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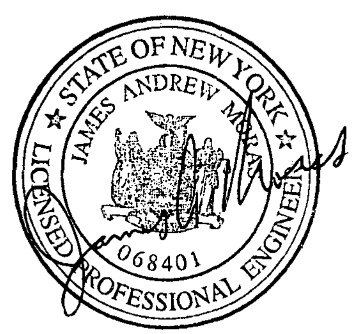
FS Report 0441

FEASIBILITY STUDY REPORT

Scobell Chemical Site

(On-site Operable Unit)

Town of Brighton, New York
Monroe County
Site No. 8-28-076



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Prepared by
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF ENVIRONMENTAL REMEDIATION

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SECTION 1 - INTRODUCTION

1.1 General

This Report has been prepared for the Scobell Chemical Site on-site operable unit, New York State Department of Environmental Conservation (NYSDEC) Site Registry No. 8-28-076, and presents the results of the Feasibility Study (FS) performed for the site. This site is a Class 2 inactive hazardous waste site located in the Town of Brighton near the eastern border of the City of Rochester and immediately northwest of the I-490/I-590 interchange ("the can of worms"). The FS has been prepared by the NYSDEC's Division of Environmental Remediation and is based upon the information and data presented in the Remedial Investigation (RI) Report for this site, dated January 1999.

1.2 Site Description

The site is the location of a former chemical operation that conducted chemical storage, warehousing, transferring and sales of hazardous materials. Originally, the site was approximately 2.6 acres in size. In 1988, as a part of the New York State Department of Transportation's (NYSDOT) "can of worms" reconstruction project, an Interim Remedial Measure (IRM) was conducted by NYSDOT. The IRM included demolition of all of the on-site buildings as well as excavation and off-site disposal of contaminated soil and bedrock from over half of the site. The present site is about one (1) acre in size, is capped with approximately twelve (12) inches of clay, and is fenced. The site is located in a highly urbanized area in the Town of Brighton, at the eastern boundary of the City of Rochester. Industrial and commercial properties are located directly to the west of the site. A major Conrail railroad line is directly north, and to the east and south is the I-490 and I-590 highway interchange. The site is presently owned by the New York State Department of Transportation (NYSDOT).

1.3 Site History

The Scobell Chemical Site is the location of a former chemical repackaging company. The former site was operated from the 1920s until 1986. Assorted chemicals were purchased by the company in bulk and repackaged into smaller containers for resale. The site had one main building, two smaller structures and four above ground storage tanks. The amount of and type of the materials handled is unclear but significant subsurface soil contamination has been identified.

In 1986, the NYSDOT condemned the property to construct the "Can of Worms" highway intersection (the intersection of I-590 and I-490). In early 1988, the NYSDOT discovered extensive contamination at the Scobell site including abandoned drums, contaminated structures, and soil and bedrock contamination. Drums and containers containing halogenated volatile organic compounds (VOCs), pesticides/herbicides (including 2,4,5-T) and toluene were found in the warehouse. The site was reported to contain deteriorated containers, discolored soils, and stained asphalt.

In 1988, the NYSDOT conducted an IRM removal action. The cost of the IRM was approximately $4 million and included decontamination and demolition of the structures, removal of containers, drums and above ground storage tanks, and excavation and disposal of contaminated soil and bedrock. Over half of the former footprint of the site was remediated by the IRM and is now a part of the highway interchange. For the remaining portion of the site, only the structures and above ground tanks were removed; no soil remediation was reported other than capping the area with 9-12 inches of clay. A fence was placed around the site. Significant subsurface soil contamination remains under the cap including toluene, trichloroethene, tetrachloroethene, 1,2-dichloroethene, chromium and pesticides (see Tables 1.2 and 1.3).

A seep prevention system was installed by NYSDOT in November 1988, near the end of the IRM. The seep prevention system was installed at the base of the slope, adjacent to the highway ramp, to prevent water from running onto the highway. The seep prevention system consisted of approximately 300 feet of six inch diameter underdrain pipe that ran from the southwest to the northeast at the base of the slope between the site and the highway. When the system was in operation water drained to a 16 cubic foot collection sump (a manhole), located at the base of the slope below the northeast corner of the Scobell site. From the collection sump the water was pumped to a 2000 gallon holding tank, located at the top of the slope in the northeast corner of the site. When the seep prevention system was temporarily shut down in 1994, no water was seeping from the bedrock face. Since the purpose of the seep prevention system (prevent water from running onto the highway) was being accomplished on its own, the system was no longer needed to accomplish its intended goal and its use was discontinued in 1995.

During the demolition of the on-site structures 62 drums of soil/dust, containing site related contamination including low levels of 2,4,5-T (silvex), were generated. At the time the waste was generated it was difficult to find a facility to accept the waste for disposal. As a result, the drums were stored in an on-site storage trailer until they were disposed of at an off-site facility in 1996.

1.4 Summary of Remedial Investigation

1.4.1 Site Characterization

The main source of contamination at this site is most likely the result of spills that occurred, due to past handling practices, over a long period of time. Volatile organic contamination is present at the site as dissolved constituents in the groundwater and apparently as free product which is more dense than water and has/is moving down into the aquifer (dense non-aqueous phase liquid or DNAPL). Some solvents remain in the on-site soil above the water table in the vicinity of the source area. This contamination exists as a residual that did not migrate to the base of the aquifer, but rather bound to individual soil particles as it passed through the unsaturated soil.

The site is underlain by approximately ten feet of overburden consisting of (from the surface down): a silty clay cover (approximately one foot thick - placed as a part of the 1988 IRM), approximately four-five feet of fill and disturbed soil consisting of cinders/brick/glass, up to seven feet of silt and clay with some sand. The bedrock present immediately below the overburden is a Dolostone.

Groundwater at the site was encountered near the bedrock overburden interface. A thin zone of groundwater was found in the overburden and appears to flow to the south, towards the I-590 ramp. The overburden groundwater levels to the north are lower than on-site (following surface elevations which are approximately five feet lower on the north side of the railroad tracks, compared to the surface elevations on-site). As a result, the possibility exists that there is some overburden groundwater which may flow from the northern edge of the site to the north. Bedrock groundwater elevations are approximately ten feet below the surface of the bedrock on-site and at, or just below the surface of the bedrock north of the site (MW-4D and MW-5D). Groundwater flow in the bedrock appears to flow to the northeast. Slug tests performed during the Site Investigation indicate average hydraulic conductivities at the overburden/bedrock interface of approximately 1.8×10^{-2} centimeters/second (cm/sec), and approximately 8.8×10^{-5} cm/sec in the shallow bedrock.

During the Remedial Investigation (RI) field work a total of 32 small diameter soil borings were advanced, 30 piezometers were installed during the small diameter soil boring program (at all locations except for GP-13 and GP-14), and seven monitoring wells were installed (two overburden and five shallow). The following environmental samples were collected for chemical analysis: 24 subsurface soil samples, 18 groundwater samples (11 from piezometers and seven from monitoring wells), three surface water samples, three sediment samples, four surface soil samples, two dense non-aqueous phase liquid samples (DNAPL), and four soil gas samples (collected during the vapor extraction pilot study).

The Site Investigation generated enough information, for the site area itself, to develop and screen remedial alternatives as a part of this Feasibility Study (FS). However, additional information is needed to define the extent of the contamination downgradient of the site. As a result, the site has been divided into two operable units: the on-site operable unit and the off-site operable unit. Since enough information is available for the on-site area, the FS for that operable unit will be performed while the investigation of the off-site area continues.

Recommendations for the off-site investigation include determining potential migration pathways for contaminant migration and the installation of additional bedrock monitoring wells to determine the extent of the contamination.

1.4.2 Soil Vapor Extraction Pilot Study

During the Site Investigation field work a soil vapor extraction pilot study was performed. During the pilot study air was extracted from the vapor extraction well (SVE-1) at a rate of approximately 39 cubic feet per minute and an average vacuum of 3 inches of mercury. The vacuum response was measured from piezometers around the extraction well at regular intervals during the test. Attachment 1 of the Remedial Investigation Report summarizes the vacuum measurements at each piezometer during the pilot test. The vacuum response measured at the piezometers showed variability throughout the duration of the test. However, the maximum vacuum response in each piezometer was recorded during the first day of vapor extraction. Based on the vacuum response data, an air permeability for the site soils has been estimated to be approximately 9.5 darcy units (or cm^2). This value is typical of soils with moderate permeability. The relationship between the maximum vacuum response at each piezometer versus distance from the vapor extraction well is linear. Based on this data, the radius of influence for the vapor extraction well has been estimated at approximately 40 feet.

Four air samples were collected during the pilot test for laboratory analyses of VOCs. Three samples were collected prior to carbon treatment and one sample was collected after carbon treatment. A total of 12 VOCs were detected in the air samples. Vinyl chloride was detected at a maximum concentration of 11 ppb after one hour of extraction. The concentration decreased to 0.3 ppb after 120 hours of extraction.

Based on the air sampling data, an estimated 37 pounds of VOCs, or an average of 7.4 pounds per day of VOCs were removed from the soil during the pilot test.

Based on the results of the pilot test, SVE appears to be an effective remedial approach for removing the key VOCs detected in site soils. The following additional conclusions and recommendations can be made from the results of the vapor extraction pilot test:

- Estimated air permeability of the site soils is approximately 9.5 darcys, which is typical of soil with moderate permeability.
- The vacuum radius of influence is approximately 40 feet.
- VOCs in the extracted air stream consisted primarily of toluene, trichloroethene, and *cis*-1,2,-dichloroethylene, with toluene accounting for between 86 percent and 96 percent of the total VOC concentration. These were the primary VOCs detected in site soils and groundwater.
- An average of approximately 7.4 pounds per day of VOCs were removed from the vapor extraction well during the test.

1.5 Nature and Extent of Contamination

1.5.1 Applicable Standards, Criteria, and Guidance (SCGs)

In order to identify potential exposure pathways, applicable SCGs must be identified. 6 NYCRR Part 375-1.10(c)(1)(I) requires that remedial actions comply with SCGs "unless good cause exists why conformity should be dispensed with." Standards and Criteria are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance. Guidance includes non-promulgated criteria and guidelines that are not legal requirements; however, the site's remedial program should be designed with consideration given to guidance that, based on professional judgement, is determined to be applicable to the site.

SCGs are categorized as chemical specific, location specific, or action specific. These categories are defined as the following:

Chemical Specific: These are health or risk based numerical values or methodologies which, when applied to site specific conditions, result in the establishment of numerical values for the chemicals of interest. These values establish the acceptable amount or concentration of a chemical that may be found in or discharged to the environment.

Location Specific: These are restrictions placed on the concentrations of hazardous substances or the conduct of activities solely because they occur in a specific location.

Action Specific: These are usually technology or activity based requirements or limitations on actions taken with respect to hazardous waste management and site cleanup.

The following lists the principal SCGs that have been identified for the Scobell Chemical site (Table 1.1 lists all of the SCGs for the site):

General - 6 NYCRR Part 375, Inactive Hazardous Waste Disposal Site Remedial Program

Soil - NYSDEC Division of Hazardous Waste Remediation Technical and Administrative Guidance Memorandum (TAGM) 4046, Determination of Soil Cleanup Objectives and Cleanup Levels

- 6 NYCRR Part 371, Identification and Listing of Hazardous Wastes

- 6 NYCRR Part 376 - Land Disposal Restrictions

- NYSDEC Division of Hazardous Substance Regulation TAGM 3028, "Contained in Criteria for Environmental Media" (11/92)

Groundwater - 6NYCRR Part 700-705, Water Quality Regulations for Surface Water and

Groundwater
- NYSDEC Division of Water TOGS 1.1.1

Air - Air Guide 1 - Guidelines for the Control of Toxic Ambient Air Contaminants

A comprehensive list of all of the potential SCGs for this site is included in Table 1.1 of this report (reproduced from Table 5.1 of the RI Report).

1.5.2 Summary of Nature and Extent of Contaminated Media (On-Site)

Based on the information developed during previous studies and this RI, chemical compounds of potential concern by environmental medium have been identified (see analytical result summaries presented in Tables 1.2 and 1.3). Compounds of potential concern were selected based on frequency of detection, range of concentrations, and potential for migration.

The main source of contamination at this site is most likely the result of spills that occurred, due to past storage and handling practices, over a long period of time. Volatile organic contamination is present at the site as dissolved constituents in the groundwater and apparently as free product which is more dense than water and has/is moving down into the shallow bedrock aquifer (dense non-aqueous phase liquid or DNAPL). Some solvents remain in the on-site soil above the water table in the vicinity of the source area. This contamination exists as a residual that did not migrate to the base of the aquifer, but rather bound to individual soil particles as it passed through the unsaturated soil.

Four surface soil samples were taken from the perimeter of the site, two each from along the western and northern borders of the site. Two pesticides (endrin and heptachlor epoxide) and certain metals (e.g., cadmium, chromium, lead, mercury, and zinc) were detected at elevated concentrations.

Subsurface soil contamination appears to be limited to on-site areas and is predominantly made up of volatile organic constituents . A total of 16 on-site subsurface soil samples were taken at eight locations during the RI. These samples were taken to supplement the subsurface soil samples collected in 1988 by NYSDOT . Elevated concentrations of the following contaminants have been found in on-site subsurface soil: trichloroethene (TCE), tetrachloroethene (PCE), 1,2-dichloroethene (1,2-DCE), toluene, xylene, 1,1,1-trichloroethane (1,1,1-TCA), lead, chromium, zinc, and MCPP (a pesticide also known as Mecoprop).

The results of the groundwater samples taken from on-site monitoring points indicated the presence of chloroform, ethylbenzene, xylene, TCE ,PCE, toluene, 1,2-DCE, 1,1-DCE, vinyl chloride, and benzene. In addition the following metals were detected at elevated concentrations in the on-site overburden groundwater: cadmium, chromium, lead, and zinc. Aqueous phase contamination is present in the overburden aquifer while both aqueous and non-aqueous phase (NAPL) contamination is present in the shallow bedrock.

1.5.2.1 Contaminants of Concern

The following contaminants have been found (historically and/or during Site Investigation) at elevated concentrations at the Scobell Chemical site:

<u>SURFACE SOIL</u>
endrin
heptachlor epoxide
cadmium
chromium
lead
mercury
zinc

<u>SUBSURFACE SOIL</u>
1,2-dichloroethene (1,2-DCE)
MCPP (pesticide) [seen in one sample during 1988 NYSDOT sampling]
tetrachloroethene (PCE)
toluene
1,1,1-trichloroethane (1,1,1-TCA)
trichloroethene (TCE)
xylene
chromium
lead
zinc

<u>GROUNDWATER</u>
benzene
chloroform
1,1-dichloroethene
1,2-dichloroethene
ethylbenzene
tetrachloroethene
toluene
trichloroethene
vinyl chloride
xylene
cadmium
chromium
lead
zinc

SECTION 2 - PROJECT GOALS and OBJECTIVES

The goal of this FS is the identification and analysis of remedial alternatives for the Scobell Chemical on-site operable unit, consistent with the objectives of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 121 and 6NYCRR Part 375. The primary objective is the selection of a remedial alternative which is protective of human health and the environment.

Based on the results of the Human Exposure Pathway Analysis and the Habitat Based Analysis, presented in the RI Report, the Remedial Action Objectives (RAOs) for this site are:

- Reduce, control, or eliminate, to the extent practicable, the contamination present in the subsurface soils at the site.

- Eliminate the potential for direct contact with/erosion of the contaminated surface soils at the site (perimeter of the site outside footprint of clay cover installed as part of "88 NYSDOT IRM).

- Reduce, control, or eliminate, to the extent practicable, the continued migration of contaminated groundwater and dense non-aqueous phase liquid (DNAPL) from the site.

The goal of the program will be to reduce contaminant concentrations to levels that are consistent with SCGs (i.e., to reduce soil concentrations to below the Recommended Soil Cleanup Objectives presented in TAGM 4046). Any remedial alternative that will later be presented as the preferred remedial action **must** demonstrate that it will be protective of human health and the environment.

SECTION 3 - DEVELOPMENT OF REMEDIAL ALTERNATIVES

The following section will present remedial alternatives that are meant to address the remedial goals presented in the previous section.

3.1 Presumptive Remedies Directive

The EPA has developed policy and procedures for presumptive remedies at sites where commonly encountered characteristics are present. Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The EPA has: evaluated technologies that have been consistently selected at sites using the remedy selection criteria set out in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP); reviewed currently available performance data on the application of these technologies, and; has determined that a particular set of remedies is presumptively the most appropriate for addressing specific types of sites. The objective of the presumptive remedies initiative is to use past experience to speed up the evaluation and selection of remedial options, to ensure consistency in remedy selection, and to reduce the time and cost required to clean up similar types of sites. The presumptive remedies directive eliminates the need for the initial step of identifying and screening a variety of alternatives during the Feasibility Study. The NCP states that "the lead agency shall include an alternatives screening step, when needed, to select a reasonable number of alternatives for detailed analysis." EPA has analyzed feasibility studies for sites with commonly encountered contamination (i.e., sites with VOC-contaminated soil) and found that certain technologies are routinely screened out based on effectiveness, implementability, or excessive costs, consistent with the procedures set forth in the NCP. Accordingly, EPA has determined that, for sites that meet the requirements of the presumptive remedies directives, site-specific identification and screening of alternatives is not necessary.

This FS will use the following presumptive remedy guidance directives: *Presumptive Remedies:*

Policies and Procedures, USEPA Directive 9355.0-47FS, September 1993; *Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils*, USEPA Directive 9355.0-48FS, September 1993; and *Presumptive Response Strategy and Ex-situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites*, USEPA Directive 9283.1-12, October 1996.

3.2 Identification of Remedial Alternatives for Soil

As discussed in the previous section, EPA has determined that, for sites that meet the requirements of the presumptive remedies directives, site-specific identification and screening of alternatives is not necessary. This section identifies remedial alternatives for the contamainated soil at the Scobell site. These alternatives have been generated based on the guidance included in EPA's document entitled *Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils.*

3.2.1 No Further Action

This alternative is listed as no further action in order to acknowledge the work that has already been completed at the site as a part of NYSDOT's 1988 IRM.

The No Action alternative is included as a procedural requirement and as a baseline to evaluate the other alternatives. Under this alternative, no additional remedial action would be taken to address contaminated soils present at the site.

3.2.2 Soil Vapor Extraction

Soil vapor extraction (SVE) is an in-situ soil remediation technology, to be used in the unsaturated (vadose) zone, in which a vacuum would be applied to the soil to induce the controlled flow of air and remove volatile (and some semivolatiles, if present) contaminants from the soil. It is possible that the gas leaving the soil would have to be treated to recover or destroy the contaminants, depending on the concentrations of the contaminants present in the discharge. Vapor extraction wells would typically be used at depths of five feet or greater. Groundwater extraction could be incorporated into the system, as necessary, to reduce groundwater upwelling induced by the vacuum or to increase the depth of the vadose zone.

Applicability: The target contaminant groups for in situ SVE are VOCs and some fuels. The technology is best applicable to volatile compounds with a Henry's law constant (see Table 3.1) greater than 0.001 or a vapor pressure greater than 0.5 mm Hg (0.02 inches Hg). Other factors, such as the moisture content, organic content, and air permeability of the soil, will also affect SVE's effectiveness.

Limitations: Factors that may limit the applicability and effectiveness of the process include:

- Soil that is tight or has high moisture content (>50%) has a reduced permeability to air, requiring higher vacuums (increasing costs) and/or hindering the operation of SVE.

- Large screened intervals are required in extraction wells for soil with highly variable permeabilities, which otherwise may result in uneven delivery of soil gas flow from the contaminated regions.
- Soil that has high organic content or is extremely dry has a high sorption capacity of VOCs, which results in reduced removal rates.
- Air emissions may require treatment to eliminate possible harm to the public and the environment. As a result of off-gas treatment, residual liquids and spent activated carbon may require treatment/disposal.
- SVE is not effective in the saturated zone; however, lowering the water table can expose more media to SVE (this may also address concerns regarding LNAPLs, if present).

3.2.3 Thermal Desorption

Thermal desorption involves the excavation of the contaminated soils and the on-site treatment of the soils using a thermal desorption treatment unit. Once the soils have been treated they are usually backfilled at the site. The process would use heat to vaporize organic contaminants from the soil. The vapors would then be condensed or otherwise collected for treatment.

Low temperature thermal desorption (LTTD) systems are physical separation processes and are not designed to destroy organics. Wastes are heated to between 200 - 600 °F to volatilize water and organic contaminants. Volatilized water and organics are conveyed to the gas treatment system. The bed temperatures and residence times designed into these systems will volatilize selected contaminants but will typically not oxidize them. Unless being heated to the higher end of the LTTD temperature range, naturally occurring organic components in the soil are not damaged, which enables treated soil to retain the ability to support future biological activity.

An example of a common thermal desorption design is the rotary dryer. Rotary dryers are horizontal cylinders that are normally inclined and rotated. All thermal desorption systems require treatment of the off-gas to remove particulates and contaminants. Particulates can be removed by conventional particulate removal equipment, such as wet scrubbers or fabric filters. Contaminants can be removed through condensation followed by carbon adsorption, or they are destroyed in a secondary combustion chamber or a catalytic oxidizer. Most of these units are transportable.

Applicability: The target contaminant groups for LTTD systems are VOCs and fuels. The technology can be used to treat SVOCs at reduced effectiveness.

Limitations: Factors that may limit the applicability and effectiveness of the process include:

- There are specific feed size and materials handling requirements that can impact applicability or cost at specific sites.
- Dewatering may be necessary to achieve acceptable soil moisture content levels.
- Highly abrasive feed potentially can damage the processor unit.
- Heavy metals in the feed may produce a treated solid residue that requires stabilization.

3.2.4 Excavation and Off-site Disposal

Contaminated material would be removed and transported to permitted off-site treatment and/or disposal facilities. Some of the soils would contain contaminant concentrations in excess of the Universal Treatment Standards, included in 6NYCRR Part 376. It is assumed that these soils would be incinerated at an off-site commercial facility. The remainder of the soils would be disposed of in an off-site landfill.

Landfill

Applicability: Excavation and off-site disposal is applicable to the complete range of contaminant groups with no particular target group.

Limitations: Factors that would limit the applicability and effectiveness of the process include:

- Generation of fugitive emissions may be a problem during operations.
- The distance from the contaminated site to the nearest disposal facility with the required permit(s) will affect cost.
- Overall cost to implement this alternative could be relatively high.
- Some pre-treatment may be necessary in order to meet the requirements of the Land Disposal Restrictions (LDRs), as discussed above.

Excavation/Off-site Incineration

This alternative would involve the excavation and off-site transport of the on-site soils to a permitted incinerator. High temperatures, 1,400 - 2,200 °F, can be used to volatilize and combust (in the presence of oxygen) halogenated and other refractory organics in contaminated soil. The destruction and removal efficiency (DRE) for properly operated incinerators exceeds the 99.99% requirement for hazardous waste. There are many types of incinerators; two examples are listed below:

Circulating Bed Combustor (CBC)
A circulating bed combustor (CBC) uses high velocity air to entrain circulating solids and create a highly turbulent combustion zone that destroys toxic hydrocarbons. The CBC operates at lower temperatures than conventional incinerators (1,450 to 1,600 °F). The CBC's high turbulence produces a uniform temperature around the combustion chamber and hot cyclone. The CBC also completely mixes the waste material during combustion. Effective mixing and low combustion temperature reduce operating costs and potential emissions of such gases as nitrogen oxide (NOx) and carbon monoxide (CO).

Rotary Kilns
Commercial incinerator designs include rotary kilns, equipped with an afterburner, a quench, and an air pollution control system. The rotary kiln is a refractory-lined, slightly-inclined, rotating

cylinder that serves as a combustion chamber and operates at temperatures up to 1,800°F. Incinerator off-gas requires treatment by an air pollution-control system to remove particulates and neutralize and remove acid gases (HCl, NOx). Baghouses, venturi scrubbers, and wet electrostatic precipitators remove particulates; packed-bed scrubbers and spray driers remove acid gases. Incineration is subject to a series of technology-specific regulations, including the Clean Air Act (CAA, for air emissions) and RCRA (Resource Conservation and Recovery Act, for hazardous waste generation, treatment, storage, and disposal).

Applicability: Incineration is used to remediate soils contaminated with hazardous wastes, particularly chlorinated hydrocarbons, PCBs, and dioxins.

Limitations: Factors that may limit the applicability and effectiveness of the process include:

- There are specific feed size and materials handling requirements that can impact applicability or cost at specific sites.
- Heavy metals can produce a bottom ash that requires stabilization.
- Volatile heavy metals, including lead, cadmium, mercury, and arsenic, leave the combustion unit with the flue gases and require the installation of gas cleaning systems for removal.
- Metals can react with other elements in the feed stream, such as chlorine or sulfur, forming more volatile and toxic compounds than the original species. Such compounds are likely to be short-lived reaction intermediates that can be destroyed in a caustic quench.

3.3 Identification of Remedial Alternatives for Groundwater

3.3.1 No Action/Groundwater Monitoring

The No Action alternative is included as a procedural requirement and as a baseline to evaluate the other alternatives. Under this alternative, no remedial action would be taken to address contaminated groundwater. Groundwater monitoring would be conducted. It is assumed that: 1)two additional downgradient bedrock wells would be installed; and 2) the two new wells, as well as the upgradient and two downgradient well pairs, would be monitored quarterly for the first year followed by annually for up to 30 years.

3.3.2 Air Sparging

Air sparging is an in-situ technology in which air is injected through a contaminated aquifer. Injected air moves horizontally and vertically in channels through the soil , effectively creating an underground stripper that removes contaminants by volatilization. This injected air helps to "flush" the contaminants up into the unsaturated zone where a vapor extraction system is usually incorporated into the system to remove the generated vapor phase contamination. This technology is designed to operate at high flow rates to maintain increased contact between groundwater and soil. Oxygen, added to contaminated groundwater and unsaturated soils, can also enhance biodegradation of contaminants above and below.

Air sparging has a medium to long duration which may last, generally, up to a few years.

Applicability: The target contaminant groups for air sparging are VOCs and fuels.

Limitations: Factors that may limit the applicability and effectiveness of the process include:

- Air flow through the saturated zone may not be uniform; if this happens it could cause uncontrolled movement of potentially dangerous vapors.
- Depth of contaminants and site-specific geology must be considered.
- Air injection wells must be designed for site-specific conditions.
- Soil heterogeneity may prevent even flow of air through the soil and cause some zones to be relatively unaffected.

3.3.3 Natural Attenuation

Natural subsurface processes, such as dilution, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials, are allowed to reduce contaminant concentrations to acceptable levels. Consideration of this option usually requires evaluation of contaminant degradation rates and pathways and predicting contaminant concentrations at downgradient receptor points. The primary objective of this evaluation would be to demonstrate that natural processes of contaminant degradation will reduce contaminant concentrations below regulatory standards or risk-based levels before potential exposure pathways are completed. In addition, long term monitoring must be conducted throughout the process to confirm that degradation is proceeding at rates consistent with meeting cleanup objectives.

Natural attenuation is not the same as "no action," although it often is perceived as such. CERCLA requires evaluation of a "no action" alternative but does not require evaluation of natural attenuation. Natural attenuation is considered on a case-by-case basis. In all cases where natural attenuation is being considered, extensive site characterization and monitoring would be required, both before and after any potential implementation of this remedial alternative.

Compared with other remediation technologies, natural attenuation has the following advantages:

- Less generation or transfer of remediation wastes.
- It would be less intrusive.
- It may be applied to all or part of a given site, depending on site conditions and cleanup objectives.
- Natural attenuation may be used in conjunction with, or as a follow-up to, other (active) remedial measures.
- Overall cost will likely be lower than active remediation.

Synonyms: Intrinsic Remediation; Bioattenuation; Intrinsic Bioremediation.

Applicability: Target contaminants for natural attenuation are VOCs, SVOCs, and fuel hydrocarbons. Fuel and halogenated VOCs are commonly evaluated for natural attenuation.

Limitations: Factors that may limit applicability and effectiveness include:

- Data used as input parameters for modeling need be collected.
- Intermediate degradation products may be more mobile and more toxic than the original contaminant.
- Natural attenuation is not appropriate where imminent site risks are present.
- Contaminants may migrate before they are degraded.
- Institutional controls may be required, and the site may not be available for reuse until contaminant levels are reduced.
- It is not meant to address source areas of relatively high contamination
- There are long term monitoring and associated costs associated with this alternative.
- Longer time frames would be required to achieve remediation objectives, compared to active remediation.

3.3.4 In-Well Air Stripping

The intent of in-well stripping would be to greatly increase contact between groundwater and air. In order to achieve equilibrium at the interface of the air and water, VOCs "move" from the contaminated groundwater to the air.

Air would be injected into a double screened well, lifting the water in the well and forcing it out the upper screen. Simultaneously, additional water would be drawn in the lower screen. Once in the well, VOCs in the contaminated groundwater would be transferred from the dissolved phase to the vapor phase by air bubbles. The contaminated would rise up through the well to the water surface where vapors would be drawn off and treated by a soil vapor extraction system. This type of system, in addition to collecting the vapors from within the well, would collect vapors from the surrounding unsaturated zone. The partially treated groundwater would not be brought to the surface; it would be forced into the unsaturated zone, and the process would be repeated as water follows a hydraulic circulation pattern or cell that allows continuous cycling of groundwater. As groundwater circulates through the treatment system, contaminant concentrations would gradually be reduced.

The duration of in-well air stripping could be short- to long-term, depending on contaminant concentrations, Henry's law constants of the contaminants, the radius of influence, and site hydrogeology.

Circulating Wells

Circulating wells (CWs) provide a technique for subsurface remediation by creating a three-dimensional circulation pattern of the groundwater. Groundwater is drawn into a well through one screened section and is pumped through the well to a second screened section where it is reintroduced to the aquifer. The flow direction through the well can be specified as either upward or downward to accommodate site-specific conditions. Because groundwater is not pumped above ground, pumping costs and permitting issues are reduced and eliminated, respectively. Also, the problems associated with storage and discharge are removed. In addition to groundwater treatment, CW systems can provide simultaneous vadose zone treatment in the form of soil vapor extraction.

Applicability: Typically, in-well air stripping systems are a cost-effective approach for remediating VOC-contaminated groundwater at sites with deep water tables because the water does not need to be brought to the surface.

CW systems are most effective at treating sites with volatile contaminants with relatively high aqueous solubility and strong biodegradation potential (e.g., halogenated and non-halogenated VOCs).

Limitations: The following factors may limit the applicability and effectiveness of the process:

- In general, in-well air strippers are more effective at sites containing high concentrations of dissolved contaminants with high Henry's law constants.
- Fouling of the system may occur by infiltrating precipatation containing oxidized constituents.
- Shallow aquifers may limit process effectiveness.
- Effective CW installations require a well-defined contaminant plume to prevent the spreading or smearing of the contamination. They should not be applied to sites containing NAPLs to prevent the possibility of smearing the contaminants.
- CWs are limited to sites with horizontal hydraulic conductivities greater that 10^{-5} cm/sec and should not be utilized at sites that have lenses of low-conductivity deposits.
- In well air stripping may not be efficient in sites with strong natural flow patterns.

3.3.5 Groundwater Extraction and Treatment

Groundwater pumping systems are used to remove dissolved contaminants from the subsurface as well as to contain contaminated groundwater to prevent its migration.

Synonyms: Pump and treat.

Applicability: Site characteristics, such as hydraulic conductivity, will determine the range of remedial options possible. Chemical properties of the site and plume need to be determined to characterize transport of the contaminant and evaluate the feasibility of groundwater pumping. To determine if groundwater pumping is appropriate for a site, one needs to know the history of the contamination event, the properties of the subsurface, and the biological and chemical contaminant characteristics. Identifying the chemical and physical site characteristics are necessary in designing an effective groundwater pumping strategy.

Surfactant-enhanced recovery may also be used to improve the effectiveness for contaminated sites with light non-aqueous phase liquids (LNAPLs) and dense non-aqueous phase liquids (DNAPLs).

Limitations: The following factors may limit the applicability and effectiveness of groundwater pumping as part of the remedial process:

- It is possible that a long time may be necessary to achieve the remediation goal.
- Residual saturation of the contaminant in the soil pores cannot be removed by ground water pumping. Contaminants tend to be sorbed in the soil matrix. Groundwater pumping is not applicable to contaminants with high residual saturation, contaminants with high sorption capabilities, and homogeneous aquifers with hydraulic conductivity less than 10^{-5} cm/sec.
- The cost of procuring and operating treatment systems can be high, in the long term. Additional cost may also be attributed to the disposal of spend carbon and the handling of other treatment residuals and wastes.
- Bio-fouling of the extraction wells, and associated treatment stream, is a common problem which can severely affect system performance. The potential for this problem should be evaluated prior to the installation.

The following factors may limit the applicability and effectiveness of surfactant-enhanced recovery:

- Subsurface heterogeneities, as with most groundwater remediation technologies, present challenges to the successful implementation of surfactant-enhanced recovery.
- Potential toxic effects of residual surfactants in the subsurface.
- Off-site migration of contaminants due to the increase solubility achieved with surfactant injection.

There are a number of water treatment options that would be available after the removal of the contaminated groundwater from the subsurface. The EPA directive, entitled *Presumptive Response Strategy and Ex-situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites*, dated October 1996, has been used to identify the following treatment options for extracted groundwater:

Air Stripping

Air stripping involves the mass transfer of volatile contaminants from water to air. For groundwater remediation, this process is typically conducted in a packed tower. The typical packed tower air stripper includes a spray nozzle at the top of the tower to distribute contaminated water over the packing in the column, a fan to force air countercurrent to the water flow, and a sump at the bottom of the tower to collect decontaminated water. Auxiliary equipment that can be added to the basic air stripper includes an air heater to improve removal efficiencies; automated control systems with sump level switches and safety features, such as differential pressure monitors, high sump level switches, and explosion-proof components; and air emission control and treatment systems, such as activated carbon units, catalytic oxidizers, or thermal oxidizers. Packed tower air strippers are installed either as permanent installations on concrete pads or on a skid or a trailer.

Air strippers can be operated continuously or in a batch mode where the air stripper is intermittently fed from a collection tank. The batch mode ensures consistent air stripper performance and greater energy efficiency than continuously operated units because mixing in the storage tanks eliminates any inconsistencies in feed water composition.

The eventual duration of cleanup using an air stripping system may be tens of years and depends on the capture of the groundwater contamination from the pumping system.

Applicability: Air stripping is used to separate VOCs from water. Henry's law constant is used to determine whether air stripping will be effective. Some examples of compounds that can be successfully separated from water using air stripping include benzene/toluene/ethylbenzene/xylene (BTEX), chloroethane, TCE, DCE, and PCE.

Limitations: The following factors may limit the applicability and effectiveness of the process:

- The potential exists for inorganic (e.g., iron greater than 5 ppm, hardness greater than 800 ppm) or biological fouling of the equipment, requiring pretreatment or periodic column cleaning.
- Most effective for contaminated water with VOC or semivolatile concentrations with a dimensionless Henry's constant greater than 0.01.
- Consideration should be given to the type and amount of packing used in the tower.
- Process energy costs are high.
- Compounds with low volatility at ambient temperature may require preheating of the groundwater.
- Off-gases may require treatment based on mass emission rate.

Granular Activated Carbon

Liquid phase carbon adsorption is a full-scale technology in which groundwater is pumped through one or more vessels containing activated carbon to which dissolved organic contaminants adsorb. When the concentration of contaminants in the effluent from the bed exceeds a certain level, the carbon can be regenerated in place; removed and regenerated at an off-site facility; or removed and disposed. Carbon used for explosives- or metals-contaminated groundwater probably cannot be regenerated and should be removed and properly disposed. Adsorption by activated carbon has a long history of use in treating municipal, industrial, and hazardous wastes.

The two most common reactor configurations for carbon adsorption systems are the fixed bed and the pulsed or moving bed. The fixed-bed configuration is the most widely used for adsorption from liquids. Pretreatment for removal of suspended solids from streams to be treated is an important design consideration. If not removed suspended solids in a liquid stream may accumulate in the column, causing an increase in pressure drop. When the pressure drop becomes too high, the accumulated solids must be removed, for example, by backwashing. The solids removal process necessitates adsorber downtime and may result in carbon loss and disruption of the mass transfer zone.

The duration of GAC is usually short-term; however, if concentrations are low enough, the duration may be long-term. The duration of operation and maintenance is dependent on the capture of the groundwater contamination from the pumping system.

Applicability: The target contaminant groups for carbon adsorption are hydrocarbons. Liquid phase carbon adsorption is effective for removing contaminants at low concentrations (less than 10 mg/L) from water at nearly any flow rate, and for removing higher concentrations of contaminants from water at low flow rates (typically 0.5 to 1 gpm). Carbon adsorption is particularly effective for polishing water discharges from other remedial technologies to attain regulatory compliance. Carbon adsorption systems can be deployed rapidly, and contaminant removal efficiencies are high. Logistic and economic disadvantages arise from the need to transport and decontaminate spent carbon.

Limitations: The following factors may limit the applicability and effectiveness of the process:

- The presence of multiple contaminants can impact process performance.
- Streams with high suspended solids (> 50 mg/L) and oil and grease (> 10 mg/L) may cause fouling of the carbon and may require frequent treatment. In such cases, pretreatment is generally required.
- Costs are high if used as the primary treatment on wastestreams with high contaminant concentration levels.
- The quality of the carbon, as well as the operating temperature, will impact process performance.
- Small molecules are not adsorbed well.
- All spent carbon will eventually need to be properly disposed.

Ultraviolet (UV) Oxidation

UV oxidation is a destruction process that oxidizes organic constituents in water by the addition of strong oxidizers and irradiation with UV light. Oxidation of target contaminants is caused by direct reaction with the oxidizers, UV photolysis, and through the action of UV light, in combination with ozone (O_3) and/or hydrogen peroxide (H_2O_2). The main advantage of UV oxidation is that it is a destruction process, as opposed to air stripping or carbon adsorption, for which contaminants are extracted and concentrated in a separate phase. UV oxidation processes can be configured in batch or continuous flow modes, depending on the throughput under consideration.

The UV oxidation process is general done with low pressure lamps operating at 65 watts of electricity for ozone systems and lamps operating at 15kW to 60kW for hydrogen peroxide systems.

Applicability: Practically any organic contaminant that is reactive with the hydroxyl radical can potentially be treated. A wide variety of organic contaminants are susceptible to destruction by UV/oxidation, including chlorinated hydrocarbons used as industrial solvents and cleaners. Typically, easily oxidized organic compounds, such as those with double bonds (e.g., TCE, PCE, and vinyl chloride), as well as simple aromatic compounds (e.g., toluene, benzene, xylene, and phenol), are rapidly destroyed in UV/oxidation processes.

Limitations: Limitations of UV oxidation include:

- The aqueous stream being treated must provide for good transmission of UV light (high turbidity causes interference).
- Free radical scavengers can inhibit contaminant destruction efficiency. Excessive dosages of chemical oxidizers may act as a scavenger.
- The aqueous stream to be treated by UV oxidation should be relatively free of heavy metal ions (less than 10 mg/L) and insoluble oil or grease to minimize the potential for fouling.
- When UV/O_3 is used on certain volatile organics, such as TCA, the contaminants may be volatilized (e.g., "stripped") rather than destroyed. They would then have to be removed from the off-gas by activated carbon adsorption or catalytic oxidation.
- Costs may be higher than competing technologies because of energy requirements.
- Pretreatment of the aqueous stream may be required to minimize ongoing cleaning and maintenance.
- Handling and storage of oxidizers require special safety precautions.

Another component of any groundwater extraction system is a groundwater monitoring program to verify its effectiveness. Monitoring the remedial with wells and piezometers allows the operator to make continuous adjustments, as necessary, to the system in response to changes in subsurface conditions caused by the remediation.

3.3.6 Passive/Reactive Treatment Walls

The use of a passive/reactive treatment wall would involve the installation of a permeable reaction wall across the flow path of a contaminant plume, allowing the water portion of the plume to passively move through the wall. These barriers would allow the passage of water while prohibiting the movement of contaminants by employing certain "agents", such as zero-valent metals, sorbents, and microbes. The contaminants would either be degraded or retained (in a concentrated form) by the barrier material. An example of a passive/reactive treatment wall would be an iron treatment wall, which is described further, below.

Iron Treatment Wall

An iron treatment wall consists of iron granules or other iron bearing minerals for the treatment of chlorinated contaminants such as TCE, DCE, and vinyl chloride. As the iron is oxidized, a chlorine atom is removed from the compound by one or more reductive dechlorination mechanisms, using electrons supplied by the oxidation of iron . The iron granules are dissolved by the process, but the metal disappears so slowly that the remediation barriers can be expected to remain effective for many years.

Applicability: Target contaminant groups for passive treatment walls are VOCs, SVOCs, and inorganics.

Limitations: Factors that may limit the applicability and effectiveness of the process include:

- Passive treatment walls may lose their reactive capacity, requiring replacement of the reactive medium.
- Passive treatment wall permeability may decrease due to precipitation of metal salts.
- The depth and width of barrier is limited to a subsurface lithology that has a continuous aquitard at a depth that is within the vertical limits of trenching equipment.
- The volume/cost of treatment medium.
- Biological activity or chemical precipitation may limit the permeability of the passive treatment wall.

3.4 Identification of Remedial Approach for DNAPL (bedrock)

In the EPA document entitled *Presumptive Response Strategy and Ex-situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites*, there is a discussion on the long-term goals to address the presence of DNAPL. DNAPL is considered as a "principal threat" because it will act as a continuing source of contamination to the groundwater. It is the expectation of the NCP to "use treatment to address the principal threats posed by a site, wherever practicable" (Federal Register, 1990a; Section 300.430(a)(1)(iii)(A)). However, based on program experience, the removal of DNAPL from the subsurface can be very difficult. Therefore, the approach that will be proposed to address DNAPL will be to reduce the quantity of/control the migration of DNAPL, to the extent practicable. This will include the installation of low-flow DNAPL recovery wells, monitoring the effectiveness of the DNAPL recovery, and adjusting the system in the future to enhance its performance (this could include future groundwater extraction in the bedrock). This approach will be included as a part of the preferred remedy later in this document.

3.5 Identification of Remedial Approach for Surface Soils

One of the goals presented in Section 2 is to "Eliminate the potential for direct contact with/erosion of the contamianted surface soils at the site (perimeter of the site outside footprint of clay cover installed as part of "88 NYSDOT IRM)". The area of surface soil identified to pose a potential threat is the area of surface soil located along the western edge of the site. Since it is such a limited area, the approach identified to address this area (approximately 10 feet wide X 200 feet long X 1 foot deep) is to excavate the soil and dispose of it in an off-site landfill. This approach will be included as a part of whatever remedy is presented as the preferred remedy later in this document.

3.6 Summary of Remedial Alternatives Identified

The following is a summary of the remedial alternatives that have been identified for the Scobell Chemical site:

Remedial Alternatives Identified for Soil

- No Further Action
- Soil Vapor Extraction
- Thermal Desorption
- Excavation and Off-site Disposal
  - Treatment to meet LDRs (UTSs)/ Landfill
- excavate/ off-site disposal (surface soil along western edge of site)

Remedial Alternatives Identified for Groundwater

- No Action/Groundwater Monitoring
- Air Sparging
- Natural Attenuation
- In-Well Air Stripping
- Groundwater Extraction and Treatment
  - Air Stripping
  - Granular Activated Carbon
  - Ultraviolet Oxidation
- Passive/Reactive Treatment Walls
- low-flow DNAPL recovery wells, monitoring the effectiveness, future adjustments as needed (shallow bedrock)

SECTION 4 - PRELIMINARY SCREENING OF ALTERNATIVES

As discussed in the presumptive remedy guidance for soils entitled *Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils* (summarized in Section 3.1), EPA has determined that, for sites that meet the requirements of the presumptive remedies directives, site-specific identification and screening of alternatives is not necessary. However, at this site one of the presumptive remedies identified for soils clearly would be eliminated by the two criteria used to evaluate the potential remedial alternatives during the preliminary screening of alternatives (short-/long-term effectiveness and implementability). Therefore, in this case a partial partial preliminary screening is appropriate.

Below is a discussion of the alternatives (for both soil and groundwater) that were eliminated as a part of the preliminary screening, and the basis for their elimination.

4.1 Screening Criteria

The criteria used to evaluate alternatives during the screening of alternatives include short-/long-term effectiveness and implementability, discussed further below.

Short-term effectiveness assesses the impacts of the alternative during the construction and implementation phase. Alternatives are evaluated with respect to their effects on human health and the environment during implementation of the remedial action. The aspects evaluated include: protection of the community during remedial actions, environmental impacts as a result of remedial actions, time until the remedial response objectives are achieved, and protection of workers during the remedial action. *Long-term Effectiveness* addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the waste or residual remaining at the site and operating system necessary for the remedy to remain effective. The factors being evaluated include the permanence of the remedial alternative, magnitude of the remaining risk, adequacy of controls used to manage residual waste, and the reliability of controls used to manage residual waste.

Implementability addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The evaluation includes: feasibility of construction and operation; the reliability of the technology; the ease of undertaking additional remedial action; monitoring considerations; activities needed to coordinate with other offices or agencies; availability of adequate off-site treatment, storage, and disposal services; availability of equipment; and the availability of services and materials.

4.2 Screening of Alternatives for Soil

The alternatives to address soil contamination at the site, presented in Section 3.2, have been generated based on presumptive remedy guidance entitled: *Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils.* Normally all of these alternatives would be evaluated during the Detailed Analysis of Alternatives, presented later in this Report. However, after reviewing the alternatives against the screening criteria, it became clear that one of the alternatives would not be implementable at this site.

Thermal desorption involves the excavation of the contaminated soil, staging of the soil, processing of the soil through the treatment unit, and backfilling of the treated soil. The Scobell site is just over an acre in size and is bordered by a commercial building to the west, railroad tracks to the north, and the I-490/I-590 highway interchange to the south and east. There would not be nearly enough space to treat on-site soils using thermal desorption. As a result, thermal desorption is eliminated from further consideration based on the evaluation of this alternative using the "*Implementabiltiy*" screening criteria.

4.3 Screening of Alternatives for Groundwater

After reviewing the alternatives identified for groundwater, it became apparent that some of the alternatives were not appropriate for the Scobell site, based on an evaluation against the screening criteria identified above. Below is a summary of the alternatives that were eliminated from further consideration, and the basis for their elimination.

The overburden groundwater is present in a thin layer on top of the bedrock. The saturated soils that are present in the overburden need to be remediated along with the soils in the unsaturated zone above the overburden groundwater. These saturated soils can be best addressed by dewatering and using technologioes such as SVE or excavation/off-site disposal. **In-well Stripping, Air Sparging,** and **Passive/Reactive Treatment Walls** would not be compatible with the other remedial objectives at this site.

Passive/Reactive Treatment Walls involves the installation of a permeable reactive wall across the groundwater flow path, allowing contaminated water to passively move flow through the wall. At the Scobell Chemical site many man-made factors influence the flow of groundwater. In addition to the issues discussed above, the use of reactive walls at this site would be difficult because the on-site overburden groundwater is mounded near the northeast corner of the site with water moving radially away from this area of the site. Since the width of the aquifer is not limited, it would be difficult to implement a remedy that relied on the passive flow of groundwater through the treatment system. As a result, the passive/ reactive wall technology is eliminated from further consideration on the basis that it could not be effectively implemented.

Natural Attenuation is a remedial approach that allows natural processes to reduce the concentration of contaminants in the groundwater. Due to the high concentrations of contaminants in the aqueous phase, along with the presence of non-aqueous phase liquid, it would not be possible for natural processes to sufficiently reduce contaminant concentrations before the contaminated groundwater had migrated a significant distance from the site. As a result, natural attenuation is eliminated from further consideration in the source area on the basis that it would not provide long-term effectiveness.

4.4 Alternatives to be Evaluated During the Detailed Analysis

The following alternatives have been retained for the Detailed Analysis of Alternatives:

<u>Remedial Alternatives Identified for Soil</u>

- No Further Action
- Soil Vapor Extraction

- Excavation and Off-site Disposal
  - Treatment to meet LDRs (UTSs)/ Landfill
- excavate/ off-site disposal (surface soil along western edge of site)

Remedial Alternatives Identified for Groundwater

- No Action/Groundwater Monitoring
- Groundwater Extraction and Treatment
  - Air Stripping
  - Granular Activated Carbon
  - Ultraviolet Oxidation
- low-flow DNAPL recovery wells, monitoring the effectiveness, future adjustments as needed (shallow bedrock)

SECTION 5 - DETAILED ANALYSIS OF ALTERNATIVES

5.1 Description of Evaluation Criteria

In Section 5.2, each of the alternatives is analyzed with respect to the criteria outlined in the 6 NYCRR Part 375, which defines the selection process for remedial actions at inactive hazardous waste sites. Each alternative is analyzed with respect to:

1. **Overall Protection of Human Health and the Environment**: This criterion serves as a final check to assess whether each alterative meets the requirements that are protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under other evaluation criteria; especially long-term effectiveness and performance, short-term effectiveness, and compliance with SCGs. This evaluation focuses on how a specific alternative achieves protection over time and how site risks are reduced. The analysis includes how each source of contamination is to be eliminated, reduced or controlled for each alternative.

2. **Compliance with SCGs**: This evaluation criterion determines how each alternative complies with applicable or relevant and appropriate SCGs, as discussed and identified in Section 1.7. The actual determination of which requirements are applicable or relevant and appropriate is made by the NYSDEC in consultation with the NYSDOH. If an SCG is not met, the basis for one of the four waivers allowed under 6 NYCRR Part 375-1.10(c)(I) is discussed. If an alternative does not meet the SCGs and a waiver is not appropriate or justifiable, such an alternative should not be considered further.

3. **Short-term Impacts and Effectiveness**: This evaluation criterion assesses the effects of the alternative during the construction and implementation phase. Alternatives are evaluated with respect to their effects on human health and the environment during implementation of the remedial action. The aspects evaluated include: protection of the

community during remedial actions, environmental impacts as a result of remedial actions, time until the remedial response objectives are achieved, and protection of workers during the remedial action.

4. **Long-term Effectiveness and Permanence**: This evaluation criterion addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the waste or residual remaining at the site and operating system necessary for the remedy to remain effective. The factors being evaluated include the permanence of the remedial alternative, magnitude of the remaining risk, adequacy of controls used to manage residual waste, and the reliability of controls used to manage residual waste.

5. **Reduction of Toxicity, Mobility and Volume**: This evaluation criterion assesses the remedial alternative's use of the technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous wastes as their principal element. The NYSDEC's policy is to give preference to alternatives that eliminate any significant threats at as site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in the contaminants mobility, or reduction of the total volume of contaminated media. This evaluation includes: the amount of the hazardous materials that would be destroyed or treated, the degree of expected reduction in toxicity, mobility, or volume measured as a percentage, the degree in which the treatment would irreversible, and the type and quantity of treatment residuals that would remain following treatment.

6. **Implementability**: This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The evaluation includes: feasibility of construction and operation; the reliability of the technology; the ease of undertaking additional remedial action; monitoring considerations; activities needed to coordinate with other offices or agencies; availability of adequate off-site treatment, storage, and disposal services; availability of equipment; and the availability of services and materials.

7. **Cost**: Cost estimates are prepared and evaluated for each alternative. The cost estimates include capital costs, operation and maintenance costs, and future capital costs. A cost sensitivity analysis is performed which includes the following factors: the effective life of the remedial action, the O&M costs, the duration of the cleanup, the volume of contaminated material, other design parameters, and the discount rate.

8. **Community Acceptance**: After completion of the FS, a Proposed Remedial Action Plan (PRAP) is prepared and released to the public for comment. Concerns of the community regarding the RI/FS reports the PRAP are evaluated. A "Responsiveness Summary" will be prepared that presents the public comments received and how the Department will

address the concerns raised. If the final remedy selected differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

5.2 Detailed Analysis of Remedial Alternatives for Soil

5.2.1 No Further Action

This alternative recognizes remediation of the site conducted under the 1988 NYSDOT IRM, discussed above. This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment.

Overall Protection of Human Health and the Environment: Although this alternative does not result in any increased short-term risks, it does not comply with chemical-specific SCGs, and is not effective in the long term. This alternative would not be protective of human health or the environment within an acceptable time frame.

Compliance with SCGs: Since high concentrations of the contaminants of concern remain on-site, this alternative would not meet chemical-specific SCGs in a reasonable time frame. No location specific SCGs have been identified. Since no action is being taken, action-specific SCGs do not apply.

Short-term Impacts and Effectiveness: Since no remedial action is occurring, there would be no increased risks caused by the implementation of a remedial action.

Long-term Effectiveness and Permanence: The potential for increased risk caused by the remaining waste is not addressed by this alternative. There would be no controls in place to manage the waste, allowing continued migration of contaminants from the soil to the groundwater.

Reduction of Toxicity, Mobility, and Volume: Reduction in the toxicity, mobility, or volume of waste would occur very slowly, if at all, through natural attenuation. The time frame, associated with any potential reductions due to natural processes, would not be acceptable.

Implementability: Since there are no technical or administrative actions required, this alternative would be easily implemented.

Cost: There are no capital or operation and maintenance costs associated with this alternative.

5.2.2 Soil Vapor Extraction

This alternative would involve the installation of approximately 14 vapor extraction wells on site, placed into the top of the fractured bedrock. The wells would be installed in a grid across the site, on approximately 60 foot centers. The SVE treatment unit would be installed, along with all of the associated piping and the air treatment unit (some form of air treatment would be installed to prevent unacceptable air emissions).

There is a limited amount of contaminated surface soil present along the western edge of the site. This alternative would include the excavation and disposal (in an off-site landfill) of approximately 100 yd^3 of contaminated surface soil located along the western edge of the site.

Present Worth	$ 528,720
Capital Cost	$ 322,000
Annual O&M	$ 44,050 (1st year)
	$ 36,200 (years 2 & 3)
Time to Implement	approx. 3 months
Estimated Time to Completion	3 years

Overall Protection of Human Health and the Environment: The short-term risks associated with this alternative could be easily mitigated with proper controls. This alternative reduces the possibility of exposure to contaminated soils, and in the long term would reduce contaminant concentrations in groundwater by controlling the source of contamination. The time to implement the alternative is estimated at 3 months, and the length of operation of the system is estimated at approximately 3 years.

Compliance with SCGs: Soil vapor extraction (SVE) would significantly reduce the concentrations of a majority of the contaminants of concern at this site, and could meet chemical-specific SCGs for the VOCs in the soil. However, there is the possibility that concentrations of all of the contaminants would not drop to below the TAGM 4046 soil cleanup objectives (e.g., metals would not be effectively addressed by SVE). Action-specific SCGs for this alternative apply to the excavation and handling of site soils during well installation, monitoring requirements, and OSHA health and safety requirements (e.g., 29 CFR 1910). Compliance with these SCGs would be achieved by following a site-specific health and safety plan. This alternative would incorporate an air emission source that is subject to New York regulations 6 NYCRR 200, 201, and 212, and the New York Air Guide 1, Guidelines for the Control of Toxic Ambient Air Contaminants. The air emissions would be treated, as necessary, to meet these regulatory requirements.

Short-Term Impacts and Effectiveness: There is the potential for worker exposure during installation of the vapor extraction wells. This exposure would be significantly reduced through the use of personal protection equipment. Air emission controls would prevent worker and resident exposure to airborne contaminants. An additional concern would be the impact that the noise of the operating treatment system would have on adjacent residents. There are no residences directly adjacent to the site, but there are commercial properties in the immediate vicinity. As the system would operate 24 hours a day, noise levels would have to be controlled.

Long-Term Effectiveness and Permanence: Soil vapor extraction is very successful at addressing volatile organic contamination. There are contaminants in the soil that would not be effectively addressed by soil vapor extraction (e.g., metals), however the results of the groundwater samples indicate that these contaminants are not very mobile at this site. This alternative would be a permanent remedy, relative to the VOCs, since the contaminants would be removed from the soil.

Reduction of Toxicity, Mobility, and Volume: By removing contaminants from the soil and treating the removed contaminants, the toxicity and volume of the contaminants in the soil would be reduced. Since removing the contaminants from the soil would prevent their migration to groundwater, the mobility would be significantly reduced.

Implementability: The equipment and material needed to install a vapor extraction system are commercially available from several vendors. There are no anticipated administrative or legal barriers to the implementation of this alternative. Following completion of the soil remediation, no further monitoring or maintenance of the soil would be needed. Continued monitoring of the groundwater is addressed in the groundwater treatment alternatives discussed below.

Cost: The estimated capital cost for this alternative would be $ 310,000. The total O&M cost would be $ 206,720. The present worth value of this alternative would be $ 516,720 using a 5% discount rate over three years.

5.2.3 Excavation and Off-Site Disposal

This alternative would involve the excavation of the on-site contaminated soil, to bedrock. Land Disposal Restrictions (LDRs) prevent the landfilling of contaminated material that exceeds certain concentrations, listed by contaminant. These concentrations are called Universal Treatment Standards (UTSs). All soils that exceed UTSs cannot be placed in a landfill and must be treated. As a result, it is estimated that this alternative would involve the excavation, transportation, and off-site incineration of approximately 5100 yd^3 of soil that exceeds the UTSs; the remainder of the soil (estimated at 8250 yd^3) would be excavated and transported to an off-site landfill for disposal.

There is a limited amount of contaminated surface soil present along the western edge of the site. This alternative would include the excavation and disposal (in an off-site landfill) of approximately 100 yd^3 of contaminated surface soil located along the western edge of the site.

Present Worth	$ 6,998,000
Capital Cost	$ 6,998,000
Annual O&M	$ 0
Time to Implement	approx. 6 months
Estimated Time to Completion	6 months

Overall Protection of Human Health and the Environment: The short-term risks associated with this alternative would be mitigated with proper controls. This alternative would destroy all site-related contaminants at concentrations exceeding the UTSs, and therefore would be protective of human health and the environment. This alternative, in the long term, would help reduce contaminant concentrations in groundwater by controlling a source of contamination.

Compliance with SCGs: Since this alternative would destroy all site-related contamination at concentrations exceeding the cleanup objective, chemical-specific SCGs would be met. No location specific SCGs have been identified. Action-specific SCGs for this alternative apply to the excavation and handling of site soils, monitoring requirements, and OSHA health and safety requirements (e.g., 29 CFR 1910). Compliance with these SCGs would be achieved by following a site-specific health and safety plan.

Short-term Impacts and Effectiveness: There would be a potential for worker exposure during excavation and transportation of contaminated soil. A risk to the public would also be present during the hauling of contaminated soil for off-site treatment and disposal. Exposure would be significantly reduced through the use of dust suppression measures, proper covering of trucks, and personal protection equipment. These dust suppression measures, as well as site access restrictions and air monitoring, would eliminate or greatly reduce any increased risk to the public or impacts to the environment during construction. Another potential concern is the impact that the additional construction traffic would have on the occupants of adjacent commercial properties. However, the use of traffic control measures/ planned traffic flow patterns would minimize any impacts caused by the heavy truck traffic during the implementation of the remedy. This alternative could be implemented in approximately three to six months.

Long-term Effectiveness and Permanence: Contaminants at concentrations exceeding the Universal Treatment Standards (UTSs) would be permanently destroyed, and contaminants at concentrations exceeding the cleanup objectives would be removed from the site, eliminating the need for any future monitoring. Therefore, this alternative would be effective in the long-term.

Reduction of Toxicity, Mobility, and Volume: The volume of contaminated soil at the site would be permanently reduced. Since soil containing contaminants at concentrations exceeding UTSs would be treated, the volume of contaminants and the toxicity of the soil would be reduced. Since soil with concentrations less than the UTSs would be placed in a landfill, the mobility of these contaminants would be reduced.

Implementability: Adequate commercial disposal capacity is available for wastes to be treated offsite. The remedy could be easily implemented. There are no anticipated administrative or legal barriers to the implementation of this alternative.

Cost: The estimated capital cost for this alternative would be $ 6,986,000. There would be no annual O&M cost.

5.3 Evaluation of Remedial Alternatives for Groundwater

5.3.1 No Action/ Groundwater Monitoring

The no action alternative is evaluated as a procedural requirement and as a basis for comparison. It requires continued monitoring only, allowing the site to remain in an unremediated state. This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment.

Present Worth	$ 104,660
Capital Cost	$ 0
Annual O&M	$ 14,000 (1st year)
	$ 5100 (years 2-30)
Time to Implement	NA

Overall Protection of Human Health and the Environment: Although this alternative does not result in any increased short-term risks, it does not comply with chemical-specific SCGs, and is not effective in the long term. This alternative would not be protective of human health or the environment within an acceptable time frame.

Compliance with SCGs: This alternative would not involve any active remediation of groundwater, groundwater standards would not be achieved in the near future, and contaminated groundwater would continue to migrate off-site.

Short-Term Impacts and Effectiveness: Since the only action would be groundwater monitoring, the only short-term impact would be the possibility of exposure of the samplers to the groundwater. Exposure would be significantly reduced through the use of appropriate levels of personal protective equipment and health and safety procedures. It is unlikely that there would be any increased risk to the public or impacts to the environment during the groundwater monitoring.

Long-Term Effectiveness and Permanence: Since no active remediation would take place, this alternative would not be effective in reducing contaminant concentrations in the groundwater in a reasonable time frame.

Reduction of Toxicity, Mobility, and Volume: This alternative would not significantly reduce the toxicity, mobility, or volume of the contamination in groundwater. Natural processes could slowly reduce the contamination, but the time frame would be unacceptable.

Implementability: This alternative would be easily implemented. There would be no activities that would need coordination with other agencies during implementation. This alternative would require sampling of groundwater for an extended period of time (30 years is assumed for cost purposes).

Cost: The would be no capital cost for this alternative. The annual O&M cost is $ 14,000 for the first year and$ 5100 thereafter, based on a conservative scenario of sampling seven wells quarterly for the first year, and then annually for up to 30 years. The present worth value of this alternative is $104,660 using a 5% discount rate over 30 years.

5.3.2 Groundwater Extraction and Treatment (via either Air Stripping, Granular Activated Carbon, or UV/Oxidation)

This alternative would involve the installation of approximately 8 groundwater pumping wells on site, installed into the top of the competent bedrock. It is estimated that the system would operate at an average withdrawal rate of approximately 20 gallons per minute for an estimated period of 3 years. Once removed, the groundwater would be treated on site and discharged to either surface water or the sanitary sewers, as necessary and appropriate.

This section discusses groundwater pump and treat as one alternative. Three different "treat" options are potentially applicable for this site including air stripping (volatile organics are partitioned from extracted ground water by aerating or increasing the surface area of the contaminated water exposed to air; aeration methods include packed towers, diffused aeration, tray aeration, and spray aeration), granular activated carbon (water passes through the carbon system and contaminant molecules are removed from the water by adsorption to the carbon), and ultraviolet oxidation (UV oxidation is a destruction process that oxidizes organic contamination in the water by the addition of strong oxidizers and irradiation with UV light). Treatment via granular activated carbon would be included in the preferred remedy, so that a cost estimate could be developed. However, if included as a part of the preferred remedy, the final decision on the method of treatment for the extracted groundwater would be deferred until the Remedial Design.

Since DNAPL is present in the shallow bedrock action must be taken to address this continuing source of contamination to groundwater. At this site the only practical way to address the need to collect/control migration of DNAPL would be to install DNAPL recovery wells in the bedrock. This alternative would include the installation of four on-site DNAPL recovery wells. The DNAPL extraction wells would be four inch wells installed approximately 40 feet into bedrock (50 feet below ground surface (bgs)). The wells would be cased/grouted into the top of the competent bedrock with open hole construction in the competent rock. A rough estimate of 1000 gallons of recovered DNAPL, over 5 years, has been made. The recovered DNAPL would be temporarily stored on site until enough accumulates to be sent off-site for incineration. At the end of the estimated five year period, the system would be evaluated and a determination made on whether to continue/ make adjustments to enhance the recovery system, as appropriate.

Pump & treat (**Air stripping**)

Present Worth	$ 563,700
Capital Cost	$ 262,100
Annual O&M (1st 3 years)	$ 84,800

(years 4&5)	$12,700
Time to Implement	approximately 3 months
Estimated Time to Completion	5 years

Pump & Treat (Granular Activated Carbon)

Present Worth	$ 445,900
Capital Cost	$ 244,300
Annual O&M (1st 3 years)	$ 54,200
(years 4&5)	$12,700
Time to Implement	approximately 3 months
Estimated Time to Completion	5 years

Pump & Treat (Ultraviolet Oxidation)

Present Worth	$ 571,600
Capital Cost	$ 303,000
Annual O&M (1st 3 years)	$ 74,700
(Years 4&5)	$12,700
Time to Implement	approximately 3 months
Estimated Time to Completion	5 years

This section discusses groundwater pump and treat as one alternative. Three separate "treat" options are discussed in this section; only one of them will be included if this alternative is included later in this FS Report as a part of the preferred remedy. The purpose of including one of the treatment options as a part of the preferred remedy is so that a comprehensive cost estimate can be included. However, the final decision on the method of treatment for the extracted groundwater would be deferred until the Remedial Design.

Overall Protection of Human Health and the Environment: The short-term risks associated with this alternative could be easily mitigated with proper controls. This alternative would reduce the possibility of exposure to contaminated groundwater by controlling/treating it on-site, thus minimizing it as a continuing source for off-site areas. The time to implement the alternative is estimated at 3 months, and the length of operation of the system is estimated at approximately 3 years.

Compliance with SCGs: This alternative would remove and treat contaminated groundwater on-site. Action-specific SCGs for this alternative apply to the excavation and handling of site soils during well installation (monitoring requirements, and OSHA health and safety requirements). Compliance with these SCGs would be achieved by following a site-specific health and safety plan. This treatment system could incorporate an air emission source that would be subject to New York regulations 6 NYCRR 200, 201, and 212, and the New York Air Guide 1, Guidelines for the Control of Toxic Ambient Air Contaminants. Since the air emissions would be treated, as appropriate, these regulatory requirements would be met. The treatment system would also result in a water discharge. This water would either be discharged to surface waters or to the local publicly owned treatment works (POTW). If discharged to surface waters, it would be subject to New York regulations for SPDES discharges; if discharged to the POTW, coordination with the local municipality would be required. Since the water discharge would be treated, these requirements would be met.

6 NYCRR Part 703, Groundwater Quality Standards, would apply to the groundwater. The history of groundwater extraction and treatment shows that overall, time is needed for this technology to lower contaminant concentrations, and that it is difficult to achieve groundwater standards. However, by hydraulically containing the plume the continued migration of contaminants would be controlled, thereby preventing the volume of contaminated groundwater from increasing.

Short-Term Impacts and Effectiveness: There would be a potential for worker exposure during installation of the groundwater extraction wells. This exposure could be significantly reduced through the use of personal protection equipment. Air and water emission controls would prevent worker and resident exposure to airborne and waterborne contaminants.

Long-Term Effectiveness and Permanence: Groundwater concentrations would be expected to decrease with time as a result of the extraction and treatment of the contaminated groundwater, assisted by natural processes.

Reduction of Toxicity, Mobility, and Volume: By removing contaminants from the groundwater and treating the removed contaminants, the toxicity and volume of the contaminants in the groundwater in this location would be reduced. Since hydraulically containing the contaminant plume would prevent further migration of contaminants in groundwater, the contaminant mobility would be significantly reduced, and an increase in the volume of contaminated groundwater would be avoided.

Implementability: The equipment and material needed to install a groundwater extraction and treatment system are commercially available from several vendors. There are no anticipated administrative or legal barriers to the implementation of this alternative.

Cost: The costs are discussed, for three of the potential treatment options, at the beginning of this section.

5.4 Comparative Analysis of Alternatives

5.4.1 Comparative Analysis for Soils

Overall Protection of Human Health and the Environment: The no further action alternative would not be protective of human health or the environment within an acceptable time frame. The remaining alternatives would actively address the on-site contamination and would be protective of human health and the environment, to different levels. Excavation and off-site disposal would offer the most protection since the contamination would be totally removed from the site. Although SVE would address most of the contamination in the soil, there would be residual contamination left behind (e.g., metals).

Compliance with SCGs: The no further action alternative would not meet SCGs since it would leave elevated contaminant concentrations in on-site soils. SVE would meet most of the SCGs for soil; elevated metals concentrations present in the subsurface soil would not be reduced by SVE, however, the metals included in the list of contaminants of concern in on-site soils have not been detected at elevated concentrations in the bedrock or in the off-site groundwater. This indicates that the metals present on site are not very mobile. Both off-site disposal alternatives discussed (surface soil along western edge of the site and site subsurface soil) would meet SCGs for soil. Both SVE and off-site disposal (of site subsurface soil) would also result in the reduction of contaminant concentrations in the groundwater by addressing a source area.

Short-Term Impacts and Effectiveness: The No Further Action alternative would cause no increased short-term impacts since no intrusive work would take place.

SVE would result in air emissions that would require treatment, posing a short-term risk should the air emissions control device be breached. This risk would be reduced through the proper use of air treatment devices. Excavation and off-site disposal would involve more extensive soil handling, with an increased risk of exposure to dust. There is the potential for greater exposure, although for a shorter period of time. However, the use of engineering controls, including air monitoring and dust suppression measures, would minimize and/or eliminate any possible impact during excavation.

All the alternatives except the No Further Action alternative would involve the handling of contaminated media. These actions could potentially impact worker health and safety, the environment, and the local community. SVE would have limited potential for worker exposure, since the only intrusive activity would be the installation of wells. Excavation and off-site disposal would involve more extensive soil handling, since contaminated soil would be excavated and hauled offsite. However, the use of engineering controls would minimize and/or eliminate any possible impact during excavation. These controls would include air monitoring, personal protective equipment, and dust suppression measures. Offsite hauling would pose a short-term risk due to possible spilling of contaminated media offsite. This could be mitigated by properly covering contaminated media and by establishing proper emergency spill response measures.

The length of time over which short-term impacts would occur would be least for the excavation and on-site disposal alternative, as under this alternative the complete remedy would be implemented within three to six months. The SVE alternative would have less of a short-term impact than excavation/off-site disposal, but it would be for a longer duration. Again, it should be possible to control these impacts through the use of engineering controls.

Long-Term Effectiveness and Permanence: The no further action alternative would allow the continued migration of contaminants from the soil to the groundwater. The remaining technologies would all be permanent remedies. SVE may not achieve soil SCGs for all of the contaminants of concern (e.g., metals in subsurface soils), resulting in some residual concentrations remaining in the soils. However, the metals included in the list of contaminants of concern in on-site soils have not been detected at elevated concentrations in the bedrock or in the off-site groundwater. This indicates that the metals present in the subsurface soil are not very mobile at this site. The SVE alternative would rely upon the cover system to prevent exposure to residual metals contamination. The excavation and off-site disposal alternative would effectively eliminate all contamination exceeding the remedial goals for the on-site operable unit.

Reduction of Toxicity, Mobility, and Volume: With the no further action alternative, reduction in the toxicity, mobility, or volume of waste would occur very slowly through natural attenuation, not in an acceptable time frame. The SVE alternative would remove/treat most of the site related contamination, with the exception of the metals. The excavation and off-site disposal alternative remove all of the soil exceeding the cleanup objectives, thereby reducing toxicity and volume. Addressing contaminated soil would result in a decrease in the movement of soil contaminants to the groundwater. As a result, both SVE and excavation/off-site disposal would reduce contaminant mobility in this way, with SVE achieving this to a lesser degree compared to excavation/off-site disposal.

Implementability: The no further action alternative would be the easiest to implement, since no construction would be necessary. Excavation and off-site disposal would also be easy to implement, since this alternative is easily engineered, treatment/disposal facilities are readily available, and regulatory requirements are easily met. SVE and off-site disposal could also be easily implemented, however, they would obviously require more engineering.

Cost: A summary of the costs are presented in Table 5.1. The costs are the present worth based on a 5% discount rate over the estimated life of the project.

5.4.2 Comparative Analysis for Groundwater

The alternatives compared in this section are all based on the assumption that an alternative for soils has been chosen which would remediate the contaminated soils that are the primary source of the on-site overburden groundwater contamination.

Overall Protection of Human Health and the Environment: The no action/groundwater monitoring alternative would not be protective of human health or the environment . The pump and treat and the DNAPL recovery alternatives would actively address the on-site groundwater contamination and would be protective of human health and the environment by reducing the volume and the mobility of the contamination.

Compliance with SCGs: The no action/groundwater monitoring alternative would not achieve groundwater standards. The groundwater extraction and treatment/DNAPL recovery alternative would actively reduce contaminant concentrations in the groundwater. The length of time for pump and treat to achieve SCGs would depend, in part, on the success of the DNAPL recovery system. Due to the difficulty in remediating DNAPL, residuals could remain behind for quite some time. As a result, although groundwater concentrations would be reduced, it may be impossible to achieve groundwater standards.

Short-Term Impacts and Effectiveness: The no action/groundwater monitoring alternative would result in the fewest short-term impacts, as the only action taken would be groundwater monitoring. The pump and treat alternative could incorporate an air emission source and a water discharge, however air emissions and the water discharge would be treated to prevent worker and resident exposure to contaminants. The DNAPL recovery alternative would involve some short term impacts related to handling of the extracted DNAPL, however, proper execution of health and safety procedures would address these potential impacts.

Long-Term Effectiveness and Permanence: The no action/groundwater monitoring alternative would not provide long term effectiveness. The pump and treat/ DNAPL recovery alternative would remove contaminants with the contaminants captured by the treatment component of these alternatives.

Reduction of Toxicity, Mobility, and Volume: The no action/groundwater monitoring alternative would not actively reduce the volume of contaminants already in the groundwater. The pump and treat/ DNAPL recovery alternative would remove contaminants from the subsurface and treat them, thereby reducing the mobility and volume of contaminants in the groundwater. As discussed above, due to the difficulty in remediating DNAPL, residuals could remain behind for quite some time.

Implementability: The no action/groundwater monitoring alternative would be the easiest to implement. The pump and treat and the DNAPL recovery alternatives would be straightforward to implement, as the systems are commercially available from several vendors. There would be no anticipated administrative or legal barriers to the implementation of any of the alternatives.

Cost: A summary of the costs are presented in Table 5.1. The costs are the present worth based on a 5% discount rate over the estimated length of the remedial action.

SECTION 6 RECOMMENDED REMEDIAL ALTERNATIVE

The NYSDEC has performed a development and evaluation of remedial alternatives based on the guidance provided in 6 NYCRR Part 375-1.10, *Inactive Hazardous Waste Disposal Site Remedial Program, Remedy Selection*. Based on this analysis, the NYSDEC is recommending: Soil Vapor Extraction as the preferred remedial alternative for the contaminated subsurface soils; Groundwater Extraction and Treatment (current treatment proposal is via granular activated carbon, but treatment option may be modified in design) as the preferred remedy for the overburden groundwater; excavation and off-site disposal of the limited amount of surface soils (along the western edge of the site); low-flow DNAPL recovery (in the shallow bedrock), with future adjustments to the system in the future to enhance its performance; long term monitoring; pursuit of deed restrictions; and maintenance of the perimeter fence and the cover over the site.

6.1 Basis For Recommendation

6.1.1 Subsurface Soil

The No Action alternative was rejected because this alternative is not protective of human health or the environment, does not meet/satisfy SCGs, and does not satisfy the RAOs. It would leave in place a volume of contaminated soil which would act as a continuing source of contamination to the groundwater.

The two remaining alternatives (evaluated during detailed analysis) were SVE and Off-Site Disposal, which have both been successfully used at other sites to remediate soil contaminated with volatile organic compounds. Of these two alternatives, excavation and off-site disposal would be assured to achieve the goals of the program, SVE is a technology that could successfully address the situation at this site at significantly less cost. Therefore, while both alternatives are expected to be effective remedies, given the site-specific soil conditions and cost considerations, SVE is the most appropriate alternative for this site, and is the recommended remedy for the contaminated soil.

6.1.2 Groundwater

The two alternatives evaluated are No Action/Groundwater Monitoring and Groundwater Extraction and Treatment. Of these, the No Action/Groundwater Monitoring alternative was rejected because it would leave in place a secondary source of off-site groundwater contamination, i.e., the contaminated shallow groundwater directly beneath the site. Groundwater Extraction and Treatment would be effective at remediating this area of contaminated groundwater, and has the added advantage of dewatering the bottom of the overburden/ fracture bedrock surface so the SVE (the preferred remedy for soil) could successfully address those areas once they are dewatered. Therefore,Groundwater Extraction and Treatment is the proposed remedy for the contaminated groundwater.

6.1.3 DNAPL (present in shallow bedrock)

As discussed in Section 3.4, DNAPL is considered as a "principal threat" because it will act as a continuing source of contamination to the groundwater. It is the expectation of the NCP to "use treatment to address the principal threats posed by a site, wherever practicable" (Federal Register, 1990a; Section 300.430(a)(1)(iii)(A)). However, based on program experience, the removal of DNAPL from the subsurface can be very difficult. Therefore, the approach that is proposed to address DNAPL will be to reduce the quantity of/control the migration of DNAPL, to the extent practicable. This will include the installation of low-flow DNAPL recovery wells, monitor the effectiveness of the DNAPL recovery, and adjust the system in the future to enhance its performance.

6.1.4 Surface Soils

One of the goals presented in Section 2 is to "Eliminate the potential for direct contact with/erosion of the contamianted surface soils at the site (perimeter of the site outside footprint of clay cover installed as part of "88 NYSDOT IRM)". As discussed in Section 3.5, the area of surface soil identified to pose a potential threat is the area of surface soil located along the western edge of the site. Since it is such a limited area, the approach identified to address this area (approximately 10 feet wide X 200 feet long X 1 foot deep) is to excavate the soil and dispose of it in an off-site landfill.

6.2 Conceptual Design of Preferred Remedy

The implementation of the remedy is discussed below in general terms. The remedial design (RD) will address the components of the remedy in detail. During the RD it may be deemed appropriate to modify various components of the conceptual design to best accommodate the treatment processes and associated equipment.

The conceptual design of the selected remedy (see figure 6.1) includes: Soil Vapor Extraction for subsurface soils; Groundwater Extraction and Treatment (current treatment proposal is via granular activated carbon, but treatment option may be modified in design) for overburden groundwater; excavation and off-site disposal of the limited amount of surface soils (along the western edge of the site); low-flow DNAPL recovery, monitor the effectiveness of the DNAPL recovery, and adjust the system in the future to enhance its performance; and maintenance of the on-site cover and perimeter fence. The total present worth of this remedial program is estimated to be $ 974,300 ($566,300 in capital costs / $ 408,000 total present worth of O&M).

The following areas would be marked out on site:

Limits of exclusion zone
Area to be excavated
Location of groundwater extraction/treatment unit
Location of SVE unit
Location of DNAPL extraction/ temporary storage area
Location of contractor trailers
Location of decontamination trailer and area

Once these areas are established, the appropriate mobilization activities would commence. A temporary drive to be used for access would be constructed by adding crushed stone. Temporary fencing would be erected to delineate the exclusion zone, as necessary (i.e., around western edge surface soil excavation). The exclusion zone would include the soil loading area, all contaminated areas, and hauling roads used during remediation. Once exclusion zones are established, only personnel involved in the remedial action and who have proper training would be allowed in the exclusion areas.

An estimated 100 cubic yards of contaminated soil from the western edge of the site would be excavated and loaded into trucks. Once confirmatory sampling has shown that soil contaminated above cleanup objectives have been removed from the area, the excavation would be backfilled with clean fill.

Approximately 14 vapor extraction wells would then be installed into the top of the fractured bedrock. The wells would be installed in a grid across the site, on approximately 60 foot centers. The SVE treatment unit would be installed, along with all of the associated piping and the air treatment unit. The unit would be operated for an estimated period of three years.

When the vapor extraction wells would be installed, approximately eight overburden groundwater extraction wells would also be installed into the top of the fractured bedrock and approximately four DNAPL recovery wells would be installed approximately 50 feet below ground surface (bgs), or approximately 40 feet into bedrock. The associated piping and treatment system would be installed to handle a water flow rate (from the 8 groundwater extraction wells) of approximately 20 gallons per minute. The overburden groundwater extraction wells will be 4 inch diameter construction; in the future these wells could be extended into the bedrock if it is determined that groundwater pump and treat is necessary in the bedrock to enhance DNAPL recovery/address aqueous concentration. If this becomes necessary in the future, the costs associated with it would be in addition to what is included in the cost estimate presented above.

The DNAPL extraction wells would be four inch wells installed approximately 40 feet into bedrock. The wells would be cased/grouted into the top of the competent bedrock with open hole construction in the competent rock. A rough estimate of 1000 gallons of recovered DNAPL, over five years, has been made. The recovered DNAPL would be temporarily stored on-site until enough accumulates to be sent off-site for incineration. At the end of the estimated five year period, necessary adjustments may be made to enhance the recovery system, as appropriate (e.g., extend the wells to address deeper bedrock if there is an indication DNAPL is present below 50 feet bgs).

SECTION 7 REFERENCES

USEPA. 1993. Presumptive Remedies: Policies and Procedures. USEPA Directive 9355.0-47FS. September 1993.

USEPA. 1993. Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils. USEPA Directive 9355.0-48FS. September 1993.

USEPA. 1996. Presumptive Response Strategy and Ex-situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites. USEPA Directive 9283.1-12. October 1996.

L.G.S. Turner & Associates,Ltd. 1997. Remediation Technologies Screning Matrix and Reference Guide, Third Edition. Prepared for the U.S. Army Environmental Center by L.G.S. Turner & Associates,Ltd. October 1997.

R.S. Means. 1996. Environmental Restoration Unit Cost & Assemblies Cost Books. Published by R.S. Means Company, Inc. and Delta Technology Group. .

Parsons. 1998. Site Investigation Summary Data Report for the Scobell Chemical Site. Prepared for the New York State Department of Environmental Conservation by Parsons Engineering Science. November 1998.

USEPA. 1989. Terra Vac In Situ Vacuum Extraction System Applications Analysis Report. USEPA Document EPA/540/A5-89/003. July 1989.

Corbitt, R.A. 1990. Standard Handbook of Environmental Engineering. Published by McGraw-Hill, Inc.

ATSDR. Various dates. Toxicological Profiles for Contaminants of Concern. Prepared for the Agency for Toxic Substances and Disease Registry by Syracuse Research Corporation.

TABLE 1.1
Standards, Criteria, & Guidance
Scobell Chemical Site - No. 8-28-076

Div./ Agcy.*	Title	Std./ Guid.	Requirements
DAR	Air Guide 1 - Guidelines for the Control of Toxic Ambient Air Contaminants	G	▸ *control of toxic air contaminants* ▸ screening analysis for ambient air impacts ▸ toxicity classifications ▸ ambient standards - short term/annual
DAR	6 NYCRR Part 200 (200.6) - General Provisions; 1/29/93	S	▸ prohibits contravention of AAQS or causes air pollution
DAR	6 NYCRR Part 201 - Permits & Certificates; 3/31/93	S	▸ prohibits construction/operation w/o permit/certificate
DAR	6 NYCRR Part 211 (211.1) - General Prohibitions	S	▸ prohibits emissions which are injurious to human, plant, or animal life or causes a nuisance
DAR	6 NYCRR Part 212 - General Process Emission Sources	S	▸ establishes control requirements
DAR	6 NYCRR Part 257 - Air Quality Standards	S	▸ applicable air quality standards
DFW	Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (FWIA); 10/94	G	▸ habitat assessments ▸ contaminant impact assessments ▸ ecological effects of remedies ▸ remedial requirements ▸ monitoring ▸ checklist
DFW	Technical guidance for screening contaminated sediments; 7/94	G	▸ sediments screening levels
DER	TAGM HWR-89-4031 Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites; 10/27/89	G	▸ dust suppression during IRM/RA
DER	TAGM HWR-92-4030 Selection of Remedial Actions at Inactive Hazardous Waste Sites; 5/90	G	▸ remedy selection criteria/evaluations
DER	TAGM HWR-92-4042 Interim Remedial Measures; 6/1/92	G	▸ define and track IRMs
DER	TAGM HWR-92-4046 Determination of Soil Cleanup Objectives and Cleanup Levels; 1/24/94	G	▸ soil cleanup goals

DER	TAGM HWR-92-4048 Interim Remedial Measures - Procedures; 12/9/92	G	▸ identifying and implementing IRMs
DER	6 NYCRR Part 375 - Inactive Hazardous Waste Disposal Site Remedial Program; 5/92	S	▸ requirements regarding remedial programs ▸ private party programs, state funded programs, state assistance to municipalities
DOW	Analytical Services Protocols (ASP); 11/91	G	▸ analytical procedures
DOW	TOGS 1.1.2 - Groundwater Effluent Limitations; 8/94	G	▸ guidance for developing effluent limits for groundwater
DOW	TOGS 1.1.1 - Ambient Water Quality Standards & Guidance Values; 10/93	G	▸ compilation of ambient water quality stds. and guidance values
DOW	TOGS 1.2.1 -Industrial SPDES Permit Drafting Strategy for Surface Waters; 4/90	G	▸ guidance for developing effluent and monitoring limits for point source releases to surface water
DOW	TOGS 1.3.8 - New Discharges to Publicly Owned Treatment Works; 10/26/94	G	▸ limits on new or changed discharges to POTWs strict requirements regarding bioaccumulative and persistent substances plus other considerations
DOW	6 NYCRR Part 702-15(a), (b), (c), (d) & (e) -	S	▸ Empowers DEC to Apply and Enforce Guidance where there is no Promulgated Standard
DOW	6 NYCRR Part 700-705 - NYSDEC Water Quality Regulations for Surface Waters and Groundwater; 9/1/91	S	▸ 700 - Definitions, Samples and Tests; 701 - Classifications Surface Waters and Groundwaters; 702 - Derivation and Use of Standards and Guidance Values; 703 - Surface Water and Groundwater Quality Standards and Groundwater Effluent Standards;
DOW	6 NYCRR Part 750-757 - Implementation of NPDES Program in NYS	S	▸ regulations regarding the SPDES program
DRS	6 NYCRR Part 364 - Waste Transporter Permits; 1/12/90	S	▸ regulates collection, transport, and delivery of regulated waste
DSHM	TAGM 3028 "Contained In" Criteria for Environmental Media; 11/92	G	▸ Soil Action Levels
DSHM	6 NYCRR Part 360 - Solid Waste Management Facilities; 10/9/93	S	▸ solid waste management facility requirements landfill closures; C&D landfill requirements; used oil; medical waste; etc.
DSHM	6 NYCRR Part 370 - Hazardous Waste Management System: General; 1/14/95	S	▸ definitions of terms and general standards applicable to Parts 370-374 & 376

DSHM	6 NYCRR Part 371 - Identification and Listing of Hazardous Wastes; 1/14/95	S	▸ haz. waste determinations
DSHM	6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities; 1/14/95	S	▸ manifest system and recordkeeping, certain management standards
DSHM	6 NYCRR Part 376 - Land Disposal Restrictions - 1/14/95	S	▸ identifies hazardous waste restricted from land disposal
DSHM	6 NYCRR Subpart 373-1 - Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements; 1/14/95	S	▸ hazardous waste permitting requirements: includes substantive requirements
DSHM	6 NYCRR Subpart 373-2 - Final Status Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities; 1/14/95	S	▸ hazardous waste management standards e.g., contingency plan; releases from SWMUs; closure/post-closure; container/management; tank management; surface impoundments; waste piles; landfills; incinerators; etc.
DSHM	6 NYCRR Subpart 373-3 - Interim Status Standards for Owners and Operators of Hazardous Waste Facilities - 1/14/95	S	▸ similar to 373-2
OSHA/ PESH	29 CFR Part 1910.120; Hazardous Waste Operations and Emergency Response	S	▸ health and safety
USEPA	Hydrologic Evaluation of Landfill Performance (HELP) Model Hydrologic Simulation of Solid Wast Disposal Sites	G	▸ cover system performance/hydrology
USEPA	Integrated Risk Information System (IRIS)	G	▸ verified RfDs and cancer slope factors
USEPA	Risk Assessment Guidance for Superfund - Volume 1 - Human Health Evaluation Manual; 12/89	G	▸ human health risk assessments

DAR: Division of Air Resources
DEP: Division of Environmental Permits
DER: Division of Environmental Remediation
DFW: Division of Fish and Wildlife
DOH: Department of Health
DOW: Division of Water
DSHM: Division of Solid and Hazardous Materials
USEPA: US Environmental Protection Agency

TABLE 1.2
Nature and Extent of Contamination (On-site)
(Based upon RI Analytical Data)

MEDIA	CLASS	CONTAMINANT OF CONCERN	CONCENTRATION RANGE (ppb, unless noted)	FREQUENCY of Detected Exceedances	SCG (ppb, unless noted)
Overburden Groundwater (including sump from former seep prevention system)	Volatile Organic Compounds (VOCs)	Benzene	ND - 76	2/5	1
		Chloroform	ND - 180	1/5	7
		1,1-Dichloroethene	ND - 94	1/5	5
		1,2-Dichloroethene	ND - 12,000	2/5	5
		Ethylbenzene	ND - 67	3/5	5
		Tetrachloroethene	ND - 27	2/5	5
		Toluene	ND - 300,000	4/5	5
		Trichloroethene	3(J) - 7400	3/5	5
		Vinyl Chloride	ND - 1200	3/5	2
		Xylene	1(J) - 320	4/5	5
	Metals	Cadmium	ND - 10.1	1/4	5
		Chromium	1.3(J) - 397	3/4	50
		Lead	ND - 1140(J)	3/4	25
		Mercury	ND - 6.5(J)	1/4	0.7
		Zinc	77(J) - 4770	3/4	2000
Shallow Bedrock Groundwater	Volatile Organic Compounds (VOCs)	1,1-Dichloroethene	ND - 130(J)	1/2	5
		1,2-Dichloroethene	3200(J) - 19,000	2/2	5
		Tetrachloroethene	ND - 1100(J)	2/2	5
		Toluene	ND - 380(J)	1/2	5
		Trichloroethene	480,000 -1,000,000	2/2	5
		Vinyl Chloride	ND - 480	1/2	2

MEDIA	CLASS	CONTAMINANT OF CONCERN	CONCENTRATION RANGE (ppb, unless noted)	FREQUENCY of Detected Exceedances	SCG (ppb, unless noted)
Subsurface Soil ●	Volatile Organic Compounds (VOCs)	1,2-Dichloroethene	ND - 460	1/14	300
		Tetrachloroethene	ND - 46,000	3/14	1400
		Toluene	ND - 1,100,000	4/14	1500
		1,1,1-Trichloroethane	ND - 13,000	2/14	800
		Trichloroethene	ND - 200,000	3/14	700
		Xylene	ND - 16,000	4/14	1200
	Metals	Chromium	6.6 - 139*	3/14	50* or SB
		Zinc	29.6(J) - 471*	14/14	20* or SB
Surface Soil	Pesticides	Endrin	ND - 130(J)	1/4	100
	Metals	Cadmium	0.7 - 33.3*	2/4	10* or SB
		Chromium	36.1 - 164*	3/4	50* or SB
		Lead	30.4(J) - 668*	2/4	200- 500+
		Mercury	ND - 0.94*	3/4	0.1*
●		Zinc	108(J) - 2320*	4/4	20* or SB
DNAPL*	Volatiles	Carbon disulfide	70*	1/1	
		Carbon tetrachloride	500*	1/1	
		Chlorobenzene	500*	1/1	
		Chloroform	66*	1/1	
		Ethylbenzene	500*	1/1	
		Tetrachloroethene	6900*	1/1	
		Toluene	740*	1/1	
		1,1,2-Trichloroethane	500*	1/1	
		Trichloroethene	790,000*	1/1	
		Xylene	240*	1/1	
		cis-1,2-Dichloroethene	270*	1/1	

● =concentrations expressed in ppm
ND =Not detected
SB =Site Background
J =Estimated value

+ =background levels in urban/suburban areas & near highways typically range from 200-500 ppm

TABLE 1.3

Summary of 1988 NYSDOT Soil Data
(Sample Locations with the Highest Soil Concentrations)

Sample Location (Depth)	Toluene (ppb)	TCE (ppb)	PCE (ppb)	1,2-DCE (ppb)	Pest (ppb)	Herb (ppb)	EP Toxicity(mg/L)	
							Cr	Pb
88-29 (12"-36")	5,730		254	3,650				
(36"-60")	30,100		6,060	6,030				
(60"-104.4")	<20		<10	<10				
88-30 (36"-60")						12,900 (MCPP)		
88-60 (0-18")	63.5	207		55.5				
(18"-36")	2,840	118		76,100				
(84"-108")	22,600	3,840		1,630				
88-61 (0-18")	849	34,300		5,800				
(18"-36")	14,100	6,400		1,000				
(84"-107)	525,000	116,000		5,000				
88-62 (0-18")				6,250				
(18"-36")				1,110				
(84"-102")				2,400				
88-71 (Surface) "A"							8.32	
(18"-36") "B"								12.2
88-72 (Surface) "A"	601		181				758	
(12"-36")	515		56.9					
(36"-60")	<5,000		<5,000					
(72"-80.4")	266,000	1,050	4,250					
88-73 (Surface) "A"							11.1	5.64
88-75 (Surface)							11.1	
88-76 (Surface)							15.3	
(0-18")								4.87
88-85 (0-18")	47,400	22,400	16,400					
(18"-36")	51,600	13,000	9,380					
88-89 (0-18")	19,300	1,380	36,000					
(18"-36")	530,000	6,320	73,600					
88-91 (0-18")	334,000							

TABLE 1.3

Summary of 1988 NYSDOT Soil Data
(Sample Locations with the Highest Soil Concentrations)

Sample Location (Depth)		Toluene (ppb)	TCE (ppb)	PCE (ppb)	1,2-DCE (ppb)	Pest (ppb)	Herb (ppb)	EP Toxicity(mg/L)	
								Cr	Pb
88-92	(0-18")	126,000							
	(18"-36")	74,900							
88-93	(0-18")	411,000							
88-93	(18"-36")	93,100							
88-95	(Surface)	<2,500							
	(0-18")	<5,000							
	(18"-36")	64,000							
88-96	(Surface)	37							
	(0-18")	14,200							
	(18"-36")	73,200							
88-97	(0-18")	574,000	1,920						
	(18"-36")	139,000	<2,500						
88-98	(Surface)	<25							
	(0-18")	37,000							
	(18"-36")	364,000							
	(36"-76")	989,000							

TABLE 3.1
Henry's Constants/Vapor Pressures for Volatile Organic Contaminants of Concern

Contaminant of Concern	Dimensionless Henry's Law Constant (at 10 ^{0}C)	Vapor Pressure (mm Hg)
SUBSURFACE SOIL		
1,2-dichloroethene (1,2-DCE)	0.1162	215
tetrachloroethene (PCE)	0.3641	
toluene	0.1640	22
1,1,1-trichloroethane (1,1,1-TCA)	0.4153	124
trichloroethene (TCE)	0.2315	59
xylene	0.1227	5
GROUNDWATER		
benzene	0.1420	95
chloroform	0.0740	159
1,1-dichloroethene	0.6628	500
1,2-dichloroethene	0.1162	215
ethylbenzene	0.1403	7
tetrachloroethene	0.3641	
toluene	0.1640	22
trichloroethene	0.2315	59
vinyl chloride	0.6456	2660
xylene	0.1227	5

References: Terra Vac In-situ Vacuum Extraction System Applications Analysis Report (EPA/ 540/A5-89/003, July 1989)/ Toxicological Profiles prepared for the Agency for Toxic Substances and Disease Registry (ATSDR)

TABLE 5.1
COST ESTIMATES - SUMMARY

Alternative	Capital Cost	Present Worth of O&M	Total Present Worth
Soil (alternatives include excavation/ disposal of western perimeter surface soil)			
Soil Vapor Extraction (SVE)	$322,000	$ 206,720	$ 528,720
Excavation/Incinerate (>UTSs)/ Landfill (<UTSs)	$ 6,998,000	————	$ 6,998,000
Groundwater (alternatives include DNAPL recovery)			
No Action/ Groundwater Monitoring	———— –	$ 104,660	$ 104,660
Pump & Treat (*Air Stripping*)	$ 262,100	$ 301,600	$ 563,700
Pump & Treat (*GAC*)	$ 244,300	$ 201,600	$ 445,900
Pump & Treat (*UV/OX*)	$ 303,000	$ 268,600	$ 571,600

COST ESTIMATE FOR PREFERRED ALTERNATIVE

Summary of Alternative	Capital Cost	Present Worth of O&M	Total Present Worth
SVE/ excavation/disposal of western perimeter surface soil/ pump & treat (GAC)/ DNAPL Recovery	$566,300	$408,000	$974,300

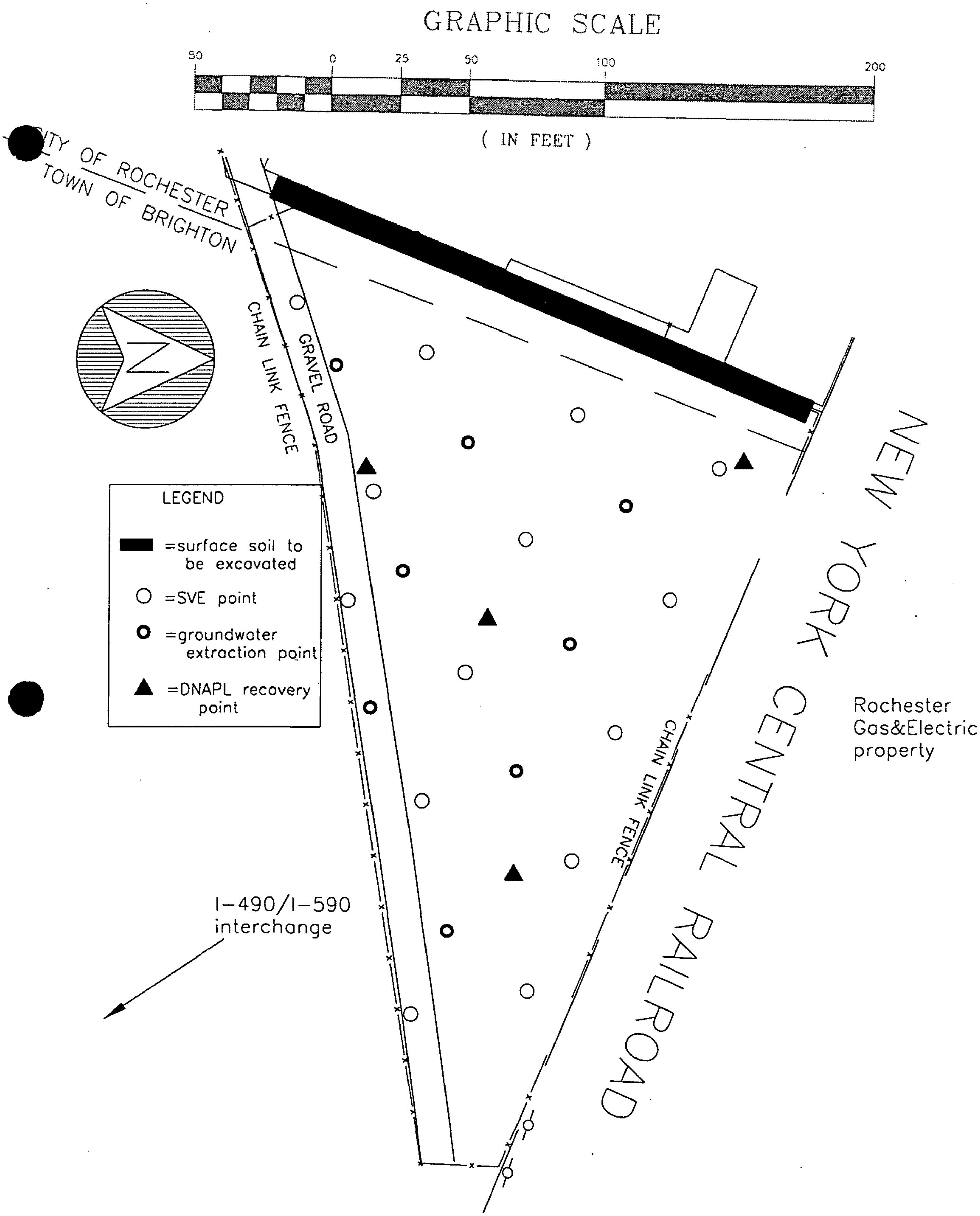

Figure 6.1 – Conceptual Design

Appendix A

Cost Estimates for Remedial Alternatives

Cost Estimates - Summary

Alternative	Capital Cost	Present Worth of O&M	Total Present Worth
Soil			
Soil Vapor Extraction	$310,000	$ 206,720	$516,720
Excavation/Incinerate (>UTSs)/ Landfill (<UTSs)	$ 6,986,000	______________	$ 6,986,000
Groundwater			
No Action/ Groundwater Monitoring	______________	$ 104,660	$ 104,660
Pump & Treat (*Air Stripping*)	$ 167,500	$ 235,600	$ 403,100
Pump & Treat (*GAC*)	$ 149,700	$ 135,600	$ 285,300
Pump & Treat (*UV/OX*)	$ 208,400	$ 202,600	$ 411,000
DNAPL Recovery (shallow bedrock)			
Extraction and Off-site Incineration	$ 94,600	$ 66,000	$ 160,600
Surface Soil			
Excavate/off-site landfill	$ 12,000	______________	$ 12,000

Remedial Alternatives for Soil

Soil Vapor Extraction

- VE pilot study indicated radius of influence of 40'.

- to provide overlap, assume VE wells on ~60' centers (30' radius of influence)

Assume: 14 vapor extraction wells (2" PVC?)

Assume: Use of a 280 SCFM, vapor recovery system
(39 SCFM blower was used for pilot study)

Assume: Assume length of connection piping as radius of influence times # of VEP's *[Means, Page 453]*
(30)(14) = 420 feet

Assume: Disposal of ~7 drums of drill cuttings as hazardous waste

Assume: Startup labor: sample crew on-site once a week for first month/once a month after *[Means, p. 456]*

Assume: 3 years of SVE operation

Capital Costs

	Units	Price/Unit	Total *(reference)*
Mobilization	1	$30,000	$30,000 *(Pelican Manufacturing bids)*
Site Services	1	$25,000	$25,000 (Pelican bids)
Vapor Extraction Well Installation	14	$2,000	$28,000*(Scobell Chemical -Site Investigation Work PlanWP)*
Blower (Including knockout tank & filter)	1	$12,000	$12,000 *(Pelican Manufacturing FS)*
Associated piping (2" PVC)	Lump sum (420 ft)	$30,000	$30,000 *(Pelican bids)*
Instrumentation/ Control System	1	$5,000	$5,000 *(Pelican FS)*
Start-up Labor	1	$30,000	$30,000 *(Pelican FS)*

Monitoring (air/ vacuum)	1	$15,000	$15,000
Installation/ Set-up Carbon System	1	$25,000	$25,000 ***(Haight Farm FS/Niagara Transformer additional investigation estimate)***
			$200,000

Annual O & M

First Year	Units	Price/Unit	Total
♦ Air Monitoring (1/week1st month|1/month rest of year)	15	$350	$5,250 ***(Haight Farm)***
♦ System Monitoring (1/month after 6 month shakedown) @ 10 hrs./mo; $50/hr	6	$500	$3,000 ***(Haight Farm)***
♦ Reporting (1/year)	1	$5,000	$5,000 ***(Pelican FS)***
♦ Electricity	1	$3,000	$3,000 ***(Haight Farm)***
♦ Carbon Cost (assume 10-1800 lb carbon canisters –> 1st year	10	$3,000	$30,000 ***(Haight Farm)***
Present Worth (1 year, 5%, P/A) [=.9524]			$46,250 **$44,050**

Years 2 & 3 - Annual O&M	Units	Price/Unit	Total
♦ Air Monitoring (1/month)	12	$350	$4,200
♦ System Monitoring (1/month)	12	$500	$6,000
♦ Reporting (1/year)	1	$5,000	$5,000
♦ Electricity	1	$3,000	$3,000

♦ Carbon Cost (assume 6-1800 lb carbon canisters/year	6	$3,000	$18,000
			$36,200/year x 2 $72,400

Total Present Work (P/A, 2, 5% - years 2 &3) (P/F, 1, 5% - to get years 2&3 to present)
(1.8594) (.9524) (72,400) = 1.771 (72,400) = **$128,220**

$240,000 (Capital + 20% contingencies)
70,000 (Engineering)
52,860 (1st year O&M +20% contingencies)
+153,860 (2nd & 3rd year O&M + 20% contingencies)
$516,720 Total Costs (Capital & O&M)

Excavation/Off-Site Disposal

- Breakdown of Area where soil exceeds LDR - Universal Treatment Standards (UTSs)

Assume: Soil from entire thickness included if a sample from a horizon exceeds UTSs.

Assume: Thickness of overburden ~9' (see attached table 3.2 from Site Investigation Report)
(See attached figure from '88 NYSDOT Sampling —› any exeedances from Site Investigation overlapped by '88 map coverage)

Area 1 (from figure attached to my notes):	120' x 83'	=	9,960	ft^2
Area 2 (from figure attached to my notes):	90' x 26'	=	2,340	ft^2
Area 3 (from figure attached to my notes):	53' x 56'	=	2,968	ft^2

15,268 ft^2
x 9' thick

137,412 ft^3
÷ 27 ft^3/yd^3

~ 5,100 yd^3
Assume: 1.5 $tons/yd^3$

7,650 tons of soils that exceed UTSs

Total Volume of Soil @ Site
Triangular shaped site with sides ~225' x 325'
Area = ½ (225) (325) = 36,562 =› ~40,000 ft^2
Volume = (40,000 ft^2) (9' thick) ≅ 13,350 yd^3

$\times \frac{1.5 \text{ tons}}{yd^3}$ = 20,025 tons

Soils that could be landfilled in Part 360/Subtitle D facility
(<"Contained-In" Criteria, TAGM 3028 (DHSM))

13,350 yd^3 - 5,100 yd^3 = 8,250 yd^3
= 12,375 tons

***Sub-Option (A) Incineration of Soils that exceed UTSs** [reference:price quotes from disposal of material at Dover Electronics site]*

Disposal of Soils (UTS's) (that Exceed LDRs) by Incineration

Disposal: (\$.25/lb) (7,650 tons) (2,000 lbs/ton) = \$3,825,000

Transportation: ($.11/lb) (7,650 tons) (2,000 lbs/ton) = $1,683,000

$5,508,000

---

b-Option (B) Treatment of Soils that exceed UTSs [reference: price quotes from disposal of material at Dover Electronics site]

Treatment: ($250/ton) (7,650 tons) = $1,912,500

Transportation: ($83/ton) (7,650) = $634,950

$2,547,450

Disposal of treated soil in landfill after treatment:
($75/ton) (7,650 tons) = $573,750

Disposal of Remainder of Soils in a Solid Waste Landfill (Don't exceed LDR's or "Contained-In" Criteria)

Assume: $75/ton for transportation & disposal
($75/ton) (12,375) = $928,125

Summary (Off-Site Disposal) - (all Capital Costs)

Excavation/off-site *incineration* (exceed UTSs) / Landfill Disposal (soils that meet UTSs)
[Sub-option (A)]

$5,508,000
928,125
$6,436,125
50,000 (Engineering Costs)
500,000 (Contingencies)
$6,986,125 (all Capital Costs)

Excavation/off-site treatment to meet UTSs / Landfill Disposal (soils that meet UTSs)
[Sub-option (B)]

$2,547,450
573,750
928,125
$4,049,325
50,000 (Engineering Costs)
500,000 (Contingencies)
$4,599,325

Summary - Groundwater Remedial Alternatives

No Action / Groundwater Monitoring

Present Worth of O&M:	$104,660	(includes 20% contingency)
Total	**$104,660**	

GW Pump - Air Stripping

Capital Costs:	$117,500	(includes 20% contingency)
	50,000	(Engineering, part of Capital Costs)
Present Worth of O&M:	$235,600	(includes 20% contingency)
Total	**$403,100**	

GW Pump - Granular Activated Carbon Treatment

Capital Costs:	$109,700	(includes 20% contingency)
	40,000	(Engineering, part of Capital Costs)
Pres. Worth of O&M:	135,600	(includes 20% contingency)
Total	**$285,300**	

GW Pump - UV Oxidation Treatment

Capital Costs:	$148,400	(includes 20% contingency)
	60,000	(Engineering)
Present Worth of O&M:	$202,600	(includes 20% contingency)
Total	**$411,000**	

Remedial Alternatives for Groundwater

No Action / Groundwater Monitoring

ume: groundwater samples collected from 7 existing monitoring wells and analyzed for VOCs/metals

Assume: analytical costs of $300/sample

Assume: quarterly sampling for 1st year / annual sampling for 30 years

Assume: 20 hrs labor / sampling event @ $50/hr

Assume: Annual Summary report @ $2,000/

Annual O&M		# of Units	Unit Cost	Total
First year	Analytical Costs	28	300	8,400
	Labor Costs	4	1,000	4,000
	Reporting	1	2,000	2,000
				14,000
Years 2-30	Analytical Costs	7	300	2,100
	Labor Costs	1	1,000	1,000
	Reporting	1	2,000	2,000
				5,100

30 Year Present Worth
- 14,400 (P/A, 1, 5%) = 14,400 (.9524) = $13,715
- 5,100 (P/A, 29, 5%) = 5,100 (15.411) = 77,220

  44,220 (P/F, 1, 5%) = 77,220 (.9524) = 73,500

Present Worth of O&M $87,215

87,215 (PW of Monitoring)

17,450 (20% Contingency)

$104,665

Assume: Installation of 8 pumping wells installed into the top of rock (~5')

Assume: Installation of 4" stainless steel wells (use 4" wells so that once overburden is done they can be cored through / converted for use as bedrock pumping wells to address GW / or enhance DNAPL recovery)

Assume: Overburden thickness of 10'

Assume: Similar length of piping needed, compared to SVE (~400 LF)

Capital Costs

	# of Units	Unit Cost	Total *(reference)*
Mobilization	1	$5,000	$5,000
Well Installation (6 1/4" Auguring / 5 7/8" rock coring/ 4" SS well installation / 4" locking cover & pad / disposal of wastes generated / decon & development = $2,455/well)	8	$2,400	$19,640
Piping (2" S.S.)	400 LF	$25/LF Means	$10,000 *(Means-Assemblies/ Cost Book)*
Pipe Trenching	400 FL	$10/FL	$4,000
100 gallon plastic sump with fittings	1	$3,000	$3,000 *(Means - Assemblies Cost Book [air stripping])*
4" Submersible pump, w/level controls	8	$1,500	$12,000 *(Haight Farm FS) (Means-Unit Cost Book, p.8-29)*
		Subtotal	**$53,640**

GW Treatment - Air Stripping

Assume: Treatment for recovered overburden GW designed to treat ~20 GPM.

Capital Costs

	Units	Unit Cost	Total *(reference)*
Mobilization	1	$10,000	$10,000
6"Structural Slab	150 SF	$5/sf	750
Misc. Fitting / Joints	1	$2,000	$2,000
Install Air Stripping Tower (Assume: 3' Diameter/20' tower)	1	$5,000	$5,000 ***(Means-Assemblies Cost Book)***
Packing for Tower	140 CF	9/CF	$1,260 ***(Means-Assemblies)***
Electrical Controls for stripper	1	$6,500	$6,500 ***(Means-Assemblies)***
3' Diameter Tower Blower	1	$1,700	$1,700 ***(Means-Assemblies)***
50 GPM, 3HP, Centrifigal Pump	1	$2,100	$2,100
Vapor Phase Carbon Installation	1	$5,000	$5,000
System Start-up Labor Costs	1	$10,000	$10,000 ***(Haight Farm FS)***
		Total Annual O&M	**$44,310**

Air Stripping (cont.)

Annual O & M

	Units	Unit Cost	Total
Replacement parts, supplies, materials Electricity/phone service	1 1	$3,000 $10,000	7,500 ***(Haight)*** 10,000 ***(Haight)***
Carbon Canisters (Vapor Phase) (Replacement/Regmeration)	5	$3,000	$15,000
Air Emissions Sampling	8	$350	$2,800
Water Emissions Sampling (influent/effluent - quarterly)	8	$350	$2,800
Weekly inspection / maintenance (assume 10 hrs/week)	520	$75/hr	$39,000
		Subtotal	**$72,100**

Assumed: 3 years of operation

Present Worth of O&M

(72,100) (P/A, 3, 5%) =
(72,100) (2.7232) = **$196,340**

GW Treatment - GAC

Assume: Treatment for recovered overburden GW @ 20 GPM

Capital Costs

	Units	Unit Cost	Total *(reference)*
Mobilization	1	$10,000	$10,000
8"Structural Slab on grade	500 SF	$6/SF	3,000
1,650 LB fill, Stainless Steel Bed	1	$11,000	$11,00 ***(Means-Assemblies)***
Carbon	1,650 lb	$1/lb	$1,650
Prefilter/Post-filter Housing & Cartridge, to 20 GPM	1	$1,000	$1,000 ***(Means Assemblies)***
20 GPM transfer pump with motor, valves & piping	1	$1,100	$1,100 ***(Means Assemblies)***
Labor, Startup	1	$10,000	$10,000
		Subtotal	**$37,750**

GW Treatment - GAC (cont)

Annual O&M

	Units	Unit Cost	Total *(reference)*
Regenerate Carbon	14,725 lbs (see carbon usage estimate)	$.83/lb	$12,220 ***(Means)***
Water Emissions Sampling (influent/effluent - quarterly)	8	$350	$2,800
Replacement Parts/Supplies	1	$1,500	$1,500
Electricity/Phone Service		$7,000	$7,000
Monthly inspection / maintenance (assume 20 hrs/month)	240	$75/hr	$18,000
		Subtotal	**$41,500**

Assumed: 3 years of operation

Present Worth of O&M

(41,500) (P/A, 3, 5%) = (41,500) (2.7232) = $113,000

Carbon Usage Estimate

- 20 GPM flow
- Estimate (conservative) of influent concentrations based on groundwater samples from:
  - geoprobes on-site
  - SVE-1
  - MW-2D/3D

PCE ≅ (1 mg/L) 20 gallons/min) 9 3.785 (liter/gallon) = 75.7 mg PCE/min
TCE ≅ (70 mg/l) (20) (3.785) = 5,219 mg TCE/min
Toluene ≅ (.4 mg/l) (20) (3.785) = 30 mg toluene/min
cis-1,2-DCE≅ (1.5 mg/l) (20) (3.785) = 113.5 mg 1,2 DCE/min

Daily Contaminant Loadings

PCE = (75.7 mg/min) 60 min/hr) 24 hr/day) = 109,000 mg/day = 109 g = .109 kg/day

TCE = (5,299) (60) (24) = 7,630,560 mg/day

toluene = (30) (60) (24) = 43,200 mg/day

cis-1,2-DCE = 113.5 (60) (24) = 163,440 mg/day

Daily Consumption of Carbon - From Isotherms

PCE = (109,000 mg/day PCE/150 mg PCE/g carbon) = 726 g carbon/day

TCE = (7,630,560/500 mg TCE/g. carbon) = 15,261 g carbon/day

cis-1,2-DCE: (163,440/70 mg DCE/g carbon) = 2,335 g carbon/day
Total = 18,322 g carbon/day = 18.3 kg/day

(18.3 kg/day) (1 lb/.4536 kg) (365 days/yr) = **14,725 lbs carbon/yr.**

GW Treatment - UV Oxidation

Assume: Ozone treatment system

Capital Costs

	Units	Unit Cost	Total *(reference)*
20 gpm UV Reaction, Capital Equipment	1	$65,000	$65,000 ***(Means-Assemblies p.3-296 line 33-12-0834)***
20 gpm Ozone Assembly & Shakedown	1	$5,000	$5,000 ***(Means-Assemblies p.3-297)***
		Subtotal	**$70,000**

Annual O&M

	Units	Unit Cost	Total
20 gpm Ozone System Consumables	52 weeks	$250/wk	$13,000 ***(Means Assemblies p.300)***
Ozone system O&M/sampling labor	(10 hrs/wk) 520 hrs	$75	$39,000
Electricity / phone service	1	$10,000	$10,000
		Annual O&M	**$62,00**

Assumed: 3 years of operation

Present Worth of O&M

(62,000) (P/A, 3, 5%) = (62,000) (2.7232) = **$168,800**

DNAPL Recovery / Treatment - SUMMARY

Capital Costs:	$39,600	(includes 20% contingency)
	$55,000	(Engineering, Including limited 3D Seismic Survey to cite recovery wells)
Present Worth of Annual O&M:	$66,000	(includes 20% contingency)
Total	**$160,600**	

DNAPL Recovery/Treatment

Assume: Engineering Costs during Design to include a limited 3D Seismic Survey to cite DNAPL recovery wells.

Assume: 4 bedrock recovery wells / 50 feet deep (40' into rock) / 4" Diameter / 5 year operating period/ total of 1,000 gallons in 5 years

Capital Costs

	Units	Unit Cost	Total *(reference)*
Mobilization	1	5,000	5,000
Well Installation	4	3,500	14,000
Submersible pump ("Product Pump" with controls)	4	3,000	12,000 ***(Means-Unit Cost p.8-303)***
Holding Tank	1	2,000	2,000
		Subtotal	**$33,000**

Annual O&M

Assume: 5 year operating period / total of 1,000 gallons recovered =⟩Although it won't be uniform, Assume 200 gallons / year for disposal.

Assume: recovered DNAPL sent off-site for incineration

Annual O&M	Units	Unit Cost	Total
Operation / Sampling (quarterly - Labor 20 hrs/quarter)	100 hrs	$75	7,500
DNAPL sample analysis (quarterly)	4	$300	1,200
DNAPL off-site incineration	4 (55 gallon drums)	$1,000	$4,000
		Total Annual O&M	**$12,700**

Present Worth of Annual O&M

(12,700) (P/A, 5, 5%) = (12,700) (4.3295) = **$55,000**

Surface Soil Excavation/off-site Disposal in a Landfill

Assume: The surface soils along the western edge of the site (between the fence and the adjacent building) will be excavated; dimensions: 10' wide X 225' long X 1'deep; total volume = 2250 ft^3 = 83.3 yd^3 → Assume 100 yd^3

Assume: Off-site disposal in a Part 360-type landfill; assume total costs for excavation/transportation/disposal/backfill = \$100/yd^3

Capital costs:	(100 yd^3) (\$100/yd^3)	= \$ 10,000
Contingency	(20%) (\$ 10,000)	= \$ 2,000
	Total	**\$ 12,000**