Shaw Environmental & Infrastructure, Inc.

13 British American Boulevard
Latham, NY 12110-1405
518.783.1996
Fax 518.783.8397

Shaw The Shaw Group Inc.™

FEASIBILITY STUDY REPORT
CAMP PHARSALIA
SOUTH PLYMOUTH, NEW YORK

Shaw Project No. 830271

February 26, 2003

Prepared for:
Mr. Robert Thompson
New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233

Prepared by:
Shaw Environmental, Inc.
13 British American Boulevard
Latham, New York 12110

Written/Submitted by:
Shaw Environmental, Inc.

Tanjia Maynard
Project Manager/Geologist

Karie Henning
Project Engineer

Reviewed/Approved by:
Shaw Environmental, Inc.

STATE OF NEW YORK
HEIDE-MARIE DUDEK
079899
LICENSED PROFESSIONAL ENGINEER

Heide-Marie Dudek, P.E.
Project Engineer

2/27/03

M:/193reps/DEC/Pharsalia FS

TABLE OF CONTENTS:

TABLES:

FIGURES:

APPENDICES:

LIST OF ACRONYMS:

APEG	Alkali Polyethylene Glycolate
ARARS	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
BCF	Bioconcentration Factor
bgs	Below Ground Surface
CAA	Clean Air Act
CDD	Chlorinated Dibenzo-p-dioxin
CDF	Chlorinated Dibenzofuran
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	Chemical of Potential Concern
CWA	Clean Water Act
ECL	Environmental Conservation Law
FRTR	Federal Remediation Technologies Roundtable
FS	Feasibility Study
GAC	Granular Activated Carbon
GRA	General Response Action
HASP	Health and Safety Plan
HTTD	High Temperature Thermal Desorption
kg	Kilogram
L	Liter
LDR	Land Disposal Restriction
LPCS	Low Permeability Cover System
LTTD	Low Temperature Thermal Desorption
mg	Milligrams
NCP	National Contingency Plan
NFESC	Naval Facilities Engineering Service Center
ng	Nanogram
NYSDCS	New York State Department of Correctional Services
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCP	Pentachlorophenol
PI	Preliminary Investigation
ppb	Parts per Billion (ug/L), (ug/kg)
PPE	Personal Protective Equipment
ppm	Parts per Million (mg/L), (mg/kg)
ppt	Parts per Trillion (ng/L), (ng/kg)
PRG	Preliminary Remediation Goal
QEA	Qualitative Human Health Exposure Assessment
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
Registry	State's Registry of Inactive Hazardous Waste Disposal Sites

RfD	Reference Dose
RI	Remedial Investigation
SCG	Standards, Criteria and Guidelines
SDWA	Safe Drinking Water Act
Shaw	Shaw Environmental, Inc.
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semivolatile Organic Compound
TAGM	Technical and Administrative Guidance Memorandum
TOGS	Technical and Operational Guidance Series
ug	Micrograms
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1.0 INTRODUCTION

1.1 Purpose of the FS

Shaw Environmental, Inc. (Shaw) has prepared this Feasibility Study (FS) on behalf of the New York State Department of Environmental Conservation (NYSDEC). This FS evaluates the remedial technologies which could be applied to address the soil and groundwater impacts observed within an area on the periphery of Department of Corrections operations (Site) at Camp Pharsalia. Camp Pharsalia is a state owned crew headquarters and incarceration facility. Camp Pharsalia is located at 496 Center Road in the Town of South Plymouth, Chenango County, New York (**Figure 1**). The Site is located within the Camp Pharsalia property (**Figure 2**).

The submittal of this Feasibility Study represents the completion of activities set forth in the Remedial Investigation and Feasibility Study (RI/FS) Work Plan for the Site dated October 4, 2001 (Shaw Environmental, 2001). The conclusions and recommendations presented within this FS are based on the characterization of the site as presented in the Preliminary Investigation Report (PI) dated August 1999 (NYSDEC, 1999) and the Remedial Investigation Report (RI) dated December 20, 2002 (Shaw, 2002). The purpose of this FS is to develop and evaluate potential remedial options that reduce, to the maximum extent practicable, potential risks to human health and the environment attributable to the occurrence of regulated substances at the Site and to allow for the future development and/or continued use of the property.

1.2 Report Organization

This FS Report contains the following elements:

- **Section 1.0** introduces and describes the organization of the FS and summarizes the data generated during historic site assessment activities. These activities were carried out to characterize the nature and extent of soil and groundwater impacts (including the delineation of "source areas", residual materials and to identify potential migration pathways both on and off site). **Section 1.5** identifies chemicals of potential concern at the Site and assesses the risk to human health associated with current and future activities at the site based upon existing soil and groundwater quality data.

- **Section 2.0** identifies remedial action objectives at the Site. **Section 2.1** discusses pertinent Federal and State guidelines for site remediation while **Section 2.2** describes the specific approach to evaluating risk-based preliminary remediation goals at the Site.
- **Section 3.0** identifies and evaluates technologies that have the potential to remediate contaminants at the Site. **Section 3.2** identifies areas of the Site requiring remedial action according to media type and **Section 3.3** discusses general, media-specific actions that satisfy the remedial action objectives identified in **Section 2.2**. **Sections 3.4.1** and **3.4.2** describe specific technologies that could be used to address impacted soils and groundwater at the Site and assesses them according to technical effectiveness and implementability. Technologies that were determined to be technically effective and implementable are further evaluated with respect to effectiveness and cost in **Section 3.4.3**.
- **Section 4.0** combines the technologies retained from the previous section into remedial alternatives. **Section 4.1** describes the process options involved in each alternative and assesses them with regard to effectiveness, implementability, and cost. **Section 4.2** presents a detailed analysis of each alternative with respect to the CERCLA screening criteria: overall protection of human health and the environment; compliance with Applicable or Relevant and Appropriate Requirements (ARARs); long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; and cost.
- **Section 5.0** presents a detailed analysis of the alternatives with respect to overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; and cost.
- **Section 6.0** Provides a comparatve analysis of the alternatives retained from **Section 5.0** with respect to overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; and cost.
- **Section 7.0** provides an overview of the selected alternative, including the involved process components.
- **Section 8.0** lists references utilized in the development of this document.

1.3 Background Information

1.3.1 Site Description

Camp Pharsalia is a large complex consisting of NYSDEC crew headquarters and a New York State Department of Correctional Services (NYSDCS) active incarceration facility, located in the Town of South Plymouth, Chenango County, New York (**Figure 1**). The incarceration facility is operated by the NYSDCS, but is located on property managed by the NYSDEC. Wood treatment operations were historically conducted within the incarceration facility on an area on the periphery of Department of Correction operations.

Based on the results from the Remedial Investigation, the impacted areas identified at the Site include the treatment plant and a former outdoor staging area for treated lumber, located immediately west and northwest of the treatment plant; these areas are illustrated on **Figure 2**. The site is surrounded by New York State Forest, and is bordered by the correctional facility to the north and the east (**Figure 3**).

The area around the Site is typified by a mature and eroded plateau that is dissected by a series of valleys several hundred feet deep. This plateau has a rolling, rugged appearance. Although the region is dominated by long ridge lines and narrow valleys, the site topography is relatively flat. In addition to State Reforestation Land, the area surrounding the site is rural, used primarily for residential and agricultural purposes. Potable water is provided in the region by wells, which are often screened in bedrock.

1.3.2 Site History

Camp Pharsalia is a large complex consisting of NYSDEC crew headquarters and a NYSDCS active incarceration facility. The incarceration facility is operated by the NYSDCS but is located on property managed by the NYSDEC. One of the work activities formerly performed by the inmates at Camp Pharsalia was a sawmill and wood treatment operation. Wood treatment operations were conducted from approximately 1960 until 1977.

Based on potential health concerns raised at a similar state facility, a review of all state owned lands formerly used for wood treatment was initiated in the summer of 1997. In October 1997 the Division of Operations recommended that the NYSDEC perform an environmental investigation at Camp Pharsalia. As a result of that request, the NYSDEC Division of Remediation initiated a preliminary site investigation. In May of 1998 the NYSDEC finalized a work plan for the Preliminary Investigation of the Camp Pharsalia site. The Preliminary Investigation was planned in response to reports of pentachlorphenol (PCP) use as part of the wood treatment operation that was conducted at the site. The objective of the Preliminary Investigation was to determine whether hazardous waste was disposed at the site and evaluate the extent of that contamination, if existing. The Preliminary Investigation was initiated in May 1998; the final *Preliminary Investigation Report* was issued by the NYSDEC in August 1999.

Based on the findings of the Preliminary Investigation (PI), it was concluded that the Site should be added to the State's Registry of Inactive Hazardous Waste Disposal Sites (Registry). In December of 1999, the site was listed on the Registry as a Class 3 Site, meaning that hazardous waste is present, but that it does not currently constitute a significant threat to public health and/or the environment. Also, based on the findings of the Preliminary Investigation, it was concluded that further investigation was warranted in the area of the treatment plant. A Remedial Investigation was conducted by Shaw Environmental, Inc. The results of the PI and subsequent RI are summarized below in **Section 1.4.**

1.4 Summary of Investigations

1.4.1 Historical Site Assessments/Investigations

As discussed in **Section 1.3.2**, the NYSDEC conducted a Preliminary Investigation at the Site. The results of the Preliminary Investigation Report (NYSDEC, 1999) are summarized below:

- No site-related analytes were detected in any of the three water supply wells on site.
- No PCP (and therefore dioxin based on the co-existance of the analytes), was detected in the surface and subsurface soil beneath or around the former treated lumber storage areas. These areas were eliminated as areas of concern based on these results.
- Four out of five surface soil samples collected west of the treatment plant contained PCP above screening levels (1 ppm) for the protection of groundwater.
- Subsurface soils beneath and around the treatment plant contained PCP and dioxin concentrations in excess of respective soil screening levels (1 ppm and 1 ppb, respectively).
- No site-related specific analytes were detected in the sediments of drainage swale that runs from the treatment plant offsite to the west.
- Sheen and odors were present in the monitoring wells during the groundwater sampling event conducted during the Preliminary Investigation although the corresponding analytical results were non-detect for volatiles and semivolatiles. Dioxin was detected in four out of five of the monitoring wells in excess of the 2, 3, 7, 8-TCDD equivalence groundwater standard of 0.0007 parts per trillion (ppt).
- The results of the Preliminary Investigation Report identified the treatment plant and surrounding area as areas requiring further contaminant delineation.

As discussed in **Section 1.3.2**, Shaw conducted a Remedial Investigation at the Site.

Shaw prepared a Remedial Investigation and Feasibility Study (RI/FS) Work Plan dated October 4, 2001 and conducted the associated field activities between October 2001 and January 2002. Additional assessment activities were conducted between October 2002 and November 2002. This Remedial Investigation was required to collect sufficient data to further characterize site conditions, identify, and determine the lateral and vertical distribution of the Contaminants of Potential Concern (COPCs), accurately evaluate the potential risk to human health and/or the environment, and to determine the potential need for remedial action. Data collected during the Remedial Investigation were detailed in the Remedial Investigation Report (2002, Shaw) and are summarized below:

- Overburden at the site consists of brown top soil underlain by glacial lodgement till interspersed with sand lenses.
- Depth to groundwater ranges from approximately three (3) to six (6) feet below ground surface (bgs).
- Groundwater appears to flow regionally in a northwesterly direction.
- Recharge of the water table is likely provided by precipitation infiltrating areas of the site.
- PCP and dioxins were detected in surface and subsurface soil samples above the soil screening levels west of and adjacent to the treatment plant.
- Groundwater exhibited sheen and odor while sampling although the corresponding analytical results were non-detect for semivolatiles. Diesel Range organics were detected in PMW-3, PMW-5 and PMW-6A
- Dioxins were not detected in any of the monitoring wells above the 2,3,7,8-TCDD equivalence in the November 2002 sampling event.

From the data collected during the PI and the RI, the impacted areas on site include; the area west and adjacent to the treatment plant as well as the area beneath the treatment plant. Sampling locations are depicted on **Figure 4**.

1.4.2 Geology and Hydrogeology

Regional Geology

The Northern part of Chenango County is located on a plateau known as the Appalachian Uplands. The plateau is mature and eroded, and is dissected by a series of valleys that are several hundred feet deep. The major valleys on the plateau have a north-south orientation. The high plateau is characterized by large, rounded, bedrock controlled hills and ridges with nearly level hilltops at a similar elevation reflecting the nearly horizontal character of the underlying bedrock. Because of stream dissection and deepening of valleys by glacial scour, the plateau uplands have a rugged, rolling appearance. The rounded shoulders of the hills and steep lower valley sides are also indications of glacial modification.

Regional bedrock consists of an Upper Devonian Formation, which includes Tully Limestone, Ithaca Siltstone and Sandstone and Geneseo Shales. The bedrock lies nearly flat, exhibiting a slight regional dip to the south of about 50 feet per mile.

Site Specific Geology

Observations of the site specific subsurface conditions were made during the Preliminary and Remedial Investigations. In general, the upper four feet of overburden consists of brown topsoil with gravel, sand fill with gravel and cobbles or silty clay with gravel and shale fragments. This surface layer is likely fill material placed as a base for buildings and staging treated and untreated lumber. Beneath the fill is glacial lodgement till consisting of clay, sand, silt, and shale cobbles and boulders with clay and sand lenses. The till varies in color including gray, tan, red-brown, and brown. The lodgement till continues to depths of at least 30 feet (which was the vertical extent of both investigations). The till is very dense, as evidenced by the very difficult drilling conditions and high blow counts encountered during monitoring well installations. Observations made during drilling and review of boring logs confirms that the upper 13 feet of the till unit contains numerous discontinuous lenses of more permeable sands and fine gravel that may or may not be interconnected.

A drinking water well (Well #1) was installed in 1981. This well is located approximately 250 feet northeast of the treatment plant and was completed to a total depth of 300 bgs. Soft shale bedrock was encountered at approximately 134 feet bgs. Clay seams were present between 107 feet and 134 feet bgs. Soft gray sandstone with clay lenses was present from approximately 134 to 140 feet bgs. From 140 to 300 feet the bedrock consisted of a gray shale unit interbedded with thin layers of gray sandstone.

Two (2) other drinking water wells also exist on site. Well #2 is located approximately 210 feet north-northeast of the treatment plant and Well #3 is located approximately 700-1000 feet north-northeast of the treatment plant. Well #3 was installed after June 2001. All three wells are located at the correctional facility.

Regional Hydrogeology

Camp Pharsalia is located approximately 1 mile east of Brakel Creek which is presumed to be the nearest discharge zone for Deer Pond. Regionally, groundwater would be anticipated to flow toward Brakel Creek, which eventually discharges into the Otselic River. Shallow groundwater in the area of the site is typically found in coarser grained glacially derived sediments or as perched water over deposits of fine grained sediments of lower permeability.

Site Specific Hydrogeology

Depth to groundwater was observed between approximately three (3) and six (6) feet bgs across the site. Based on groundwater elevations and evaluation of topographic maps, groundwater flow appears to flow in a north-northwesterly direction.

Recharge of the water table is likely provided by precipitation infiltrating areas of the property. Shallow groundwater likely exists as isolated "perched pockets" in permeable sandy lenses found within the till. Precipitation accumulates in these pockets and likely slowly disperses into the regional groundwater flow regime.

Groundwater recovery rates during the sampling event indicate that the hydraulic conductivity for the till unit is relatively low.

1.4.3 Nature and Extent of Soil Contamination

Surface Soil

A total of five (5) surface soils were collected during the PI in the area west of the treatment plant. These soils were analyzed for PCP only. A total of nine (9) surface soils samples were collected during the RI and were sent to the contract laboratory for analysis of SVOCs, dioxins, and metals. The results of both investigations are included as **Table 1** and **Figure 5**.

PCP was detected in eight (PSS-1, PSS-2, PSS-3, PSS-5, SS-5, SS-6, SS-8 and SS-9) out of the fourteen surface soil samples above TAGM 4046 guidance value of 1.0 ppm. PCP was the only analyte that exceeded TAGM 4046 guidance values. All eight areas were located on the west side of the treatment plant. Concentrations of PCP ranged from 1.0 mg/kg (ppm) in SS-8 to 550 mg/kg (ppm) in PSS-1 (**Figure 5**).

PCP was also detected in SS-7 (0.096 mg/kg (ppm)) and PSS-4 (0.74 mg/kg (ppm)) in the area west of the treatment plant at levels below the TAGM 4046 guidance value. PCP was not detected in any of the other surface samples collected. One potential explanation of the differences in concentrations from this Remedial Investigation and the Preliminary Investigation of PCP in surface soils is that PCP will readily break down by photochemical processes when exposed to the ultraviolet radiation in sunlight (e.g., concentrations decreased over time due to exposure to sunlight).

Other SVOCs were randomly detected in five (5) of the nine (9) samples collected ranging in concentrations from 0.096 mg/kg (ppm) to 271.87 mg/kg (ppm) total SVOCs. None of the locations exhibited total SVOC concentrations in excess of the TAGM 4046 guidance value of 500 mg/kg (ppm).

Surface soil sample SS-5 possessed the highest concentrations of total SVOCs and PSS-1 possessed the highest concentration of PCP. These samples were collected from the western side of the treatment plant.

All surface soil samples collected were sent to the laboratory for analysis of metals. Background samples were collected at Camp Georgetown due to the proximity of the two sites and in accordance with the approved work plan. The background sample data collected from Camp Georgetown was averaged and the resulting averages were used to compare to the surface soil data collected at the Camp Pharsalia site. Zinc, nickel, iron, chromium and beryllium were detected above guidance values in all nine samples. These metals are not related to the treatment process and likely represent natural soil concentrations. Arsenic was detected slightly above background averages in SS-1, SS-3, SS-6 and SS-7. These low concentrations most likely represent natural soil concentrations.

In addition, all nine (9) samples were sent for the analysis of dioxins. Although dioxins and furans were detected in all the samples, only four (4) samples (SS-5, SS-6, SS-8 and SS-9) possessed 2,3,7,8-TCDD equivalence of above the 1.0 ug/kg (ppb) guidance value. This is consistent with the elevated concentrations of PCP detected in these locations.

Subsurface Soil

A total of 36 subsurface soil samples (soil borings and test pits) were collected from the area beneath and around the treatment plant during the PI and the RI. These samples were sent for laboratory analysis of SVOCs and dioxins. The results are summarized on **Table 2** and **Figure 6**.

PCP was detected above the 1.0 ppm TAGM 4046 guidance value in PB-1, PB-2, PB-3 and PB-4 at concentrations ranging from 82 mg/kg (ppm) to 330 mg/kg (ppm). All four of the samples were from the 0-4 foot interval and were collected from beneath the slab of the treatment plant.

PCP was detected in PTP-9 above the 1.0 ppm TAGM 4046 guidance value. PTP-9 is located west of the treatment plant. PCP was detected below the TAGM 4046 guidance value in test pits PTP-2, PTP-5, PTP-7 and PTP-8. The test pit results are summarized in **Table 2** and **Figure 6**.

No other exceedences for PCP were detected in any of the other soil samples collected. Other subsurface soil samples exhibited random SVOCs; however, no analytes were detected above TAGM 4046 guidance values for total SVOCs or individual analytes. Concentrations ranged from 0.125 mg/kg (ppm) to 1.412 mg/kg (ppm) total SVOCs.

PB-2, PB-3 and PB-4 exceeded the 2,3,7,8-TCDD equivalence of 1.0 ppb screening level. All three samples were collected from the 0-4' interval beneath the slab of the treatment plant. The occurrence of dioxins correlates with the high concentrations of PCP found in the same locations.

None of the other subsurface soil samples collected exceeded the 2,3,7,8-TCDD equivalence greater than the 1.0 ug/kg (ppb) screening level. The equivalence concentrations ranged from 0.0000856 ug/kg (ppb) (SB-4 6-8 feet) to 0.002183 ug/kg (ppb) (SS-2 10-12 feet).

1.4.4 Nature and Extent of Groundwater Contamination

Three (3) rounds of groundwater sample collection have been completed on site. The first round was conducted by the NYSDEC during the PI. Samples collected from the monitoring wells were analyzed for VOCs, SVOCs, metals and dioxins. During this sampling event, no VOCs or SVOCs, including PCP, were detected above TOGS 1.1.1 guidance values. The results from all three sampling events are included as **Table 3 and Figure 7**.

Several metals were detected above TOGS 1.1.1 guidance values including arsenic, aluminum, manganese, sodium and thallium. However, these impacts likely represent natural concentrations since these metals are not related to the wood treatment process.

The TOGS 1.1.1 2,3,7,8-TCDD equivalence guidance value of 0.0007 ng/L (ppt) was exceeded in PMW-1, PMW-2, PMW-4 and PMW-5. Dioxins were not analyzed in PMW-3. PMW-5 possessed the highest 2,3,7,8-TCDD equivalence concentration of 0.19 ng/L.

Shaw collected groundwater samples on December 6, 2001 during the second sampling event. Samples from the monitoring wells were sent for laboratory analysis of SVOCs, PCB/Pesticides and fuel oil. Samples were not analyzed for dioxins. The results of the 2001 sampling event are summarized on **Table 4** and **Figure 7**.

Fuel oil components, including diesel, were detected in PMW-1 at an estimated concentration of 1100 J ug/l. PMW-1 is located southeast of the treatment plant.

Several SVOCs were detected in PMW-1, PMW-3 and PMW-5. None of the analytes detected were above TOGS 1.1.1 groundwater standards. No PCP was detected in any of the monitoring wells.

Heptaclor epoxide was detected above TOGS 1.1.1 guidance values of 0.03 ug/l in PWM-4 at 0.11 ug/l. PMW-4 is located west of the treatment plant.

The third groundwater sampling event was conducted in November 2002. Groundwater samples collected were analyzed for SVOCs, dioxins and fuel oil via Method 310-13, respectively. This method for fuel oil was used to attain lower laboratory method detection limits. The results of the 2002 sampling event are summarized on **Table 5** and **Figure 7**.

At the request of the NYSDEC additional samples were also collected from PMW-5 and PMW-6A and were filtered with an 0.45 micron in-line filter. The filtered samples were analyzed for SVOCs, dioxins and fuel oil in an effort to determine if elevated contaminant concentrations could be attributed to suspended sediments or turbid water at the time of sample collection.

Diesel range organics were detected in PMW-3, (340 ug/L) PMW-5 filtered (290J ug/L), PMW-6A (140J ug/L) and PMW-6A filtered (190J ug/L).

Naphthalene was detected below TOGS 1.1.1 in PMW-1 (0.5J ug/L) and bis(2-ethylhexyl)phthalate was detected in all monitoring wells as well as the associated laboratory blanks. The presence of the bis(2-ethylhexyl)phthalate in the laboratory blanks suggests that it is a laboratory contaminant and does not actually exist at the site.

Dioxins were not detected in any of the on site monitoring wells above the 2,3,7,8-TCDD equivalence screening level of 0.0007 ng/L. Dioxins were present at very low levels in all monitoring wells except PMW-3 and PMW-6A filtered.

Filtering of the samples from PMW-5 and PMW-6A dropped dioxin congener concentrations slightly but more data would be necessary to definitively conclude a direct correlation between contaminant concentration and suspended sediments in water. The results of the November 2002 sampling event are summarized on **Table 5**.

While there are minimal groundwater impacts on site, groundwater monitoring as discussed in **Section 4.2** is justified.

1.5 Summary of Qualitative Human Health Exposure Assessment

The Qualitative Human Health Exposure Assessment (QEA) (Shaw, 2002) was used to determine the current and potential future exposure pathways associated with baseline (that is, current or unremediated) site conditions **(Appendix A**). The QEA identified chemicals of potential concern (COPCs) and complete exposure pathways (mechanisms by which receptors may come into contact with site-related contaminants). The risk to receptors via complete pathways were then assessed based on comparison to screening levels in the context of current and reasonably foreseeable site exposures. The role of completed, ongoing and proposed remedial activities at the site in mitigating exposures was addressed where appropriate. The QEA used data from the PI (NYSDEC, 1999) and the RI (Shaw, 2002).

The QEA process was derived from the guidance set forth in the United States Environmental Protection Agency's Risk Assessment Guidance for Superfund (RAGS; 1989, 1991).

1.5.1 Chemicals of Potential Concern

The following media were addressed during investigative activities: surface soils (0-1 foot below grade), subsurface soils and groundwater. Samples were collected for each medium and laboratory analysis was performed to determine chemicals present in the samples during site assessment activities (Shaw, 2001-2002). Chemicals present in the samples were compared to NYSDEC TAGM and NYSDEC Ambient Groundwater Quality Standards values to determine COPCs. The following substances were identified as COPCs:

- Dioxin
- Pentachlorophenol (PCP)
- Fuel Oil

Table 6 lists each COPC and identifies the maximum concentration of each chemical detected at the Site.

PCP and dioxin are considered to pose the biggest risk to human health and the environment. The constituents of fuel oil are relatively stable, immobile, and pose little risk to human health and the environment.

1.5.2 Exposure Assessment

An exposure assessment is defined as the measurement or estimation of the amount or concentration of a chemical(s) coming into contact with the body at potential sites of entry. The objectives of an exposure assessment are to:

- Identify a contaminant source;
  Specify a mechanism for release, retention, or transport within a given medium;
- Identify a point of human contact with the medium (i.e. exposure point);
  Identify a plausible receptor and route of exposure at the exposure point; and
- Estimate the magnitude, duration, and frequency of exposure.

Contaminant Sources

One of the work projects at Camp Pharsalia was the operation of a wood treatment facility and sawmill, which operated between 1960 and 1977. During this time, pentachlorophenol (PCP) was the primary chemical biocide used in treating lumber at the site. During the treatment process, PCP and No. 2 fuel oil were combined in the dip tanks. After treatment, poles were hoisted from the tank and allowed to drip over the tank for a period of time. Poles were then moved outside of the western end of the treatment plant and allowed to dry. They were then moved to a designated treated material storage area, located south of the treatment plant. The sources of release to the environment are historical surficial spills of wood treatment products (PCP and fuel oil) to soil, based upon this treatment process.

Release Mechanisms

The probable release mechanism(s) for the chemicals to soil include deposition onto surface soil and infiltration and percolation through the soil into the subsurface soil and groundwater. Hence, the principal on-site media impacted by the historic wood treatment operations are surface and subsurface soils.

Fate and Transport

Contaminant release and transport mechanisms may carry contaminants from the source to points where individuals may be exposed. Chemical migration between media such as soil and groundwater is influenced by chemical parameters such as water solubility or molecular size or shape, in addition to the chemical and physical characteristics particular to a site's media. This section discusses information about the fate and transport of the source chemicals present at the site.

Pentachlorophenol and Dioxin

Pentachlorophenol is a moderately acidic substance, and thus its fate is strongly influenced by pH. At a neutral pH it is almost completely found in the ionized form, the pentachlorophenate anion, which is much more mobile than PCP (ATSDR, 2000). PCP has a low water solubility and a strong tendency to adsorb onto soil or sediment particles in the environment. Adsorption to soils and sediments is dependent on pH and organic content. Adsorption at a given pH increases with increasing organic content of soil or sediment. No adsorption occurs at pH values above 6.8 (ATSDR, 2000; Howard, 1991). Since it is expected that soils at the site are acidic (less than 7.0) based on soil type (no pH data is available) and soils are low in organic content (TOC is 0.0439% in SB-11 (8-10')) some adsorption is likely to occur.

The ionized form of pentachlorophenol may be rapidly photolyzed by sunlight; PCP may also undergo biodegradation by microorganisms, animals, and plants, although degradation is generally slow (Howard, 1991). Given that at expected pH conditions a portion of PCP will be present in the ionized form, photolysis may be an important degradation pathway at this site in shallow soils.

PCP has an octanol-water partition coefficient (K_{ow}) of 100,000 (Howard, 1991), which indicates that it is lipid-soluble and therefore has a tendency to bioaccumulate in organisms. Bioaccumulation is largely pH-dependent, with considerable variation among species. Bioconcentration factors (BCFs) for PCP in aquatic organisms are generally under 1,000, but some studies have reported BCFs up to 10,000. BCFs, however, for earthworms in soil were 3.4-13 (ATSDR, 2000). Significant biomagnification of PCP in either terrestrial or aquatic foodchains, however, has not been demonstrated (ATSDR, 2000).

Pentachlorophenol products often contain chlorophenols, dioxins, and furans which may also be formed through the degradation of PCP. Once released to the environment, chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs) are persistent and generally adsorb to soil or sediment particles due to their low water solubilities. Adsorption is generally the predominate fate process affecting these chemicals, with the potential for adsorption related to the organic carbon content. CDDs and CDFs may undergo degradation through biological action or by photolysis, with a half-life ranging from weeks to months. Photolysis and hydrolysis are generally not significant processes, however, these compounds persist in the adsorbed phase (USEPA, 2002).

Due to their high adsorption rate, CDDs are not expected to leach from soil, although some leaching of disassociated forms of the compound may occur, especially at lower pHs (USEPA, 2002). Since the pH of site soils are not known but are not expected to be highly acidic, leaching of CDDs and CDFs is unlikely. Migration of CDD-contaminated soil may occur through erosion and surface runoff. Upon reaching surface waters, additional adsorption may occur due to the typically higher levels of organic matter content of sediments as compared to surface soils (ATSDR 2000). Volatilization from either subsurface soil or water is not expected to be a major transport pathway, although it may occur from surface soils (ATSDR, 2000). As with PCP and other lipophilic pesticides, CDDs and CDFs tend to bioaccumulate in exposed organisms, with BCFs for aquatic organisms ranging from 5,000 to 10,000 (Montgomery, 1996). Uptake from soil by plants can occur, although it is limited by the strong adsorption of these compounds to soils. BCFs in plants have been measured to be 0.0002, with most accumulation occurring in the roots with little translocated to the foliage (ATSDR, 2000). Terrestrial organisms may accumulate CDDs and CDFs as a result of direct ingestion and contact with soils.

At the Pharsalia site, PCP is expected to be adsorbed to soil organic matter content, although leaching is expected due to the expected pH (slightly acidic) and low organic matter content in site soils. Some photolysis of PCP from surface soils can be expected. Uptake of PCP from soil by plants or terrestrial organisms may occur, but biomagnification is not expected. CDDs and CDFs are expected to be strongly sorbed to soil, as well as persistent. Leaching of these compounds is likely to be limited. Accumulation of these compounds in plants as a result of root uptake is unlikely to be significant, although absorption of CDDs and CDFs deposited on leaves as a result of windborne migration may occur. Accumulation in terrestrial organisms may occur as a result of soil ingestion.

<u>Fuel Oil</u>

At the site, PCP was mixed with No. 2 fuel oil for wood treatment application. Fuel oils are mixtures of numerous aliphatic and aromatic hydrocarbons. Individual components of fuel oil include n-alkanes, branched alkanes, benzene and alkylbenzenes, naphthalenes, and polycyclic aromatic hydrocarbons (PAHs) (ATSDR, 2000). Primary constituents identified in soil and/or groundwater at the site are PAHs. Soil adsorption, volatilization to air, and leaching potential depend on a PAH's individual chemical characteristics; however, as a class of compounds, they are generally insoluble in water, with a strong tendency to bind to soil or sediment particles. Some of the lighter-weight PAHs (such as naphthalene, acenaphthene, and phenanthrene) may volatilize from soil or groundwater into the air. Degradation may occur through photolysis, oxidation, biological action, and other mechanisms. Microbial degradation appears to be a major degradation pathway in soil (ATSDR, 2000).

As nonpolar, organic compounds, PAHs may be accumulated in aquatic organisms from water, soil, sediments, and food. BCFs vary among PAHs and receptor species, but in general, bioconcentration is greater for the higher molecular weight compounds than for the lower molecular weight compounds (ATSDR, 2000). BCFs for accumulation of PAHs by plants from soil are low, with values of 0.001 to 0.18 reported for total PAHs (ATSDR, 2000). Accumulation of PAHs from soil by terrestrial organisms is also limited, with BCF values for voles of 12 reported for phenanthrene and 31 for acenapthene.

At this Site, PAHs, the primary fuel oil constituents of interest, are expected to be adsorbed to soil, with limited potential for leaching. Microbial degradation may occur, with other degradation processes less important in soil. Uptake of PAHs from soil by terrestrial organisms or plants may occur, but bioconcentration is expected to be limited.

Exposure Points

The impacted surface soils currently act as potential exposure points because they may be contacted directly. It is possible for chemical constituents in subsurface soil to be excavated and redistributed onto the surface to become mixed with surface soil. Excavation activities may also cause the generation of dust and the volatilization of chemical constituents from soil and groundwater, resulting in air being considered a secondarily impacted medium.

Routes of Exposure

Routes for exposure to chemical constituents include ingestion and absorption through direct contact with the soil and groundwater and inhalation of dust and vapors under existing and future site conditions (assuming that no remediation is completed).

Potential Receptors

Current land use at Camp Pharsalia and the immediate vicinity is institutional (prison), commercial, and wooded area. Soil and vegetation cover the majority of the site, but a portion is covered with asphalt, concrete, and other impervious structures. The property is expected to remain an incarceration facility in the future and impacted soils will be removed, capped, or covered, eliminating the risk of potential receptors coming into contact with the impacted soils.

Potential exposure pathways and receptors were evaluated for both current use/current site conditions as well as hypothetical future use/future site conditions. The mixing of surface and subsurface soils were evaluated for future receptors to account for potential excavation and redistribution of soils that may occur during redevelopment. Current receptors include adult inmates, facility personnel, authorized visitors, industrial/commercial workers and wildlife;

potential future receptors include adult inmates, facility personnel, authorized visitors, industrial/commercial workers, construction workers, and wildlife.

- Adult Inmates/Facility Personnel/Authorized Visitors: These receptors may be exposed to surface soils (provided that they are not capped or covered). Incidental ingestion of soil, dermal contact, inhalation of fugitive dust from soil, and inhalation of volatiles from soil and/or groundwater were identified as potential pathways for exposure to be considered provided that a direct exposure pathway remains to surface soils.

- Industrial/Commercial Workers (Authorized Visitors and Facility Personnel): Workers are defined as individuals that are employed at an industrial commercial facility and have unlimited access to media at the Site. These workers include employees of Camp Pharsalia (facility personnel) and workers contracted by Camp Pharsalia (authorized visitors). Workers are assumed to be exposed daily (5-day workweek) to site media.

  Industrial/commercial workers represent the most likely receptors. These receptors may be exposed to surface and subsurface soils as well as groundwater if below grade construction activities occur at the site in the area of the impacted soils. Incidental ingestion of soil and/or groundwater, dermal contact, and inhalation of fugitive dust from soil were identified as potential pathways for exposure to be considered. Inhalation of volatiles from soil and/or groundwater were identified as potential pathways for exposure to be considered if they work below ground surface (i.e. in a basement).

- Construction Workers: In addition to the workers described above, hypothetical construction workers may also be exposed to media in the future. The difference between industrial/commercial workers and construction workers is that construction workers have the potential to be more highly exposed than other workers do, but over a shorter period of time (i.e. the duration of construction activity). However, they will be informed of the risks and would be required to use pertinent health and safety protocols for below grade excavation and earthwork activities.

  Construction workers are also likely receptors. These receptors may be exposed to surface and subsurface soils as well as groundwater. Incidental ingestion of soil and/or groundwater, dermal contact, inhalation of fugitive dust from soil, and inhalation of volatiles from soil and/or groundwater were identified as potential pathways for exposure to be considered.

- Wildlife: The perimeter of Camp Pharsalia is fenced; however, it is possible that wildlife may obtain access to the property through openings in the fence. These receptors may be exposed to surface soils (provided that they are not capped or covered). Incidental ingestion of soil, dermal contact, inhalation of fugitive dust from soil, and inhalation of volatiles from soil and/or groundwater were identified as potential pathways for exposure to be considered provided that a direct exposure pathway remains to surface soils.

  There is some potential for the uptake of site contaminants by terrestrial organisms that may then be consumed as game species. Terrestrial game likely to be hunted in this area would include species such as white-tailed deer and turkey. Both species consume vegetation; additionally, turkeys are opportunistic feeders that will also include invertebrates to their diet. Uptake by plants from soil is not expected to result in significant bioaccumulation in plants. In addition, the area of impact is small relative to the expected home range of these two species. White-tailed deer have a home range of 120 to 400 acres (Burnett et al. 2002), while turkey can have a home range of 1000 acres or more (North Caroline State University 1995). Any contribution of site-related contaminants to the body burden of these species is, therefore, expected to be insignificant.

2.0 IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES

The purpose of this FS is to evaluate and focus upon remedial response actions that may be applicable for the reduction of potential future risks to human health and the environment at the Site. Remedial Action Objectives (RAOs) are goals developed to protect human health and the environment. This section of the FS describes the development of RAOs for impacted media identified during recent site assessment activities (2001-2002, Shaw), and how the RAOs will be used to evaluate potentially applicable remedial alternatives within this FS. The general requirements for this work are described in relevant guidance, including the NYSDEC TAGM 4030 (NYSDEC, 1990) and USEPA (USEPA, 1988) guidance for developing remedial actions.

RAOs consist of medium-specific (i.e., soil, groundwater, etc.) goals for protecting human health and the environment (USEPA, 1988). The process of developing RAOs includes the identification of:

- COPCs at Camp Pharsalia;
- Exposure routes and receptors of potential concern;
- Qualitative and quantitative goals for COPC cleanup in each medium that may require treatment.

The COPCs, exposure routes, and receptors of potential concern were discussed in **Sections 1.5.2.1** and **1.5.2.2** of this report.

2.1 Applicable or Relevant and Appropriate Requirements

Regulations and guidance for New York State's Inactive Hazardous Waste Disposal Site Remedial Program, 6 NYCRR Part 375 (NYSDEC, 1992) were promulgated to promote the orderly and efficient administration of Article 27, Title 13 of the Environmental Conservation Law (ECL). The scope, nature, and content of an inactive hazardous waste site remedial program performed in accordance with this statute are to be determined on a site-specific basis. Specifically, Part 375 pertains to the development and implementation of remedial programs under authority of ECL Article 27. Subpart 375-1.10(c)(1) states that “due consideration” must be given to "standards, criteria and guidelines" (SCGs) when evaluating remedial alternatives for Class 3 inactive hazardous waste disposal sites. The regulation states that such "consideration" should be given to guidance "determined, after the exercise of engineering judgment, to be applicable on a case-specific basis" (6 NYCRR 375.1-10(c)(1)(ii)).

These SCGs include both New York State's criteria applicable to cleanup of contaminated media and federal ARARs that may be more stringent than the State's criteria. As part of this FS, SCGs were evaluated for Site applicability to develop the medium-specific RAOs. SCGs may be chemical-specific, location-specific, or action-specific. Chemical-specific SCGs were evaluated to establish appropriate action levels for impacted site media (e.g., soil standards). Action-specific SCGs were evaluated to establish acceptable standards for the management of impacted media (e.g., minimum technology standards for treatment of specific wastes such as stormwater and erosion control during construction). Location-specific SCGs were evaluated to establish acceptable actions with respect to location and/or the presence of specific Site conditions (e.g., protection of waters). A complete list of SCGs and ARARs identified for the surface soils, subsurface soils and groundwater is presented in **Table 7**.

The New York State SCGs and federal ARARs that were considered during the development of this FS include:

- Federal Resource Conservation and Recovery Act (RCRA) requirements apply to soil, groundwater, or other material removed from Camp Pharsalia that is categorized as hazardous. These materials may be subject to all RCRA standards including the 40 CFR 268 land disposal regulations. All RCRA wastes would be disposed at RCRA-permitted facilities where land disposal restrictions would apply. RCRA is not applicable for determining remedial action levels.
- The Clean Air Act (CAA) regulates air emissions of certain hazardous air pollutants. The CAA would not be applicable during site remediation unless treatment technologies creating air emissions are used. Any future particulate or volatile emissions from the Site would be controlled by risk-based standards, which are more protective than CAA standards. As a result, CAA standards would be fully addressed by the more stringent risk-based standards.
- The Clean Water Act (CWA) regulates the discharge of pollutants into the waters of the United States. No discharges will be made directly to any body of water or to the ground surface at the Site.

  The Safe Drinking Water Act (SDWA) was created to protect the quality of drinking water in the United States. This law focuses on all waters actually or potentially designed for drinking use, whether from above ground or underground sources. Water will not be discharged directly to any potable water source or to the ground surface. Camp Pharsalia is an active incarceration facility that uses an unimpacted bedrock aquifer as a public potable water supply.
- The New York State standards for groundwater quality promulgated under 6NYCRR Part 703 and set forth in NYSDEC guidance (e.g. TOGS 1.1.1) were considered.

- The primary guidance for soil cleanup values under Part 375 remedial actions is derived in the Technical and Administrative Guidance Memorandum on Determination of Soil Cleanup Objectives and Cleanup Levels HWR-94-4046, commonly referred to as TAGM 4046 (NYSDEC 1994). This guidance provides a basis for determining generic soil cleanup values that essentially ensures that all significant threats to human health and/or the environment posed by an inactive hazardous waste site are eliminated. For organic contaminants, the recommendation for an appropriate cleanup objective is based on the following criteria:
  - Health-based levels that correspond to excess lifetime cancer risks of 1 in 1 million for Class A and B carcinogens, or 1 in 100,000 for Class C carcinogens.
  - Human health-based levels for systemic toxicants, calculated from RfDs.
  - Environmental concentrations protective of groundwater/drinking water quality.

The generic guidance values listed in TAGM 4046 were used in screening the COPCs for each media and were used in the development of remedial actions, as required by the NYSDEC.

- New York State effluent standards for discharge to groundwater would apply to potential discharges. Potential discharges may arise from the dewatering process used to treat the excavated soil and the decontamination process.

  New York State solid waste regulations guide the disposal of newly generated solid waste (6NYCRR Part 360). Each solid waste landfill will have specific acceptance criteria for individual chemical constituents.

  New York State air emission guidelines would not be applicable unless treatment technologies creating air emissions are used. Applicable guidance for short-term emissions during construction activities is contained in TAGM-4031.

The quantitative criteria retained from the review of SCGs for the COPCs identified in each medium at the Site are discussed in the following section.

2.2 Remedial Action Objectives

As described in **Section 1.5** of this FS, the Qualitative Exposure Assessment (2002, Shaw) evaluated human health risks from potential on-site exposures to COPCs under current conditions and hypothetical future land-use scenarios. According to USEPA (1988) guidance, RAOs for protecting human receptors should express a remediation goal for COPCs in association with an exposure route (e.g. soil, groundwater, etc.), because protection may be achieved by reducing exposure (such as capping an area or limiting access,) as well as by reducing COPC levels. The COPCs identified at the Site in the RI and QEA are discussed in **Section 1.5.1**. The concentrations and spatial distribution of COPCs across the Site were also evaluated in the context of potentially complete exposure pathways associated with current land-use during the QEA. The potentially complete exposure pathways and potential receptors for these land uses are discussed in **Section 1.5.2**.

This section summarizes the qualitative and quantitative RAOs developed for the Site by medium. The criteria discussed in **Section 2.0** of this FS (SCGs and ARARs) are presented in this section relative to each impacted medium and relevant exposure pathway. According to USEPA guidance, RAOs are required to specify:

- The contaminants of concern;
- The media of concern;

  Exposure routes and receptors;

  The acceptable contaminant levels for each exposure route (i.e., a preliminary remediation goal (PRG)).

These stipulations have been provided to address protection of human health that may be achieved through exposure reductions. Exposure reduction may be achieved through barriers to contact and/or institutional controls, or by removal actions and/or treatment. NYSDEC's regulations state that the goal of the remedial program for a specific site is "to restore that site to pre-disposal conditions, to the extent feasible and authorized by law" (6 NYCRR § 375.1-10(b)). At a minimum, the remedy must "eliminate or mitigate all significant threats" to human health or the environment through the "proper application of scientific and engineering principles."

In accordance with USEPA (1988) guidance, RAOs were developed for each medium and potential exposure route. Surface and subsurface soils were the areas identified as requiring remedial action in this FS. Qualitative and quantitative RAOs are summarized in **Tables 8** and **9** and are discused in **Sections 2.2.1** through **2.2.4**. In the ensuing sections of this FS, each alternative will be evaluated relative to its effectiveness in achieving these goals by either limiting exposures to media containing COPCs exceeding these numeric criteria or by removal of and treatment or off-site disposal of the media.

2.2.1 *Soils*

Surface Soils

Analytical results from samples collected across the site indicate that contaminants have been identified in surface soils (0-2 inches bgs) northwest of the treatment plant.

Pentachlorophenol was detected at concentrations greater than the guidance value at SS-5 through SS-9 at concentrations up to 270 mg/kg. Previous investigations showed that soil samples under the building detected PCP up to 330 mg/kg based on immunoassay analysis. Other semi-volatile organic compounds (including PAHs and phthalate esters) were only detected infrequently at estimated concentrations below the reporting limit. Pyrene, however, was detected at concentrations above the reporting limit at SS-5 and SS-6. Polychlorinated dioxins and furans were detected at all surface soil sampling locations, with the highest concentrations at SS-5 and SS-6, the same locations where the highest concentrations of PCP were detected. Metals were detected at all sampling locations, however, concentrations were generally less than or similar to background concentrations in New York State or the eastern United States (NYDEC, 1994). Lead, however, was detected at a concentration of 145 mg/kg at SS-9. This metal is not known to be related to wood treatment activities.

The quantitative remedial action objectives for surface soils are given in **Table 8**. The qualitative remedial action objectives for surface soils include:

- Minimize recharge and surface water flow into the soils and
- Eliminate incidental ingestion of or direct contact with soils impacted with elevated COPC concentrations.

Subsurface Soils

Subsurface soil samples also showed infrequent detection of SVOCs at, for the most part, estimated concentrations below the reporting limit. PCP was not detected in subsurface soils during the RI however, the PI supports that elevated levels of PCP exist in the subsurface. Polychlorinated dioxins and furans were detected beneath the treatment plant during the PI in PB-1, PB-2, PB-3, PB-4 and PTP-9.

The quantitative remedial action objectives for subsurface soils are given in **Table 8**. The qualitative remedial action objectives for subsurface soils include:

- Minimize recharge and surface water flow into the soils and

- Eliminate incidental ingestion of or direct contact with soils impacted with elevated COPC concentrations.

2.2.2 Groundwater

Remedial action for groundwater is not necessary because the most recent groundwater data indicates that minimal dissolved groundwater impacts exist. There were no TOGS 1.1.1 guidance value exceedences for PCP or dioxins in the data collected during the November 2002 sampling event. Quantitative RAOs for groundwater are given in **Table 9**. However, in light of the previous investigation sample data (eg. PI), groundwater remains a media of concern. While active groundwater remediation (eg. pumping and treating), is not warranted, groundwater should be addressed in conjunction with any remedial action selected for soil.

3.0 IDENTIFICATION AND SCREENING OF REMEDIAL ACTION TECHNOLOGIES

This section considers technologies that can be employed to meet the qualitative and quantitative Remedial Action Objectives (RAOs) as presented in **Section 2.2** for the Site cleanup. General response actions (GRAs) are listed in **Section 3.1** for each medium of concern. Each GRA and relevant technology applications will be screened to select the most applicable technologies to meet the RAO for each medium of concern. In **Section 4.0**, site-specific remedial alternatives are assembled and evaluated relative to their effectiveness in addressing the RAOs and identified areas and/or volumes of impacted media. Areas and/or volumes of media impacted with COPCs at the site that exceed SCGs, ARARs, and PRGs were developed and are discussed in the evaluation of remedial alternatives. **Section 5.0** compares the selected alternative to RAOs, including an evaluation of the overall protection of health and the environment, implementability, effectiveness, and compliance.

3.1 Identification and Screening of General Response Actions

General Response Actions (GRAs) are media-specific actions that satisfy the RAOs. The process of developing GRAs to address impacted media is consistent with guidance for implementing the National Contingency Plan (NCP) under CERCLA (USEPA, 1988) and NYSDEC (NYSDEC, 1990). The process also ensures that a wide range of potential responses are considered during the development of remedial alternatives for the Site.

GRAs were developed to address the RAOs for surface and subsurface soil. GRAs were not developed to address groundwater because, as discussed in **Section 2.3.2**, the most recent groundwater data indicates that minimal dissolved groundwater impacts exist. The following list represents potentially relevant GRAs that could be applied to the impacted media, given the unique Site conditions:

- No Action
- Institutional Controls
- Containment
- Excavation
- Disposal
- In-situ Treatment
- Ex-situ Treatment

Some GRAs are not applicable to the Site as a whole because of site-specific conditions. The application of specific GRAs is discussed in the following sections.

3.1.1 No Action

The "No Action" category serves as a baseline against which other response actions can be compared. The "No Action" category can include activities such as periodic soil sampling, groundwater monitoring, or air quality monitoring to identify changes in site conditions.

3.1.2 Institutional Controls and/or Engineering Controls

Under this response category, measures would be taken to restrict access and/or control specified activities at the Site. Physical and/or legal controls could be employed to restrict site access. Physical controls include access restrictions such as fencing, postings, warning signs, and other barriers. Most, if not all, of these physical controls are already in place at the site due to its use as an incarceration facility. Legal controls include zoning or notice of covenant on deed transfers, and the classification of the Site within the NYSDEC Inactive Hazardous Waste Site Registry in order that future land uses consider the Site's limitations specified by those documents.

3.1.3 Containment

The containment category refers to the use of natural or engineered barriers on-site to minimize potential direct contact with, or migration of, contaminated media. Technologies within the containment response category may include contact barriers, capping, and surface controls (e.g., drainage/grading), or combinations thereof.

3.1.4 Excavation

This GRA refers to the excavation of impacted soils at the Site. Removal operations at the Site would require the use of both common and specialized excavation equipment, depending upon the location of the impacted soil with respect to ground surface and groundwater. Excavated soils may be conditioned for subsequent transportation to an off-site disposal facility and/or treated on-site or off-site to meet land disposal restriction (LDR) treatment standards, if applicable. Excavations below the water table would require dewatering.

3.1.5 Disposal

This GRA refers to disposal of impacted media after excavation and treatment. Both on-site and off-site disposal options will be evaluated as GRAs.

3.1.6 In-situ Treatment

In-situ treatment GRAs refer to appropriate technologies used to treat impacted soil without bringing it to the surface or physically removing the soils. Available technologies include bioremediation, stabilization, and vitrification.

3.1.7 Ex-situ Treatment

Ex-situ treatment GRAs refer to appropriate technologies used to treat excavated soils on site. Available technologies include bioremediation, stabilization, dechlorination, soil washing, and thermal desorption.

3.2 Identification and Preliminary Screening of Technology Types and Process Options

This section identifies and describes potentially applicable technology types for each GRA and presents the preliminary screening of each technology and process option. During this preliminary screening, process options and entire technology types may be eliminated from further consideration on the basis of technical effectiveness or implementability. Three factors, which are specified in the USEPA guidance for conducting RI/FS investigations (USEPA, 1988) to evaluate and screen out technologies or process options are the:

- Nature of the contaminants;
- Specific media of concern at the Site; and
- Physical characteristics of the Site, including geology and hydrogeology.

3.2.1 No Action

Pursuant to the NCP and USEPA guidance for conducting RI/FS investigations (USEPA, 1988), the "No Action" response must be developed and examined as a baseline by which other remedial alternatives will be compared. The "No Action" category can include activities such as periodic soil sampling, groundwater monitoring, or air quality monitoring to identify changes in site conditions. This response is easily implementable.

Further screening of this response/alternative is not required. It is retained as a general option for the later assembly of alternatives (**Section 4.0**) and for comparative purposes in the detailed analysis (**Section 5**).

3.2.2 Institutional Controls and/or Engineering Controls

Institutional controls are physical or legal measures taken to prevent direct exposure to impacted media. Institutional controls are not technologies; however, they can be used to enhance the long-term effectiveness and permanence of a remedial action. Potentially executable institutional controls include access restrictions, deed restrictions, and zoning restrictions that prevent exposure to soil.

Implementation of any institutional controls would require negotiated agreement between the current property owner (New York State) and local and state government agencies. Institutional controls would enhance the effectiveness of other technologies and will be retained for further consideration.

Physical Mechanisms

Access restrictions could include fencing, alarm systems, security gates and patrols, and other physical barriers that restrict access to select areas of the Site. These measures are currently being utilized at the site as part of daily operations (e.g., it is an incarceration facility). Other measures to control specific activities could be employed as dictated by future land use. For example, workers engaged in activities potentially exposing them to impacted media would require Occupational Safety and Health Administration (OSHA) training and certification (29 CFR 1910.120), medical fitness testing, and/or other appropriate documentation, including an approved Health and Safety Plan (HASP) and requirements. These plans would stipulate appropriate protective measures to prevent worker exposures during the completion of work on-site. In addition, a written summary of work performed or completed, documenting compliance with all established administrative controls, would be a customary requirement for work completed in "hazardous" environments. Future land-use activities may require control measures such as mandatory periodic training or signed compliance agreements prohibiting specified activities for on-site employees.

Legal Mechanisms

Notice of covenant on deed transfers may be used to impose specific legal restrictions for future land use or to require training programs or specific actions designed to prevent exposure to impacted media. For example, prohibitions on excavation or construction in capped areas can be stated in the deed, and maintenance of a cap or other remedial control structures can be required. Future Site remedial actions can also be specified in a notice of covenant on deed transfers, such as requiring that subsurface soil exposed by future construction be handled in a specified manner or that a newly exposed area be capped. Access restriction controls can also be included as a notice of covenant on deed transfers.

Zoning restrictions are similar to deed restrictions and could be used for the same purposes described above. Re-zoning would require working closely with the Town of South Plymouth to develop a special zoning district with specific building limitations or prohibitions, although this may not be practical given the use of the property. Approval would require a public hearing and/or a public participation process, in addition to the public participation process necessary for FS approval. This option would limit future exposure through property-use restrictions. The "layering" of this form of property use restriction in addition to deed or title covenants would provide a more effective control mechanism than either of these actions completed individually.

Under New York State's Inactive Hazardous Waste Disposal Site Remedial Program, limitations are placed on physical alterations or substantial change in use of sites included in the Registry. These limitations would effectively limit significant changes in the exposure pathways present at portions of the Site included in the Registry, and require notification and NYSDEC approval prior to the implementation of these changes. Institutional controls will be retained for further consideration.

3.2.3 Containment

Containment of impacted media would prevent potential receptors from directly contacting these media or impede potential migration of impacted media off-site. Technology types identified to achieve containment of the soil include surface controls and capping.

Surface Controls

Surface controls can be used to divert surface water from impacted areas, minimize infiltration, or prevent erosion. Several measures, including diversion channels, grading, revegetation, or collection drains and basins can accomplish the control of surface water run-on/run-off. Surface controls reduce the amount of water that infiltrates and percolates into and out of impacted soils, thus decreasing the potential for exposure. Surface controls will be retained for further consideration.

Capping

Containment can be accomplished through the use of a capping system that reduces potential exposures by preventing direct contact with impacted media and collection of gases generated during the degradation of contaminants. Also, capping can reduce or eliminate the amount of precipitation that infiltrates and percolates into and out of impacted soils. Capping process options include permeable soil caps, asphalt/concrete caps, and multi-layered caps.

- Permeable Soil Covers: Permeable soil covers typically consist of 1 to 2 feet of locally available, inexpensive earthen materials and a 6-inch layer of topsoil for vegetative support. A permeable soil cover would reduce the risk of direct contact with impacted surface soils and prevent the potential erosion of exposed surface soils. However, a permeable soil cover is not a suitable medium for future development of the Site. For this reason, this technology will not be retained for further consideration.
- Low Permeability Cover System (LPCS): A LPCS typically consists of 1 to 2 feet of compacted clay and a 6-inch layer of topsoil for vegetative support. The clay must have a maximum remolded coefficient of permeability of 1×10^{-7} cm/s throughout its thickness. A LPCS would reduce the potential for direct contact with impacted media and prevent the potential erosion of exposed surface soils. A LPCS would also reduce the infiltration of precipitation into the impacted media. This technology will be retained for further consideration.

  Asphalt/Concrete Caps: Both asphalt and concrete are considered to be good cap materials that effectively reduce surface erosion. By altering the asphalt mix (decreasing the aggregate grain size and adding extra asphalt), permeability of typically less than 10^{-7} cm/sec, and sometimes as low as 10^{-11} cm/sec can be achieved. These mixtures are known as dense-grade or hydraulic-grade asphalts (Asphalt Institute, 1989) and have been approved for use in environmental caps and pond liners (Asphalt Magazine, Winter 1991/1992). They cannot withstand heavy design loads, but they are resistant to erosion and are more durable than highway asphalt. Asphalt/concrete cap systems should be engineered/constructed with suitable surface water drainage controls such that internal, downward drainage of precipitation does not occur. Although the treatment plant is expected to be destroyed prior to the commencement of remedial activities, if the building foundation is left in place it may not require modification in order to implement this process option. The integrity of this area would have to be evaluated prior to designing an asphalt/concrete cap system. This technology will be retained for further consideration.

- Multi-Layered Caps: A multi-layered cap system is a more sophisticated technology than a soil cap and involves layers of compacted soil underlying and overlying a synthetic liner. These caps are most appropriately used in cases where a low-permeability cap must be constructed to prevent infiltrating water from leaching through the waste. A multi-layered cap meeting the performance requirements of 6NYCCR Part 360 would be practicable and is a proven isolation technology. This technology will be retained for further consideration.

3.2.4 Excavation

This process option constitutes the excavation of contaminated material and on-site treatment or transport to permitted off-site treatment and/or disposal facilities. Pretreatment of the contaminated media may be required to meet land disposal restrictions. Treatment and disposal issues are further evaluated in the ensuing sections of this FS report.

The effectiveness of excavation would depend upon the location and depth of the impacted media to be excavated. Excavations greater than 4 feet deep may require bracing and/or sloping to stabilize the sidewalls of the excavation. The vertical limit of excavation for hot spot removal would be the water table. Groundwater is first encountered on-site at depths ranging from 3 to 6 feet below ground surface. Depending on the depth to groundwater in the vicinity of the excavation and the area of the site, water may or may not be encountered. If groundwater is encountered water management technologies will be utilized. Excavation water will be treated and discharged on-site or containerized and shipped off-site for treatment and disposal. Excavation will be retained for further consideration.

3.2.5 Disposal

Depending upon the nature of the material requiring disposal and the concentration of the COPCs present in the material, both on-site and off-site disposal, as either non-hazardous solid waste or as hazardous waste, were retained for further consideration. All of the disposal options considered below would effectively limit exposure to potential receptors; however, these processes would not reduce, but rather transfer, the volume and toxicity of wastes to a permitted disposal facility.

On-Site Disposal

On-site disposal of soil in an engineered containment cell would effectively limit exposure to potential receptors. However, the creation and maintenance of a disposal cell at the Site would be cost prohibitive and may not be consistent with future use scenarios, essentially rendering portions of the property not suitable for reuse. Additionally, this technology is not considered to be cost effective given the relatively small volume of impacted soils observed at the site. On-site disposal will not be retained for further consideration.

Off-Site Disposal as Non-Hazardous or Hazardous Waste

This disposal process would be effective in removing COPCs from the Site and limiting long-term exposure to potential receptors; however, an increased short-term risk of exposure would be posed to workers during excavation and to potential receptors along the transportation route. This process would result in reductions in waste volume, toxicity, and mobility at the Site through the transfer of this waste to a secure, approved, off-site solid waste disposal or treatment plant. All disposal and waste management practices will comply with applicable Land Disposal Restrictions (LDRs). Transfer to a disposal facility, however, would not result in an ultimate reduction in toxicity or volume. Waste mobility would be reduced by placement of the waste within a secured landfill off-site.

The staging, loading, and transportation processes of excavation materials would be considered practicable. Depending on the quantities and characteristics of material to be excavated and transported, the result of health risks may exceed those posed by leaving the material in place on-site. This process will be retained for further consideration.

3.2.6 In-situ Treatment

Bioremediation

Bioremediation uses a process in which indigenous or inoculated microorganisms (e.g., fungi, bacteria, and other microbes) degrade (i.e., metabolize) organic contaminants found in soil and/or groundwater. In the presence of sufficient oxygen (aerobic conditions), microorganisms will ultimately convert many organic contaminants to carbon dioxide, water, and microbial cell mass. In the absence of oxygen (anaerobic conditions), the contaminants will be ultimately metabolized to methane and carbon dioxide. Bioremediation is effective in reducing dioxin and PCP concentrations. Sometimes contaminants may not be completely degraded, but only transformed to intermediate products that may be less, equally, or more hazardous than the original contaminant. The in-situ bioremediation of soil typically involves the injection of groundwater or uncontaminated water mixed with nutrients via subsurface wells. However, since the depth to the impacted zone is very shallow, it would be impractical to implement drilling operations. Thus, in-situ bioremediation will not be retained for further consideration.

Stabilization

The goal of the stabilization process is to limit the leaching of contaminants. Stabilization techniques limit the solubility or mobility of contaminants, even though the physical characteristics of the waste may not be changed or improved. To accomplish this, stabilizing agents, which chemically react with the contaminants and reduce their mobility, are added and blended with the soil. Types of stabilizing agents include Portland cement, bitumen, and fly ash. Stabilization is a proven method for reducing the mobility of inorganic compounds; amendments such as granular activated carbon (GAC) have been proven effective in immobilizing organic constituents. GAC removes contaminants by sorption; it attracts and adsorbs organic molecules as well as certain metal and inorganic molecules until available active sites are occupied. Carbon is "activated" for this purpose by being processed to create porous particles with a large internal surface area. The target contaminant groups for carbon adsorption are SVOCs and explosives.

Soil stabilization techniques are accomplished either in-situ or ex-situ. In-situ techniques involve the injection of a stabilizing agent into the soil. Auger/caisson systems and injector head systems are techniques used to apply the stabilizing agents to the soil. Auger/caisson systems involve using an auger equipped with a nozzle to inject the agents into the subsurface while simultaneously drilling into and mixing the soil. Injector head systems involve using high pressure to force stabilizing agents into the soil pore spaces through pipes. However, since the depth to the impacted zone is very shallow, it would be impractical to implement drilling operations. Thus, in-situ stabilization will not be retained for further consideration.

Vitrification

Vitrification of soils is a thermal treatment process that converts contaminated soil into a chemically inert, stable glass and crystalline product. In-situ vitrification is a relatively complex, high-energy technology requiring a high degree of skill and training. An array of electrodes is inserted into the ground to the desired treatment depth. An electrical current heats the soil to approximately 2,000 °C, well above the initial melting temperature (e.g., fusion) of soils. The pyrolyzed byproducts migrate to the surface of the vitrified zone, where they combust in the presence of oxygen. A vacuum hood placed over the treated area collects off gases, which are treated before release. The off-gas treatment system consists typically of a glycol cooling system, a wet scrubbing system and condenser, and carbon filters. In-situ vitrification is effective in the unsaturated zone, thus groundwater suppression pumps will need to be employed. In-situ vitrification is currently considered an innovative technology in the pilot stage of development. Since the volume of the impacted zone is very small, it would be impractical to implement in-situ vitrification. Hence, this technology will not be retained for further consideration.

3.2.7 Ex-situ Treatment

Bioremediation

As in in-situ bioremediation, ex-situ bioremediation uses a process in which indigenous or inoculated microorganisms (e.g., fungi, bacteria, and other microbes) degrade (i.e., metabolize) organic contaminants found in soil and/or groundwater. In the presence of sufficient oxygen (aerobic conditions), microorganisms will ultimately convert many organic contaminants to carbon dioxide, water, and microbial cell mass. In the absence of oxygen (anaerobic conditions), the contaminants will be ultimately metabolized to methane and carbon dioxide. Ex-situ bioremediation typically uses tilling or continuously mixed slurries to apply oxygen and nutrients, and is performed in a prepared bed (liners and aeration) or reactor. Ex-situ bioremediation requires a relatively large area, which is not available at the Site. Hence, ex-situ bioremediation will not be retained for further evaluation.

Stabilization

The goal of the stabilization process is to limit the leaching of contaminants. Stabilization techniques limit the solubility or mobility of contaminants, even though the physical characteristics of the waste may not be changed or improved. To accomplish this, stabilizing agents, which chemically react with the contaminants and reduce their mobility, are added and blended with the soil. Types of stabilizing agents include Portland cement, bitumen, and fly ash; GAC may be also be added. Ex-situ stabilizaton involves excavating the impacted materials, machine-mixing them with a stabilizing formula in a pug mill or rotating drum mixer, and depositing the treated soil in a designated area. Ex-situ stabilization will be retained for further consideration.

Dechlorination

Although not yet considered a fully proven technology by USEPA, dechlorination does have some track record of success for the treatment of the dioxin, furan, and PCP contaminants often found at wood-treatment sites. Dechlorination will not, however, be useful for treating PAHs, which do not contain chlorine. If site cleanup requires destruction of dioxins, then dechlorination is one of very few techniques that are capable of remediation. The USEPA data show that wood-treatment site wastes containing dioxins and furans treated with alkali polyethylene glycolate (APEG) for 45 minutes at 160°F showed greater than 99 percent destruction of the dioxins and furans. However, there is some concern that incomplete dechlorination of the heavily chlorinated dioxins typically found at wood treating sites (containing up to 8 chlorine atoms) could result in the production of much more toxic forms of dioxins including the most toxic 2,3,7,8-tetrachloro-p-dioxin. Dechlorination will not be retained because more toxic forms of dioxin may be formed by the process.

Soil Washing

Soil washing is an ex-situ process where soil is excavated and washed to remove contaminants that are sorbed onto soil particles. Washing may be enhanced by special surfactants or chelating agents. This is strictly a full-scale technology, and it is unclear as to whether it is effective in reducing wood treatment contaminants, although empirically it should be effective. The cost of this technology can be relatively high, depending on the volume of washwater generated and amount of additives that must be added and then treated in the wastewater. Soil washing will not be retained because the fines that are removed must be handled by another technology or disposed off site and no system to manage the washwater currently exists at the site. Costs for the setup, operation, and treatment of secondary waste streams are not cost effective for small volumes.

Thermal Desorption

Thermal desorption is a physical separation process that aims to volatilize contaminants. In this process, soil is heated and agitated in a chamber, causing water and organic contaminants to be vaporized. A gas or vacuum system transports the volatilized water and organic contaminants to a gas treatment system.

Three types of thermal desorption are available:

- Direct Fired: Fire is applied directly upon the surface of contaminated media. The main purpose of the fire is to desorb contaminants from the soil, though some contaminants may be thermally oxidized during the treatment process (FRTR, 2002).
- Indirect Fired: A direct fired rotary dryer heats an air stream, which, by direct contact, desorbs water and organic contaminants from the soil (FRTR, 2002).
- Indirect Heated: An externally fired rotary dryer volatilizes the water and organics from the contaminated media into an inert carrier gas stream. The carrier gas is later treated to remove or recover the contaminants (FRTR, 2002).

Two common thermal desorption designs are the rotary dryer and thermal screw.

- Rotary Dryers: Horizontal cylinders, normally inclined and rotated, that can be indirect or direct fired.
- Thermal Screw: Screw conveyors or hollow augers are used to transport the medium through an enclosed trough while hot oil or steam circulates through the auger to indirectly heat the medium.

All thermal desorption systems require off-gas treatment. Condensers, activated carbon, wet scrubbers, and/or fabric filters may be employed to remove particulates and contaminants.

The thermal desorption processes can be categorized into two groups based upon the operating temperature of the desorber:

- Low temperature thermal desorption (LTTD): Wastes are heated to 90-320 °C (200-600 °F). The target contaminant groups for LTTD systems are nonhalogenated VOCs and fuels; it can be used, but is less effective, in treating SVOCs.
- High temperature thermal desorption (HTTD): Wastes are heated to 320-560 °C (600-1,000 °F). The target contaminants for HTTD are SVOCs, PAHs, PCBs, and pesticides; VOCs and fuels also may be treated, but treatment may be less cost-effective.

HTTD would need to be implemented to treat the primary COPCs at the Site. One disadvantage of HTTD is that organic components in the soil would be damaged, causing treated soil to lose the ability to support future biological activity. Accordingly, amendments would be introduced to the soil after treatment to rejuvenate biological activity. Thermal desorption will be retained for further consideration.

3.3 Evaluation of Retained Technologies

In **Section 3.2** technologies were presented and evaluated primarily with respect to applicability and technical implementability. In this Section remedial action technologies deemed applicable, implementable and retained for further consideration at the Site are evaluated in greater detail. The technologies are evaluated in terms of effectiveness, implementability (primarily construct ability and administrative feasibility), and relative cost in accordance with USEPA guidance (USEPA, 1988).

Effectiveness

The retained technologies are further evaluated based upon their effectiveness relative to other processes within the same technology type. This evaluation focuses on:

- The potential effectiveness of the process option in handling the estimated areas or volumes of media and meeting the remedial action objectives.
- How proven and reliable the process is, with respect to Site contaminants and conditions, in meeting the PRGs from **Section 2.2**.

Implementability

Process options are evaluated for institutional implementability; technical implementability was evaluated during the preliminary evaluation. Institutional implementability includes the ability to obtain permits and approvals for on-site and off-site actions, the availability of disposal facilities (if required), and the availability of necessary equipment and skilled workers

Cost

Process options are evaluated for relative cost. Options are eliminated if they are an order of magnitude or greater in cost and do not offer greater effectiveness, reliability, or environmental protection than other options. Costs are discussed only when the screening process is affected.

At this stage, in accordance with USEPA guidance (USEPA, 1988), the evaluation focuses on effectiveness factors, with less emphasis on implementability and cost evaluation. Additionally, a greater emphasis is placed on the institutional aspects of implementability rather than the construction aspects.

3.3.1 No Action

The "No Action" technology provides a baseline from which to evaluate the effectiveness of other alternatives in reducing the toxicity, mobility, or volume of COPCs, or potential exposure pathways to COPCs at the Site. The "No Action" technology would be readily implementable as previously discussed. Costs associated with the "No Action" technology include annual costs for maintenance and repair of paved surfaces, maintenance of fencing, site security operations, and costs associated with sample collection, laboratory analyses, and reporting of results.

Pursuant to the NCP and USEPA guidance for conducting RI/FS investigations, the "No Action" alternative must be developed and examined as a baseline of comparison for other remedial alternatives. This technology will be retained for further consideration.

3.3.2 Limited Action

Limited Action uses institutional controls and/or engineering controls as physical or legal measures taken to deter Site access or direct exposure with impacted soil. Potentially implementable institutional controls include access restrictions, deed restrictions, zoning restrictions, and site use limitations under the New York State Environmental Conservation Law (NYS ECL). Specific control measures are evaluated below.

Access Restrictions

Access restrictions effectively minimize the potential for direct contact with soil and groundwater. Access restrictions include fencing and site security operations.

Currently, access to the Site is limited to adult inmates, facility personnel, and authorized visitors. Visitors must sign in at the gate and be accompanied on-site by authorized personnel. However, once inside the facility, the contaminated area is not restricted. The entire site would be encompassed by chain-link fencing. Continued implementation of the current access restrictions would not be difficult.

Postings regarding Site activities or access to the Site would also be feasible and appropriate.

Costs cannot be accurately assessed at this point in this FS report because measures to restrict Site access with respect to specific remedial alternatives are not defined; however, on an order-of-magnitude basis, the anticipated costs for access restrictions would be reasonable. Access restrictions will be retained for further consideration.

Notice of Covenant on Deed Transfers

Notice of covenant on deed transfers can be used to effectively convey information regarding the remedial action. Deed restrictions can also be used to regulate future Site activities, thus controlling potential exposures to impacted media. These notifications could be placed on the title and all subsequent plot plans for the Site. This option could be implemented provided the appropriate legal actions are taken to prepare a negotiated agreement between the current property owner and local and state government agencies. Since the State of New York is the current property owner, this is a readily achievable action.

Costs cannot be accurately assessed at this time, but on an order-of-magnitude basis, the anticipated costs for a notice of covenant on deed transfers would be reasonable. Notice of covenant on deed transfers is potentially applicable and will be retained for further consideration.

Zoning and Land Use Restrictions

Zoning restrictions could be used to regulate future Site activity and thus control potential exposures to impacted media.

This option could be implemented at the local level; appropriate zoning actions would have to be adopted by local government agencies. Zoning restrictions may be more difficult to implement than deed restrictions due to the local government approval process, which may require the creation of a special zoning district with specific building restrictions or prohibitions. Once created, this zoning district would require plan review and approval prior to any changes in site conditions that may impact potential exposures. This process creates an additional level of inspection and enforcement to maintain the effectiveness of the implemented remedy. Therefore, zoning restrictions will be retained for further consideration.

Costs cannot be accurately assessed at this time, but on an order-of-magnitude basis, the anticipated costs for implementing land use restrictions would be considered minimal relative to the overall estimated remedial costs.

3.3.3 Containment

As previously discussed, containment technologies determined to be technically implementable at the Site include surface water controls and capping.

Surface Controls

Surface controls are generally effective in minimizing erosion caused by surface water run-on and run-off. Surface controls would be used in conjunction with other remedial measures, depending on topography and other factors. The use of surface controls (vegetated areas, retention ponds, diversion channels, etc.) must be consistent with present Site conditions and future land use scenarios. These options would employ standard construction practices, be effective when employed properly, and be relatively easy to implement.

The costs associated with surface controls vary depending upon the type and application of the controls. Surface controls will be integrated into any remedial alternative that involves regrading site topography. Specific controls will be identified in the remedial design.

Capping

The treatment plant currently covers approximately 40% of the Site thus, there are no impervious structures that limit potential direct contact with impacted media and infiltration of rainwater into the subsurface for the other 60% of the Site. If a soil cap is installed over newly exposed soil, the potential exists for increased infiltration into the subsurface. However, increased infiltration is not expected to increase groundwater concentrations of the COPCs because these compounds are hydrophobic and tend to partition to organic matter (such as soil) rather than partitioning into the aqueous phase.

It is also important to note that while caps impede the vertical entry of precipitation into the impacted area, they do not prevent the horizontal flow of groundwater through the impacted area. However, the horizontal flow of groundwater through the impacted zone is not significant due to the low transmissivity of the soils at the Site.

Capping process options retained for further consideration based upon their technical implementability include a low permeability cover system asphalt/concrete caps and multi-layered caps.

- Low Permeability Cover System: The LPCS would consist of 1 to 2 feet of compacted clay (maximum remolded coefficient of permeability of 1×10^{-7} cm/s throughout its thickness) and a 6-inch layer of topsoil for vegetative support. Construction of a LPCS is readily implementable. A LPCS would effectively prevent direct contact with impacted soils and the migration of contaminants due to erosion. It would also prevent infiltration of precipitation into the impacted media and would control gas emissions. As with other containment options, the installation of a LPCS would be restrictive to some future land uses. Additionally, environmental stresses, settling, and erosion may lessen the effectiveness of a LPCS and render it susceptible to cracking. Thus, LPCSs require long-term maintenance and inspection. Institutional controls would be necessary to prevent damage to the cover. This process option will be retained for further consideration.
- Asphalt/Concrete Caps: Asphalt/concrete caps would be effective in preventing the erosion of surface soils, exposure to impacted media, and controlling soil gas emissions.

  The Site's impacted areas could be covered with asphalt or concrete using conventional construction practices. Construction of an asphalt or concrete cap is readily implementable and available. The use of an asphalt/concrete cap would have to be carefully integrated with long-range development plans for the Site because caps may be restrictive for some future land uses. Institutional controls would be required to prevent damage to the cap. Additionally, environmental stresses, settling, and chemical compatibility may lessen the effectiveness of asphalt/concrete caps and render them susceptible to cracking. Thus, as with other capping options, asphalt/concrete caps require long-term maintenance. This process option will be retained for further consideration.
- Multi-Layered Caps: Multi-layered cap systems are effective and are commonly used for capping hazardous waste landfills. A multi-layered system meeting the substantive performance requirements of 6NYCCR Part 360 would effectively prevent direct contact with impacted soil and the migration of contaminants due to erosion. One of the primary objectives of a multi-layered cap is to prevent infiltration of rainwater through the subsurface soils.

  An impermeable multi-layered cap system incorporating a synthetic liner, an overlying compacted soil layer, and an underlying drainage soil layer could be installed at the Site. Substantial design and construction engineering, site preparation, quality control, and long-term maintenance would be inherent to the use of a multi-layered cap.

This solution would be much more complicated to implement than an asphalt or concrete cap, but there are technical benefits of using an impermeable multi-layered cap rather than an asphalt or concrete. Multi-layered caps are less susceptible to cracking than asphalt/concrete caps as well as LPCS and the multiple layers provide several opportunities to impede infiltration of precipitation. As with other capping options, a multi-layered cap would have to be carefully integrated with the long-range development plans for the Site. Institutional controls would be required to prevent damage to a multi-layered system.

The cost of a multi-layered system would be greater than an asphalt/concrete cap due to the additional tasks identified above. However, multi-layered caps provide a higher degree of containment. Multi-layered caps will be retained for further consideration.

3.3.4 Excavation

The effectiveness of source removal would depend upon the location and depth of the impacted soil to be removed by excavation. Excavated materials could either be treated on site or transported off-site for subsequent treatment/disposal. Treatment and disposal issues are further evaluated in the ensuing sections of this FS report.

Excavations greater than 4 feet deep may require bracing and/or sloping to stabilize the sidewalls fo the excavation. Groundwater is first encountered at the Site at depths ranging from 3 to 6 feet bgs. Depending on the depth to groundwater in the vicinity of the excavation, water may or may not be encountered.

Three zones were considered when evaluating the possibility of excavating materials at the Site: shallow excavations not requiring bracing, excavations above the water table requiring bracing, and excavations below the water table requiring bracing and control of water.

Shallow Excavations

Shallow excavations would be conducted in the top 1-foot of soil at the Site. It would not require bracing to complete and would be effective in removing impacted surface soils. Shallow excavations would not encounter water; therefore, no dewatering/water treatment-disposal-provisions were considered.

Labor crews trained and certified in accordance with OSHA Standard 1910.120 would perform shallow excavations with standard construction equipment. In accordance with 29 CFR Part 1926 Subpart P, a Competent Person with the authority and knowledge to make decisions regarding health and safety issues must be designated on-site.

Shallow excavation costs would depend upon the volume of material to be excavated from a given area and the presence/absence of underground utilities in the vicinity of the excavation. Shallow excavations would be the least costly of the excavation process options evaluated in this FS. Shallow excavations will be retained for further consideration.

Engineering Controls Employed Above the Water Table

Braced or sloped excavations above the water table can be completed with standard excavation and shoring equipment labor crews trained and certified in accordance with OSHA Standard 1910.120. In accordance with 29 CFR Part 1926 Subpart P of OSHA, a Competent Person with the authority and knowledge to make decisions regarding health and safety issues must be designated on-site. Excavation costs will be directly related to the depth of the excavation and the presence/absence of underground utilities and obstructions. Braced or sloped excavations above the water table will be retained for further consideration.

Engineering Controls Employed Below the Water Table

Braced and/or sloped excavations below the water table would be regarded as an effective method for removing impacted soil from the subsurface, however, several technical challenges associated with this category of excavations must be overcome to use this technology. These challenges are enumerated below and include:

- The risk of exposing construction workers, inmates, facility personnel, and authorized visitors to contaminants would be greater the deeper the excavation. The exposures are greater when compared to other remedial alternatives. Additionally, increased health and safety and engineering oversite will be required during these excavations processes.
- The act of dewatering for deep excavation may result in a large volume of water requiring treatment and disposal.

It is believed that the technical challenges associated with this option can be overcome, but with a decrease in efficacy and an exponential increase in cost. Braced excavations below the water table will be retained for further consideration.

3.3.5 Off-site Disposal

Depending upon the nature of the material requiring disposal and the concentration of the COPCs present in the material, off-site disposal, as either non-hazardous solid waste (applicable standards from NYSDEC DS&HM TAGM 3028 will be adhered to) or as hazardous waste, were retained for further consideration. All of the disposal options considered below would effectively limit exposure to potential receptors; however, these processes would not reduce the volume and toxicity of wastes.

The disposal process would be effective in removing COPCs from the Site and limiting long-term exposure to potential receptors; however, an increased short-term risk of exposure would be posed to workers during excavation and to potential receptors along the transportation route. This process would result in reductions contaminant volume at the Site through the transfer of this waste to a secure, approved, off-site solid waste disposal facility; however, it would not result in an ultimate reduction in toxicity or mobility.

Depending on the quantities of material to be transported, the result of health risks may exceed those posed by leaving the material in place on-site. Difficulties associated with material excavation are discussed in **Section 3.3.4**.

In NYS, materials containing listed hazardous constituents are considered hazardous waste, as well as wastes that are hazardous by virtue of their toxicity characteristic (as determined by pertinent testing standards). NYCRR Part 371 defines the contaminated soils as a F032 waste which is described as "waste waters, process residue, preservative drippings, and spent formulations from wood preserving processes generated at plants at currently or previously used pentachlorophenol. Disposal costs of hazardous wastes are significantly higher than disposal as non-hazardous. Costs for transportation, treatment to LDR standards (LDR standards define the level to which soils must be treated prior to land disposal), and disposal can range from approximately $350 to $500 per ton. This process will be retained for further consideration.

Water generated during dewatering of the excavation will be treated and disposed of off-site. If on-site water treatment systems are developed in the future, any excavation water generated by the implementation of potential future remedies potentially could be containerized and treated on-site if the quantities are reasonable compared to treatment system capacity.

3.3.6 Ex-Situ Treatment

Stabilization

Stabilization aims to limit the spread, via leaching, of contaminants in soil. To accomplish this, stabilizing agents and GAC are blended into excavated impacted soil to reduce contaminant mobility.

Several factors may limit the applicability and effectiveness of the process. The type, pore size, and quality of the carbon will impact process performance. Also, highly water-soluble compounds and small molecules do not readily adsorb to carbon. The method employed to mix the stabilizing agents and GAC significantly influence the effectiveness of this technology, however this parameter is less costly for ex-situ applications than for in-situ applications. Furthermore, it can be difficult to determine an effective formula for complex waste of various contaminant groups.

Shaw performed ex-situ stabilization at a former wood preserving site contaminated with PAHs, PCP, dioxins/furans, and metals. A combination of Portland cement, fly ash, GAC, and water was used in the stabilizing formula. PCP concentrations of 4,800 mg/kg (maximum) were reduced to <100 ug/L in the synthetic precipitation leaching procedure (SPLP). Dioxin concentrations of 0.0383 mg/kg (maximum) were reduced to <0.05 ug/L in the SPLP (2,3,7,8-TCDD equivalent). Thus, ex-situ stabilization is a viable treatment technology for wood treatment sites. Bench scale and related treatability tests would be required to determine an appropriate stabilizing formula for this particular site.

Ex-situ stabilization is a mature remediation technology. Costs for this technology are approximately $100 per ton, including excavation (FRTR, 2002). Ex-situ stabilization will be retained for further consideration.

Thermal Desorption

Thermal desorption is a physical separation process that volatilizes contaminants. In this process, soil is heated and agitated in a chamber, causing water and organic contaminants to be vaporized. A gas or vacuum system transports the volatilized water and organic contaminants to a gas treatment system.

Factors that may limit the applicability or effectiveness of thermal desorption include:

- Treated soil may no longer be able to support biological activity;
- High clay, humic material, or moisture content may increase reaction time as a result of binding of contaminants;
- Dust and organic matter in the soil increases the difficulty of treating off-gas;
- Dewatering may be necessary to achieve acceptable soil moisture content levels;
- High abrasive feed may damage the processor unit; and
- Debris greater than 60 mm in diameter typically must be removed prior to processing.

The operation and maintenance duration depends on the processing rate of the treatment unit and the volume of soil. The processing rate is dependent upon the contaminant type and soil characteristics. The throughput of a typical mobile unit ranges from 50 to 400 cubic yards per day (2002, NFESC); the dense soils at the Site will likely cause the average daily throughput to be on the low end of this range. Additionally, the COPCs at the Site may require longer treatment times. Costs for a mobile unit typically range from $95 to $195 per cubic yard (2002, NFESC). However, the small volume of material to be treated at the Site may be cost prohibitive to this technology with regards to transport and setup of the unit. Thermal desorption will be retained for further consideration.

3.4 Summary

In this section, a wide range of potentially applicable remedial technologies for each GRA were developed, screened, and evaluated for the Site based upon their effectiveness, implementability, and cost. These technologies include an assemblage of the most widely used processes for the COPCs and impacted media identified in the RAOs for the Site. Technologies that were retained from this evaluation for assemblage into site-wide remedial alternatives are listed below and are summarized in **Table 10**.

- No Action
- Limited Action
  - Monitored Natural Attenuation
  - Institutional Controls (access restrictions, notice of covenant on deed transfers, and zoning restrictions)
- Containment
  - Surface Controls
  - Capping (low permeability soil cover, asphalt/concrete cap, and multi-layered cap)
- Excavation
  - Shallow
  - Engineering Controls Employed Above the Water Table
  - Engineering Controls Employed Below the Water Table
- Disposal
  - Off-site
- Ex-Situ Treatment
  - Stabilization
  - Thermal Desorption

4.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

The technologies retained in **Section 3.0** are assembled into remedial alternatives designed to achieve the RAOs discussed in **Section 2.0**. The RAOs are goals developed to protect human health and the environment. The remedial alternatives are assembled primarily to address the adsorbed impacts observed in site soils. As discussed previously, the most recent groundwater data indicates that minimal dissolved groundwater impacts exist.

The range of alternatives for the Site have been developed within the framework of the regulatory guidelines outlined in the RI/FS Guidance Document (USEPA 1988).

A brief discussion of the alternatives developed, and the rationale behind their development, is presented in the following sections. The detailed evaluation of the retained alternatives is then presented in **Section 5.0**.

4.1 Alternative 1 – No Action

The No Action alternative has been included in order to provide a baseline by which to compare other alternatives. Under this alternative soil and groundwater will not be actively treated and the site conditions would remain the same. Property maintenance (security, fence repairs, etc.) currently exists and will continue to exist as part of the daily operations of the Site as an incarceration facility. Thus, there are no additional costs to maintain the Site. Biannual groundwater monitoring would continue for at approximately 30 years.

4.2 Alternative 2 – Limited Action

Under this alternative institutional controls would be used in conjunction with groundwater monitoring to address site contamination. An initial round of groundwater sampling is warranted to establish base groundwater parameters for monitored natural attenuation analysis. A 6-foot high chain-link fence and gate would be placed around the perimeter of the impacted area, specifically to restrict access to impacted media. Overall property maintenance currently exists and will continue to exist as part of the daily operations of the Site as an incarceration facility. Thus, there are no additional costs to maintain the Site. Easements and deed restrictions that would limit future land use or prohibit activities that may increase risk of exposure to site contaminants would be implemented. Biannual groundwater monitoring would continue for approximately 30 years to monitor changes in groundwater quality and natural attenuation.

Effectiveness
Currently, access to Camp Pharsalia is limited to inmates, facility personnel, and authorized visitors. However, once inside the facility, the contaminated area is not restricted. Under this alternative, inmates, facility personnel, and authorized visitors would be able to directly contact contaminated media. This alternative would not specifically address soil COPC contamination; however, natural attenuation of the COPCs would ultimately reduce the soil impacts.

Implementability
This alternative is easily implemented. Institutional controls regarding site access are already in place and can easily be enhanced and, as site ownership belongs to the State of New York, deed restrictions and easements would be easy to implement.

Cost
For the purposes of alternative screening, the net present worth of this alternative was estimated to be approximately $206,214. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

Conclusion
Although this alternative does not actively address site contamination, it is retained as a possible remedial action.

4.3 Alternative 3 – Excavation and Off-site Disposal

In this treatment alternative, the PCP and dioxin impacts in the soil would be addressed by excavation. Specifically, the source areas delineated in **Figure 8** would be excavated using conventional methods and equipment. Since the treatment plant is expected to be demolished prior to the commencement of remedial activities, no access restrictions are foreseen at this time. As detailed in **Section 2.2**, surface soil impacts were observed in the area northwest of the treatment plant and subsurface soil impacts were observed beneath the treatment plant. Consequently, soils would be excavated to a depth of 5 feet bgs in the area northwest of the treatment plant and 10 feet bgs beneath the treatment plant to remove the impacted soils above TAGM 4046 guidance values (**Figure 8**). The estimated removal volume is approximately 860 cubic yards. NYCRR Part 371 defines the contaminated soils as hazardous (F032) waste. As such, soils will have to be disposed of in an appropriate hazardous waste landfill and may require pretreatment prior to disposal.

The excavation will be performed in cells in order to minimize exposure and construction hazards. Construction workers will wear adequate personal protective equipment (PPE). No sheeting, shoring, or bracing is expected to be required due to the dense soils at the Site and the manageable size of the excavation; however, the excavation will be benched. Excavated soils would be transported to a permitted treatment and disposal facility. Some pre-treatment of the excavated soils, prior to disposal, may be necessary. The excavation will be backfilled with clean fill from an off-site source. Residual soil impacts would be addressed via natural degradation. Since the water table at the Site is typically found at 3 to 6 feet bgs, excavation operations will require dewatering. Approximately 800 gallons of groundwater could be present within the excavation at any time. The total volume of water requiring disposal could range between zero (0) and 3,200 gallons per day.

Biannual groundwater monitoring would continue for five years. Institutional controls would remain in effect to limit site access and prohibit contact with impacted material.

Effectiveness

This alternative will provide an effective and long-term remedy for the removal and treatment of PCP and dioxin impacts observed at the site. Based on the Preliminary Investigation data and the Remedial Investigation data, PCP and dioxin source areas as shown on **Figure 8** would be excavated to a depth of 5 feet bgs in the area northwest of the treatment plant and 10 feet bgs beneath the treatment plant. This removal action will eliminate the risk of contact with the soil and will reduce the potential for the pH dependent flux of PCP and dioxin into the groundwater. The excavation and off-site disposal of the impacted soils will reduce the on-site volume, toxicity, and mobility of the COPCs.

Implementability

This alternative can be implemented using conventional construction equipment and construction practices. Excavation may be limited by the geotechnical properties of the soil. Excavation may also be limited by the need to stage and characterize material prior to transport to various facilities based on contaminant concentration. Limitations of excavation could include:

- Geotechnically unstable soil;
- Obstruction by subsurface boulders;
- Building or foundation structures; and
- Hydrostatic failure of the excavation.

These geotechnical limitations are not expected to exist, with the exception of the possibility of subsurface boulders. If any of these limitations do exist, they are manageable. Excavation and transport equipment, clean fill, and other items associated with this alternative are readily accessible. This alternative is easily implementable.

Cost

For the purposes of alternative screening, the net present worth of this alternative was estimated to be approximately $1,047,736. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

Conclusion

This alternative is an efficacious and practicable alternative. Excavation and off-site disposal will be retained for further consideration.

4.4 Alternative 4 – Ex-situ Stabilization and Capping

In this treatment alternative, the PCP and dioxin contamination in the soil would be addressed using stabilization techniques after the soils have been excavated. Impacted soils would be excavated to a depth of 5 feet bgs in the area northwest of the treatment plant and 10 feet bgs beneath the treatment plant, as described in **Section 4.3**. The excavated soils would be mixed with an appropriate stabilizing formula (most likely a combination of Portland cement, fly ash, and GAC) in a rotary device. The treated soils would then be returned to the excavation. A pilot test would need to be performed to determine an adequate stabilization formula, amount of stabilizing agents, overall technical effectiveness, and sizing/cost of equipment. Once the contaminants are immobilized, a cap would be constructed to eliminate the potential for direct contact with impacted media. The cap would consist of 3-inch asphalt base course and a 2-inch wearing course. All future site development will account for the capping requirements of the site in their design. Biannual groundwater monitoring would continue for five years. Soil samples would be collected annually for five years to document changes in soil quality and natural attenuation. Institutional controls would remain in effect to limit site access and prohibit contact with contaminated material.

Effectiveness

This alternative will provide an effective and long-term remedy for the treatment and containment of soil PCP and dioxin impacts at the site. Stabilization is a proven method for reducing the mobility of inorganic compounds; amendments such as GAC have proven effective in immobilizing organic constituents. Stabilization will effectively reduce the mobility and toxicity of the COPCs in the environment. The chemical properties of the contaminants and the physical properties of the soil may limit the effectiveness of stabilization. A pilot test would be necessary to determine an adequate stabilization formula, amount of stabilizing agents, overall technical effectiveness, and sizing/cost of equipment. The treatment of impacted soils will reduce the potential for the pH dependent flux of PCP and dioxin into the groundwater. Emplacement of a cap will eliminate direct contact with contaminated soil, reduce the flux of soil gas vapor into the atmosphere and rainwater infiltration into the soil and groundwater.

Implementability

This alternative can be implemented using conventional construction equipment and construction practices. The geotechnical limitations pertaining to excavation (**Section 4.3**), if they exist, are manageable. The stabilizing agents and equipment are readily available. The asphalt cap would be installed using commercial construction equipment and conventional methods. This alternative is easily implementable

Cost

For the purposes of alternative screening, the net present worth of this alternative was estimated to be approximately $655,207. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

Conclusion

This alternative will provide an effective and permanent remedy for the contamination at the Site. However, this is not a functional alternative. The aim of stabilization is to render the contaminants immobile, preventing them from dissolving into groundwater. However, the contaminants at the Site are hydrophobic and tend to partition to organic matter (such as soil) rather than partitioning into the aqueous phase. Leaching may occur due to the slightly acidic nature of Site soils, but it is expected to be minimal. Additionally, the stabilization of organic constituents is not a mature technology. In summary, the expense associated with treating the impacted soils via stabilization and capping cannot be justified from a functional standpoint. Ex-situ stabilization will not be retained for further evaluation.

4.5 Alternative 5 – Thermal Desorption

In this treatment alternative, the PCP and dioxin impacts in the soil would be addressed using thermal desorption. Impacted soils would be excavated to a depth of 5 feet bgs in the area northwest of the treatment plant and 10 feet bgs beneath the treatment plant, as described in **Section 4.3**. The excavated soils would be treated in a mobile HTTD unit at the Site, which will physically separate the contaminants from the soils by causing the water and organic contaminants in the soils to be vaporized. A gas or vacuum system transports the volatilized water and organic contaminants to a gas treatment system. The treated soils would then be mixed with amendments to rejuvenate microbial activity and returned to the excavation. Some clean fill secured from an off-site source may also be added due to loss of soil volume during the treatment process. Residual contamination in the saturated soils would be addressed via natural degradation. Biannual groundwater monitoring would continue for five years. Soil samples would be collected annually for five years to document changes in soil quality and natural attenuation. Institutional controls would remain in effect to limit site access and prohibit contact with contaminated material.

Effectiveness
This alternative will provide an effective and long-term remedy for the removal and treatment of soil PCP and dioxin contamination at the site. Thermal desorption is a proven method for remediating PCP and dioxin contamination. The process volatilizes contaminants so that they can be subsequently treated in an off-gas treatment system. The treatment of impacted soils will reduce the risk of contact with the contaminated soil and the potential for pH dependent flux of PCP and dioxin into the groundwater.

Implementability
This alternative can be implemented using conventional construction equipment and construction practices. The geotechnical limitations pertaining to excavation (**Section 4.3**), if they exist, are manageable. Thermal desorption units are readily accessible. A treatability study should be implemented prior to design to determine if soil properties (such as clay, humic, and moisture content, abrasiveness, etc.) will impede the process. This alternative is easily implementable.

Cost
For the purposes of alternative screening, the net present worth of this alternative was estimated to be approximately $926,047. A breakdown of the cost estimate for the alternative is included in **Appendix B**.

Conclusion
This alternative will provide an effective and permanent remedy for the contamination at the Site. Thermal desorption will be retained for further evaluation.

4.6 Alternative 6A – Containment; Multi Layered Synthetic Cap

In this treatment alternative, the PCP and dioxin impacts would be addressed by installing a RCRA Subtitle C cap across the impacted area (**Figure 8**). A multi-layered cap was chosen over an asphalt/concrete cap for this FS because a multi-layered cap provides a higher degree of containment. The RCRA cap would eliminate the potential for direct contact with impacted media and prevent rainwater infiltration into the area of concern. A RCRA Subtitle C cap typically consists of the following layers:

- Vegetative Layer – approximately 6 inches of topsoil that serves to reduce erosion and infiltration of precipitation;
- Drainage Layer – approximately 24 inches of porous material (sand) that enhances lateral drainage of any precipitation that infiltrates through the vegetative layer; the vegetative and drainage layers help protect the underlying barrier layers from the environmental stresses of wetting/drying and freezing/thawing;
- Synthetic Barrier – low permeability membrane (at least 20 mil thickness) that represents the final impedance to precipitation infiltration;
- Low Permeability Layer – approximately 18 inches of compacted clay to prevent infiltration into the impacted media in the event that the synthetic barrier develops a leak or tear; and
- Subgrade Layer – approximately 12 inches of sand or other porous material that serves as the foundation for the cap; also, gases formed during biodegradation may be collected for subsequent treatment. For the purposes of this FS it is anticipated that a gas collection system will not be necessary, therefore it has not been incorporated into the cost estimate (**Appendix B**) for this alternative.

All future site development will account for the capping requirements of the Site in their design. Biannual monitoring would continue for approximately 30 years. Institutional controls would be implemented to limit site access and usage.

Effectiveness

This alternative will provide an effective and long-term remedy for the containment of soil PCP and dioxin impacts at the Site. Capping the impacted area would effectively prevent direct exposures with impacted media. It would also serve to impede the transport of COPCs into groundwater. While caps prevent the vertical entry of precipitation into the impacted area, they do not prevent the horizontal flow of groundwater through the impacted area. However, the horizontal flow of groundwater through the impacted zone is not significant due to the low transmissivity of the soils at the Site.

Implementability

This alternative can be implemented using conventional construction equipment and construction practices. A cap would have to be carefully integrated into the long-range development plans for the Site, as it will limit future land uses. Institutional controls would be implemented to limit land use activities that may compromise the condition of the cap. Vegetation that has tendency for deep root penetration must be eliminated from cap area. Long-term maintenance and monitoring would be necessary to ensure the integrity and effectiveness of the cap.

Cost

For the purposes of alternative screening, the net present worth of this alternative was estimated to be approximately $289,390. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

Conclusion

This alternative is an efficacious and cost efficient option. Containment via a multi layered synthetic cap will be retained for further consideration.

4.7 Alternative 6B – Containment; Low Permeability Cover System

In this treatment alternative, the PCP and dioxin impacts would be addressed by installing a clay and topsoil cover (12" clay with 6" topsoil), across the impacted area (**Figure 8**). This LPCS was recommended because it prevents direct contact with PCP and dioxin and, due to its low permeability, will prevent infiltration through the contaminated soil.

A LPCS typically consists of the following layers:

- Vegetative Layer – approximately 6 inches of topsoil that serves to reduce erosion and infiltration of precipitation;
- Low Permeability Layer – approximately 12 inches of compacted clay (maximum remolded coefficient of permeability of 1×10^{-7} cm/s throughout its thickness) to prevent infiltration into the impacted media.

All future site development will account for the containment requirements of the Site in their design. Biannual monitoring would continue for approximately 30 years. Groundwater samples would be collected annually for approximately 30 years to document changes in water quality.

Institutional controls would be implemented to limit site access and usage. An engineered pavement system may be considered as an alternative LCPS.

Effectiveness

This alternative will provide an effective and long-term remedy for the containment of soil PCP and dioxin impacts at the Site. Covering the impacted area with the LPCS would effectively prevent direct exposures with impacted media. It would also serve to impede the transport of COPCs into groundwater. While the LPCS prevents the vertical entry of precipitation into the impacted area, it does not prevent the horizontal flow of groundwater through the impacted area. However, the horizontal flow of groundwater through the impacted zone is not significant due to the low transmissivity of the soils at the Site.

Implementability

This alternative can be implemented using conventional construction equipment and construction practices. The LPCS would have to be carefully integrated into the long-range development plans for the Site, as it will limit future land uses. Institutional controls would be implemented to limit land use activities that may compromise the condition of the LPCS. Vegetation, which has tendency for deep root penetration, must be eliminated from LPCS area. Long-term maintenance and monitoring would be necessary to ensure the integrity and effectiveness of the LPCS.

Cost

For the purposes of alternative screening, the net present worth of this alternative was estimated to be approximately $259,269. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

Conclusion

This alternative is an efficacious and cost efficient option. Containment via a Low Permeability Cover System will be retained for further consideration.

5.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

In this section, the five alternatives introduced and retained for further consideration in **Section 4.1** are evaluated using the seven criteria recommended by NYSDEC TAGM 4030 and the National Contingency Plan (USEPA, 1988). This evaluation provides information to facilitate the comparison of the alternatives and the selection of a final remedy. The following criteria are used in the detailed analysis:

- Overall Protection of Human Health and the Environment
- Compliance with PRGs, ARARs and Other Regulations
- Short-term Effectiveness
- Long-term Effectiveness and Permanence
- Reduction in Mobility, Toxicity, and Volume
- Implementability
- Cost

The analysis is three tiered. The first tier is comprised of threshold factors 1) overall protection of human health and the environment, and 2) compliance with PRGs, ARARs and other regulations. Any selected remedy must result in overall protection of human health and the environment. Similarly, the PRGs, ARARs, and other regulations must be complied with unless there is an overriding reason why compliance is not possible. The second tier is comprised of the remaining five criteria from the list above. The relative merits and problems associated with meeting these factors must be balanced in arriving at a remedy. The issues associated with each of these seven criteria are briefly described below. The third tier is comprised of modifying criteria; agency and community acceptance. Satisfaction of these criteria will be determined after submittal of this report; community acceptance will be addressed following the submittal of this report during the public comment period for the purposed plan. Thus, these criteria are not evaluated in this section.

Overall Protection of Human Health and the Environment

This criterion is concerned with the overall protection of human health and the environment which would be achieved by eliminating, reducing, or controlling site risks posed through the exposure pathways. This criterion includes direct contact risks, inhalation risks, and potential risks to ecosystems.

Compliance with PRGs, ARARs, and Other Regulations

This criterion evaluates the compliance of each alternative with PRGs, ARARs, and other regulations. The three regulatory categories that will be considered are chemical specific, location-specific, and action-specific PRGs and ARARs. These regulations are discussed in detail in **Section 2.1**.

Short-term Effectiveness

The effectiveness of an alternative in protecting human health and the environment during construction and implementation of the remedial alternative is assessed under short-term effectiveness. This criterion encompasses concerns about short-term impacts, as well as the length of time required to implement the alternative. Factors such as cross-media impacts, the need to transport impacted material through populated areas, current site operations, and the potential disruption of neighborhoods and ecosystems may be pertinent. Due to the affinity of COPCs to preferentially adsorb to soil organics, excavation remedies that release dust could create potential short-term risks through the inhalation pathway. The health and safety issues associated with the implementation of any remedial action involving excavation and transport of soil are included under this criterion.

Long-term Effectiveness and Permanence

The long-term effectiveness of a remedial alternative is evaluated under this criterion with particular focus on the residual contamination remaining in a particular medium after completion of the selected alternative and the degree to which a remedial measure provides a permanent remedy for the Site. The long-term integrity of containment options is also evaluated.

Reduction in Mobility, Toxicity, and Volume

This criterion evaluates contaminant reductions with respect to concentration and/or mass based on a percentage or generalized estimate and the mass of contaminants or the volume of impacted media that will be destroyed or contained through treatment. This criterion also addresses potential decreased risks associated with changes in the mobility, toxicity, and volume. For this site, the current potential risk levels are low for all impacted media. However, the alternatives have been designed to further reduce potential risk and to meet remedial objectives.

Implementability

This criterion involves an evaluation of the alternative with respect to performance, reliability, and technical implementability. Performance and reliability focus on the ability of the alternative to meet specific goals or remedial levels. The technical implementability of an alternative addresses construction and operation with regard to site-specific conditions, including the operational impact of the existing on-site activities and the ability to safely implement the alternative. Administrative implementability focuses on the time and effort required in obtaining appropriate approvals and addressing other administrative issues.

Cost

Estimated costs are included for each alternative. These costs may include design and construction costs, remedial action O&M costs, other capital and short term costs, and costs of field and project management associated with the implementation of the remedial alternatives. Estimates of permitting costs have also been included where appropriate. Costs are also calculated on a present worth basis, assuming a 5-year or 30-year period and an interest rate of 5%. Detailed cost estimates for each alternative evaluated are provided in **Appendix B**.

5.1 Alternative 1 – No Action

Under this alternative no further action will be taken to address the presence of COPCs at the Site.

5.1.1 Overall Protection of Human Health and the Environment

This alternative would not reduce potential risks to human health or the environment for future use scenarios.

5.1.2 Compliance with ARARs

Under this alternative, limited institutional controls would remain in place. However, soil with concentrations exceeding PRGs would remain available for direct contact and for contamination of soil gas. Site cleanup objectives would not be achieved for future use scenarios until the soil cleanup objectives are met by natural attenuation.

5.1.3 Short-term Effectiveness

Minimal disturbance to the Site would occur under this alternative, primarily occurring during sampling activities, thus presenting a limited short-term risk to personnel collecting, transporting, and analyzing the samples. Since no construction activities will be performed, no short-term risks to inmates, facility personnel, authorized visitors, the community, or the environment would be presented as a result of construction activities.

5.1.4 Long-term Effectiveness and Permanence

The long-term risk of direct contact with the impacted soil or exposure to contaminated soil gas is not reduced under this alternative. However, the volume and toxicity of impacted media would gradually decrease over time through natural degradation and attenuation. Redevelopment of the Site and changes in its usage scenario could present an increased potential for risks to human health and the environment.

5.1.5 Reduction of Toxicity, Mobility, and Volume

The toxicity of impacted media would gradually decrease over an extended period of time through natural degradation and attenuation. Although the rate of COPC degradation at the Site has not been modeled, based on the available data it is reasonable to expect that this process may take longer than 30 years, which is often used as the time frame of comparison for CERCLA remedies. This alternative provides no reduction in the mobility of COPCs or the volume of impacted media.

5.1.6 Implementability

This alternative would be readily implementable at the site. This technology would require minimal planned or implemented activities. Suppliers and materials to complete groundwater monitoring are widely available with no anticipated delays in implementation.

5.1.7 Cost

The estimated present worth of this remedial alternative is approximately $180,780. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

5.1.8 Summary

Under this alternative, the site would be left in its present condition. The major shortcoming of this alternative is that it does not address the RAOs nor is it compatible with possible future development uses at Camp Pharsalia. Pursuant to the revised National Contingency Plan (NCP, 1990) and USEPA guidance (USEPA, 1988), the No Action alternative must be developed and assessed as a potential remedial action. The No Action alternative constitutes the baseline by which the other remedial alternatives are compared; therefore, this alternative will be retained, for comparative purposes, throughout the remainder of this FS report.

5.2 Alternative 2 – Limited Action

Under this alternative institutional controls would be used in conjunction with groundwater monitoring to address site contamination. An initial round of groundwater sampling is warranted to establish base groundwater parameters for monitored natural attenuation. A 6' high chain-link fence and gate would be placed around the perimeter of the impacted area, specifically to restrict access to impacted media. Overall property maintenance currently exists and will continue to exist as part of the daily operations of Camp Pharsalia as an incarceration facility. Thus, there are no additional costs to maintain the Site. Easements and deed restrictions that would limit future land use or prohibit activities that may increase risk of exposure to site contaminants would be implemented. Biannual groundwater monitoring would continue for approximately 30 years to monitor changes in water quality and natural attenuation.

5.2.1 Overall Protection of Human Health and the Environment

Current institutional controls (limited site access, as well as the procedures outlined in the HASP) would remain in place and augmented as necessary to prohibit direct contact exposures to impacted media. This alternative would not contain the impacted soils. Local plants and animals would continue to come into contact with impacted media. Migration, toxicity and mobility of the contaminants would be slowly reduced, over a period of several years. In the meantime, however, the potential for human contact with impacted media would remain.

5.2.2 Compliance with ARARs

Under this alternative institutional controls would be implemented and/or enhanced. However, because soil with concentrations exceeding PRGs would remain available for direct contact and for contamination of soil gas. Site cleanup objectives would not be achieved for future use scenarios until the soil cleanup objectives are met by natural attenuation.

5.2.3 Short-term Effectiveness

Minimal disturbance to the impacted soil would occur under this alternative during sampling activities, thus presenting a limited short-term risk to personnel collecting, transporting, and analyzing the samples. Since no construction activities will be performed, no short-term risks to inmates, facility personnel, authorized visitors, the community, or the environment would be presented as a result of construction activities.

5.2.4 Long-term Effectiveness and Permanence

The long-term risk of direct contact with the impacted soil or exposure to contaminated soil gas is not reduced under this alternative. However, the toxicity of impacted media would gradually decrease over an extended time period through natural degradation and attenuation. Redevelopment of the Site and changes in its usage scenario could present an increased potential for risks to human health and the environment.

5.2.5 Reduction of Toxicity, Mobility, and Volume

The toxicity of impacted media would gradually decrease over time through natural degradation and attenuation. Although the rate of COPC degradation at the Site has not been modeled, based on the available data it is reasonable to expect that this process would take longer than 30 years, which is often used as the time frame of comparison for CERCLA remedies. This alternative provides no reduction in the mobility of COPCs or the volume of impacted media.

5.2.6 Implementability

This alternative would be readily implementable. It would require minimal planned or implemented activities. Suppliers and materials to complete soil and groundwater monitoring are widely available. Institutional controls regarding site access are already in place and can easily be enhanced and, as site ownership belongs to the State of New York, institutional controls and easements are easy to implement.

5.2.7 Cost

The estimated present worth of this remedial alternative is approximately $206,214. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

5.2.8 Summary

Under this alternative, the site would be left in its present condition. The major shortcoming of this alternative is that it does not address the RAOs nor is it compatible with possible future development uses at the Site. This alternative will not be retained for further consideration.

5.3 Alternative 3 – Excavation and Off-site Disposal

In this treatment alternative, the PCP and dioxin impacts in the soil would be addressed by excavation. Specifically, the source areas delineated in **Figure 8** would be excavated using conventional methods and equipment. Since the treatment plant is expected to be demolished prior to the commencement of remedial activities, no access restrictions are foreseen at this time. As detailed in **Section 2.2**, surface soil impacts were observed in the area northwest of the treatment plant and subsurface soil impacts were observed beneath the treatment plant. Consequently, soils would be excavated to a depth of 5 feet bgs in the area northwest of the treatment plant and 10 feet bgs beneath the treatment plant to remove the impacted soils above TAGM 4046 guidance values (**Figure 8**). The estimated removal volume is approximately 860 cubic yards. Soils at the Site were determined by NYSDEC personnel to be hazardous. As such, soils will have to be disposed of in an appropriate hazardous waste landfill and may require pretreatment prior to disposal.

The excavation will be performed in cells in order to minimize exposure and construction hazards. Construction workers will wear adequate personal protective equipment (PPE). No sheeting, shoring, or bracing is expected to be required due to the dense soils at the Site and the manageable size of the excavation; however, the excavation will be benched. Excavated soils would be transported to a permitted treatment and disposal facility. Some pre-treatment of the excavated soils, prior to disposal, may be necessary. The excavation will be backfilled with clean fill from an off-site source. Residual soil impacts would be addressed via natural degradation. Since the water table at the Site is typically found at 3 to 6 feet bgs, excavation operations will require dewatering. Approximately 800 gallons of groundwater could be present within the excavation at any time. The total volume of water requiring disposal could range between zero (0) and 3,200 gallons per day.

Biannual groundwater monitoring would continue for five years. Institutional controls would remain in effect to limit site access and prohibit contact with impacted material.

5.3.1 Overall Protection of Human Health and the Environment

This alternative provides overall protection of human health and the environment by removing a potential source of groundwater contamination. Furthermore, it eliminates the potential for exposures to surface soil above the PRGs and will help prevent potential exposures to subsurface soils above the PRGs.

5.3.2 Compliance with ARARS

This alternative would eliminate exposure to impacted soils exceeding the PRGs through the excavation and off-site disposal of soils exceeding the PRGs for PCP and dioxin. During excavation and backfilling, air pollution regulations would be complied with by controlling fugitive dust and emissions. In general, this alternative actively addresses the primary sources of soil and potential groundwater contamination, and hence, is consistent with SCGs that regulate soil and groundwater quality.

5.3.3 Short-Term Effectiveness

Minimal short-term risks to the communities surrounding the transportation routes exist during the excavation and transportation of waste and clean soil by trucks. During the implementation of this remedial alternative, an increased risk of exposure would be posed to on-site construction workers and the community. Even with proper engineering controls, short-term mobility of COPCs would be increased through vapor and dust inhalation pathways. Air monitoring would be performed and dust generation emissions would be controlled by utilizing engineering measures, such as periodic water spray or the application of foam. Truck traffic on the local roads would increase due to construction vehicles entering and leaving the Site. Traffic control measures (e.g., signage and construction entrances) would be implemented as needed to limit the impact of the increased traffic.

Risks to workers performing remedial and monitoring activities under this alternative can be controlled and mitigated by the implementation of proper health and safety measures, including air monitoring and use of PPE, in accordance with OSHA 1910.120.

Risks to the environment resulting from implementation of this alternative include the potential for dust generation and sediment transport during excavation of the contaminated soil. Appropriate use of erosion and sediment control measures, such as silt fence/hay bale barriers, tarpaulins over material stockpiles, and dust suppression actions would mitigate these risks.

5.3.4 Long-Term Effectiveness

This remedial alternative provides a long-term effective and permanent solution to soil contamination exceeding the PRGs. Excavating and disposing of the material in a secured landfill provides a permanent solution to the potential source of contamination to the groundwater and soil gas.

5.3.5 Reduction of Toxicity, Mobility, and Volume

This remedial alternative relies on excavation and removal of COPCs at the Site instead of treatment. A limited volume of PCP and dioxin impacted soil will remain on-site in the soils. There is no expected reduction in the volume, toxicity, or mobility of the COPCs excavated and disposed of off-site. Excavation will reduce the on-site volume, toxicity, and mobility of the soil containing COPCs. Natural attenuation of COPCs in the remaining subsurface soil will also slowly reduce residual COPC concentrations remaining at the Site, thereby reducing the toxicity, mobility, and volume of impacted soil.

5.3.6 Implementability

This alternative can be implemented using conventional construction equipment and construction practices. Excavation may be limited by the geotechnical properties of the soil. Limitations of implementation of excavation could include:

- Geotechnically unstable soil;
- Obstruction by subsurface boulders;
- Building or foundation structures; and
- Hydrostatic failure of the excavation.

These geotechnical limitations are not expected to exist, with the exception of the possibility of subsurface boulders. If any of these limitations do exist, they are manageable. Excavation and transport equipment, clean fill, and other items associated with this alternative are readily accessible. This alternative is easily implementable.

5.3.7 Cost

Costs associated with this alternative include the equipment, labor, oversight, and transport and disposal fees. The estimated net present worth of this remedial alternative is approximately \$1,047,736. A breakdown of the cost estimate for this alternative is provided in **Appendix B**.

5.3.8 Summary

Excavation and off-site disposal of PCP and dioxin impacted soils may pose some technical challenges while also posing some short-term risk to the construction workers and surrounding occupants of the facility. This remedy provides an effective long-term remedy for PCP and dioxin contamination in the soil and will reduce on-site mobility, toxicity, and volume of PCP and dioxins. The major shortcoming of this alternative is that disposal fees for F032 class wastes are significant. This remedial alternative will be retained for further consideration because it achieves all of the remedial action objectives and the short-term risks associated with its implementation are manageable.

5.4 Alternative 5 – Thermal Desorption

In this treatment alternative, the PCP and dioxin impacts in the soil would be addressed using thermal desorption. Impacted soils would be excavated to the depth of groundwater, as described in **Section 5.3**. The excavated soils would be treated in a mobile HTTD unit at the Site, which will physically separate the contaminants from the soils by causing the water and organic contaminants in the soils to be vaporized. A gas or vacuum system transports the volatilized water and organic contaminants to a gas treatment system. The treated soils would then be mixed with amendments to rejuvenate microbial activity and returned to the excavation. Some clean fill may also be added due to loss of soil volume during the treatment process. Residual contamination in the saturated soils would be addressed via natural degradation. Biannual groundwater monitoring would continue for five years. Soil samples would be collected annually for five years to document changes in soil quality and natural attenuation. Institutional controls would remain in effect to limit site access and prohibit contact with impacted material.

5.4.1 Overall Protection of Human Health and the Environment
This alternative provides overall protection of human health and the environment by removing a potential source of groundwater contamination. Furthermore, it eliminates the potential for exposures to surface soil above the PRGs and will help prevent potential exposures to subsurface soils above the PRGs.

5.4.2 Compliance with ARARs
This alternative would eliminate exposure to impacted soils exceeding the PRGs through the excavation and thermal treatment of soils exceeding the PRGs for PCP and dioxin. During excavation and backfilling, air pollution regulations would be met by controlling fugitive dust and emissions. In general, this alternative actively addresses the primary sources of soil and potential groundwater contamination, and hence, is consistent with SCGs that regulate soil and groundwater quality.

5.4.3 *Short-term Effectiveness*

Minimal short-term risks to the communities surrounding the transportation routes exist during the excavation and transportation of waste and clean soil by truck. During the implementation of this remedial alternative, an increased risk of exposure would be posed to on-site construction workers and the community. Even with proper engineering controls, short-term mobility of COPCs would be increased through vapor and dust inhalation pathways. Air monitoring would be performed and dust generation emissions would be controlled by utilizing engineering measures, such as periodic water spray or the application of foam. Truck traffic on the local roads would increase due to construction vehicles entering and leaving the Site. Traffic control measures (e.g., signage and construction entrances) would be implemented as needed to limit the impact of the increased traffic.

Risks to workers performing remedial and monitoring activities under this alternative can be controlled and mitigated by implementation of proper health and safety measures, including air monitoring and use of PPE, in accordance with OSHA 1910.120.

Risks to the environment resulting from implementation of this alternative include the potential for dust generation and sediment transport during excavation of the contaminated soil. Appropriate use of erosion and sediment control measures, such as silt fence/hay bale barriers, tarpaulins over material stockpiles, and dust suppression actions would mitigate these risks.

The indirectly or directly-heated thermal desorption process included as part of this alternative is not considered an incineration process and is capable of yielding non-detectable concentrations of compounds such as dioxins/furans in its air emissions. The desorbed contaminants are condensed and a liquid waste stream is generated which would be treated in the unit or disposed off-site. The remaining non-condensable contaminants are treated with an air emissions control system.

5.4.4 *Long-term Effectiveness and Permanence*

This remedial alternative provides an effective and permanent solution to soil contamination exceeding the PRGs. The ex-situ thermal treatment of soils is intended to provide a permanent solution to soils acting as primary sources of potential groundwater contamination by reducing PCP and dioxin concentrations in soils to below levels capable of resulting in significant groundwater contamination (e.g., below TAGMs).

5.4.5 Reduction in Toxicity, Mobility, or Volume

This remedial alternative relies on treatment of COPCs at the site. Thermal desorption will reduce contaminant levels in the soil to below the PRGs. The "clean" soil will then be returned to the site. Air emissions will be treated by an off-gas system and moisture from the scrubber will be recovered and treated in the mobile unit. Any residual water generated from the treatment process is used to remoisten the soil before it is returned to the excavation to promote compaction. Therefore, this alternative meets the statutory preference for treatment. Thus, thermal desorption will reduce the toxicity, mobility, and volume of contamination. Natural attenuation of COPCs in the remaining subsurface soil will also slowly reduce residual contaminant concentrations remaining on the Site, thereby reducing the toxicity, mobility, and volume of impacted soil.

5.4.6 Implementability

This alternative can be implemented using conventional construction equipment and construction practices. Excavation may be limited by the geotechnical properties of the soil. Excavation may also be limited by the need to stage and characterize material prior to transport to various facilities based on contaminant concentration. Limitations of implementation of excavation could include:

- Geotechnically unstable soil;
- Obstruction by subsurface boulders;
  Building or foundation structures; and
- Hydrostatic failure of the excavation.

These geotechnical limitations, if they exist, are manageable.

The indirectly and directly heated thermal desorption processes included in this alternative are relatively new remedial technologies; however, their effectiveness has been demonstrated at numerous sites by multiple vendors and contractors. Based on information provided by vendors, operation of the indirectly and directly heated thermal desorption units would require significant volumes of liquid propane (or the equivalent of an alternate fuel) per day, which would require multiple fuel deliveries per week and the potential for leaks or releases of fuel (as well as providing additional costs).

With regard to monitoring, the excavation and ex-situ thermal treatment of impacted soils would be monitored directly, including air quality. Additionally, it may be necessary to acquire permits to operate the HTTD unit. Excavation and transport equipment, the thermal desorption unit, and other items associated with this alternative are readily accessible. This alternative is easily implementable.

5.4.7 Cost

Costs associated with this alternative include the site and system design, site construction, and system setup and operation. The estimated net present worth of this remedial alternative is approximately $926,047. A breakdown of the cost estimate for this alternative is provided in **Appendix B**.

5.4.8 Summary

Excavation and thermal treatment of PCP and dioxin impacted soils may pose some technical challenges while posing some short-term risk to the construction workers and facility occupants. The challenges and risks are manageable. This remedy provides an effective long-term remedy for PCP and dioxin contamination in the soil and will reduce on-site mobility, toxicity, and volume of PCP and dioxins. This remedial alternative will be retained for further consideration because it achieves all of the remedial action objectives and the short-term risks associated with its implementation are manageable. However, the small volume of soil to be treated at the Site may render this technology cost prohibitive.

5.5 Alternative 6A – Containment; Multi Layered Synthetic Cap

In this treatment alternative, the PCP and dioxin impacts would be addressed by installing a RCRA Subtitle C cap across the impacted area (**Figure 8**). A multi-layered cap was chosen over an asphalt/concrete cap for this FS because a multi-layered cap provides a higher degree of containment. The RCRA cap would eliminate the potential for direct contact with impacted media and prevent rainwater infiltration into the area of concern. A RCRA Subtitle C cap typically consists of the following layers:

> Vegetative Layer – approximately 6 inches of topsoil that serves to reduce erosion and infiltration of precipitation;
>
> Drainage Layer – approximately 24 inches of porous material (sand) that enhances lateral drainage of any precipitation that infiltrates through the vegetative layer; the vegetative and drainage layers help protect the underlying barrier layers from the environmental stresses of wetting/drying and freezing/thawing;

- Synthetic Barrier – low permeability membrane (at least 20 mil thickness) that represents the final impedance to precipitation infiltration;
- Low Permeability Layer – approximately 18 inches of compacted clay to prevent infiltration into the impacted media in the event that the synthetic barrier develops a leak or tear; and
- Subgrade Layer – approximately 12 inches of sand or other porous material that serves as the foundation for the cap; also, gases formed during biodegradation may be collected for subsequent treatment. For the purposes of this FS it is anticipated that a gas collection system will not be necessary, therefore it has not been incorporated into the cost estimate (**Appendix B**) for this alternative.

All future site development will account for the capping requirements of the Site in their design. Biannual monitoring would continue for approximately 30 years. Institutional controls would be implemented to limit site access and usage.

5.5.1 Overall Protection of Human Health and the Environment

This alternative provides overall protection of human health and the environment by eliminating all current exposures and future-use occupant exposures to surface and subsurface soil above the PRGs by containment of Site soil. Although capping does not prevent groundwater migration, it does limit the potential for further groundwater contamination.

5.5.2 Compliance with ARARs

This alternative would eliminate exposure to contaminated soil exceeding the PRGs through containment. During installation procedures, air pollution regulations would be complied with by controlling fugitive dust emissions through the use of periodic water spray or similar measures. In general, this alternative addresses the primary sources of soils and potential groundwater contamination, and hence, is consistent with SCGs that regulate soil and groundwater quality.

5.5.3 Short-Term Effectiveness

There are minimal short-term risks to construction workers during the implementation of this alternative. Even with proper engineering controls, short-term mobility of COPCs would be increased through vapor and dust inhalation pathways. Air monitoring would be performed and dust generation emissions would be controlled through the utilization of engineering measures, such as periodic water spray. Risks to workers performing remedial and monitoring activities under this alternative can be controlled and mitigated by the implementation of proper health and safety measures, including air monitoring and use of PPE, in accordance with OSHA 1910.120.

5.5.4 Long-Term Effectiveness

This remedial alternative provides an effective and long-term solution to soil impacts exceeding the PRGs. The cap will prevent direct contact with impacted soils as well as impede the transport of COPCs into groundwater. The long-term effectiveness of the cap will be ensured through routine inspection and maintenance of the cap and monitoring of groundwater.

5.5.5 Reduction of Toxicity, Mobility, and Volume

Caps are a containment technology, and as such do not lessen the toxicity or volume of hazardous wastes. However, caps do impede migration by preventing infiltration and transport of COPCs. Natural attenuation of the COPCs would slowly reduce the toxicity, mobility, and volume of impacted soil.

5.5.6 Implementability

This alternative can be implemented using conventional construction equipment and construction practices. A cap would have to be carefully integrated into the long-range development plans for the Site, as it will limit future land uses. Institutional controls would be implemented to limit land use activities that may compromise the condition of the cap. Vegetation that has tendency for deep root penetration must be eliminated from cap area. Long-term maintenance and monitoring would be necessary to ensure the integrity and effectiveness of the cap. Suppliers and materials to complete groundwater monitoring are widely available.

5.5.7 Cost

Unlike Alternatives 3, 4, and 5, containment does not require the excavation of soils, which lowers capital costs. However, long-term inspection and maintenance of the cap for at least 30 years will increase post-closure costs. The duration of inspection and maintenance is dependent on deep-rooted vegetation and burrowing animals, settling of the cap, and erosion. For the purposes of alternative screening, the net present worth of this alternative was estimated to be approximately $289,390. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

5.5.8 Summary

This alternative provides an effective, long-term remedy for PCP and dioxin impacts in the soil. A multi-layered cap would effectively prevent direct contact with impacted soils as well as impede the transport of COPCs into groundwater. The toxicity, mobility, and volume of COPCs in the soils will be gradually reduced via natural attenuation. Short-term risks to workers can be mitigated through the utilization of air monitoring equipment and PPE. Institutional controls would be implemented at the Site to ensure the integrity of the cap. This remedial alternative will be retained for further consideration because it achieves all of the remedial action objectives and the short-term risks associated with its implementation are manageable.

5.6 Alternative 6B – Containment; Low Permeability Cover System

In this treatment alternative, the PCP and dioxin impacts would be addressed by installing a clay and topsoil cover (12" clay with 6" topsoil), across the impacted area (**Figure 8**). This LPCS was recommended because a LPCS prevents direct contact with PCP and dioxin and, due to its low permeability, will prevent infiltration through the contaminated soil.

A LPCS typically consists of the following layers:

- Vegetative Layer – approximately 6 inches of topsoil that serves to reduce erosion and infiltration of precipitation;
- Low Permeability Layer – approximately 12 inches of compacted clay (maximum remolded coefficient of permeability of 1×10^{-7} cm/s throughout its thickness) to prevent infiltration into the impacted media.

All future site development will account for the containment requirements of the Site in their design. Biannual monitoring would continue for approximately 30 years. Groundwater samples would be collected annually for approximately 30 years to document changes in water quality. Institutional controls would be implemented to limit site access and usage. An engineered pavement system may be considered as an alternative LCPS.

5.6.1 Overall Protection of Human Health and the Environment

This alternative provides overall protection of human health and the environment by eliminating all current exposures and future-use occupant exposures to surface and subsurface soil above the PRGs by containment of Site soil. Although the LPCS does not prevent groundwater migration, it does limit the potential for further groundwater contamination.

5.6.2 Compliance with ARARs

This alternative would eliminate exposure to contaminated soil exceeding the PRGs through containment. During installation procedures, air pollution regulations would be complied with by controlling fugitive dust emissions through the use of periodic water spray or similar measures. In general, this alternative addresses the primary sources of soils and potential groundwater contamination, and hence, is consistent with SCGs that regulate soil and groundwater quality.

5.6.3 Short-Term Effectiveness

There are minimal short-term risks to construction workers during the implementation of this alternative. Even with proper engineering controls, short-term mobility of COPCs would be increased through vapor and dust inhalation pathways. Air monitoring would be performed and dust generation emissions would be controlled through the utilization of engineering measures, such as periodic water spray. Risks to workers performing remedial and monitoring activities under this alternative can be controlled and mitigated by the implementation of proper health and safety measures, including air monitoring and use of PPE, in accordance with OSHA 1910.120.

5.6.4 Long-Term Effectiveness

This remedial alternative provides an effective and long-term solution to soil impacts exceeding the PRGs. The LPCS will prevent direct contact with impacted soils as well as impede the transport of COPCs into groundwater. The long-term effectiveness of the LPCS will be ensured through routine inspection and maintenance of the LPCS and monitoring of groundwater.

5.6.5 Reduction of Toxicity, Mobility, and Volume

Covers are a containment technology, and as such do not lessen the toxicity or volume of hazardous wastes. However, the LPCS will impede migration by preventing infiltration and transport of COPCs. Natural attenuation of the COPCs would slowly reduce the toxicity, mobility, and volume of impacted soil.

5.6.6 Implementability

This alternative can be implemented using conventional construction equipment and construction practices. The LPCS would have to be carefully integrated into the long-range development plans for the Site, as it will limit future land uses. Institutional controls would be implemented to limit land use activities that may compromise the condition of the LPCS. Long-term maintenance and monitoring would be necessary to ensure the integrity and effectiveness of the LPCS. Suppliers and materials to complete groundwater monitoring are widely available.

5.6.7 Cost

Unlike Alternatives 3, 4, and 5, containment does not require the excavation of soils, which lowers capital costs. However, long-term inspection and maintenance of the cap for at least 30 years will increase post-closure costs. The duration of inspection and maintenance is dependent on deep-rooted vegetation and burrowing animals, settling of the LPCS, and erosion. For the purposes of alternative screening, the net present worth of this alternative was estimated to be approximately $259,269. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

5.6.8 Summary

This alternative provides an effective, long-term remedy for PCP and dioxin impacts in the soil. A LPCS would effectively prevent direct contact with impacted soils as well as impede the transport of COPCs into groundwater. The toxicity, mobility, and volume of COPCs in the soils will be gradually reduced via natural attenuation. Short-term risks to workers can be mitigated through the utilization of air monitoring equipment and PPE. Institutional controls would be implemented at the Site to ensure the integrity of the cover system. This remedial alternative achieves all of the remedial action objectives and the short-term risks associated with its implementation are manageable.

6.0 COMPARATIVE ANALYSIS AND SUBCATEGORIES

This section compares the relative performance of each of the remedial alternatives retained for further detailed analysis using the specific evaluation criteria presented in **Section 5.0**. The retained Remedial Alternatives are:

- Alternative 1 – No Action
- Alternative 3 – Excavation and Off-site Disposal
- Alternative 5 – Thermal Desorption
- Alternative 6A – Containment, Multi Layered Synthetic Cap
- Alternative 6B – Containment, Low-Permeability Cover System

Comparisons are presented in a qualitative manner in order to identify substantive differences between the alternatives. As with the detailed analysis, the following criteria were used for the comparative analysis:

- Overall Protection of Human Health and the Environment
- Compliance with SCGs, ARARs, and Other Regulations
- Short-Term Effectiveness
- Long-Term Effectiveness and Permanence
- Reduction in Mobility, Toxicity, and Volume
- Implementability
- Cost

The qualitative comparison is outlined in the following sections.

6.1 Overall Protection of Human Health and the Environment

The comparative evaluation of overall protection of human health and the environment evaluates attainment of PRGs, as well as the analysis of other criteria evaluated for each alternative (specifically, short- and long-term effectiveness). The evaluation of this criteria focuses on such factors as the manner in which the remedial alternatives achieve protection over time, the degree to which site risks would be reduced, and the manner in which the source of COPCs would be eliminated, reduced, or controlled.

Alternatives 1 (No Action) is not protective of human health and the environment. Alternative 3 (Excavation and Off-site Disposal) is protective of human health and the environment. Alternative 3 would effectively reduce potential human health exposure to the soil exceeding the PRGs by excavating the soil that contains COPCs above the PRGs and disposing the soil off-site in a secured landfill. Excavation of the soil exceeding the PRGs will remove the continuing source of groundwater contamination. Alternative 5 would effectively reduce the potential human health exposure to the soil exceeding the PRGs by excavating the soil that contains COPCs above the PRGs, separating the COPCs from the soil by thermal desorption, and treating the volatilized contaminants. Excavation of the soil exceeding the PRGs will remove the continuing source of groundwater contamination. Alternative 6A and 6B would effectively reduce potential human health exposure to the soil exceeding the PRGs by containing the soil and preventing direct or indirect contact with the soil. Preventing surface water infiltration would mitigate continuing groundwater contamination.

Short-term impacts to both human health and the environment during the implementation of Alternatives 3, 5, 6A, and 6B are minimal and easily managed. Alternatives 3, 5, 6A, and 6B would be considered effective measures to protect against potential long-term human health risks and environmental impacts.

6.2 Compliance with SCGs and ARARs

The comparative evaluation of the compliance of each Alternative focuses on the following criteria:

- Published NYSDEC Standards, Criteria, and Guidance (SCGs)
- Other applicable federal relevant and appropriate requirements (ARARs)

Alternative 1 (No Action) does not comply with the SCGs and ARARs. Alternatives 3, 5, 6A, and 6B would comply with SCGs and ARARs by excavation and off-site disposal; excavation and ex-situ treatment; or containment of the soils. All remedial actions would be completed in a manner compliant with action-specific standards.

6.3 Short-Term Effectiveness

The short-term effectiveness comparison includes the evaluation of the relative potential for impacts to the nearby communities, site workers exposures, environmental impacts, and the time frame for implementation of the alternatives.

The implementation of Alternative 1 (No Action) would result in the least short-term impact, because no action would be taken to disturb the impacted soil or groundwater at the site. Of the alternatives that will achieve the PRGs, Alternative 6B (Containment; Low Permeability Cover System) is anticipated to have the short-term effectiveness. Alternative 6B presents controllable risk to the nearby communities, site workers, and the environment. Any risks associated with implementing Alternative 6B are easily managed.

Although similar in effectiveness to Alternative 6B, the time requirement for Alternative Alternative 6A (Containment; Multi Layered Synthetic Cap) is greater than that of Alternative 6B, thereby rendering it less effective.

Although manageable, the potential risks associated with Alternatives 3 (Excavation and Off-site Disposal) and 5 (Thermal Desorption) to the site workers and surrounding communities during excavation and transport and disposal is greater with these alternatives than with other alternatives presented herein.

6.4 Long-Term Effectiveness

The comparative evaluation of long-term effectiveness focuses on the reduction of residual risk and adequacy and reliability of controls provided by each alternative.

Alternative 1 (No Action) does not reduce the risk of direct contact with impacted media or exposure to contaminated gas. Therefore, it is not a permanent or effective remedy.

Alternative 3 (Excavation and Off-site Disposal) is anticipated to have the greatest long-term effectiveness because the impacted media will be physically removed from the Site and residual impacts will be minimal.

Alternative 5 (Thermal Desorption) also provides a long-term and permanent remedy for the Site by volatilizing, capturing, and subsequently treating the contaminants and residual impacts will be minimal.

Alternatives 6A and 6B (Containment; Multi Layered Synthetic Cap and Containment; Low Permeability Cover System, respectively) are capable of impeding direct contact with impacted soils as well as impede the transport of COPCs into groundwater. Routine inspections and maintenance as well as institutional controls restricting land usage would increase the long-term effectiveness of the cap or cover.

6.5 Reduction of Toxicity, Mobility, and Volume

The comparative evaluation of the reduction of mobility, toxicity, and volume focuses on the ability of the alternative to address the impacted material on-site, the mass of material destroyed or treated, the irreversibility of the process employed, and the nature of the impacted materials after the implementation of the alternative.

Under Alternative 1 (No Action) the volume and toxicity of impacted media would gradually decrease over time through natural degradation and attenuation.

Alternative 3 (Excavation and Off-site Disposal) will reduce the on-site volume, toxicity, and mobility of COPCs. A limited volume of PCP and dioxin will remain on-site; the toxicity, mobility, and volume of which will be reduced via natural degradation. However, there is no expected reduction in the volume, toxicity, or mobility of the COPCs excavated and disposed of off-site.

Alternative 5 (Thermal Desorption) will achieve the greatest overall reduction in toxicity, mobility, and volume of COPCs. Thermal desorption will cause the contaminants to volatilize, physically separating the contaminants from the soils. The "clean" soil will then be returned to the excavation. Air emissions will be treated by an off-gas treatment system and moisture from the scrubber will be recovered and treated in the mobile unit. The toxicity, mobility, and volume of any residual contaminant concentrations remaining on-site will be reduced via natural degradation.

Alternatives 6A and 6B (Containment; Multi Layered Synthetic Cap and Containment; Low Permeability Cover System, respectively) are containment technologies, and as such, do not lessen the toxicity or volume of COPCs. However, caps are effective in impeding contaminant migration by minimizing infiltration of precipitation into the impacted zone and the erosion of surface soils.

6.6 Implementability

The comparative evaluation of implementability focuses on the feasibility of construction and operation of each alternative, the administrative feasibility, the availability or required disposal facilities, technical and service personnel, and contractors.

Alternative 1 (No Action) is readily implementable. This Alternative requires minimal planned or implemented activities. Suppliers and materials to complete groundwater monitoring are widely available.

Alternative 3 (Excavation and Off-site Disposal) can be implemented using standard construction equipment and practices. Excavation and transport equipment, clean fill, and other items associated with this alternative are readily available. Geotechnical limitations are not likely to impede this alternative. Although Alternative 3 is easily implementable, when compared to non-excavation alternatives it will be more difficult to implement due to the dewatering process, transport and disposal of soil, and possible unknown obstacles in the subsurface.

Alternative 5 (Thermal Desorption) is not readily implemented. Permits may be required to operate the HTTD unit. Indirectly and directly heated thermal desorption units require significant volumes of fuel, which would require multiple fuel deliveries per week and increased potential for leaks or releases of fuel. Excavation and transport equipment, the thermal desorption unit, and other items associated with this alternative are readily accessible.

Alternatives 6A and 6B (Containment; Multi Layered Synthetic Cap and Containment; Low Permeability Cover System, respectively) can be implemented using standard construction equipment and practices. The materials associated with cap installation and groundwater monitoring are easily accessible. The cap or cover would have to be carefully integrated into the long-range development plans for the site, as it will restrict future land usage. Implementation of 6A will require several different layers of construction material to be placed (including a welded seam geosynthetic), each requiring sufficient quality assurance and quality control to insure the cap integrity. In comparison, Alternative 6B requires only two layers with requisite quality assurance and quality control. Therefore, Alternative 6B is considered a more implementable alternative.

6.7 Cost

The comparative evaluation of the cost of remediation is abased on the net present worth of each alternative. The total capital, annual O&M, periodic, and present worth costs for all Alternatives are presented in **Appendix B**. The approximate costs associated with each Alternative are as follows:

Alternative 1 (No Action): $180,780
Alternative 3 (Excavation and Off-site Disposal): $1,047,736
Alternative 5 (Thermal Desorption): $926,047
Alternative 6A (Containment; Multi Layered Synthetic Cap): $289,390
Alternative 6B (Containment; Low Permeability Cover System): $259,269

6.8 Summary

Each alternative was qualitatively evaluated by each of the criteria described above. Alternative 6B was selected as the preferred remedy because it was determined, in comparison to the other evaluated alternatives, to have: equal protection to the overall protection of human health and the environment, a greater short-term effectiveness, easier implementation, and was more cost effective. Alternative 6B is technically and administratively feasible to implement. Short-term risks are controllable and long-term effectiveness is considered sufficient. Alternative 6B is the most cost effective alternative.

7.0 RECOMMENDED ALTERNATIVE

7.1 Description of Recommended Alternative

Alternative 6B (Containment; Low Permeability Cover System (LPCS)) is the recommended remedial alternative for the site. In this treatment alternative, the PCP and dioxin impacts would be addressed by installing a clay and topsoil cover (12-inches of clay with 6-inches of soil) across the impacted area (**Figure 8**). Based on the Comparative Analysis in **Section 6.0**, LPCS was recommend because in comparison to the alternatives it was equally protective to the overall protection of human health and the environment, had a greater short-term effectiveness, was easier to implement, and was more cost effective.

A LPCS typically consists of the following layers:

- Vegetative Layer – approximately 6 inches of topsoil that serves to reduce erosion and infiltration of precipitation;
- Low Permeability Layer – approximately 12 inches of compacted clay (maximum remolded coefficient of permeability of 1×10^{-7} cm/s throughout its thickness) to prevent infiltration into the impacted media.

All future site development will account for the capping requirements of the Site in their design. Biannual monitoring would continue for approximately 30 years. Groundwater samples would be collected annually for approximately 30 years to document changes in water quality. Institutional controls would be implemented to limit site access and usage. An engineered pavement system may be considered as an alternative LCPS.

This alternative effectively and economically addresses the impacts observed at the Site. An "active" groundwater remediation strategy is not proposed because the most recent groundwater data indicates that minimal dissolved groundwater impacts exist however, continued groundwater monitoring as discussed in **Section 4.2** is recommended.

7.2 Comparison of the Recommended Alternative to the CERCLA Criteria

7.2.1 Overall Protection of Human Health and the Environment

This alternative provides overall protection of human health and the environment by eliminating all current exposures and future-use occupant exposures to surface and subsurface soil above the PRGs by containment of Site soil. Although a protective cover does not prevent groundwater migration, it does limit the potential for further groundwater contamination.

7.2.2 Compliance with ARARs

This alternative would eliminate exposure to contaminated soil exceeding the PRGs through containment. During installation procedures, air pollution regulations would be complied with by controlling fugitive dust emissions through the use of periodic water spray or similar measures. In general, this alternative addresses the primary sources of soils and potential groundwater contamination, and hence, is consistent with SCGs that regulate soil and groundwater quality.

7.2.3 Short-Term Effectiveness

There are minimal short-term risks to construction workers during the implementation of this alternative. Even with proper engineering controls, short-term mobility of COPCs would be increased through vapor and dust inhalation pathways. Air monitoring would be performed and dust generation emissions would be controlled through the utilization of engineering measures, such as periodic water spray. Risks to workers performing remedial and monitoring activities under this alternative can be controlled and mitigated by the implementation of proper health and safety measures, including air monitoring and use of PPE, in accordance with OSHA 1910.120.

7.2.4 Long-Term Effectiveness

This remedial alternative provides an effective and long-term solution to soil impacts exceeding the PRGs. The LPCS will prevent direct contact with impacted soils as well as impede the transport of COPCs into groundwater. The long-term effectiveness of the cap will be ensured through routine inspection and maintenance of the LPCS and monitoring of groundwater.

7.2.5 Reduction of Toxicity, Mobility, and Volume

Low Permeability Cover Systems are a containment technology, and as such do not lessen the toxicity or volume of hazardous wastes. However, the LPCS will impede migration by preventing infiltration and transport of COPCs. Natural attenuation of the COPCs would slowly reduce the toxicity, mobility, and volume of impacted soil.

7.2.6 Implementability

This alternative can be implemented using conventional construction equipment and construction practices. The LPCS would have to be carefully integrated into the long-range development plans for the Site, as it will limit future land uses. Institutional controls would be implemented to limit land use activities that may compromise the condition of the LPCS. Long-term maintenance and monitoring would be necessary to ensure the integrity and effectiveness of the LPCS. Suppliers and materials to complete groundwater monitoring are widely available.

7.2.7 Cost

Unlike Alternatives 3, 4, and 5, containment does not require the excavation of soils, which lowers capital costs. However, long-term inspection and maintenance of the LPCS for at least 30 years will increase post-closure costs. The duration of inspection and maintenance is dependent on deep-rooted vegetation and burrowing animals, settling of the cover, and erosion. For the purposes of alternative screening, the net present worth of this alternative was estimated to be approximately $259,269. A breakdown of the cost estimate for this alternative is included in **Appendix B**.

7.2.8 Summary

This alternative provides an effective, long-term remedy for PCP and dioxin impacts in the soil. A LPCS would effectively prevent direct contact with impacted soils as well as impede the transport of COPCs into groundwater. The toxicity, mobility, and volume of COPCs in the soils will be gradually reduced via natural attenuation. Short-term risks to workers can be mitigated through the utilization of air monitoring equipment and PPE. Institutional controls would be implemented at the Site to ensure the integrity of the cover system. This remedial alternative achieves all of the remedial action objectives and the short-term risks associated with its implementation are manageable.

8.0 REFERENCES

Asphalt Institute, 1989.

Asphalt Magazine, 1991/1992.

New York State Department of Environmental Conservation (NYSDEC), 1998. Division of Water Technical and Operation Guidance Series (TOGS) (1.1.1). Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, June 1998.

NYSDEC, 1989. Division Technical and Administrative Guidance Memorandum (TAGM) Guidelines for Remedial Investigations/Feasibility Studies HWR-89-4025, March 1989.

NYSDEC, 1989. TAGM 4031, Fugitive Dust Suppression and Particulate Monitoring Program and Inactive Hazardous Waste Sites, October 27, 1989.

NYSDEC, 1990. TAGM 4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites, May 15, 1990.

NYSDEC, 1992. Inactive Waste Disposal Site Remedial Program. 6 NYCRR part 375. 1992.

NYSDEC, 1994. TAGM 4046. Determination of Soil Cleanup Objectives and Cleanup Levels, January 1994.

Remediation Technologies. Naval Facilities Engineering Service Center. Accessed November 2002. <http://erb.nfesc.navy.mil/restoration/technologies/remed/main.htm>.

Remediation Technologies Screening Matrix and Reference Guide, Version 4.0. Federal Remediation Technologies Roundtable. Accessed November 2002. <http://www.frtr.gov/matrix2/section1/toc.html>.

Shaw Environmental, Inc., 2002. Qualitative Human Health Exposure Assessment Report, Camp Pharsalia, South Plymouth, New York Site, December 17, 2002.

Shaw Environmental, Inc., 2002. Remedial Investigation Report, Camp Pharsalia, South Plymouth, New York Site, December 17, 2002.

USEPA, 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, October 1988.

USEPA, 1993. Remedial Technologies Screening Matrix and Reference Guide, July 1993.

TABLES

Table 1
Surface Soil Sample Analytical Results
Camp Pharsalia

Analyte *(Units)*	TAGM	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9	PSS-1	PSS-2	PSS-3	PSS-4	PSS-5
SVOC *(mg/kg)*															
Bis (2-ethylhexyl) phthalate	50	<0.33	<0.33	<5.9	<1.65	<5.9	**0.17 J**	<0.33	<0.33	<1.65	-	-	-	-	-
Chrysene	0.4	<0.33	<0.33	<4.0	<1.65	**0.26 J**	<1.65	<0.33	<0.33	<1.65	-	-	-	-	-
Di-n-butyl phthalate	8.1	<0.33	<0.33	<4.0	<1.65	<3.5	<0.33	<0.33	**0.044 J**	<1.65	-	-	-	-	-
Fluoranthene	50	<0.33	<0.33	<5.9	<1.65	**0.31 J**	**0.12 J**	<0.33	<0.33	<0.33	-	-	-	-	-
Pentachlorophenol	1	<1.6	<1.6	<16	<80	**270 D**	**70 D**	**0.096 J**	**1.0 J**	**7.8**	**550**	**10**	**25**	**0.74**	**1.9**
Pyrene	50	<0.33	<0.33	<5.9	<1.65	**1.3**	**0.57 J**	<0.33	<0.33	<1.65	-	-	-	-	-
Total SVOC		BDL	BDL	BDL	BDL	**271.87 J**	**70.86 J**	**0.096 J**	**1.044 J**	**7.8**	-	-	-	-	-
Metals *(mg/kg)*	**Background**	**SS-1**	**SS-2**	**SS-3**	**SS-4**	**SS-5**	**SS-6**	**SS-7**	**SS-8**	**SS-9**	-	-	-	-	-
Aluminum	135200	**11800 J**	**12300 J**	**11000 J**	**12400 J**	**9960 J**	**13700 J**	**14100 J**	**14400 J**	**12500 J**	-	-	-	-	-
Antimony	0.974	**1.8 B**	**1.1 B**	**1.4 B**	**0.94 B**	**1.0 B**	**1.3 B**	**0.97 B**	**1.1 B**	**1.5 B**	-	-	-	-	-
Arsenic	8.04	**8.5**	**7.5**	**9**	**7.5**	**5**	**10.3**	**7.7**	**7.4**	**3.8**	-	-	-	-	-
Barium	40.82	**67.9 J**	**62.2 J**	**58.0 J**	**67.6 J**	**52.8 J**	**85.0 J**	**67.2 J**	**79.5 J**	**74.6 J**	-	-	-	-	-
Berillium	0.45	**0.52 B**	**0.41 B**	**0.41 B**	**0.47 B**	**0.36 B**	**0.54 B**	**0.49 B**	**0.53 B**	**0.49 B**	-	-	-	-	-
Cadmium	U	**0.18 B**	<0.03	<0.04	**0.10 B**	<0.03	<0.04	**0.26 B**	<0.03	<0.03	-	-	-	-	-
Calcium	430	**1570 J**	**636 J**	**2680 J**	**1070 J**	**755 J**	**1190 J**	**544 B**	**916 J**	**967 J**	-	-	-	-	-
Chromium	17.44	**15.1 J**	**14.6 J**	**14.2 J**	**15.9 J**	**13.7 J**	**18.4 J**	**16.4 J**	**19.4 J**	**16.8 J**	-	-	-	-	-
Cobalt	9.74	**10.9 J**	**11.2 J**	**10.6 J**	**12.6 J**	**8.2 J**	**13.7 J**	**13.1 J**	**12.9 J**	**11.6 J**	-	-	-	-	-
Copper	13.32	**23.1 J**	**18.4 J**	**36.7 J**	**119 J**	**80.4 J**	**79.2 J**	**57.7 J**	**50.4 J**	**139 J**	-	-	-	-	-
Iron	26060	**25300 J**	**25800 J**	**24100 J**	**28800 J**	**23400 J**	**31800 J**	**26500 J**	**33600 J**	**29900 J**	-	-	-	-	-
Lead	10.42	**20.8 J**	**17.7 J**	**20.6 J**	**22.2 J**	**41.9 J**	**77.2 J**	**50.8 J**	**38.2 J**	**145 J**	-	-	-	-	-
Magnesium	3532	**3510 J**	**3240 J**	**3620 J**	**4230 J**	**3440 J**	**4660 J**	**3150 J**	**4980 J**	**4310 J**	-	-	-	-	-
Manganese	298.2	**805 J**	**947 J**	**558 J**	**807 J**	**253 J**	**960 J**	**740 J**	**692 J**	**698 J**	-	-	-	-	-
Nickel	22.94	**22.8 J**	**22.2 J**	**23.9 J**	**29.0 J**	**21.3 J**	**30.2 J**	**21.5 J**	**32.2 J**	**28.0 J**	-	-	-	-	-
Potassium	626.6	**860 J**	**718 J**	**820 J**	**670 J**	**775 J**	**1060 J**	**718 J**	**906 J**	**760 J**	-	-	-	-	-
Selenium	1.3	**1.6**	**1**	**1.1**	**1.1**	**1.1**	**1.4**	**1.6**	**1.6**	**1.3**	-	-	-	-	-
Silver	U	**0.41 B**	**0.17 B**	<0.11	<0.10	<0.10	<0.11	<0.12	<0.10	<0.10	-	-	-	-	-
Mercury	0.0158	**0.064**	**0.028 B**	<0.021 B	**0.008 B**	**0.016 B**	**0.011 B**	**0.037 B**	**0.012 B**	**0.011 B**	-	-	-	-	-
Sodium	38.34	**50.4 B**	**40.0 B**	**73.3 B**	**44.9 B**	<29.6	**45.4 B**	<37.0	**61.9 B**	**43.5 B**	-	-	-	-	-
Thallium	U	<0.61 J	<0.59 J	<0.63 J	<0.55 J	<0.57 J	<0.61 J	<0.70 J	<0.58 J	<0.60 J	-	-	-	-	-
Vanadium	17.6	**15.0 J**	**15.9 J**	**15.3 J**	**14.0 J**	**11.9 J**	**16.7 J**	**18.4 J**	**17.2 J**	**16.1 J**	-	-	-	-	-
Zinc	53.66	**57.1 J**	**53.8 J**	**56.6 J**	**61.9 J**	**49.4 J**	**69.5 J**	**64.0 J**	**72.3 J**	**59.9 J**	-	-	-	-	-
Dioxins *(ng/g)*	**TEF's**	**SS-1**	**SS-2**	**SS-3**	**SS-4**	**SS-5**	**SS-6**	**SS-7**	**SS-8**	**SS-9**	-	-	-	-	-
Total TCDF		**0.001 J**	**0.00092**	**0.014**	**0.037**	<0.15	<0.29	**0.021**	<0.087	<0.13	-	-	-	-	-
Total PeCDF		**0.31 J**	**0.031**	**0.2**	**0.59**	<0.59	**2.1 J**	**3.4**	<0.75	**1.3 J**	-	-	-	-	-
TotalHxCDF		**0.49 J**	**0.43**	**2.2**	**6.3**	**47 J**	**25 J**	**7.9**	**14 J**	**24 J**	-	-	-	-	-
Total HpCDF		**1.9 J**	**1.5**	**7**	**24 J**	**270 J**	**130 J**	**53**	**66**	**100 J**	-	-	-	-	-
Total TCDD		**0.001 J**	**0.0016**	**0.0086**	**0.0088**	<0.027	<0.053	**0.015**	<0.037	<0.050	-	-	-	-	-
Total PeCDD		**0.019 J**	**0.0083**	**0.083**	**0.15**	<0.48	<0.51	**0.2**	<0.49	<0.76	-	-	-	-	-
Total HxCDD		**0.49 J**	**0.36**	**1.4**	**3.7**	**30 J**	**19 J**	**4.1**	**10 J**	**18 J**	-	-	-	-	-
Total HpCDD		**5 J**	**3.3**	**15**	**47**	**730 J**	**560 J**	**44**	**220 J**	**350 J**	-	-	-	-	-
2,3,7,8-TCDD	1	**0.0011 J**	**0.00083 J**	**0.0028**	**0.0035**	<0.027	<0.053	**0.0065**	<0.037	<0.050	-	-	-	-	-
1,2,3,7,8-PeCDD	0.5	**0.01 J**	**0.0083**	**0.032**	**0.056**	<0.48	<0.51	**0.1**	<0.49	<0.76	-	-	-	-	-
1,2,3,4,7,8-HxCDD	0.1	**0.029 J**	**0.021 J**	**0.068 J**	**0.18 J**	**0.72 J**	**0.70 J**	**0.25 J**	<0.62	**1.1 J**	-	-	-	-	-
1,2,3,6,7,8-HxCDD	0.1	**0.12 J**	**0.099**	**0.39**	**1.2**	**13 J**	**7.2 J**	**1.3**	**3.7 J**	**5.8 J**	-	-	-	-	-
1,2,3,7,8,9-HxCDD	0.1	**0.074 J**	**0.056 J**	**0.2 J**	**0.44 J**	**2.1 J**	**1.8 J**	**0.59 J**	**1.4 J**	**2.5 J**	-	-	-	-	-
1,2,3,4,6,7,8-HpCDD	0.01	**3.2 E J**	**2.1**	**9.3 EJ**	**30 D**	**520 EJ**	**370 EJ**	**28.0 D**	**150 EJ**	**230 EJ**	-	-	-	-	-
OCDD	0.0001	**23.0 E J**	**13.0 EJ**	**58.0 EJ**	**210 DEJ**	**2500 EJ**	**1700 EJ**	**170.0 D**	**600 EJ**	**870 EJ**	-	-	-	-	-
2,3,7,8-TCDF	0.1	<0.05 J	**0.00092 JCON**	**0.0037 CON**	**0.011 CON**	<0.15	<0.29	**0.0043 CON**	<0.087	<0.13	-	-	-	-	-
1,2,3,7,8-PeCDF	0.05	**0.0039 J**	**0.0052 J**	**0.025**	**0.066**	<0.34	<0.18	**0.031**	<0.35	<0.40	-	-	-	-	-
2,3,4,7,8-PeCDF	0.5	**0.0031 J**	<0.0029	**0.015**	**0.047**	<0.33	<0.17	**0.024**	<0.35	<0.39	-	-	-	-	-
1,2,3,4,7,8-HxCDF	0.1	**0.018 J**	**0.021**	**0.1**	**0.24**	**1.2 J**	**0.78 J**	**0.4**	<0.55	**0.87 J**	-	-	-	-	-
1,2,3,6,7,8-HxCDF	0.1	**0.012 J**	**0.012**	**0.057**	**0.11**	<0.42	<0.29	**0.16**	<0.29	<0.49	-	-	-	-	-
2,3,4,6,7,8-HxCDF	0.1	**0.0071 J**	**0.0083**	**0.045**	**0.086**	**1.1 J**	**0.78 J**	**0.11**	<0.46	**1.0 J**	-	-	-	-	-
1,2,3,7,8,9-HxCDF	0.1	<0.0013 J	<0.002	**0.0079**	**0.02**	<0.14	<0.067	**0.0095**	<0.12	<0.17	-	-	-	-	-
1,2,3,4,6,7,8-HpCDF	0.01	**0.51 J**	**0.37**	**1.7**	**5.3 DJ**	**50 EJ**	**27 J**	**12.0 D**	**16 J**	**25 J**	-	-	-	-	-
1,2,3,4,7,8,9-HpCDF	0.01	**0.037 J**	**0.029**	**0.13**	**0.36 DJ**	**3.4 J**	**2 J**	**0.78 D**	**0.99 J**	**1.6 J**	-	-	-	-	-
OCDF	0.0001	**1.9 J**	**1.3**	**6.5 EJ**	**20.0 D**	**450 EJ**	**100 EJ**	**53.0 D**	**56 EJ**	**81 EJ**	-	-	-	-	-
2,3,7,8-TCDD Equivalance	1.0	**0.073815 JE**	**0.053482 JECON**	**0.23246 ECON**	**0.6666 DECON**	**7.841 EJ**	**5.296 EJ**	**0.78253 DCON**	**2.2455 EJ**	**3.7881 EJ**	-	-	-	-	-

Notes:
*PSS results from PIR PCP Immunoassay Results
Bold Text=Analyte detected above laboratory method detection limit
Shaded Text=Exceedence of TAGM soil cleanup objectives to protect groundwater quality
Only analytes detected at or above laboratory method detection limits included on tables

SVOC Data Qualifiers:
All results in mg/kg
<U=Analyte was not detected above laboratory detection limits
J=Estimated Value
B=Analyte was found in method blank as well as the sample

Dioxins Data Qualifiers:
All results in ng/g
D=Result obtained from dilution
J=Estimated result, result is less than the reporting limit
E=Estimated result, result exceeds calibration range
CON=Confirmation analysis

Metals Data Qualifiers:
All results in mg/kg
B=Indicates a value greater than or equal to the instrument detection limit but less than the quantitation limit
J=Estimated result, result is less than the reporting limit

M:/193reps/DEC/Pharsalia FS Table 1 Soils

Table 2
Subsurface Soil Boring Analytical Results
Camp Pharsalia

Analyte (Units)	TAGM	SB-1 10-12'	SB-2 10-12'	SB-3 10-12'	SB-4 6-8'	SB-5 8-10'	SB-6 4-6'	SB-7 2-4'	SB-8 6-8'
SVOC (mg/kg)									
Acenaphthene	50	<0.33	0.13 J	0.046 J	<0.33	<0.33	<0.33	<0.33	<0.38
Bis(2-ethylhexyl)Phthalate	50	-	-	-	-	-	-	-	0.055 J
Dibenzofuran	6.2	<0.33	0.081 J	0.039 J	<0.33	<0.33	<0.33	<0.33	<0.38
Di-n-butyl phthalate	8.1	<0.33	0.075 J	<0.33	<0.33	<0.33	<0.33	<0.33	<0.38
Fluorene	50	0.025 J	0.3 J	0.15 J	<0.33	<0.33	<0.33	<0.33	<0.38
2-Methylnaphthalene	36.4	<0.33	0.14 J	0.019 J	<0.33	<0.33	<0.33	<0.33	<0.38
Pentachlorophenol	1	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.94
Phenanthrene	50	0.1 J	0.64	0.4	<0.33	<0.33	<0.33	<0.33	<0.38
Pyrene	50	<0.33	0.046 J	0.018 J	<0.33	<0.33	<0.33	<0.33	<0.38
Total SVOCs		0.125 J	1.412 J	0.672 J	BDL	BDL	BDL	BDL	0.055 J
Dioxins (ng/g)	TEF's	SB-1	SB-2	SB-3	SB-4	SB-5	SB-6	SB-7	SB-8
Total TCDF		<0.0003	<0.00036	<0.00029	<0.00027	<0.00019	<0.00025	<0.00052	<0.00003
Total PeCDF		<0.0003	<0.00058	<0.00056	<0.00022	<0.0002	<0.0004	<0.00084	<0.00031
TotalHxCDF		<0.00096	0.022	0.014	<0.00076	<0.0023	<0.0017	<0.0016	<0.00003
Total HpCDF		0.0052	0.15	0.12	0.0039	0.019	0.0066	0.013	<0.00004
Total TCDD		<0.00026	<0.00058	<0.0004	<0.00016	<0.00013	<0.00036	0.018	<0.00004
Total PeCDD		<0.0015	<0.00079	<0.002	<0.00068	<0.00036	<0.00081	0.014	<0.00019
Total HxCDD		<0.00057	0.012	0.0083	<0.00068	<0.00085	<0.00069	0.0035	<0.00010
Total HpCDD		0.015	0.18	0.15	0.013	0.031	0.017	0.023	<0.00012
2,3,7,8-TCDD	1	<0.00026	<0.00058	<0.0004	<0.00016	<0.00013	<0.0036	<0.00064	<0.00004
1,2,3,7,8-PeCDD	0.5	<0.0015	<0.00079	<0.002	<0.00068	<0.00036	<0.00081	<0.0016	<0.00019
1,2,3,4,7,8-HxCDD	0.1	<0.00029	<0.00067	<0.00066	<0.00016	<0.00014	<0.00065	<0.00094	<0.00010
1,2,3,6,7,8-HxCDD	0.1	<0.00037	0.0061	0.0043 J	<0.00047	<0.00085	<0.00069	<0.0012	<0.00008
1,2,3,7,8,9-HxCDD	0.1	<0.00027	<0.0027	<0.0013	<0.00026	<0.00024	<0.00064	<0.00092	<0.00008
1,2,3,4,6,7,8-HpCDD	0.01	0.0098	0.12	0.099	0.008	0.019	0.012	0.017	<0.00012
OCDD	0.0001	0.063	0.55	0.5	0.05	0.16	0.045	0.042	0.00022 J
2,3,7,8-TCDF	0.1	<0.0003	<0.00036	<0.00029	<0.00027	<0.00019	<0.00025	<0.00052	<0.00002
1,2,3,7,8-PeCDF	0.05	<0.00024	<0.00058	<0.00056	<0.00015	<0.00014	<0.0004	<0.00079	<0.00031
2,3,4,7,8-PeCDF	0.5	<0.00024	<0.00056	<0.00056	<0.00015	<0.00014	<0.0004	<0.00079	<0.00030
1,2,3,4,7,8-HxCDF	0.1	<0.00016	<0.0011	<0.0012	<0.00017	<0.0002	<0.00049	<0.001 J	<0.00002
1,2,3,6,7,8-HxCDF	0.1	<0.00028	<0.00092	<0.00046	<0.00017	<0.000075	<0.00043	<0.00087 J	<0.00003
2,3,4,6,7,8-HxCDF	0.1	<0.00017	<0.0011	<0.0007	<0.00018	<0.000084	<0.00054	<0.0011 J	<0.00003
1,2,3,7,8,9-HxCDF	0.1	<0.00018	<0.0012	<0.0033	<0.0002	<0.00009	<0.00057	<0.0012 J	<0.00003
1,2,3,4,6,7,8-HpCDF	0.01	<0.0016	0.03	0.024	<0.002	0.0037 J	<0.0022	0.0034 J	<0.00003
1,2,3,4,7,8,9-HpCDF	0.01	<0.00093	<0.002	<0.0038	<0.00046	<0.0046	<0.0006	<0.00083	<0.00004
OCDF	0.0001	0.0077 J	0.18	0.16	0.0056 J	0.021	0.0073 J	0.011 J	<0.00003
2,3,7,8-TCDD Equivalance	1.0	0.000105 J	0.002183	0.001726	0.0000856 J	0.000245 J	0.000125 J	0.000209 J	0.000000022 J

Analyte (Units)	SB-8 10-12'	SB-9 8-10'	SB-9 12-14'	SB-10 12-14'	SB-10 14-16'	SB-11 10-12'	SB-12 4-6'	SB-12 12-14'	SB-13 8-10'	SB-13 12-14'	PMW-6A 6-8'	PMW-6A 12-14'
SVOC (mg/kg)												
Acenaphthene	<0.38	<0.37	<0.37	<0.38	<0.37	<0.36	<0.37	<0.35	<0.39	<0.37	0.38	<0.39
Bis(2-ethylhexyl)Phthalate	<0.38	0.023 J	0.021 J	0.048 J	0.13 J	0.035 J	<0.37	0.053 J	0.074 J	<0.37	0.024 J	0.031 J
Dibenzofuran	<0.38	<0.37	<0.37	<0.38	<0.37	<0.36	<0.37	<0.35	<0.39	<0.37	<0.38	<0.39
Di-n-butyl phthalate	<0.38	<0.37	<0.37	<0.38	<0.37	<0.36	<0.37	<0.35	<0.39	<0.37	<0.38	<0.39
Fluorene	<0.38	<0.37	<0.37	<0.38	<0.37	<0.36	<0.37	<0.35	<0.39	<0.37	<0.38	<0.39
2-Methylnaphthalene	<0.38	<0.37	<0.37	<0.38	<0.37	<0.36	<0.37	<0.35	<0.39	<0.37	<0.38	<0.39
Pentachlorophenol	<0.94	<0.92	<0.92	<0.96	<0.92	<0.91	<0.92	<0.89	<0.97	<0.92	<0.96	<0.97
Phenanthrene	<0.38	<0.37	<0.37	<0.38	<0.37	<0.36	<0.37	<0.35	<0.39	<0.37	<0.38	<0.39
Pyrene	<0.38	<0.37	<0.37	<0.38	<0.37	<0.36	<0.37	<0.35	<0.39	<0.37	<0.38	<0.39
Total SVOCs	BDL	0.023 J	0.021 J	0.048J	0.13 J	0.035 J	BDL	0.053 J	0.074 J	BDL	0.024 J	0.031 J
Dioxins (ng/g)	SB-8	SB-9	SB-9	SB-10	SB-10	SB-11	SB-12	SB-12	SB-13	SB-13	PMW-6A	PMW-6A
Total TCDF	<0.00002	<0.00002	<0.00002	<0.00001	<0.00001	<0.00011	<0.00002	<0.00001	<0.00002	<0.00001	<0.00002	<0.00002
Total PeCDF	<0.00004	<0.00004	<0.00005	<0.00004	<0.00007	<0.00012	<0.00005	<0.00004	<0.00007	<0.00003	<0.00007	<0.00009
TotalHxCDF	<0.00002	<0.00002	<0.00002	<0.00002	>0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00003
Total HpCDF	<0.00003	<0.00005	<0.00002	<0.00004	<0.00003	<0.00003	<0.00005	<0.00016	<0.00005	<0.00005	<0.00003	<0.00004
Total TCDD	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00003	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Total PeCDD	<0.00008	<0.00003	<0.00004	<0.00004	<0.00007	<0.00010	<0.00005	<0.00005	<0.00004	<0.00003	<0.00004	<0.00003
Total HxCDD	<0.00004	<0.00003	<0.00006	<0.00004	<0.00003	<0.00004	<0.00003	<0.00003	<0.00005	<0.00004	<0.00003	<0.00003
Total HpCDD	<0.00004	<0.00007	<0.00004	<0.00003	<0.00004	<0.00005	<0.00004	<0.00004	<0.00014	<0.00004	<0.00004	<0.00004
2,3,7,8-TCDD	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00003	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
1,2,3,7,8-PeCDD	<0.00008	<0.00003	<0.00004	<0.00003	<0.00007	<0.00010	<0.00005	<0.00005	<0.00004	<0.00003	<0.00004	<0.00003
1,2,3,4,7,8-HxCDD	<0.00004	<0.00004	<0.00006	<0.00004	<0.00002	<0.00004	<0.00003	<0.00003	<0.00005	<0.00004	<0.00003	<0.00003
1,2,3,6,7,8-HxCDD	<0.00003	<0.00003	<0.00005	<0.00003	<0.00002	<0.00003	<0.00003	<0.00003	<0.00004	<0.00003	<0.00003	<0.00003
1,2,3,7,8,9-HxCDD	<0.00003	<0.00003	<0.00005	>0.00004	<0.00003	<0.00004	<0.00003	<0.00003	<0.00004	<0.00003	<0.00003	<0.00003
1,2,3,4,6,7,8-HpCDD	<0.00004	<0.00007	<0.00004	<0.00004	<0.00004	<0.00005	<0.00004	<0.00004	<0.00014	<0.00004	<0.00004	<0.00004
OCDD	<0.00003	<0.00004	<0.00004	<0.00003	<0.00003	0.00014 JS	<0.00003	<0.00003	<0.00003	<0.00005	<0.00003	<0.00003
2,3,7,8-TCDF	<0.00002	<0.00002	<0.00002	<0.00001	<0.00001	<0.00011	<0.00002	<0.00001	<0.00002	<0.00001	<0.00002	<0.00002
1,2,3,7,8-PeCDF	<0.00004	<0.00004	<0.00005	<0.00004	<0.00007	<0.00012	<0.00005	<0.00004	<0.00007	<0.00003	<0.00007	<0.00009
2,3,4,7,8-PeCDF	<0.00004	<0.00004	<0.00005	<0.00004	<0.00007	<0.00011	<0.00005	<0.00004	<0.00007	<0.00003	<0.00007	<0.00009
1,2,3,4,7,8-HxCDF	<0.00002	<0.00002	<0.00002	<0.00001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
1,2,3,6,7,8-HxCDF	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
2,3,4,6,7,8-HxCDF	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00003
1,2,3,7,8,9-HxCDF	<0.00002	<0.00002	<0.00002	<0.00001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
1,2,3,4,6,7,8-HpCDF	<0.00003	<0.00005	<0.00002	<0.00004	<0.00002	<0.00003	<0.00004	<0.00013	<0.00004	<0.00004	<0.00003	<0.00004
1,2,3,4,7,8,9-HpCDF	<0.00003	<0.00005	<0.00002	<0.00004	<0.00003	<0.00003	<0.00005	<0.00016	<0.00005	<0.00005	<0.00003	<0.00004
OCDF	<0.00002	<0.00003	<0.00003	<0.00002	<0.00004	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003
2,3,7,8-TCDD Equivalance	BDL	BDL	BDL	BDL	BDL	0.000000014 JS	BDL	BDL	BDL	BDL	BDL	BDL

Analyte (Units)	PB-1 0-4'	PB-2 0-4'	PB-3 0-4'	PB-4 0-4'	PB-6 0-4'	PB-7 0-2'	PB-11 0-2'	PTP-1 10'x2'x8'	PTP-2 11'x2'x7'	PTP-3 12'x2'x7'	PTP-4 11'x2'x7'	PTP-5 12'x2'x9'	PTP-6 12'x2'x8'	PTP-7 9'x2'x6'	PTP-8 11'x2'x6'	PTP-9 10'x2'x10'
SVOC (mg/kg)																
Acenaphthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)Phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	3000 JD	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	-	-	-	8100 D	-	-	-	-	-	-	-	-	-	-	-	-
Pentachlorophenol	111	330	128	82	0.16	0.24	0.22	ND	0.14	0.18	0.2	0.22	ND	0.16	0.19	56
Phenanthrene	-	-	-	6300 D	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	-	-	-	1800 JD	-	-	-	-	-	-	-	-	-	-	-	-
Total SVOCs	-	-	-	101.2	-	-	-	-	-	-	-	-	-	-	-	-
Dioxins (ng/g)	PB-1	PB-2	PB-3	PB-4	PB-6	PB-7	PB-11	PTP-1	PTP-2	PTP-3	PTP-4	PTP-5	PTP-6	PTP-7	PTP-8	PTP-9
Total TCDF	-	0.136	0.0988	0.255	-	-	-	-	-	-	-	-	-	-	-	-
Total PeCDF	-	1.89	1.38	4.4	-	-	-	-	-	-	-	-	-	-	-	-
TotalHxCDF	-	23.3	18	43.1	-	-	-	-	-	-	-	-	-	-	-	-
Total HpCDF	-	83.4	80	126	-	-	-	-	-	-	-	-	-	-	-	-
Total TCDD	-	0.00184	0.00149	0.00103	-	-	-	-	-	-	-	-	-	-	-	-
Total PeCDD	-	0.0221	0.0497	0.0472	-	-	-	-	-	-	-	-	-	-	-	-
Total HxCDD	-	7.15	5.83	8.2	-	-	-	-	-	-	-	-	-	-	-	-
Total HpCDD	-	141	99.2	136	-	-	-	-	-	-	-	-	-	-	-	-
2,3,7,8-TCDD	-	0.00037	0.00049	0	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,7,8-PeCDD	-	0.0106	0.0249	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,4,7,8-HxCDD	-	0.1	0.142	0.135	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,6,7,8-HxCDD	-	3.19	2.48	3.91	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,7,8,9-HxCDD	-	0.2	0.284	0.271	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,4,6,7,8-HpCDD	-	90.5	63.9	89.1	-	-	-	-	-	-	-	-	-	-	-	-
OCDD	-	815	518	693	-	-	-	-	-	-	-	-	-	-	-	-
2,3,7,8-TCDF	-	0.0564	0.0395	0.135	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,7,8-PeCDF	-	0.36	0.241	0.863	-	-	-	-	-	-	-	-	-	-	-	-
2,3,4,7,8-PeCDF	-	0.25	0.179	0.577	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,4,7,8-HxCDF	-	1.17	0.821	2.65	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,6,7,8-HxCDF	-	0.38	0.308	0.837	-	-	-	-	-	-	-	-	-	-	-	-
2,3,4,6,7,8-HxCDF	-	0.116	0.0681	0.241	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,7,8,9-HxCDF	-	0.281	0.201	0.591	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,4,6,7,8-HpCDF	-	17.8	15.7	28.2	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3,4,7,8,9-HpCDF	-	1.3	1.03	2.04	-	-	-	-	-	-	-	-	-	-	-	-
OCDF	-	78.1	82.7	102	-	-	-	-	-	-	-	-	-	-	-	-
2,3,7,8-TCDD Equivalance	-	2.7	1.9	3.32	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
*PB results from PIR PCP Immunoassay Results
Bold Text=Analyte detected above laboratory method detection limit
Shaded Text=Exceedence of TAGM soil cleanup objectives to protect groundwater quality
Only analytes detected at or above laboratory method detection limits included on tables

Dioxins Data Qualifiers:
All results in ng/g
D=Result obtained from dilution
J=Estimated result, result is less than the reporting limit
E=Estimated result, result exceeds calibration range
CON=Confirmation analysis

SVOC Data Qualifiers:
All results in mg/kg
<U=Analyte was not detected above laboratory detection limits
J=Estimated Value
B=Analyte was found in method blank as well as the sample

Table 3
Preliminary Investigation Groundwater Sampling Event Analytical Results
Camp Pharsalia

Analyte (Units)	TOGS	PMW-1	PMW-2	PMW-3	PMW-4	PMW-5
VOCs (ug/L)						
Acetone	50	3.1 J	ND	6.2 J	ND	3.4 J
SVOCs (ug/L)						
Flourene	50	ND	ND	ND	ND	1.6 J
2-Methylnaphthalene	NA	ND	ND	ND	ND	1.6 J
Phenanthrene	50	ND	ND	ND	ND	1.8 J
Metals (mg/L)						
Aluminum	0.1	24.5	53.7	111	6.96	4.56
Arsnic	0.025	0.0634	0.0925	0.151	0.0406	0.0266
Barium	1	0.265	0.481	2.32	0.237	0.101
Berillium	0.003	ND	ND	0.00685	ND	ND
Cadmium	0.005	ND	ND	0.018	ND	ND
Calcium	NA	99.3	89	118	94.4	112
Chromium	0.05	0.0429	0.104	0.457	0.0199	0.01
Cobalt	NA	ND	0.0552	0.17	ND	ND
Copper	0.2	0.0434	0.0862	0.26	ND	ND
Iron	0.3	67.2	124	318	17	11.1
Lead	0.025	0.0354	0.0797	0.185	0.00993	ND
Magnesium	35	25.8	30.8	52.2	19.6	30
Maganese	0.3	1.99	3.04	7.11	1.29	1.47
Nickel	0.1	0.0589	0.124	0.841	ND	ND
Potassium	NA	3.9	10.8	15.4	3.04	2.84
Selenium	0.01	ND	ND	0.0456	ND	ND
Silver	0.05	ND	ND	0.0352	ND	ND
Sodium	20	8.63	172	31.6	29.8	6.24
Thallium	0.0005	0.0218	0.0257	0.0297	0.017	0.0187
Vanadium	NA	ND	0.0685	0.129	ND	ND
Zinc	2	0.137	0.26	0.597	0.0456	0.04
Dioxins/Furans (ng/L)	TEF's					
2,3,7,8-TCDD	1	<0.00013	0.00026	-	0.00055	<0.001
1,2,3,7,8-PeCDD	0.5	0.00019 EMPC	0.00029	-	0.00055 EMPC	0.00916
1,2,3,4,7,8-HxCDD	0.1	0.00027	0.00036	-	0.0005	0.0295
1,2,3,6,7,8-HxCDD	0.1	0.00213	0.00069	-	0.00098	0.185
1,2,3,7,8,9-HxCDD	0.1	0.00085	0.00083	-	0.0009	0.0671
1,2,3,4,6,7,8-HpCDD	0.01	0.0543	0.00974	-	0.0177	6.56
OCDD	0.001	0.468	0.129	-	0.256	58.6
2,3,7,8-TCDF	0.1	0.00321	0.00329	-	0.00364	0.00507
1,2,3,7,8-PeCDF	0.05	0.00021	0.0003	-	0.00065	0.00999
2,3,4,7,8-PeCDF	0.5	0.00047	<0.0001	-	0.00077	0.00946
1,2,3,4,7,8-HxCDF	0.1	0.00071	0.00059	-	0.00062	0.0457
1,2,3,6,7,8-HxCDF	0.1	0.00035 EMPC	0.00027 EMPC	-	0.00042	0.0198
1,2,3,7,8,9-HxCDF	0.1	<0.00010	0.00016 EMPC	-	0.00013	<0.00287
2,3,4,6,7,8-HxCDF	0.1	0.00031 EMPC	0.0003	-	0.00023	0.012 EMPC
1,2,3,4,6,7,8-HpCDF	0.01	0.00963	0.00176	-	0.00255	1.18
1,2,3,4,7,8,9-HpCDF	0.01	0.00063	0.00019	-	<0.00015	0.0919
OCDF	0.001	0.0625	0.00611	-	0.00826	7.11
Total Tetra-Dioxins	-	0.00028	0.00026	-	0.00257	0.0127
Total Penta-Dioxins	-	0.00028	0.00124	-	0.00107	0.0258
Total Hexa-Dioxins	-	0.00795	0.00666	-	0.0102	0.612
Total Hepta-Dioxins	-	0.0927	0.0211	-	0.0361	10.3
Total Tetra-Furans	-	0.0049	0.00836	-	0.00945	0.00907
Total Penta-Furans	-	0.00176	0.00108	-	0.00203	0.128
Total Hexa-Furans	-	0.0109	0.00189	-	0.00432	1.19
Total Hepta-Furans	-	0.0397	0.00599	-	0.00725	5.27
2,3,7,8-TCDD Equivalence	0.0007	0.0023 EMPC	0.00132 EMPC	-	0.00245 EMPC	0.19 EMPC

Notes:
Data taken form the NYSDEC Preliminary Investigation Report

Table 4
December 2001 Groundwater Sampling Event Analytical Results
Camp Pharsalia

Analyte (Units)	TOGS	PMW-1	PMW-2	PMW-3	PMW-4	PMW-5
SVOCs (ug/L)						
Anthracene	50	<10 J	<10 J	<10 J	<10 J	**0.5 J**
Di-n-octyl phthalate	50	**1J**	<10 J	**0.7 J**	<10 J	<10 J
Hexochloroethane	5	<10 J	<10 J	<10 J	<10 J	**2 J**
Phenanthrene	50	<10 J	<10 J	<10 J	<10 J	**0.5 J**
Total SVOCs		**1 J**	BDL	**0.7 J**	BDL	**3 J**
Pesticides (ug/L)						
Heptachlor epoxide	0.03	<0.054	<0.049	<0.049	**0.11**	<0.050
Method 310.34		**1100 J**	<5000	<5000	<5000	<5000

Notes: All results in ug/L
Bold Text=Analyte detected above laboratory method detection limit
Shaded Text=Exceedence of TOGS 1.1.1 guidance values
Only analytes detected at or above laboratory method detection limits included on tables
<U=Analyte was not detected above laboratory detection limits
J=Estimated Value
BDL=Below Detection Limits

Table 5
November 2002 Groundwater Sampling Event Analytical Results
Camp Pharsalia

Analyte *ug/L*	TOGS	PMW-1	PMW-2	PMW-3	PMW-4	PMW-5	PMW-5 Filtered	PMW-6A	PMW-6A Filtered
Turbidity at time of sample	-	29	600	6	0	0	0	730	615
Method 310.13	-	<303	<309	<303	<303	**340**	**290 J**	**140 J**	**190 J**
SVOCs *ug/L*									
Naphthalene	10	**0.5 J**	<10	<10	<10	<10	<10	<10	<10
Bis(2-ethylhexyl)phthalate	5	**13 B**	**38 B**	**6 JB**	**5 JB**	**5 JB**	**5 JB**	**6 JB**	**12 JB**
Dioxins *ng/L*	**TEF**	**PMW-1**	**PMW-2**	**PMW-3**	**PMW-4**	**PMW-5**	**PMW-5 Filtered**	**PMW-6A**	**PMW-6A Filtered**
2,3,7,8-TCDD	1	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-PeCDD	0.5	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-HxCDD	0.1	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-HxCDD	0.1	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-HxCDD	0.1	**0.0012**	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,6,7,8-HpCDD	0.01	**0.0076**	ND	ND	ND	**0.0213**	ND	**0.00606**	ND
OCDD	0.001	**0.0274**	**0.0443**	ND	**0.0251**	ND	**0.0114**	**0.0415**	ND
2,3,7,8-TCDF	0.1	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-PeCDF	0.05	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,7,8-PeCDF	0.5	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8-HxCDF	0.1	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-HxCDF	0.1	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-HxCDF	0.1	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6,7,8-HxCDF	0.1	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,6,7,8-HpCDF	0.01	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,4,7,8,9-HpCDF	0.01	ND	ND	ND	ND	ND	ND	ND	ND
OCDF	0.001	ND	ND	ND	ND	**0.0296**	ND	ND	ND
2,3,7,8-TCDD Equivalance	0.0007	**0.000223**	**0.0000443**	BDL	**0.0000251**	**0.000359**	**0.0000114**	**0.000102**	BDL

Notes:
Bold Text=Analyte detected above laboratory method detection limit
Shaded Text=Exceedence of TOGS 1.1.1 guidance values
Only analytes detected at or above laboratory method detection limits included on tables
<=Analyte was not detected above laboratory detection limits
J=Estimated Value
BDL=Below Detection Limits
B=Analyte was found in method blank as well as the sample

Table 6 - Identification of Chemicals of Potential Concern Camp Pharsalia, South Plymouth, New York				
Chemical of Potential Concern	**CASRN [1]**	**Concentration [2] in Surface Soil**	**Concentration [2] in Subsurface Soil**	**Concentration [2] in Groundwater**
Pentachlorophenol	87-86-5	550 ppm [3]	330 ppm	ND [4]
2,3,7,8-TCDD equivalent	NA [5]	7.841 ppb [6]	3.32 ppb	0.19 ppt [7]
Fuel Oil	NA	ND	ND	340 ppb

NOTES
1 Chemical Abstracts Service Registry Number
2 Maximum detected concentration at Camp Pharsalia
3 ppm = Parts per Million (equivalent to mg/kg soil or mg/L water)
4 ND = Not Detected
5 NA = Not Applicable
6 ppb = Parts per Billion (equivalent to ug/kg soil or ug/L water)
7 ppt = Parts per Trillion (equivalent to ng/kg soil or ng/L water)

Table 7 - Standards, Criteria And Guidelines Evaluation				
Requirements/Criteria	**Citation**	**Description**	**Evaluation**	**Evaluation Comment**
FEDERAL				
Resource Conservation and Recovery Act (RCRA)	**40 U.S.C. 6901-6987**			
Identification and Listing of Hazardous Wastes	40 CFR Part 261-265	Outlines criteria determining whether solid waste is a hazardous waste after generation and is subject to regulation under 40 CFR Parts 260-266. Does not address cleanup action levels.	Applicable to removed media only.	These regulations would only apply to media removed from the site as part of a remedial action.
Land Disposal Restrictions	40 CFR Part 268	Established constituent-specific standards to which hazardous wastes must be treated prior to land disposal. Only applies to newly generated solid wastes.	Applicable to removed media only.	These requirements would be applicable to media removed from the site which are determined to be hazardous wastes that are land disposed off site as part of a remedial action.
Clean Air Act (CAA)	**42 U.S.C. 7401-7642**			
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes ambient air quality standards for protection of public health.	Applicable.	NAAQS may be applicable in evaluating whether there are air impacts at a site prior to remediation, or during long-term remediation programs. Due to the site conditions, air emissions would not be a significant issue.
Clean Water Act (CWA)	**33 U.S.C. 251-1376**			
Ambient Ground Water Quality Criteria Guidelines	40 CFR Part 141	Establishes maximum contaminant levels (MCLs) for treatment of groundwater for public potable water supplies.	Not Applicable.	Camp Pharslia is an active incarceration facility that uses an unimpacted bedrock aquifer as a public potable water supply.

Table 7 - Standards, Criteria And Guidelines Evaluation				
Requirements/Criteria	**Citation**	**Description**	**Evaluation**	**Evaluation Comment**
Safe Drinking Water Act (SDWA)	**40 U.S.C.300**			
National Primary Drinking Water Standards	40 CFR Part 141	Establishes maximum contaminant levels or MCLs, which are health-based standards for public water systems.	Not Applicable.	Water will not be discharged directly to any potable water source. Camp Pharslia is an active incarceration facility that uses an unimpacted bedrock aquifer as a public potable water supply.
National Secondary Drinking Water Standards	40 CFR Part 132	Non-enforceable health goals for public water systems that relate to aesthetic quality.	Not Applicable.	Water will not be discharged directly to any potable water source. Camp Pharslia is an active incarceration facility that uses an unimpacted bedrock aquifer as a public potable water supply.
STATE				
New York State Environmental Conservation Law	**Chapter 10 Articles 15, 17**			
New York State Pollution Discharge Elimination System	15 NYCRR 750-758	Defines permitting requirements for discharges.	Relevant and Appropriate.	The regulations would be applicable only for alternatives that include discharge to surface water.
Ambient Water Quality Standards and Guidance Values	6 NYCRR 700-705	Establishes quality standards for groundwater and incorporates federal MCLs and standards from other state regulations.	Applicable.	The regulations would be applicable only for alternatives that include discharge to surface water and groundwater.
Ambient Water Quality Standards and Guidance Values	TOGS 1.1.1	Establishes quality standards for groundwater in New York State and incorporates federal MCLs.	Applicable.	The regulations would be applicable only for alternatives that include discharge to surface water and groundwater.
Technical Guidance for Screening Contaminated Sediments		Describes the methodology used by the Division of Fish and Wildlife and the Division of Marine Resources for establishing criteria for the purpose of identifying contaminated sediments.	Not Applicable.	Relevant for sedimentation control.

Table 7 - Standards, Criteria And Guidelines Evaluation

Requirements/Criteria	Citation	Description	Evaluation	Evaluation Comment
Groundwater Effluent Standards	6 NYCRR 700-705	Establishes effluent standards and/or limitations for discharges to groundwater.	Applicable.	The regulations would be applicable only for alternatives that include discharge to surface water and groundwater.
New York State Environmental Conservation Law	**Article 27**			
Determination of Soil Clean-Up Objectives and Clean-Up Levels	TAGM HWR-94-4046	Establishes general clean-up goals for environmental media.	Applicable.	Widely used as a guidance document for calculating soil cleanup levels.
Identification and Listing of Hazardous Wastes	6 NYCRR 371	Outlines criteria determining whether solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 370-376.	Applicable.	Applies to material generated from the site for off-site disposal and determined to be hazardous waste.
Solid Waste Management	6 NYCRR 360	Includes solid waste disposal requirements.	Applicable.	These regulations would only be applicable to the off site disposal of non-hazardous waste.
New York State Environmental Conservation Law	**Article 19**			
New York State Air Guide 1	6 NYCRR 750-758	Provides guidance for permitting emissions from new or existing sources.	Applicable but not relevant.	No air emissions are being considered.
Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites	TAGM HWR 89-4031	Provides guidance for fugitive dust suppression and particulate monitoring at inactive hazardous waste sites.	Relevant and appropriate.	This guidance provides a basis for developing and implementing a fugitive dust suppression and particulate monitoring program as an element of a hazardous waste site's health and safety program.

Table 8 - Remedial Action Objectives for Soil			
Camp Pharsalia, South Plymouth, New York			
Chemical of Potential Concern	SCGs/ARARs		Qualitative Remedial Action Objective
	TAGM 4046 [1] Generic Soil Cleanup Values	TAGM 4046 Soil Cleanup Values for Groundwater Protection	
Pentachlorophenol	1 ppm [2] or MDL [3]	1 ppm	1 Minimize recharge and surface water flow into the soils 2 Eliminate incidental ingestion of or direct contact with soils impacted with elevated COPC concentrations
2,3,7,8 TCDD equivalent	NA [4]	1 ppb [5,6]	
Fuel Oil	NV [7]	NV	

NOTES

1 Division Technical and Administrative Guidance Memorandum (TAGM) 4046: Determination of Soil Cleanup Objectives and Cleanup Levels (1994)
2 ppm = parts per million (equivalent to milligrams per kilogram)
3 MDL = Method Detection Limit
4 NA = Not available
5 ppb = parts per billion (equivalent to micrograms per kilogram)
6 TAGM 4046 does not include a soil cleanup objective for dioxins and furans, but a value of 1 ppb has been used as a cleanup goal at hazardous waste sites and this value has been adopted as a screening concentration for Camp Pharsalia.
7 NV = No value is listed in New York regulations for this COPC

Table 9 - Remedial Action Objectives for Groundwater		
Camp Pharsalia, South Plymouth, New York		
Chemical of Potential Concern	SCGs/ARARs TOGS 1.1.1 [1]	Qualitative Remedial Action Objective
Pentachlorophenol	1 ppb [2,3]	1 Eliminate potential for contamination of groundwater
2,3,7,8-TCDD equivalent	0.0007 ppt [4]	
Fuel Oil	NV [5]	

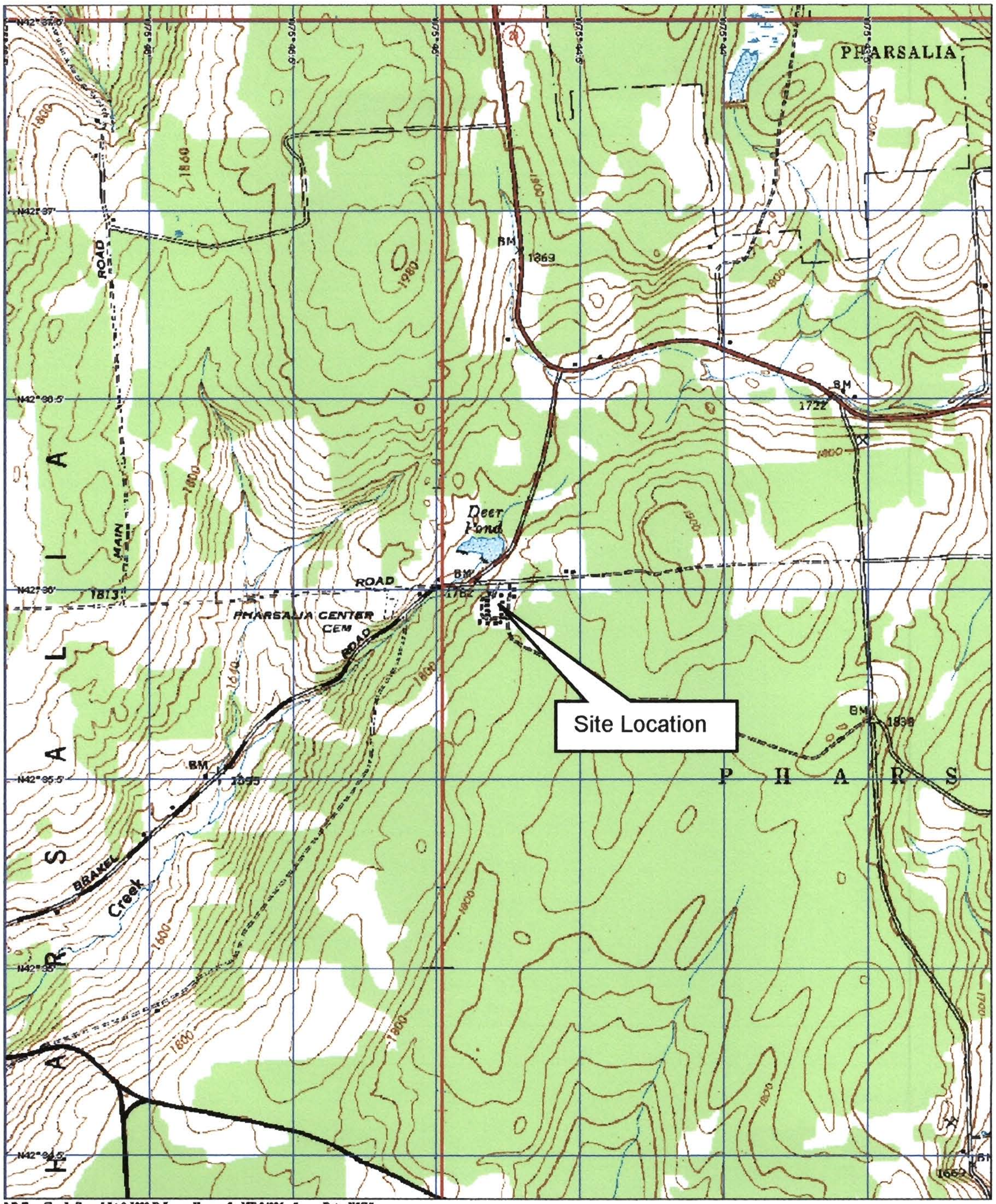
NOTES

1 Division of Water Technical and Operational Guidance Series (TOGS 1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. All values shown are standards promulgated under 6NYCRR Part 703 unless otherwise annotated.
2 ppb = parts per billion (equivalent to micrograms per liter)
3 Applies to the sum of phenolic compounds
4 ppt = parts per trillion (equivalent to nanograms per liter)
5 NV = No standard or guidance value is listed in New York regulations for this COPC

Table 10 - Technology Evaluation Summary						
Camp Pharsalia, South Plymouth, New York						
General Response Actions	Remedial Technology Type	Process Options	Effectiveness	Implementability	Cost	Retained
No Action	None	Not Applicable	Does not achieve remedial action objectives	Readily implementable	Negligible	Yes
Limited Action	Institutional Controls	Access Restrictions	Depends upon continued future implementation	Readily implementable	Negligible	Yes
		Notice of Covenant on Deed Transfers	Depends upon continued future implementation	Appropriate legal actions required	Negligible	Yes
		Zoning Restrictions	Depends upon continued future implementation	Approval of local government required	Negligible	Yes
	Monitored Natural Attenuation	Monitored Natural Attenuation	Effective, dependent on contaminant behavior	Easily implementable	High maintenance	Yes
Containment	Surface Controls	Diversion Channels, Revegetation, Grading	Effective in preventing erosion	Implementable	Low capital and maintenance	Yes
	Capping	Permeable Soil Cap	Not effective in containing VOCs and SVOCs	Implementable, restricts future land use	Moderate capital and maintenance	No
		Asphalt / Concrete Cap	Effective, susceptible to cracking	Implementable, restricts future land use	Moderate capital and maintenance	Yes
		Multi Layered Synthetic Cap	Effective	Implementable, restricts future land use	High capital and maintenance	Yes
Excavation	Shallow Excavation	Not Braced	Effective in reducing on-site volume and toxicity	Implementable	Moderate capital	Yes
	Deep Excavation	Engineering Controls Employed Above Water Table	Effective in reducing on-site volume and toxicity, however, mobility may be increased during implementation of deeper excavations	Implementable, dependent on subsurface characteristics	Moderate to high capital	Yes
	Deep Excavation	Engineering Controls Employed Below Water Table	Effective in reducing on-site volume and toxicity, however, mobility may be increased during implementation of deeper excavations	Implementable, dependent on subsurface characteristics	High capital	Yes
Disposal	Disposal	On-site Disposal	Effective in reducing contaminant mobility	Requires construction and placement of containment cell	Moderate capital and high maintenance	No
		Off-site Disposal	Effective in reducing contaminant mobility	Implementable	Moderate capital	Yes

Table 10 - Technology Evaluation Summary						
Camp Pharsalia, South Plymouth, New York						
General Response Actions	Remedial Technology Type	Process Options	Effectiveness	Implementability	Cost	Retained
In-situ Treatment	In-situ Biological Treatment	Bioremediation	Not effective due to shallowness of impacted zone	Implementable	Moderate capital and maintenance	No
	In-situ Physical / Chemical Treatment	Stabilization	Not effective due to shallowness of impacted zone	Implementable	Moderate capital and low maintenance	No
		Vitrification	Not cost effective for small volumes	Implementable	Moderate capital and low maintenance	No
Ex-situ Treatment	Ex-situ Biological Treatment	Bioremediation	Effective	Not implementable, requires large amount of space	Moderate capital and maintenance	No
	Ex-situ Physical / Chemical Treatment	Stabilization	Effective	Implementable	Moderate capital and low maintenance	Yes
		Dechlorination	More toxic substances may be formed	Implementable	Moderate capital and low maintenance	No
		Soil Washing	Fines will remain contaminated	Implementable	Moderate capital and low maintenance, treatment of small volume of fines will not be cost effective	No
	Ex-situ Thermal Treatment	Thermal Desorption	Effective	Implementable	Moderate capital and low maintenance	Yes

FIGURES



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS

700 ft Scale: 1 : 24,000 Detail: 13-0 Datum: WGS84

Scale: 1:24,000

Reference:
DeLorme 3-D Topo Quads, 1999
Yarmouth, Me.
Datum WGS84

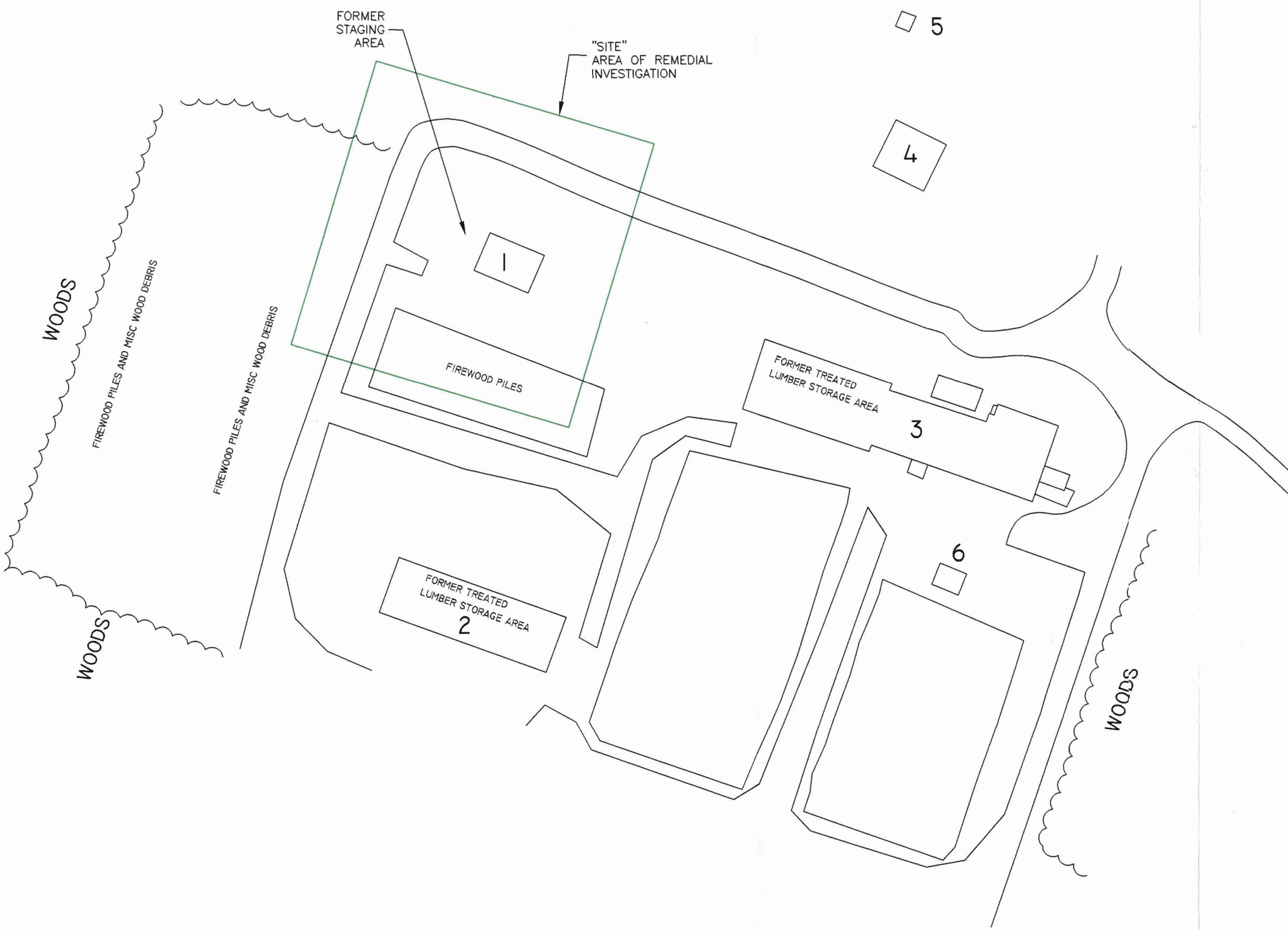
Shaw
Shaw Environmental, Inc.

NYSDEC

Figure 1
Site Location Map
Camp Pharsalia

L:\project\830271\830271B23.dwg
Plot Date/Time: 02/13/03 12:41pm   Image: .
Format Revised: 12/15/99   Xref: .

OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
ALBANY, NY	SSH/DMC	01-24-03					830271B23



LEGEND

1 TREATMENT BUILDING
2 LUMBER STORAGE
3 LUMBER STORAGE
4 WATER TOWER
5 WELL HOUSE
6 GAS STORAGE
—— AREA OF INVESTIGATION

REFERENCE:

BASED ON MAP PREPARED BY MODI ENGINEERS AND LAND SURVEYORS.

N

SCALE
0 60 120 FEET

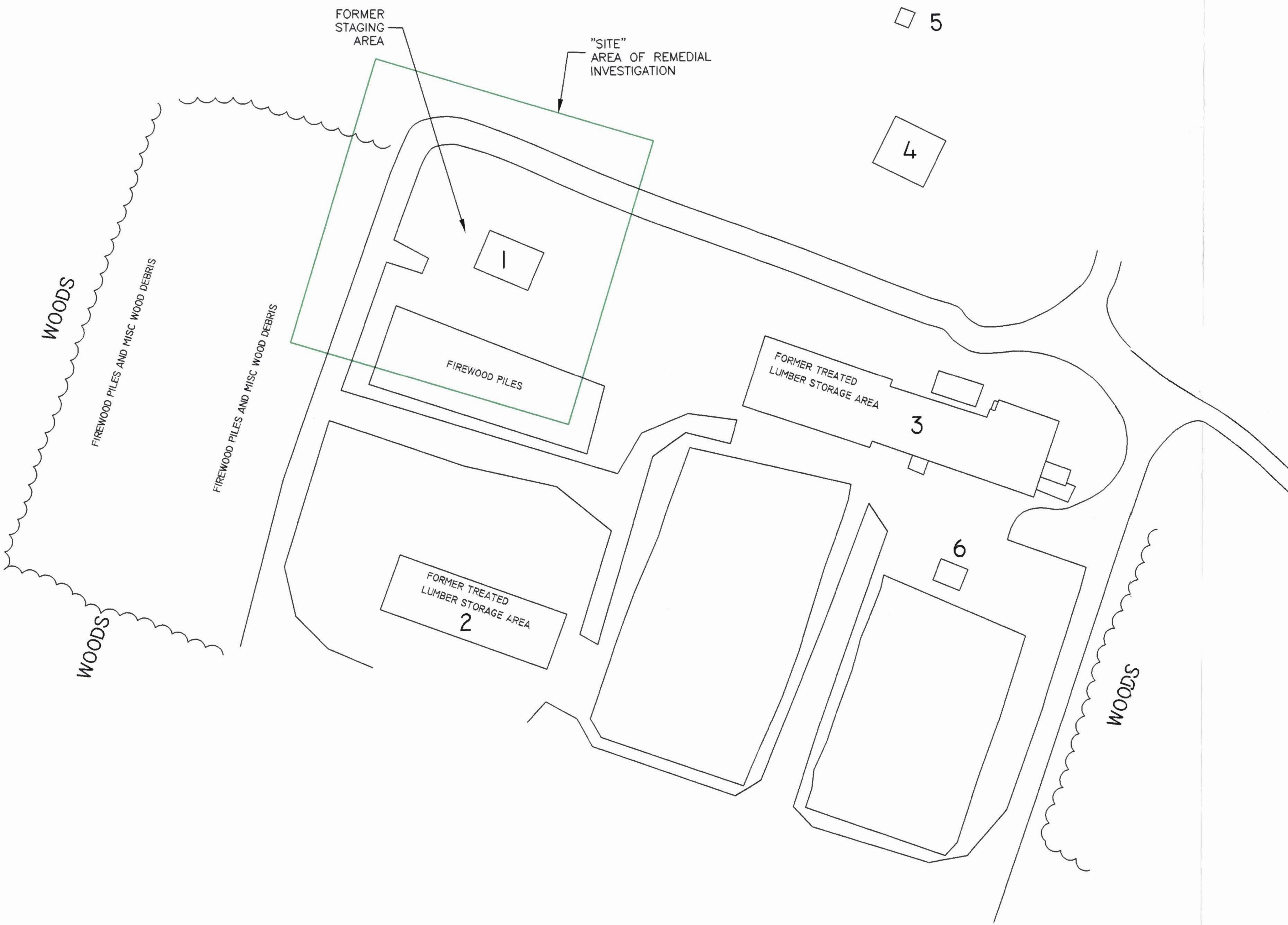
Shaw™
Shaw E & I, Inc.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FIGURE 2
FACILITY DIAGRAM
CAMP PHARSALIA
PHARSALIA
CHENANGO COUNTY, NEW YORK

OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
ALBANY, NY	SSH/DMC	01-24-03					830271B23

L:\project\830271\830271B23.dwg
Plot Date/Time: 01/28/03 04:33pm
Format Revised: 12/15/99
Image: .
Xref: .



LEGEND

1 TREATMENT BUILDING
2 LUMBER STORAGE
3 LUMBER STORAGE
4 WATER TOWER
5 WELL HOUSE
6 GAS STORAGE
— AREA OF INVESTIGATION

REFERENCE:
BASED ON MAP PREPARED BY MODI ENGINEERS AND LAND SURVEYORS.

N

SCALE
0 60 120 FEET

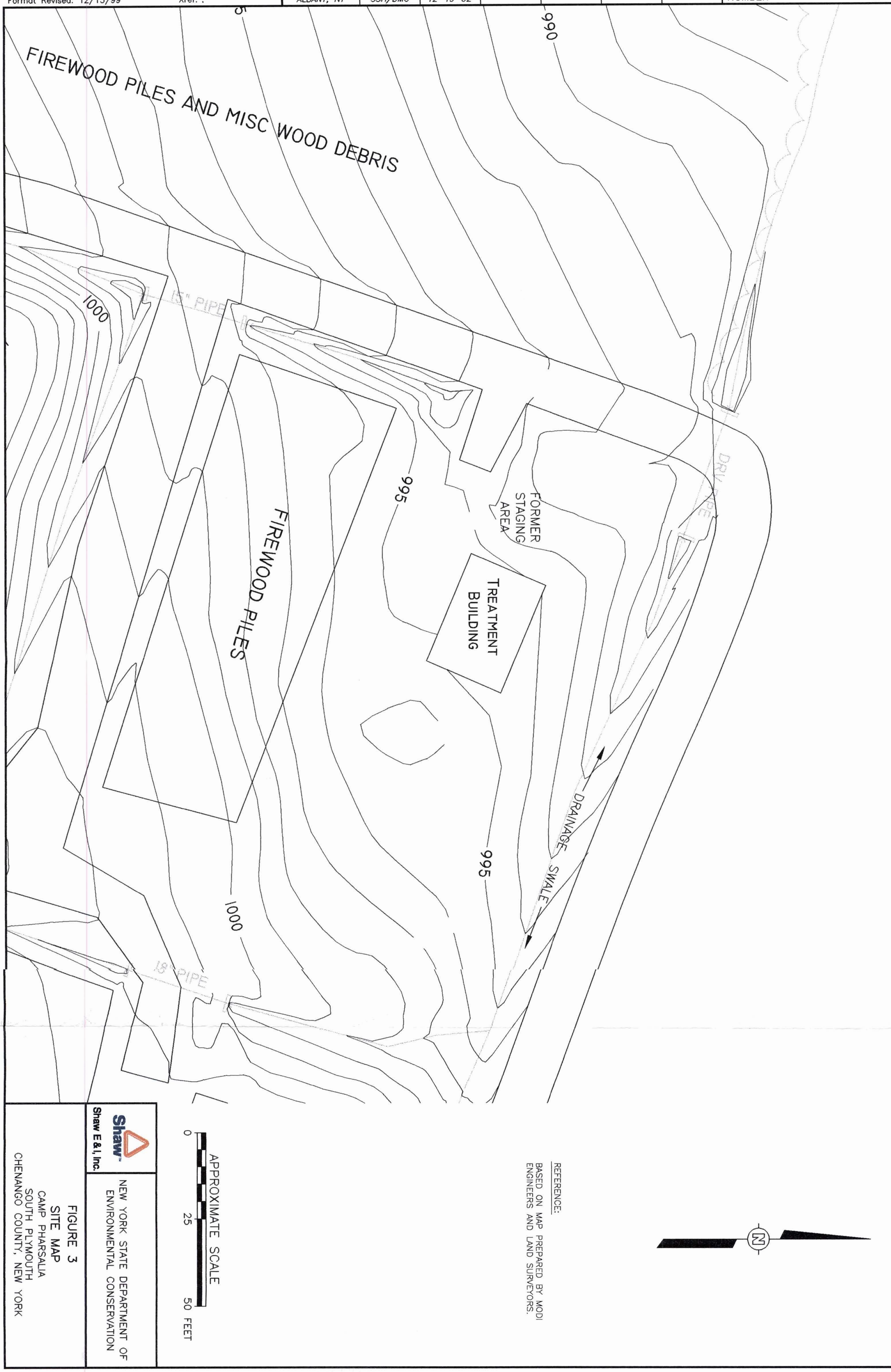
Shaw™ Shaw E & I, Inc.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FIGURE 2
FACILITY DIAGRAM
CAMP PHARSALIA
PHARSALIA
CHENANGO COUNTY, NEW YORK

L:\project\830271\830271B21.dwg
Plot Date/Time: 01/28/03 04:32pm Image: .
Format Revised: 12/15/99 Xref: .

OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
ALBANY, NY	SSH/DMC	12-19-02					830271B21



REFERENCE:
BASED ON MAP PREPARED BY MODI ENGINEERS AND LAND SURVEYORS.

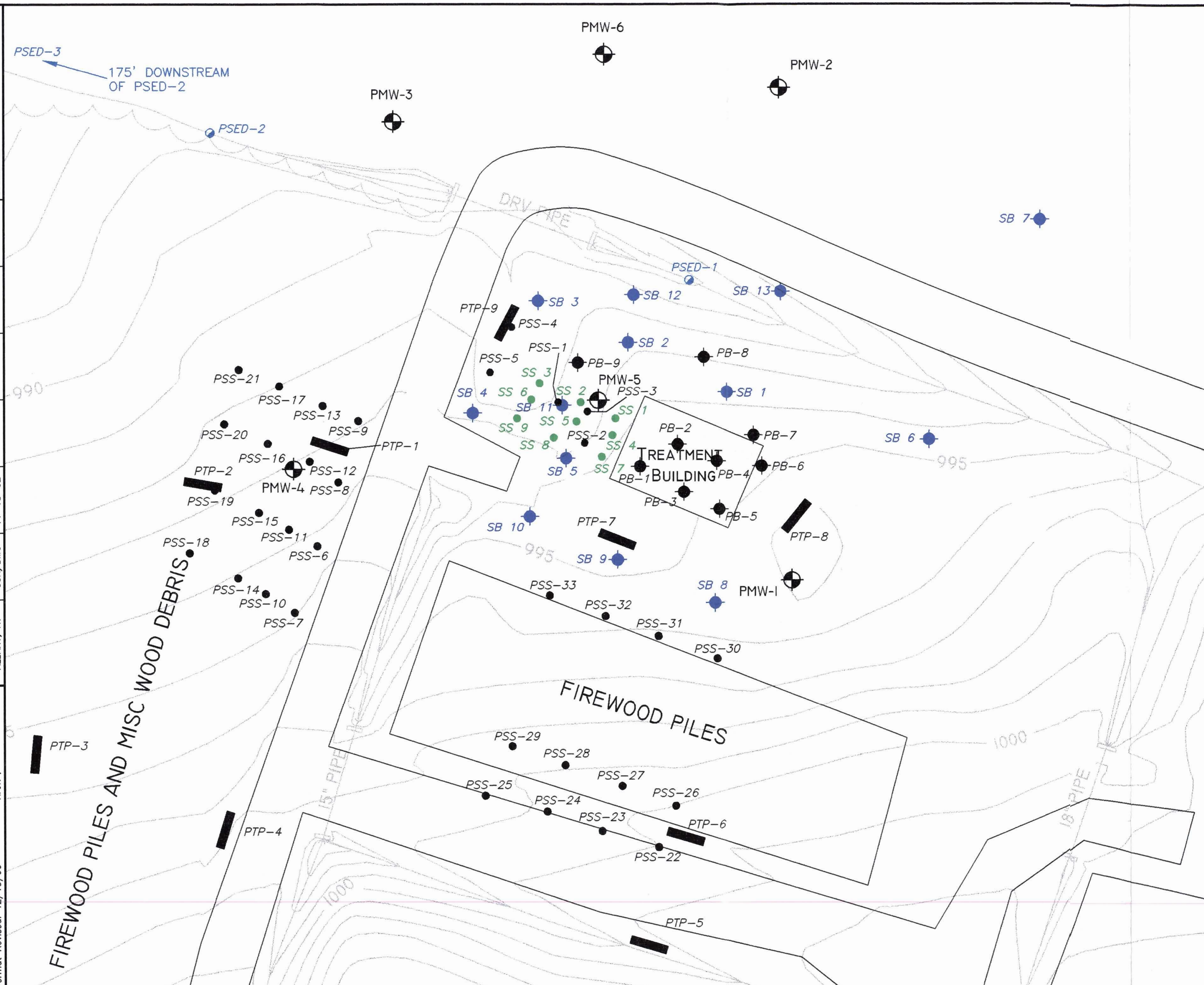
Shaw
Shaw E&I, Inc.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FIGURE 3
SITE MAP
CAMP PHARSALIA
SOUTH PLYMOUTH
CHENANGO COUNTY, NEW YORK

L:\project\830271\830271B11.dwg
Plot Date/Time: 01/31/03 01:18pm
Format Revised: 12/15/99
Image: .
Xref: .

OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
ALBANY, NY	SSH/DMC	11-18-02					830271B11



REFERENCE:

BASED ON MAP PREPARED BY MODI ENGINEERS AND LAND SURVEYORS.

LEGEND

- EXISTING MONITORING WELL
- SOIL BORING
- SURFACE SOIL SAMPLE
- HISTORIC SURFACE SOIL SAMPLE
- HISTORIC SEDIMENT SAMPLE
- HISTORIC TEST PIT
- HISTORIC SOIL BORING

APPROXIMATE SCALE

0 25 50 FEET

Shaw
Shaw E & I, Inc.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

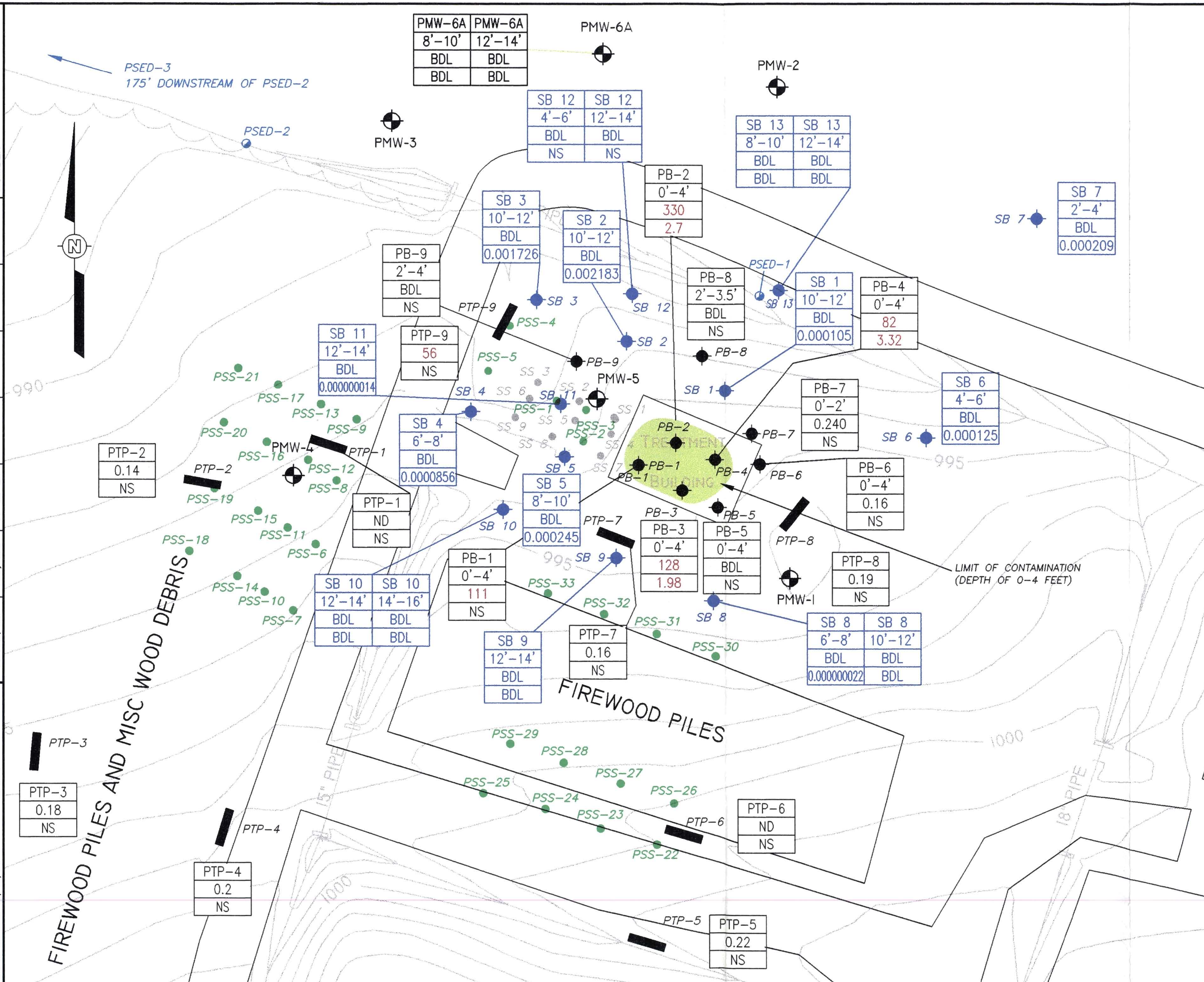
FIGURE 4
SAMPLING LOCATION MAP
CAMP PHARSALIA
SOUTH PLYMOUTH
CHENANGO COUNTY, NEW YORK

L:\project\830271\830271B8.dwg
Plot Date/Time: 01/30/03 03:51pm Image: .
Format Revised: 12/15/99 Xref: .

OFFICE	DRAWN BY		CHECKED BY	APPROVED BY	DRAWING NUMBER
ALBANY, NY	SSH, DMC	11-18-02			830271B8

L:\project\830271\830271B7.dwg
Plot Date/Time: 01/30/03 03:50pm
Format Revised: 12/15/99
Image: .
Xref: .

OFFICE	DRAWN BY		CHECKED BY	APPROVED BY	DRAWING NUMBER
ALBANY, NY	SSH/DMC	11-18-02			830271B7



LEGEND

- EXISTING MONITORING WELL
- SOIL BORING
- HISTORIC SOIL BORING
- SURFACE SOIL SAMPLE
- HISTORIC SURFACE SOIL SAMPLE
- HISTORIC SEDIMENT SAMPLE
- HISTORIC TEST PIT

RI DATA

SB-7	LOCATION ID
2'-4'	SAMPLING DEPTH
BDL	PCP mg/kg
0.000209	DIOXINS ug/kg

HISTORIC DATA

PB-1	LOCATION ID
0'-4'	SAMPLING DEPTH
111	PCP mg/kg (ppb)
NS	DIOXINS ug/kg (ppb)

BDL BELOW DETECTABLE LIMITS
NS NOT SAMPLED

PCP > 1.0 mg/kg (ppm)
DIOXINS > 1.0 ug/kg (ppb)

REFERENCE:
BASED ON MAP PREPARED BY MODI ENGINEERS AND LAND SURVEYORS.

NOTE:
CONTAMINATED AREA OUTLINED.

APPROXIMATE SCALE
0 25 50 FEET

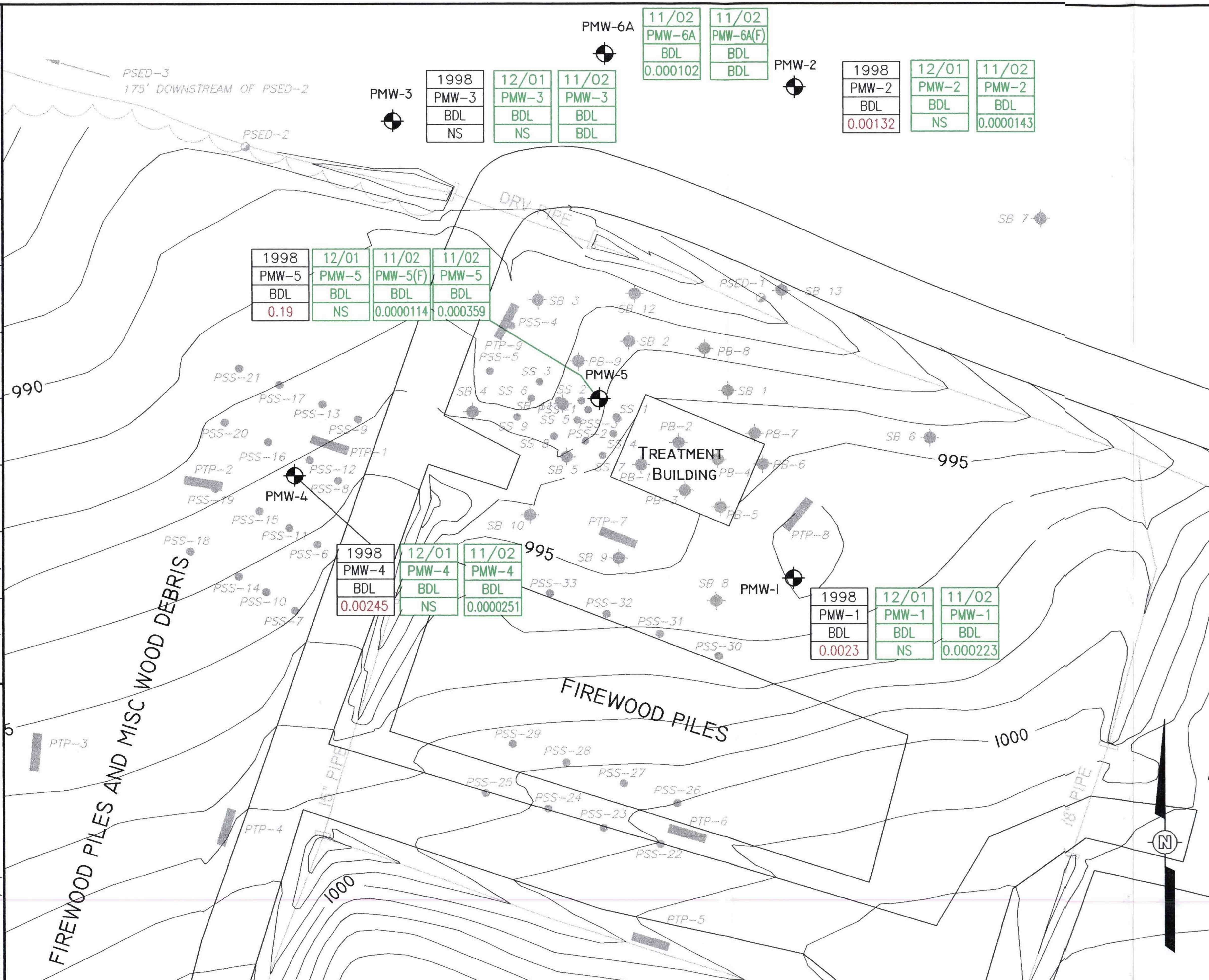
Shaw™ Shaw E & I, Inc.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FIGURE 6
SUBSURFACE SOIL BORING MAP
CAMP PHARSALIA
SOUTH PLYMOUTH
CHENANGO COUNTY, NEW YORK

L:\project\830271\830271B18.dwg
Plot Date/Time: 01/30/03 03:01pm
Format Revised: 12/15/99
Image: .
Xref: .

OFFICE	DRAWN BY		CHECKED BY	APPROVED BY	DRAWING NUMBER	830271B18
ALBANY, NY	SSH/DMC	12-04-02				



LEGEND

- EXISTING MONITORING WELL
- SOIL BORING
- SURFACE SOIL SAMPLE LOCATION
- HISTORIC SURFACE SOIL SAMPLE
- HISTORIC SEDIMENT SAMPLE
- HISTORIC TEST PIT
- HISTORIC SOIL BORING

RI DATA

12/01	SAMPLING DATE
PMW-2	WELL ID
BDL	PCP ug/L (ppb)
NS	DIOXINS ng/L (ppt)

HISTORIC DATA

1998	SAMPLING DATE
PMW-2	WELL ID
BDL	PCP ug/L (ppb)
0.00132	DIOXINS ng/L (ppt)

BDL BELOW DETECTABLE LIMITS
NS NOT SAMPLED

DIOXINS > 0.0007 ng/L (ppt)

NOTE:
* (F) FILTERED SAMPLE

REFERENCE:

BASED ON MAP PREPARED BY MODI ENGINEERS AND LAND SURVEYORS.

APPROXIMATE SCALE
0 25 50 FEET

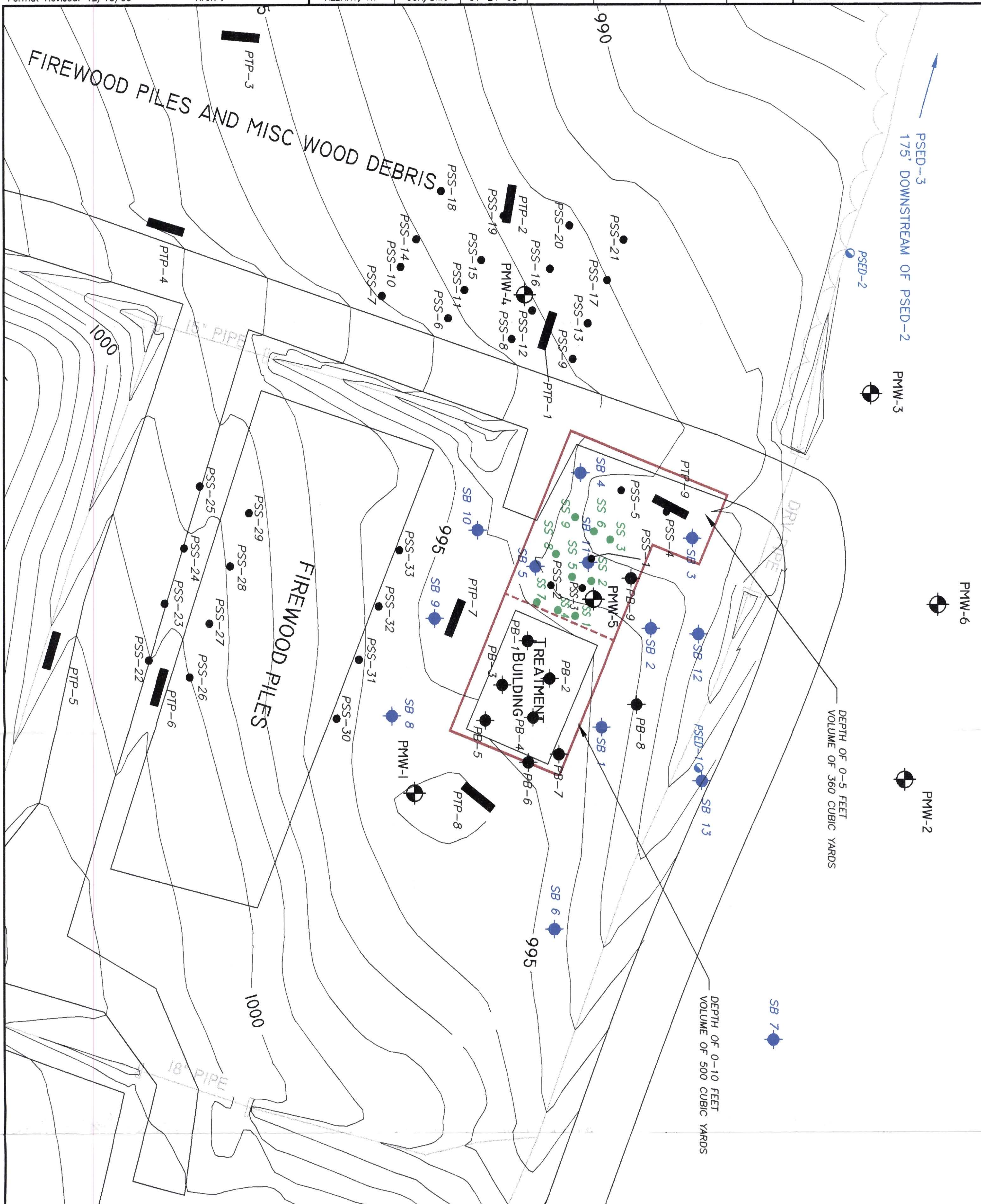
Shaw Environmental, Inc.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FIGURE 7
GROUNDWATER ANALYTICAL MAP
CAMP PHARSALIA
SOUTH PLYMOUTH
CHENANGO COUNTY, NEW YORK

L:\project\830271\830271B24.dwg
Plot Date/Time: 01/30/03 03:03pm Image: .
Format Revised: 12/15/99 Xref: .

OFFICE	DRAWN BY		CHECKED BY	APPROVED BY	DRAWING NUMBER 830271B24
ALBANY, NY	SSH/DMC	01-24-03			



Shaw E&I, Inc.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FIGURE 8
LIMIT OF TREATMENT
CAMP PHARSALIA
SOUTH PLYMOUTH
CHENANGO COUNTY, NEW YORK

APPENDIX A

QUALITATIVE HUMAN HEALTH EXPOSURE ASSESSMENT

APPENDIX A

QUALITATIVE HUMAN HEALTH EXPOSURE ASSESSMENT for the CAMP PHARSALIA SITE PHARSALIA, NEW YORK

DEC Site No. 7-09-013

February 26, 2003

Prepared for:
New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233-7015

TABLE OF CONTENTS:

1.0 BACKGROUND

Exposure assessment is the process of identifying potential current and future receptors, and characterizing the nature of their contact with a chemical. A qualitative exposure assessment was performed for the Camp Pharsalia site in order to determine potential exposure pathways associated with current site conditions and to evaluate their potential significance.

The qualitative exposure assessment results in the creation of site-specific exposure profiles, which provide the narrative description of the mechanisms by which exposure to contaminants may occur at a site. Chemical, physical, and toxicological parameters for the chemicals of concern are also identified and taken into account when developing the exposure profiles. The potential significance of the identified exposures is evaluated in a qualitative manner.

2.0 EXPOSURE SETTING

The exposure setting is evaluated with respect to both current and potential future land uses of the site and surrounding area in order to aid in the identification of potential receptors, exposure points and exposure pathways.

Camp Pharsalia is a large complex of NYSDEC crew headquarters and an active NYDCS incarceration facility, situated in the town of Pharsalia, Chenango County, NY. The surrounding area is rural, generally consisting of farmland and undeveloped forest. Wood treatment operations were conducted at Camp Pharsalia between 1960 and 1977. The area of concern includes the former wood treatment plant and staging area, which is located immediately northwest of the former treatment plant.

3.0 IDENTIFICATION OF EXPOSURE PATHWAYS

For identified receptors to be exposed to a chemical of concern at the site, a current or reasonable future exposure pathway must be established leading from the source to the receptor. The exposure pathway is the route that the chemical takes from the source of the material to the receptor of concern. An exposure pathway has five elements:

- a contaminant of significance
- contaminant release and transport mechanisms
- a point of exposure
- a route of exposure
- a potential receptor

An exposure pathway is complete when all five elements of an exposure pathway are documented; a potential exposure pathway exists when any one or more of the five elements comprising an exposure pathway is possible, but not documented. An exposure pathway may be eliminated from further evaluation when any one of the five elements comprising an exposure pathway has not existed in the past, does not exist in the present, and will never exist in the future.

3.1 Source of Contamination

One of the work projects at Camp Pharsalia was the operation of a wood treatment facility and sawmill, which operated between 1960 and 1977. During this time, pentachlorophenol (PCP) was the primary chemical biocide used in treating lumber at the site. During the treatment process, PCP and No. 2 fuel oil were combined in the dip tanks. After treatment, poles were hoisted from the tank and allowed to drip over the tank for a period of time. Poles were then moved to outside the western end of the treatment plant and allowed to dry. They were then moved to a designated treated material storage area, located south of the treatment plant. Therefore, the sources of release to the environment are historical surficial spills of wood treatment products (PCP and fuel oil) to soil.

3.2 Fate and Transport

Contaminant release and transport mechanisms may carry contaminants from the source to points where individuals may be exposed. Chemical migration between media such as soil and groundwater is influenced by chemical parameters such as water solubility or molecular size or shape, in addition to the chemical and physical characteristics particular to a site's media. This section discusses information about the fate and transport of the source chemicals present at the site.

Pentachlorophenol

Pentachlorophenol is a moderately acidic substance, and thus its fate is strongly influenced by pH. At a neutral pH it is almost completely found in the ionized form, the pentachlorophenate anion, which is much more mobile than PCP (ATSDR, 2000). PCP has a low water solubility and a strong tendency to adsorb onto soil or sediment particles in the environment. Adsorption to soils and sediments is dependent on pH and organic content. Adsorption at a given pH increases with increasing organic content of soil or sediment. No adsorption occurs at pH values above 6.8 (ATSDR, 2000; Howard, 1991). Since it is expected that soils at the site are acidic (less than 7.0) based on soil type (no pH data is available) and soils are low in organic content, (TOC is 0.0439% in SB-11 [8-10']), some adsorption is likely to occur, but it may be limited.

The ionized form of pentachlorophenol may be rapidly photolyzed by sunlight; PCP may also undergo biodegradation by microorganisms, animals, and plants, although degradation is generally slow (Howard, 1991). Given that at expected pH conditions a portion of PCP will be present in the ionized form, photolysis may be an important degradation pathway at this site in shallow soils.

PCP has an octanol-water partition coefficient (Kow) of 100,000 (Howard, 1991), which indicates that it is lipid-soluble and therefore has a tendency to bioaccumulate in organisms. Bioaccumulation is largely pH-dependent, with considerable variation among species. Bioconcentration factors (BCFs) for PCP in aquatic organisms are generally under 1,000, but some studies have reported BCFs up to 10,000. BCFs, however, for earthworms in soil were 3.4-13 (ATSDR, 2000). Significant biomagnification of PCP in either terrestrial or aquatic foodchains, however, has not been demonstrated (ATSDR, 2000).

Pentachlorophenol products often contain chlorophenols, dioxins, and furans. Once released to the environment, the chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs) are persistent and generally adsorb to soil or sediment particles, due to their low water solubilities. Adsorption is generally the predominate fate process affecting these chemicals, with the potential for adsorption related to the organic carbon content. CDDs and CDFs may undergo degradation through biological action or by photolysis, with a half-life ranging from weeks to months. Photolysis and hydrolysis are generally not significant processes, however, as these compounds persist in the adsorbed phase (USEPA, 2002).

Due to their high adsorption rate, CDDs are not expected to leach from soil, although some leaching of disassociated forms of the compound may occur, especially at lower pHs (USEPA, 2002). Since the pH of site soils are not known but are not expected to be highly acidic, leaching of CDDs and CDFs is unlikely. Migration of CDD-contaminated soil may occur through erosion and surface runoff. Upon reaching surface waters, additional adsorption may occur due to the typically higher levels of organic matter content of sediments as compared to surface soils (ATSDR 2000). Volatilization from either subsurface soil or water is not expected to be a major transport pathway, although it may occur from surface soils (ATSDR, 2000). As with PCP and other lipophilic pesticides, CDDs and CDFs tend to bioaccumulate in exposed organisms, with BCFs for aquatic organisms ranging from 5,000 to 10,000 (Montgomery, 1996). Uptake from soil by plants can occur, although it is limited by the strong adsorption of these compounds to soils. BCFs in plants have been measured to be 0.0002, with most accumulation occurring in the roots with little translocated to the foliage (ATSDR, 2000). Terrestrial organisms may accumulate CDDs and CDFs as a result of direct ingestion and contact with soils.

At the Pharsalia site, PCP is expected to be adsorbed to soil organic matter content, although leaching may occur due to the expected pH (slightly acidic) and low organic matter content in site soils (TOC 0.0439% in SB-11 [8-10']). However, leaching is most likely not occurring as there has been no PCP detected in any of the monitoring wells. Some photolysis of PCP from surface soils can be expected. Uptake of PCP from soil by plants or terrestrial organisms may occur, but biomagnification is not expected. CDDs and CDFs are expected to be strongly sorbed to soil, as well as persistent. Leaching of these compounds is likely to be limited. Accumulation of these compounds in plants as a result of root uptake is unlikely to be significant.

Fuel Oil

At the site, PCP was mixed with No. 2 fuel oil for wood treatment application. Fuel oils are mixtures of numerous aliphatic and aromatic hydrocarbons. Individual components of fuel oil include n-alkanes, branched alkanes, benzene and alkylbenzenes, naphthalenes, and PAHs (ATSDR, 2000). Primary constituents identified in soil and/or groundwater at the site are PAHs. Soil adsorption, volatilization to air, and leaching potential depend on a PAH's individual chemical characteristics; however, as a class of compounds, they are generally insoluble in water, with a strong tendency to bind to soil or sediment particles. Some of the lighter-weight PAHs (such as naphthalene, acenaphthene, and phenanthrene) may volatilize from soil or groundwater into the air. Degradation may occur through photolysis, oxidation, biological action, and other mechanisms. Microbial degradation appears to be a major degradation pathway in soil (ATSDR, 2000).

As nonpolar, organic compounds, PAHs may be accumulated in aquatic organisms from water, soil, sediments, and food. BCFs vary among PAHs and receptor species, but in general, bioconcentration is greater for the higher molecular weight compounds than for the lower molecular weight compounds (ATSDR, 2000). BCFs for accumulation of PAHs by plants from soil are low, with values of 0.001 to 0.18 reported for total PAHs (ATSDR, 2000). Accumulation of PAHs from soil by terrestrial organisms is also limited, with BCF values for voles of 12 reported for phenanthrene and 31 for acenapthene.

At this site, PAHs, the primary fuel oil constituents of interest, are expected to be adsorbed to soil, with limited potential for leaching. Microbial degradation may occur, with other degradation processes less important in soil. Uptake of PAHs from soil by terrestrial organisms or plants may occur, but bioconcentration is expected to be limited.

3.3 Points of Exposure

The exposure point is a location where actual or potential human contact with a contaminated medium may occur. Analytical results for samples collected at Camp Pharsalia indicate that soil and to a lesser extent, groundwater, have been impacted by:

- Pentachlorophenol (PCP);
- Polychlorinated dioxins (CDDs) and dibenzofurans (CDFs); and
- Fuel oil.

Analytical results from samples collected across the site indicate that contaminants have been identified in surface soils (0-2 inches bgs) northwest of the treatment plant. Pentachlorophenol was detected at SS-5 to SS-9 at concentrations up to 270 mg/kg, but not at the other 4 shallow soil sampling locations northwest of the treatment plant. Previous investigations showed that soil samples under the building detected PCP up to 330 mg/kg based on immunoassay analysis, with one sample submitted for laboratory analysis showing PCP of 47 mg/kg. Other semi-volatile organic compounds (including polycyclic aromatic hydrocarbons and phthalate esters) were only detected infrequently at estimated concentrations below the reporting limit. Pyrene, however, was detected at concentrations above the reporting limit at SS-5 and SS-6. Polychlorinated dioxins and furans were detected at all surface soil sampling locations, with the highest concentrations at SS-5 and SS-6, the same locations where the highest concentrations of PCP were detected. Metals were detected at all sampling locations, however, concentrations were generally less than or similar to background concentrations in New York State or the eastern United States (NYDEC, 1994). Lead was detected at a concentration of 145 mg/kg at

SS-9, however, this metal is not known to be related to wood treatment activities and may represent natural concentrations.

Subsurface soil samples also showed infrequent detection of SVOCs at, for the most part, estimated concentrations below the reporting limit. PCP was not detected in subsurface soils in this investigation. However, PCP was detected in the previous investigation in Test Pit 9 (PTP-9), west of the treatment plant, at 40 mg/kg and in four sampling locations beneath the treatment plant. Polychlorinated dioxins and furans were detected above the 1 ppb screening level in the sampling locations beneath the treatment plant. Points of exposure for soil are limited to the surface soil west and adjacent to the treatment plant.

Groundwater samples showed low concentrations of a few semi-volatile organic conpounds that were detected at estimated concentrations below the reporting limit. PCP was not detected in any groundwater sample during any sampling event. Fuel oil components were detected in PMW-1, PMW-5 and PMW-6A.

Dioxins and furans were detected above the 0.0007 ng/L 2,3,7,8-TCDD guidance value in the four wells in which they were analyzed (PMW-1, PMW-2, PMW-4, and PMW-5) during the sampling event conducted in 1999. Concentrations ranged from 0.19 ng/L (PMW-5) to 0.00132 ng/L (PMW-2). Groundwater samples from this round were also analyzed for metals. While concentrations were detected above screening criteria, as reported in the Preliminary Investigation Report, they were attributed to background conditions, since they are not known to be site related.

The water supply well used by the facility is located at the site located approximately 250 feet northeast of the treatment plant. It was installed in bedrock at a depth of 300 feet below grade, as compared to the monitoring wells at the site that are screened at depths of 6-16 feet below grade. This well was previously sampled by New York State Department of Health in May 1998 and analyzed for VOCs, SVOCs, pesticides and PCBs, and metals. No volatiles, pesticides, PCP, or PCBs were detected, and does not appear to be impacted by the site. Sampling of this well in June 2001 and analysis for ketones and petroleum products and herbicides (including PCP), confirmed that this well was not impacted by fuel oil or PCP.

3.4 Potential Receptors and Exposure Routes

Exposure assessment includes a description of the potentially exposed persons who live, work, play, visit, or otherwise come to the site or surrounding environment. Consideration is given to the characteristics of the current populations (including sensitive subpopulations) as well as those of any potential future populations that may be exposed under any reasonable foreseeable future site activities and uses.

Camp Pharsalia is currently maintained as a NYSDEC management area and as a NYSDCS correctional facility, and is located in a heavily wooded, rural area. Inmates at Camp Pharsalia and NYSDEC employees conduct no activities in the impacted area. In fact, inmates have been instructed not to go in this area. This area is, however, currently accessible (i.e. no fence or gate limits access), nor are there any deed restrictions on the property that would restrict future land use. Therefore, the following receptors have been identified for the site under current and reasonable foreseeable future land use scenarios:

Current Use

- Adult inmates and staff at Camp Pharsalia (infrequent); and

Future Use

- Construction workers performing excavation activities
- NYSDEC Maintenance and Operations activities

The route of exposure is the manner in which a contaminant actually enters or contacts the body (i.e., ingestion, inhalation, dermal absorption). Based on the nature of the chemicals of potential concern, the types of media impacted at the site, and land use scenarios, the following exposure routes were identified:

- Direct contact with exposed surficial soil. Exposure routes include incidental ingestion of and dermal contact with impacted soil and the inhalation of particulate-bound contaminants.
- Direct contact with subsurface soil and/or groundwater, although impacts to surface soil are more significant than subsurface soil. Future activities involving excavation in the area of concern may allow exposure to impacted soil and shallow groundwater. Exposure routes include incidental ingestion of and dermal contact with soil and groundwater, and the inhalation of particulate-bound contaminants.
- Direct contact with groundwater used as a future drinking water source. Routes of exposure include ingestion and dermal contact. Currently, there are three active bedrock water supply wells located at the site, upgradient of the area of concern. Samples previously collected from two of these wells confirmed that contaminants related to the wood processing activities were not present at detectable levels, and the third well is located further upgradient. However, there are no restrictions on the property that would limit the future placement of a water supply well in any area of the site.

There is some potential for the uptake of site contaminants (PCP and dioxins) by terrestrial organisms that may then be consumed as game species. Terrestrial game likely to be hunted in this area would include species such as white-tailed deer and turkey. Both species consume vegetation; additionally, turkeys are opportunistic feeders that will also include invertebrates to their diet. As discussed above, uptake by plants from soil is not expected to result in significant bioaccumulation in plants. In addition, the area of impact is small relative to the expected home range of these two species. White-tailed deer have a home range of 120 to 400 acres (Burnett et al. 2002), while turkey can have a home range of 1000 acres or more (North Caroline State University 1995). Any contribution of site-related contaminants to the body burden of these species is, therefore, expected to be insignificant.

4.0 CONCLUSIONS

Complete exposure pathways have been identified for potential current and future human receptors based on exposure to contaminated soil and groundwater, although such exposures are expected to be very infrequent. The impacted area (PCP and dioxins and furans) is located under the treatment plant and in a small area of surface soils west of the treatment plant. Due to the narrow area of known contamination and the fact that the treatment plant is abandoned, under current conditions, prison inmates, NYSDEC and NYSDCSS staff, are unlikely to be present in impacted areas.

Concentrations of PCP are above the NYSDOH guidance value for human health of 20 mg/kg at SS-5 and SS-6, and at previous sampling locations in the same area PSS-1 and PSS-3 (immunoassay results). Concentrations of dioxins (as 2,3,7,8-TCDD equivalents) are above the criteria of 1 ug/kg that NYSDEC has used at other sites at SS-5, SS-6, SS-8, and SS-9.

While no site background has been established for metals has been established at this site, background samples taken at Camp Georgetown were used as a point of comparison. Concentrations of lead at several locations are above background concentrations found at Georgetown (7.1 to 16.6 mg/kg), with the maximum detected concentration of 145 mg/kg at SS-9. The presence of lead is unlikely to be related to site releases of wood preservatives, since it was not used at the site, nor does it appear to be related to any fuel oil release based on the low concentrations of PAHs in surface soil. Concentrations of other metals are below the soil cleanup objective or within the range of background concentrations specified in TAGM 4046 (NYSDEC, 1995), and background concentrations at Georgetown.

Given the limited potential for exposure to soil and the relatively small size of the areas where concentrations exceed standards, potential site exposures are unlikely to pose a significant risk to human health under current use. In addition, the soil standards are based on long-term exposure on a frequent basis. Actual exposures at this site are very infrequent, and not likely to occur over an extended period of time. Site concentrations may pose a significant risk in the future if site use were to change, resulting in increased exposure to the area of concern.

Groundwater concentrations of SVOCs from the recent round of sampling were all below either applicable groundwater criteria or standards (NYSDEC, 1998). The concentration of heptachlor epoxide at PMW-4 of 0.11 ug/L was above the groundwater standard of 0.03 ug/L. This pesticide was not detected in any other groundwater sample, nor is it known to be site-related. Historic concentrations of dioxins and furans in the monitoring wells in 1999 were higher than the groundwater standard of 0.0007 ng/L 2,3,7,8-TCDD equivalents. However, no dioxins were detected in the monitoring wells above the 0.0007 ng/L guidance value during the most recent round of groundwater sampling. Also, PCP was not detected in any of the wells in any round of sampling, making the origin of the dioxin congeners unclear. Since there is no use of shallow groundwater for drinking water purposes, the historic presence of dioxins and furans in groundwater does not pose a risk to human health under current use. Site groundwater concentrations may pose a risk in the future if shallow groundwater at the site were to be used for drinking water purposes.

5.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. ATSDR's Toxicological Profiles on CD-ROM, Version 3.1. Chapman & Hall/CRC.

Agency for Toxic Substances and Disease Registry (ATSDR). 2002. ATSDR – ToxFAQs: Dioxin. 2/5/2002. Online document: http://www.atsdr.cdc.gov/tfacts104.html

Burnett, Andrew. 2002. White-tailed Deer – Natural History and Autumn Behavior. New Jersey Division of Fish and Wildlife. Online document: http://www.state.nj.us/dep/fgw/deerart.htm

North Caroline State University. 1995. Working with Wildlife – Wild Turkey. North Carolina Cooperative Extension Service. Online document: http://www.ces.ncsu.edu/nreos/forest/steward/www5.html

Howard, P.H. 1991. *Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Vol. III: Pesticides.* Lewis Publ., Inc., Chelsea, MI.

New York State Department of Environmental Conservation (NYSDEC). 1995. *Division Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels.* HWR-94-4046.

New York State Department of Environmental Conservation (NYSDEC). 1998. Division of Water Technical and Operational Guidance Series 1.1.1. *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limits. June, 1998 and updates.*

APPENDIX B

REMEDIAL ALTERNATIVE COST ESTIMATES

Cost Estimate
Camp Pharsalia, South Plymouth, New York

Alternative 1 - No Action					
No.	**Item**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Post-Closure Costs					
1	Groundwater Sample Analysis (Biannually)	2	LS	$ 5,100.00	**$ 10,200**
2	Labor for Groundwater Monitoring Program	20	HR	$ 58.00	**$ 1,160**
3	Equipment	1	LS	$ 400.00	**$ 400**
	Sub-Total				**$ 11,760**
	Sub-Total: Present Worth - 30 Yr Post Closure Period				**$ 180,780**
	GRAND TOTAL				**$ 180,780**

NOTES

1 To calculate the Total Present Worth O&M, the equation $P = A \{[(1+i)^n-1]/[i(1+i)^n]\}$ was used, where A = Sub-total of Post Closure Costs, i = 5%, and n = 30 years.

2 Property maintenance (security, fence repairs, etc.) currently exists and will continue to exist as part of the daily operations of Camp Pharsalia as an incarceration facility. Thus, there are no additional costs to maintain the Site.

3 Laboratory analysis is of SVOCs, dioxins, and fuel oil components.

Cost Estimate
Camp Pharsalia, South Plymouth, New York

No.	Item	Quantity	Unit	Unit Cost	Total Cost
Alternative 2 - Limited Action					
Monitored Natural Attenuation					
1	Groundwater Sample Analysis	6	EA	$ 850.00	**$ 5,100**
2	Labor for Groundwater Sampling	20	HR	$ 58.00	**$ 1,160**
3	Equipment	1	LS	$ 400.00	**$ 400**
	Sub-Total				**$ 6,660**
Access Restrictions					
4	6' High Chain Link Fencing	260	LF	$ 19.74	**$ 5,133**
5	Corner Posts	6	EA	$ 105.28	**$ 632**
6	Gate	1	EA	$ 279.18	**$ 280**
	Sub-Total				**$ 6,045**
	Total Construction Cost				**$ 12,705**
	Contingency (15% Bid)				**$ 1,906**
	Sub-Total: Construction/Contingency Cost				**$ 14,611**
	Engineering & Design (10%)				**$ 1,461**
	Supervision, Administration & CQA (10%)				**$ 1,461**
	Sub- Total: Capital Cost				**$ 17,533**
Post-Closure Costs					
7	Groundwater Sample Analysis (Biannually)	2	LS	$ 5,100.00	**$ 10,200**
8	Labor for Groundwater Monitoring Program	20	HR	$ 58.00	**$ 1,160**
9	Equipment	1	LS	$ 400.00	**$ 400**
10	Fence Repairs	26	LF	$ 19.74	**$ 514**
	Sub-Total				**$ 12,274**
	Sub-Total: Present Worth - 30 Yr Post Closure Period				**$ 188,681**
	GRAND TOTAL				**$ 206,214**

NOTES

1. Contingency determined by combining the weighted-by-cost-element scope contingency with a fixed 15% bid contingency. The scope contingency used for each cost element is shown above. Contingency determined in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, USEPA, July 2000.
2. Engineering and Design Costs represent 10% of the Construction/Contingency Cost.
3. Supervision, Administration & CQA Costs represent 10% of the Construction/Contingency Cost. This percentage is based on a recommendation from "Superfund Remedial Design and Remedial Action Guidance", USEPA, June 1986.
4. To calculate the Total Present Worth O&M, the equation $P = A \{[(1+i)^n-1]/[i(1+i)^n]\}$ was used, where A = Sub-total of Post Closure Costs, i = 5%, and n = 30 years.
5. Disposal Volumes Derived by Using 1.35 Multiplier to Convert Cubic Yards to Tons.
6. Annual fence repairs represents 10% of the total perimeter.
7. The fence listed in this estimate is meant to specifically limit access to the impacted area. Overall property maintenance (security, fence repairs, etc.) currently exists and will continue to exist as part of the daily operations of Camp Pharsalia as an incarceration facility. Thus, there are no additional costs to maintain the Site.
8. Laboratory analysis is of SVOCs, dioxins, and fuel oil components.

Cost Estimate
Camp Pharsalia, South Plymouth, New York

No.	Item	Quantity	Unit	Unit Cost	Total Cost
Alternative 3 - Excavation and Off-site Disposal					
General Site Work					
1	Submittals/Implementation Plans	1	LS	$ 25,000.00	$ 25,000
2	Mobilization/Demobilization of Equipment	1	EA	$ 3,000.00	$ 3,000
3	Temporary Facilities and Utilities	1	LS	$ 1,500.00	$ 1,500
4	Post-construction Submittals	1	LS	$ 25,000.00	$ 25,000
5	Demolition of Treatment Plant	1	LS	$ 5,000.00	$ 5,000
	Sub-Total				$ 59,500
Excavation and Backfilling Work (assuming no sheeting, shoring, or bracing is necessary)					
6	Erosion and Sediment Controls	260	LF	$ 3.16	$ 822
7	Excavation	860	CY	$ 12.00	$ 10,320
8	Confirmatory Sidewall Samples (4 on each wall, 4 on bottom)	20	EA	$ 560.00	$ 11,200
9	Backfilling w/ Clean Soil and Compaction	860	CY	$ 22.92	$ 19,712
	Sub - Total				$ 42,054
Dewatering					
10	Trash Pump, 300 GPM	1	EA	$ 69.16	$ 70
11	Frac Tank, delivery and pickup	1	EA	$ 912.00	$ 912
12	Frac Tank	4	DAY	$ 30.00	$ 120
13	Transport and Disposal, providing no pretreatment is necessary	12,800	GAL	$ 1.72	$ 22,016
	Sub - Total				$ 23,118
Transportation and Disposal of Excavated Soils - Hazardous					
14	Testing of Excavated Fill Samples (1 per 22 tons)	53	EA	$ 560.00	$ 29,680
15	Transport and Disposal, providing no pretreatment is necessary	1,161	TON	$ 375.00	$ 435,375
	Sub - Total				$ 465,055
Equipment Decon					
16	PPE	15	DAY	$ 100.00	$ 1,500
17	Decontamination of Equipment	1	LS	$ 20,000.00	$ 20,000
18	Stormwater Controls	1	LS	$ 10,000.00	$ 10,000
	Sub - Total				$ 31,500
	Total Construction Cost				$ 621,227
	Contingency (27% Scope + 15% Bid)				$ 260,915
	Sub-Total: Construction/Contingency Cost				$ 882,142
	Engineering & Design (6%)				$ 52,929
	Supervision, Administration & CQA (7%)				$ 61,750
	Sub-Total: Capital Cost				$ 996,821
Post-Closure Costs					
19	Groundwater Sample Analysis (Biannually)	2	LS	$ 5,100.00	$ 10,200
20	Labor for Groundwater Monitoring Program	20	HR	$ 58.00	$ 1,160
21	Equipment	1	LS	$ 400.00	$ 400
	Sub-Total				$ 11,760
	Sub-Total: Present Worth - 5 Yr Post Closure Period				$ 50,915
	GRAND TOTAL				$ 1,047,736

Alternative 3 - Excavation and Off-site Disposal	
NOTES	
1	Contingency determined by combining the weighted-by-cost-element scope contingency with a fixed 15% bid contingency. The scope contingency used for each cost element is shown above. Contingency determined in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, USEPA, July 2000.
2	Engineering and Design Costs represent 6% of the Construction/Contingency Cost.
3	Supervision, Administration & CQA Costs represent 7% of the Construction/Contingency Cost. This percentage is based on a recommendation from "Superfund Remedial Design and Remedial Action Guidance", USEPA, June 1986.
4	To calculate the Total Present Worth O&M, the equation $P = A \{[(1+i)^n-1]/[i(1+i)^n]\}$ was used, where A = Sub-total of Post Closure Costs, i = 5%, and n = 5 years.
5	Disposal Volumes Derived by Using 1.35 Multiplier to Convert Cubic Yards to Tons.
6	Property maintenance (security, fence repairs, etc.) currently exists and will continue to exist as part of the daily operations of Camp Pharsalia as an incarceration facility. Thus, there are no additional costs to maintain the Site.
7	Laboratory analysis is of SVOCs, dioxins, and fuel oil components.

Cost Estimate
Camp Pharsalia, South Plymouth, New York

No.	Item	Quantity	Unit	Unit Cost	Total Cost
Alternative 4 - Ex-situ Stabilization and Capping					
General Site Work					
1	Submittals/Implementation Plans	1	LS	$ 25,000.00	**$ 25,000**
2	Mobilization/Demobilization of Equipment	1	EA	$ 12,250.00	**$ 12,250**
3	Temporary Facilities and Utilities	1	LS	$ 1,500.00	**$ 1,500**
4	Post-construction Submittals	1	LS	$ 25,000.00	**$ 25,000**
5	Demolition of Treatment Plant	1	LS	$ 5,000.00	**$ 5,000**
	Sub-Total				**$ 68,750**
Backfill and Excavation (assuming no sheeting, shoring, or bracing is necessary)					
6	Erosion and Sediment Controls	260	LF	$ 3.16	**$ 822**
7	Excavation	860	CY	$ 12.00	**$ 10,320**
8	Confirmatory Sidewall Samples (4 on each wall, 4 on bottom)	20	EA	$ 560.00	**$ 11,200**
9	Backfill and Compaction	972	CY	$ 12.00	**$ 11,664**
	Sub - Total				**$ 34,006**
Dewatering					
10	Trash Pump, 300 GPM	1	EA	$ 69.16	**$ 70**
11	Frac Tank, delivery and pickup	1	EA	$ 912.00	**$ 912**
12	Frac Tank	4	DAY	$ 30.00	**$ 120**
13	Transport and Disposal, providing no pretreatment is necessary	12,800	GAL	$ 1.72	**$ 22,016**
	Sub - Total				**$ 23,118**
Stabilization					
14	6" Unreinforced Treatment Pad (20' x 20')	400	SF	$ 4.78	**$ 1,912**
15	10 CY Mixer System	1	MO	$ 5,057.00	**$ 5,057**
16	Water System for Mixer	1	EA	$ 1,205.00	**$ 1,205**
17	Belt Feeder for 10 CY Mixer (13' long)	1	MO	$ 2,500.00	**$ 2,500**
18	Dust Collection System	1	MO	$ 1,500.00	**$ 1,500**
19	Ancillary Equipment	1	EA	$ 7,420.00	**$ 7,420**
20	Discharge Conveyor	1	MO	$ 2,500.00	**$ 2,500**
21	Operations	1,101	HR	$ 65.00	**$ 71,552**
22	Portland Cement	58	TON	$ 98.70	**$ 5,725**
23	Class F Fly Ash	70	TON	$ 8.46	**$ 593**
24	Granular Activated Carbon	23	TON	$ 2,820.00	**$ 64,860**
25	Bulk Chemical Transport (40,000 lb Truckload)	9	EA	$ 2,134.00	**$ 19,206**
26	Treatability Study	1	LS	$ 20,000.00	**$ 20,000**
	Sub - Total				**$ 204,030**
Asphalt Cap					
27	3" Asphalt Binder Course	320	SY	$ 5.29	**$ 1,693**
28	2" Wearing Course	320	SY	$ 4.12	**$ 1,318**
	Sub - Total				**$ 3,011**
Equipment Decon					
29	PPE	30	DAY	$ 100.00	**$ 3,000**
30	Decontamination of Equipment	1	LS	$ 20,000.00	**$ 20,000**
31	Stormwater Controls	1	LS	$ 10,000.00	**$ 10,000**
	Sub - Total				**$ 33,000**
	Total Construction Cost				**$ 365,915**

Cost Estimate
Camp Pharsalia, South Plymouth, New York

Alternative 4 - Ex-situ Stabilization and Capping					
No.	**Item**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	Contingency (27% Scope + 15% Bid)				**$ 153,684**
	Sub-Total: Construction/Contingency Cost				**$ 519,600**
	Engineering & Design (6%)				**$ 31,176**
	Supervision, Administration & CQA (7%)				**$ 36,372**
	Sub-Total: Capital Cost				**$ 587,148**
Post-Closure Costs					
32	Soil Sample Analysis (Annually)	1	LS	$ 2,800.00	**$ 2,800**
33	Groundwater Sample Analysis (Biannually)	2	LS	$ 5,100.00	**$ 10,200**
34	Labor for Soil Monitoring Program	20	HR	$ 58.00	**$ 1,160**
35	Labor for Groundwater Monitoring Program	20	HR	$ 58.00	**$ 1,160**
36	Equipment	1	LS	$ 400.00	**$ 400**
	Sub-Total				**$ 15,720**
	Sub-Total: Present Worth - 5 Yr Post Closure Period				**$ 68,059**
	GRAND TOTAL				**$ 655,207**

NOTES

1. Contingency determined by combining the weighted-by-cost-element scope contingency with a fixed 15% bid contingency. The scope contingency used for each cost element is shown above. Contingency determined in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, USEPA, July 2000.
2. Engineering and Design Costs represent 6% of the Construction/Contingency Cost.
3. Supervision, Administration & CQA Costs represent 7% of the Construction/Contingency Cost. This percentage is based on a recommendation from "Superfund Remedial Design and Remedial Action Guidance", USEPA, June 1986.
4. To calculate the Total Present Worth O&M, the equation $P = A \{[(1+i)^n-1]/[i(1+i)^n]\}$ was used, where A = Sub-total of Post Closure Costs, i = 5%, and n = 5 years.
5. Disposal Volumes Derived by Using 1.35 Multiplier to Convert Cubic Yards to Tons.
6. Property maintenance (security, fence repairs, etc.) currently exists and will continue to exist as part of the daily operations of Camp Pharsalia as an incarceration facility. Thus, there are no additional costs to maintain the Site.
7. Laboratory analysis is of SVOCs, dioxins, and fuel oil components.

Cost Estimate
Camp Pharsalia, South Plymouth, New York

No.	Item	Quantity	Unit	Unit Cost	Total Cost
Alternative 5 - Thermal Desorption					
General Site Work					
1	Submittals/Implementation Plans	1	LS	$ 25,000.00	**$ 25,000**
2	Mobilization/Demobilization of Equipment	1	EA	$ 118,000.00	**$ 118,000**
3	Temporary Facilities and Utilities	1	LS	$ 1,500.00	**$ 1,500**
4	Post-construction Submittals	1	LS	$ 25,000.00	**$ 25,000**
5	Demolition of Treatment Plant	1	LS	$ 5,000.00	**$ 5,000**
	Sub-Total				**$ 174,500**
Backfill and Excavation (assuming no sheeting, shoring, or bracing is necessary)					
6	Erosion and Sediment Controls	260	LF	$ 3.16	**$ 822**
7	Excavation	860	CY	$ 12.00	**$ 10,320**
8	Confirmatory Sidewall Samples (4 on each wall, 4 on bottom)	20	EA	$ 560.00	**$ 11,200**
9	Backfill and Compaction	860	CY	$ 12.00	**$ 10,320**
	Sub - Total				**$ 32,662**
Dewatering					
10	Trash Pump, 300 GPM	1	EA	$ 69.16	**$ 70**
11	Frac Tank, delivery and pickup	1	EA	$ 912.00	**$ 912**
12	Frac Tank	4	DAY	$ 30.00	**$ 120**
13	Transport and Disposal, providing no pretreatment is necessary	12,800	GAL	$ 1.72	**$ 22,016**
	Sub - Total				**$ 23,118**
Thermal Desorption					
14	Bench Scale Treatability Study	1	LS	$ 20,000.00	**$ 20,000**
15	Pretreatment of Excavated Soil	1,161	TON	$ 15.00	**$ 17,415**
16	Demonstration	1	LS	$ 40,000.00	**$ 40,000**
17	Treatment	1,161	TON	$ 167.11	**$ 194,010**
	Sub - Total				**$ 271,425**
Equipment Decon					
18	PPE	30	DAY	$ 100.00	**$ 3,000**
19	Decontamination of Equipment	1	LS	$ 20,000.00	**$ 20,000**
20	Stormwater Controls	1	LS	$ 10,000.00	**$ 10,000**
	Sub - Total				**$ 33,000**
	Total Construction Cost				**$ 534,705**
	Contingency (27% Scope + 15% Bid)				**$ 224,576**
	Sub-Total: Construction/Contingency Cost				**$ 759,281**
	Engineering & Design (6%)				**$ 45,557**
	Supervision, Administration & CQA (7%)				**$ 53,150**
	Sub-Total: Capital Cost				**$ 857,988**
Post-Closure Costs					
21	Soil Sample Analysis (Annually)	1	LS	$ 2,800.00	**$ 2,800**
22	Groundwater Sample Analysis (Biannually)	2	LS	$ 5,100.00	**$ 10,200**
23	Labor for Soil Monitoring Program	20	HR	$ 58.00	**$ 1,160**
24	Labor for Groundwater Monitoring Program	20	HR	$ 58.00	**$ 1,160**
25	Equipment	1	LS	$ 400.00	**$ 400**
	Sub-Total				**$ 15,720**
	Sub-Total: Present Worth - 5 Yr Post Closure Period				**$ 68,059**
	GRAND TOTAL				**$ 926,047**

Alternative 5 - Thermal Desorption	
NOTES	
1	Contingency determined by combining the weighted-by-cost-element scope contingency with a fixed 15% bid contingency. The scope contingency used for each cost element is shown above. Contingency determined in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, USEPA, July 2000.
2	Engineering and Design Costs represent 6% of the Construction/Contingency Cost.
3	Supervision, Administration & CQA Costs represent 7% of the Construction/Contingency Cost. This percentage is based on a recommendation from "Superfund Remedial Design and Remedial Action Guidance", USEPA, June 1986.
4	To calculate the Total Present Worth O&M, the equation $P = A \{[(1+i)^n-1]/[i(1+i)^n]\}$ was used, where A = Sub-total of Post Closure Costs, i = 5%, and n = 5 years.
5	Disposal Volumes Derived by Using 1.35 Multiplier to Convert Cubic Yards to Tons.
6	Property maintenance (security, fence repairs, etc.) currently exists and will continue to exist as part of the daily operations of Camp Pharsalia as an incarceration facility. Thus, there are no additional costs to maintain the Site.
7	Assume not more than 1.5% TPH by weight, 40 gpm water supplied by Site at no cost, and operation 12-hr/day 6-day/week.
8	Laboratory analysis is of SVOCs, dioxins, and fuel oil components.

Cost Estimate
Camp Pharsalia, South Plymouth, New York

Alternative 6A - Containment: Multi Layered Synthetic Cap					
No.	**Item**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
General Site Work					
1	Submittals/Implementation Plans	1	LS	$ 15,000.00	**$ 15,000**
2	Mobilization/Demobilization of Equipment	1	EA	$ 3,000.00	**$ 3,000**
3	Temporary Facilities and Utilities	1	LS	$ 1,500.00	**$ 1,500**
4	Post-construction Submittals	1	LS	$ 10,000.00	**$ 10,000**
5	Demolition of Treatment Plant	1	LS	$ 5,000.00	**$ 5,000**
	Sub-Total				**$ 34,500**
Multi-Layered Cap					
6	Vegetative Layer - 6 inches of topsoil	55	CY	$ 42.98	**$ 2,364**
7	Drainage Layer - 24 inches of sandy loam	220	CY	$ 42.98	**$ 9,456**
8	40 mil High Density Polyethylene Liner	2880	SF	$ 2.15	**$ 6,192**
9	Low Permeability Layer - 18 inches of clay	165	CY	$ 33.40	**$ 5,511**
10	Subgrade Layer - 12 inches of sandy loam	110	CY	$ 42.98	**$ 4,728**
11	Grading and seeding, including fertilizer	320	SY	$ 2.11	**$ 676**
	Sub - Total				**$ 28,927**
Equipment Decon					
12	PPE	30	DAY	$ 100.00	**$ 3,000**
13	Decontamination of Equipment	1	LS	$ 5,000.00	**$ 5,000**
14	Stormwater Controls	1	LS	$ 3,000.00	**$ 3,000**
	Sub - Total				**$ 11,000**
	Total Construction Cost				**$ 74,427**
	Contingency (15% Scope + 5% Bid)				**$ 14,885**
	Sub-Total: Construction/Contingency Cost				**$ 89,312**
	Engineering & Design (6%)				**$ 5,359**
	Supervision, Administration & CQA (7%)				**$ 6,252**
	Sub-Total: Capital Cost				**$ 100,923**
Post-Closure Costs					
15	Groundwater Sample Analysis (Biannually)	2	LS	$ 5,100.00	**$ 10,200**
16	Labor for Groundwater Monitoring Program	20	HR	$ 58.00	**$ 1,160**
17	Equipment	1	LS	$ 400.00	**$ 400**
18	Cap Maintenance	1	LS	$ 500.00	**$ 500**
	Sub-Total				**$ 12,260**
	Sub-Total: Present Worth - 30 Yr Post Closure Period				**$ 188,466**
	GRAND TOTAL				**$ 289,390**

Cost Estimate
Camp Pharsalia, South Plymouth, New York

Alternative 6A - Containment: Multi Layered Synthetic Cap	
NOTES	
1	Contingency determined by combining the weighted-by-cost-element scope contingency with a fixed 15% bid contingency. The scope contingency used for each cost element is shown above. Contingency determined in accordance with *A Guide to Developing and Doc*
2	Engineering and Design Costs represent 6% of the Construction/Contingency Cost.
3	Supervision, Administration & CQA Costs represent 7% of the Construction/Contingency Cost. This percentage is based on a recommendation from "Superfund Remedial Design and Remedial Action Guidance", USEPA, June 1986.
4	To calculate the Total Present Worth O&M, the equation $P = A \{[(1+i)^n-1]/[i(1+i)^n]\}$ was used, where A = Sub-total of Post Closure Costs, i = 5%, and n = 30 years.
5	Disposal Volumes Derived by Using 1.35 Multiplier to Convert Cubic Yards to Tons.
6	Property maintenance (security, fence repairs, etc.) currently exists and will continue to exist as part of the daily operations of Camp Pharsalia as an incarceration facility. Thus, there are no additional costs to maintain the Site.
7	Laboratory analysis is of SVOCs, dioxins, and fuel oil components.

Cost Estimate
Camp Pharsalia, South Plymouth, New York

Alternative 6B - Containment: Low Permeability Cover System					
No.	**Item**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
General Site Work					
1	Submittals/Implementation Plans	1	LS	$ 15,000.00	**$ 15,000**
2	Mobilization/Demobilization of Equipment	1	EA	$ 3,000.00	**$ 3,000**
3	Temporary Facilities and Utilities	1	LS	$ 1,500.00	**$ 1,500**
4	Post-construction Submittals	1	LS	$ 10,000.00	**$ 10,000**
5	Demolition of Treatment Plant	1	LS	$ 5,000.00	**$ 5,000**
	Sub-Total				**$ 34,500**
Multi-Layered Cap					
6	Vegetative Layer - 6 inches of topsoil	55	CY	$ 42.98	**$ 2,364**
7	Low Permeability Layer - 12 inches of clay	110	CY	$ 33.40	**$ 3,674**
8	Grading and seeding, including fertilizer	320	SY	$ 2.11	**$ 676**
	Sub - Total				**$ 6,714**
Equipment Decon					
9	PPE	30	DAY	$ 100.00	**$ 3,000**
10	Decontamination of Equipment	1	LS	$ 5,000.00	**$ 5,000**
11	Stormwater Controls	1	LS	$ 3,000.00	**$ 3,000**
	Sub - Total				**$ 11,000**
	Total Construction Cost				**$ 52,214**
	Contingency (15% Scope + 5% Bid)				**$ 10,443**
	Sub-Total: Construction/Contingency Cost				**$ 62,657**
	Engineering & Design (6%)				**$ 3,760**
	Supervision, Administration & CQA (7%)				**$ 4,386**
	Sub-Total: Capital Cost				**$ 70,803**
Post-Closure Costs					
12	Groundwater Sample Analysis (Biannually)	2	LS	$ 5,100.00	**$ 10,200**
13	Labor for Groundwater Monitoring Program	20	HR	$ 58.00	**$ 1,160**
14	Equipment	1	LS	$ 400.00	**$ 400**
15	Cap Maintenance	1	LS	$ 500.00	**$ 500**
	Sub-Total				**$ 12,260**
	Sub-Total: Present Worth - 30 Yr Post Closure Period				**$ 188,466**
	GRAND TOTAL				**$ 259,269**

Alternative 6B - Containment; Low Permeability Cover System	
NOTES	
1	Contingency determined by combining the weighted-by-cost-element scope contingency with a fixed 15% bid contingency. The scope contingency used for each cost element is shown above. Contingency determined in accordance with *A Guide to Developing and Doc*
2	Engineering and Design Costs represent 6% of the Construction/Contingency Cost.
3	Supervision, Administration & CQA Costs represent 7% of the Construction/Contingency Cost. This percentage is based on a recommendation from "Superfund Remedial Design and Remedial Action Guidance", USEPA, June 1986.
4	To calculate the Total Present Worth O&M, the equation $P = A \{[(1+i)^n-1]/[i(1+i)^n]\}$ was used, where A = Sub-total of Post Closure Costs, i = 5%, and n = 30 years.
5	Disposal Volumes Derived by Using 1.35 Multiplier to Convert Cubic Yards to Tons.
6	Property maintenance (security, fence repairs, etc.) currently exists and will continue to exist as part of the daily operations of Camp Pharsalia as an incarceration facility. Thus, there are no additional costs to maintain the Site.
7	Laboratory analysis is of SVOCs, dioxins, and fuel oil components.