FOCUSED FEASIBLITY STUDY
VINELAND CHEMICALS SUPERFUND SITE

Operable Unit Three (River Areas Sediments)
VINELAND, NEW JERSEY
EPA ID: NJD002385664

Prepared for:

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USACE

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Acronyms and Abbreviations

List of Acronyms

%	Percent
µg/L	micrograms per liter
µg/kg	micrograms per kilogram
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tank
BHHRA	baseline human health risk assessment
bgs	below ground surface
CEA	Classification Exception Area
CERCLA	Comprehensive Environment Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cm/sec	centimeter per second
COC	contaminant of concern
COPC	chemical of potential concern
CSM	conceptual site model
DNAPL	dense non-aqueous phase liquid
DOT	Department of Transportation
DPT	direct-push technology
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ERT	Environmental Response Team
ESD	Explanation of Significant Differences
EVO	emulsified vegetable oil
FFS	Focused feasibility study
ft/d	feet per day
GAC	granular activated carbon
gpm	gallon per minute
GRA	general response action
GWQS	Ground Water Quality Standards
HHRA	human health risk assessment
HI	hazard index
IA	Interagency agreement
ISCO	in-situ chemical oxidation
Kg	Kilogram
KOC	organic carbon partition coefficient
LPGAC	liquid phase granular activated carbon
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligram per liter
MNA	monitored natural attenuation
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan
N.J.A.C	New Jersey Administrative Code

NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PCB	polychlorinated biphenyl
PPE	personal protective equipment
PRG	Preliminary Remediation Goal
PRP	potential responsible party
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
ROD	Record of Decision
RSL	Regional Screening Levels
Site	Vineland Chemical Corporation Superfund Site
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TBC	to be considered
TCA	Trichloroethane
TCE	Trichloroethene
TI	technical impracticability
TMP	temperature monitoring point
T/M/V	Toxicity, Mobility, or Volume
TOC	total organic carbon
TSCA	Toxic Substances and Control Act
USACE	United States Army Corps of Engineers
UV	Ultraviolet
VOC	volatile organic compound
VPGAC	vapor phase granular activated carbon

Executive Summary

Purpose

The purpose of this Focused Feasibility Study (FFS) is to assemble and evaluate remedial alternatives for a portion of the Vineland Chemical Superfund Site (Site), Operable Unit Three (River Areas Sediments) (OU3) located in Cumberland County, Vineland, New Jersey. This FFS was prepared by United States Army Corps of Engineers (USACE) under an interagency agreement (IA) on behalf of the United States Environmental Protection Agency (USEPA), Region II.

The FFS was prepared in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986. The FFS follows guidance outlined in USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988).

The 1989 Record of Decision (ROD) that was issued for the Site describes the Selected Remedy for OU3 as:

- Excavation and treatment of the exposed arsenic-contaminated sediments in the Blackwater Branch floodplain.
- Dredging/removal and treatment, by water wash extraction, of the submerged arsenic-contaminated sediments in the Blackwater Branch adjacent to and downstream of the Vineland Chemical Company plant site.
- After stopping the flow of arsenic-contaminated groundwater from the Vineland Chemical Company plant site, a three year period for natural river flushing will be implemented. This will allow the submerged, arsenic-contaminated sediments in the Maurice River to be flushed clean through natural processes.

Implementation of the first two components of the Selected Remedy was initiated in June 2006 and completed in December 2012. However, monitoring since that time has shown that exposed sediments of the Blackwater Branch have become re-contaminated with arsenic above the cleanup goals identified in the 1989 ROD for OU3 due to arsenic in groundwater reaching the sediments. As such, additional actions may be required to address this portion of OU3; options are evaluated herein.

Remedial Action Objectives

The 1989 ROD identified the following Remedial Action Objectives (RAO) for the sediments in OU3.

- Operable Unit Three addresses the river areas sediments. The primary objective is to minimize public exposure, either through containment, removal, or institutional controls, for those areas

with unacceptably high sediment arsenic concentrations, such as the exposed former sediments in the Blackwater Branch floodplain.

This overall RAO for OU3 remains in effect. The specific RAOs for the remedial alternatives discussed in this FFS, which apply to the exposed sediment of the Blackwater Branch floodplain, are:

- Reduce concentrations of arsenic in the exposed sediments in the Blackwater Branch floodplain to below acceptable levels of risk.
- Prevent recontamination of exposed sediments of the Blackwater Branch floodplain from site-related groundwater contamination.

Additional amendments to the 1989 ROD may be required for other components of the site including submerged sediment, groundwater, and the Maurice River.

Preliminary Remediation Goals

The 1989 ROD identified a Preliminary Remediation Goal (PRG) of 20 mg/kg for arsenic in exposed sediments. Since then, the state of New Jersey has conducted a much more robust study of statewide levels of arsenic and from this study a statewide background concentration of 19 mg/kg has been determined. The PRG for arsenic has been updated to meet the current New Jersey Soil Remediation Standard of 19 mg/kg.

Remedial Alternatives

The descriptions of the remedial alternatives in this FFS are conceptual and have been developed to a level of detail sufficient for the purposes of evaluating the alternatives against the National Contingency Plan (NCP) criteria, developing cost estimates, and comparing the alternatives. Per the NCP requirement, a no further action alternative has been included and is carried through the entire FFS process as the baseline condition against which the performance of the remaining alternatives are evaluated. The alternative selected for the site will be further developed during the remedial design process, and the specific methodologies and construction sequences used may change based on additional information that is gathered as part of predesign investigations.

The following alternatives were developed:

- Alternative 1: No Further Action
- Alternative 2: Ongoing Hot Spot Excavation

  This alternative consists of periodic excavation and off-site disposal of the exposed sediments of the Blackwater Branch floodplain as the arsenic concentrations exceed the PRG.

- Alternative 3: In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring

  This alternative consists of installation of in-situ treatment technologies to prevent recontamination of the exposed sediments to concentrations above PRGs, hot-spot excavations

to remove exposed sediments in the Blackwater Branch floodplain above PRGs, and performance monitoring to assure the remedy is effective and assess the need for additional in-situ treatment and/or excavation.

The in-situ technology used may vary across the site and will depend on the geochemistry and subsurface conditions in each particular location. Examples of such technologies include air sparging in iron rich groundwater environments and iron chloride injection in addition to air sparging or peroxide injection in iron poor groundwater environments. In-situ technologies may also include reactive barriers. The specific technologies described have been proven effective in bench scale testing with soil and groundwater from the site, however other technologies may be effective as well. Final selection of the in-situ treatment technology appropriate for each area of the site will be made after further studies during remedial design.

In addition, the need for excavation before and/or after in-situ treatment for each area of the site will be determined during the remedial design and further refined during implementation of the remedial action through performance monitoring.

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1 INTRODUCTION

This FFS was prepared by United States Army Corps of Engineers (USACE) under an interagency agreement (IA) on behalf of the United States Environmental Protection Agency (USEPA), Region II. This FFS addresses exposed sediments of the Blackwater Branch floodplain (OU3).

The 1989 Record of Decision (ROD) that was issued for the Site describes the Selected Remedy for OU3 as:

- Excavation and treatment of the exposed arsenic-contaminated sediments in the Blackwater Branch floodplain.
- Dredging/removal and treatment, by water wash extraction, of the submerged arsenic-contaminated sediments in the Blackwater Branch adjacent to and downstream of the Vineland Chemical Company plant site.
- After stopping the flow of arsenic-contaminated groundwater from the Vineland Chemical Company plant site, a three year period for natural river flushing will be implemented. This will allow the submerged, arsenic-contaminated sediments in the Maurice River to be flushed clean through natural processes.

Implementation of the first two components of the Selected Remedy was initiated in June 2006 and completed in December 2012. However, monitoring since that time has shown that exposed sediments of the Blackwater Branch floodplain have become re-contaminated with arsenic above the cleanup goals identified in the 1989 ROD for OU3 due to arsenic in groundwater reaching the sediments. As such, additional actions may be required to address this portion of OU3; alternatives are evaluated herein. This FFS does not fully address the Maurice River or the submerged sediments of the Blackwater Branch, which are also portions of OU3 of the site.

1.1 Purpose and Organization of the Report

The purpose of the FFS is to identify, develop, screen, and evaluate a range of remedial alternatives for the contaminated media and to provide the regulatory agencies with data sufficient to select a feasible and cost-effective remedial alternative that protects human health and the environment from potential risks at the Site.

The report was prepared in accordance with Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (EPA 1988). This FS report is comprised of five sections as described below.

- **Section 1 - Introduction** provides a summary of Site background information including the Site description, Site history, physical characteristics of the Site, RI sampling activities, nature and extent of contamination.
- **Section 2** - **Site Investigation Findings** presents contaminants of potential concern, Remedial Action Areas (RAA) and Risk Assessment(s)
- **Section 3 - Remedial Action Objectives and Applicable or Relevant and Appropriate Requirements** develops a list of remedial action objectives (RAOs) by considering the characterization of contaminants, the risk assessment, and compliance with Site-specific applicable or relevant and appropriate requirements (ARARs); and identifies and screens remedial technologies and process options.
- **Section 4 - Development and Screening of Alternatives** describes the criteria used to select alternatives to evaluate.
- **Section 5 – Remedial Alternatives** describes each of the Alternatives evaluated as part of the FFS.
- **Section 6 – NCP Evaluation** describes each of the nine NCP evaluation criteria and evaluates each of the Alternatives against those nine criteria.
- **Section 7 – Comparative Analysis of Alternatives** compares each alternative relative to the nine evaluation criteria.
- **Section 8 – Summary** provides a brief summary of the FFS findings.
- **Section 9 - References** provides a list of references used to prepare the FFS.

1.2 Background

The Vineland Chemical Company operated from 1949 to 1994 and produced arsenical herbicides and fungicides. There were twelve buildings and five abandoned chicken coops on the plant site. Some of these structures were used by the Vineland Chemical Company for various manufacturing purposes.

As early as 1966, the New Jersey Department of Health observed untreated wastewater being discharged into unlined lagoons at the Vineland site. This wastewater was contaminated with arsenic at concentrations up to 67,000 parts per billion (ppb). Waste salts containing 1-2 percent arsenic were stored outside in uncovered piles. Precipitation dissolved some of these salts and carried them into the groundwater and eventually into nearby surface water bodies. Contaminated sediment was mapped 1.5 miles downstream in Blackwater Branch to its confluence with the Maurice River and then 7.5 miles downstream to Union Lake.

The site was added to the National Priorities List (NPL) in September 1984. A Remedial Investigation and Feasibility Study (RI/FS) was completed in 1989 to identify the types, quantities, and locations of contaminants, and to develop ways to remediate the problems posed by the contaminants.

Based on the RI/FS findings, EPA implemented a number of response actions that included securing the site with a perimeter fence and removing thousands of gallons of arsenic solutions and demolition of eight buildings.

A ROD for the site was signed in 1989 and determined that actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response actions selected in the ROD, may present an existing or potential threat to public health, welfare or the environment. The ROD divided the site into four operable units (OUs) as described in Section 1.2.2.

1.2.1 Site Location

The Vineland Chemical Superfund Site is located in the northwestern portion of Vineland, in Cumberland County, south central New Jersey, in an area of mixed industrial, low-density residential and agricultural properties. The site is bordered immediately to the north by other industrial properties and the Blackwater Branch, a perennial stream that flows westward to the Maurice River. See Site Location Figure 1.2.1.

1.2.2 Physical Characteristics

The 1989 RI/FS encompassed the aerial extent of the contamination in a study area approximately 8 miles long with several sub areas, including (see Figure 1.2.2):

- OU1: The Vineland Chemical Company Plant Site;
- OU2: The Groundwater Aquifer Plume
- OU3: The Blackwater Branch, Maurice River and associated flood plains; and
- OU4: Union Lake, an 870-acre impoundment on the Maurice River

This FFS focuses on further analyses completed in relation to OU3.

According to the Five-Year Review Report (EPA 2011), the Vineland Chemical Company site is essentially a level plain, sloping from northwest to southeast with topographic variations from 60 to 80 feet above mean sea level (MSL) near the former plant site to just below 30 feet MSL near Union Lake. Soils in the general area of the site are marine deposits.

The Blackwater Branch of the Maurice River flows northeast to southwest, in proximity to, and partially through, the site itself. A floodplain lies immediately adjacent to the Blackwater Branch

along the entire length of the tributary extending to the Maurice River. The Maurice River flows in a southerly direction approximately six miles to its confluence with Union Lake. A broad floodplain also borders the Maurice River. As an institutional control, signs are posted in accessible areas of Blackwater Branch and the Maurice River advising the public that sediments are contaminated with arsenic and there are risks associated with prolonged exposure to arsenic. Periodic monitoring of the signage is necessary, as signs have been removed in the past.

A city park is located approximately one-half mile downstream of the confluence of the Blackwater Branch and the Maurice River at the Almond Road Bridge. The swimming area here was closed by the New Jersey Department of Environmental Protection (NJDEP) as a result of arsenic contamination, but was reopened in June 1988. The city park was closed during the summer season of 2010 due to elevated levels of fecal coliform in the water and the lack of funding for recreational security/safety personnel. Beach and boating recreation areas are present at Union Lake.

Available climatological data were obtained from cooperative weather stations, maintained by the National Weather Service, located in Vineland (precipitation and wind) and Bridgeton (temperature). The Vineland station had accumulated data since 1885, while the Bridgeton station had data dating back to 1894. Vineland receives approximately 45 inches of rainfall per year. Monthly averages range from 3.46 inches in April to 5.21 inches in August. No temperature data are available for Vineland proper, but Bridgeton (12 miles west - southwest of Vineland) exhibits a mean annual temperature of 12.6 degrees Celsius (°C). The mean maximum and minimum annual temperatures are 18.3 °C and 7°C, respectively.

Although detailed information on wind direction is not available for the site, from October through April, the predominant wind direction is from the northwest. From May through August, the dominant direction is out of the southwest; during September, the wind is from the southeast.

1.2.3 Regional Geology and Groundwater Movement

The text in this section is extracted from the Classification Exception Area and Well Restriction Area Report (CEA Report). The site is located in the Atlantic Coastal Plain physiographic province, which consists of a seaward-dipping wedge of unconsolidated sediments (sand, silt, clay, and gravel) that range in age from Cretaceous to Quaternary. Locally the site is situated on a relatively level plain that slopes slightly from the southeast toward the northwest with topographic elevations that range from 65 to 75 feet above mean sea level.

Groundwater levels vary seasonally at the site with an average of approximately 10 feet below ground surface (bgs), and a typical minimum and maximum of between 4 and 19 feet bgs.

Under non-pumping conditions, groundwater south of the Blackwater Branch moves in an east to west direction with groundwater discharging at several locations along Blackwater Branch. Under pumping conditions, the direction of flow is somewhat altered to a more southeast to northwest flow direction south of Blackwater Branch, and a northeast to southwest flow direction north of Blackwater Branch (**Appendix A**). Groundwater that is not captured by the recovery system discharges to Blackwater Branch.

1.2.4 Past OU3 Remedial Actions

The excavation and treatment of arsenic impacted sediments from the Blackwater Branch and its floodplain was carried out in four phases from 2006 through 2012 (**Appendix A**). In each phase, the Blackwater Branch was diverted to a clean location before excavation of the contaminated material was performed. Once material with arsenic concentrations exceeding 20 mg/kg was removed, the excavated area was backfilled with clean material and stream flow was restored to the re-constructed stream channel.

Treatment of Phase 1 began in 2006 and was completed in 2007. Both contaminated peat and sand were encountered in this phase and had to be removed. Excavated sand was treated at an onsite soil washing plant to arsenic concentrations of 20 mg/kg or below, and the treated material was used as backfill on the site. The fine-grained peat was not suitable for soil washing and was disposed of at an offsite non-hazardous waste landfill (Subtitle D).

In Phase 2, contamination was found only in the shallow peat, and excavation of this 3-4 foot layer began in 2008. The excavated material was disposed of at an offsite landfill. Excavation concluded in 2010. Plantings and repairs due to storm damage were completed in 2011.

Excavation of Phase 3 began in 2009 and was completed in 2010. All material excavated from this phase was disposed of at an offsite landfill. Restoration plantings were completed in 2012.

Phase 4 excavation took place from 2011 through 2012, with excavated materials disposed of offsite. The final alignment of the stream channel was slightly repositioned to avoid an area where arsenic contaminated seeps had appeared. Restoration plantings were also completed in 2012.

At the conclusion of the OU3 restoration, a total of 318,491 tons of contaminated sediment was excavated and disposed of in a non-hazardous offsite landfill. Approximately 111,000 additional tons of sand were excavated and used to backfill Phase 1 after undergoing soil washing.

1.2.5 OU3 – Nature and Extent of Contamination

After arsenic excavation in the floodplain in OU3 Phases 1 and 2, iron staining along the banks and within Blackwater Branch was observed in some locations. Sediment and water samples

taken at a few of these iron-stained locations were analyzed in 2010 to determine if these iron-stained sediments also contained arsenic. Approximate locations of these isolated sediment and water samples are shown in **Figure 1.3.1**. Sample 1 was taken along the OU3 Phase 1 Blackwater Branch streambank after excavation in the floodplain had occurred and after flow had been restored to the creek channel. Samples 2 through 5 were taken along the OU3 Phase 2 Blackwater Branch streambank after excavation in the floodplain had occurred and clean sand was placed but while the diversion channel was still in operation (i.e. before stream flow was restored to the original creek channel). Samples 2 and 3 were clustered as shown in **Figure 1.3.2** where Sample 2 was estimated to be the point of groundwater issuance and Sample 3 was taken at a point just downstream of the estimated point of issuance where significant iron staining was evident. Samples 4 and 5 were clustered similarly at a distance downstream of Samples 2 and 3.

The sediment samples at each location were taken with a 2-inch auger at a depth between 0 and 2 inches below ground surface (scrape) and a depth between 2 and 6 inches below ground surface (composite). The sediment samples were tested for total arsenic, total iron and total aluminum. All water samples were taken with a Mityvac vacuum water sampler. The water samples were tested for total and dissolved arsenic, iron and aluminum. The results are shown in **Table 1.3.1**.

The 2010 water sample results showed that at sampling location cluster 2 and 3, the seep entering the dry creek bed had levels of dissolved arsenic greater than 700 ppb. The sediment scrape in the same location contained arsenic just above the floodplain sediment goal of the ROD (20 mg/kg) but the composite sample was less than the ROD goal. The OU3 remedy was selected based on the assumption that the flow of arsenic-contaminated groundwater into the Blackwater Branch will have been stopped by the pump and treat system. These results provide evidence that arsenic is seeping into Blackwater Branch at some of the locations sampled even with the pump and treat system at full operation. In one location the scrape sample exceeded the ROD goal and, over time, the sediment contamination could build up to levels above the ROD goals for exposed sediments. Despite the elevated arsenic levels at these seeps, the surface water arsenic levels appear to be diluted by the natural creek flow.

Sampling of surface sediments was performed between 2011 and 2012 along Phases 2, 3 and 4, soon after stream restoration and prior to re-diverting the surface water back to the stream. Samples were biased toward the iron-stained sediments and were comprised of scrape sediment samples (i.e. sediments scraped of the top iron-stained surface) and 6-inch composite samples. Arsenic concentrations in surface sediments of these samples from 2012 are shown on **Figures 1.3.3 to 1.3.7** and a portion of the data is summarized in **Table 1.3.2**. Results indicate that arsenic in surface sediment samples accumulated soon after restoration and

exceed the 20 mg/kg ROD criteria for unsubmerged sediment. In Phases 3 and 4, the arsenic concentrations that were identified in surface sediments also exceeded the ROD remedial goal of 120 mg/kg for submerged sediments. Due to the extensive arsenic exceedances along the Phase 4 segment of the Blackwater Branch, surface water was not re-diverted back to this section of the Blackwater Branch. The Blackwater Branch was eventually re-diverted back to a stream alignment that was similar to the original alignment but followed an alternate alignment around the reach where the arsenic exceedances were encountered.

Additional sediment sampling was conducted in Phases 1 and 2 between 2013 and 2015. Samples were biased to locations that were iron-stained and were collected from floodplain areas as well as locations near the banks of the Blackwater Branch where sediments are likely to be exposed during low-flow conditions. During this time period, operation of the pump and treat system varied between full pumping, no pumping and partial pumping. Sediment samples exceeded 20 mg/kg while the pump and treat system was fully operational as well as while the pump and treat system was shut down. Instances of exceedances are described below. Figures showing the locations where samples were collected (both exceedances and non-exceedances) can be found in **Figures 1.3.3 to 1.3.7**.

- April 25, 2013 – Sampling was conducted approximately 2 weeks after a 2-week shutdown of the pump and treat system. Six surface scrape samples collected in Phase 1 exceeded 20 mg/kg, the highest of which was 146 mg/kg.

- October 29, 2013 – Sampling was conducted while the pump and treat system was fully operational. Six surface scrape samples collected in Phases 1 and 2 exceeded 20 mg/kg, the highest of which was 104 mg/kg.

- February 24 and 26, 2014 – Sampling was conducted after the pump and treat system was shut down for almost 4 months. Four surface scrape samples collected in Phases 1 and 2 exceeded 20 mg/kg, the highest of which was 456 mg/kg. The sample with the highest arsenic concentration was collected from a location in the floodplain where a groundwater seep was observed. This location was not sampled when the pump and treat system was in fully operation. The highest arsenic concentration along the banks of the Blackwater Branch was 96 mg/kg. Six-inch composite sediment samples were also collected at this time. One of these composite samples exceeded the 20 mg/kg sediment criterion (48.7 mg/kg in Phase I).

- June 24, 2015 – Sampling was conducted while the pump and treat system was partially operating. Four samples were collected from the floodplain in Phase 1, and two samples were collected from the floodplain in Phase 2. Prior to this sampling event, pump and treat had been discontinued in March and April, but the recovery wells

closest to the samples collected in Phase 1 had resumed pumping at the beginning of May. Surface scrape samples from the floodplain of Phase 1 were all substantially higher than 20 mg/kg, with the highest concentration recorded at 1,470 mg/kg. Three of four six-inch composite sediment samples collected in Phase 1 were also higher than 20 mg/kg, the highest of which was 196 mg/kg.

Sediment samples collected between 2011 and 2015 demonstrated that full operation of the pump and treat system is not preventing arsenic from accumulating in the sediment. The pump and treat system slightly redistributes the locations where arsenic concentrations above 20 mg/kg are observed, but it does not eliminate the threat of recontaminating the floodplain.

1.2.6 Optimization

A Remedial System Evaluation (RSE) was conducted at the site in April of 2010. RSEs are performed as part of a program conducted by the USEPA Office of Superfund Remediation Technology Innovation (U.S. EPA OSRTI) in support of "*Action Plan for Ground Water Remedy Optimization*" (OSWER 9283.1-25, August 25, 2004). The objective of the program is to conduct RSEs at selected pump and treat systems to determine if there are opportunities for improvement or optimization of plant operations. The RSE identified a number of recommendations to reduce costs and improve operations. One recommendation included investigating the potential for using in-situ treatment technologies to immobilize arsenic.

1.2.7 Bench Scale Testing

Sediment sampling conducted after implementation of the OU2 and OU3 remedies demonstrated that pump and treat alone cannot prevent recontamination of OU3 from the arsenic plume shown on the figures in Appendix B. Preliminary bench scale testing was conducted to evaluate the viability of in-situ treatment as a method of controlling recontamination. In-situ treatments evaluated at the bench scale focused on creating conditions for which the accumulation of arsenic in sediment would be unfavorable either by reducing the flux of arsenic to the sediments or reducing the availability of sorption sites on which arsenic can accumulate.

Results of the bench scale studies indicate that several methods of in-situ treatment can reduce arsenic accumulation in sediment so that concentrations in the Blackwater Branch floodplain would remain below 20 mg/kg. These methods include in-situ treatment with oxygen (such as air sparge or peroxide), in-situ treatment with iron, and/or in-situ pH adjustment.

2 SITE INVESTIGATION FINDINGS

The OU3 remedy selected in the 1989 ROD was based on the assumption that the flow of arsenic-contaminated groundwater into the sediment of the Blackwater Branch floodplain would be stopped by the pump and treat system. Sediment samples collected between 2011 and 2015 demonstrated that full operation of the pump and treat system did not prevent arsenic from accumulating in the sediment. The pump and treat system slightly redistributes the locations where arsenic concentrations above 20 mg/kg are observed, but it does not eliminate the threat of recontaminating the floodplain.

2.1 Contaminants of Potential Concern

The original ROD for the site identified arsenic as the contaminant of concern. Therefore, arsenic is identified as the contaminant of potential concern for this FFS.

2.2 Remedial Action Areas (RAA)

Four areas have been identified that require remedial action. These areas have been separated based on location and geochemistry as shown in Figure 2.2.1. Additional areas may also require remedial action.

- Area A: Blackwater Branch and Floodplain from 600 to 1300 feet downstream of N Mill Rd
- Area B: Blackwater Branch and Floodplain from 600 to 1000 feet upstream of N Mill Rd
- Area C: Blackwater Branch and Floodplain from 1100 to 1600 feet upstream of N Mill Rd
- Downstream Blackwater Branch (Area A to Maurice River)

Sediment samples were collected in Areas A, B, and C of the Blackwater Branch floodplain during six separate sampling events between 2012 and 2015 discussed above. The exposure point concentrations identified for the determination of risks/hazards are the maximum concentrations detected in each area. Table 2.1 details the exposure point concentrations from each area of Blackwater Branch.

2.3 Risk Assessments

Human health and ecological evaluations were conducted for the exposed sediments of the Blackwater Branch floodplain. This supplemental evaluation reviews post-excavation exposed sediment data collected between 2012 and 2015 in areas A, B and C of the Blackwater Branch against current risk-based screening levels (RSLs).

2.3.1 Human Health Risk Assessment

A supplemental human health risk evaluation was conducted to update the risk assessment that was used to select the OU3 remedy in the 1989 ROD. The supplemental evaluation reviewed post-excavation exposed sediment data collected between 2012 and 2015 in areas A, B and C of the Blackwater Branch floodplain against current risk-based screening levels (RSLs), and a semi-quantitative screening evaluation was conducted for the future recreator in Area A.

Calculation of risk-based RSLs for soil/sediment (which combine the ingestion, dermal and inhalation pathways) were based on standardized equations that combine exposure information and assumptions with available toxicity data. Recreator exposure parameters were used to best approximate site exposure during future recreational use of the Blackwater Branch. The exposure parameters used in the calculations reflect currently recommended default exposure factors as documented in EPA's February 2014 OSWER Directive 9200.1-120, along with site-specific considerations about the time a child/adult receptor may spend at the site. Any current site user (e.g., treatment plant worker or trespasser) would have less frequent exposures, and thereby lower risks, than these future receptors. A reasonable maximum exposure scenario of 4 hours per day and 40 days per year was considered, in line with the 1989 Baseline Risk Assessment's evaluation of recreational use. The exposure parameters used to calculate the recreator RSLs are outlined in Table 2.2. The RSLs for all pathways (ingestion, dermal and inhalation) are detailed in Table 2.3.

The maximum detected arsenic concentrations in Areas A, B and C are greater than the human health-based RSLs, which indicates the potential for unacceptable risk and adverse health effects from recreational exposure to exposed Blackwater Branch sediments. Additionally, the EPCs in all three areas of the Blackwater Branch exceed the 1989 site cleanup level of 20 mg/kg for arsenic in exposed soil/sediment by an order of magnitude or more.

A semi-quantitative screening evaluation was conducted for Area C and is summarized in Tables 2.4 and 2.5. The results indicate that the current remedy is likely not protective of human health for a future recreator. The estimated cancer risk for a child and adult recreator utilizing the Blackwater Branch in Area C would equal 2 $x10^{-4}$, and the noncancer hazard estimates for a child and adult recreator in Area C are 5 and 0.5, respectively, exceeding EPA's acceptable risk range of 10^{-6} to 10^{-4} and noncancer hazard of 1.

The comprehensive RSL calculator output, including all the current exposure parameters, chemical-specific toxicity information, and resultant risk and non-cancer hazard estimates are provided in Appendix C.

2.3.2 Ecological Risk Evaluation

A qualitative, screening level ecological risk evaluation was conducted to determine if the New Jersey soil remediation standard of 19 mg/kg is protective of the environment. To do this, the standard was compared to ecological screening values. For the purpose of this evaluation the exposed sediments were assessed as floodplain soils.

The floodplain soil is considered to be representative of a terrestrial environment, so concentrations of arsenic were compared to EPA's Ecological Soil Screening Level (Eco-SSLs), which are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or consume biota that live in or on soil. As such, these values are presumed to provide adequate protection of terrestrial avian and mammalian receptors. The wildlife Eco-SSLs represent back-calculations from a hazard quotient (HQ) of 1.0. The HQ is equal to the estimated exposure dose divided by the toxicity reference value (TRV). An HQ of 1.0 is the condition where the exposure and the dose associated with no adverse chronic effects are equal, indicating adverse effects at or below this soil concentration are unlikely. The TRV represents a receptor-class specific estimate of a no-observed adverse effect level (dose) for reproduction, growth or survival based upon chronic exposure. Eco-SSLs for plants and invertebrates were derived based upon a similar approach in evaluating TRVs. The values were derived directly after an evaluation of all available plant and soil invertebrate chronic toxicity test data (measured toxicity related to soil contaminant concentrations). The plant value represents the maximum acceptable toxicant concentration for growth. The EPA Eco SSLs are 18 mg/kg for plants, 43 mg/kg for avian receptors and 46 mg/kg for mammalian receptors. It should be noted that acceptable literature values were not available to develop soil invertebrate Eco SSLs.

Comparison of these screening levels to the New Jersey soil remediation standard of 19 mg/kg shows that the standard is protective for avian receptor and mammalian receptors. The only ecological value in exceedance of 19 mg/kg is the value that was derived to be protective to plants. However, this value of 18 mg/kg is only slightly below 19 mg/kg. Further, it should be noted as part of the full ecological risk assessment process, as the risk assessment continues from the screening level ecological risk assessment to the baseline ecological risk assessment (BERA), a refinement of potential contaminants of concern is conducted. During this step inorganic contaminants of potential concern may be screened against background inorganic values, and inorganic concentrations at or below background values are not carried through to the BERA. Therefore, arsenic concentrations below 19 mg/kg, which is the statewide background concentration, would not be carried through to the BERA.

In summary, the qualitative, screening-level ecological risk evaluation concludes that the New Jersey soil remediation standard of 19 mg/kg is protective of the environment.

3 REMEDIAL ACTION OBJECTIVES & ARARS

Remedial action objectives (RAOs) are specific goals for protecting human health and the environment. The development of these goals involved considering ARARs and To Be Considered (TBC) guidance as well as the results of the Human Health Risk Assessment and Ecological Risk Assessment. An overview of ARARs and TBC guidance is presented in this section, followed by identification of site-specific ARARs. PRGs were subsequently selected that conform to the ARARs and TBCs and then, General Response Actions (GRAs) were selected to satisfy the RAOs.

3.1 Overview of ARARs

3.1.1 Definition of ARARs

Section 121(d) of CERCLA states that remedial actions must attain a degree of cleanup of hazardous substances, pollutants, and contaminants which would assure protection of human health and the environment. Section 121(d)(2)(A) of CERCLA provides that the cleanup must meet certain standards, requirements, criteria, and limitations derived from specified Federal environmental laws. This section also provides that the cleanup must meet certain standards, requirements, criteria, and limitations derived from State environmental or facility siting laws if these are more stringent than the Federal standards or criteria or if these State standards come from an approved, delegated program and have been identified by the State in a timely manner, and that remedial actions must comply with or waive identified ARARs.

Many federal and state environmental and public health agencies develop criteria, advisories, guidance, and proposed standards that are not legally enforceable, but contain information that would be helpful in carrying out or in determining the level of protectiveness of selected remedies. TBC materials are meant to complement the use of ARARs not compete with or replace them. Because TBCs are not ARARs, their identification and use are not mandatory. Where no ARARs exist to address a particular situation, the TBCs may be used to set cleanup targets (in conjunction with a baseline risk assessment).

ARARs consist of two sets of requirements: those that are applicable and those that are relevant and appropriate.

- Applicable requirements are those substantive standards that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.
- Relevant and appropriate requirements are those cleanup requirements promulgated under federal or state law that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at an National

Priority List site, address problems or situations sufficiently similar (relevant) to those encountered, and are well-suited (appropriate) to circumstances at the particular site. The relevance and appropriateness of a requirement can be judged by comparing a number of factors including the characteristics of the remedial action, the hazardous substances in question, or the physical circumstances of the site with those addressed in the requirement. The objective and origin of the requirement are also considered. Requirements must be both relevant and appropriate to be ARARs.

- A requirement that is judged to be relevant and appropriate must be complied with to the same degree as if it were applicable.

All ARARs are considered 'potential' in this FFS and in the Proposed Plan; final ARARs will be identified in the ROD Amendment.

3.1.2 Types of ARARs

Any substantive environmental requirement has the potential to be an ARAR. A substantive requirement typically specifies a level or standard of control, although it could also provide performance criteria or location restrictions. To simplify the universe of such requirements, USEPA divides ARARs into three categories to facilitate identification:

- Chemical-Specific ARARs are either health- or risk-based numerical values or methodologies that establish the acceptable amount or concentration of a chemical that may remain in or be discharged to the environment. If more than one such requirement applies to a contaminant, compliance with the more stringent applicable requirement is necessary. Potential Chemical-Specific ARARs for this site are in Table 3.1.
- Location-Specific ARARs are restrictions based on the concentration of hazardous substances or the conduct of activities in specific locations. Requirements addressing wetlands, historic places, floodplains, or sensitive ecosystems and habitats are potential location-specific ARARs. Potential Location-Specific ARARs for this site are in Table 3.2.
- Action-Specific ARARs are restrictions on the conduct of certain activities or the operation of certain technologies at a particular site, and are primarily used to assess the feasibility of remedial technologies and alternatives. Regulations that dictate the design, construction, and operating characteristics of incinerators, air stripping units, or landfills are examples of action-specific ARARs. Potential Action-Specific ARARs for this site are in Table 3.3.

3.2 Remedial Action Objectives

RAOs are media-specific goals for protecting human health and the environment. They serve as guidance for the development of remedial alternatives. The RAOs are based on regulatory

requirements and risk based evaluations, which may apply to the various remedial activities being considered for the Site.

The process of identifying the RAOs is summarized below.

- The identification of affected media and contaminant characteristics
- The evaluation of exposure pathways, contaminant migration pathways, and exposure limits
- The evaluation of chemical concentrations that will result in unacceptable exposure

The 1989 ROD identified the following RAO for the sediments in OU3.

- Operable Unit Three addresses the river areas sediments. The primary objective is to minimize public exposure, either through containment, removal, or institutional controls, for those areas with unacceptably high sediment arsenic concentrations, such as the exposed former sediments in the Blackwater Branch floodplain.

This overall RAO for OU3 remains in effect. The specific RAO for the remedial alternatives discussed in this FFS is:

- Reduce concentrations of arsenic in the exposed sediments in the Blackwater Branch floodplain to below acceptable levels of risk.
- Prevent recontamination of exposed sediments of the Blackwater Branch floodplain from site-related groundwater contamination.

3.3 Preliminary Remediation Goals

Preliminary remediation goals (PRGs) are target chemical concentrations that the remedial action needs to achieve in order to protect human health and the environment. PRGs are selected based on federal or state promulgated ARARs, risk-based levels, and background concentrations, with consideration also given to other requirements such as analytical detection limits and guidance values. These PRGs were then used as a benchmark in the technology screening, alternative development and screening, and detailed evaluation of alternatives presented in the subsequent sections of the FFS report.

The 1989 ROD identified a cleanup goal of 20 mg/kg for arsenic in exposed sediments, which was based on the then-current New Jersey soil remediation standard. Since then, the State of New Jersey has conducted additional studies to determine a more robust statewide background level and has revised its soil remediation standard for arsenic. As such, the PRG for arsenic has been updated to meet the current New Jersey soil remediation standard of 19mg/kg.

4 DEVELOPMENT AND SCREENING OF ALTERNATIVES

4.1 Rationale for Assembly of Alternatives

The FFS does not present screening of technologies but presents proposed alternatives that were assembled based on engineering judgement and experience at this site and other similar sites.This section presents proposed remedial alternatives that were identified to meet the RAO developed for the site. Remedial alternatives must conform to the requirements identified in CERCLA, as amended, and to the NCP. CERCLA Section 121(d) requires that Superfund remedial actions attain ARARs unless specific waivers are granted and that remedial actions be protective of human health and the environment. CERCLA Section 121(b) and the NCP identify the following statutory preferences when developing and evaluating remedial alternatives:

- Remedial actions involving treatment which permanently and significantly reduce the volume, toxicity, or mobility of contaminants are preferred over remedial actions not involving such treatment.
- Off-site transport and disposal of hazardous substances or contaminated materials without treatment is considered to be the least favored remedial action alternative when practical treatment technologies are available.
- Remedial actions using permanent solutions, alternative treatment technologies, or resource recovery technologies shall be assessed.
- Use engineering controls (*i.e.,* containment) for wastes that pose a relatively low long-term threat or where treatment is impracticable.
- Use a combination of methods where appropriate.
- Use institutional controls, as appropriate, for short- and long-term management to prevent or limit exposure.

4.2 Optimization and Benchscale Testing Results

In April 2010, a Remedial System Evaluation (RSE) was performed on the Vineland site. One of the determinations made during this RSE was that based on contaminant trends, the current pump and treat system was unlikely to restore the aquifer within a reasonable period specified in the ROD. The RSE recommended several different approaches that could be investigated to attempt to expedite the time to site closeout. A strategy proposed by the RSE was to leverage the natural geochemistry of the aquifer in ways that allow stable immobilization of the arsenic in the subsurface. Investigations to evaluate the geochemistry of the site were performed along with benchscale testing to determine the most effective approach to immobilizing the arsenic in each area. Benchscale testing led to a proof of concept to immobilize the, although the approach in each area was different. Pilot testing has been initiated in Area A, but final

results are not yet available. This FFS focuses on the technologies recommended in the RSE and for which bench scale testing has shown proof of concept, and compare these approaches with the No Action Alternative. The site will ultimately be divided up into at least four separate areas that represent different characteristics and thus different required approaches to meeting the RAOs.

5 REMEDIAL ALTERNATIVES

Three remedial alternatives have been developed for OU-3 from the retained remedial technologies.

- Alternative 1: No Further Action
- Alternative 2: Ongoing Hot Spot Excavation
- Alternative 3: In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring

5.1.1 Alternative 1 – No Action

The No Action alternative is considered in accordance with NCP requirements and provides a baseline for comparison with the other alternatives. Under this alternative, no further action would be implemented, and the current status of the Site would remain unchanged. A CEA for the site already exists to restrict use of groundwater. Institution Controls for signs are posted in accessible areas of Blackwater Branch and the Maurice River advising the public that sediments are contaminated with arsenic and there are risks associated with prolonged exposure of arsenic. With the exception of the existing security fences, engineering controls would not be implemented to prevent site access or exposure to site contaminants.

5.1.2 Alternative 2 - Ongoing Hot Spot Excavation

This alternative consists of periodic excavation and off-site disposal of the exposed sediments of the Blackwater Branch floodplain as the arsenic concentrations exceed the PRG.

5.1.3 Alternative 3 – In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring

This alternative consists of implementation of in-situ treatment technologies to prevent recontamination of the exposed sediments to concentrations above PRGs, hot-spot excavations to remove exposed sediments in the Blackwater Branch floodplain above PRGs, and performance monitoring to assure the remedy is effective and assess the need for additional in-situ treatment and/or excavation.

The in-situ technology used may vary across the site and will depend on the geochemistry and subsurface conditions in each particular location. Examples of such technologies include air sparging in iron rich groundwater environments and iron chloride injection in addition to air sparging or peroxide injection in iron poor groundwater environments. In-situ technologies may also include reactive barriers. The specific technologies described have been proven effective in bench scale testing with soil and groundwater from the site, however other technologies may be effective as well. Final selection of the in-situ treatment technology appropriate for each area of the site will be made after further studies during remedial design.

In addition, the need for excavation before and/or after in-situ treatment for each area of the site will be determined during the remedial design and further refined during implementation of the remedial action through performance monitoring.

6 NCP CRITERIA EVALUATION

The selection of a remedial alternative is based on an evaluation of nine criteria established in the NCP pursuant to CERCLA statutory requirements, as summarized below:

- Overall Protection of Human Health and the Environment: Under this criterion, an alternative is assessed to determine whether it can adequately protect human health and the environment, in both the short-term and long-term, from unacceptable risks posed by hazardous substances, pollutants or contaminants present at the Site, by eliminating, reducing or controlling exposures to levels established during development of remediation goals.
- Compliance with ARARs: This criterion evaluates whether and how the alternative attains applicable or relevant and appropriate requirements under federal environmental laws and state environmental or facility siting laws, or provides grounds for invoking the legal waiver of such requirements.
- Short-Term Effectiveness: This criterion evaluates the impacts of the alternative during implementation with respect to human health and the environment.
- Reduction of Toxicity, Mobility, and Volume Through Treatment: Under this criterion, the degree to which an alternative employs recycling or treatment that reduces toxicity, mobility, or volume is assessed, including how treatment is used to address the principal threats posed at the Site.
- Long-Term Effectiveness and Permanence: Under this criterion, an alternative is assessed for the long-term effectiveness and permanence it affords, along with the degree of uncertainty that the alternative will prove successful.
- Implementability: This criterion addresses the technical and administrative feasibility of implementing the alternative as well as the availability of various services and materials required.
- Cost: This criterion addresses the estimated costs of implementing the alternative to the level necessary for comparison between alternatives with a typical accuracy of plus 50% and minus 30%. A discount rate of 7%is used for the present value calculation, in accordance with USEPA guidance (USEPA 2000). Although USEPA guidance directs the use of a 7% discount rate for the FS present value analysis, the real 30-year discount rate as published in Appendix C of the Office of Management and Budget Circular A-94, Guidance and Discount Rates for Benefit-Cost Analysis of Federal Programs (January 2014), is 1.9%.
- State Acceptance: This criterion includes an evaluation of the technical and administrative concerns of the state regarding the alternatives.
- Community Acceptance: This criterion includes an evaluation of the concerns of the public regarding the alternatives.

The final two criteria (state acceptance and community acceptance) will be addressed by USEPA after the public comment period following USEPA's publication of a Proposed Remedial Action Plan. The remaining criteria are evaluated in subsequent sections of this Feasibility Study.

6.1 Alternative Analysis

6.1.1 Alternative 1 – No Action

Overall Protection of Human Health and the Environment

This alternative would not meet the RAOs. It would not minimize public and ecological receptor exposure to those areas with unacceptably high sediment arsenic concentrations, such as those in the Blackwater Branch floodplain. Nor would it reduce the arsenic concentration in seeps so precipitation of arsenic does not result in re-contamination of sediments to greater than 19 mg/kg.

Compliance with ARARs

This alternative would result in the PRG of 19 mg/kg in the sediments to be exceeded. This alternative involves no action, therefore there are no location-specific or action-specific ARARs.

Short-term Effectiveness

This alternative would not include a remedial action. The no action alternative will have no adverse short-term impact to the local community or the environment.

Reduction of Toxicity, Mobility or Volume through Treatment

The implementation of this alternative would not affect the toxicity, mobility or volume through treatment of the contaminants.

Long-Term Effectiveness and Permanence

Magnitude of Residual Risk - The magnitude of residual risk would be the same as the existing site conditions. The contaminants would not be destroyed or degraded. The contaminant concentrations are not likely to decrease over time. The soil contamination could be a continuous source of contamination for other media. Currently there are potential risks to human health. This alternative would not provide adequate controls of risks to human health over the long-term because there are no mechanisms to prevent future exposure.

Reliability of Controls - Under this alternative no mechanism would be in place to prevent future risk to human health and the environment; therefore, this alternative would not be considered reliable.

Implementability

This alternative is easily implemented, since no services or permits would be required.

Cost

There would be no cost under this alternative.

State Acceptance

It is assumed this Alternative would not be acceptable to the state.

Community Acceptance

It is assumed this Alternative would not be acceptable to the community.

6.1.2 Alternative 2 - Ongoing Hot Spot Excavation

Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment. Human and ecological receptors will not be exposed to unacceptably high levels of arsenic in the sediments because the arsenic will be excavated before exceeding levels that pose a risk.

Compliance with ARARs

This alternative would comply with ARARs but would require diligent monitoring and maintenance in order to do so. In addition, the wetlands in the floodplain would be destroyed due need to excavate them on a frequent basis. This alternative would require creating wetlands elsewhere in order to comply with ARARs. There would be off-site waste transportation and disposal of the initial hot spot removal material each time the hot spot removal is conducted.

Long-term Effectiveness and Permanence

This alternative is only effective in the long term with a high level of constant maintenance. It does not treat the source of contamination and excavation could go on indefinitely. Although steps will be taken to protect the surrounding community, operation of construction equipment and hauling contaminated soil for offsite disposal would be nearly continuous and would last for an indefinite period of time.

Reduction of Toxicity, Mobility or Volume through Treatment

This alternative does not reduce the toxicity, mobility or volume of contaminates through treatment. Therefore it does not meet EPAs preference for treatment.

Short-term Effectiveness

Construction activities associated with the excavation of sediment will cause temporary, though ongoing, inconvenience to the community in terms of traffic impacts and noise issues. Excavation will need to be performed in such a way as to minimize the potential for dust or odor issues.

Implementability

Technically, this alternative would be easily implemented. No special techniques, materials, permits, or labor would be required for installation of the in-situ treatment technologies. Supplies and services would be readily obtainable.

Cost

Each time sediments need to be excavated it is estimated it will cost $1,160,646. Assuming this has to be performed every 3 months, that is an annual cost of $4,642,584. The present worth cost over a 30-year period is estimated to be $103,942,518.

State Acceptance

This Alternative is being reviewed by the state.

Community Acceptance

Community acceptance of the alternatives will be evaluated after the public comment period closes for the Proposed Plan and this FFS.

6.1.3 Alternative 3 – In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring

Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment. Human and ecological receptors will not be exposed to unacceptably high levels of arsenic in the sediments because groundwater containing levels of arsenic that would lead to unacceptable risk would be prevented from seeping into the exposed sediments of the Blackwater Branch floodplain, and already impacted areas of the floodplain would be excavated.

Compliance with ARARs

This alternative would meet chemical-, location-, and action-specific ARARs/TBCs as identified in Tables 3.1 through 3.3. However, wetlands would be affected by the initial hot spot removals and may require creating wetlands elsewhere. No federally listed endangered or threatened species are known to exist at the Site. There would be off-site waste transportation and disposal of the hot spot removal material.

Short-term Effectiveness

This alternative would include installation of wells or barriers so would have low to moderate short-term impact to the community. Construction activities associated with the excavation of sediment will cause temporary inconvenience to the community in terms of traffic impacts and noise issues. Excavation will need to be performed in such a way as to minimize the potential for dust or odor issues. Risk posed to the environment would be minimal due to the limited area affected by the construction operations.

Reduction of Toxicity, Mobility or Volume through Treatment

This in-situ alternative is not expected to reduce the overall volume of arsenic at the site but will reduce the volume of arsenic seeping into the exposed sediments of Blackwater branch and floodplain soils. However, in-situ treatment is expected to reduce the mobility of arsenic and reduce the toxicity of the groundwater seeping into Blackwater Branch and the floodplain soils.

Long-term Effectiveness and Permanence

This alternative is effective in the long-term in that it prevents recontamination of the sediments and is anticipated to expedite overall site cleanup.

Implementability

Technically, this alternative would be easily implemented. No special techniques, materials, permits, or labor would be required for installation of the in-situ treatment technologies. Supplies and services would be readily obtainable.

Cost

The estimated capital cost of this alternative is $9,988,488. The O&M costs for the first year are estimated at $745,569 which includes additional labor for startup of the systems. For years 2 through 30 the O&M costs are estimated at $557,670 per year. Performance Monitoring cost area estimated at $213,438 which included quarterly monitoring. It is assumed this will taper off to every 6 months in year 2 at a cost of $135,461 and then annually for year 3 through 30 at an annual cost of $95,663.

State Acceptance

This Alternative is being reviewed by the state.

Community Acceptance

Community acceptance of the alternatives will be evaluated after the public comment period closes for the Proposed Plan and this FFS.

7 COMPARATIVE ANALYSIS OF ALTERNATIVES

Overall Protection of Human Health and the Environment

Alternative 1 does not protect human health and the environment because no action is taken to prevent exposure to sediments that exceed risk based cleanup levels for arsenic. Alternative 2 would be protective of human health and the environment because sediments are removed prior to reaching arsenic levels that exceed the risk based cleanup levels. Alternative 3 is protective of human health and the environment because in-situ treatment systems are installed and operated that prevent recontamination of sediments with arsenic and sediments currently exceeding risk based arsenic levels are removed and disposed of offsite.

Compliance with ARARs

Alternative 1 would not comply with ARARs in that it would leave exposed sediments in place that exceed the site cleanup level and pose unacceptable risk the human health and the environment. Alternatives 2 and 3 would both comply with ARARs in that exposed sediments exceeding risk based levels would be removed and prevent exposure to sediment exceeding and level that would pose unacceptable risk to human health and the environment. Alternative 2 would accomplish this by removal of sediment prior to them being recontaminated to levels exceeding ARARs and Alternative 3 would accomplish this by in-situ treatment that would prevent groundwater from recontaminating the sediments.

Short-term Effectiveness

There would be no short-term impact to the local community or the environment for Alternative 1. The construction and implementation activities involved in Alternative 2 would be frequent and would have almost continuous impact on the local community with truck traffic to haul contaminated sediments for offsite disposal. Alternative 3 would have some impacts to the nearby community due to truck traffic to haul contaminated sediments offsite and drilling activities to install the in-situ treatment systems. However, these impacts would be relatively short term and ongoing a long term treatment activities at the site are expected to have minimal impact to the community.

Reduction of Toxicity, Mobility or Volume through Treatment

Alternatives 1 and 2 do not reduce the toxicity, mobility, or volume of contaminants through treatment and therefore do not meet EPAs preference for treatment.

Alternative 3 does not reduce the overall volume of arsenic but does reduce the mobility of arsenic in the groundwater which reduces the volume entering Blackwater Branch. This effectively reduces the toxicity of the groundwater entering Blackwater Branch and the floodplain soils.

Long-term Effectiveness and Permanence

Alternative 1 does not provide adequate controls of risks to human health over the long-term because there is no mechanism to prevent future exposure. Alternative 2 is only effective in the long-term with a high level of constant maintenance. It does not treat the source of contamination and although steps would be taken to protect the surrounding community, there would be nearly continuous operation of construction equipment and hauling of contaminated soil off-site for an indefinite period of time. Alternative 3 is effective in the long-term in that it prevents recontamination of the sediments and is anticipated to expedite the overall site cleanup, although the timeframe when this will be achieved is uncertain.

Implementability

All the Alternatives are easily implemented. There are no special techniques, materials, or labor required to implement any of the alternatives.

Cost

A summary of the capital cost and present worth costs over a 30 year period for each alternatives are summarized in the table below:

Vineland FFS Cost Summary	Capital Cost	Annual O&M	Performance Monitoring	30-year Present Worth
Alternative 1: No Action	$0	$0	-	$0
Alternative 2: - Ongoing Hot Spot Excavation [1]	$1,160,646	$4,642,584	-	$103,942,518
Alternative 3: In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring [2]	$9,988,488	$745,569	$213,438	$24,790,888
Alternative 3: Year 2	-	$557,670	$135,461	-
Alternative 3: Years 3-30	-	$557,670	$95,663	-

[1] $1,160,646 is for one time excavation of all areas. $4,642,584 annual cost is excavation every 3 months

[2] Capital Cost includes installation of in-situ remedies in Areas A, B, and C and one time excavation of hotspots in Areas A, B, C, and certain areas of the Blackwater Branch floodplain between Area A and the Maurice River.

State Acceptance

This Alternative is being reviewed by the state.

Community Acceptance

Community acceptance of the selected alternative will be evaluated after the public comment period closes for the Proposed Plan and this FFS.

8 SUMMARY

Monitoring of sediments has shown that the existing pump and treat system has not been effective at preventing the recontamination of exposed sediment in the Blackwater Branch floodplain with arsenic at concentrations that pose unacceptable risk to humans and the environment. Therefore, this FFS evaluated alternatives to meet the Remedial Action Objectives for this portion of OU3, which include:

- Reduce concentrations of arsenic in the exposed sediments in the Blackwater Branch floodplain to below acceptable levels of risk.
- Prevent recontamination of exposed sediments of the Blackwater Branch floodplain from site-related groundwater contamination.

To meet the Remedial Action Objectives, the following three remedial action alternatives were developed, in consultation with USEPA, for evaluation against the NCP criteria:

- Alternative 1: No Further Action
- Alternative 2: Ongoing Hot Spot Excavation
- Alternative 3: In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring

Alternatives 2 and 3 are the only alternatives that meet the Remedial Action Objectives and comply with ARARs. Alternative 3 is the only alternative that satisfies the statutory preference, for treatment. Alternative 3 has advantages over Alternative 2 in terms of short-term impacts and cost, and potentially could reduce the overall duration of the remedy.

9 REFERENCES

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January 2014 Office of Management and Budget Circular A-94, Guidance and Discount Rates for Benefit-Cost Analysis of Federal Programs

Tables

Table 1.3.1: 2010 Seep and Sediment Sampling

Scrape Sediment Samples 0"- 2"

Sample ID	Aluminum (mg/kg dry)	Arsenic (mg/kg dry)	Iron (mg/kg dry)	% Solids
Sample 1	170	4.36	283	85.5
Sample 2	200	15.1	531	86.3
Sample 3	250	21.8	317	87.2
Sample 4	206	ND	344	86.5
Sample 5	254	ND	463	87

Composite Sediment Samples 2"- 6"

Sample ID	Aluminum (mg/kg dry)	Arsenic (mg/kg dry)	Iron (mg/kg dry)	% Solids
Sample 1	123	3.72	204	82.6
Sample 2	310	10.3	334	85.9
Sample 3	219	16.4	281	86.2
Sample 4	210	ND	368	85.7
Sample 5	251	ND	464	86.4

Water Samples

Sample ID	Total Aluminum (mg/L)	Dissolved Aluminum (mg/L)	Total Arsenic (mg/L)	Dissolved Arsenic (mg/L)	Total Iron (mg/L)	Dissolved Iron (mg/L)
Sample 1	0.259	0.171	ND	ND	1.32	0.534
Sample 2	138	ND	5.82	0.126	105	1.08
Sample 3	104	0.175	11.6	0.746	182	3.17
Sample 4	26.1	0.44	0.185	0.011	47.2	2.2
Sample 5	20.9	0.078	0.092	0.009	31.5	1.12

ND=Non-detect

Table 1.3.2: As(mg/kg) in surface sediment samples (0 to 0.5 inches)

Sample ID	Sample Date	Sample Location	As (mg/Kg)
ST1	April 2011	Phase 2	4.1
ST2	April 2011	Phase 2	6.3
P1	April 2011	Phase 2	7.6
P2	April 2011	Phase 2	8.1
P3	April 2011	Phase 2	17
ST4	April 2011	Phase 2	0
ST5	April 2011	Phase 2	0
ST3	April 2011	Phase 2	19
P4	April 2011	Phase 2	0
ST6	April 2011	Phase 2	5.4
ST7	April 2011	Phase 2	0
ST8	April 2011	Phase 2	10
ST9	April 2011	Phase 2	32
ST10	April 2011	Phase 2	8
ST11	April 2011	Phase 2	22
ST12	April 2011	Phase 2	8.3
SS_1_P3	August 2012	Phase 3	118
SS_2_P3	August 2012	Phase 3	149
SS_3_P3	August 2012	Phase 3	9
SS_5_P3	August 2012	Phase 3	12
SS_5_P3	August 2012	Phase 3	0
SS_6_P3	August 2012	Phase 3	4
SS_7_P3	August 2012	Phase 3	11
SS_8_P3	August 2012	Phase 3	33
SS_9_P3	August 2012	Phase 3	0
SS_10_P3	August 2012	Phase 3	377
SS_11_P3	August 2012	Phase 3	484
SS_12_P3	August 2012	Phase 3	11
SS_13_P3	August 2012	Phase 3	11
SS_14_P3	August 2012	Phase 3	7
SS_15_P3	August 2012	Phase 3	5
SS_16_P3	August 2012	Phase 3	15
SS_17_P3	August 2012	Phase 3	28
SS_18_P3	August 2012	Phase 3	11
SS-STA_01-77S	June - Aug 2012	Phase 4	17
SS-STA_02-225	June - Aug 2012	Phase 4	8.6
SS-STA_02-48S	June - Aug 2012	Phase 4	32
SS-STA_02-70S	June - Aug 2012	Phase 4	18
SS-STA_02-85S	June - Aug 2012	Phase 4	8.6
SS-STA_03-05S	June - Aug 2012	Phase 4	27
SS-STA_03-25N	June - Aug 2012	Phase 4	15
SS-STA_03-25S	June - Aug 2012	Phase 4	17
SS-STA_03-45S	June - Aug 2012	Phase 4	190
SS-STA_03-65S	June - Aug 2012	Phase 4	24
SS-STA_03-95S	June - Aug 2012	Phase 4	5.3
SS-STA_04-05N	June - Aug 2012	Phase 4	11
SS-STA_04-15S	June - Aug 2012	Phase 4	4.9
SS-STA_04-40S	June - Aug 2012	Phase 4	4.8
SS-STA_04-60S	June - Aug 2012	Phase 4	5.4
SS-STA_04-90S	June - Aug 2012	Phase 4	15
SS-STA_05-10S	June - Aug 2012	Phase 4	11
SS-STA_05-30S	June - Aug 2012	Phase 4	5.1
SS-STA_05-60N	June - Aug 2012	Phase 4	5
SS-STA_05-70S	June - Aug 2012	Phase 4	5.8
SS-STA_05-90S	June - Aug 2012	Phase 4	5.1
SS-STA_06-10N	June - Aug 2012	Phase 4	60
SS-STA_06-15S	June - Aug 2012	Phase 4	73
SS-STA_06-50S	June - Aug 2012	Phase 4	50
SS-STA_1-97S	June - Aug 2012	Phase 4	0

Sample ID	Sample Date	Sample Location	As (mg/Kg)
usace_1	June - Aug 2012	Phase 4	455
usace_2	June - Aug 2012	Phase 4	278
usace_3	June - Aug 2012	Phase 4	10
usace_4	June - Aug 2012	Phase 4	7
usace_6	June - Aug 2012	Phase 4	6
usace_7	June - Aug 2012	Phase 4	0
usace_8	June - Aug 2012	Phase 4	10
usace_9	June - Aug 2012	Phase 4	6
usace_10	June - Aug 2012	Phase 4	7
usace_11	June - Aug 2012	Phase 4	13
usace_12	June - Aug 2012	Phase 4	24
usace_13	June - Aug 2012	Phase 4	8
usace_14	June - Aug 2012	Phase 4	10
usace_15	June - Aug 2012	Phase 4	98
SS_1	June - Aug 2012	Phase 4	0
SS_2	June - Aug 2012	Phase 4	52
SS_3	June - Aug 2012	Phase 4	43
SS_5	June - Aug 2012	Phase 4	18
SS_5	June - Aug 2012	Phase 4	26
SS_6	June - Aug 2012	Phase 4	37
SS_7	June - Aug 2012	Phase 4	14
SS_8	June - Aug 2012	Phase 4	16
SS_9	June - Aug 2012	Phase 4	14
SS_10	June - Aug 2012	Phase 4	49
SS_11	June - Aug 2012	Phase 4	19
SS_12	June - Aug 2012	Phase 4	37
SS_13	June - Aug 2012	Phase 4	383
SS_14	June - Aug 2012	Phase 4	184
SS_15	June - Aug 2012	Phase 4	29
SS_16	June - Aug 2012	Phase 4	9
SS_17	June - Aug 2012	Phase 4	5
SS_18	June - Aug 2012	Phase 4	7
SS_19	June - Aug 2012	Phase 4	5
SS_20	June - Aug 2012	Phase 4	7
SS_21	June - Aug 2012	Phase 4	7
SS_22	June - Aug 2012	Phase 4	11
SS_23	June - Aug 2012	Phase 4	7
SS_24	June - Aug 2012	Phase 4	5
SS_25	June - Aug 2012	Phase 4	0
SS_26	June - Aug 2012	Phase 4	7
SS_27	June - Aug 2012	Phase 4	0
SS_30	June - Aug 2012	Phase 4	0
SS_31	June - Aug 2012	Phase 4	38
SS_32	June - Aug 2012	Phase 4	39
SS_33	June - Aug 2012	Phase 4	11
SS_34	June - Aug 2012	Phase 4	8
SS_35	June - Aug 2012	Phase 4	11
SS_36	June - Aug 2012	Phase 4	6
SS_37	June - Aug 2012	Phase 4	139
SS_38	June - Aug 2012	Phase 4	10
SS_39	June - Aug 2012	Phase 4	13
SS_40	June - Aug 2012	Phase 4	27

Shaded values exceed the 20 mg/kg criterion for arsenic in exposed sediments.

Table 2.1

Blackwater Branch Location	Maximum Arsenic Concentration 2012-2015 (mg/kg)	Sampling Event Date
Area A	456	April 2012
Area B	146	April 2012
Area C	1,470	July 2015

Table 2.2

Exposure Parameter	Adult Recreator	Child Recreator
Body weight	80 kg	15 kg
Lifetime	70 years	70 years
Soil/sediment Ingestion Rate	100 mg/day	200 mg/day
Skin Adherence Factor	0.2 mg/cm^2	0.07 mg/cm^2
Surface Area	6032 cm^2/day	2373 cm^2/day
Exposure Frequency	40 days/year[1]	40 days/year[1]
Exposure Duration	20 years	6 years
Exposure Time	4 hrs/day[1]	4 hrs/day[1]
Particulate Emission Factor (PEF)	3.23E+09 m^3/kg [2]	3.23E+09 m^3/kg [2]

Footnotes:

1) "Worst case" exposure as determined in the 1989 Baseline Risk Assessment
2) PEF based on Philadelphia, PA climactic zone, 0.5 acres, and a fraction of vegetative cover of 0.5

Table 2.3

Chemical of Concern (COC)	Sediment Exposure Point Concentration (EPC)[1]	EPC units	EPC Statistic	Soil/Sediment RSL (mg/kg)	
				Cancer Risk ($TR=10^{-6}$)	Noncancer Hazard (HQ=1)
Arsenic	383-1,470	mg/kg	Max	5.93	306

Footnotes:
(1) Arsenic concentrations from 2012-2015 sampling events

Definitions:
Max = maximum detected value

Table 2.4

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	Area C	Arsenic	2.17E-04	3.06E-05	1.32E-08	2.48E-04

Summary of Risk Characterization - Carcinogens

The table presents cancer risks for each route of exposure and for all routes of exposure combined. As stated in the National Contingency Plan, the acceptable risk range for site-related exposure is 10^{-6} to 10^{-4} (E-06 to E-04).

Table 2.5

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary Target Organ[1]	Noncarcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	Area C	Arsenic	Skin	4.30E+00	5.10E-01	5.53E-04	4.81E+00

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary Target Organ[1]	Noncarcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	Area C	Arsenic	Skin	4.03E-01	8.50E-02	5.53E-04	4.88E-01

Summary of Risk Characterization - Noncarcinogenic

The table presents hazard quotients (HQs) for each route of exposure and the hazard index (sum of hazard quotients) for all routes of exposure. The Risk Assessment Guidance for Superfund states that, generally, a hazard index (HI) greater than 1 indicates the potential for adverse noncancer effects.

Table 3.1
Potential ARARs and To Be Considered (TBC) Criteria
Vineland Chemical Company Superfund Site - OU3: River Area Sediments

POTENTIAL CHEMICAL-SPECIFIC ARARS OR TBC CRITERIA

REGULATOR	CRITERION	CITATION	DESCRIPTION	COMMENTS
NJ Statutes and Rules	Remediation Standards Rule	NJAC 7:26D	Establishes minimum remediation standards for direct contact exposure to soil.	
Federal Acts and Regulations	OSWER Guidance for Developing Ecological Soil Screening Levels	OSWER 9285.7.55	Guidance for deriving risk based eco-SSLs for soil contaminants of ecological concern.	May be used to screen soil contaminants to determine if further ecological study is warranted.
Federal Acts and Regulations	OSWER Soil Screening Guidance	OSWER 9285.7.55	Guidance for developing site specific soil screening levels.	May be used to identify areas of soil contamination.

Table 3.2
Potential ARARs and To Be Considered (TBC) Criteria
Vineland Chemical Company Superfund Site - OU3: River Area Sediments

POTENTIAL LOCATION-SPECIFIC ARARS OR TBC CRITERIA

REGULATOR	CRITERION	CITATION	DESCRIPTION	COMMENTS
NJ Statutes and Rules	Flood Hazard Control Act	NJAC 7:13	Floodplain Use and Limitations which establishes limits on land development within flood hazard areas	Pertinent to activities that may occur within the floodplain.
NJ Statutes and Rules	Freshwater Wetlands Protection Act	NJSA 13:9B-1 et seq	Requires permits for regulated activity disturbing freshwater wetlands	Potentially applicable for construction activities performed in the vicinity of a freshwater wetland
NJ Statutes and Rules	Endangered Plant Species List Act	NJSA 13:1B et seq.	Establishes the requirement to protection threatened and endangered plant species in New Jersey by developing and adopting a list	
NJ Statutes and Rules	Endangered and Non-Game Species Conservation Act	NJSA 23:2A-1	Standards for the protection of Federal and NJ threatened and endangered species	
NJ Statutes and Rules	Stream Encroachment Permit	N.J.S.A. 58:16A-50 et seq.; N.J.A.C. 7:8-3.15	Construction of structures and placement of fill within flood hazard areas including floodplains and floodways	Potentially applicable for construction activities performed in floodplains and floodways (e.g., treatment facilities)
Federal Acts and Regulations	National Environmental Policy Act (NEPA)	40 CFR 6, Appendix A	Statement of Procedures on Floodplain Management and Wetlands Protection. Establishes policy and guidance to avoid the occupancy and modification of floodplains, or the destruction or modification of wetlands	
Federal Acts and Regulations	Endangered Species Act	40 CFR 400 50 CFR 17, 81, 223, 224, 226, 402	Standards for the protection of threatened and endangered species (wildlife, marine and anadromous species and plants) and establish cooperation with the Federal and State Governments	
Federal Acts and Regulations	Fish and Wildlife Conservation Act	16 USC 2901 et seq.	Established EPA policy and guidance for promoting the conservation of non-game fish and wildlife and their habitats	Potentially applicable for construction activities performed which may impact non- game fish and wildlife and their habitats

Table 3.2
Potential ARARs and To Be Considered (TBC) Criteria
Vineland Chemical Company Superfund Site - OU3: River Area Sediments

POTENTIAL LOCATION-SPECIFIC ARARS OR TBC CRITERIA

REGULATOR	CRITERION	CITATION	DESCRIPTION	COMMENTS
Federal Acts and Regulations	Protection of Migratory Game & Insectivorous Birds	16 USC 703	Preservation of migratory birds and habitat	Potentially applicable for any area with nesting migratory birds
Federal Acts and Regulations	National Historic Preservation Act	16 USC 469 et seq.; 40 CFR 6301	Establishes procedures to provide for preservation of historical and archaeological data that might be destroyed through alteration of terrain as a result of a Federally licensed activity or program	

Table 3.3
Potential ARARs and To Be Considered (TBC) Criteria
Vineland Chemical Company Superfund Site - OU3: River Area Sediments

POTENTIAL ACTION-SPECIFIC ARARS OR TBC CRITERIA

REGULATOR	CRITERION	CITATION	DESCRIPTION	COMMENTS
NJ Statutes and Rules	Well Construction and Maintenance	NJAC 7:9D	Establishes requirements for construction and decommission (sealing) of wells, and well driller / pump installer licensing	Applicable if wells are constructed or decommissioned
NJ Statutes and Rules	New Jersey Soil Erosion and Sediment Control Act	NJSA 4:24-39 et seq	To establish soil erosion and sediment control standards for Department of Transportation certification of its projects to the Soil Conservation Districts	
NJ Statutes and Rules	New Jersey Air Pollution Control Act	NJAC 7:27-8, 16	Establishes standards for discharge of pollutants to air	
NJ Statutes and Rules	Pollutant Discharge Elimination System	NJAC 7:14A	Establishes standards for discharge of pollutants to surface and ground waters	Potentially applicable if wastewater is discharged to surface or ground water
NJ Statutes and Rules	Technical Requirements for Site Remediation (TRSR) and Administrative Requirements for the Remediation of Contaminated Sites (ARRCS)	NJAC 7:26E- 8	Identifies requirements for institutional controls for contaminated soils left in place, and for contaminated groundwater; identifies administrative requirements for site remediation that may be applicable	Potentially applicable if chemical residuals in soils left in place are above the industrial SRS; potentially applicable to CEA and MNA implementation
NJ Statutes and Rules	Noise Control	NJAC 7:29	Establishes allowable noise levels	Potentially applicable in residential areas
Federal Acts and Regulations	SDWA	40 CFR 144- 147	Underground injection control regulations that provide for the protection of underground sources of drinking water	
Federal Acts and Regulations	Clean Water Act (CWA)	33 USC 1251 et seq.	Procedures to preserve surface water quality by reducing direct pollutant discharges into waterways, finance municipal wastewater treatment facilities and manage polluted runoff	
Federal Acts and Regulations	National Pollution Discharge Elimination System (NPDES)	40 CFR 122- 125	Establishes requirements for discharges associated with industrial activity, to water bodies or wetlands	Water quality standards and best management practices apply, and a discharge permit is required

Table 3.3
Potential ARARs and To Be Considered (TBC) Criteria
Vineland Chemical Company Superfund Site - OU3: River Area Sediments

POTENTIAL ACTION-SPECIFIC ARARS OR TBC CRITERIA

REGULATOR	CRITERION	CITATION	DESCRIPTION	COMMENTS
Federal Acts and Regulations	Ambient Water Quality Criteria (AWQC)	40CFR131, 401	Provides criteria developed for the protection of freshwater and marine aquatic life and for the protection of human health from the ingestion of water and/or organisms	
	General Pretreatment Regulations for Existing and New Sources of Pollution	40 CFR 403	Prohibits discharge of pollutants to a Publically Operated Treatment Works (POTW) which cause or may cause pass-through or interference with operation of the POTW	Potentially applicable if water is discharged to a POTW
Federal Acts and Regulations	Fish and Wildlife Coordination Act	16 USC 661- 666	Requires consultation when a federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources	
Federal Acts and Regulations	Toxic Pollutant Effluent Standards	40 CFR 129	Establishes effluent standards or prohibitions for certain toxic pollutants such as pesticides and PCBs	
Federal Acts and Regulations	RCRA	42 USC 6901 et seq.; 40 CFR 260-270	Establishes responsibilities and standards for the management of hazardous and non-hazardous waste	Applicable to solid waste streams from drill cuttings during well installation
Federal Acts and Regulations	Hazardous Materials Transportation Act (HMTA)	49 USC 1801- 1813; 49 CFR 107, 171-177	Regulates transportation of hazardous materials in commerce	Potentially applicable for transportation of drill cuttings
Federal Acts and Regulations	Clean Air Act (CAA)	42 USC 7401	Establishes requirements to preserve air quality and to reduce air pollution	
Federal Acts and Regulations	National Ambient Air Quality Standards (NAAQs)	40 CFR 50	Establishes primary and secondary standards for six pollutants to protect the public health and welfare	
Federal Acts and Regulations	National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR 63	Establishes regulations for specific air pollutants (such as benzene and PCE)	

Table 3.3
Potential ARARs and To Be Considered (TBC) Criteria
Vineland Chemical Company Superfund Site - OU3: River Area Sediments

POTENTIAL ACTION-SPECIFIC ARARS OR TBC CRITERIA

REGULATOR	CRITERION	CITATION	DESCRIPTION	COMMENTS
Federal Acts and Regulations	Occupational Safety and Health Act (OSHA)	29 USC 651- 678; 29 CFR 1910, 1926	Regulates worker health and safety by establishing permissible exposure levels (PELs)	Applicable to remedy construction and operation

Figures

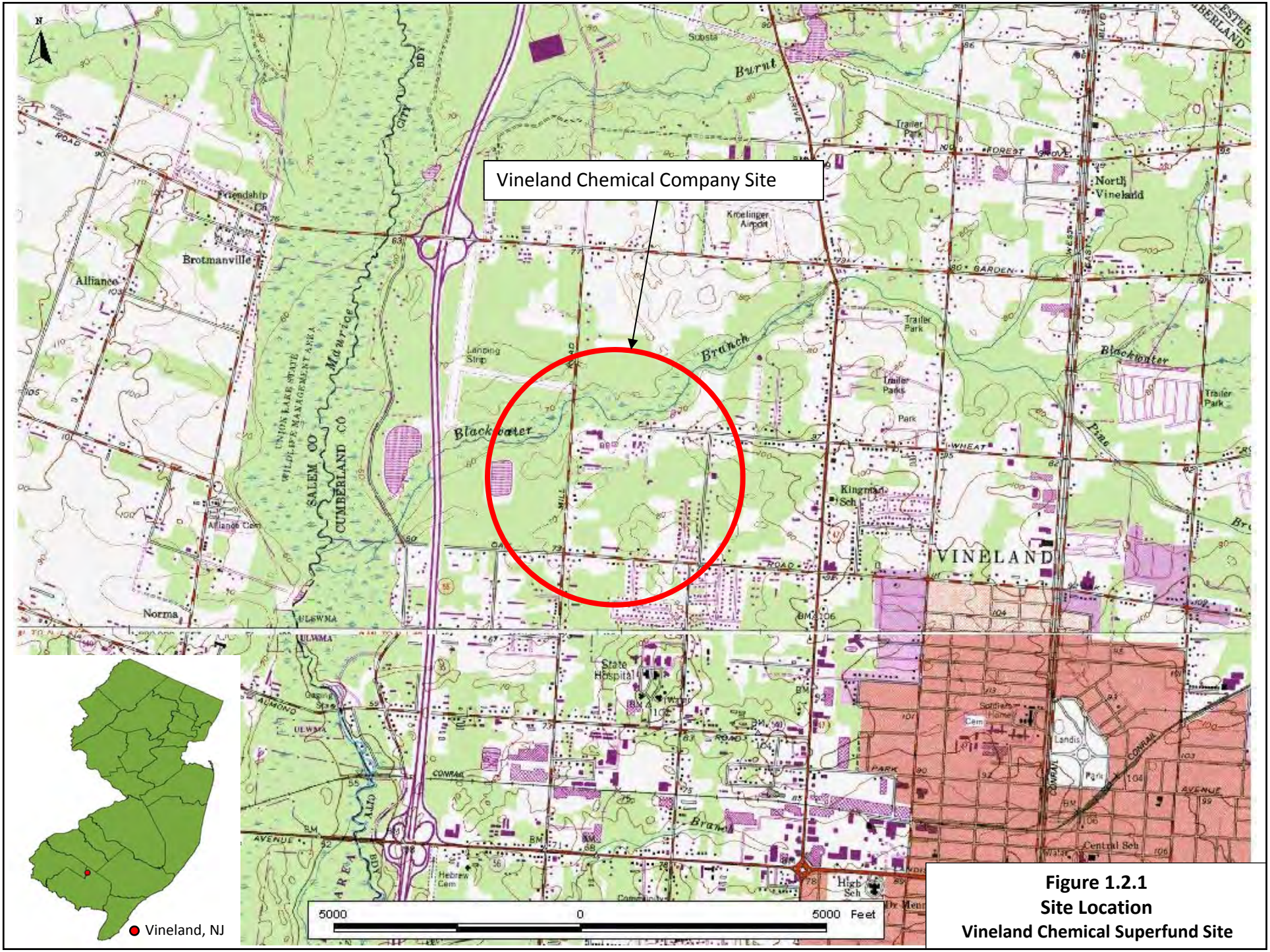


Figure 1.2.1
Site Location
Vineland Chemical Superfund Site

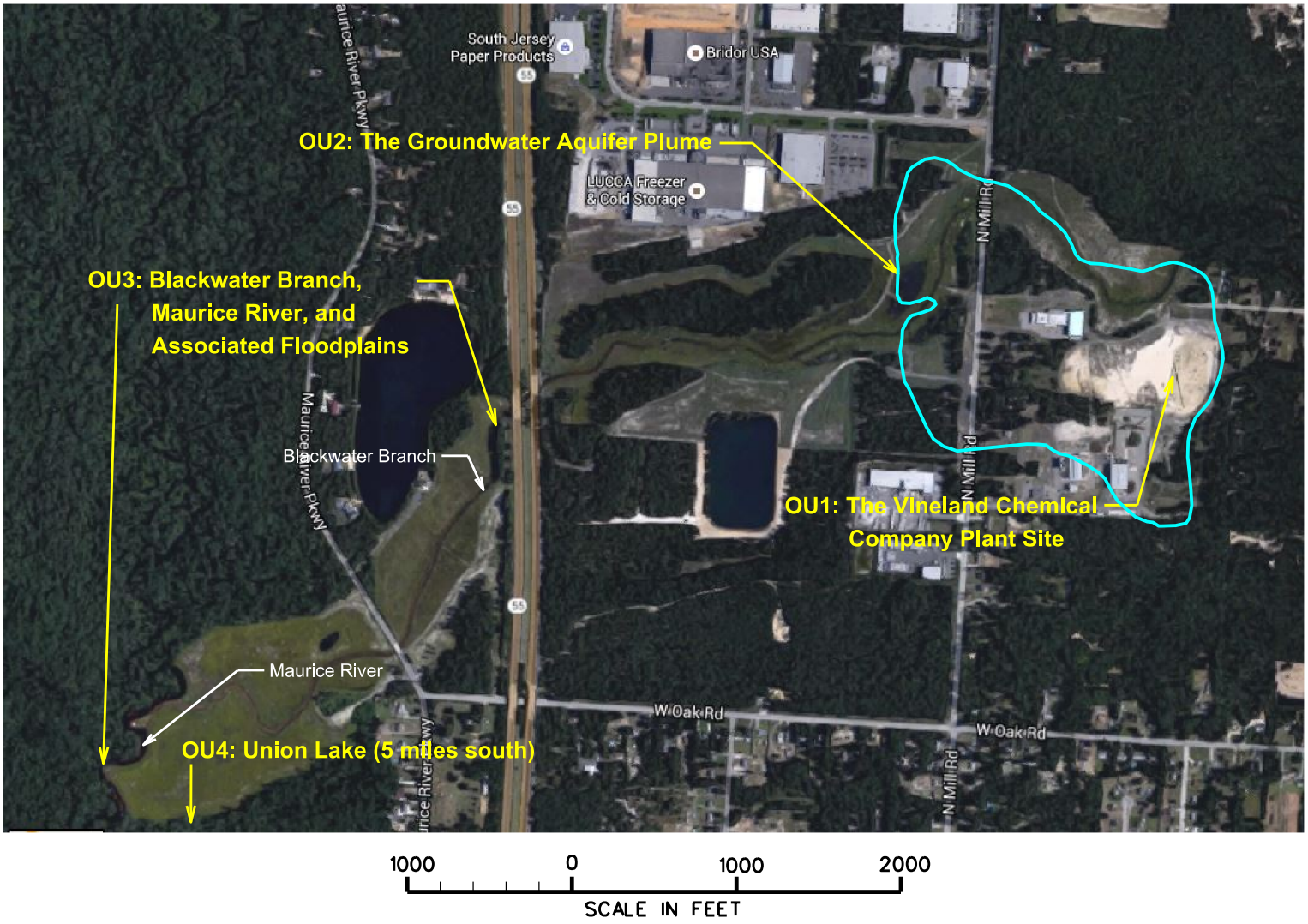


Figure 1.2.2
Vineland Chemical Company Superfund Site
Operable Unit Identification

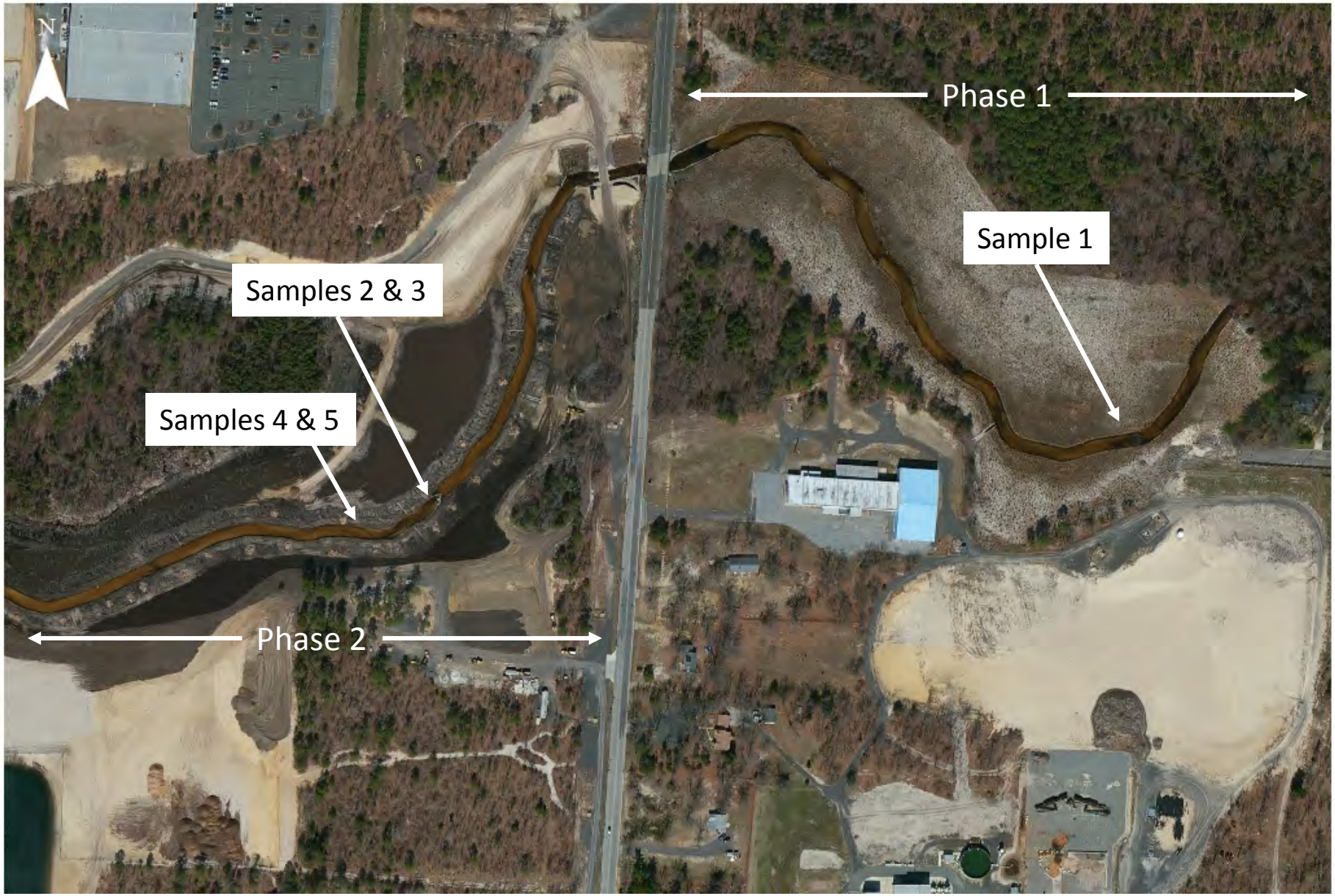


Figure 1.3.1
2010 Seep and Sediment Sampling Locations in Plan View

Figure 1.3.2
2010 Seep and Sediment Sampling
Location Photo: Samples 2 and 3

Figure 1.3.3
Sediment Samples April 2011 –August 2012

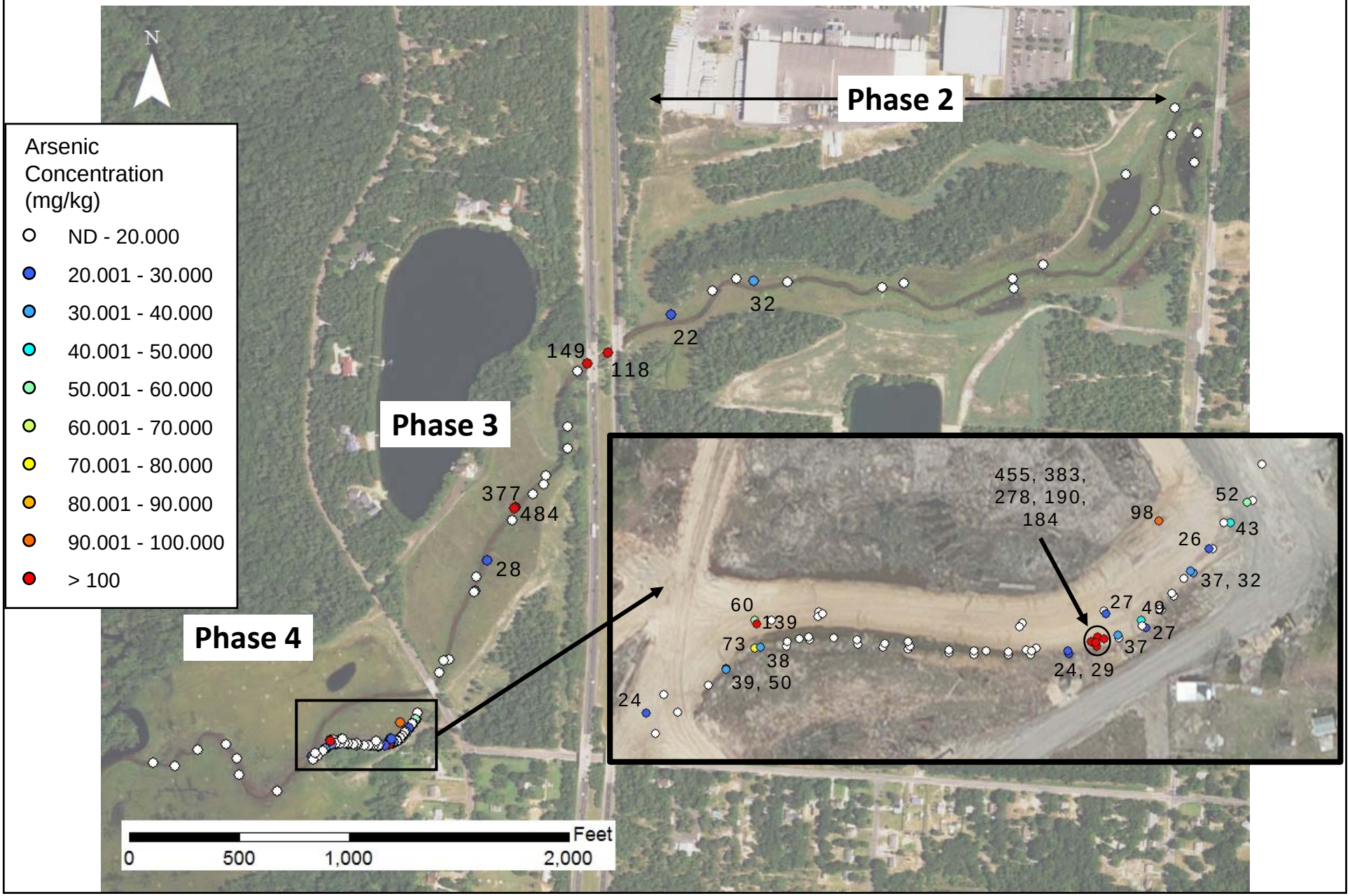


Figure 1.3.4

Scrape Sediment Samples
March and April 2013

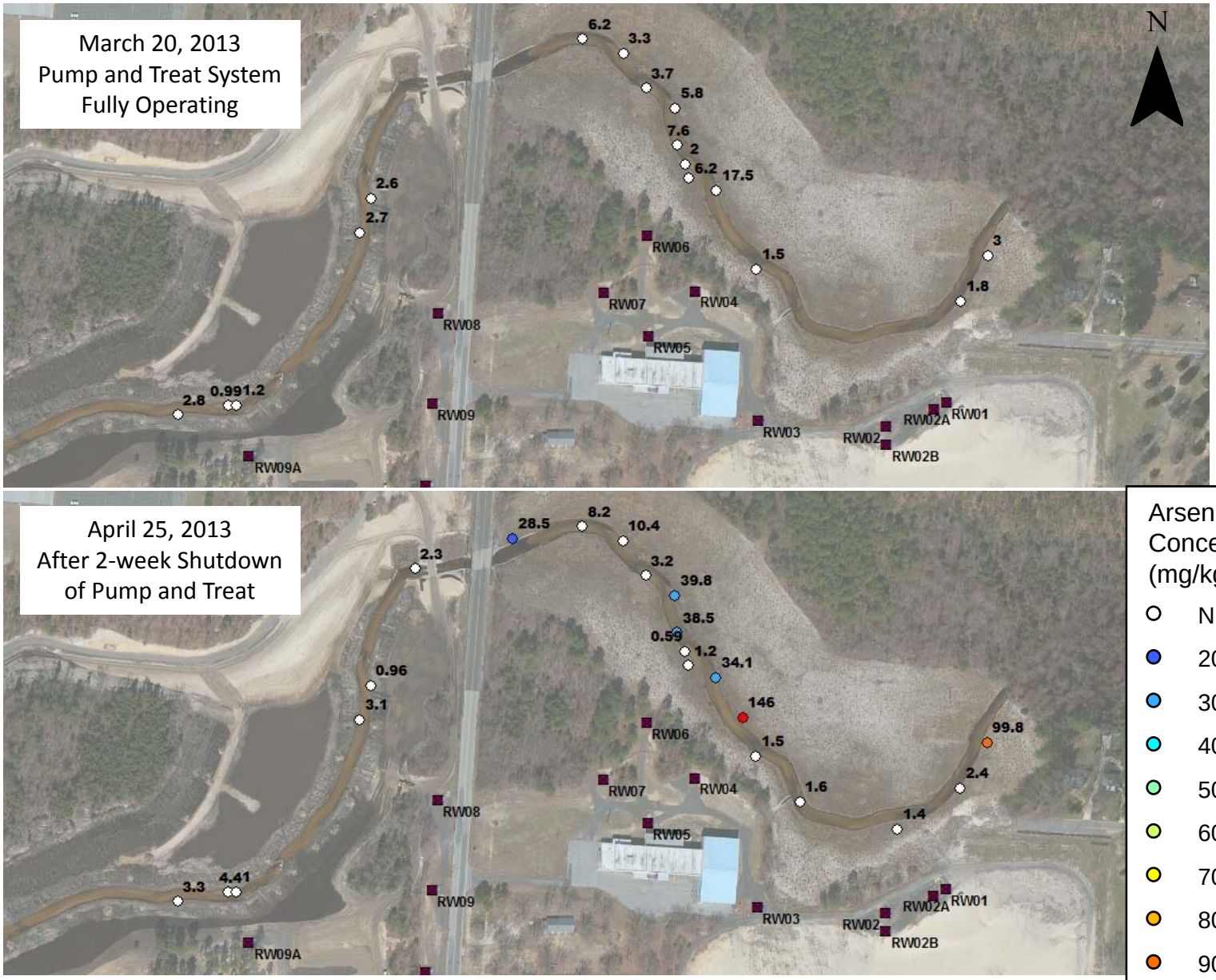


Figure 1.3.5
Scrape Sediment Samples
October 2013 and February 2014

Arsenic Concentration (mg/kg)

- ND - 20.000
- 20.001 - 30.000
- 30.001 - 40.000
- 40.001 - 50.000
- 50.001 - 60.000
- 60.001 - 70.000
- 70.001 - 80.000
- 80.001 - 90.000
- 90.001 - 100.000
- > 100

Figure 1.3.6
Scrape and Composite Sediment Samples
February 24 and 26, 2014

Arsenic Concentration (mg/kg)

- ND - 20.000
- 20.001 - 30.000
- 30.001 - 40.000
- 40.001 - 50.000
- 50.001 - 60.000
- 60.001 - 70.000
- 70.001 - 80.000
- 80.001 - 90.000
- 90.001 - 100.000
- > 100

Figure 1.3.7
Scrape and Composite Sediment Samples
June 24, 2015

Arsenic Concentration (mg/kg)

- ND - 20.000
- 20.001 - 30.000
- 30.001 - 40.000
- 40.001 - 50.000
- 50.001 - 60.000
- 60.001 - 70.000
- 70.001 - 80.000
- 80.001 - 90.000
- 90.001 - 100.000
- > 100

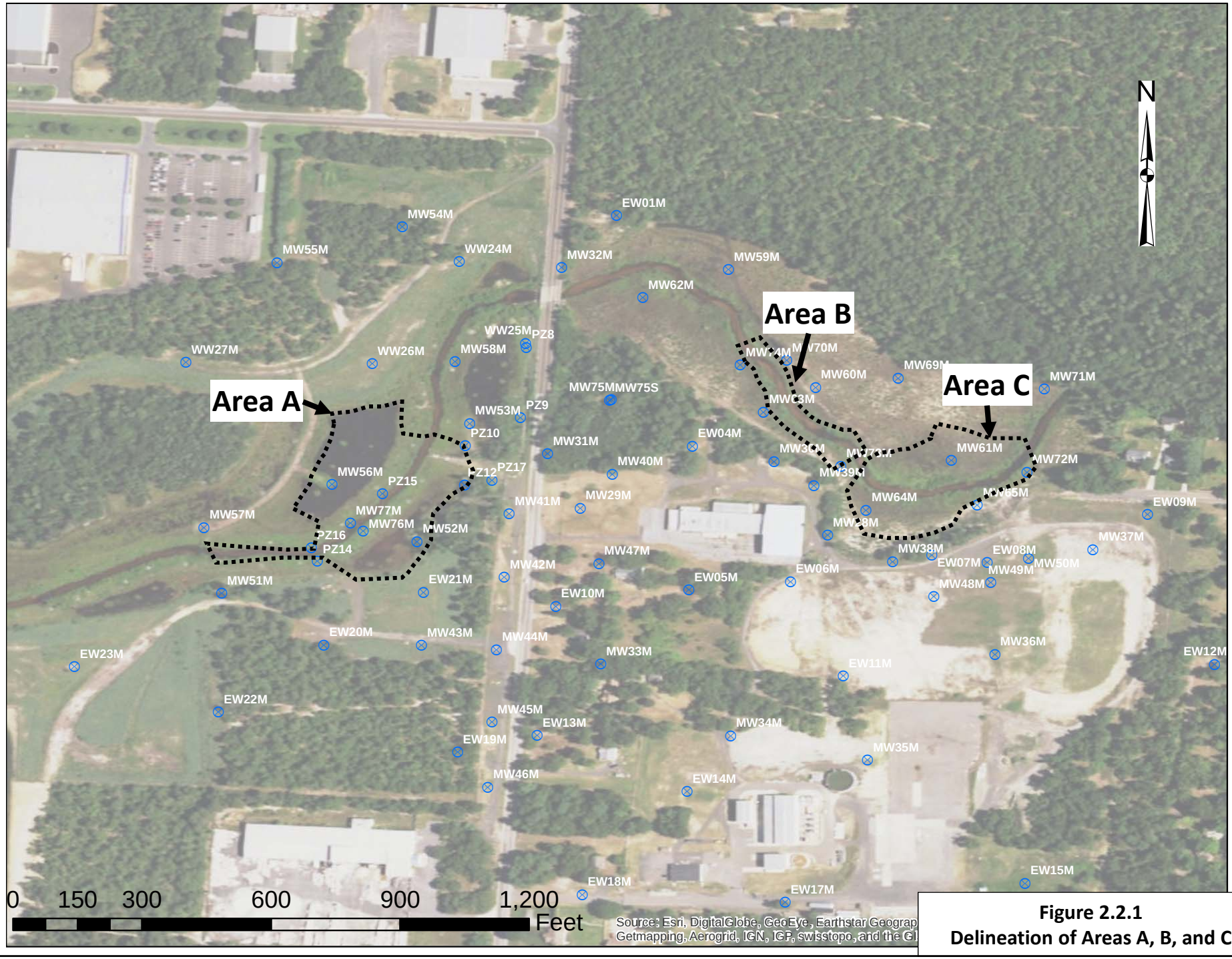


Figure 2.2.1
Delineation of Areas A, B, and C

Appendix A – Phase Figures

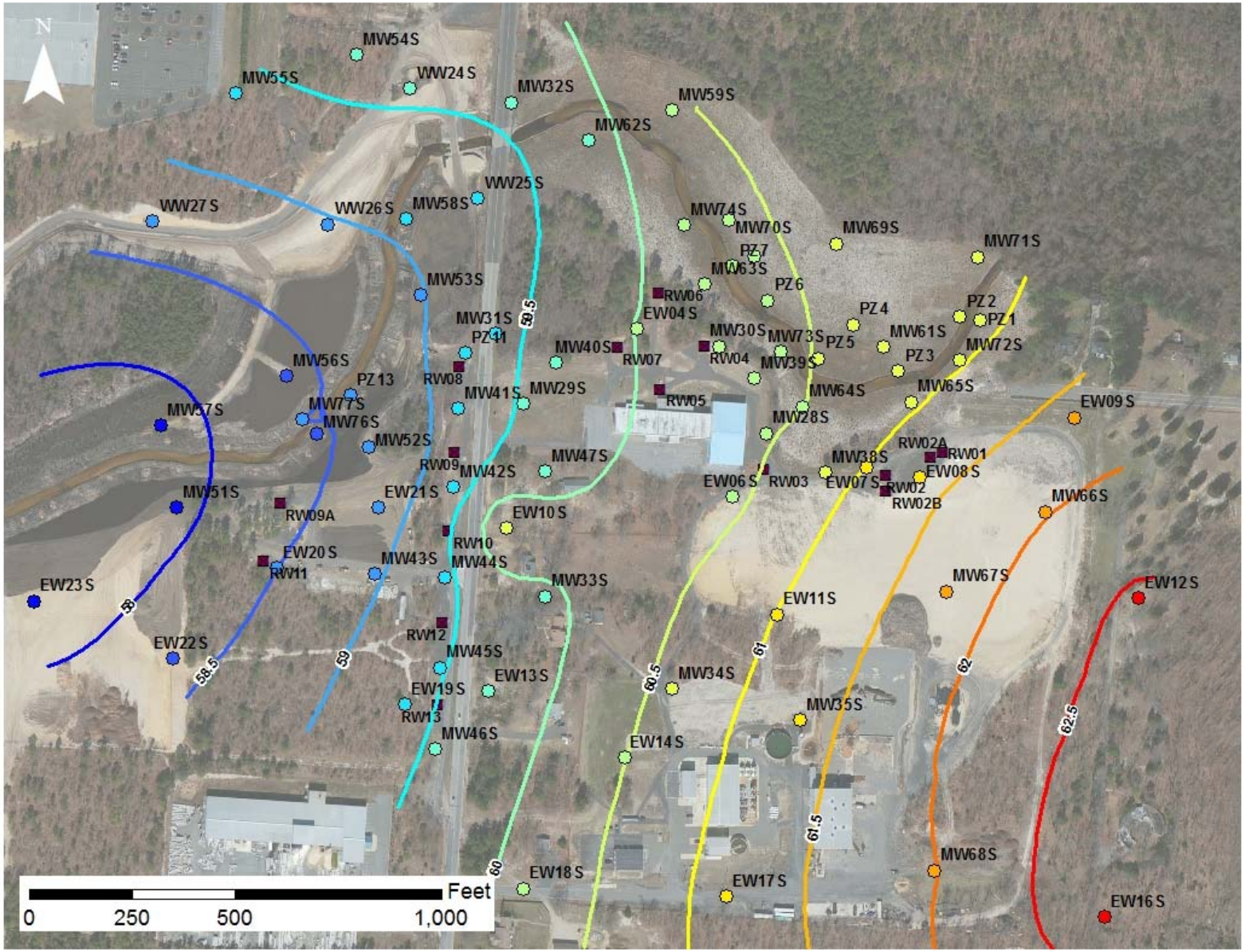
Appendix A
OU3 Remediation Phases

Aerial photo - 2011

Appendix A

Groundwater Contours in the Shallow Aquifer

December 2013



Legend

- Recovery Well

Shallow Well Groundwater Level (ft)

- 57.710 - 58.000
- 58.001 - 58.500
- 58.501 - 59.000
- 59.001 - 59.500
- 59.501 - 60.000
- 60.001 - 60.500
- 60.501 - 61.000
- 61.001 - 61.500
- 61.501 - 62.000
- 62.001 - 62.500
- 62.501 - 63.000

Groundwater Level Contours (ft)

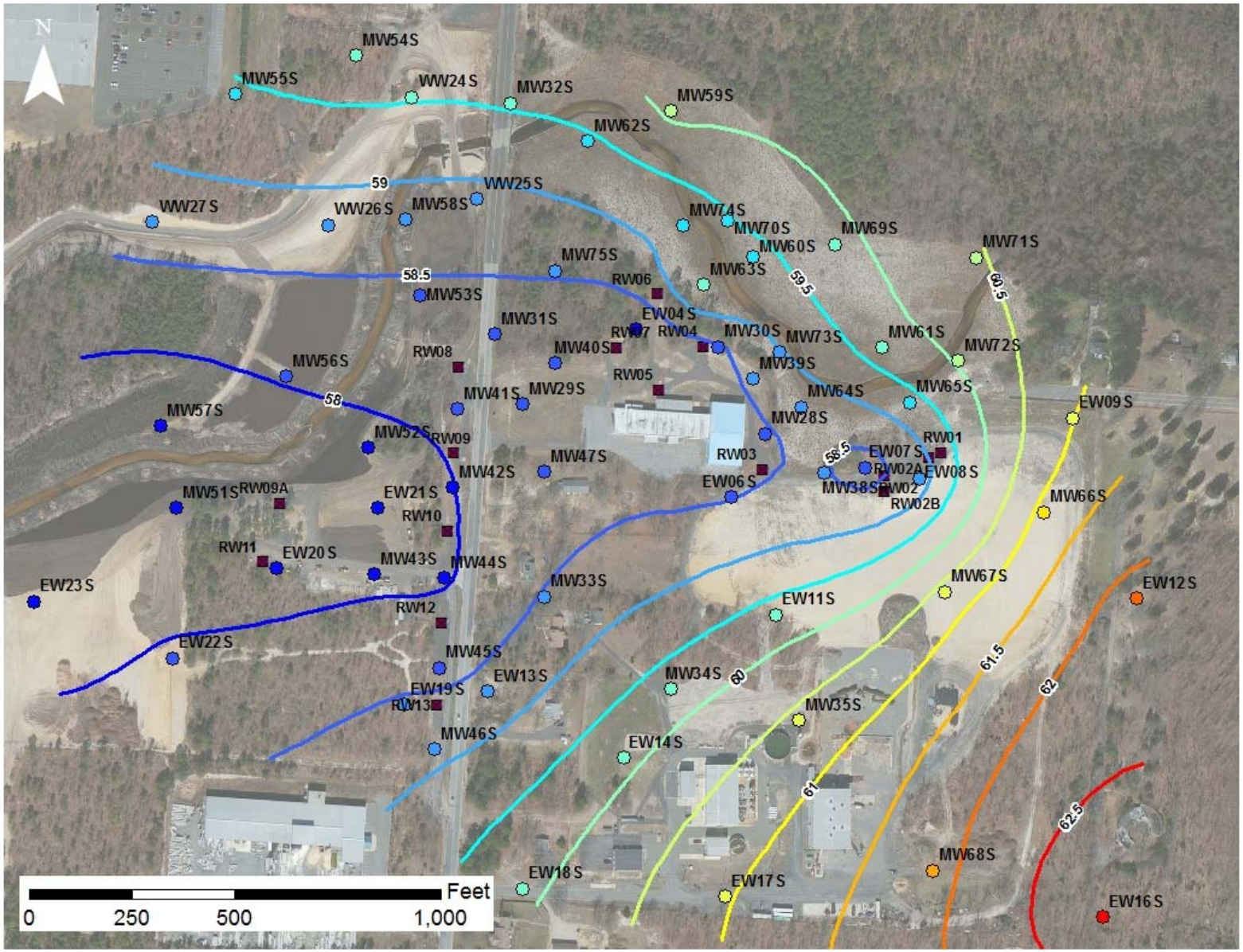
- 58
- 58.5
- 59
- 59.5
- 60
- 60.5
- 61
- 61.5
- 62
- 62.5

Pump and treat system was not operating at this time.

Appendix A

Groundwater Contours in the Shallow Aquifer

April 2013



Legend

- Recovery Well

Shallow Well Groundwater Level (ft)

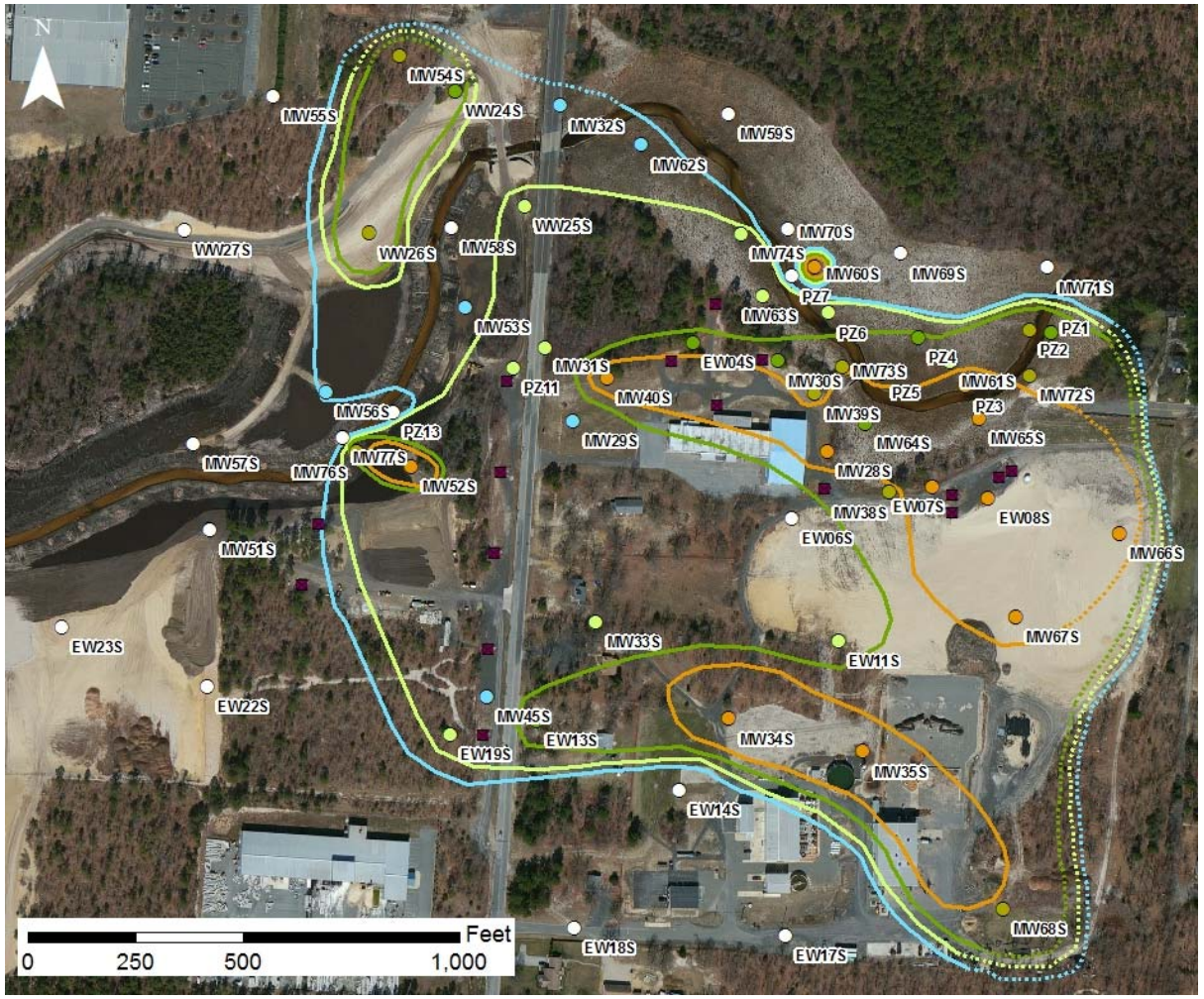
- 57.610 - 58.000
- 58.001 - 58.500
- 58.501 - 59.000
- 59.001 - 59.500
- 59.501 - 60.000
- 60.001 - 60.500
- 60.501 - 61.000
- 61.001 - 61.500
- 61.501 - 62.000
- 62.001 - 62.500
- 62.501 - 63.000

Groundwater Level Contours (ft)

- 58
- 58.5
- 59
- 59.5
- 60
- 60.5
- 61
- 61.5
- 62
- 62.5

Pump and treat system was fully operational at this time.

Appendix B - Arsenic In Groundwater Figures



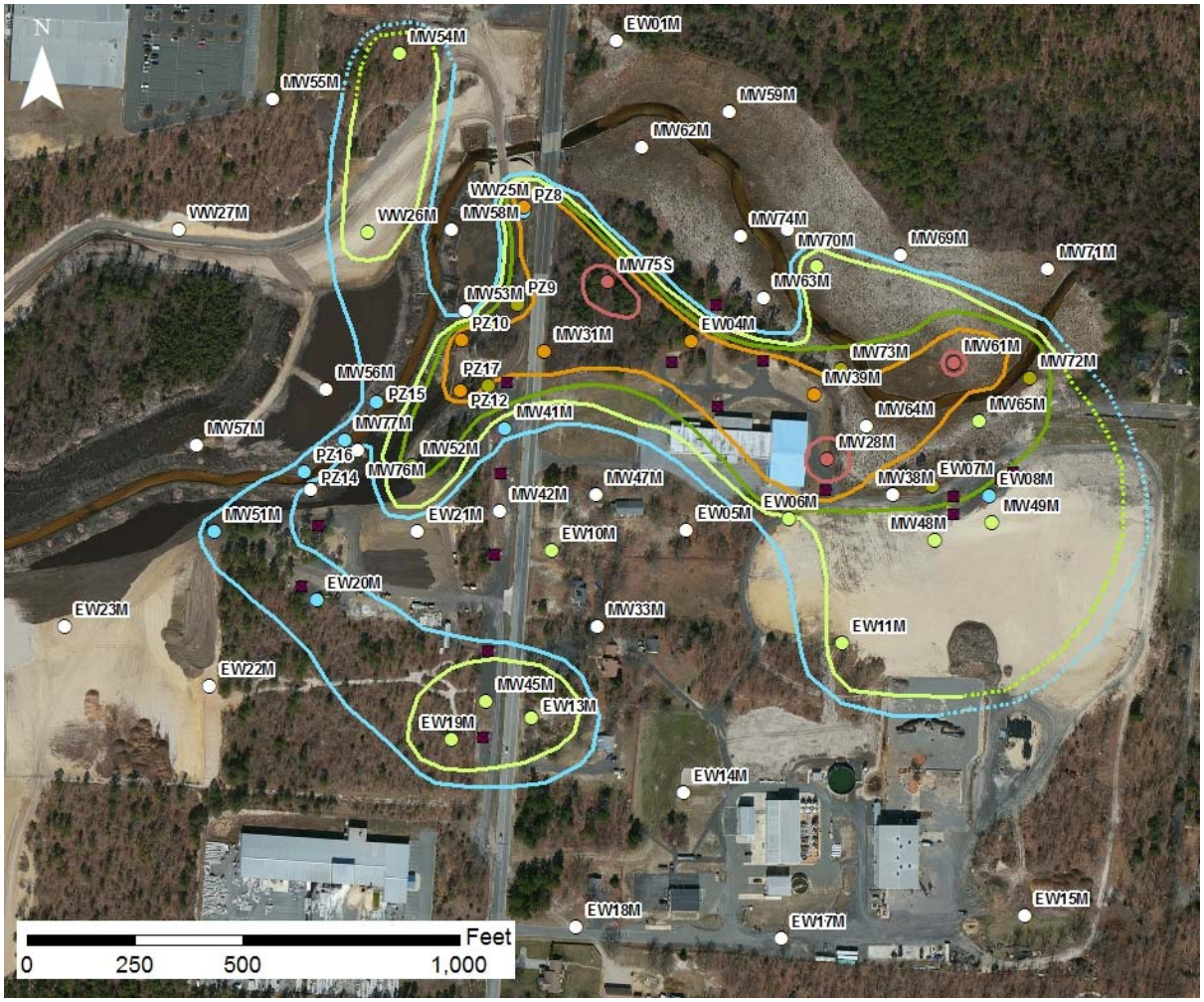
Dissolved Arsenic Concentration (µg/L)

- ND - 3
- 3 - 10
- 10 - 50
- 50 - 100
- 100 - 350
- 350 - 1000
- 1000 – 10000
- Extraction Well

Arsenic Contours (µg/L)

- 3
- 10
- 50
- 350
- 1000
- Assumed Contour

Appendix B
As(D) - Shallow Aquifer, 2013



Dissolved Arsenic Concentration (µg/L)

- ND - 3
- 3 - 10
- 10 - 50
- 50 - 100
- 100 - 350
- 350 - 1000
- 1000 – 10000
- Extraction Well

Arsenic Contours (µg/L)

- 3
- 10
- 50
- 350
- 1000
- Assumed Contour

Appendix B
As(D) – Mid-Depth Aquifer, 2013

Appendix C – Risk Calculations

RISK EVALUATION

Purpose

A risk evaluation was conducted for the exposed sediments of the Blackwater Branch floodplain portion of the river area sediments, Operable Unit 3 (OU3), of the Vineland Chemical Site. This supplemental evaluation reviews post-excavation exposed sediment data collected between 2012 and 2015 in areas A, B and C of the Blackwater Branch against current risk-based screening levels (RSLs). A semi-quantitative screening evaluation was conducted for the future recreator in Area A of the Blackwater Branch floodplain to assess the protectiveness of the remedy that was selected in the original 1989 Record of Decision for OU3.

Evaluation

Sediment samples were collected in Areas A, B and C of the Blackwater Branch floodplain during six separate sampling events between 2012 and 2015. The exposure point concentrations identified for the determination of risks/hazards are the maximum concentrations detected in each area, due to the small number of samples collected from each area. Table 1 details the exposure point concentrations from each area of Blackwater Branch.

Table 1

Blackwater Branch Location	Maximum Arsenic Concentration 2012-2015 (mg/kg)	Sampling Event Date
Area A	1,470	July 2015
Area B	455	April 2012
Area C	383	April 2012

Calculation of risk-based RSLs for soil/sediment (which combine the ingestion, dermal and inhalation pathways) were based on standardized equations that combine exposure information and assumptions with available toxicity data. Recreator exposure parameters were used to best approximate site exposure during future recreational use of the Blackwater Branch. The exposure parameters used in the calculations reflect currently recommended default exposure factors as documented in EPA's February 2014 OSWER Directive 9200.1-120, along with site-specific considerations about the time a child/adult receptor may spend at the site. Any current site user (e.g., treatment plant worker or trespasser) would have less frequent exposures, and thereby lower risks, than these future receptors. A reasonable maximum exposure scenario of 4 hours per day and 40 days per year was considered, in line with the 1989 Baseline Risk Assessment's evaluation of recreational use. The exposure parameters used to calculate the recreator RSLs are outlined in Table 2. The RSLs for all pathways (ingestion, dermal and inhalation) are detailed in Table 3.

Table 2

Exposure Parameter	Adult Recreator	Child Recreator
Body weight	80 kg	15 kg
Lifetime	70 years	70 years
Soil/sediment Ingestion Rate	100 mg/day	200 mg/day
Skin Adherence Factor	0.2 mg/cm^2	0.07 mg/cm^2
Surface Area	6032 cm^2/day	2373 cm^2/day
Exposure Frequency	40 days/year[1]	40 days/year[1]
Exposure Duration	20 years	6 years
Exposure Time	4 hrs/day[1]	4 hrs/day[1]
Particulate Emission Factor (PEF)	3.23E+09 m^3/kg [2]	3.23E+09 m^3/kg [2]

Footnotes:

1) "Worst case" exposure as determined in the 1989 Baseline Risk Assessment
2) PEF based on Philadelphia, PA climactic zone, 0.5 acres, and a fraction of vegetative cover of 0.5

Table 3

Chemical of Concern (COC)	Sediment Exposure Point Concentration (EPC)[1]	EPC units	EPC Statistic	Soil/Sediment RSL (mg/kg)	
				Cancer Risk (TR=10^{-6})	Noncancer Hazard (HQ=1)
Arsenic	383-1,470	mg/kg	Max	5.93	306

Footnotes:

(1) Arsenic concentrations from 2012-2015 sampling events

Definitions:

Max = maximum detected value

Results and Conclusions

The maximum detected arsenic concentrations in Areas A, B and C are greater than the human health-based RSLs, which indicates the potential for unacceptable risk and adverse health effects from recreational exposure to exposed Blackwater Branch sediments. Additionally, the EPCs in all three areas of the Blackwater Branch exceed the site cleanup level of 20 mg/kg for arsenic in exposed sediments by an order of magnitude or more.

A semi-quantitative screening evaluation was conducted for Area A and is summarized in Tables 4 and 5 below. The results indicate that the current remedy is likely not protective of human health for a future recreator. The estimated cancer risk for a child and adult recreator utilizing the Blackwater Branch in Area A would equal 2.48 x10^{-4}, and the noncancer hazard estimates for a child and adult recreator in Area A are 4.81 and 0.49, respectively, exceeding EPA's acceptable risk range of 10^{-6} to 10^{-4} and noncancer hazard of 1.

The comprehensive RSL calculator output, including all the current exposure parameters, chemical-specific toxicity information, and resultant risk and non-cancer hazard estimates are provided in Attachment a.

Table 4

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	Area A	Arsenic	2.17E-04	3.06E-05	1.32E-08	2.48E-04

Summary of Risk Characterization - Carcinogens

The table presents cancer risks for each route of exposure and for all routes of exposure combined. As stated in the National Contingency Plan, the acceptable risk range for site-related exposure is 10^{-6} to 10^{-4} (E-06 to E-04).

Table 5

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary Target Organ[1]	Noncarcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	Area A	Arsenic	Skin	4.30E+00	5.10E-01	5.53E-04	4.81E+00

Scenario Timeframe: Future
Receptor Population: Recreator
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary Target Organ[1]	Noncarcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	Area A	Arsenic	Skin	4.03E-01	8.50E-02	5.53E-04	4.88E-01

Summary of Risk Characterization - Noncarcinogenic

The table presents hazard quotients (HQs) for each route of exposure and the hazard index (sum of hazard quotients) for all routes of exposure. The Risk Assessment Guidance for Superfund states that, generally, a hazard index (HI) greater than 1 indicates the potential for adverse noncancer effects.

Attachment A

RSL Output: Area A

Site-specific

Recreator Equation Inputs for Soil

Variable	Value
TR (target cancer risk) unitless	1.0E-6
THQ (target hazard quotient) unitless	1
SA_{rec-c} (skin surface area - child) cm^2/day	2373
SA_{rec-a} (skin surface area - adult) cm^2/day	6032
SA_{0-2} (skin surface area - mutagenic) cm^2/day	2373
SA_{2-6} (skin surface area - mutagenic) cm^2/day	2373
SA_{6-16} (skin surface area - mutagenic) cm^2/day	6032
SA_{16-30} (skin surface area - mutagenic) cm^2/day	6032
SA_{rec-a} (skin surface area - adult) cm^2/day	6032
LT (lifetime - recreator) year	70
$IFS_{rec-adj}$ (age-adjusted soil ingestion factor) mg/kg	4200
$DFS_{rec-adj}$ (age-adjusted soil dermal factor) mg/kg	11816
$IFSM_{rec-adj}$ (mutagenic age-adjusted soil ingestion factor) mg/kg	19066.667
$DFSM_{rec-adj}$ (mutagenic age-adjusted soil dermal factor) mg/kg	48944
EF_{0-2} (exposure frequency) day/year	40
EF_{2-6} (exposure frequency) day/year	40
EF_{6-16} (exposure frequency) day/year	40
EF_{16-30} (exposure frequency) day/year	40
EF_{rec-c} (exposure frequency - child) day/year	40
EF_{rec-a} (exposure frequency - adult) day/year	40
EF_{rec-a} (exposure frequency - adult) day/year	40
EF_{rec} (exposure frequency - recreator) day/year	40
IRS_{0-2} (soil intake rate) mg/day	200
IRS_{2-6} (soil intake rate) mg/day	200
IRS_{6-16} (soil intake rate) mg/day	100
IRS_{16-30} (soil intake rate) mg/day	100
IRS_{rec-c} (soil intake rate - child) mg/day	200
IRS_{rec-a} (soil intake rate - adult) mg/day	100
IRS_{rec-a} (soil intake rate - adult) mg/day	100
ED_{0-2} (exposure duration) year	2
ED_{2-6} (exposure duration) year	4
ED_{6-16} (exposure duration) year	10
ED_{16-30} (exposure duration) year	10

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Site-specific

Recreator Equation Inputs for Soil

Variable	Value
ED_{rec-c} (exposure duration - child) year	6
ED_{rec-a} (exposure duration - adult) year	20
ED_{rec-a} (exposure duration - adult) year	20
ED_{rec} (exposure duration - recreator) year	26
ET_{0-2} (exposure time) hr/day	4
ET_{2-6} (exposure time) hr/day	4
ET_{6-16} (exposure time) hr/day	4
ET_{16-30} (exposure time) hr/day	4
ET_{rec-c} (exposure time - child) hr/day	4
ET_{rec-a} (exposure time - adult) hr/day	4
ET_{rec-a} (exposure time - adult) hr/day	4
ET_{rec} (exposure time - recreator) hr/day	4
BW_{0-2} (body weight) kg	15
BW_{2-6} (body weight) kg	15
BW_{6-16} (body weight) kg	80
BW_{16-30} (body weight) kg	80
BW_{rec-c} (body weight - child) kg	15
BW_{rec-a} (body weight - adult) kg	80
BW_{rec-a} (body weight - adult) kg	80
AF_{0-2} (skin adherence factor) mg/cm ^{2}	0.2
AF_{2-6} (skin adherence factor) mg/cm ^{2}	0.2
AF_{6-16} (skin adherence factor) mg/cm ^{2}	0.07
AF_{16-30} (skin adherence factor) mg/cm ^{2}	0.07
AF_{rec-c} (skin adherence factor - child) mg/cm ^{2}	0.2
AF_{rec-a} (skin adherence factor - adult) mg/cm ^{2}	0.07
AF_{rec-a} (skin adherence factor - adult) mg/cm ^{2}	0.07
City (Climate Zone) PEF Selection	Philadelphia, P
A_c (acres)	.5
Q/C_{wp} (g/m^2-s per kg/m^3)	87.368977216230
PEF (particulate emission factor) m ^{3}/kg	3236886889.7786
A (PEF Dispersion Constant)	14.0111
B (PEF Dispersion Constant)	19.6154
C (PEF Dispersion Constant)	225.3397

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Site-specific

Recreator Equation Inputs for Soil

Variable	Value
V (fraction of vegetative cover) unitless	0.5
U_m (mean annual wind speed) m/s	4.29
U_t (equivalent threshold value)	11.32
F(x) (function dependant on U_m/U_t) unitless	0.0991806905416
City (Climate Zone) VF Selection	Philadelphia, P
A_c (acres)	.5
Q/C_{vol} (g/m^2-s per kg/m^3)	87.368977216230
foc (fraction organic carbon in soil) g/g	0.006
ρ$_b$ (dry soil bulk density) g/cm^3	1.5
ρ$_s$ (soil particle density) g/cm^3	2.65
n (total soil porosity) L_{pore}/L_{soil}	0.43396
θ$_a$ (air-filled soil porosity) L_{air}/L_{soil}	0.28396
θ$_w$ (water-filled soil porosity) L_{water}/L_{soil}	0.15
T (exposure interval) s	819936000
A (VF Dispersion Constant)	14.0111
B (VF Dispersion Constant)	19.6154
C (VF Dispersion Constant)	225.3397
City (Climate Zone) VF_{ml} Selection	Default
VF_s (volitization factor) m^3/kg	.
Q/C_{vol} (g/m^2-s per kg/m^3)	68.18365
A_c (acres)	.5
T (exposure interval) yr	26
d_c (depth of source) m	.
ρ$_b$ (dry soil bulk density) g/cm^3	1.5
A (VF Dispersion Constant - Mass Limit)	11.911
B (VF Dispersion Constant - Mass Limit)	18.4385
C (VF Dispersion Constant - Mass Limit)	209.7845

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Site-specific

Recreator Screening Levels (RSL) for Soil

ca=Cancer, nc=Noncancer, ca* (Where nc SL < 100 x ca SL),
ca** (Where nc SL < 10 x ca SL), max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat,
Smax=Soil SL exceeds ceiling limit and has been substituted with the max value (see User's Guide),
Ssat=Soil inhalation SL exceeds csat and has been substituted with the csat

Chemical	CAS Number	Mutagen?	VOC?	Ingestion SF (mg/kg-day) $^{-1}$	SFO Ref	Inhalation Unit Risk (ug/m ^{3})$^{-1}$	IUR Ref	Chronic RfD (mg/kg-day)	Chronic RfD Ref	Chronic RfC (mg/m ^{3})	Chronic RfC Ref	GIABS
Arsenic, Inorganic	7440-38-2	No	No	1.50E+00	I	4.30E-03	I	3.00E-04	I	1.50E-05	C	1

Chemical	ABS	RBA	Volatilization Factor (m ^{3}/kg)	Soil Saturation Concentration (mg/kg)	Particulate Emission Factor (m ^{3}/kg)	Ingestion SL TR=1.0E-6 (mg/kg)	Dermal SL TR=1.0E-6 (mg/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL Child THQ=1 (mg/kg)
Arsenic, Inorganic	0.03	0.6	-	-	3.24E+09	6.76E+00	4.81E+01	1.11E+05	5.93E+00	3.42E+02

Chemical	Dermal SL Child THQ=1 (mg/kg)	Inhalation SL Child THQ=1 (mg/kg)	Noncarcinogenic SL Child THI=1 (mg/kg)	Ingestion SL Adult THQ=1 (mg/kg)	Dermal SL Adult THQ=1 (mg/kg)	Inhalation SL Adult THQ=1 (mg/kg)	Noncarcinogenic SL Adult THI=1 (mg/kg)	Screening Level (mg/kg)
Arsenic, Inorganic	2.88E+03	2.66E+06	3.06E+02	3.65E+03	1.73E+04	2.66E+06	3.01E+03	5.93E+00 ca*

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Site-specific

Recreator Risk for Soil

Chemical	Ingestion SF (mg/kg-day) $^{-1}$	SFO Ref	Inhalation Unit Risk (ug/m ^{3})$^{-1}$	IUR Ref	Chronic RfD (mg/kg-day)	Chronic RfD Ref	Chronic RfC (mg/m ^{3})	Chronic RfC Ref	GIABS	ABS	RBA	Volatilization Factor (m ^{3}/kg)	Soil Saturation Concentration (mg/kg)	Particulate Emission Factor (m ^{3}/kg)	Concentration (mg/kg)
Arsenic, Inorganic	1.50E+00	I	4.30E-03	I	3.00E-04	I	1.50E-05	C	1	0.03	0.6	-	-	3.24E+09	1.47E+03
**Total Risk/HI*	-		-		-		-		-	-	-	-	-	-	-

Chemical	Ingestion Risk	Dermal Risk	Inhalation Risk	Carcinogenic Risk	Ingestion Child HQ	Dermal Child HQ	Inhalation Child HQ	Noncarcinogenic Child HI	Ingestion Adult HQ	Dermal Adult HQ	Inhalation Adult HQ	Noncarcinogenic Adult HI
Arsenic, Inorganic	2.17E-04	3.06E-05	1.32E-08	2.48E-04	4.30E+00	5.10E-01	5.53E-04	4.81E+00	4.03E-01	8.50E-02	5.53E-04	4.88E-01
**Total Risk/HI*	*2.17E-04*	*3.06E-05*	*1.32E-08*	*2.48E-04*	*4.30E+00*	*5.10E-01*	*5.53E-04*	*4.81E+00*	*4.03E-01*	*8.50E-02*	*5.53E-04*	*4.88E-01*

Appendix D – Cost Calculations

Vineland FFS Cost Assumptions

Area A

Excavate 1/3 on Pond 2 and a 5-ft swath around the perimeter of pond 3 and a 5-ft swath along both banks of Blackwater Branch for a distance of 800-ft.

For Alternative 2 – Excavation only, assume excavation and backfill of this area once every 3 months. Assume 30% of the material excavated is disposed of at a subtitle C landfill and 70% at a subtitle D landfill.

- Pond 2 Excavation Area = (850' x 5') + 20,000sf/3 = 10,900 sf
- Pond 3 Excavation Area = 1500' x 5' = 7,500 sf
- Blackwater Branch Exc. Area = 800' x 5' x 2 = 8,000 sf
- Total Excavation Area = 26,400 sf
- Excavation Volume (1-ft exc depth) = (26,400 sf x 1')/27 = 980 CY use 1,000 CY
- Subtitle D disposal = 0.7 x 1,000 CY = 700 CY
- Subtitle C disposal = 0.3 x 1,000 CY = 300 CY

It is estimated that this would need to be performed every 3 months to prevent exposure to levels that would present an unacceptable risk to human health and the environment.

For Alternative 3 – one time excavation and backfill followed by installation and of 30 air sparge wells to a depth of 40-feet. There are currently 6 air sparge wells installed for the pilot so the estimate will only include installation of 24 air sparge wells. In addition, injection of bicarbonate to change the pH of the water. Area A will require 9 injection wells, 40-ft deep and spaced at 50-ft.

This alternative would perform excavation/backfill one time and assume that operation of the in-situ treatment system would prevent recontamination of the sediments. The bicarbonate dosing is an intial dose of 17 tons and then 10 tons annually thereafter. This system will be operated for 30-years.

Area B

Excavate 1-ft of sediments from 5-ft swath along each bank of the Blackwater Branch for a stretch of 400-ft.

For Alternative 2 – Excavation Only, assumes excavation of exposed sediments along both banks of Blackwater Branch for a distance of 400-ft. Assume 30% of the material excavated is disposed of at a subtitle C landfill and 70% at a subtitle D landfill.

- Blackwater Branch Exc. Area = 400' x 5' x 2 = 4,000 sf
- Excavation Volume (1-ft exc depth) = (4,000 sf x 1')/27 = 148 CY use 150 CY
- Subtitle D disposal = 150 x 0.7 = 105 CY
- Subtitle C disposal = 150 x 0.3 = 45 CY

It is estimated that this would need to be performed every 3 months to prevent exposure to levels that would present an unacceptable risk to human health and the environment. It is assumed the injection system will be operated for 30 years.

Alternative 3: One time excavation and installation of a line of 16 bicarbonate injection wells on 50-ft spacing to inject bicarbonate for pH adjustment. The bicarbonate dosing is an initial dose of 17 tons and then 4.5 tons annually thereafter. This system will be operated for 30-years.

Area C

Alternative 2: Excavation Only, assumes excavation of exposed sediments along both banks of Blackwater Branch for a distance of 730-ft and excavation of floodplain soils from a total area of 0.50 acres. Assume 30% of the material excavated is disposed of at a subtitle C landfill and 70% at a subtitle D landfill. The volume of the excavation is:

- Floodplain Seeps = ((43,560'/2) x 1')/27 = 807 CY
- Blackwater Branch Exc. = (730 x 2 x 5 x 1')/27 = 270 CY

Total Excavation = 807 + 270 = 1077 CY Use 1,100 CY

Disposal Subtitle D = 770 CY

Disposal Subtitle C = 330 CY

It is estimated that this would need to be performed every 3 months to prevent exposure to levels that would present an unacceptable risk to human health and the environment.

Alternative 3: One time Excavation and In-situ Treatment

On the north side of Blackwater Branch in Area C, the groundwater is iron rich. Therefore, it will be assumed that the in-situ remedy will consist of installation of 30 air sparging wells over a 730-ft distance at 25 ft spacing and 16 bicarbonate injection wells on 50-ft spacing.

On the South side of Blackwater Branch, the groundwater is iron poor so the in-situ remedy is assumed to be installation of 50 iron chloride injection wells on a 15-foot spacing. The pH of the iron chloride injection will be adjusted using Sodium Hydroxide. It is also assumed that a line of 30 air sparge wells at 25-ft spacing will be necessary to provide the source of oxygen. Due to groundwater fluctuation in the area, groundwater only seeps into Blackwater Branch 6 months out of the year, so for the annual O&M estimates, only 6 month operation will be assumed.

Blackwater Branch from Area A to confluence with Maurice River

It is estimated that 700 ft of exposed sediment on each side of Blacewater Branch will need to remediated in addition to the exposed sediments in Area A, B, and C. For costing purposes, it is assumed 2,000 liner feet of mud matting 14-feet wide will be required.

Excavation Volume (1-ft exc depth) = (1,400' x 5' x 1')/27 = 260 CY

TOTALS

Alternative 2:

Excavation Total = 1,000 CY + 150 CY + 1,100 CY + 260 CY = 2,510 CY – USE 2,600 CY

Subtitle D disposal = 1,820 CY

Subtitle C disposal = 780 CY

Alternative 2:

On-Going Excavation

Alternative 2: On-Going Excavation

Item	Quantity	Unit	Unit Cost	Estimated Cost
Mobilization and Site Preparatioin				
Mob/Demob	1	LS	$10,000.00	$10,000
Mud Matting - 60 day rental cost	2000	LF	$32.40	$64,800
Mud Matting Delivery	1	LS	$100,000.00	$100,000
Mud Matting Placement				
Equipment	60	HR	$80.00	$4,800
Operator	60	HR	$60.00	$3,600
Laborer - 2	120	HR	$40.00	$4,800
Mud Matt Removal/Decon				
Equipment	40	HR	$80.00	$3,200
Operrator	40	HR	$60.00	$2,400
Laborer - 2	80	HR	$40.00	$3,200
Silt Fence	6000	LF	$4.00	$24,000
Project Manager	60	HR	$109.53	$6,572
QA/QC Officer	100	HR	$91.34	$9,134
Excavation/Backfill				
12 CY Dump Truck Haul/Hour	160	HR	$130.97	$20,954
Excavate and load, bank measure, medium material, 2 C.Y. bucket, hydraulic excavator	2601	BCY	$7.69	$20,002
Unclassified Fill, 6" Lifts, Off-Site, Includes Delivery, Spreading, and Compaction	2990	CY	$33.55	$100,304
Seeding, Vegetative Cover	1.93	ACR	$4,801.80	$9,267
Project Manager	120	HR	$109.53	$13,144
Project Scientist	40	HR	$91.34	$3,654
QA/QC Officer	80	HR	$91.34	$7,307
Field Technician	160	HR	$45.91	$7,346
Word Processing/Clerical	24	HR	$49.31	$1,183
Draftsman/CADD	40	HR	$52.87	$2,115
Off-Site Disposal @ Subtitle D Landfill				
Bulk Solid Waste Loading Into Disposal Vehicle	1820	BCY	$3.08	$5,604
Transport Bulk Solid Hazardous Waste, Maximum 20	1820	MI	$3.09	$5,631
Waste Stream Evaluation Fee, Not Including 50% Re	1	EA	$59.50	$60
32 Ft. Dump Truck, 6 Mil Liner, disposable	91	EA	$30.63	$2,787
Landfill Nonhazardous Solid Bulk Waste by CY	1820	CY	$33.92	$61,725
Off-Site Disposal @ Subtitle C Landfill				
Bulk Solid Waste Loading Into Disposal Vehicle or Bu	780	BCY	$3.08	$2,402
Transport Bulk Solid Hazardous Waste, Maximum 20	780	MI	$3.09	$2,413
Waste Stream Evaluation Fee, Not Including 50% Re	1	EA	$59.50	$60
32 Ft. Dump Truck, 6 Mil Liner, disposable	39	EA	$30.63	$1,195
Landfill Hazardous Solid Bulk Waste Requiring Stabil	780	CY	$216.97	$169,239
Subtotal				**$169,239**
Direct Cost Professional Labor				$50,455
Professional Labor Overhead (140%)				$70,637
Subtotal Professional Labor				**$121,092**
Materials, Labor, and Equipment (MLE)				$214,533
MLE Overhead (25%)				$53,633
Subtotal MLE				**$268,167**
Subcontracts				**$407,909**
Subtotal Prime and Subcontracts				**$797,169**
Profit (8%)				$63,773
Subtotal w/Profit				**$860,942**
Owner Cost (11%)				$94,704
Subtotal Construction Cost				**$955,646**
Other Costs				
Pre-Design Investigation				$50,000
Project Management				$30,000
Remedial Design				$50,000
Permitting				$25,000
USACE Construction Oversight				$50,000
Subtotal Other Costs				**$ 205,000**
TOTAL Capital Cost - Area A				**$ 1,160,646**

Present Value Costs for Vineland Chemical Superfund Site - Alternative 2: On-Going Excavation

Year	Fiscal Year	RI/FS Costs ($)	RD Costs ($)	RA In-Situ Costs($)	Annual LTM/O&M Costs ($)	5-Year Reviews Costs ($)	Site Close-Out Costs($)	Total Costs ($)	Discount Rate at 1.90%	Total Present Value Cost at 1.90% ($)
		$0	$0	$0	$0	$0	$0	$0	1.000	$0
0	FY16	$0	$0	$1,160,646	$0	$0	$0	$1,160,646	1.000	$1,160,646
1	FY17	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.981	$4,556,020
2	FY18	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.963	$4,471,069
3	FY19	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.945	$4,387,703
4	FY20	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.927	$4,305,891
5	FY22	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.910	$4,225,605
6	FY23	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.893	$4,146,815
7	FY24	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.877	$4,069,495
8	FY25	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.860	$3,993,616
9	FY26	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.844	$3,919,152
10	FY27	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.828	$3,846,077
11	FY28	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.813	$3,774,364
12	FY29	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.798	$3,703,988
13	FY30	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.783	$3,634,924
14	FY31	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.768	$3,567,149
15	FY32	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.754	$3,500,636
16	FY33	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.740	$3,435,365
17	FY34	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.726	$3,371,310
18	FY35	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.713	$3,308,449
19	FY36	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.699	$3,246,761
20	FY37	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.686	$3,186,222
21	FY38	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.674	$3,126,813
22	FY39	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.661	$3,068,511
23	FY40	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.649	$3,011,297
24	FY41	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.637	$2,955,149
25	FY42	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.625	$2,900,048
26	FY43	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.613	$2,845,974
27	FY44	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.602	$2,792,909
28	FY45	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.590	$2,740,833
29	FY46	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.579	$2,689,728
30	FY47	$0	$0	$0	$4,642,584	$0	$0	$4,642,584	0.569	$2,639,576
Total		$0	$0	$1,160,646	$139,277,520	$0	$0	$140,438,166		**$103,942,518**

Alternative 3:

In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring

Capital Cost

Alternative 3: AREA A - Insitu Treatment - Capital Cost

Item	Quantity	Unit	Unit Cost	Estimated Cost
Site Preparation				
Mob/Demob	1	LS	$10,000	$10,000
Clearinging and Grubbing	1	LS	$35,000	$35,000
Grading	10000	SY	$1	$10,000
Silt Fence	2000	LF	$4	$8,000
Decon Pad	1	LS	$5,000	$5,000
Subtotal				**$68,000**
Monitoring Well Installation				
Decontaminate Rig, Augers, Screen (Rental Equipment)	3	DAY	$752.29	$2,257
Contractor's Field Oversight	48	HR	$50.00	$2,400
2" PVC, Schedule 40, Well Casing	120	LF	$14.29	$1,714
2" PVC, Schedule 40, Well Screen	40	LF	$16.09	$644
2" PVC, Well Plug	4	EA	$45.25	$181
Move Rig/Equipment Around Site	3	EA	$475.80	$1,427
DOT steel drums, 55 gal., open, 17C	8	EA	$100.94	$807
Sonic Drill 5" - 6" OD Borehole, Boring Depth <= 100 feet, soil boring and continuous sampling, includes material, equipment and labor	164	LF	$40.46	$6,635
Sonic Drill Rig - Mobilization/Demobilization	1	EA	$4,144.77	$4,145
2" Screen, Filter Pack	48	LF	$13.99	$671
Surface Pad, Concrete, 2' x 2' x 4"	4	EA	$76.93	$308
2" Well, Portland Cement Grout	108	LF	$6.60	$712
2" Well, Bentonite Seal	4	EA	$240.30	$961
Well Development	4	EA	$900.00	$3,600
DOT steel drums, 55 gal., open, 17C	8	EA	$100.94	$807
5' Guard Posts, Cast Iron, Concrete Fill	16	EA	$262.45	$4,199
IDW Disposal	8	Drum	$250.00	$2,000
Subtotal				**$33,470**
Air Sparge System Installation				
Prefab Building 675 SF	1	EA	$45,000	$45,000
Air Sparge System, Blower 163 SCFM, 15 HP, 15 PSI, base, intake filter, silencer, pulleys, belt, belt guard.	2	EA	$10,883.88	$21,768
Decontaminate Rig, Augers, Screen (Rental Equipment)	13	DAY	$752.29	$9,780
DOT steel drums, 55 gal., open, 17C	48	EA	$100.94	$4,845
Contractor's Field Oversight	208	HR	$50.00	$10,400
2" Stainless Steel, Well Casing	912	LF	$75.48	$68,834
2" Stainless Steel, Well Screen	48	LF	$131.41	$6,307
2" Stainless Steel, Well Plug	24	EA	$143.13	$3,435
Move Rig/Equipment Around Site	23	EA	$475.80	$10,943
Sonic Drill 5" - 6" OD Borehole, Boring Depth <= 100 feet, soil boring and continuous sampling, includes material, equipment and labor	984	LF	$40.46	$39,813
Sonic Drill Rig - Mobilization/Demobilization	1	EA	$4,144.77	$4,145
2" Screen, Filter Pack	96	LF	$13.99	$1,343
2" Well, Portland Cement Grout	840	LF	$6.60	$5,541
2" Well, Bentonite Seal	24	EA	$240.30	$5,767
Flush Mount Vault	24	EA	$275.00	$6,600
2" PVC, Schedule 80, Connection Piping	1200	LF	$14.82	$17,786
4" PVC, Schedule 80, Manifold Piping	400	LF	$24.18	$9,671
2" PVC, Schedule 80, Tee	24	EA	$107.71	$2,585
2" PVC, Schedule 80, 90 Degree, Elbow	24	EA	$53.51	$1,284
4" x 2" Reducer, PVC Schedule 80	24	EA	$129.12	$3,099
2" PVC, Sch 80, Ball Valve	24	EA	$75.90	$1,822
Pressure Gauge	24	EA	$229.23	$5,502
Heat Trace System (5 Watt/LF)	400	LF	$10.20	$4,080
IDW Disposal	48	Drum	$250.00	$12,000
PLC System	1	LS	$100,000.00	$100,000
Pipe Trench			$0.00	$0
Cat 215, 1.0 CY, Soil, Shallow, Trenching, Excludes Sheeting, Excludes Dewatering	1335	BCY	$1.29	$1,725
On-Site Backfill for Large Excavations, Includes Compaction	1335	ECY	$2.14	$2,857
Backfill with Crushed Stone	320	CY	$35.91	$11,490
Compaction, subgrade, 18" wide, 8" lifts, walk behind, vibrating plate	319.85	ECY	$3.29	$1,052

Alternative 3: AREA A - Insitu Treatment - Capital Cost

Item	Quantity	Unit	Unit Cost	Estimated Cost
Subtotal				**$419,472**
Bicarbonate Injection System				
Water level indicators, water level chart recorder, battery operated	9	EA	$717.87	$6,461
Monitor well sampling equipment, rental, water quality testing parameter device rental	1	WK	$101.15	$101
Recycle Flow Meter, 3/4 HP Unit	9	EA	$357.00	$3,213
Contractor's Field Oversight	108	HR	$50.00	$5,400
BiCarbonate-Initial Injection	17	TON	$1,020.00	$17,340
2" PVC, Schedule 40, Well Casing	90	LF	$14.29	$1,286
2" PVC, Schedule 40, Well Screen	270	LF	$16.09	$4,346
2" PVC, Well Plug	9	EA	$45.25	$407
Hollow Stem Auger, 8" Dia Borehole, Depth <= 100 ft	360	LF	$44.08	$15,870
Move Rig/Equipment Around Site	8	EA	$475.80	$3,806
Mobilization/Demobilization, Drill Equipment or Trencher, Crew	1	EA	$2,068.71	$2,069
DOT steel drums, 55 gal., open, 17C	19	EA	$100.94	$1,918
Load Supplies/Equipment	1	LS	$1,241.23	$1,241
2" Screen, Filter Pack	297	LF	$13.99	$4,154
Surface Pad, Concrete, 4' x 4' x 4"	9	EA	$119.67	$1,077
2" Well, Portland Cement Grout	63	LF	$6.60	$416
2" Well, Bentonite Seal	9	EA	$240.30	$2,163
Flush Mount Vault	9	EA	$275.00	$2,475
1" PVC, Schedule 80, Connection Piping	900	LF	$14.82	$13,339
2" PVC, Schedule 40, 90 Degree, Elbow	9	EA	$42.84	$386
Valves, iron body, silent check, bronze trim, compact wafer type, for 125 or 150 lb. flanges, 2"	9	EA	$269.57	$2,426
10 GPM, 1/2 HP, Centrifugal Pump	9	EA	$1,597.04	$14,373
IDW Disposal	19	Drum	$250.00	$4,750
Trenching			$0.00	$0
Cat 215, 1.0 CY, Soil, Shallow, Trenching, Excludes Sheeting, Excludes Dewatering	312	BCY	$1.29	$403
On-Site Backfill for Large Excavations, Includes Compaction	360	ECY	$2.14	$770
Backfill with Crushed Stone	40	CY	$35.91	$1,436
Compaction, subgrade, 18" wide, 8" lifts, walk behind, vibrating plate	38.89	ECY	$3.29	$128
2" PVC, Schedule 40, Connection Piping	500	LF	$13.35	$6,677
Subtotal				**$118,431**
Direct Cost Professional Labor				$32,000
Professional Labor Overhead (140%)				$44,800
Subtotal Professional Labor				**$76,800**
Materials, Labor, and Equipment (MLE)				$515,947
MLE Overhead (25%)				$128,987
Subtotal MLE				**$644,933**
Subcontracts				**$91,427**
Subtotal Prime and Subcontracts				**$813,160**
Profit (8%)				$65,053
Subtotal w/Profit				**$878,212**
Owner Cost (11%)				$96,603
Subtotal Construction Cost				**$974,816**
Other Costs				
Pre-Design Investigation				$200,000
Project Management				$85,000
Remedial Design				$250,000
Permitting				$34,000
USACE Construction Oversight				$100,000
Pilot throgh the end of Dec 2017				$250,000
Subtotal Other Costs				**$ 919,000**
TOTAL Capital Cost - Area A				**$ 1,893,816**

Alternative 3: AREA B In-Situ Treatment - Capital Cost

Item	Quantity	Unit	Unit Cost	Estimated Cost
Site Preparation				
Mob/Demob	1	LS	$5,000	$5,000
Clearinging and Grubbing	1	LS	$20,000	$20,000
Grading	5000	SY	$1	$5,000
Silt Fence	1000	LF	$4	$4,000
Decon Pad	1	LS	$5,000	$5,000
Subtotal				**$39,000**
Monitoring Well Installation				
Decontaminate Rig, Augers, Screen (Rental Equipment)	3	DAY	$752.29	$2,257
Contractor's Field Oversight	48	HR	$50.00	$2,400
2" PVC, Schedule 40, Well Casing	120	LF	$14.29	$1,714
2" PVC, Schedule 40, Well Screen	40	LF	$16.09	$644
2" PVC, Well Plug	4	EA	$45.25	$181
Move Rig/Equipment Around Site	3	EA	$475.80	$1,427
DOT steel drums, 55 gal., open, 17C	8	EA	$100.94	$807
Sonic Drill 5" - 6" OD Borehole, Boring Depth <= 100 feet, soil boring and continuous sampling, includes material, equipment and labor	164	LF	$40.46	$6,635
Sonic Drill Rig - Mobilization/Demobilization	1	EA	$4,144.77	$4,145
2" Screen, Filter Pack	48	LF	$13.99	$671
Surface Pad, Concrete, 2' x 2' x 4"	4	EA	$76.93	$308
2" Well, Portland Cement Grout	108	LF	$6.60	$712
2" Well, Bentonite Seal	4	EA	$240.30	$961
Well Development	4	EA	$900.00	$3,600
DOT steel drums, 55 gal., open, 17C	8	EA	$100.94	$807
5' Guard Posts, Cast Iron, Concrete Fill	16	EA	$262.45	$4,199
IDW Disposal	8	Drum	$250.00	$2,000
Subtotal				**$33,470**
Bicarbonate Injection System				
Water level indicators, water level chart recorder, battery operated	16	EA	$717.87	$11,486
Monitor well sampling equipment, rental, water quality testing parameter device rental	1	WK	$101.15	$101
Recycle Flow Meter, 3/4 HP Unit	16	EA	$357.00	$5,712
Contractor's Field Oversight	192	HR	$50.00	$9,600
BiCarbonate-Initial Injection	12	TON	$1,020.00	$12,240
2" PVC, Schedule 40, Well Casing	160	LF	$14.29	$2,286
2" PVC, Schedule 40, Well Screen	800	LF	$16.09	$12,876
2" PVC, Well Plug	16	EA	$45.25	$724
Hollow Stem Auger, 8" Dia Borehole, Depth <= 100 ft	960	LF	$44.08	$42,321
Move Rig/Equipment Around Site	15	EA	$475.80	$7,137
Mobilization/Demobilization, Drill Equipment or Trencher, Crew	1	EA	$2,068.71	$2,069
DOT steel drums, 55 gal., open, 17C	51	EA	$100.94	$5,148
Load Supplies/Equipment	1	LS	$1,241.23	$1,241
2" Screen, Filter Pack	832	LF	$13.99	$11,637
Surface Pad, Concrete, 4' x 4' x 4"	16	EA	$119.67	$1,915
2" Well, Portland Cement Grout	112	LF	$6.60	$739
2" Well, Bentonite Seal	16	EA	$240.30	$3,845
Flush Mount Vault	16	EA	$275.00	$4,400
1" PVC, Schedule 80, Connection Piping	1600	LF	$14.82	$23,714
2" PVC, Schedule 40, 90 Degree, Elbow	16	EA	$42.84	$685
Valves, iron body, silent check, bronze trim, compact wafer type, for 125 or 150 lb. flanges, 2"	16	EA	$269.57	$4,313
10 GPM, 1/2 HP, Centrifugal Pump	16	EA	$1,597.04	$25,553
IDW Disposal	51	Drum	$250.00	$12,750
Trenching				
Cat 215, 1.0 CY, Soil, Shallow, Trenching, Excludes Sheeting, Excludes Dewatering	624	BCY	$1.29	$806
On-Site Backfill for Large Excavations, Includes Compaction	720	ECY	$2.14	$1,541
Backfill with Crushed Stone	80	CY	$35.91	$2,873
Compaction, subgrade, 18" wide, 8" lifts, walk behind, vibrating plate	80	ECY	$3.29	$263
2" PVC, Schedule 40, Connection Piping	1000	LF	$13.35	$13,354

Alternative 3: AREA B In-Situ Treatment - Capital Cost

Item	Quantity	Unit	Unit Cost	Estimated Cost
Subtotal				**$221,327**
Direct Cost Professional Labor				$12,000
Professional Labor Overhead (140%)				$16,800
Subtotal Professional Labor				**$28,800**
Materials, Labor, and Equipment (MLE)				$212,463
MLE Overhead (25%)				$53,116
Subtotal MLE				**$265,579**
Subcontracts				**$78,484**
Subtotal Prime and Subcontracts				**$372,863**
Profit (8%)				$29,829
Subtotal w/Profit				**$402,692**
Owner Cost (11%)				$44,296
Subtotal Construction Cost				**$446,988**
Other Costs				
Pre-Design Investigation				$140,000
Project Management				$44,000
Remedial Design				$75,000
Permitting				$34,000
USACE Construction Oversight				$50,000
Area B Bench Scale and Pilot				$170,000
Subtotal Other Costs				**$ 513,000**
TOTAL Capital Cost - Area B				**$ 959,988**

Alternative 3: AREA C ((North) - Insitu Treatment - Capital Cost

Item	Quantity	Unit	Unit Cost	Estimated Cost
Site Preparation				
Mob/Demob	1	LS	$10,000	$10,000
Clearinging and Grubbing	1	LS	$35,000	$35,000
Grading	10000	SY	$1	$10,000
Silt Fence	2000	LF	$4	$8,000
Decon Pad	1	LS	$5,000	$5,000
Subtotal				**$68,000**
Monitoring Well Installation				
Decontaminate Rig, Augers, Screen (Rental Equipment)	3	DAY	$752.29	$2,257
Contractor's Field Oversight	48	HR	$50.00	$2,400
2" PVC, Schedule 40, Well Casing	120	LF	$14.29	$1,714
12	40	LF	$16.09	$644
2" PVC, Well Plug	4	EA	$45.25	$181
Move Rig/Equipment Around Site	3	EA	$475.80	$1,427
DOT steel drums, 55 gal., open, 17C	8	EA	$100.94	$807
Sonic Drill 5" - 6" OD Borehole, Boring Depth <= 100 feet, soil boring and continuous sampling, includes material, equipment and labor	164	LF	$40.46	$6,635
Sonic Drill Rig - Mobilization/Demobilization	1	EA	$4,144.77	$4,145
2" Screen, Filter Pack	48	LF	$13.99	$671
Surface Pad, Concrete, 2' x 2' x 4"	4	EA	$76.93	$308
2" Well, Portland Cement Grout	108	LF	$6.60	$712
2" Well, Bentonite Seal	4	EA	$240.30	$961
Well Development	4	EA	$900.00	$3,600
DOT steel drums, 55 gal., open, 17C	8	EA	$100.94	$807
5' Guard Posts, Cast Iron, Concrete Fill	16	EA	$262.45	$4,199
IDW Disposal	8	Drum	$250.00	$2,000
Subtotal				**$33,470**
Air Sparge System Installation				
Prefab Building 675 SF	1	EA	$45,000	$45,000
Air Sparge System, Blower 163 SCFM, 15 HP, 15 PSI, base, intake filter, silencer, pulleys, belt, belt guard.	2	EA	$10,883.88	$21,768
Decontaminate Rig, Augers, Screen (Rental Equipment)	23	DAY	$752.29	$17,303
DOT steel drums, 55 gal., open, 17C	90	EA	$100.94	$9,084
Contractor's Field Oversight	368	HR	$50.00	$18,400
2" Stainless Steel, Well Casing	1740	LF	$75.48	$131,328
2" Stainless Steel, Well Screen	60	LF	$131.41	$7,884
2" Stainless Steel, Well Plug	30	EA	$143.13	$4,294
Move Rig/Equipment Around Site	29	EA	$475.80	$13,798
Sonic Drill 5" - 6" OD Borehole, Boring Depth <= 100 feet, soil boring and continuous sampling, includes material, equipment and labor	1830	LF	$40.46	$74,042
Sonic Drill Rig - Mobilization/Demobilization	1	EA	$4,144.77	$4,145
2" Screen, Filter Pack	120	LF	$13.99	$1,678
2" Well, Portland Cement Grout	1650	LF	$6.60	$10,883
2" Well, Bentonite Seal	30	EA	$240.30	$7,209
Flush Mount Vault	30	EA	$275.00	$8,250
2" PVC, Schedule 80, Connection Piping	1200	LF	$14.82	$17,786
4" PVC, Schedule 80, Manifold Piping	400	LF	$24.18	$9,671
2" PVC, Schedule 80, Tee	30	EA	$107.71	$3,231
2" PVC, Schedule 80, 90 Degree, Elbow	30	EA	$53.51	$1,605
4" x 2" Reducer, PVC Schedule 80	30	EA	$129.12	$3,874
2" PVC, Sch 80, Ball Valve	30	EA	$75.90	$2,277
Pressure Gauge	30	EA	$229.23	$6,877
Heat Trace System (5 Watt/LF)	400	LF	$10.20	$4,080
IDW Disposal	90	Drum	$250.00	$22,500
PLC System	1	LS	$100,000.00	$100,000
Pipe Trench			$0.00	$0
Cat 215, 1.0 CY, Soil, Shallow, Trenching, Excludes Sheeting, Excludes Dewatering	1335	BCY	$1.29	$1,725
On-Site Backfill for Large Excavations, Includes Compaction	1335	ECY	$2.14	$2,857
Backfill with Crushed Stone	320	CY	$35.91	$11,490
Compaction, subgrade, 18" wide, 8" lifts, walk behind, vibrating plate	319.85	ECY	$3.29	$1,052

Alternative 3: AREA C ((North) - Insitu Treatment - Capital Cost

Item	Quantity	Unit	Unit Cost	Estimated Cost
Subtotal				**$564,090**
Bicarbonate Injection System				
Water level indicators, water level chart recorder, battery operated	16	EA	$717.87	$11,486
Monitor well sampling equipment, rental, water quality testing parameter device rental	1	WK	$101.15	$101
Recycle Flow Meter, 3/4 HP Unit	16	EA	$357.00	$5,712
Contractor's Field Oversight	288	HR	$50.00	$14,400
BiCarbonate-Initial Injection	12	TON	$1,020.00	$12,240
2" PVC, Schedule 40, Well Casing	160	LF	$14.29	$2,286
2" PVC, Schedule 40, Well Screen	800	LF	$16.09	$12,876
2" PVC, Well Plug	16	EA	$45.25	$724
Hollow Stem Auger, 8" Dia Borehole, Depth <= 100 ft	960	LF	$44.08	$42,321
Move Rig/Equipment Around Site	15	EA	$475.80	$7,137
Mobilization/Demobilization, Drill Equipment or Trencher, Crew	1	EA	$2,068.71	$2,069
DOT steel drums, 55 gal., open, 17C	51	EA	$100.94	$5,148
Load Supplies/Equipment	1	LS	$1,241.23	$1,241
2" Screen, Filter Pack	848	LF	$13.99	$11,861
Surface Pad, Concrete, 4' x 4' x 4"	16	EA	$119.67	$1,915
2" Well, Portland Cement Grout	112	LF	$6.60	$739
2" Well, Bentonite Seal	16	EA	$240.30	$3,845
Flush Mount Vault	16	EA	$275.00	$4,400
1" PVC, Schedule 80, Connection Piping	1600	LF	$14.82	$23,714
2" PVC, Schedule 40, 90 Degree, Elbow	16	EA	$42.84	$685
Valves, iron body, silent check, bronze trim, compact wafer type, for 125 or 150 lb. flanges, 2"	16	EA	$269.57	$4,313
10 GPM, 1/2 HP, Centrifugal Pump	16	EA	$1,597.04	$25,553
IDW Disposal	51	Drum	$250.00	$12,750
Trenching			$0.00	$0
Cat 215, 1.0 CY, Soil, Shallow, Trenching, Excludes Sheeting, Excludes Dewatering	312	BCY	$1.29	$403
On-Site Backfill for Large Excavations, Includes Compaction	360	ECY	$2.14	$770
Backfill with Crushed Stone	40	CY	$35.91	$1,436
Compaction, subgrade, 18" wide, 8" lifts, walk behind, vibrating plate	38.89	ECY	$3.29	$128
2" PVC, Schedule 40, Connection Piping	500	LF	$13.35	$6,677
Subtotal				**$216,929**
Direct Cost Professional Labor				$32,000
Professional Labor Overhead (140%)				$44,800
Subtotal Professional Labor				**$76,800**
Materials, Labor, and Equipment (MLE)				$679,884
MLE Overhead (25%)				$169,971
Subtotal MLE				**$849,854**
Subcontracts				**$170,606**
Subtotal Prime and Subcontracts				**$1,097,260**
Profit (8%)				$87,781
Subtotal w/Profit				**$1,185,041**
Owner Cost (11%)				$130,355
Subtotal Construction Cost				**$1,315,396**
Other Costs				
Pre-Design Investigation				$238,333
Project Management				$85,000
Remedial Design				$150,000
Permitting				$34,000
USACE Construction Oversight				$100,000
Bench Svale and Pilot				$400,000
Subtotal Other Costs				**$ 1,007,333**
TOTAL Capital Cost - Area C North				**$ 2,322,729**

Alternative 3: AREA C ((South) - Insitu Treatment - Capital Cost

Item	Quantity	Unit	Unit Cost	Estimated Cost
Site Preparation				
Mob/Demob	1	LS	$10,000	$10,000
Clearinging and Grubbing	1	LS	$35,000	$35,000
Grading	10000	SY	$1	$10,000
Silt Fence	2000	LF	$4	$8,000
Decon Pad	1	LS	$5,000	$5,000
Subtotal				**$68,000**
Monitoring Well Installation				
Decontaminate Rig, Augers, Screen (Rental Equipment)	3	DAY	$752.29	$2,257
Contractor's Field Oversight	48	HR	$50.00	$2,400
2" PVC, Schedule 40, Well Casing	120	LF	$14.29	$1,714
2" PVC, Schedule 40, Well Screen	40	LF	$16.09	$644
2" PVC, Well Plug	4	EA	$45.25	$181
Move Rig/Equipment Around Site	3	EA	$475.80	$1,427
DOT steel drums, 55 gal., open, 17C	8	EA	$100.94	$807
Sonic Drill 5" - 6" OD Borehole, Boring Depth <= 100 feet, soil boring and continuous sampling, includes material, equipment and labor	164	LF	$40.46	$6,635
Sonic Drill Rig - Mobilization/Demobilization	1	EA	$4,144.77	$4,145
2" Screen, Filter Pack	48	LF	$13.99	$671
Surface Pad, Concrete, 2' x 2' x 4"	4	EA	$76.93	$308
2" Well, Portland Cement Grout	108	LF	$6.60	$712
2" Well, Bentonite Seal	4	EA	$240.30	$961
Well Development	4	EA	$900.00	$3,600
DOT steel drums, 55 gal., open, 17C	8	EA	$100.94	$807
5' Guard Posts, Cast Iron, Concrete Fill	16	EA	$262.45	$4,199
IDW Disposal	8	Drum	$250.00	$2,000
Subtotal				**$33,470**
Air Sparge System Installation				
Prefab Building 675 SF	1	EA	$45,000	$45,000
Air Sparge System, Blower 163 SCFM, 15 HP, 15 PSI, base, intake filter, silencer, pulleys, belt, belt guard.	2	EA	$10,883.88	$21,768
Decontaminate Rig, Augers, Screen (Rental Equipment)	23	DAY	$752.29	$17,303
DOT steel drums, 55 gal., open, 17C	90	EA	$100.94	$9,084
Contractor's Field Oversight	368	HR	$50.00	$18,400
2" Stainless Steel, Well Casing	1740	LF	$75.48	$131,328
2" Stainless Steel, Well Screen	60	LF	$131.41	$7,884
2" Stainless Steel, Well Plug	30	EA	$143.13	$4,294
Move Rig/Equipment Around Site	29	EA	$475.80	$13,798
Sonic Drill 5" - 6" OD Borehole, Boring Depth <= 100 feet, soil boring and continuous sampling, includes material, equipment and labor	1830	LF	$40.46	$74,042
Sonic Drill Rig - Mobilization/Demobilization	1	EA	$4,144.77	$4,145
2" Screen, Filter Pack	120	LF	$13.99	$1,678
2" Well, Portland Cement Grout	1650	LF	$6.60	$10,883
2" Well, Bentonite Seal	30	EA	$240.30	$7,209
Flush Mount Vault	30	EA	$275.00	$8,250
2" PVC, Schedule 80, Connection Piping	1200	LF	$14.82	$17,786
4" PVC, Schedule 80, Manifold Piping	400	LF	$24.18	$9,671
2" PVC, Schedule 80, Tee	30	EA	$107.71	$3,231
2" PVC, Schedule 80, 90 Degree, Elbow	30	EA	$53.51	$1,605
4" x 2" Reducer, PVC Schedule 80	30	EA	$129.12	$3,874
2" PVC, Sch 80, Ball Valve	30	EA	$75.90	$2,277
Pressure Gauge	30	EA	$229.23	$6,877
Heat Trace System (5 Watt/LF)	400	LF	$10.20	$4,080
IDW Disposal	90	Drum	$250.00	$22,500
PLC System	1	LS	$100,000.00	$100,000
Pipe Trench			$0.00	$0
Cat 215, 1.0 CY, Soil, Shallow, Trenching, Excludes Sheeting, Excludes Dewatering	1335	BCY	$1.29	$1,725
On-Site Backfill for Large Excavations, Includes Compaction	1335	ECY	$2.14	$2,857
Backfill with Crushed Stone	320	CY	$35.91	$11,490
Compaction, subgrade, 18" wide, 8" lifts, walk behind, vibrating plate	319.85	ECY	$3.29	$1,052

Alternative 3: AREA C ((South) - Insitu Treatment - Capital Cost

Item	Quantity	Unit	Unit Cost	Estimated Cost
Subtotal				**$564,090**
Bicarbonate Injection System				
Water level indicators, water level chart recorder, battery operated	50	EA	$717.87	$35,893
Monitor well sampling equipment, rental, water quality testing parameter device rental	1	WK	$101.15	$101
Recycle Flow Meter, 3/4 HP Unit	50	EA	$357.00	$17,850
Contractor's Field Oversight	600	HR	$50.00	$30,000
BiCarbonate-Initial Injection	17	TON	$1,020.00	$17,340
2" PVC, Schedule 40, Well Casing	500	LF	$14.29	$7,143
2" PVC, Schedule 40, Well Screen	2500	LF	$16.09	$40,237
2" PVC, Well Plug	50	EA	$45.25	$2,262
Hollow Stem Auger, 8" Dia Borehole, Depth <= 100 ft	3000	LF	$44.08	$132,252
Move Rig/Equipment Around Site	49	EA	$475.80	$23,314
Mobilization/Demobilization, Drill Equipment or Trencher, Crew	1	EA	$2,068.71	$2,069
DOT steel drums, 55 gal., open, 17C	183	EA	$100.94	$18,471
Load Supplies/Equipment	1	LS	$1,241.23	$1,241
2" Screen, Filter Pack	2600	LF	$13.99	$36,366
Surface Pad, Concrete, 4' x 4' x 4"	50	EA	$119.67	$5,983
2" Well, Portland Cement Grout	350	LF	$6.60	$2,309
2" Well, Bentonite Seal	50	EA	$240.30	$12,015
Flush Mount Vault	50	EA	$275.00	$13,750
1" PVC, Schedule 80, Connection Piping	3000	LF	$14.82	$44,464
2" PVC, Schedule 40, 90 Degree, Elbow	50	EA	$42.84	$2,142
Valves, iron body, silent check, bronze trim, compact wafer type, for 125 or 150 lb. flanges, 2"	50	EA	$269.57	$13,478
10 GPM, 1/2 HP, Centrifugal Pump	50	EA	$1,597.04	$79,852
IDW Disposal	183	Drum	$250.00	$45,750
Trenching			$0.00	$0
Cat 215, 1.0 CY, Soil, Shallow, Trenching, Excludes Sheeting, Excludes Dewatering	312	BCY	$1.29	$403
On-Site Backfill for Large Excavations, Includes Compaction	360	ECY	$2.14	$770
Backfill with Crushed Stone	40	CY	$35.91	$1,436
Compaction, subgrade, 18" wide, 8" lifts, walk behind, vibrating plate	38.89	ECY	$3.29	$128
2" PVC, Schedule 40, Connection Piping	500	LF	$13.35	$6,677
Subtotal				**$593,698**
Direct Cost Professional Labor				$32,000
Professional Labor Overhead (140%)				$44,800
Subtotal Professional Labor				**$76,800**
Materials, Labor, and Equipment (MLE)				$933,721
MLE Overhead (25%)				$233,430
Subtotal MLE				**$1,167,152**
Subcontracts				**$293,537**
Subtotal Prime and Subcontracts				**$1,537,489**
Profit (8%)				$122,999
Subtotal w/Profit				**$1,660,488**
Owner Cost (11%)				$182,654
Subtotal Construction Cost				**$1,843,142**
Other Costs				
Pre-Design Investigation				$376,667
Project Management				$102,500
Remedial Design				$220,000
Permitting				$34,000
USACE Construction Oversight				$100,000
Pilot and Bench Scale				$ 975,000
Subtotal Other Costs				**$ 1,808,167**
TOTAL Capital Cost - Area C South				**$ 3,651,309**

Alternative 3: One Time Excavation

Item	Quantity	Unit	Unit Cost	Estimated Cost
Mobilization and Site Preparatioin				
Mob/Demob	1	LS	$10,000.00	$10,000
Mud Matting - 60 day rental cost	2000	LF	$32.40	$64,800
Mud Matting Delivery	1	LS	$100,000.00	$100,000
Mud Matting Placement				
Equipment	60	HR	$80.00	$4,800
Operator	60	HR	$60.00	$3,600
Laborer - 2	120	HR	$40.00	$4,800
Mud Matt Removal/Decon				
Equipment	40	HR	$80.00	$3,200
Operrator	40	HR	$60.00	$2,400
Laborer - 2	80	HR	$40.00	$3,200
Silt Fence	6000	LF	$4.00	$24,000
Project Manager	60	HR	$109.53	$6,572
QA/QC Officer	100	HR	$91.34	$9,134
Excavation/Backfill				
12 CY Dump Truck Haul/Hour	160	HR	$130.97	$20,954
Excavate and load, bank measure, medium material, 2 C.Y. bucket, hydraulic excavator	2601	BCY	$7.69	$20,002
Unclassified Fill, 6" Lifts, Off-Site, Includes Delivery, Spreading, and Compaction	2990	CY	$33.55	$100,304
Seeding, Vegetative Cover	1.93	ACR	$4,801.80	$9,267
Project Manager	120	HR	$109.53	$13,144
Project Scientist	40	HR	$91.34	$3,654
QA/QC Officer	80	HR	$91.34	$7,307
Field Technician	160	HR	$45.91	$7,346
Word Processing/Clerical	24	HR	$49.31	$1,183
Draftsman/CADD	40	HR	$52.87	$2,115
Off-Site Disposal @ Subtitle D Landfill				
Bulk Solid Waste Loading Into Disposal Vehicle	1820	BCY	$3.08	$5,604
Transport Bulk Solid Hazardous Waste, Maximum 20	1820	MI	$3.09	$5,631
Waste Stream Evaluation Fee, Not Including 50% Re	1	EA	$59.50	$60
32 Ft. Dump Truck, 6 Mil Liner, disposable	91	EA	$30.63	$2,787
Landfill Nonhazardous Solid Bulk Waste by CY	1820	CY	$33.92	$61,725
Off-Site Disposal @ Subtitle C Landfill				
Bulk Solid Waste Loading Into Disposal Vehicle or Bu	780	BCY	$3.08	$2,402
Transport Bulk Solid Hazardous Waste, Maximum 20	780	MI	$3.09	$2,413
Waste Stream Evaluation Fee, Not Including 50% Re	1	EA	$59.50	$60
32 Ft. Dump Truck, 6 Mil Liner, disposable	39	EA	$30.63	$1,195
Landfill Hazardous Solid Bulk Waste Requiring Stabil	780	CY	$216.97	$169,239
Subtotal				**$169,239**
Direct Cost Professional Labor				$50,455
Professional Labor Overhead (140%)				$70,637
Subtotal Professional Labor				**$121,092**
Materials, Labor, and Equipment (MLE)				$214,533
MLE Overhead (25%)				$53,633
Subtotal MLE				**$268,167**
Subcontracts				**$407,909**
Subtotal Prime and Subcontracts				**$797,169**
Profit (8%)				$63,773
Subtotal w/Profit				**$860,942**
Owner Cost (11%)				$94,704
Subtotal Construction Cost				**$955,646**
Other Costs				
Pre-Design Investigation				$50,000
Project Management				$30,000
Remedial Design				$50,000
Permitting				$25,000
USACE Construction Oversight				$50,000
Subtotal Other Costs				**$ 205,000**
TOTAL Capital Cost - Area A				**$ 1,160,646**

Alternative 3:

In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring

Operation and Maintenance Costs

Alternative 3: AREA A - O&M 1st Year

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Bicarbonate	10	TON	$1,020.00	$10,200
Project Manager	20	HR	$109.53	$2,191
Project Engineer	118	HR	$80.16	$9,459
Staff Engineer	118	HR	$97.16	$11,465
Project Scientist	7	HR	$91.34	$639
QA/QC Officer	11	HR	$91.34	$1,005
Word Processing/Clerical	30	HR	$49.31	$1,479
Draftsman/CADD	10	HR	$52.87	$529
Treatment System Operator - 1st year Startup	516	HR	$50.92	$26,277
Other Direct Costs	1	LS	$1,327.23	$1,327
Electrical Charge (bldg heating , cooling, lighting)	8000	KWH	$0.11	$880
Electrical Charge (Air Sparge pumps)	196000	KWH	$0.11	$21,560
Electrical Charge (heating air for 6 months)	78840	KWH	$0.11	$8,672
Electrical Charge (heat trace - 6 months)	8760	KWH	$0.11	$964
Subtotal				**$96,647**
Direct Cost Professional Labor				$53,043
Professional Labor Overhead (140%)				$74,261
Subtotal Professional Labor				**$127,304**
Materials, Labor, and Equipment (MLE)				$11,527
MLE Overhead (25%)				$2,882
Subtotal MLE				**$14,409**
Subcontracts				**$32,076**
Subtotal Prime and Subcontracts				**$173,789**
Profit (8%)				$13,903
Subtotal w/Profit				**$187,692**
Owner Cost (11%)				$20,646
Subtotal 1st Year O&M Cost				**$208,338**
Other Costs				
USACE Oversight				$30,000
Subtotal Other Costs				**$ 30,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 238,338**

Alternative 3: AREA A O&M Years 2-30

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Bicarbonate	10	TON	$1,020.00	$10,200
Project Manager	20	HR	$109.53	$2,191
Project Engineer	40	HR	$80.16	$3,206
Staff Engineer	40	HR	$97.16	$3,886
Project Scientist	7	HR	$91.34	$639
QA/QC Officer	11	HR	$91.34	$1,005
Word Processing/Clerical	30	HR	$49.31	$1,479
Draftsman/CADD	10	HR	$52.87	$529
Treatment System Operator - yrs 2-30	254	HR	$50.92	$12,935
Other Direct Costs	1	LS	$1,327.23	$1,327
Electrical Charge (bldg heating , cooling, lighting)	8000	KWH	$0.11	$880
Electrical Charge (Air Sparge pumps)	196000	KWH	$0.11	$21,560
Electrical Charge (heating air for 6 months)	78840	KWH	$0.11	$8,672
Electrical Charge (heat trace - 6 months)	8760	KWH	$0.11	$964
Subtotal				**$69,473**
Direct Cost Professional Labor				$25,870
Professional Labor Overhead (140%)				$36,218
Subtotal Professional Labor				**$62,089**
Materials, Labor, and Equipment (MLE)				$11,527
MLE Overhead (25%)				$2,882
Subtotal MLE				**$14,409**
Subcontracts				**$32,076**
Subtotal Prime and Subcontracts				**$108,574**
Profit (8%)				$8,686
Subtotal w/Profit				**$117,259**
Owner Cost (11%)				$12,899
Subtotal Yrs 2-30 O&M Cost				**$130,158**
Other Costs				
USACE Oversight				$30,000
Subtotal Other Costs				**$ 30,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 160,158**

Alternative 3: AREA B - O&M 1st Year

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Bicarbonate	5.5	TON	$1,020.00	$5,610
Project Manager	16	HR	$109.53	$1,753
Project Engineer	98	HR	$80.16	$7,856
Staff Engineer	98	HR	$97.16	$9,522
Project Scientist	21	HR	$91.34	$1,918
QA/QC Officer	9	HR	$91.34	$822
Word Processing/Clerical	26	HR	$49.31	$1,282
Draftsman/CADD	8	HR	$52.87	$423
Treatment System Operator - 1st year Startup	86	HR	$50.92	$4,379
Other Direct Costs	1	LS	$1,327.23	$1,327
Electrical Charge (Injection Pumps)	52000	KWH	$0.11	$5,720
Electrical Charge (water and building htg)	82526	KWH	$0.11	$9,078
Subtotal				**$49,690**
Direct Cost Professional Labor				$27,955
Professional Labor Overhead (140%)				$39,136
Subtotal Professional Labor				**$67,091**
Materials, Labor, and Equipment (MLE)				$6,937
MLE Overhead (25%)				$1,734
Subtotal MLE				**$8,672**
Subcontracts				**$14,798**
Subtotal Prime and Subcontracts				**$90,561**
Profit (8%)				$7,245
Subtotal w/Profit				**$97,805**
Owner Cost (11%)				$10,759
Subtotal 1st Year O&M Cost				**$108,564**
Other Costs				
USACE Oversight				$10,000
Subtotal Other Costs				**$ 10,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 118,564**

Alternative 3: AREA B - O&M Years 2-30

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Bicarbonate	5.5	TON	$1,020.00	$5,610
Project Manager	8	HR	$109.53	$876
Project Engineer	98	HR	$80.16	$7,856
Staff Engineer	0	HR	$97.16	$0
Project Scientist	0	HR	$91.34	$0
QA/QC Officer	4	HR	$91.34	$365
Word Processing/Clerical	12	HR	$49.31	$592
Draftsman/CADD	4	HR	$52.87	$211
Treatment System Operator - 1st year Startup	127	HR	$50.92	$6,467
Other Direct Costs	1	LS	$409.20	$409
Electrical Charge (Injection Pumps)	52000	KWH	$0.11	$5,720
Electrical Charge (water and building htg)	82526	KWH	$0.11	$9,078
Subtotal				**$37,185**
Direct Cost Professional Labor				$16,368
Professional Labor Overhead (140%)				$22,915
Subtotal Professional Labor				**$39,283**
Materials, Labor, and Equipment (MLE)				$6,019
MLE Overhead (25%)				$1,505
Subtotal MLE				**$7,524**
Subcontracts				**$14,798**
Subtotal Prime and Subcontracts				**$61,605**
Profit (8%)				$4,928
Subtotal w/Profit				**$66,533**
Owner Cost (11%)				$7,319
Subtotal 1st Year O&M Cost				**$73,852**
Other Costs				
USACE Oversight				$10,000
Subtotal Other Costs				**$ 10,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 83,852**

Alternative 3: AREA C (North) - O&M - 1st Year (6 months)

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Bicarbonate	5.5	TON	$1,020.00	$5,610
Project Manager	20	HR	$109.53	$2,191
Project Engineer	60	HR	$80.16	$4,810
Staff Engineer	60	HR	$97.16	$5,830
Project Scientist	7	HR	$91.34	$639
QA/QC Officer	11	HR	$91.34	$1,005
Word Processing/Clerical	30	HR	$49.31	$1,479
Draftsman/CADD	10	HR	$52.87	$529
Treatment System Operator - 1st year Startup	270	HR	$50.92	$13,749
Other Direct Costs	1	LS	$1,327.23	$1,327
Electrical Charge (bldg heating , cooling, lighting)	4000	KWH	$0.11	$440
Electrical Charge (Air Sparge pumps)	98000	KWH	$0.11	$10,780
Electrical Charge (heating air for 3 months)	39420	KWH	$0.11	$4,336
Electrical Charge (heat trace - 3 months)	4380	KWH	$0.11	$482
Subtotal				**$53,207**
Direct Cost Professional Labor				$30,231
Professional Labor Overhead (140%)				$42,324
Subtotal Professional Labor				**$72,555**
Materials, Labor, and Equipment (MLE)				$6,937
MLE Overhead (25%)				$1,734
Subtotal MLE				**$8,672**
Subcontracts				**$16,038**
Subtotal Prime and Subcontracts				**$97,265**
Profit (8%)				$7,781
Subtotal w/Profit				**$105,046**
Owner Cost (11%)				$11,555
Subtotal 1st Year O&M Cost				**$116,601**
Other Costs				
USACE Oversight				$20,000
Subtotal Other Costs				**$ 20,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 136,601**

Alternative 3: AREA C (North) - O&M - Years 2-30 (6 months Operation per Year)

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Bicarbonate	1	LS	$1,020.00	$1,020
Project Manager	20	HR	$109.53	$2,191
Project Engineer	24	HR	$80.16	$1,924
Staff Engineer	24	HR	$97.16	$2,332
Project Scientist	7	HR	$91.34	$639
QA/QC Officer	11	HR	$91.34	$1,005
Word Processing/Clerical	30	HR	$49.31	$1,479
Draftsman/CADD	10	HR	$52.87	$529
Treatment System Operator - yrs 2-30	135	HR	$50.92	$6,875
Other Direct Costs	1	LS	$1,327.23	$1,327
Electrical Charge (bldg heating , cooling, lighting)	4000	KWH	$0.11	$440
Electrical Charge (Air Sparge pumps)	98000	KWH	$0.11	$10,780
Electrical Charge (heating air for 6 months)	39420	KWH	$0.11	$4,336
Electrical Charge (heat trace - 6 months)	4380	KWH	$0.11	$482
Subtotal				**$35,358**
Direct Cost Professional Labor				$16,973
Professional Labor Overhead (140%)				$23,762
Subtotal Professional Labor				**$40,736**
Materials, Labor, and Equipment (MLE)				$2,347
MLE Overhead (25%)				$587
Subtotal MLE				**$2,934**
Subcontracts				**$16,038**
Subtotal Prime and Subcontracts				**$59,708**
Profit (8%)				$4,777
Subtotal w/Profit				**$64,484**
Owner Cost (11%)				$7,093
Subtotal Yrs 2-30 O&M Cost				**$71,577**
Other Costs				
USACE Oversight				$20,000
Subtotal Other Costs				**$ 20,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 91,577**

Alternative 3: AREA C (South) - O&M - 1st Year (6 months)

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Bicarbonate	1	LS	$86,000.00	$86,000
Project Manager	20	HR	$109.53	$2,191
Project Engineer	60	HR	$80.16	$4,810
Staff Engineer	60	HR	$97.16	$5,830
Project Scientist	7	HR	$91.34	$639
QA/QC Officer	11	HR	$91.34	$1,005
Word Processing/Clerical	30	HR	$49.31	$1,479
Draftsman/CADD	10	HR	$52.87	$529
Treatment System Operator - 1st year Startup	270	HR	$50.92	$13,749
Other Direct Costs	1	LS	$1,327.23	$1,327
Electrical Charge (bldg heating , cooling, lighting)	4000	KWH	$0.11	$440
Electrical Charge (Air Sparge pumps)	98000	KWH	$0.11	$10,780
Electrical Charge (heating air for 3 months)	39420	KWH	$0.11	$4,336
Electrical Charge (heat trace - 3 months)	4380	KWH	$0.11	$482
Subtotal				**$133,597**
Direct Cost Professional Labor				$30,231
Professional Labor Overhead (140%)				$42,324
Subtotal Professional Labor				**$72,555**
Materials, Labor, and Equipment (MLE)				$87,327
MLE Overhead (25%)				$21,832
Subtotal MLE				**$109,159**
Subcontracts				**$16,038**
Subtotal Prime and Subcontracts				**$197,753**
Profit (8%)				$15,820
Subtotal w/Profit				**$213,573**
Owner Cost (11%)				$23,493
Subtotal 1st Year O&M Cost				**$237,066**
Other Costs				
USACE Oversight				$15,000
Subtotal Other Costs				**$ 15,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 252,066**

Alternative 3: AREA C (South) - O&M - Years 2-30 (6 months Operation per Year)

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Bicarbonate	1	LS	$86,000.00	$86,000
Project Manager	20	HR	$109.53	$2,191
Project Engineer	40	HR	$80.16	$3,206
Staff Engineer	40	HR	$97.16	$3,886
Project Scientist	7	HR	$91.34	$639
QA/QC Officer	11	HR	$91.34	$1,005
Word Processing/Clerical	30	HR	$49.31	$1,479
Draftsman/CADD	10	HR	$52.87	$529
Treatment System Operator - 1st year Startup	135	HR	$50.92	$6,875
Other Direct Costs	1	LS	$1,327.23	$1,327
Electrical Charge (bldg heating , cooling, lighting)	4000	KWH	$0.11	$440
Electrical Charge (Air Sparge pumps)	98000	KWH	$0.11	$10,780
Electrical Charge (heating air for 3 months)	39420	KWH	$0.11	$4,336
Electrical Charge (heat trace - 3 months)	4380	KWH	$0.11	$482
Subtotal				**$123,176**
Direct Cost Professional Labor				$19,810
Professional Labor Overhead (140%)				$27,734
Subtotal Professional Labor				**$47,545**
Materials, Labor, and Equipment (MLE)				$87,327
MLE Overhead (25%)				$21,832
Subtotal MLE				**$109,159**
Subcontracts				**$16,038**
Subtotal Prime and Subcontracts				**$172,742**
Profit (8%)				$13,819
Subtotal w/Profit				**$186,561**
Owner Cost (11%)				$20,522
Subtotal 1st Year O&M Cost				**$207,083**
Other Costs				
USACE Oversight				$15,000
Subtotal Other Costs				**$ 15,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 222,083**

Alternative 3:

In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring

Performance Monitoring Costs

Alternative 3: Performanced Monitoring - Entire Site - Year 1 (Quarterly)

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Sample collection, vehicle mileage charge, car or van	160	MI	$0.51	$82
Disposable Materials per Sample	167	EA	$12.43	$2,076
Decontamination Materials per Sample (SD)	167	EA	$17.25	$2,881
Hip Waders	1	EA	$80.10	$80
Lysimeter accessories, nylon tubing, 1/4" OD	745	LF	$0.42	$310
Sludge sampler, stainless steel, thread on, 3.25" x 12"	1	EA	$764.92	$765
Monitor well sampling equipment, rental, water quality testing parameter device rental	4	WK	$101.15	$405
Monitor well sampling equipment, rental, water quality testing parameter device rental	1	WK	$101.15	$101
Testing, dissolved solids	121	EA	$26.18	$3,168
Testing, suspended solids	121	EA	$26.18	$3,168
Testing, TAL metals (6010/7000s)	167	EA	$149.55	$24,975
Overnight delivery service, 51 to 70 lb packages	1680	LB	$7.31	$12,275
Testing, RCRA evaluations, EP toxicity analysis, metals (6010,7470)	1	EA	$214.20	$214
Project Manager	42	HR	$109.53	$4,600
Project Engineer	30	HR	$80.16	$2,405
Project Scientist	115	HR	$91.34	$10,504
Staff Scientist	80	HR	$52.87	$4,230
QA/QC Officer	28	HR	$91.34	$2,558
Field Technician	408	HR	$45.91	$18,733
Word Processing/Clerical	24	HR	$49.31	$1,183
Draftsman/CADD	20	HR	$52.87	$1,057
Peristaltic Pump, Weekly Rental	4	WK	$107.10	$428
Subtotal				**$96,199**
Direct Cost Professional Labor				$45,270
Professional Labor Overhead (140%)				$63,379
Subtotal Professional Labor				**$108,649**
Materials, Labor, and Equipment (MLE)				$7,128
MLE Overhead (25%)				$1,782
Subtotal MLE				**$8,910**
Subcontracts				**$43,800**
Subtotal Prime and Subcontracts				**$161,360**
Profit (8%)				$12,909
Subtotal w/Profit				**$174,268**
Owner Cost (11%)				$19,170
Subtotal 1st Year O&M Cost				**$193,438**
Other Costs				
USACE Oversight				$20,000
Subtotal Other Costs				**$ 20,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 213,438**

Alternative 3: Performanced Monitoring - Entire Site - Year 2 (Every 6 months)

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Sample collection, vehicle mileage charge, car or van	80	MI	$0.51	$41
Disposable Materials per Sample	84	EA	$12.43	$1,044
Decontamination Materials per Sample (SD)	84	EA	$17.25	$1,449
Hip Waders	1	EA	$80.10	$80
Lysimeter accessories, nylon tubing, 1/4" OD	385	LF	$0.42	$160
Sludge sampler, stainless steel, thread on, 3.25" x 12"	1	EA	$764.92	$765
Monitor well sampling equipment, rental, water quality testing parameter device rental	2	WK	$101.15	$202
Monitor well sampling equipment, rental, water quality testing parameter device rental	1	WK	$101.15	$101
Testing, dissolved solids	61	EA	$26.18	$1,597
Testing, suspended solids	61	EA	$26.18	$1,597
Testing, TAL metals (6010/7000s)	84	EA	$149.55	$12,562
Overnight delivery service, 51 to 70 lb packages	840	LB	$7.31	$6,138
Testing, RCRA evaluations, EP toxicity analysis, metals (6010,7470)	1	EA	$214.20	$214
Project Manager	27	HR	$109.53	$2,957
Project Engineer	30	HR	$80.16	$2,405
Project Scientist	84	HR	$91.34	$7,673
Staff Scientist	80	HR	$52.87	$4,230
QA/QC Officer	22	HR	$91.34	$2,010
Field Technician	210	HR	$45.91	$9,642
Word Processing/Clerical	18	HR	$49.31	$887
Draftsman/CADD	14	HR	$52.87	$740
Peristaltic Pump, Weekly Rental	2	WK	$107.10	$214
Subtotal				**$56,709**
Direct Cost Professional Labor				$30,544
Professional Labor Overhead (140%)				$42,761
Subtotal Professional Labor				**$73,305**
Materials, Labor, and Equipment (MLE)				$4,057
MLE Overhead (25%)				$1,014
Subtotal MLE				**$5,072**
Subcontracts				**$22,108**
Subtotal Prime and Subcontracts				**$100,485**
Profit (8%)				$8,039
Subtotal w/Profit				**$108,524**
Owner Cost (11%)				$11,938
Subtotal 1st Year O&M Cost				**$120,461**
Other Costs				
USACE Oversight				$15,000
Subtotal Other Costs				**$ 15,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 135,461**

Alternative 3: Performanced Monitoring - Entire Site - Years 3-30 (Annually)

Item	Quantity	Unit	Unit Cost	Estimated Cost
O&M				
Sample collection, vehicle mileage charge, car or van	40	MI	$0.51	$20
Disposable Materials per Sample	44	EA	$12.43	$547
Decontamination Materials per Sample (SD)	44	EA	$17.25	$759
Hip Waders	1	EA	$80.10	$80
Lysimeter accessories, nylon tubing, 1/4" OD	205	LF	$0.42	$85
Sludge sampler, stainless steel, thread on, 3.25" x 12"	1	EA	$764.92	$765
Monitor well sampling equipment, rental, water quality testing parameter device rental	1	WK	$101.15	$101
Monitor well sampling equipment, rental, water quality testing parameter device rental	1	WK	$101.15	$101
Testing, dissolved solids	32	EA	$26.18	$838
Testing, suspended solids	32	EA	$26.18	$838
Testing, TAL metals (6010/7000s)	44	EA	$149.55	$6,580
Overnight delivery service, 51 to 70 lb packages	480	LB	$7.31	$3,507
Testing, RCRA evaluations, EP toxicity analysis, metals (6010,7470)	1	EA	$214.20	$214
Project Manager	19	HR	$109.53	$2,081
Project Engineer	30	HR	$80.16	$2,405
Project Scientist	69	HR	$91.34	$6,303
Staff Scientist	80	HR	$52.87	$4,230
QA/QC Officer	19	HR	$91.34	$1,735
Field Technician	117	HR	$45.91	$5,372
Word Processing/Clerical	15	HR	$49.31	$740
Draftsman/CADD	11	HR	$52.87	$582
Peristaltic Pump, Weekly Rental	1	WK	$107.10	$107
Subtotal				**$37,990**
Direct Cost Professional Labor				$23,447
Professional Labor Overhead (140%)				$32,826
Subtotal Professional Labor				**$56,272**
Materials, Labor, and Equipment (MLE)				$2,566
MLE Overhead (25%)				$642
Subtotal MLE				**$3,208**
Subcontracts				**$11,977**
Subtotal Prime and Subcontracts				**$71,458**
Profit (8%)				$5,717
Subtotal w/Profit				**$77,174**
Owner Cost (11%)				$8,489
Subtotal 1st Year O&M Cost				**$85,663**
Other Costs				
USACE Oversight				$10,000
Subtotal Other Costs				**$ 10,000**
TOTAL 1st-Year O&M Cost - Area A				**$ 95,663**

Alternative 3:

In-Situ Treatment, Hot Spot Excavation, and Performance Monitoring

Present Worth Cost

Present Value Costs for Vineland Chemical Superfund Site - Alternative 3: Initial Excavation and In-situ Treatment

Year	Fiscal Year	RI/FS Costs ($)	RD Costs ($)	RA In-Situ Costs($)	Annual O&M Costs ($)	Performance Monitoring	Site Close-Out Costs($)	Total Costs ($)	Discount Rate at 1.90%	Total Present Value Cost at 1.90% ($)
		$0	$0	$0	$0	$0	$0	$0	1.000	$0
0	FY16	$0	$0	$9,988,488	$0	$0	$0	$9,988,488	1.000	$9,988,488
1	FY17	$0	$0	$0	$745,569	$213,438	$0	$959,007	0.981	$941,126
2	FY18	$0	$0	$0	$557,670	$135,461	$0	$693,131	0.963	$667,524
3	FY19	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.945	$617,465
4	FY20	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.927	$605,951
5	FY22	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.910	$594,653
6	FY23	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.893	$583,565
7	FY24	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.877	$572,684
8	FY25	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.860	$562,006
9	FY26	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.844	$551,527
10	FY27	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.828	$541,244
11	FY28	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.813	$531,152
12	FY29	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.798	$521,248
13	FY30	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.783	$511,529
14	FY31	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.768	$501,991
15	FY32	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.754	$492,631
16	FY33	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.740	$483,446
17	FY34	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.726	$474,431
18	FY35	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.713	$465,585
19	FY36	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.699	$456,904
20	FY37	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.686	$448,385
21	FY38	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.674	$440,024
22	FY39	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.661	$431,820
23	FY40	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.649	$423,768
24	FY41	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.637	$415,867
25	FY42	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.625	$408,113
26	FY43	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.613	$400,503
27	FY44	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.602	$393,035
28	FY45	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.590	$385,707
29	FY46	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.579	$378,515
30	FY47	$0	$0	$0	$557,670	$95,663	$0	$653,333	0.569	$371,457
Total		$0	$0	$9,988,488	$16,917,999	$3,027,463	$0	$29,933,950		**$24,790,888**