'Hara, Ohio EPA
Nadia Silvestri, SulTRAC
C. Geadelmann, Honeywell

FEASABILLITY STUDY

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MACTEC Engineering and Consulting, Inc.

Novi, Michigan

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Project 3293-07-1298

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AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
AS	Alternative Screening
BERA	Baseline Ecological Risk Assessment
BGS	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CAA	Comparative Analysis of Alternatives
C-PAH	Carcinogenic Polynuclear Aromatic Hydrocarbons
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Chemicals of Potential Concern
CPLA	Coke Plant/Lagoon Area
CY	Cubic Yards
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DPE	Dual-Phase Extraction
FS	Feasibility Study
GDA	Goldcamp Disposal Area
GPS	Global Positioning System
HHRA	Human Health Risk Assessment
ICMP	Institutional Control Monitoring Plan
M	Million
MACTEC	MACTEC Engineering and Consulting, Inc.
MCL	Maximum Contaminant Levels
MCLG	Maximum Contaminant Level Goals
MPE	Multi-Phase extraction
MW	Monitoring Well

NPDES	National Pollutant Discharge Elimination System
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
OEPA	Ohio Environmental Protection Agency
O&M	Operation and Maintenance
ORP	Oxidation Reduction Potential
OU-1	Operable Unit
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
POTW	Publicly Owned Treatment Works
PRG	Preliminary Remediation Goals
PVE	Polyvinyl Chloride
RAO	Remedial Action Objective
RI	Remedial Investigation
RMU	Remedial Management Unit
SARA	Superfund Amendments and Reauthorization Act
SERA	Screening Ecological Risk Assessment
SLERA	Screening Level Ecological Risk Assessment
SOW	Statement of Work
SVE	Soil Vapor Extraction
SVOC	Semivolatile Organic Compound
TBC	To Be Considered
TPE	Two-Phase Extraction
TSD	Transfer, Storage, or Disposal
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
VOC	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant

Executive Summary

The Ironton Tar Plant (Site) is located at 3330 South Third Street in Ironton, Ohio. It is the third operable unit (OU) of the former Allied Chemical & Ironton Coke facility, which was placed on the National Priorities List in 1983. Remedial construction at OU-1, known as the Goldcamp Disposal Area (GDA) and at OU-2, known as the Coke Plant/Lagoon Area (CPLA) was completed in 1995 and 2001, respectively. These remedies included a groundwater extraction and treatment system to control contaminated groundwater migration from all three OUs and dense non-aqueous phase liquid (DNAPL) recovery from a well located on the Tar Plant. Between 2001 and 2003, operations at the Tar Plant were terminated and nearly all above-grade facilities in that area were demolished.

The Tar Plant occupies approximately 27 acres in an industrially zoned section of Ironton. The City of Ironton (City) municipal water supply provides potable water to the area and potable uses of groundwater is not permitted by the City. The Site is bordered to the east by the CPLA, to the south by Ironton Bulk Terminals Inc. (a coal distribution facility), to the west by the Ohio River, and to the north by the GDA. An active rail line (that they may be expanded) divides the Site into a 16.1-acre parcel and an 11-acre parcel. The 16.1-acre parcel of the Tar Plant, located east of the railroad tracks is above the 100-year flood level and is identified in this report as the Main Parcel. The Main Parcel lies on relatively flat alluvial deposits that extend to approximately 90 feet depth. Bedrock beneath the Site is shale and is competent and impermeable. The 11-acre parcel located between the railroad track and the Ohio River, is identified as the River Parcel. According to the legal description of the property, approximately 5.2 acres are located in the Ohio River, leaving (depending on the river elevation, since the entire parcel is known to flood) 4.8 acres of land. The River Parcel has a small flat area near the railroad tracks, but the majority of the parcel slopes steeply to the Ohio River.

<u>Remedial Investigation Results</u>

The remedial investigation results showed the presence of Site-related contamination in soil, groundwater, and a limited amount of Ohio River sediment. Surface water does not appear to be impacted with Site-related contaminants. The predominant family of contaminants in Site soils is polynuclear aromatic hydrocarbons (PAHs). Elevated PAH concentrations are found in both shallow and deep soils on the Main Parcel. In the southern half of the Main Parcel, PAH contamination is present from ground surface to bedrock, whereas in the northern Main Parcel, PAH contamination is primarily associated with the shallow soils. On the River Parcel, high PAH concentrations were identified only in shallow soils. Benzene, toluene, ethylbenzene and xylene (BTEX) compounds in shallow soils are also present over much of the Site. Arsenic is present throughout shallow and deep soils, with no apparent pattern in distribution. DNAPL is also present in the southern half of the Main Parcel and has migrated vertically through the aquifer and is pooled at the bedrock surface. The process of DNAPL migration is affected by the presence of high and low permeable lenses within the soil and has left residual ganglia of DNAPL within the unsaturated and saturated soil zones. Horizontal migration of DNAPL is controlled by the topography of the bedrock surface. Site investigation data suggests that DNAPL has not migrated, nor it is likely to migrate due to a rise in bedrock surface. Arsenic is present at elevated concentrations in the majority of the groundwater monitoring wells, with no clear pattern to its distribution. Beyond arsenic, the most prevalent compound group present in Site groundwater is BTEX. The typically low solubility of PAH compounds limits their concentrations in groundwater. However, some elevated concentrations of naphthalene (a more soluble PAH) are found in groundwater. The extent of contaminated groundwater appears to be controlled by the groundwater extraction wells at the Site and at the CPLA. However, the extent of impacted groundwater at the southern end of the Site has not been fully delineated. Sediment samples collected upriver from the Site showed the presence of PAHs and provide a basis for assessing the potential contribution of Site-related contaminants to sediment adjacent to the Tar Site. Sediment sampling adjacent to the Site indicated concentrations of primarily PAHs higher than those observed upriver. These elevated concentrations are likely the result of historical releases at the docking facility during the transfer of process materials and/or discharges through outfall 001.

Risk Assessment Results

The Human Health Risk Assessment (HHRA) concluded that direct contact with surface and subsurface soil at the Main Parcel, and surface soil at the River Parcel, is associated with cancer risks (primarily due to PAHs) that exceed applicable National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and OEPA risk management criteria. The Screening Ecological Risk Assessment (SERA) concluded that PAHs in surface soils could also pose a risk to invertebrates, worm-eating birds, and predatory birds. The HHRA concluded that ambient air did not pose a risk but that vapors from soil, DNAPL, and groundwater contamination could pose unacceptable cancer and non-cancer risks to workers in future buildings on the Site and to workers excavating Site soils. While Site groundwater is not expected to be used, the HHRA evaluated the risk associated with potable uses and concluded that such uses would pose an unacceptable risk. The HHRA concluded that risks associated with exposure to sediments while swimming (9×10^{-6}) are within the NCP and Ohio Environmental Protection Agency acceptable risk management criteria, the risk is above the NCP point of departure of 1 $X10^{-6}$. The SERA concluded that PAHs in sediments could result in adverse effects to benthic organisms. As a result, this Feasibility Study screened technologies and conducted a detailed evaluation of alternatives to address exposure pathways associated with soil, air (soil vapor), groundwater, and sediment.

Feasibility Study Results

The following four alternatives for soil were evaluated and costs estimated:

- Alternative Soil-1: No Further Action: $0
- Alternative Soil-3: Soil Cover: $3.9 Million (M)
- Alternative Soil-4: Limited Excavation, Offsite Disposal and Soil Cover: $4.4 M to $12.4 M (depending on land use and residual risk achieved)
- Alternative Soil-6: Limited Excavation, Onsite Consolidation and Soil Cover: $4.0 M to $5.6 M (depending on land use and residual risk achieved)

Alternative Soil-5, Extensive Excavation and Offsite Disposal, was screened out as being impractical to completely remove contaminated soil. The depth of soil contamination (i.e., up to 90 feet below ground surface), the presence of contamination below the water table, raised concerns for implementability and cost.

Alternative Soil-1 would not involve any actions being taken. Under Alternative Soil-3, a soil cover consisting of 18 inches of clean fill and 6 inches of top soil would be installed across the Main Parcel and the most upland portion of the River Parcel. The cover system along the steep slopes of the River Parcel would include rip rap into the river and up a portion of the slope. Above the rip rap, the bank would be shaped using clean fill and top soil and native grasses and trees would be planted. Under this alternative, soils exceeding the most protective risk level (10^{-6}) in USEPAs risk range of 10^{-4} to 10^{-6} would be covered as would soils posing an ecological risk. Deed restrictions would be placed on the property requiring that the land use remain industrial; that the soil cover be maintained; that monitoring and /or engineering controls be used to protect workers from vapor intrusion to buildings, and that health and safety measures be utilized to protect workers during future grading and/or excavation activities. Alternative Soil-4 would include excavation and offsite landfilling of up to five feet (as allowed by the potential presence of large subsurface structures associated with the former Tar Plant) of shallow soil from the northern portion of the Main Parcel. Up to five feet of shallow soil would be removed from the River Parcel to the extent feasible, given the close proximity of the railroad. Fifteen excavation scenarios were evaluated for this alternative, corresponding to five potential human land-use exposure scenarios at 10^{-4}, 10^{-5}, and 10^{-6} risk levels. Soils remaining after excavation (depending on the excavation scenario) that pose an ecological risk would be covered using the soil cover system included in Alternative Soil-3. As with Alternative Soil-3, deed restrictions would be placed on the property requiring that the land use remain industrial; that the soil cover (where present) be maintained; that monitoring and /or engineering controls be used to protect workers from vapor intrusion to buildings, and implement health and safety measures to protect workers during future grading and/or excavation activities. Under Alternative Soil-6, the soils exceeding 10^{-5}, 10^{-5}, or 10^{-6} risk for the most stringent human health exposure scenario would be excavated and consolidated onto the southern portion of the Main Parcel (instead of being landfilled off Site) and install a soil cover where necessary (southern Main Parcel and areas of concern for ecological receptors.). The northern portion of the Main Parcel and the River Parcel would be backfilled with up to five feet of soil to promote Site redevelopment.

Alternative Soil-1 would not be protective and would not comply with Applicable or Relevant and Appropriate Requirements (ARARs). Alternative Soil-3 is protective to the most protective level of the USEPA mid range (10^{-6}) because it uses a soil cover with institutional controls to prevent unmanaged direct contact exposures to soil. Alternatives Soil-4 and -6 provide for a wide range of protection to human health, depending on the degree of excavation. None of these variations provide more protection than Alternative Soil-3. The most aggressive excavation scenario under Alternative Soil-4 and 6 would result in the level of protection of human health, equivalent to that of Alternative Soil-3. All three would provide the same degree of long term protection and reduction of toxicity, mobility, and volume of contamination. While Alternative Soil-4 includes offsite disposal of soils, the volume of these soils only accounts for approximately 4 percent of the total volume of contaminated soils at the Site. Therefore, all three alternatives would provide essentially the same degree of long-term protection and reduction of toxicity, mobility, and volume of contamination. Alternative Soil-3 could be implemented the most easily and could be completed in a shorter timeframe than the other two alternatives, with the least adverse impacts to the surrounding area. Alternative Soil-4 would be the most difficult to implement, would take the longest to complete, and would result in the greatest adverse impacts to the surrounding area by more than doubling the amount of truck traffic than that required by Alternative Soil-3 (i.e., an estimated increase from 3,000 to 7,500 truckloads), resulting in a significant increase in dust and the risk of traffic accidents. Alternative Soil-6 could be difficult to implement because initial inquiries with local contractors have yet to identify a source for the 40,000 cubic yards of low-permeability clay required by this alternative. Alternative Soil-4 would be the most costly to implement while Alternative Soil-3 would be the least costly of the three alternatives.

The following two alternatives for air (soil vapor) were evaluated and costs estimated:

- Alternative Air-1: No Further Action: $0
- Alternative Air-2: Institutional Controls: $75,000

Alternative Air-1 would not involve any actions being taken. Under Alternative Air-2, deed restrictions across the entire property would require that indoor air of onsite buildings be monitored for contaminants and/or such buildings be outfitted with engineering controls (e.g. vapor barriers, venting systems). The deed restrictions would also require that health and safety measures be implemented to protect outside workers during excavation or grading of Site soils and any location on Site. Alternatives to directly address the sources of potential vapors (i.e. soil, DNAPL and groundwater) were considered impracticable, given the depth (up to 90 feet below ground surface) of these potential sources.

Alternative Air-1 is not protective and would not comply with ARARs. Alternative Air-2 would be protective and comply with ARARs. Neither alternative includes treatment because it was deemed impracticable. The deed restrictions included in Alternative Air-2 would provide long-term protection, and because Honeywell owns the property, could be implemented easily and at a low cost.

The following three alternatives for groundwater were evaluated and costs estimated:

- Alternative Groundwater-1: No Further Action: $0
- Alternative Groundwater-3: Groundwater Collection/Treatment/Discharge: $2.2 M
- Alternative Groundwater-4: Low-Permeability Cover: $6.2 M

Alternative Groundwater-2, Limited Action/Institutional Controls and Monitoring, was eliminated in the screening process of alternatives, as not being effective in controlling the plume and preventing potential impact to uncontaminated areas.

Alternative Groundwater-1 would not involve any actions being taken. Under Alternative Groundwater-3, the existing groundwater extraction and DNAPL recovery systems would be expanded. In developing this alternative, it was assumed that up to two groundwater extraction wells would be added to the system and that the existing overhead piping conveying groundwater from the Tar Plant to the treatment plant located on the CPLA OU would be replaced with underground piping to make the property more attractive for redevelopment. It was further assumed that DNAPL would be collected from four additional wells and the product disposed at an offsite treatment facility. The current groundwater monitoring program would be expanded to confirm the effectiveness of the expanded systems. Deed restrictions across the entire property would prohibit potable use of Site groundwater. The City has stated that it does not permit the installation of potable water wells. To the extent that industrial wells may impact groundwater capture, Honeywell will use institutional controls to prevent installation of such water wells. Alternative Groundwater-4 includes those aspects of Alternative Groundwater-3, but also includes the installation of a low-permeability cover system to reduce the effects that infiltration may have on the leaching of contaminants and DNAPL in the unsaturated soils to groundwater. Deed restrictions would require that the cover system be maintained.

Alternative Groundwater-1 would not be protective and would not comply with ARARs. Both Alternative Groundwater-3 and Groundwater-4 would be protective and comply with ARARs. Both alternatives would provide the same degree of long-term protection, through the groundwater and DNAPL collection systems and use restrictions included in both alternatives. While Alternative Groundwater-4 includes a low-permeability cover to reduce leaching of contaminants from the unsaturated zone to groundwater, the benefit associated with this is expected to be negligible since the majority of the Site contaminant mass is located within the saturated zone and pooled on the bedrock. Both will result in a reduction in toxicity, mobility, and volume of contaminants by collecting and disposing of DNAPL and treatment of groundwater. Alternative Groundwater-3 could be implemented more quickly and more easily than Alternative Groundwater-4, given the additional complexity of installing a the cap and the potential difficulty in finding a local source for the 40,000 cubic yards of low permeability clay (initial inquiries with contractors have yet to identify a local source). In addition, Alternative Groundwater-4 would result in more adverse short-term impacts to the area around the Site, given the additional truck traffic, resulting in an increase in dust and risk of traffic accidents in the community. Alternative Groundwater-4 is significantly more costly than Alternative Groundwater-3.

The following five alternatives for sediment were evaluated and cost ranges estimated:

- Alternative Sediment - 1: No Further Action - $0
- Alternative Sediment – 2: Monitored Natural Recovery - $0.7 M - $1.0 M

- Alternative Sediment – 3: In-Situ Capping - \$1.8 M to \$3.4 M (depending on cap materials)
- Alternative Sediment – 4: Dredging and Offsite Disposal - \$6.8 M - \$9.9 M
- Alternative Sediment – 5: Combination of Dredging and In-Situ Capping - \$2.8 M - \$4.5 M

Alternative Sediment-1 would not involve any actions being taken. Under Alternative Sediment-2, Monitored Natural Recovery would be allowed to take place and restrictions prohibiting dredging. Alternative Sediment-3 would cap the area above PRGs. As part of cap installation, it would also be likely that some sediment along the bank would have to be dredged and disposed off Site to make room for the cap. Deed restrictions would require cap maintenance. Alternative Sediment-4 would involve the dredging of sediment above PRGs. Alternative Sediment-5 would allow for a combination of dredging and capping. Specific areas and depths to be dredged and areas to be capped would be determined during design, following a significant pre-design investigation. Deed restrictions would require cap maintenance.

Alternative Sediment-1 is not protective but would comply with ARARs. Alternative Sediment-3, Alternative Sediment-4 and Alternative Sediment-5 would be protective, comply with ARARs, and provide long-term effectiveness. Due to a lack of data indicating that natural recovery of sediments is occurring, it is uncertain whether Alternative Sediment-2 would be protective, and/or provide long-term effectiveness. It would comply with ARARs. Alternative Sediment-3 would reduce contaminant mobility through capping while Alternative Sediment-4 would reduce contaminant volume through dredging. Alternative Sediment-5 would reduce mobility and volume through a combination of capping and dredging. Alternative Sediment-2 would rely on natural recovery to reduce mobility and toxicity. Alternative Sediment-3 would provide immediate protectiveness while the likely presence of residual contamination remaining under Alternative Sediment-4 would take significantly longer to provide protection. Both alternatives could cause short-term impacts to the river and protective measures would be necessary to minimize these. Alternative Sediment-5 would include both capping and dredging and the short-term benefits would be balanced with potential short-term impacts while designing the actual combination. Alternative Sediment-2 would not result in any short-term impacts, however, the time to reach recovery is unknown. Alternative Sediment-2 involves monitoring only and would be the easiest to implement. Alternative Sediment-3 would likely be easier to implement than Alternative Sediment-4 because capping would not require a large dewatering area and subsequent treatment of dewatering fluids, as would dredging. Alternative Sediment-5, however, allows for a combination of capping and dredging and during its design, implementation issues could be balanced with other benefits. The cost estimates for the alternatives are highly uncertain, given the need for additional data regarding sediment volume and depths of contamination. Alternative Sediment-2 would clearly be the least costly; however, it is uncertain whether it is an effective alternative. Alternative Sediment-3 is estimated to be significantly less costly than Alternative Sediment-4. Alternative Sediment -5 is estimated to cost somewhere between these two alternatives.

1.0 INTRODUCTION

This Feasibility Study (FS) report was prepared by MACTEC Engineering and Consulting, Inc., (MACTEC) for the Allied Chemical & Ironton Coke – Honeywell Coal Tar Facility (Tar Plant; Site). The FS report was prepared in accordance with the requirements of the Administrative Order on Consent (AOC), V-W-03-C-755, and Statement of Work (SOW) issued by the United States Environmental Protection Agency (USEPA) Region V on August 22, 2003. This document was also prepared in accordance with the Guidance for Conducting Remedial Investigations and Feasibility Studies (RIs/FSs) under the Comprehensive Environmental Response, Compensation, and Liability Act [(CERCLA) USEPA, 1988].

1.1 PURPOSE AND ORGANIZATION REPORT

The purpose of this FS report is to develop, screen, and evaluate remedial alternatives to reduce potential human-health risks and ecological risks posed by exposure to Site contamination. These alternatives are evaluated on the basis of effectiveness in achieving RAOs, and technical implementability. A detailed analysis of alternatives and the selection of recommended alternatives are also presented. In the detailed analysis, alternatives are evaluated with regard to:

- Overall protection of human health and the environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost

The FS report is based on a series of three technical memoranda that have been previously submitted to USEPA to ensure that the FS process for this project is progressing in an expedited manner. The first of the technical memoranda was the RAOs Technical Memorandum (MACTEC, 2006a) presented to USEPA on March 30, 2006. The second of the technical memoranda was the Alternative Screening (AS) Technical Memorandum (MACTEC, 2006b) presented to USEPA on October 24, 2006. The third of the technical memoranda was the Comparative Analysis of

Alternatives (CAA) Technical Memorandum (MACTEC, 2007a) presented to USEPA on January 26, 2007. Comments received from the USEPA for each technical memorandum have been incorporated in the subsequent technical memorandum and in this FS report.

This FS report is organized into an executive summary and six sections as follows:

Section 1: Introduction - This section presents a description of the plant and surrounding area and a discussion of the Site history, as well as summaries of findings from the RI and risk assessments (RA).

Section 2: Identification and Screening of Technologies - This section presents the RAOs and general response actions for the potentially impacted media. Technology process options capable of meeting the general response actions are then identified and screened.

Section 3: Development and Screening of Remedial Alternatives - In this section, the technology process options are combined to develop remedial alternatives appropriate to source soils and groundwater. The assembled alternatives are then screened based on effectiveness, implementability, and cost.

Section 4: Detailed Analysis of Alternatives - This section individually analyzes the assembled alternatives based on the criteria identified in the USEPA guidance (USEPA 1988). The alternatives are then evaluated in a comparative analysis and recommended alternatives are identified.

Section 5: Comparative Analysis of Alternatives – This section discusses the results of the comparative analysis of alternatives for each medium, including a presentation of preferred alternatives and the rationale for the preference.

Section 6: Literature Cited - This section lists the literature used in the preparation of this document.

1.2 BACKGROUND INFORMATION

The following subsections briefly describe the Site and the nature and extent of contamination at the Site.

1.2.1 Site Description

The Ironton Tar Plant is located at 3330 South Third Street in Ironton, in the southwest quarter of section 30, T1N, R18 E, Lawrence County, Ohio (Figure 1.1). The Tar Plant, along with the former Coke Plant and Lagoon Area (CPLA) and Goldcamp Disposal Area (GDA), comprised the former Allied Chemical/Ironton Coke facility. The Tar Plant occupies approximately 27 acres in an industrially zoned section of Ironton. The Site is bordered to the east by the former CPLA, to the south by Ironton Bulk Terminals Inc. (a coal distribution facility), to the west by the Ohio River, and to the north by the GDA. The 16.1-acre parcel, located east of the railroad tracks is identified in this report as the Main Parcel. The Main Parcel lies on relatively flat alluvial deposits and is above the 100-year flood level. The 4.8-acre parcel located between the railroad track and the Ohio River, is identified as the River Parcel. The River Parcel has a small flat area near the railroad tracks, but the majority of the parcel slopes steeply to the Ohio River and is within the 100 year flood level. According to the legal description of the property, an additional 5.2 acres on the River Parcel is within the Ohio River. Industries along the Ohio River include steel mills, paper mills, coal-processing facilities, coke plants, coal plants, pottery plants, and chemical and tools manufacturers. Industries in the vicinity of the Site include coal loading and processing, oil shipping, chemical manufacturing and storage, and steel manufacturing.

One small office building, an open air shed, aboveground water conveyance lines, two groundwater extraction wells, and several monitoring wells are currently located on Main Parcel. The Main Parcel is covered by paved or gravel roads, demolition debris, and vacated railroad beds. The Main Parcel is secured by a 6-foot chain-linked fence. The Site layout is shown in Figure 1.2.

1.2.2 Site History

The Site was placed on the National Priorities List of sites in 1983, and investigation of the Site began the same year under an AOC pursuant to CERCLA. Investigations completed between 1983 and 1998 focused on: (1) the area that received wastes from the Tar Plant, which came to be known as the Goldcamp Disposal Area (GDA); and (2) the Coke Plant and the lagoons that received process wastewater and solid waste from the Coke Plant, which came to be known as the Coke Plant/Lagoon Area (CPLA) (Figure 1.3). The GDA was designated Operable Unit 1 (OU-1) and the CPLA was designated OU-2. Remedial construction was completed at OU-1 in 1995 and at OU-2 in 2001.

Between 2001 and 2003, operations at the Tar Plant were terminated and nearly all above-grade facilities in that area were demolished. On August 22, 2003, USEPA issued *Administrative Order on Consent for Remedial Investigation/Feasibility Study, Allied Chemical & Ironton Coke – Honeywell Coal Tar Facility (Operable Unit No. 3)*, designating the former Tar Plant as OU-3. In response to the AOC, Honeywell retained Parsons of Cleveland, Ohio (Parsons) to conduct a CERCLA RI/FS at the Tar Plant. In 2004-2005, Parsons prepared a draft Remedial Investigation Report and submitted it to the USEPA on behalf of Honeywell. On September 19, 2005, Honeywell received USEPA's and the Ohio Environmental Protection Agency's (OEPA) comments on the report. In their comments on the report, USEPA and OEPA identified data gaps in the first phase of RI work performed. It was determined that another phase of RI would be needed to address these data gaps and to facilitate the identification and evaluation of remediation alternatives during the FS.

On November 3, 2005, MACTEC submitted a RI/FS Work Plan Amendment (MACTEC 2005) in accordance with the AOC, which received regulatory approval on December 23, 2005. Additional RI activities were initiated in February 2006 and the RI was submitted on October 23, 2006. On December 7, 2006 Honeywell and MACTEC received comments from USEPA, OEPA and a consultant assisting USEPA, SulTRAC, Inc. (SulTRAC). On January 26, 2007, a revised RI report was submitted to USEPA, OEPA and SulTRAC, addressing comments received. The revised RI report was approved by USEPA on March 12, 2007.

1.2.3 Nature and Extent of Contamination

The following is a brief description of the nature and extent of chemical constituents at the Site by medium. This information is based on the results presented in the Draft Phase I RI Report, dated June 2005 (Parsons, 2005), and the Draft Phase IA RI Report, dated January 2007 (MACTEC, 2007b). Selected figures from the Phase IA RI Report, illustrating contaminant distribution in soil and groundwater are presented in Appendix A.

Soil: The predominant family of contaminants present in Site soils is polynuclear aromatic hydrocarbons (PAHs). Elevated PAH concentrations are found in both shallow and deep soils on the Main Parcel. The highest PAH concentrations were identified in the southern half of the Main Parcel, mainly associated with the former crude tar unloading operations, the tank farms (both south and north), the former laboratory storage building, and the former boiler house. On the River Parcel, high PAH concentrations were identified only in shallow soils north of the elevated pipeline leading from the dock to the former plant. Benzene, toluene, ethylbenzene and xylene (BTEX) compounds in shallow soils are also present over much of the Site, with xylene being predominant. BTEX were identified in the deep soils only within the southern half of the Main Parcel, with the highest concentrations located within the area of the former carbolate tank on the southwest corner of the Main Parcel. The BTEX and PAHs distribution pattern in shallow soils is similar to the dense non-aqueous phase liquid (DNAPL) distribution appearing to suggest a likely correlation with the presence of DNAPL. Concentrations of arsenic are present throughout shallow and deep soils, with no apparent pattern in distribution. PCBs, phenols, cyanide, and ammonia were also present, but at relatively low concentrations (see Appendix A, Figures 5.3 through 5.9).

DNAPL: DNAPL is present within the southern half of the Site. DNAPL has migrated vertically through the aquifer and it is pooled at the bedrock surface (see Appendix A, Figures 4.2 through 4.5, and 5.10). The process of DNAPL migration into deeper soil is affected by the presence of high and low permeability lenses within the soil and has left residual ganglia of DNAPL within the unsaturated and saturated zones. These residual DNAPL ganglia were noted in the soil samples collected during drilling of the monitoring wells. Horizontally, migration of DNAPL is controlled by the topography of the bedrock surface. The highs and lows identified in the bedrock surface beneath the Main Parcel create "holding areas" for the pooled DNAPL. Site investigation data suggest that DNAPL has not migrated, nor is it likely to migrate (due to the rise in bedrock surface) to the Ohio River.

Groundwater: Arsenic is present at elevated concentrations in the majority of the monitoring wells, with no clear pattern to its distribution. Beyond arsenic, the most prevalent compound group present in Site groundwater is BTEX, with benzene concentrations elevated particularly in the former anthracene production facility, and the southern portion of the Site. The typically low solubility of PAH compounds limits their concentrations in groundwater. However, some elevated concentrations of naphthalene (a more soluble PAH) are found in groundwater. Low concentrations of ammonia, nitrate, phenols, and cyanide are present in the Site monitoring wells; however, in some localized areas concentrations were found to be somewhat elevated. The extent of contaminated groundwater appears to be controlled by the groundwater extraction wells at the Site and at the CPLA operable unit. However, the extent of impacted groundwater at the southern end of the Site (south of monitoring wells MW-49 and MW-11) has not been fully delineated (see Appendix A, Figures 5.11 through 5.13).

Sediment: Sediment samples collected upriver from the Site showed the presence of PAHs and can provide a basis for assessing the potential contribution of Site-related contaminants to sediment adjacent to the Tar Site. Sediment sampling adjacent to the Site indicated concentrations of primarily PAHs higher than those observed upriver; however, the maximum concentrations of all PAHs were at one location. These elevated concentrations are likely the result of historical releases at the docking facility during the transfer of process materials. Concentrations of other Site-related constituents were generally only slightly elevated over upriver samples.

Surface Water: Surface water samples did not appear to be impacted with Site-related contaminants. Elevated concentrations of PAHs detected in one sample are believed to have been associated with entrained sediments. In addition to the existing groundwater extraction system preventing Site groundwater from discharging to the river, the enormous dilution factors available in the river limit the potential for Site-related constituents to impact surface water.

Ambient Air and Soil Vapor: Samples of ambient air showed no significantly elevated concentrations of BTEX or naphthalene. A few samples of soil vapor did show elevated VOCs, primarily benzene, with some styrene and naphthalene. The elevated concentrations of soil vapor were detected primarily in the former tank farm areas. There was no apparent correlation between soil vapor and ambient air results.

1.2.4 Data Gaps

Minor data gaps remain in delineating the extent of soil, DNAPL, and groundwater contamination to the south and southeast of the Site. Each of these is described further below.

Soil: PAH and VOC impacts to soils appear to extend off the Site to the south. Pending authorization for offsite access, additional soil samples would be collected to further evaluate extent.

DNAPL: Monitoring wells MW-48D, MW-49D, and MW-59D located at the south end of the Site contained measurable thicknesses of DNAPL. While MW-11 offers some coverage to the south, and wells MW-52D, MW-46D, and C-3 offer some coverage to the west and east, the DNAPL extent is not well-defined to the southeast and southwest. Additional wells would be installed and sampled, pending offsite access authorization in these directions.

Groundwater: The extent of contaminated groundwater appears to be controlled by the groundwater extraction wells at the Site and at the CPLA operable unit. However, the extent of the impacted groundwater at the southern end of the Site (south of monitoring wells MW-49 and MW-11) has not been fully delineated. Additional wells would be installed and sampled, pending offsite access authorization in these directions.

Sediments: The presence of contaminants in river sediments may be attributed to releases of process materials at the riverside docking facilities. The general horizontal extent of PAH impacted sediments has been identified as the area of the docking facility and directly downstream of the docking facility where PAH-contaminated sediment exceeds PRGs. Samples would be collected at depth to further characterize the sediment.

1.2.5 Contaminant Fate and Transport

This subsection discusses the potential fate and transport of contaminants detected at the Site by medium.

The Site has undergone considerable surficial cleanup including tank removal, building demolition and removal, underground piping removal. The two extraction wells at the Tar Site represent a portion of a network of groundwater extraction wells that are designed to prevent groundwater from migrating off the Site. Groundwater extraction appears to prevent offsite migration of Main Parcel contaminated groundwater and DNAPL removal is performed routinely.

Remaining contaminants in soils (primarily arsenic, PAHs and BTEX) may migrate through leaching to groundwater and the BTEX may volatilize to air. Contaminants in the overburden groundwater would normally tend to migrate towards the Ohio River, but groundwater extraction at the Tar Site and the nearby CPLA operable unit prevents the discharge of most Site-related contaminated groundwater to the Ohio River. Migration of strongly-sorbed compounds such as PAHs and PCBs is likely to be very slow. Migration of VOCs in groundwater toward the extraction wells may be more rapid, but these compounds, as well as others such as cyanide and phenols, may undergo significant biodegradation or other attenuation mechanisms to reduce concentrations. Given the slow migration rates of PAHs, these may also undergo some limited degradation in groundwater. The fate of arsenic in groundwater is controlled mainly by geochemical conditions within the aquifer. These include the presence of iron minerals, and pH and oxidation reduction potential (ORP). As geochemical conditions return to normal over time, the mobility and concentrations of arsenic in groundwater are expected to decline.

DNAPL has migrated vertically through the aquifer to the surface of the bedrock, and appears to be pooled at the bedrock surface. The potential for further lateral migration of the DNAPL is governed by the slope and undulations within the bedrock surface, the conductivity of the DNAPL (i.e., its viscosity relative to groundwater), and the volume of DNAPL which could led to localized gradients greater than those in surrounding groundwater. Movement of DNAPL may also be influenced by the recovery of product (over 4,000 gallons since recovery was initiated at WE-618). Site investigation data suggest that DNAPL has not migrated, nor is it likely to migrate (due to the rise in bedrock surface) to the Ohio River.

The presence of contaminants in river sediments are likely attributed to releases of process materials at the riverside docking facilities. PAHs in these releases have persisted in river sediments, but, based on tests conducted for similarly impacted Ice Creek sediments, leaching of significant concentrations from impacted sediments does not pose a threat to the water column. The extent appears to be limited in area and the maximum for all PAHs detected was at a single location.

Surface water, with the exception of samples believed to reflect suspended sediments, exhibits very little indication of impact from Site-related compounds and differ little from upriver surface water samples.

While soil vapor samples did contain elevated BTEX, none of the associated ambient air samples exhibited elevated concentrations. This is likely due to a slow rate of release of soil vapor relative to ambient air movement, leading to significant dilution.

1.2.6 Summary of Risk Assessment Results

Human health risks and ecological risks associated with the Site were evaluated. Results of this work are summarized below.

1.2.6.1 Human Health

The Human Health Risk Assessment (HHRA) evaluated health risks associated with potential exposures to surface soil, subsurface soil, groundwater, air, and surface water and sediment in the reach of the Ohio River adjacent to the Site. To provide an evaluation that reflects risks associated with a range of possible Site re-uses, and develops a range of options to support risk management decision-making, the risk assessment evaluated future land uses for both open space/recreational and commercial/industrial activities. Conservative calculations indicate that:

- Direct contact with surface soil and subsurface soil at the Main Parcel, and surface soil at the River Parcel, is associated with cancer risks (primarily due to PAHs) that exceed applicable National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and OEPA risk management criteria.
- Inhalation exposures to air within commercial/industrial buildings that may be constructed at the Site in the future are associated with cancer risks of $2x10^{-5}$ (primarily due to benzene), which are within the $1x10^{-4}$ to $1x10^{-6}$ risk but in excess of the OEPA cancer risk limit. Benzene risks associated with this exposure pathway are primarily associated with four locations (SV-5, SV-06, SV-24, and SV-33).
- Potential exposures to vapors (associated with benzene, toluene, and naphthalene) in air by construction workers during active excavation and grading of the Site in support of re-development are associated with a cancer risk and a non-cancer hazard index in excess of NCP and OEPA risk management criteria.

- Potential exposures to dust and ambient vapors that may be released from the Site under the current conditions are associated with risks well below the NCP, and OEPA risk management criteria.
- Groundwater beneath the Site is not expected to be used for any purposes in the future because a municipal water supply is available to the Site and surrounding properties and the City of Ironton (City) has stated that it does not permit the installation of potable water wells. Nevertheless, to aid in risk management decision-making, risks associated with potable use of the groundwater beneath the Site by commercial/industrial workers were evaluated. The results of the risk characterization indicate that both cancer and non-cancer risks (predominantly due to arsenic, benzene, and PAHs) for potable use of the groundwater by commercial/industrial workers exceed NCP and OEPA risk management criteria.
- Cancer and non-cancer risks associated with sediment in the reach of the Ohio River adjacent to the Site (under the assumption that children and adults use the adjacent reach of the river for swimming) are within the USEPA acceptable risk range and below the OEPA risk management criteria.
- Non-Cancer risks associated with surface water in the reach of the Ohio River adjacent to the Site (under the assumption that children and adults use the river for swimming) are below OEPA and USEPA risk limits. The presence of PAHs in surface water is an artifact of sediment entrained in the water, and not dissolved PAHs in the water. This artifact would make the dermal exposure pathway to the PAHs incomplete, resulting in an estimated cancer risk of $2x10^{-7}$, below the USEPA NCP and OEPA risk management criteria.

1.2.6.2 Ecological

The Screening Ecological Risk Assessment (SERA) evaluated potential adverse impacts to ecological receptors due to possible exposures to soil, surface water, and surficial sediment in the reach of the Ohio River adjacent to the Site. Conservative calculations performed as part of the SERA indicated that:

- Some PAHs in soil may present a potential hazard to soil invertebrates, worm-eating birds, and predatory birds.

- Adverse effects to aquatic receptors from exposure to surface water may be possible; however, subsequent evaluation risks to aquatic life indicated that PAHs in surface water adjacent to the Site are unlikely to cause adverse effects in aquatic organism.
- Both screening criteria and Site-specific benchmark calculations suggest that adverse effects to benthic organisms may be possible due to PAHs in sediment.
- The results of the food-chain model predict that the only receptor potentially impacted may be the belted kingfisher.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This Section in the FS report presents the identification and screening of technologies.

2.1 INTRODUCTION

Remedial action objectives (RAOs) were identified for Site soil, air, groundwater, and sediments for those exposure pathways identified by the risk assessment work as having unacceptable risks. Following development of the RAOs, a wide range of technologies to address the unacceptable risks were identified and screened for further consideration.

2.2 REMEDIAL ACTION OBJECTIVES

RAOs are general statements of cleanup goals along with medium- or operable unit-specific, quantitative goals defining the extent of cleanup required to achieve response objectives. They specify contaminants of concern, exposure routes and receptors, and preliminary remediation goals (PRGs). Remedial action objectives are used as the framework for developing remedial alternatives. The remedial action objectives are formulated to protect human health and the environment. To develop Remedial Action Objectives, it is first necessary to identify the following:

- Remedial Response Objectives
- Applicable or Relevant and Appropriate Requirements (ARARs)
- Preliminary Remediation Goals

2.2.1 Identification of Remedial Response Objectives

Remedial response objectives are Site-specific qualitative cleanup objectives used for defining RAOs and for developing appropriate remedial alternatives. They are developed based on the nature and distribution of contamination, the resources currently or potentially threatened, and the potential for human and environmental exposure. At the Ironton Tar Plant Site, remedial response objectives are based on potential human-health and ecological risks as follows:

- Mitigate human health risks (to the extent that the risk assessment identifies unacceptable) associated with potential exposure to Site soil, air, groundwater, and sediment[1]

[1] The potential risk associated with human exposure to sediments is estimated to be within the

- Mitigate possible ecological risks (to the extent that the risk assessment identifies unacceptable) associated with potential exposure to Site soil, surface water, and sediment.

2.2.2 Applicable Or Relevant And Appropriate Requirements (ARARs)

CERCLA, the Superfund Amendments and Reauthorization Act (SARA), and the NCP require that onsite Superfund remedial actions attain federal standards, requirements, limitations, or more stringent state standards determined to be legally applicable or relevant and appropriate to the circumstances at a given site. ARARs are federal and state environmental and facility sitting requirements and guidelines used to: (1) evaluate the appropriate extent of site cleanup; (2) define and formulate remedial action alternatives; and (3) govern implementation and operation of the selected action. In addition to ARARs, other criteria or guidelines that are not legally binding are "to be considered" (TBC) while evaluating ARARs. Inherent in the interpretation of ARARs and TBCs is the assumption that protection of human health and the environment is ensured.

ARARs are divided into the three categories: chemical-specific; location-specific; and action-specific. Chemical-specific ARARs are usually health- or risk-based standards that limit the concentration of a chemical found in or discharged to the environment. They govern the extent of site remediation by providing either actual cleanup levels, or the basis for calculating such levels. For example, groundwater Maximum Contaminant Levels (MCLs) may provide the necessary cleanup goals for sites with contaminated groundwater. Chemical-specific ARARs may also be used to indicate acceptable levels of discharge in determining treatment and disposal requirements, and to assess the effectiveness of future remedial alternatives. In the case of the Tar Plant Site, chemical-specific ARARs and TBCs were developed for each media affected, and are presented in Tables 2.1 and 2.2.

USEPA acceptable risk range of 10-4 to 10-6 and OEPA risk target of 10-5. However, because the estimated risk of 9x10-6 is in excess of USEPA's "point of departure" (1x10-6) and because chemical-specific Applicable and/or Relevant Appropriate Requirements are not available for use in evaluating the need to address sediment contamination, USEPA requested that an RAO be developed for potential human exposure to sediment.

Location-specific ARARs pertain to natural site features (e.g., wetlands, floodplains, and sensitive ecosystems) and man-made features (e.g., existing landfills, disposal areas, and places of historical or archeological significance). These ARARs generally restrict the concentration of hazardous substances, or the conduct of activities based on a Site's particular characteristics or location. For the Tar Plant Site, location-specific ARARs were developed for the natural site features potentially affected and are presented in Table 2.3.

Action-specific ARARs, unlike location-specific and chemical-specific ARARs, are usually technology-based or activity-based limitations that direct how remedial actions are conducted. Potential action-specific ARARs were developed and are presented in Table 2.4.

2.2.3 Development of Preliminary Remediation Goals (PRGs)

PRGs are long-term numerical goals used during analysis and selection of remedial alternatives. PRGs should comply with ARARs and result in residual risks consistent with NCP requirements for protection of human health and the environment. As a result, PRGs are based both on risk-based concentrations and on ARARs.

Documentation of the Site-specific PRGs for soil, air, groundwater, and sediment protective of human health risks is presented Appendix B. Documentation of the Site-specific PRGs protective of ecological receptors for soil, and sediment is presented in Appendix C. As documented in Appendix C, ecological-based PRGs for surface water were not developed because comparison of surface water contamination with alternate benchmarks suggests that concentrations of analytes in surface water are unlikely to pose a risk to aquatic life.

To assist in identifying and evaluating technologies and alternatives in the subsequent sections of this report, the extent of contamination to be addressed was identified for each land use scenario/RAOs, as follows:

- Soil: current trespasser, future construction worker, future commercial/industrial indoor worker, future recreational visitor, and future commercial/industrial outdoor worker for 10^{-4}, 10^{-5}, and 10^{-6} levels of risk; and ecological receptors. Figures 2.1 through 2.5 show sample locations and/or the estimated extent where contaminant concentrations in soil were identified above the indicator PRGs.

- Air (soil vapor): future construction worker and future commercial/industrial indoor worker. Figure 2.6 shows sample locations where contaminant concentrations in soil vapor were identified above the indicator PRGs.
- Groundwater: future commercial/industrial worker. Figure 2.7 shows extent of groundwater contamination where contaminant concentrations in groundwater were identified above the indicator PRGs/MCLs.
- Sediment: belted kingfisher and benthic invertebrates. No areas of concern were identified for the belted kingfisher. For benthic invertebrates, the extent of sediment contamination is defined as the area directly downstream of the docking facility, corresponding to the location of samples for which the sum of the equilibrium sediment benchmark toxic unit (ΣESBTU) exceeds the ΣESBTU calculated for the samples upstream of Ice Creek, which are considered background for sediment in the Ohio River. Figure 2.8 shows extent of sediment contamination.

Tables summarizing analytical data and Site-specific PRGs for each medium are presented in Appendix D.

2.2.4 Selection of Remedial Action Objectives

Current project RAOs are summarized below by media.

2.2.4.1 RAOs for Soil

Soils that are the subject of RAOs are surface and subsurface soils located on the Main Parcel and River Parcel. RAOs for soil include:

- Prevent human ingestion/direct contact with soils containing PAHs that exceed applicable NCP and OEPA management criteria for applicable exposure scenarios
- Prevent exposure of terrestrial invertebrates to PAHs at concentrations ecological risk assessment calculations indicate may be harmful to them
- Prevent exposure of worm-eating birds to PAHs in terrestrial invertebrates at concentrations ecological risk assessment calculations indicate may be harmful to populations of worm-eating birds

- Prevent exposure of predatory birds to PAHs at concentrations ecological risk assessment calculations indicated may be harmful to populations of predatory birds
- Reduce, to the extent practical, the leaching of contaminants in soil that may contribute to groundwater contamination above NCP and/or OEPA risk management criteria

2.2.4.2 Air

Soil vapor data indicates a potentially unacceptable risk to Site workers during future excavation activities as well as indoor air inhalation in any potential buildings. As a result, the following RAOs have been developed for risks associated with air as it relates to soil vapor:

- Prevent inhalation of vapors in indoor air in possible future buildings in excess of NCP and OEPA risk management criteria. Risks currently are driven by benzene.
- Prevent inhalation of vapors by construction workers during any future Site grading and/or excavation activities. Risks currently are driven by benzene, toluene, and naphthalene.

2.2.4.3 RAOs for Groundwater

The existing groundwater extraction system is intended to create a hydraulic control boundary to prevent further migration of Site-related compounds beyond the facility property boundary. RAOs for groundwater include:

- Prevent potable use of onsite groundwater containing arsenic, benzene, and PAHs at concentrations above NCP and OEPA risk management criteria and/or chemical-specific ARARs
- Reduce, to the extent practical, further degradation of groundwater to allow for eventual reductions in arsenic, benzene, and PAH concentrations to below NCP and Ohio risk management criteria and/or chemical-specific ARARs
- Prevent offsite migration of onsite groundwater
- Prevent offsite potable use of groundwater contaminated above NCP and OEPA risk management criteria and/or chemical-specific ARARs

2.2.4.4 RAOs for Sediments

RAOs for sediment include:

- Prevent human direct contact with sediment containing PAHs that exceed applicable NCP and OEPA management criteria for applicable and future exposure scenarios
- Prevent benthic invertebrates from direct contact with sediment containing PAHs that exceed PRGs (i.e., the ΣESBTUs calculated for the samples that represent background for the Ohio River)

2.3 GENERAL RESPONSE ACTIONS

General response actions describe those actions that would satisfy the remedial action objectives. General response actions for the Site are:

- No action
- Institutional controls
- Containment
- In-situ treatment
- Collection/extraction/removal
- Ex-situ treatment
- Onsite discharge/disposal
- Offsite discharge/disposal

Table 2.5 presents the general response actions.

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

This section identifies and screens remedial technologies using the process outlined in USEPA RI/FS guidance (USEPA, 1998) and the NCP. First, technologies are identified that may be capable of attaining the remedial action objectives listed above. Demonstrated performance of each technology for Site contaminants and conditions is considered during technology identification. The result is a list of potential remedial technologies that are then screened based on their applicability to Site- and waste-limiting characteristics. The purpose of the screening is to produce an inventory of suitable technologies that can be assembled into candidate remedial alternatives capable of mitigating actual or potential risks at the Site. An extensive list of potential technologies representing a range of general response actions (i.e., no action, institutional controls, containment, collection, treatment, and disposal) was considered, consistent with USEPA guidance, to develop the candidate remedial alternatives.

2.4.1 Identification of Technologies

Categories of remedial technologies and specific process options were identified based on a review of literature, vendor information, performance data, and experience in developing other FSs under CERCLA. Process options considered potentially applicable to attaining the remedial response objectives were selected for screening. Table 2.5 identifies applicable remedial technologies and associated process options for each general response action for soil, air, and groundwater. Table 2.6 describes the identified technologies and process options.

2.4.2 Evaluation of Technologies and Selection of Representative Technologies

The technology screening process reduces the number of potentially applicable technologies and process options by evaluating factors that may influence process-option effectiveness and implementability. This overall screening is consistent with guidance for performing FSs under CERCLA (USEPA, 1988).

The screening process assesses each technology or process option for its probable effectiveness and implementability with regard to Site-specific conditions, Site-related contaminants, and affected environmental media. The effectiveness evaluation focuses on: (1) whether the technology is capable of handling the estimated areas or volumes of media and meeting the contaminant reduction goals identified in the RAOs; (2) the effectiveness of the technology in protecting human health and the environment during the construction and implementation phase; and (3) how proven and reliable the technology is with respect to contaminants and conditions at the Site. Implementability encompasses both the technical and administrative feasibility of implementing a technology. Effectiveness and implementability are incorporated into two screening categories: waste- and Site-limiting characteristics.

Waste-limiting characteristics primarily establish the effectiveness and performance of a technology; site-limiting characteristics affect the implementability of a technology. Waste-limiting characteristics consider the suitability of a technology based on contaminant types, individual compound properties (e.g., volatility, solubility, specific gravity, adsorption potential, and biodegradability), and interactions that may occur between mixtures of compounds (e.g., chemical reactions or increased solubility). Site-limiting characteristics consider the effect of site-specific physical features on the implementability of a technology, including topography, buildings, underground utilities, available space, and proximity to sensitive operations. Technology screening based on waste- and Site-limiting characteristics serves a twofold purpose of screening out technologies whose applicability is limited by Site-specific waste or Site considerations, while retaining as many potentially applicable technologies as possible.

Table 2.7 summarizes the technology screening process. Technologies and process options judged ineffective or not implementable were eliminated from further consideration. The technologies retained following screening represent an inventory of technologies considered most suitable for addressing soil, air, and groundwater at the Site. Technologies/process options retained in this section may be used either alone or integrated with other technologies to develop remedial alternatives. Treatability studies may be required prior to final technology selection to confirm effectiveness of the given technology. Table 2.8 lists the technologies and process options retained after screening.

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

The following subsections describe the development and screening of remedial alternatives.

3.1 DEVELOPMENT OF ALTERNATIVES

Technically feasible technologies that are retained following screening are combined to form remedial action alternatives that may be applicable to the Site, the contaminated media, and the contaminants of concern. Technologies that are potentially capable of attaining project RAOs are assembled, either singly or in combination, into remedial alternatives. At that point, the initial list of potential remedial alternatives is screened with respect to the following criteria: effectiveness; implementability; and cost in accordance with USEPA guidance. Potential remedial alternatives have been screened independently of one another. An evaluation of combining alternatives would be developed in the detailed analysis of alternatives.

The objective of the alternative screening step is to eliminate impractical alternatives or higher cost alternatives (i.e., order of magnitude cost differences) that provide little or no increase in effectiveness or implementability over their lower-cost counterparts. The effectiveness, implementability, and cost criteria used for screening the alternatives are defined below.

Effectiveness. Each alternative is evaluated for its ability to protect human health and the environment, including the extent to which toxicity, mobility, or volume of contaminants is reduced. Both short- and long-term effectiveness are considered. Short-term effectiveness involves the extent to which existing risks to receptors during the construction and implementation period are reduced, identifying and mitigating expected effects to the environment during construction and implementation, the alternative’s ability to meet RAOs, and the relative time frame required to achieve RAOs. Long-term effectiveness, which applies after RAOs have been attained, considers the magnitude of the remaining residual risk due to residual contaminant sources, and the adequacy and reliability of specific technical components and control measures to maintain compliance with RAOs over the life of the remediation.

Implementability. Each alternative is also evaluated in terms of technical and administrative feasibility. In the assessment of short-term technical feasibility, availability of a technology for construction or mobilization and operation, as well as compliance with action-specific ARARs during the remedial action, are considered. Long-term technical feasibility considers the ease of operation and maintenance (O&M), technical reliability, the ease of undertaking additional remedial actions, and the degree of monitoring of technical controls for residuals and untreated wastes. Administrative feasibility for implementing a given technology addresses coordination with other agencies, public acceptance, and the commercial availability of required services and trained specialists or operators.

Cost. Quantitative cost estimates are not developed during screening of alternatives. Rather, based on knowledge of relative costs, professional judgment is used to identify the relative cost-effectiveness of each alternative. Detailed cost evaluations are developed later in the FS process, as part of the detailed evaluation of those alternatives passing the screening process.

For each alternative, a table was developed highlighting the alternative's advantages and disadvantages with respect to effectiveness, implementability, and relative cost. Based on this table, a decision is made to either retain the alternative for detailed analysis or eliminate it from further consideration.

The No Action Alternatives for the various media are not evaluated according to the screening criteria. Rather; these will pass screening and be used as a baseline for comparing the performance of the alternatives undergoing detailed analysis.

3.1.1 Remedial Alternatives for Soil

Remedial alternatives for soil must address the potential for direct contact and ingestion risks to people using the Site; potential impacts to terrestrial invertebrates, worm-eating birds, and predatory birds; and leaching to groundwater. Based on the technologies that passed screening, the following soil remedial alternatives have been identified.

Alternative Soil-1: No Further Action. The No Further Action Alternative does not include any remedial action components to reduce or control potential risks from contaminated Site soil. The No Further Action Alternative will be evaluated during the detailed analysis as a baseline for comparison with other retained alternatives.

Alternative Soil-2: Limited Action/Institutional Controls. Alternative Soil-2 includes institutional controls to protect human health from risks associated with soil contamination at the Site.

Actions that would be taken under this alternative would include both institutional controls (e.g. zoning restrictions and/or deed covenants) and engineering controls (e.g. fencing and warning signs) to control access, and therefore, human exposure to contaminated soils. Restrictions would specifically limit excavations at the Site without proper protective measures to prevent exposure to soil contamination remaining in place as part of this alternative, and would limit future use at the Site to industrial or commercial activity only.

Site inspections would be conducted on a regular basis to evaluate the compliance and effectiveness of institutional controls at the Site. A summary of the Site inspection and results would be included in a summary report. Five-year review reports would present the results of environmental sampling and institutional control inspections and provide recommendations for future actions.

Alternative Soil-3: Soil Cover. This alternative would include the installation of a soil cover system over portions of the Site with a potential cancer risk above 10^{-6}, which is the most protective end of the NCP risk range of 10^{-4} to 10^{-6}(see Figure 2.5). The current estimate is that approximately 20.9 acres of the Site would have to be covered. The soil cover would consist of 6 inches of top soil and a minimum of 18 inches of clean fill to prevent direct contact with or ingestion of affected soils by humans and to protect potential ecological receptors. Institutional controls would be implemented to require appropriate health and safety measures for future construction or utility workers conducting excavation work at the Site. Site inspections would be conducted periodically to ensure the soil cover remains intact and that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports.

Alternative Soil-4: Limited Excavation, Offsite Disposal, and Soil Cover. This alternative would include the removal and offsite disposal at a landfill of up to 5 feet of contaminated soil from the northern portion of the Main Parcel and from a portion of the River Parcel. Figure 2.1 through 2.5 denote the areas for each exposure pathway at various risk levels where possible excavation would take place. When subsurface structures are encountered, the depth of the excavation would be to the depth of the structure. The River Parcel would be excavated to the extent feasible, given the proximity to the active railroad and the steepness of the bank along the river. It is estimated that a strip of surface soils of a minimum width of 10 feet along the property line shared with the railroad would remain, as it is not feasible to safely excavate these soils. A soil cover would be installed on the southern Main Parcel. Following backfilling of excavated areas, a soil cover may also be installed on the northern Main Parcel and on the River Parcel for some of the 10^{-4} excavation scenarios to address residual ecological risks. Institutional controls would be implemented and Site inspections would be conducted periodically to ensure that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports.

Alternative Soil-5: Extensive Excavation and Offsite Disposal. Under this alternative, soils that exceed the risk-based exposure criteria for organics would be excavated and disposed of offsite at an approved landfill. It is currently estimated that approximately 900,000 in-place cy of contaminated soil would be excavated. Soils in the vadose zone containing DNAPL, PAHs, VOCs and arsenic at concentrations that could pose a threat to groundwater would remain. An excavation of this size and depth would require a carefully developed excavation approach. Perimeter excavation walls would either need to be sloped to create stable sidewalls, or sheetpiling would need to be installed with additional bracing added as the excavation progressed to counteract lateral soil pressures. The complexity of the shoring and bracing system that would be required would add significant difficulty in implementing this alternative. Particular care would be necessary where existing structures (roadways, rail lines, utilities, etc.) require protection. Excavation would proceed in lifts, working across the Site in layers of approximately 10 to 15 feet. Soil ramps would be constructed to provide access for excavation and hauling equipment. Since workers would actually be located within the excavation, inhalation risks would need to be carefully monitored and controlled through the use of personal protective equipment. Excavation within the River Parcel would likely place excavation crews within the 100-year flood boundary, so adequate flood protection measures may need to be devised. With such a large open excavation, management of water from precipitation, runoff, and infiltration would be a major complicating factor in project execution. As the excavation depth approached the water table (or any potential zones of perched water), stability of the subsoils would need to be carefully evaluated to ensure adequate bearing capacity for excavation and hauling equipment. After completing the excavation, backfilling would be performed in sequential lifts to ensure stable and safe working conditions. A strategy for characterizing soils for disposal would need to be developed, as it would not be practical to temporarily stage the large quantities of excavated soils while awaiting analytical results. A transportation plan would also be required to deal with the extensive truck traffic necessary to accomplish offsite disposal of the excavated soils. Finding disposal sites with adequate capacity for this large quantity of soil would also pose a formidable challenge.

Alternative Soil-6: Limited Excavation, Onsite Consolidation and Soil Cover

This alternative would include the removal of up to 5 feet of contaminated soil from the northern portion of the Main Parcel and from a portion of the River Parcel. The excavated soil would then be consolidated onto the southern portion of the Main Parcel. Figure 2.5 denotes the areas for the most restrictive exposure pathway (i.e., outdoor worker) at various risk levels where possible excavation would take place. When subsurface structures are encountered, the depth of the excavation would be to the depth of the structure. The River Parcel would be excavated to the extent feasible, given the proximity to the active railroad. It is estimated that a strip of surface soils of a minimum width of 10 feet along the property line shared with the railroad would remain, as it is not feasible to safely excavate these soils. A soil cover would be installed on the southern portion of the Main Parcel. Institutional controls would be implemented and Site inspections would be conducted periodically to ensure that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports.

3.1.2 Remedial Alternatives for Air

Remedial alternatives for air address potential risks to future occupants of buildings that may be constructed on the Site and construction worker exposure during possible future subsurface construction. There are no unacceptable risks to receptors at the Site under current conditions that need to be addressed. Based on the technologies that passed screening, the following soil remedial alternatives have been identified:

Alternative Air-1: No Further Action. The No Further Action Alternative does not include any remedial action components to reduce or control potential future risks from air at the Site.

Alternative Air-2: Institutional Controls. This alternative would establish institutional controls, in the form of deed covenants to require the use of vapor barriers and/or sub-slab ventilation systems in any new construction of occupied buildings at the Site. With proper design and operation, vapor barriers and ventilation systems can effectively prevent the migration of soil vapors into indoor air. The institutional controls would also require that health and safety measures be implemented during any subsurface construction activities.

Technologies involving source removal did not pass the screening process, as it is impractical to remove contamination from the Site soils [particularly contaminated soils located within the saturated zone (i.e., 40 to 90 feet below ground surface)], or the Site groundwater (as long as DNAPL saturated soils will continue to act as a source for groundwater contamination).

3.1.3 Remedial Alternatives for Groundwater

Remedial alternatives for groundwater are intended to prevent offsite migration of impacted water, prevent the potable use of onsite groundwater, and if possible, restore groundwater. Based on the technologies that have passed screening, the following remedial alternatives have been identified for groundwater.

Alternative Groundwater-1: No Further Action. The No Further Action Alternative does not include any remedial action components to reduce or control potential risks from contaminated groundwater. Under this alternative, operation of the existing groundwater extraction and treatment system would cease. The No Further Action Alternative will be evaluated during the detailed analysis as a baseline for comparison with other retained alternatives.

Alternative Groundwater-2: Limited Action/Institutional Controls and Monitoring. Actions under this alternative would involve institutional controls (e.g., deed covenants, and/or groundwater use restrictions) to control human exposure to contaminated groundwater. The City has stated that it does not permit the installation of potable water wells. Under this alternative, operation of the existing groundwater extraction and treatment system would cease.

Five-year review reports would present the results of environmental sampling and institutional control inspections and provide recommendations for future actions.

Alternative Groundwater-3: Groundwater Collection/Treatment/Discharge. This alternative involves the continued operation of the existing (or expansion, if deemed necessary) groundwater collection and treatment system at the Site. The system provides collection of contaminated groundwater and DNAPL with extraction wells, treatment using granular activated carbon, and discharge of the treated groundwater to the Ohio River. This alternative provides both ex-situ treatment of groundwater and Site wide hydraulic containment, and prevents the transport of contamination off site. Provisions for expanding DNAPL recovery are also included in this alternative. The City was contacted to evaluate potential for discharge to a Publicly Owned Treatment Works (POTW). It was concluded that the City POTW would not be able to handle an additional flow of 200 to 300 million gallons per year, generated from the three operable units.

The current long-term groundwater monitoring program would be expanded to evaluate the effectiveness of the expanded groundwater control and DNAPL collection programs.

The City currently prohibits the installation of groundwater wells for potable use. There would also need to be a restriction (i.e. institutional contact) of groundwater wells for other uses that could adversely affect the groundwater capture system.

Five-year review reports would present the results of environmental sampling and institutional control inspections and provide recommendations for future actions.

Alternative Groundwater-4: Low-Permeability Cover. Alternative Groundwater-4 would include the installation of a low-permeability cover over the contaminated portions of the Site to reduce the infiltration of precipitation and the associated leaching of Site-related contaminants to groundwater. The low-permeability cover system would consist of six inches of top soil and a minimum of 18 inches of clay with a maximum permeability of $1x10^{-6}$ centimeters/ second. This alternative would include the expanded groundwater and DNAPL collection programs, institutional controls, and groundwater monitoring described in Alternative Groundwater-3.

Monitoring and maintenance activities would include routine inspections of the integrity of the cover, and long-term groundwater monitoring. Because contaminants would remain on Site above risk-based levels, five-year reviews would be conducted.

3.1.4 Remedial Alternatives for Sediment

Remedial alternatives were developed for sediment to address the potential for direct contact to people that use the river for wading/swimming and direct contact to benthic invertebrates from PAH impacted sediments in excess of PRGs. Based on the technologies that passed screening, the following remedial alternatives have been identified:

Alternative Sediment-1: No Further Action. The No Further Action Alternative does not include any remedial action components to isolate or reduce contaminant concentrations in sediment or control potential risks from exposure to contaminated sediment by implementing institutional controls or by environmental monitoring. Site reviews would not be performed as part of this alternative.

Alternative Sediment-2: Monitored Natural Recovery. Monitored natural recovery (MNR) involves leaving the sediments in place and allowing ongoing aquatic, sedimentary, and biological processes to reduce the bioavailability of the contaminants to protect receptors. The implementation of MNR requires an initial assessment of the Site and then monitoring every five years. If it is determined that natural recovery is not occurring at a rate sufficient to reduce risks within an acceptable time frame, enhanced natural recovery may be implemented. Enhanced natural recovery consists of methods (e.g., placing a thin layer of clean sediment over the contaminated sediment) to accelerate the recovery process. The Site would be further monitored over time to confirm the potential for risk-reduction processes.

Typically, long-term monitoring commences five years following the baseline study and every five years after that. The results of each monitoring event would be evaluated against PRGs and compared with the baseline study and previous monitoring events.

Alternative Sediment-3: In-Situ Capping: The contaminated sediment exceeding PRGs would be covered with either earthen materials (such as sand, gravel, and/or cobbles), engineered materials (such as, geosynthetics or marine mattresses), or a combination of these materials. Design and material selection depends on the physical characteristics of the waterway, and long-term plans for the area (i.e., development and maintenance activities).

The integrity and effectiveness of the cap would be monitored every five years, and/or following a 100-year storm event. Monitoring may include sampling and analysis and visual inspections by divers. Institutional controls would be established to protect the cap.

Alternative Sediment-4: Dredging and Offsite Disposal: Contaminated sediment would be removed using dredging techniques appropriate for the sediment and site conditions. Prior to dredging, the work area may be bordered by turbidity curtains, which are made of materials that are permeable to water but prevent migration of suspended solids and are installed vertically in the water by anchoring to the bottom of the river. If the river flow velocities are too great to use turbidity curtains, other turbidity control alternatives may be considered. Turbidity levels in the river would be measured and compared with PRGs during dredging to ensure suspended solids are not migrating downstream.

During design, methods to dewater excavated sediment will be evaluated. This would include evaluating the potential use of geotubes located in a containment area for dewatering. Water generated during the dewatering process would be treated by the onsite waste-water treatment system. If necessary, water may need to be stored in above-ground tanks or frac tanks until treatment. Following dewatering, the sediment would be transported off Site to an approved landfill and disposed.

Because of the practical limitations of removing sediment in a dynamic river environment, some residual contaminated sediment may remain at the Site. Following the completion of dredging, verification sample collection would be attempted to assess whether residuals are present. If verification samples can be collected and the results indicate that PAHs remain at concentrations exceeding the PRGs, a residual management plan may be implemented.

Alternative Sediment-5: Combination of Dredging and Offsite Disposal In-situ Capping: This alternative combines capping and dredging. Alternative Sediment – 3 and Alternative Sediment – 4. This alternative would include all of the procedures, controls, and residual management activities discussed in Alternative Sediment - 3 and Alternative Sediment - 4.

3.2 SCREENING OF ALTERNATIVES

The objective of the alternative screening step is to eliminate impractical alternatives or higher cost alternatives that provide little or no increase in effectiveness or implementability over their lower-cost counterparts. Tables 3.1 through 3.4 summarize the screening results for each affected environmental medium. The following alternatives were retained for detailed evaluation in Section 4:

Soil

Alternative Soil-1: No Further Action

Alternative Soil-3: Soil Cover

Alternative Soil-4: Limited Excavation, Offsite Disposal, and Soil Cover

Alternative Soil-6: Limited Excavation, Onsite Consolidation and Soil Cover

Air

Alternative Air-1: No Further Action

Alternative Air-2: Institutional Controls

Groundwater

Alternative Groundwater-1: No Further Action

Alternative Groundwater-3: Groundwater Collection/Treatment/Discharge

Alternative Groundwater-4: Low-Permeability Cover

Sediment

Alternative Sediment-1: No Further Action

Alternative Sediment-2: Monitored Natural Recovery

Alternative Sediment-3: In-Situ Capping

Alternative Sediment-4: Dredging and Offsite Disposal

Alternative Sediment-5: Combination of Dredging and Offsite Disposal and In-Situ Capping

4.0 DETAILED ANALYSIS OF ALTERNATIVES

This section presents the detailed analysis of remedial action alternatives for soil, air, groundwater, and sediment. The detailed analysis is intended to provide decision-makers with information to aid in selection of a remedial alternative that best meets the following CERCLA requirements:

- Protects human health and the environment
- Attains ARARs (or provides grounds for invoking a waiver)
- Utilizes permanent solutions and alternative treatment technologies or resource-recovery technologies to the maximum extent practicable
- Satisfies the preference for treatment that reduces toxicity, mobility, or volume of hazardous substances as a principal element
- Is cost effective.

The detailed analysis was performed in accordance with CERCLA Section 121, the NCP, USEPA, 1990, and USEPA RI/FS guidance (USEPA, 1988b). The detailed analysis contains the following:

- A detailed description of each candidate remedial alternative, emphasizing the application of various component technologies; and
- An assessment of each alternative compared to the first seven of the nine evaluation criteria described in the NCP (USEPA, 1990).

The detailed description of technologies or processes used for each alternative includes, where appropriate, preliminary Site layouts and a discussion of limitations, assumptions, and uncertainties for each component. The descriptions provide a conceptual design of each alternative. Remedial alternatives are then evaluated according to the first seven of nine NCP evaluation criteria. The nine NCP evaluation criteria are defined in the following paragraphs as they pertain to this FS.

Overall Protection of Human Health and the Environment - This criterion assesses how well an alternative, as a whole, achieves and maintains protection of human health and the environment.

Compliance with ARARs – This criterion assesses how the alternative complies with location-, chemical-, and action-specific ARARs, and whether a waiver is required or justified.

Long-Term Effectiveness and Permanence – This criterion evaluates the effectiveness of the alternative in protecting human health and the environment after response objectives have been met. This criterion includes consideration of the magnitude of residual risks and the adequacy and reliability of controls.

Reduction of Toxicity, Mobility, and Volume through Treatment – This criterion evaluates the effectiveness of treatment processes used to reduce toxicity, mobility, and volume of hazardous substances. It also considers the degree to which treatment is irreversible, and the type and quantity of residuals remaining after treatment.

Short-Term Effectiveness – This criterion examines the effectiveness of the alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met. It also considers the protection of the community, workers, and the environment during implementation of remedial actions.

Implementability – This criterion assesses the technical and administrative feasibility of an alternative and availability of required goods and services. Technical feasibility considers the ability to construct and operate a technology and its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a remedy. Administrative feasibility considers the ability to obtain approvals from other parties or agencies and the extent of required coordination with other parties or agencies.

Cost – This criterion evaluates the capital, and operation and maintenance costs of each alternative. Present worth costs are presented to help compare costs among alternatives.

State Acceptance – This criterion considers the state's preferences among or concerns about the alternatives, including comments on ARARs or proposed use of waivers. This criterion is addressed following state inputs on the FS and Proposed plan.

Community Acceptance – This criterion considers the community's preferences or concerns about the alternatives. This criterion is addressed following community input on the FS and Proposed Plan.

The detailed analysis of each alternative includes an estimate of the time necessary for completion of the alternative (i.e., remedial duration) and a cost estimate. The time frame estimates were based on published construction scheduling material and professional judgment.

Costs are presented as a present worth and as a total cost for the lifetime of the remedial alternative based on the estimated clean-up time (USEPA, 2000). Tables presenting a summary of the costs for each alternative and identifying capital, operation and maintenance, total, and present worth costs are included in each alternative's cost description.

Costs are intended to be within the target accuracy range of minus 30 percent to plus 50 percent of actual cost (USEPA, 1988b). Assumptions used to develop and cost alternatives may or may not remain valid during alternative implementation.

Each cost estimate includes a present worth analysis to evaluate expenditures that occur over different time periods. The analysis discounts future costs to a present worth and allows the cost of remedial alternatives to be compared on an equal basis. Present worth represents the amount of money that, if invested now and disbursed as needed, would be sufficient to cover costs associated with the remedial action over its planned life. Consistent with USEPA guidance (USEPA, 2000), a discount rate of 5 percent was used to prepare the cost estimates (OMB, 2005).

Each cost estimate includes the following items, as applicable:

- Engineering design as a percentage of direct capital costs
- Project and construction management, including health and safety, legal, and administrative fees, as a percentage of direct capital costs
- A contingency to account for unforeseen project complexities such as adverse weather, the need for additional and unexpected Site characterization, and increased construction standby times as a percentage of direct capital costs
- Operation, maintenance, and monitoring cost

Details and assumptions pertaining to the cost estimates are also included in each alternative's cost description. Detailed cost estimates are contained in Appendix E.

4.1 DETAILED ANALYSIS OF SOIL ALTERNATIVES

The following alternatives underwent a detailed evaluation using the seven criteria:

- Alternative Soil-1: No Further Action
- Alternative Soil-3: Soil Cover
- Alternative Soil-4: Limited Excavation, Offsite Disposal and Soil Cover
- Alternative Soil-6: Limited Excavation, Onsite Consolidation, and Soil Cover

4.1.1 Alternative Soil-1: No Further Action

Alternative Soil-1, the No Further Action alternative, was retained as a baseline with which to compare the other alternatives, as required by the NCP. This alternative would not include remedial action components to contain or reduce contaminant concentrations in the soil, nor would Alternative Soil-1 control potential risks from exposure to contaminated soil by implementing institutional controls or environmental monitoring. Site reviews would not be performed as part of this alternative.

4.1.1.1 Overall Protection of Human Health and the Environment

The HHRA identified potential risks to human receptors at the Site under current land use conditions which were not within acceptable risk guidelines. Direct contact with surface soil and subsurface soil at the Main Parcel, and surface soil at the River Parcel, is associated with cancer risks (primarily due to PAHs) that exceed applicable NCP and OEPA risk management criteria. The SERA identified potential risks to ecological receptors in, generally, the same areas where potential concern for human receptors was also identified. Alternative Soil-1 does not include any actions to prevent future human or ecological exposures to the soil and is not considered protective of human-health and the environment.

4.1.1.2 Compliance with ARARs

Chemical-specific ARARs triggered by Alternative Soil-1 are presented in Table 4.1. The No Further Action alternative does not include any actions to reduce exposure to contamination in surface soils or subsurface soils of the Main Parcel or the River Parcel; therefore, chemical-specific ARARs would not be attained.

No action-specific or location-specific ARARs would be triggered by this alternative.

4.1.1.3 Long-Term Effectiveness and Permanence

No controls for exposure and no long-term management measures would be taken. As a result, there would not be long-term effective or permanent control on current and potential future risks.

4.1.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative Soil-1 would not provide any reduction in toxicity, mobility, or volume of contaminated soil through removal or treatment.

4.1.1.5 Short-Term Effectiveness

Alternative Soil-1 would not provide any short-term protectiveness or create any additional risks posed to the community, workers, or the environment.

4.1.1.6 Implementability

There are no implementability concerns associated with Alternative Soil-1, since no action would be taken.

4.1.1.7 Cost

The present worth and capital costs of Alternative Soil-1 are presented in table 4.4 and are estimated to be $0, since there would be no action (see Appendix E).

4.1.2 Alternative Soil-3: Soil Cover

This alternative would include the installation of a soil cover system over portions of the Site with soil contamination with a potential cancer risk above 10^{-6}, which is the conservative end of the NCP risk range of 10^{-4} to 10^{-6} and below the OEPA target of 10^{-5}. Areas identified as having a potential ecological risk would also be covered. As shown on figure 2.5, the covered area would include the majority of the area on the Main Parcel and River Parcel. The soil cover system would create a physical barrier to direct contact with contaminated soils by human and ecological receptors. Institutional controls would be implemented, and Site inspections conducted periodically to ensure the soil cover remains intact and that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports. The following key components are described further:

- Pre-Design Studies
- Installation of a Soil Cover
- Institutional Controls and Inspections
- Five-Year Review

<u>Pre-Design Studies</u>
Pre-design studies would include a topographic survey of the Main Parcel and River Parcel.

<u>Installation of Soil Cover</u>
Because of the differences in construction on the Main Parcel and the River Parcel, this section of the alternative has been split into the Main Parcel and the River Parcel.

Main Parcel – The Main Parcel consists on 16.1 acres. Existing information indicates that the shallow and deep soil is contaminated with PAHs. BTEX compounds are found in shallow soils over the majority of the parcel and found in deep soils only on the south half. Arsenic is also found in shallow and deep soils with no apparent pattern. Alternative Soil-3 includes grading of the current Site surface, followed by the installation of a geotextile, which would then be covered by a minimum of 18 inches of clean fill, followed by 6 inches of topsoil and seeding. As part of installing the cover system, some Site soils would be excavated and either used on Site as fill or disposed off Site. This would include the removal of soil along the property perimeter to allow proper grading to the adjacent properties. Materials showing visual evidence of free flowing tar would be segregated and disposed of off Site. The final Site grade would be designed to allow flexibility in redevelopment and promote drainage of Site. Clean runoff from the Site would be managed appropriately. To further prepare the Site for redevelopment, the existing aboveground piping would be replaced with underground piping and the above ground structures (i.e., metal shed, retaining walls, and sumps) and debris piles would be removed.

River Parcel – The River Parcel consists of 4.8 acres along the Ohio River and lies within the 100 year flood plain. It is bordered by a very active railroad line that, according to railroad officials, may be expanded. From the railroad right-of-way, the parcel slopes steeply to the Ohio River. Existing information indicates that high PAHs were identified only in shallow soils north of the elevated pipeline leading from the dock to the former plant. Alternative Soil-3 proposes clearing and grubbing 4 acres of the River Parcel; grading to achieve the necessary slope along the river bank; installation of a geotextile fabric; soil cover consisting of 6 inches of top soil and a minimum of 18 inches of clean fill to prevent direct contact with or ingestion of affected soils by humans and to protect potential ecological receptors; and restoration of the river bank. Trees would be planted to anchor the embankment while improving riverbank aesthetics.

The length of the river bank where the soil cover would be installed would be restored and stabilized by installing a geotextile and then installing dump rock or riprap onto the bank. The size, the depth, and the elevation on the bank would be dictated by the river hydrology, but for the purposes of this study, it has been assumed that Class A size rock, 3 feet deep, would be installed to the top of the bank. As part of installing the rock toe, it may be necessary to remove sediment along the bank. Highly contaminated sediment would be disposed at a permitted offsite facility. At the normal pool elevation, the dump rock would be mixed with soil and live posts would be inserted between the rocks. These posts would be willow and cottonwood and will grow to trees. Above the dump rock toe, the bank would be shaped to the necessary slope, seeded with native grasses and a temporary seed matrix, mulched, and covered with a 900 gram woven coir blanket. The entire bank of the river would be planted with native shrubs and trees supplied in 2-gallon containers. A swale would be installed at the top of the bank to prevent surface flow from running onto the bank. At four locations, flow would be concentrated and run down the bank on a dumprock swale. The premise of this alternative is that it is environmentally friendly and self sustaining. The vegetation is self renewing and the banks increase in strength over time. Burrowing wildlife is not a concern in the long-term because the banks are self repairing as they would be in nature. Other options (e.g., rip rap along the entire face of the bank and/or an interlocking concrete and cable system) were considered but are not recommended since they are less consistent with the environment and not as pleasing aesthetically.

Institutional Controls and Inspections

This alternative also includes institutional controls in the form of land-use restrictions requiring that land use remains industrial. Additional restrictions would also require maintenance of the cover and use of appropriate health and safety measures for future construction or utility workers conducting excavation work on the Site. Restrictive covenants would be properly recorded in the property records.

An ICMP would be prepared for the Site. The ICMP would detail the land-use restrictions to be incorporated. The ICMP would include a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the onsite inspection would include review of the integrity of the soil cover, review of physical barriers, such as fencing to insure its integrity, verifying warning signs are in place and intact, and no structure or pavement has been disturbed or removed. For cost estimating purposes, it is assumed that the institutional control inspections would be performed once per year.

Five-Year Site Reviews

Under CERCLA 121(c), any remedial action that results in contaminants remaining on Site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year Site reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The USEPA document *Comprehensive Five-Year Review Guidance* (USEPA, 2001a) provides guidance on the performance of five-year reviews. The five-year review for this alternative would be considered a statutory review.

The five-year review for this alternative would consist of conducting a Site visit and interviews, evaluating environmental monitoring data, institutional control inspection reports, and reviewing the Record of Decision requirements and ARARs. The assumptions of the risk assessment would be reviewed for appropriateness and upon consideration of available monitoring data, ARARs, institutional control inspection reports, and results of the Site visit and interviews, a conclusion would be made concerning the protectiveness of the remedy. The review would assess/recommend whether institutional controls should be continued. If contaminant concentrations remain above the cancer risk and non-cancer hazard index in excess of NCP and OEPA risk management criteria, the data and inspections reports would be evaluated to confirm that the alternative continues to be protective of human health and the environment.

The Site reviews would consider benefits of new or emerging technologies that may improve remedial performance.

4.1.2.1 Overall Protection of Human Health and the Environment

The HHRA identified potential risks to human receptors under current and future land-use conditions. Direct contact with surface soil and subsurface soil at the Main Parcel, and surface soil at the River Parcel, is associated with cancer risks (primarily due to PAHs) that exceed applicable NCP and OEPA risk management criteria. The SERA evaluated potential adverse impacts to ecological receptors due to possible exposures to soil, and PAHs in soil may present a potential hazard to soil invertebrates, worm-eating birds, and predatory birds.

The combination of soil cover, institutional controls, and five-year reviews would provide for protection of humans to the $1x10^{-6}$ risk level and would provide protection of ecological receptors. As a result, Alternative Soil-3 is protective of human health and the environment under future land-use conditions.

4.1.2.2 Compliance with ARARs

Alternative Soil-3 would comply with the chemical specific ARARs indicated in Table 4.1 by covering and restricting access to soils with Site contaminant levels exceeding the selected remedial action goals.

Field activities performed as part of this alternative would include pre-design activities, the installation of a soil cover, and sampling of groundwater monitoring wells. To the extent that these activities take place in flood plain areas the location-specific ARARs in Table 4.2 would apply. It is expected that all such activities can be designed and implemented to comply with location-specific ARARs.

Action-specific ARARs that may be triggered by Alternative Soil-3 are listed in Table 4.3. It is expected that all activities can be designed and implemented to comply with action-specific ARARs.

4.1.2.3 Long-Term Effectiveness and Permanence

For both the Main Parcel and River Parcel, this alternative relies on a soil cover that provides a physical barrier for separation of the contaminated soils, and human and ecological receptors. A cap maintenance plan will be developed. Maintenance of the cover would provide long-term effective protection of potential receptors. The river bank restoration would be designed to withstand high velocities, a moderate depth scour, wave action, ice heaving, and debris being dragged across the face. The toe would be relatively impenetrable to wildlife. The geotextile would allow water to flow through it, but would not allow fine materials to pass. It is robust enough to withstand tearing as the rock is placed on it. Both the rock and geotextile have a design life that far exceeds 50 years. The live posts would reduce velocities along the edge of the bank and fill the voids between the rock. Silt would be trapped and vegetation growth would cover the bank. Debris and ice would wear on vegetation. The bank treatment above the rock toe would be robust in the long-term. The deep rooted trees would result in strong soil stability.

4.1.2.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Under this alternative, free flowing tars encountered during the remedial activities would be segregated and disposed off Site at a facility permitted to dispose of such wastes. In addition, impacted sediment would be excavated, as part of installing the rip rap toe during river bank restoration and would be disposed at a permitted offsite disposal facility. The mobility of contaminants within Site soils would be reduced by covering them, thereby reducing the potential for spreading of the contaminants via direct contact, surface water runoff and/or dust.

4.1.2.5 Short-Term Effectiveness

The soil cover could be installed relatively quickly, resulting in effective protection over the short-term. The construction activities associated with this alternative would pose some risks to the community and to construction workers from dust; however, appropriate measures would be in place to properly manage risks. Erosion control measures would also be in place for proper management of soil erosion.

4.1.2.6 Implementability

The key components of this alternative (i.e., installation of a soil cover, riverbank restoration, implementation of institutional controls, and five-year reviews) are all readily implementable.

All portions of this alternative on the Main Parcel and River Parcel would be visible for monitoring except for measures that occur under water. The toe should be monitored as it is installed and during drought conditions when the river is low.

The ability to coordinate and obtain approvals from agencies would be straightforward for soil cover over the Main Parcel and River Parcel. Riverbank restoration would require coordination with the Corps of Engineers and OEPA.

Work along the River Parcel would require close coordination with the railroad. Construction firms are available to perform the work. Any necessary borrow material is readily available within short distances from a number of sources.

The ability to construct on the banks of the Ohio River would be dependent upon the river elevation and this should be coordinated with the Corps of Engineers (who is responsible for maintaining river elevations). River bank restoration and bioengineering requirements would dictate the time of year that the construction can occur, may limit the contractors qualified to perform the work, and would require coordination with nurseries.

4.1.2.7 Cost

Table 4.4 presents a summary of the estimated present worth costs to implement Alternative Soil-3. The present worth for Alternative Soil-3 is estimated to be approximately $3.9 M. The cost estimate assumes that soil cover maintenance would be performed for 30 years. Detailed cost estimates are presented in Appendix E.

4.1.3 Alternative Soil-4: Limited Excavation, Offsite Disposal, and Soil Cover

This alternative would include the removal and offsite disposal at a landfill of up to 5 feet of contaminated soil from the northern portion of the Main Parcel and from a portion of the River Parcel. Figures 2.1 through 2.5 denote the areas for each exposure pathway at various risk levels where possible excavation would take place. A soil cover would be installed on the southern Main Parcel, and on areas of the northern Main Parcel and River Parcel under those excavation scenarios where potential ecological risks would remain after excavation. Areas of the riverbank disturbed by excavation on the River Parcel would be restored as described in Alternative Soil-3 (soil cover). The risk ranges, in conjunction with the ranges in exposure pathways, result in a wide range of areas and volumes of soils that could be removed under this alternative. The ranges of volumes and associated costs have been carried through this evaluation for use in risk management decision-making.

Institutional controls would be implemented, and Site inspections conducted periodically to ensure the soil cover remains intact and that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports. The following key components are described further:

- Pre-Design Studies
- Excavation of Shallow Soil
- Installation of a Soil Cover
- Institutional Controls and Inspections
- Five-Year Review

Pre-Design Studies

Pre-design studies would include a topographic survey of the Main Parcel and River Parcel.

Excavation of Shallow Soil

Alternative Soil-4 includes excavation of up to 5 feet of contaminated soil from the northern portion of the Main Parcel, based on the selected risk-based criteria. When subsurface structures are encountered, the depth of the excavation would be to the depth of the structure. The River Parcel, while not recommended given the proximity of the active rail line, would be excavated to the extent feasible. It is assumed that a strip of surface soils a minimum of 10 feet wide along the property line shared with the railroad would remain, as it is not feasible to safely excavate these soils. The required distance would be finalized with the railroad during design. Excavated soil would be transported to and disposed at a permitted offsite facility.

Installation of Soil Cover

The cover systems previously described in subsection 4.1.2 (Alternative Soil-3: Soil Cover) would also be installed at the southern portion of the Main Parcel Under some excavation scenario, a soil cover may also be installed on the northern Main Parcel and the River Parcel for protection of residual ecological risks. A soil cover would be installed on the southern Main Parcel, and on areas of the northern Main Parcel and River Parcel under those excavation scenarios where potential ecological risks would remain after excavation. To install the cover system, to keep the property attractive for redevelopment, and to promote positive Site drainage, more significant grading would be required than under the previous alternative. Backfill from offsite sources would likely be required.

Institutional Controls and Inspections

The institutional controls and inspections described previously in subsection 4.1.2 (Alternative Soil-3: Soil Cover) would be implemented under this alternative except for the northern Main Parcel and the River Parcel where maintenance of the soil cover would not be necessary. Institutional controls to prevent vapor intrusion to indoor air and to protect construction workers would still be necessary on the northern Main Parcel and the River Parcel.

Five-Year Site Reviews

The five-year reviews described previously in subsection 4.1.2 (Alternative Soil-3: Soil Cover) would be implemented under this alternative.

4.1.3.1 Overall Protection of Human Health and the Environment

The HHRA identified potential risks to human receptors under current and future land-use conditions. Direct contact with surface soil and subsurface soil at the Main Parcel, and surface soil at the River Parcel, is associated with cancer risks (primarily due to PAHs) that exceed applicable NCP and OEPA risk management criteria. The SERA evaluated potential adverse impacts to ecological receptors due to possible exposures to soil, and PAHs in soil may present a potential hazard to soil invertebrates, worm-eating birds, and predatory birds.

Excavation of the northern Main Parcel soils and a portion of the River Parcel, with offsite disposal, would address human health risk to the risk level used to define the extent of excavation (see Figure 2.5) and remaining ecological risks would be addressed by the cover. Collectively, the excavation, the soil covering, institutional controls, and five-year reviews would address human health risks and ecological risks. As a result, Alternative Soil-4 is protective of human health and the environment under future land-use conditions.

4.1.3.2 Compliance with ARARs

Alternative Soil-4 would comply with the chemical specific ARARs indicated in Table 4.1 by excavating, covering and/or restricting access to soils with Site contaminant levels exceeding the selected remedial action goals.

Field activities performed as part of this alternative would include pre-design activities, excavation of up to 5 feet of contaminated soil, and the installation of a soil cover. To the extent that these activities take place in wetland or flood plain areas, the location-specific ARARs in Table 4.2 would apply. It is expected that all such activities can be designed and implemented to comply with location-specific ARARs.

Action-specific ARARs that may be triggered by Alternative Soil-4 are listed in Table 4.3. It is expected that all activities can be designed and implemented to comply with action-specific ARARs.

4.1.3.3 Long-Term Effectiveness and Permanence

This alternative includes removal of a portion of the contaminated soils from the northern portion of the Main Parcel and a portion of the River Parcel, followed by soil cover across the southern Main Parcel and under certain excavation scenario, portions of the northern Main Parcel and the River Parcel. A cover maintenance plan would be developed. Removal of soils, maintenance of the cover, and institutional controls to prevent vapor intrusion to indoor air and health and safety measures to protect excavation workers, would provide long-term effective protection of potential receptors. The river bank restoration would be designed for long-term protection, as previously described in subsection 4.1.2 (Alternative Soil-3: Soil Cover).

4.1.3.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Under this alternative, free flowing tars would be segregated and disposed off Site at a facility permitted to dispose of such wastes. In addition, impacted sediment would be excavated, as part of installing the rip rap toe during the river bank restoration and would be disposed at a permitted offsite disposal facility. The mobility of contaminants within Site soils would be reduced by a combination of excavation and offsite disposal and covering them, thereby reducing the potential for spreading of the contaminants via direct contact, surface water runoff and/or dust.

4.1.3.5 Short-Term Effectiveness

Offsite transportation of excavated soils would pose a risk over the short-term due to the potential for traffic accidents and dust from the trucks. More easily controlled are the risks directly associated with onsite work, such as dust. Dust control measures would be instituted to protect both onsite and offsite receptors and health and safety measures to protect workers from exposures would also be used. The River Parcel would be vulnerable to flooding of the adjacent Ohio River during installation and establishment of the soil cover and bioengineering system.

4.1.3.6 Implementability

The key components of this alternative (i.e., soil excavation, transport and disposal, installation of a soil cover, riverbank restoration, implementation of institutional controls, and five-year reviews) are all implementable. However, the degree which soil can be excavated safely on the River Parcel is a very significant implementation issue that would need to be worked out with the railroad.

All portions of this alternative on the Main Parcel and River Parcel would be visible for monitoring except for measures that occur under water. The toe should be monitored as it is installed and during drought conditions when the river is low.

Construction firms are available to perform the work. The borrow material is readily available within short distances from a number of sources. There is a chance that some problems could arise when excavating the Main Parcel due to underground structures that still exist near the surface (approximately 2 feet below ground surface).

The ability to construct on the banks of the Ohio River would be dependent upon the river elevation and this should be coordinated with the Corps of Engineers and OEPA. River bank restoration and bioengineering requirements would dictate the time of year that the construction can occur, may limit the contractors qualified to perform the work, and would require coordination with nurseries.

4.1.3.7 Cost

Table 4.4 presents a summary of the estimated present worth costs to implement Alternative Soil-4. The present worth for Alternative Soil-4 is estimated to be (depending on the excavation scenario) between approximately $4.4 M to $12.4 M. The cost estimate assumes that soil cover maintenance would be performed for 30 years. Detailed cost estimates are presented in Appendix E.

4.1.4 Alternative Soil-6: Limited Excavation, Onsite Consolidation and Soil Cover

This alternative would include the removal of up to 5 feet of contaminated soil from the northern portion of the Main Parcel and from a portion of the River Parcel. The excavated soil would then be consolidated onto the southern portion of the Main Parcel. Figure 2.5 denotes the areas for the most restrictive exposure pathway, (i.e., outdoor worker), at various risk levels, where possible excavation would take place. The southern Main Parcel would be covered to address human health and ecological risks associated with the contaminated soil. Areas of the riverbanks disturbed by the excavation would be restored as descried in Alternative Soil-3. The risk ranges result in ranges of areas and volumes of soils that could be removed under this alternative. The ranges of volumes and associated costs have been carried through this evaluation for use in risk management decision-making.

Institutional controls would be implemented, and Site inspections conducted periodically to ensure that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports. The following key components are described further:

- Pre-Design Studies
- Excavation of Shallow Soil
- Soil Consolidation and Installation of a Soil Cover
- Institutional Controls and Inspections

- Five-Year Review

Pre-Design Studies

Pre-design studies would include a topographic survey of the Main Parcel and River Parcel, and Geotech study for stream bank restoration.

Excavation of Shallow Soil

Alternative Soil-6 includes excavation of up to 5 feet of contaminated soil from the northern portion of the Main Parcel, based on the selected risk-based criteria. When subsurface structures are encountered, the depth of the excavation would be to the depth of the structure. The River Parcel, while not recommended, given the proximity of the active rail line would be excavated to the extent feasible. It is assumed that a strip of surface soils a minimum of 10 feet wide along the property line shared with the railroad would remain as it is not feasible to safely excavate these soils. The required distance would be finalized with the railroad during design. Excavated soil would be transported to and disposed at a permitted offsite facility.

Soil Consolidation and Installation of Soil Cover

Excavated soil would be consolidated onto the southern portion of the Main Parcel. Significant grading and offsite sources of backfill would be required to keep the property attractive for redevelopment and to promote positive drainage. A soil cover as described in Alternative Soil-3 would be installed on the southern Main Parcel. Areas of the riverbank disturbed by excavation on the River Parcel would be restored as described in Alternative Soil-3. This alternative also includes converting the existing stick-up wells to flush-mount wells and converting aboveground piping to underground piping for redevelopment purposes; removal of debris; demolition of above ground structures (i.e., metal shed, retaining walls and sumps); grading the Main Parcel for stormwater containment and collection; construction of a stormwater collection system; and restoration of the entire Main Parcel with topsoil, and grass.

Institutional Controls and Inspections

This alternative also includes institutional controls in the form of land-use restrictions requiring that land use remains industrial. Additional restrictions would also require maintenance of any areas where a soil cover was installed and the use of appropriate health and safety measures for future construction or utility workers conducting excavation work at any location on the Site below clean fill or the soil cover. Restrictive covenants would be properly recorded in the property records.

An ICMP would be prepared for the Site. The ICMP would detail the land-use restrictions to be incorporated. The ICMP would include a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the onsite inspection would include review of the integrity of the soil cover review of physical barriers, such as fencing to insure its integrity, verifying warning signs are in place and intact, and no structure or pavement has been disturbed or removed. For cost estimating purposes, it is assumed that the institutional control inspections would be performed once per year.

Five-Year Site Reviews

The five-year reviews described previously in subsection 4.1.2 (Alternative Soil-3: Soil Cover) would be implemented under this alternative.

4.1.4.1 Overall Protection of Human Health and the Environment

The HHRA identified potential risks to human receptors under current land-use conditions. Direct contact with surface soil and subsurface soil at the Main Parcel, and surface soil at the River Parcel, is associated with cancer risks (primarily due to PAHs) that exceed applicable NCP and OEPA risk management criteria. The SERA evaluated potential adverse impacts to ecological receptors due to possible exposures to soil, and PAHs in soil may present a potential hazard to soil invertebrates, worm-eating birds, and predatory birds.

Consolidation of the northern Main Parcel and a portion of the River Parcel soils onto the southern portion of the Main Parcel, followed by soil cover, with institutional controls and five-year reviews, would address human health risks and ecological risks. As a result, Alternative Soil-6 is protective of human health and the environment under future land-use conditions.

4.1.4.2 Compliance with ARARs

Alternative Soil-6 would comply with the chemical-specific ARARs indicated in Table 4.1 by excavating, covering and/or restricting access to soils with Site contaminant levels exceeding the selected remedial action goals.

Field activities performed as part of this alternative would include pre-design activities, excavation of up to 5 feet of contaminated soil, and the installation of a soil cover. To the extent that these activities take place in wetland or flood plain areas the location-specific ARARs in Table 4.2 would apply. It is expected that all such activities can be designed and implemented to comply with location-specific ARARs.

Action-specific ARARs that may be triggered by Alternative Soil-6 are listed in Table 4.3. It is expected that all activities can be designed and implemented to comply with action-specific ARARs.

4.1.4.3 Long-Term Effectiveness and Permanence

This alternative includes removal of a portion of the contaminated soils from the northern portion of the Main Parcel and a portion of the River Parcel, followed by soil cover on the southern Main Parcel. A cap maintenance plan would be developed. Soil consolidation, maintenance of the cover, and institutional controls to prevent vapor intrusion to indoor air and health and safety measures to protect excavation workers, would provide long-term effective protection of potential receptors. The river bank restoration would be designed for long-term protection, as previously described in subsection 4.1.2 (Alternative Soil-3: Soil Cover). The long-term impact of excavation and backfilling work in the vicinity of the rail line is uncertain. Performance of the railroad bed after the "unloading" of the soils in the vicinity of the bed by removing 5 feet of soil, followed by replacing the soils would have inherent uncertainty, particularly during flooding events.

4.1.4.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Under this alternative, free flowing tars would be segregated and disposed off Site at a facility permitted to dispose of such wastes. In addition, impacted sediment would be excavated, as part of installing the rip rap toe during river bank restoration and would be disposed at a permitted offsite disposal facility. The mobility of contaminants within Site soils would be reduced by a combination of excavation, onsite consolidation, and covering them thereby reducing the potential for spreading of the contaminants via direct contact, surface water runoff and/or dust.

4.1.4.5 Short-Term Effectiveness

Under this alternative, there would be no offsite transportation of excavated soils to pose a risk over the short-term due to the potential for traffic accidents and dust from the trucks. Onsite dust control measures would be instituted to protect both onsite and offsite receptors and health and safety measures to protect workers from exposures would also be used. The River Parcel would be vulnerable to flooding of the adjacent Ohio River during installation and establishment of the soil cover and bioengineering system.

4.1.4.6 Implementability

The key components of this alternative (i.e., soil excavation and consolidation, installation of a soil cover, riverbank restoration, implementation of institutional controls, and five-year reviews) are all, generally, implementable. However, the degree which soil can be excavated safely on the River Parcel is a very significant implementation issue that would need to be worked out with the railroad.

Construction firms are available to perform the work. There is a chance that some problems could arise when excavating the Main Parcel due to underground structures that still exist near the surface (approximately 2 feet below ground surface).

All portions of this alternative on the Main Parcel and River Parcel would be visible for monitoring except for measures that occur under water. The toe should be monitored as it is installed and during drought conditions when the river is low.

The ability to construct on the banks of the Ohio River would be dependent upon the river elevation and this should be coordinated with the Corps of Engineers and OEPA. River bank restoration and bioengineering requirements would dictate the time of year that the construction can occur, may limit the contractors qualified to perform the work, and would require coordination with nurseries.

4.1.4.7 Cost

Table 4.4 presents a summary of the estimated present worth costs to implement Alternative Soil-6. The present worth for Alternative Soil-6 is estimated to be approximately (depending on the excavation scenarios) $4.0 M to $5.6 M. The cost estimate assumes that soil cover maintenance would be performed for 30 years. Detailed cost estimates are presented in Appendix E.

4.2 DETAILED ANALYSIS OF AIR ALTERNATIVES

The following alternatives underwent a detailed evaluation using the seven criteria:

- Alternative Air-1: No Further Action
- Alternative Air-2: Institutional Controls

4.2.1 Alternative Air-1: No Further Action

Alternative Air-1, the No Further Action alternative, was retained as a baseline with which to compare the other alternative, as required by the NCP. This alternative would not include remedial action components to contain or reduce contaminant concentrations in the air, nor would Alternative Air-1 control potential risks from exposure to vapors via indoor air or future excavation work. Site reviews would not be performed as part of this alternative.

4.2.1.1 Overall Protection of Human Health and the Environment

The HHRA identified potential risks to human receptors at OU-3 under current land use conditions which were not within acceptable risk guidelines. Inhalation exposures to air within commercial/industrial buildings that may be constructed at the Site in the future are associated with cancer risks mainly due to benzene. Benzene risks associated with this exposure pathway are primarily associated with four locations (SV-05, SV-06, SV-24, and SV-33) scattered across the Site with no discernible pattern (see Figure 2.6). Potential exposures to vapors (associated with benzene, toluene, and naphthalene) in air by construction workers during active excavation and grading of the Site in support of re-development are associated with a cancer risk and a non-cancer hazard index in excess of NCP and OEPA risk management criteria. The source of the vapors is the product trapped throughout the soil column, groundwater and product pooled on the bedrock surface.

4.2.1.2 Compliance with ARARs

The No Further Action alternative does not include any actions to control exposures or reduce contaminant concentrations of vapors on the Main Parcel or the River Parcel.

No location-specific or action-specific ARARs would be triggered by this alternative.

4.2.1.3 Long-Term Effectiveness and Permanence

Because no action would be taken, all current and potential future risks would remain under this alternative.

4.2.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Selection of Alternative Air-1, would not provide any reduction in toxicity, mobility, or volume of vapors.

4.2.1.5 Short-Term Effectiveness

Alternative Air-1, would not provide any short-term value or create any additional risks to the community, workers, or the environment.

4.2.1.6 Implementability

There are no issues associated with implementing Alternative Air-1, since no action would be taken.

4.2.1.7 Cost

The present worth and capital costs of Alternative Air-1 are estimated to be $0, since there would be no action.

4.2.2 Alternative Air-2: Institutional Controls

Alternative Air-2 relies on institutional controls, and five-year reviews to control potential human-health risks from exposure to vapor. This alternative would consist of the following key components:

- Institutional Control and Inspections
- Five-Year Reviews

Institutional Controls and Inspections

This alternative also includes institutional controls in the form of land-use restrictions requiring that land use remains industrial. Additional restrictions would require that future buildings include measures (e.g., physical barriers, venting, monitoring) to protect indoor workers and that health and safety procedures be established to protect putdoor workers during any excavation or Site grading activities. Restrictive covenants would be properly recorded in the property records.

An ICMP would be prepared for the Site. The ICMP would detail the restrictive covenants to be recorded. The ICMP would include a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the onsite inspection would include physical barriers, such as fencing, to insure its integrity, verifying warning signs are in place and intact, and no structure or pavement has been disturbed or removed. For cost estimating purposes, it is assumed that the institutional control inspections would be performed once per year

Five-Year Site Reviews

Under CERCLA 121(c), any remedial action that results in contaminants remaining onsite at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year Site reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The USEPA document (USEPA, 2001a) provides guidance on the performance of five-year reviews. The five-year review for this alternative would be considered a statutory review.

The five-year review for this alternative would consist of conducting a Site visit and interviews, evaluating environmental monitoring data and institutional control inspection reports, and reviewing the Record of Decision requirements and ARARs. The assumptions of the risk assessment would be reviewed for appropriateness and upon consideration of available monitoring data, ARARs, institutional control inspection reports, results of the Site visit and interviews, and a conclusion would be made concerning the protectiveness of the remedy. The review would assess/recommend whether institutional controls should be continued. If contaminant concentrations remain above the cancer risk and non-cancer hazard index in excess of NCP and OEPA risk management criteria, the data and inspections reports would be evaluated to confirm that the alternative continues to be protective of human health and the environment.

The Site reviews would consider benefits of new or emerging technologies that may improve remedial performance.

4.2.2.1 Overall Protection of Human Health and the Environment

This alternative includes actions in the form of institutional controls, institutional control inspections, and five-year reviews to prevent future human exposure to vapors. Maintenance of the institutional controls would be ensured through institutional control inspections, and the five-year review process. As a result, Alternative Air-2 is considered protective of human health and the environment.

4.2.2.2 Compliance with ARARs

Institutional controls would be established and enforced to prevent exposures to soil vapors at levels exceeding acceptable risk levels. No actions would be taken to reduce contaminant concentrations to levels below criteria established based on the chemical-specific.

Implementation of this remedy would not trigger any location-specific or action-specific ARARs.

4.2.2.3 Long-Term Effectiveness and Permanence

The restrictions placed on the property and the long-term inspection and five-year review process would provide long-term, permanent protection of the air exposure pathways.

4.2.2.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

As stated in subsection 3.1.2 (screening of alternatives), the source of potentially unacceptable levels of soil vapor are due to the presence of product in both the saturated and unsaturated soils, contaminated groundwater, and product that has pooled on the bedrock approximately 90 feet below ground surface. As a result, it is impractical to remove the materials that may pose this threat and Alternative Air-2 does not include active removal or treatment processes to address soil vapors.

4.2.2.5 Short-Term Effectiveness

Honeywell owns the property and can easily institute the restrictions required by this alternative. As a result, short-term effectiveness of this alternative is very high.

4.2.2.6 Implementability

Because Honeywell owns the property, placing the restrictions on the property is easily accomplished. Implementing the restrictions is also not expected to be difficult. Health and safety procedures to protect outdoor workers are those commonly instituted at properties with contaminants and generally consist of monitoring and personal protective clothing. If necessary, venting of excavations is easily accomplished. Future buildings would be designed to include a vapor barrier system, active or passive venting below the building and/or monitoring of indoor air. These provisions are commonly utilized without difficulty on former industrial properties being redeveloped for industrial or commercial uses.

4.2.2.7 Cost

Table 4.5 presents a summary of the estimated present worth costs to implement Alternative Air-2. The present worth for Alternative Air-2 is estimated to be approximately $75,000. Detailed cost estimates are presented in Appendix E.

4.3 DETAILED ANALYSIS OF GROUNDWATER ALTERNATIVES

The following alternatives underwent a detailed evaluation using the seven criteria:

- Alternative Groundwater-1: No Further Action

- Alternative Groundwater-3: Groundwater Collection/Treatment/Discharge
- Alternative Groundwater-4: Low-Permeability Cover

4.3.1 Alternative Groundwater-1: No Further Action

Alternative Groundwater-1, the No Further Action alternative, was retained as a baseline with which to compare the other alternatives, as required by the NCP. This alternative would not include remedial action components to contain or reduce contaminant concentrations in the groundwater, beyond what is currently being done on the CPLA and GDA, (i.e., groundwater extraction and DNAPL recovery from wells located on the Tar Plant property would cease) nor would Alternative Groundwater-1 control potential risks from exposure to groundwater by implementing institutional controls or environmental monitoring. Site reviews would not be performed as part of this alternative.

4.3.1.1 Overall Protection of Human Health and the Environment

The HHRA identified potential risks to human receptors at the Site under current land use conditions which were not within acceptable risk guidelines. Groundwater beneath the Site is not expected to be used for potable purposes in the future because a municipal water supply is available to the Site and surrounding properties. The City has indicated that they would not permit the installation of a potable water supply well. Nevertheless, to aid in risk management decision-making, risks associated with potable use of the groundwater beneath the Site by commercial/industrial workers were evaluated. The results of the risk characterization indicate that both cancer and non-cancer risks (predominantly due to arsenic, benzene, and PAHs) for potable use of the groundwater by commercial/industrial workers exceed NCP and OEPA risk management criteria. Under this alternative, the current onsite risks would remain and risks to offsite receptors may increase with groundwater extraction ceasing on the Tar Plant property. As a result, this alternative is deemed not to be protective of human health and the environment.

4.3.1.2 Compliance with ARARs

Chemical-specific ARARs triggered by Alternative Groundwater-1 are presented in Table 4.1. The No Further Action alternative does not include any actions to reduce contaminant concentrations in groundwater on the Main Parcel or the River Parcel and, therefore, would not attain chemical-specific ARARs.

No location-specific or action-specific ARARs would be triggered by this alternative.

4.3.1.3 Long-Term Effectiveness and Permanence

This alternative does not provide for long-term protection.

4.3.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative Groundwater-1, would not provide any reduction in toxicity, mobility, or volume of contaminants in groundwater.

4.3.1.5 Short-Term Effectiveness

Alternative Groundwater-1, would not provide any short-term protection and potentially would increase risks to offsite receptors (as a result of the onsite groundwater extraction ceasing).

4.3.1.6 Implementability

There are no issues associated with implementing Alternative Groundwater-1, since no action would be taken.

4.3.1.7 Cost

The present worth for Alternative Groundwater-1 is estimated to be $0, since there would be no action.

4.3.2 Alternative Groundwater-3: Groundwater Collection/Treatment/Discharge

Alternative Groundwater-3 includes actions to continue operation of the existing the groundwater collection and treatment system at the Site, with provisions to potentially expand the system, if ongoing evaluations deem it necessary to enhance hydraulic containment of Site groundwater within the property boundaries. This alternative provides for up to two additional groundwater extraction wells. Extracted groundwater would continue to be treated at the existing treatment plant located on the CPLA property and discharged via NPDES permit to the Ohio River. The option of discharging to the POTW was eliminated due to the high flow rates (200 – 300 million gallons per year) and the inability of the POTW to handle this amount of flow. Provisions for expanding DNAPL recovery are also included in this alternative. Based upon the RI results, and pending pre-design study results, up to four additional DNAPL recovery pumps would be placed in recovery wells to collect the DNAPL. Details regarding the management of collected DNAPL and incorporating the current DNAPL recovery into the expanded system would be developed during design. The City has stated that it does not permit the installation of potable water wells. To the extent that industrial wells may impact groundwater capture, institutional controls will be used to prevent installation of such water wells. Performance of this alternative would be evaluated through a groundwater monitoring and evaluation program. Additional details regarding the following key components of this alternative are presented below:

- Pre-Design Studies
- Expansion of Groundwater Extraction System
- Expansion of DNAPL Extraction System
- Groundwater Monitoring
- Institutional Controls and Inspections
- Five-Year Site Review.

Pre-Design Studies

Pre-design studies would include review of current groundwater monitoring data already obtained for the Site, groundwater modeling would be performed to optimize extraction well locations and refine preliminary estimates of extraction rates, groundwater drawdown, and capture zones. DNAPL recovery test would be conducted to evaluate the ability and effectiveness of methods to remove DNAPL from wells found to contain the product.

Expansion of Groundwater Extraction System

The hydraulic containment and contaminant mass removal portion of Alternative Groundwater-3 is based on additional extraction of contaminated groundwater and subsequent ex-situ treatment at the TF located on CPLA. The conceptual design is based on the installation of up to two additional groundwater extraction wells.

The extracted groundwater would be pumped via buried pipeline to the existing treatment facility located on the CPLA property where it would be treated and discharged to the Ohio River under the NPDES permit.

Expansion of DNAPL Extraction System

Currently, extraction well WE-618 is used to pump DNAPL to a drum located next to the well. This alternative would provide for using up to four additional wells to remove the DNAPL. While details would be developed during the design phase, it is anticipated that underground piping would be installed connecting to all of the DNAPL extraction wells, and the DNAPL would be pumped to a product storage tank located at the treatment facility located on CPLA. When the product tank reaches capacity, a disposal company would be contacted to empty the tank and dispose of the DNAPL.

Groundwater Monitoring

A comprehensive groundwater monitoring program was instituted in 1997. The purpose of the program is to verify that the groundwater extraction wells located on the three operable units (i.e., GDA, CPLA, and Tar Plant) continue to prevent groundwater migration from the three operable units. This program consists of quarterly sampling of 23 wells located across the three operable units, including monitoring wells MW-11, MW-17, MW-24, and MW-27, located on or adjacent to the Tar Plant (see Figure 4.1), plus semiannual sampling of 12 wells in the Ice Creek area. Data from this monitoring program has defined the characteristics of the impacted groundwater in the Tar Plant Area, and with the exception of an area near MW-11, clearly shows the groundwater plume to be stable and controlled.

The monitoring program comprising this alternative is to serve as an augmentation to the program already in place across the three operable units. The purpose of these additions is to verify the effectiveness of the expansion of the groundwater control and DNAPL collection programs, as proposed under this alternative. Based upon the large amount of data generated by the existing monitoring program indicating the stability of the plume, semiannual monitoring is proposed.

Table 4.8 lists the monitoring wells included in the program and Figure 4.1 illustrates the well locations. Water elevation measurements and samples for analytical parameters would be collected in four wells. Five wells would be used to obtain water elevation measurements only, and 18 wells would be used for DNAPL measurements. Monitoring wells MW-17 and MW-24 would be replaced with recently installed wells that do not have fully penetrating screens, therefore providing more accurate groundwater data. Monitoring wells already included in the current quarterly monitoring program, and others to be added as part of additional investigation of the MW-11 area (and that may be added to the existing quarterly program), would be used to further evaluate groundwater near MW-11.

The wells would be sampled using low-flow sampling techniques. In conjunction with the low-flow sampling methodology, a series of field parameter readings would be recorded to evaluate stabilization prior to sample collection. These parameters include depth to water, temperature, pH, dissolved oxygen (DO), specific conductance, ORP, and turbidity.

The Table 4.8 lists the analytes, analytical methods, and rationale for sampling the wells included in the monitoring program. According to the HHRA, 55% of the risk associated with groundwater is due to arsenic, while 23% is due to benzene and the remaining 22% is due to carcinogenic PAHs. As a result, arsenic, benzene, and naphthalene were selected as the analytes for the monitoring program. While naphthalene is not a carcinogenic PAH, it is more mobile than the carcinogenic PAHs and it was selected as a conservative indicator for monitoring PAHs.

Reports would be prepared to document methods and results of each groundwater sampling event. The reports would summarize groundwater monitoring activities and include tables summarizing groundwater elevations, and groundwater analytical data. A groundwater capture map would be included and analytical data would be compared to remediation goals. If needed, adjustments to the monitoring program would be made.

Monitoring wells not used in the Groundwater Monitoring Program would be evaluated for abandonment. The wells determined not to be needed for the Groundwater Monitoring Program would be properly abandoned by an Ohio-licensed driller and the well abandonment records submitted to the Ohio Department of Natural Resources. Table 4.9 lists the monitoring wells that have been tentatively identified for abandonment with rationale for abandonment.

There is a total of 62 stick-up groundwater monitoring wells on the Site. This alternative would include converting remaining stick-up wells to flush-mount wells for redevelopment purposes. This would be accomplished by removing the existing well cover and concrete pad; cutting the casing flush with grade; and installing a new flush-mount well cover in a new concrete pad.

Institutional Controls and Inspections

Honeywell would establish groundwater use restrictions prohibiting the potable use of onsite groundwater. The City has stated that it does not permit the installation of potable water wells. To the extent that industrial wells may impact groundwater capture, institutional controls would be to prevent installation of such water wells. Restrictive covenants would be properly recorded in the property records.

An ICMP would be prepared for the Site. The ICMP would detail the restrictive covenants to be recorded. The ICMP would include a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the onsite inspection would include physical barriers, such as fencing, to insure its integrity, verifying warning signs are in place and intact, and no structure or pavement has been disturbed or removed. For cost estimating purposes, it is assumed that the institutional control inspections would be performed once per year.

Five-Year Site Reviews

Under CERCLA 121(c), any remedial action that results in contaminants remaining onsite at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year Site reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The USEPA document (USEPA, 2001a) provides guidance on the performance of five-year reviews. The five-year review for this alternative would be considered a statutory review.

The five-year review for this alternative would consist of conducting a Site visit and interviews, evaluating environmental monitoring data and institutional control inspection reports, and reviewing the Record of Decision requirements and ARARs. The assumptions of the risk assessment would be reviewed for appropriateness and upon consideration of available monitoring data, ARARs, institutional control inspection reports, and results of the Site visit and interviews, a conclusion would be made concerning the protectiveness of the remedy. The review would assess/recommend whether institutional controls should be continued. If contaminant concentrations remain above the cancer risk and non-cancer hazard index in excess of NCP and OEPA risk management criteria, the data and inspections reports would be evaluated to confirm that the alternative continues to be protective of human health and the environment.

The Site reviews would consider benefits of new or emerging technologies that may improve remedial performance.

4.3.2.1 Overall Protection of Human Health and the Environment

The HHRA identified potential risks to human receptors under current land-use conditions. The results of the risk characterization indicate that both cancer and non-cancer risks (due to arsenic, benzene, and PAHs), for potable use of groundwater exceed NCP and OEPA risk management criteria.

The existing groundwater extraction system that was installed, as part of the previous two operable unit remedies, has proven to effectively protect public health and the environment by controlling groundwater migration from the three operable units (including the Tar Plant site). Under this alternative, the groundwater extraction system would be expanded to enhance groundwater control. In addition, collection of DNAPL would be expanded, based upon design studies. Use restrictions would prohibit potable uses of Site groundwater. The City has stated that it does not permit the installation of potable water wells. To the extent that industrial wells may impact groundwater capture, institutional controls would be used to prevent installation of such water wells. Institutional control inspections and the five-year reviews would monitor the effectiveness of this approach. As a result, Alternative Groundwater-3 is protective of human health and the environment under future land-use conditions.

4.3.2.2 Compliance with ARARs

Alternative Groundwater-3 relies on groundwater extraction and treatment to contain impacted groundwater and ultimately reduce contaminant concentrations to below remedial action goals. Until these goals are attained, the alternative would rely on institutional controls to prevent exposure to impacted groundwater. The chemical-specific ARARs applicable to Alternative Groundwater-3 are indicated in Table 4.1.

4.3.2.3 Long-Term Effectiveness and Permanence

The current groundwater extraction system has proven effective over the past 10 years. This alternative is expected to provide additional long-term effectiveness.

4.3.2.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternative Groundwater-3 includes groundwater extraction and treatment to reduce the mobility of contaminants.

4.3.2.5 Short-Term Effectiveness

Alternative Groundwater-3 can be implemented relatively quickly with no adverse effects to onsite or offsite receptors.

4.3.2.6 Implementability

The key components of this alternative (i.e., installation of additional groundwater extraction wells, implementation of land-use restrictions groundwater monitoring, and five-year reviews) are all readily implementable. It is anticipated that the current treatment system is capable of handling the additional flow. Groundwater extraction and treatment with technologies such as oil/water separator, sand filter, and activated carbon are proven and reliable technologies.

Groundwater monitoring is a routine environmental activity and many qualified firms are available to perform them. The City has a public water supply and it does not permit the installation of potable water wells. To the extent that industrial wells may impact groundwater capture, institutional controls would be used to prevent installation of such water wells.

4.3.2.7 Cost

Table 4.6 presents a summary of the estimated present worth costs to implement Alternative Groundwater-3. The present worth for Alternative Groundwater-3 is estimated to be approximately

$2,200,000. The cost estimate assumes that groundwater monitoring would be performed for 30 years. Detailed cost estimates are presented in Appendix E.

4.3.3 Alternative Groundwater-4: Low-Permeability Cover

Alternative Groundwater-4 would include the installation of a low-permeability cover over the contaminated portions of the Main Parcel to reduce the infiltration of precipitation and the associated leaching of Site-related contaminants to groundwater. The low-permeability cover would consist of six inches of top soil and a minimum of 18 inches of clay with a maximum permeability of $1x10^{-6}$ centimeters per second. The River Parcel would be covered as described in section 4.1.2 (Alternative Soil-3: Soil Cover). This alternative would also include the expanded groundwater and DNAPL collection programs, institutional controls and monitoring described Alternative Groundwater-3. Additional monitoring and maintenance activities would include routine inspections of the integrity of the cover. Because contaminants would remain on Site above risk-based levels, five-year reviews would be conducted. Institutional control inspections would include verification that restrictions prohibiting the installation of groundwater use wells remain in effect. Key components of this alternative are described in great detail below:

- Pre-Design Studies
- Installation of a Low-Permeability Cover on the Main Parcel
- Installation of Soil Cover on River Parcel
- Expansion of Groundwater and DNAPL Extraction Systems
- Groundwater Monitoring
- Institutional Controls and Inspections
- Five-Year Site Reviews.

Pre-Design Studies

Pre-design studies would include a topographic survey of the Main Parcel and River Parcel for use in designing the cover and those studies described in Alternative Groundwater-3.

Installation of Low-Permeability Cover

The low-permeability cover would consist of six inches of top soil and a minimum of 18 inches of clay with a maximum permeability of $1x10^{-6}$ centimeters/second. This alternative also includes converting the existing stick-up wells to flush-mount wells and converting aboveground piping to underground piping for redevelopment purposes; removal of debris; demolition of above ground structures (i.e., metal shed, retaining walls and sumps); a 2-foot perimeter cut (to allow for the additional height of the cover) and grading the Main Parcel for stormwater containment and collection; construction of a stormwater collection system; and restoration of the entire Main Parcel with topsoil, grass and erosion control materials.

Installation of Soil Cover on River Parcel

Installation of soil cover on River Parcel would be as described in section 4.1.2 (Alternative Soil-3: Soil Cover).

Expansion of Groundwater and DNAPL Extraction Systems

The groundwater and DNAPL collection systems would be expanded as described in Alternative Groundwater-3.

Groundwater Monitoring

Groundwater monitoring would consist of the program described in Alternative Groundwater-3.

Institutional Controls and Inspections

This alternative would include those institutional controls and inspections described in Alternative Groundwater-3 with the addition of requirements for maintaining and monitoring the integrity of the cover.

Five-Year Site Reviews

Five reviews would be conducted as described in Alternative Groundwater-3.

4.3.3.1 Overall Protection of Human Health and the Environment

The HHRA identified potential risks to human receptors under current land-use conditions. The results of the risk characterization indicate that both cancer and non-cancer risks (due to arsenic, benzene, and PAHs), for potable use of groundwater exceed NCP and OEPA risk management criteria.

The existing groundwater extraction system that was installed, as part of the previous two operable unit remedies, has proven to effectively protect public health and the environment by controlling groundwater migration from the three operable units (including the Tar Plant Site). Under this alternative, the groundwater extraction system would be expanded to enhance groundwater control. In addition, collection of DNAPL would be expanded, based upon design studies. Use restrictions would prohibit potable uses of Site groundwater. The City has stated that it does not permit the installation of potable water wells. To the extent that industrial wells may impact groundwater capture, institutional controls would be used to prevent installation of such water wells. Institutional control inspections and the five-year reviews would monitor the effectiveness of this approach. In addition, a low-permeability cover would be installed to prevent leaching of contaminants from soils in the unsaturated zone. Contaminants located within the saturated zone and pooled on the bedrock surface would continue to leach to groundwater. Primarily as a result of the groundwater and DNAPL collection and control systems, this alternative would be protective of human health and the environment under future land-use conditions.

4.3.3.2 Compliance with ARARs

Alternative Groundwater-4 relies on a combination of a low-permeability cover system to reduce mobilization of soil contaminants to groundwater and continued operation of the existing groundwater extraction and treatment system to contain impacted groundwater and ultimately reduce contaminant concentrations to below remedial action goals. Until these goals are attained, the alternative would rely on institutional controls to prevent exposure to impacted groundwater. The chemical-specific ARARs applicable to Alternative Groundwater-4 are indicated in Table 4.1.

Field activities performed as part of this alternative would include pre-design activities, the installation of a low permeability cover, and sampling of groundwater monitoring wells. To the extent that these activities take place in wetland or flood plain areas the location-specific ARARs in Table 4.2 would apply. It is expected that all such activities can be designed and implemented to comply with location-specific ARARs.

Action-specific ARARs that may be triggered by Alternative Grounwater-4 are listed in Table 4.3. It is expected that all activities can be designed and implemented to comply with action-specific ARARs.

4.3.3.3 Long-Term Effectiveness and Permanence

The current groundwater extraction system has proven effective over the past 10 years. In addition, the cover could easily be maintained over the long-term. As a result, this alternative is expected to provide additional long-term effectiveness.

4.3.3.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

This alternative includes groundwater extraction and treatment to reduce the mobility of contaminants.

4.3.3.5 Short-Term Effectiveness

Installation of the cover would require that a significant amount (approximately 40,000 cubic yards) of low-permeability clay be brought on Site. This would result in significant truck traffic through the City during construction, which increases the risk of traffic accidents.

Alternative Groundwater-3 can be implemented relatively quickly with no adverse effects to onsite or offsite receptors.

4.3.3.6 Implementability

The key components of this alternative for the Main Parcel (i.e., installation of additional groundwater extraction and DNAPL collection wells, installation of a low-permeability cover, implementation of land-use restrictions groundwater monitoring, and five-year reviews) are all readily implementable.

The low-permeability cover on the River Parcel is not implementable due to hydraulic instability caused by hydrostatic pressure difference between the groundwater and surface water, which could cause the low-permeability cover to fail. Additionally, the installation of a clay cover on the embankment would be hazardous during a rain or flood event. The lack of good adhesion between the clay and the geotextile could cause the clay cover to slide down the embankment.

In addition, a borrow source for the large volume of low-permeability clay has yet to be identified, despite a number of inquires with contractors

Groundwater extraction and treatment with technologies such as oil/water separator, sand filter, and activated carbon are proven and reliable technologies.

Groundwater monitoring is a routine environmental activity and many qualified firms are available to perform them. The City has a public water supply and there is no present use of groundwater at the Site. The City has stated that it does not permit the installation of potable water wells. To the extent that industrial wells may impact groundwater capture, institutional controls would be used to prevent installation of such water wells.

4.3.3.7 Cost

Table 4.5 presents a summary of the estimated present worth costs to implement Alternative Groundwater-4. The present worth for Alternative Groundwater-4 is estimated to be approximately $7,100,000. The cost estimate assumes that groundwater monitoring would be performed for 30 years. Detailed cost estimates are presented in Appendix E.

4.4 DETAILED ANALYSIS OF SEDIMENT ALTERNATIVES

The following alternatives underwent a detailed evaluation using the seven criteria:

- Alternative Sediment-1: No Further Action
- Alternative Sediment – 2: Monitored Natural Recovery
- Alternative Sediment – 3: In-Situ Capping
- Alternative Sediment – 4: Dredging and Offsite Disposal
- Alternative Sediment – 5: Combination of Dredging and In-Situ Capping

4.4.1 Alternative Sediment – 1: No Further Action

Alternative Sediment – 1: No Further Action was retained as a baseline for comparison of other alternatives, as required by the NCP. This alternative would not include remedial action components to isolate or reduce contaminant concentrations in sediment or control potential risks from exposure to contaminated sediment by implementing institutional controls or by environmental monitoring. Site reviews would not be performed as part of this alternative.

Overall Protection of Human Health and the Environment

Potential human health risks are within the acceptable USEPA and OEPA risk management criteria. As a result, this alternative is protective of human health. Risks to benthic organisms due to direct contact with surface sediment containing PAH concentrations exceeding PRGs would remain, and as a result this alternative may not be protective of sensitive benthic organisms.

Compliance with ARARs

There are no chemical-specific ARARs. Because No Further Action is proposed, location-, and action-specific ARARs would not be triggered by this alternative. As a result, this alternative would comply with ARARs.

Long-Term Effectiveness and Permanence

No controls for exposure and no long-term management measures would be taken. As a result, there would not be long-term effective or permanent control on current and potential future risks to benthic organisms.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative Sediment – 1, would not provide any reduction in toxicity, mobility, or volume of contaminated sediment.

Short-Term Effectiveness

Alternative Sediment-1 would not adversely effect the existing benthic population. It would not provide additional protection to sensitive benthic invertebrates.

Implementability

There are no implementability concerns associated with Alternative Sediment - 1, since no action would be taken.

Cost

Table 4.7 summarizes the present worth cost of this alternative. The present worth cost of Alternative Sediment - 1 is estimated to be $0, since there would be no action (see Appendix E).

4.4.2 Alternative Sediment – 2: Monitored Natural Recovery

Monitored natural recovery (MNR) involves leaving the sediments in place and allowing ongoing aquatic, sedimentary, and biological processes to reduce the bioavailability of the contaminants to protect receptors. The Site would be monitored over time to confirm the risk-reduction processes. The following key components are described further:

- Baseline Study and Long-Term Monitoring Plan
- Long-Term Monitoring and Five-Year Review
- Institutional Controls

Baseline Study and Long-Term Monitoring Plan

The study consists of establishing a baseline to compare with subsequent monitoring results for the purpose of evaluating long-term decreasing trends of contamination and risk. A Baseline data collection program would be developed based on further evaluation of Site conditions and presented in a plan to the Agency for review and approval. As part of the evaluation of risk, the results would be compared with the PRGs. Based on the results of the Baseline Study, a long-term monitoring plan would be completed that would provide guidance for ongoing monitoring necessary to evaluate the long-term decreasing trends.

Monitored Natural Recovery

The implementation of MNR requires that the source of the contamination be controlled followed by an initial assessment of the Site and monitoring (every five years). If it is determined that natural recovery is not occurring at a rate that is sufficient to reduce risks within an acceptable time frame, enhanced natural recovery may be implemented. Enhanced natural recovery could consist of placing a thin layer of clean sediment over the contaminated sediment to accelerate the recovery process. Some considerations in applying MNR include:

- Stability of the river bottom/sediment resistance to re-suspension
- Whether natural deposition is occurring
- Sedimentation rates
- The potential for natural reductions in contaminant concentrations covering diffuse areas
- Contaminants have low ability to bioaccumulate

- Expected human exposure is low and/or can be reasonably controlled by institutional controls
- Anticipated land uses or new structures would not inhibit the natural recovery process

Long-Term Monitoring and Five-Year Review

Long-term monitoring would be completed beginning five years after the baseline study and continues every five years after that until recovery is documented. The results of each monitoring event would be evaluated against PRGs and compared with the baseline study and previous monitoring events. During the data evaluation, a review would be completed to evaluate the effectiveness of the remedy.

Under CERCLA 121(c), any remedial action that results in contaminants remaining on Site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year Site reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The USEPA document (USEPA, 2001a) provides guidance on the performance of five-year reviews. The five-year review for this alternative would be considered a statutory review.

Institutional Controls and Inspections

Institutional controls would be established for the sediment that may prohibit dredging allowing natural sedimentation to occur.

An ICMP would be prepared for the Site. The ICMP would detail the institutional controls to be implemented. The ICMP would include a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the onsite inspection may include verifying warning signs are in place and intact. For cost estimating purposes, it is assumed that the institutional control inspections would be performed once per year.

Overall Protection of Human Health and the Environment

Potential human health risks are within the acceptable USEPA and OEPA risk management criteria. As a result, this alternative is considered protective of human health. Natural processes are reducing the potential for unacceptable exposures to benthic invertebrates over a period of time. Additional data would need to be collected to evaluate this further.

Compliance with ARARs

Chemical-specific ARARs have not been established. This alternative would not trigger any location-specific or action-specific ARARs. As a result, this alternative would comply with ARARs.

Long-Term Effectiveness and Permanence

Natural reduction in contaminant concentrations and decreasing bioavailability would potentially reduce the risks over time. Additional data would need to be collected to evaluate this further.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative does not involve active treatment. However, natural reductions in contaminant concentrations and bioavailability would potentially occur over time.

Short-Term Effectiveness

Under this alternative there would be no risks associated with suspension of sediments and existing contaminants and no disruption to the existing benthic and aquatic environment. Based on the limited data, short-term effective protection has not been determined.

Implementability

There are no concerns with implementing this alternative.

Cost

Table 4.7 summarizes the estimated present worth costs to implement Alternative Sediment - 2. The present worth for Alternative Sediment – 2 is estimated to be \$0.7 M to \$1.0 M. Costs for implementing this alternative are based on establishing a baseline and reviewing the remedy effectiveness and monitoring every five years over a 30-year period. The range in cost is associated with uncertainty regarding the extent of the level of effort necessary to complete baseline sampling and long-term monitoring.

4.4.3 Alternative Sediment – 3: In-Situ Capping

In-situ capping would isolate the contaminated sediment from the benthic and aquatic ecosystems. The following key components are described further:

- Pre-design Studies
- Installation of an In-Situ Cap
- Institutional Controls and Inspections
- Five-Year Reviews/Long-Term Monitoring

Pre-Design Studies

Additional data would be collected to utilize in design of the cap. The additional data may include: river flow velocities; grain size distribution; sediment shear strength; and hydrographic and side-scan sonar surveying.

Installation of In-Situ Cap

The contaminated sediment exceeding PRGs would be covered with either earthen materials (such as, sand, or gravel, and/or cobbles), engineered materials (such as, geosynthetics or marine mattresses), or a combination of these materials. Design and material selection depends on the nature of the contamination, the physical and hydraulic characteristics of the waterway, long-term plans for the area (i.e., development and maintenance activities), and permitting requirements. One cap design consideration consists of rip rap that would be installed as part of any riverbank restoration (see subsection 4.2) extending down into the river to act as a portion of the cap and/or as armor protecting the cap.

Institutional Controls and Inspections

Institutional controls to prevent activities that could damage the cap. One such control may include a prohibition of dredging in the area of the cap. Restrictions would be stated as described in the institutional controls for Alternative Sediment - 2.

An ICMP would be prepared as described in the institutional controls for Alternative Sediment - 2.

Five-Year Site Reviews

As described in the five-year Site review for Alternative Sediment – 2, in accordance with CERCLA 121(c), the integrity and effectiveness of the cap would be monitored every five years, and/or following a 100-year storm event. Monitoring may consist of sediment sampling and analysis and visual inspections by divers. The review would include evaluation of the Record of Decision requirements and ARARs. The assumptions of risk assessment work would be reviewed for appropriateness and upon consideration of available monitoring data. The review would include a conclusion concerning the protectiveness of the remedy.

The Site reviews would consider benefits of new or emerging technologies that may improve remedial performance.

Overall Protection of Human Health and the Environment

Potential human health risks are within the acceptable USEPA and OEPA risk management criteria. As a result, this alternative is considered protective of human health. Contaminants that exceed PRGs would be isolated from direct contact by benthic organisms, resulting in protection of the environment.

Compliance with ARARs

Capping activities can be designed and implemented to comply with these location-specific (Table 4.2) and action-specific (Table 4.3) ARARs associated with Alternative Sediment – 3. Areas to be capped would be outside the navigational channel and will not interfere with shipping. All substantive requirements as regulated under Section 10 of the River and Harbors Act of 1989 (33§403) and Section 404 of the Clean Water Act (33§1344) would be followed.

Long-Term Effectiveness and Permanence

The in-situ cap would be designed to last long-term and is considered a permanent remedy. There is a potential for upstream contaminants at or below background concentrations to deposit on top of the clean cap material; however, this is true for any active remedial technology. Monitoring of the cap effectiveness and cap integrity would be conducted over a 30-year period.

Reduction of Toxicity, Mobility, and Volume through Treatment

While capping does not reduce the volume of the contaminants, capping would decrease exposure risks due to direct contact and the mobility of the contaminants by isolating them from the benthic environment.

Short-Term Effectiveness

In-situ capping quickly reduces the risks providing effectiveness over the short-term. An initial short-term impact to the existing benthic ecosystem would occur following cap placement. The cap material would be placed in such a manner as to prevent re-suspension of contaminated sediment. For example, cap material can be placed using a tremie system which releases the material directly above the sediment surface. A turbidity control system can be put in place prior to capping, if necessary.

Implementability

In-situ capping is a proven technology. Areas to be capped would be outside the navigational channel and will not interfere with shipping. Various cap placement and Global Positioning System (GPS) equipment are available to implement cap placement. The cap can be installed relatively quickly (i.e., two to three months). Capping does not require dewatering and disposal. There would not be transportation issues. Obstructions and structures, such as the mooring structures of the former docking facility and debris, such as fallen trees may need to be removed prior to capping. Institutional controls may be established to protect the cap.

Cost

Table 4.7 summarizes the estimated present worth costs to implement Alternative Sediment - 3. The present worth for Alternative Sediment – 3 is estimated to be $1.8 M; however, if based on the evaluation of additional data the Site conditions warrant using different materials or modify the cap area, the present worth cost is estimated to be $3.4 M. Costs for this alternative are based on time and materials and the long-term (30 years) monitoring of the cap effectiveness and integrity. Range in cost is associated with uncertainty regarding area to be capped and the types of materials to be used.

4.4.4 Alternative Sediment – 4: Dredging and Offsite Disposal

Dredging consists of the removal of contaminated sediment from the river bottom, dewatering the sediment, followed by transportation and offsite disposal. Because the vertical extent of the sediment contamination was not determined prior to evaluating this alternative, MACTEC assumed that dredging would be completed to either the depth of gravel/cobbles or bedrock. The extent of dredging would be based on additional data collection and evaluation. The following key components are described further:

- Pre-Design Studies
- Dredging
- Dewatering, Transportation, and Disposal
- Post-Dredging Sampling and Residual Management

Pre-Design Studies

Additional data would be collected to utilize in the design of the dredging alternatives and assist in controlling turbidity during the dredging activities. The additional data would include: river flow velocities; grain size distribution; sediment shear strength; hydrographic and side-scan sonar surveying; and HEC-RAS modeling.

Dredging

Sediment would be removed using dredging techniques appropriate to the site conditions. The work area may be bordered by turbidity curtains, which are made of materials permeable to water but prevent migration of suspended solids. These are installed vertically in the water by anchoring to the bottom of the river. If the river flow velocities are too great to use turbidity curtains, a coffer dam may be considered as an alternative. Turbidity levels in the river would be measured and compared with PRGs during dredging to ensure suspended solids are not migrating downstream.

Dewatering, Transfer, and Disposal

During design, methods to dewater excavated sediment will be evaluated. This would include evaluating the potential use of geotubes located in a containment area constructed on the Main Parcel of the Site. Water generated during the dewatering process may be collected and treated by the existing water treatment system located on the CPLA operable unit. Due to the potential limited capacity of the treatment system, water may need to be stored in above-ground tanks or frac tanks until treatment.

Following dewatering, the sediment would be transported off Site to an approved landfill and disposed. Sediment transportation to the landfill would be by truck. For the purposes of estimating costs for this remedial alternative, MACTEC assumed the tonnage unit cost includes loading, unloading, and round-trip transportation from the Site to the landfill. Waste characterization, profiling, and landfill approval would be completed during the pre-design and design phases of the sediment investigation.

Prior to sediment transportation to the landfill for disposal, the sediment may need to be stabilized. Stabilization would involve mixing the sediment with lime or cement kiln dust so that it would pass the paint-filter test. A paint-filter test would be used to determine if free liquids are present, which would make the waste unacceptable for landfill disposal. For the purposes of estimating costs for this evaluation, MACTEC assumed that the total volume of material to be sent to the landfill would include the volume of the dredged sediment plus an additional 25 percent of material to account for the addition of lime or cement kiln dust used for stabilization

Post-Dredging Sampling and Residual Management

Because of the practical limitations of removing sediment in a dynamic river environment, some residual contaminated sediment may remain at the Site. Following the completion of dredging, verification samples collection would be attempted to assess whether residuals are present. If verification samples can be collected and the results indicate that PRGs are still exceeded, a residual management plan can be implemented. One example of such a plan would be the placement of a thin layer of sand on top of the residuals.

Overall Protection of Human Health and the Environment

Potential human health risks are within the acceptable USEPA and OEPA risk management criteria. As a result, this alternative is considered protective of human health. Contaminants that exceed PRGs would be removed from the river bottom, eliminating direct contact by benthic organisms, resulting in protection of the environment.

Compliance with ARARs

It is anticipated that these activities can be designed and implemented to comply with these location-specific (Table 4.2) and action-specific (Table 4.3) ARARs associated with Alternative

Sediment – 4. Dewatered sediment and debris removed from the river would be disposed off Site in a RCRA and state-approved landfill. No effluents would be directly discharged into the river following dewatering. All substantive requirements as regulated under Section 10 of the River and Harbors Act of 1989 (33§403) and Section 404 of the Clean Water Act (33§1344) would be followed.

Long-Term Effectiveness and Permanence

Contaminated sediment will be removed from the river. However, there is a potential for residuals to remain. If necessary, a residual management plan can be implemented to address any remaining contamination that exceeds PRGs. There is the potential for upstream contaminants at or below background levels to migrate to areas addressed by this alternative, as is true for any active remediation approach.

Reduction of Toxicity, Mobility, and Volume through Treatment

Toxicity and mass volumes would be reduced by removing the contaminants from the river, but these reductions are not a result of treatment.

Short-Term Effectiveness

Because there is a potential for residuals to remain risk is not as quickly reduced and there is a potential for residuals to remain. If necessary, a residual management plan can be implemented to address any remaining contamination that exceeds PRGs. Re-suspension of contaminated sediment during dredging may be a concern. Therefore, significant turbidity controls and monitoring may be necessary to prevent migration. An initial short-term impact to the benthic ecosystem would occur as a result of dredging.

Implementability

This alternative is implementable, but would involve resolving numerous logistical issues. Dewatering and stabilization of the dredged sediment would require a large upland area. Because remediation of the upland areas of the Site may occur concurrently, finding areas for dewatering may be difficult. In addition, transporting the sediment up the steep slope of the river parcel and over the railroad right-of-way may be difficult. Excessive debris along the shore, such as rip rap and fallen trees, may slow the dredging progress. In addition, obstructions and structures, such as the mooring structures of the former docking facility, may need to be removed prior to dredging and backfilling following dredging near the shore may be necessary to prevent failure of the stream bank.

Cost

Table 4.7 summarizes the estimated present worth costs to implement Alternative Sediment - 4. The present worth for Alternative Sediment – 4 is estimated to be $6.8 M to $9.9 M. The range in cost is associated with the uncertainty regarding the volume of sediment to be removed and dredge depths.

4.4.5 Alternative Sediment – 5: Combination of Dredging and In-Situ Capping

This alternative consists of implementing both Alternative Sediment – 3: In-Situ Capping and Alternative Sediment – 4: Dredging and Offsite Disposal. Combining capping with dredging would limit the volume of material that would need to be dewatered and limit the volume disposed in the landfill, which affects landfill capacity. This alternative may include all of the procedures, controls, and residual management discussed in Alternative Sediment - 3 and 4.

Overall Protection of Human Health and the Environment

Potential human health risks are within the acceptable USEPA and OEPA risk management criteria. Contaminants above PRGs would either be removed from the river or isolated from contact by benthic organisms. As a result, this alternative would be protective of the environment. As a result, this alternative is considered protective of human health.

Compliance with ARARs

It is anticipated that these activities can be designed and implemented to comply with these location-specific (Table 4.2) and action-specific (Table 4.3) ARARs associated with Alternative Sediment – 5. Dewatered sediment and debris removed from the river would be disposed off Site in a RCRA and state-approved landfill. All substantive requirements as regulated under Section 10 of the River and Harbors Act of 1989 (33§403) and Section 404 of the Clean Water Act (33§1344) would be followed.

Long-Term Effectiveness and Permanence

This alternative would provide protection over the long term as described under Alternative Sediment – 3: In-Situ Capping and Alternative Sediment – 4: Dredging and Offsite Disposal.

Reduction of Toxicity, Mobility, and Volume through Treatment

Toxicity and mass contaminant volume would be reduced in the areas that are dredged. Mobility would be reduced in areas that are capped.

Short-Term Effectiveness

In areas that are capped risks would be quickly reduced. In areas where dredging is performed there is a potential for residuals to remain, therefore risks are not quickly reduced. Short-term effectiveness and permanence would be as discussed under Alternative Sediment – 3: In-Situ Capping and Alternative Sediment – 4: Dredging and Offsite Disposal. Short-term impacts to the benthic environment would occur and measures to prevent re-suspensions and migration of contaminated sediment would be necessary.

Implementability

Implementability of this alternative is subject to the same logistics discussed in Alternative Sediment - 3 and 4.

Cost

Table 4.7 summarizes the estimated present worth costs to implement Alternative Sediment - 5. The present worth for Alternative Sediment – 5 is estimated to be $2.8 M to $4.5 M.

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

A comparative analysis of the four groups (i.e., soil, air, groundwater and sediment) of alternatives was performed. Results are presented in the four subsections, followed by a presentation of preferred alternatives and the rationale for the preference.

5.1 SOIL ALTERNATIVES

The following four soil alternatives were evaluated:

- Alternative Soil-1: No Further Action
- Alternative Soil-3: Soil Cover
- Alternative Soil-4: Limited Excavation and Soil Cover
- Alternative Soil-6: Limited Excavation, Onsite Consolidation, and Soil Cover

5.1.1 Overall Protection of Human Health and the Environment

Alternative Soil-3 is protective to the most protective level of the USEPA mid range (10^{-6}) because it uses a soil cover with institutional controls to prevent unmanaged direct contact exposures to soil. Alternatives Soil-4 and -6 provide for a wide range of protection to human health, depending on the degree of excavation. None of these variations provide more protection than Alternative Soil-3. The most aggressive excavation scenario under Alternative Soil-4 and 6 would result in the level of protection of human health, equivalent to that of Alternative Soil-3. All of the alternatives provide for equal protection of the environment. Alternative Soil-1 (No Further Action) is not protective of human health and the environment.

5.1.2 Compliance with ARARs

Alternatives Soil-3, -4, and -6 all comply with ARARs. Alternative Soil-1 (No Further Action) does not comply with ARARs since risks above USEPA and OEPA risk management ranges would remain.

5.1.3 Long-Term Effectiveness and Permanence

Alternatives Soil-3, -4, and -6 provide very similar long-term effectiveness and permanence. All three require the same or very similar use restrictions and maintenance activities to provide protection from remaining contaminant levels below the cover soil cover.

5.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives Soil-3, -4, and -6 all provide for the segregation and offsite disposal of free flowing tars encountered during Site work. In addition, all these would involve the offsite disposal of sediment removed during riverbank restoration. While Alternative Soil-4 involves the removal of a substantial volume of soil from the Site (and disposes of it off Site), this would result in a reduction in volume of contaminated soil remaining at the Site by only approximately 4 percent.

5.1.5 Short-Term Effectiveness

Alternative Soil-3 could be installed the most quickly, resulting in immediate effective protection. Alternatives Soil-4 and Soil-6 would take longer due to increased construction complexity associated with excavating soil from the northern portion of the Main Parcel. All three alternatives would need to control dust from onsite work to protect both onsite workers and the surrounding community. Alternative Soil-4 would include an additional impact in the community due to the increased truck traffic required for offsite transportation of soils. It is estimated that Alternative Soil-3 would require that approximately 3,000 truckloads of soil be brought on Site for the cover system. Alternative Soil-4 is estimated to require these same 3,000 truckloads but could require an additional 4,500 truckloads to transport excavated soil off Site for disposal. This increase in traffic would result in additional dust and an increased risk of traffic accidents. Alternative Soil-1 would not provide any short-term effective protection, but would also not create any short-term impacts to the community or workers.

5.1.6 Implementability

Alternative Soil-1 is the most easily implemented alternative since it does not involve any actions. Of the other alternatives, Alternative Soil-3 is most easily implemented since it involves the placement of a relatively simple, yet effective, cover system, but does not involve the extensive excavation of soils from the northern portion of the Main Parcel as do Alternative Soil-4 and -6.

Alternatives Soil-4 and -6 also require excavation in the vicinity of the railroad. Given the proximity of the active rail line create a significant safety concern.

5.1.7 Cost

The following are the present worth estimates for the alternatives:

- Alternative Soil-1: No Further Action: $0
- Alternative Soil-3: Soil Cover: $3.9 M
- Alternative Soil-4: Limited Excavation, Offsite Disposal and Soil Cover: $4.4 M to $12.4 M
- Alternative Soil-6: Limited Excavation, Onsite Consolidation and Soil Cover: $4.0 M to $5.6 M

The greatest amount of uncertainty in these cost estimates is associated with Alternative Soil-4. While this alternative is already estimated to have the highest cost, these costs could significantly increase. The alternative includes the offsite disposal of (potentially) a very large quantity of soil. Increasing fuel prices would significantly increase transportation costs for offsite disposal. Another area of uncertainty that would affect both Alternative Soil-4 and Alternative Soil-6, is the amount of subsurface structures that are encountered. This would affect the amount soils actually removed, the area backfilled and the final grading plan. Depending on the location and degree of structures encountered, less backfilling may be required to achieve the proper final grading for redevelopment. Lastly, the volume of sediment that would need to be removed during installation of the rip rap toe (as part of riverbank restoration) is uncertain. This uncertainty would impact Alternatives Soil -3, -4, and -6.

5.2 AIR

The following two air alternatives were evaluated:

- Alternative Air-1: No Further Action
- Alternative Air-2: Institutional Controls

5.2.1 Overall Protection of Human Health and the Environment

Alternative Air-2 is protective of human health and the environment. Alternative Air-1 (No Further Action) is not protective.

5.2.2 Compliance with ARARs

Alternative Air-2 complies with ARARs. Alternative Air-1 (No Further Action) does not comply with ARARs since risks above USEPA and OEPA risk management ranges would remain.

5.2.3 Long-Term Effectiveness and Permanence

Alternative Air-2 would provide long-term, permanent control of risk through use restrictions requiring health and safety measures for construction (i.e., excavation) workers and engineering controls for potential future buildings. Alternative Air-1 would not provide for long-term or permanent protection.

5.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Neither alternative provides a reduction of risks through treatment.

5.2.5 Short-Term Effectiveness

Honeywell owns the property and is able to institute the necessary use restrictions. As a result, Alternative Air-2 would provide short-term effectiveness in addressing potential risks associated with indoor air and worker exposure to soil vapors. No adverse effects would result from this alternative. Alternative Air-1 would not provide any short-term value or create any additional short-term risks.

5.2.6 Implementability

Since Honeywell owns the property, the necessary use restrictions, required in Alternative Air-2, are easily instituted. Alternative Air-1 is easily implemented also, since it does not require any actions.

5.2.7 Cost

The following are the present worth estimates for the alternatives:

- Alternative Air-1: No Further Action: $0
- Alternative Air-2: Institutional Controls: $75,000

The costs for engineering controls, if necessary for future buildings, are not included in the cost of Alternative Air-2.

5.3 GROUNDWATER

The following three groundwater alternatives were evaluated:

- Alternative Groundwater-1: No Further Action
- Alternative Groundwater-3: Groundwater Collection/Treatment/Discharge
- Alternative Groundwater-4: Low-Permeability Cover

5.3.1 Overall Protection of Human Health and the Environment

Alternatives Groundwate-3 and -4 are protective of human health and the environment. Alternative Groundwater-1 (No Further Action) is not protective.

5.3.2 Compliance with ARARs

Alternatives Groundwate-3 and -4 comply with ARARs. Alternative Groundwater-1 (No Further Action) does not comply with ARARs since risks above USEPA and OEPA risk management ranges would remain.

5.3.3 Long-Term Effectiveness and Permanence

Alternatives Groundwate-3 and -4 both provide long-term and permanent protection through enhancement of the existing groundwater and DNAPL extraction systems. These systems have proven effective and the enhancements would more aggressively address risk by DNAPL and groundwater contamination. Alternative Groundwater-4 also includes a low-permeability cover to prevent infiltration from promoting the leaching of contaminants in unsaturated soils to groundwater. However, the benefit associated with is likely to be negligible because existing contaminants located within the saturated zone and pooled on the bedrock surface, which represent the largest fraction of the contaminant mass, would continue to leach to groundwater. Alternative Groundwater-1 would not provide for long-term or permanent protection.

5.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Both Alternative Groundwate-3 and -44 provide a reduction of toxicity, mobility and volume of contaminants through treatment of groundwater and DNAPL. Alternative Groundwater-1 does not.

5.3.5 Short-Term Effectiveness

Alternative Groundwater-3 could be quickly implemented to provide additional protection in a short time. No adverse impacts are anticipated with this alternative. Alternative Groundwater-4 would take significantly longer because of the time and additional complexity associated with installing a clay cover. In addition, truck traffic hauling clay to the Site would increase the risk of traffic accidents and add to noise and dust in the City. Alternative Groundwater-1 would not provide a short-term value but would not create any adverse impacts either.

5.3.6 Implementability

Alternative Groundwater-1 is most easily implemented since it does not involve any actions. Alternative Groundwater-3 is easily implemented. Honeywell owns the property on which the additional wells and piping would be installed. Alternative Groundwater-4 is also implementable, but the added complexity of installing the clay cover is not commensurate with the minimal improvement of the long-term effectiveness of this alternative, compared to Alternative Groundwater-3. In addition, obtaining the large amount of low permeability clay (approximately 40,000 cubic yards) required for Alternative Groundwater-4, from a local source may be difficult. Inquiries with contractors have not identified a local source for this volume of clay. Lastly, the clay cover in Alternative Groundwater-4 would also make the Site less desirable for redevelopment. Provisions for constructing through the cover can increase design costs, measures to minimize damage to the cover during construction can increase construction costs, and repair of the cover, following construction would further increase costs.

5.3.7 Cost

The following are the present worth estimates for the alternatives:

- Alternative Groundwater-1: No Further Action: $0
- Alternative Groundwater-3: Groundwater Collection/Treatment/Discharge: $2.2 M
- Alternative Groundwater-4: Low-Permeability Cover: $6.2 M

The cost estimates for Alternative Groundwate-3 and -4 do not include costs for replacing groundwater extraction wells over the life of the remedy. The costs have assumed that an aggressive maintenance program would maintain the usefulness of the wells. A significant uncertainty is the cost of the clay for the low-permeability cover included in Alternative Groundwater-4. As stated above, a large amount of low-permeability clay would be required and inquiries with contractors, to date, have not identified a local source for the clay.

5.4 SEDIMENTS

The following five sediment alternatives were evaluated:

- Alternative Sediment - 1: No Further Action
- Alternative Sediment – 2: Monitored Natural Recovery
- Alternative Sediment – 3: In-Situ Capping
- Alternative Sediment – 4: Dredging and Offsite Disposal
- Alternative Sediment – 5: Combination of Dredging and In-Situ Capping

5.4.1 Overall Protection of Human Health and the Environment

Alternatives 3, 4, and 5 are all protective of human health and the environment. Due to a lack of available data, it is uncertain whether Alternative Sediment-2 (Monitored Natural Recovery) is protective. Alternative Sediment-1 (No Further Action) is not protective.

5.4.2 Compliance with ARARs

Chemical-specific ARARS are not established.

Alternatives 1,2,3, 4, and 5 all comply with location and action-specific ARARs.

5.4.3 Long-Term Effectiveness and Permanence

Alternatives 3, 4, and 5 would provide long-term effectiveness through proven technologies and potential implementation of a residual management plan. Monitored Natural Recovery (Alternative Sediment-2) may also provide long-term effectiveness but insufficient information exists to evaluate this. Alternative Sediment-1 would not provide for long-term or permanent protection.

5.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative Sediment-3 utilizes capping to reduce contaminant mobility by isolating contaminated sediments from the benthic environment. Alternative Sediment-4 utilizes dredging to remove contaminants from the benthic environment. Alternative Sediment-2 allows the environment to naturally recover, but additional data is necessary to evaluate this. Alternative Sediment-5 provides for a combination of capping and dredging which would reduce contaminant mass and toxicity in dredged areas and reduce mobility in capped areas. Alternative Sediment-1 would not reduce toxicity, volume, or mobility of the contaminants.

5.4.5 Short-Term Effectiveness

Alternative Sediment-3 quickly reduces the risks by providing an immediate clean substrate for the benthic environment. Because resuspension may occur and residuals may remain under Alternative Sediment-4, risks are not immediately reduced during dredging. Both alternatives would require protective measures to minimize adverse impacts to the aquatic environment during implementation. Alternative Sediment-5 includes capping and dredging in areas to be determined after additional data collection and design. The same short-term benefits and potential adverse impacts over the short-term apply as with Alternative Sediment – 3 and - 4. Alternative Sediment-2 relies on natural recovery. While the rate of recovery is unknown, at present, this alternative does not have any short-term adverse impacts on the aquatic environment. Alternative Sediment-1 does not include any actions. As a result, it does not provide any short-term value, but does not result in short-term adverse impacts.

5.4.6 Implementability

Alternative Sediment-1 is the most easily implemented because it does not involve any actions. Alternative Sediment-2 involves monitoring of natural recovery, which is easily implemented. Alternative 3 can be implemented far more easily than alternative Sediment 4 since capping does not require a large dewatering area and subsequent treatment of dewatering fluids, as does dredging. In addition, there are no contaminated sediment transportation and disposal issues with capping. Alternative Sediment-5 has the same implementation advantages and disadvantages as Alternative Sediment – 3 and - 4.

5.4.7 Cost

The following are the present worth estimates for the alternatives:

- Alternative Sediment - 1: No Further Action - $0
- Alternative Sediment – 2: Monitored Natural Recovery - $0.7 M to $1.0 M
- Alternative Sediment – 3: In-Situ Capping - $1.8 M to 3.4 M
- Alternative Sediment – 4: Dredging and Offsite Disposal - $6.8 M to 9.9 M
- Alternative Sediment – 5: Combination of Dredging and In-Situ Capping - $2.8 M to $4.5 M

Cost estimates for Alternatives 3, 4, and 5 are highly uncertain and can be verified following additional data collection efforts, which would include sediment sampling at depth, sediment thickness measurements, grain size analysis, hydrographic and side-scan sonar surveying, and river flow velocity measurements. Once additional data is collected, the estimated volume and area to be remediated would be refined and details regarding the remedy developed.

6.0 REFERENCE

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FIGURES

TABLES

APPENDIX A
SELECTED FIGURES FROM THE PHASE IA RI REPORT

APPENDIX B
SITE-SPECIFIC PRELIMINARY REMEDIATION GOALS – HUMAN HEALTH

APPENDIX C
SITE-SPECIFIC PRELIMINARY REMEDIATION GOALS – ECOLOGICAL

APPENDIX D
REMEDIAL INVESTIGATION ANALYTICAL DATA TABLES

APPENDIX E
COST ESTIMATES