VOLUME II- FS REPORT

NEW YORK STATE SUPERFUND STANDBY CONTRACT
POLYMER APPLICATIONS SITE
Town of Tonawanda, Erie County

WORK ASSIGNMENT NUMBERS: D002478-22
SITE NO. 9-15-044

PREPARED FOR

New York State
Department of
Environmental Conservation
50 Wolf Road, Albany, New York 12233
Michael D. Zagata, Commissioner

Division of Hazardous Waste Remediation
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BUREAU OF WESTERN REMEDIAL ACTION
DIVISION OF HAZARDOUS
WASTE REMEDIATION

REMEDIAL INVESTIGATION REPORT FOR

NEW YORK STATE SUPERFUND STANDBY CONTRACT

POLYMER APPLICATIONS SITE
TOWN OF TONAWANDA, ERIE COUNTY
WORK ASSIGNMENT NO. D002478-22
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VOLUME II - APPENDICES

Prepared For:

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF HAZARDOUS WASTE REMEDIATION

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EXECUTIVE SUMMARY

FEASIBILITY STUDY

The Feasibility Study (FS) develops appropriate remedial alternatives for areas of environmental concern, screens alternatives, and conducts a detailed analysis of retained alternatives in order to select the most appropriate alternative for implementation. This FS was conducted in accordance with NYSDEC (1990) and USEPA (1988) guidance.

Five Remedial Action Objectives (RAOs) were developed for the Polymer Applications site based on the results of the Baseline Risk Assessment and exceedences of standards, criteria, and guidelines (SCGs) in site media samples from the Remedial Investigation. The primary objective is to eliminate the contact threat posed by surface soil contamination. The other RAOs are, to the extent practicable, to restore groundwater quality and to prevent the impact of contaminated soils and sediments on groundwater quality and on fish and wildlife and to prevent air emissions that pose an unacceptable risk or exceed air quality guidelines. Recommended clean-up goals were developed for the compounds of concern and the areas and volumes of soil and sediments that exceeded the clean-up goals were identified. These areas are the focus of site remediation, and they include the surface soils in the yard area or backyard and along the sides of the main warehouse, subsurface soils in the northern two-thirds of the backyard, and offsite surface soils and sediments in ditches south and north of the site, and across River Road.

The general categories of response actions that were considered for remediation of soils/sediments and groundwater include:

- No Action;
- Containment or Source Control;
- *In situ* Soil Treatment;
- *Ex situ* Onsite Treatment; and
- Offsite Disposal

Potentially applicable treatment technologies for soil and groundwater were evaluated. Selected technologies were combined into five remedial alternatives which were screened on the basis of effectiveness and implementability. All the alternatives were retained through screening. They are:

- Alternative 1 - No Further Action
- Alternative 2 - Soil Consolidation and Multi-layer Cap

  Option A - Soil-Geomembrane Cap

  Option B - Asphalt Cap
- Alternative 3 - *In situ* Soil Treatment

- Alternative 4 - Excavation and *Ex situ* Soil Treatment
  - Option A - Low Temperature Thermal Desorption
  - Option B - Solid Phase Biological Treatment
- Alternative 5 - Offsite Disposal of Soils

Each of these alternatives was evaluated in detail using the following criteria:

- Overall Protection of Human Health and the Environment
- Achieving Remedial Action Objectives
- Compliance with SCGs
- Short-term Effectiveness
- Long-term Effectiveness
- Reduction of Toxicity, Mobility, and Volume
- Implementability
- Cost

Based on the detailed evaluation, Alternative 4B was determined to best meet the RAOs. Through implementatin of Alternative 4B, the surface soil contact threat and the impacts of contaminated soil would be eliminated by:

- excavation of offsite soils and sediments and relocation to the backyard area for treatment;
- construction of a bioventing treatment cell in the backyard for permanent soil treatment; and
- short-term containment during soil treatment via capping.

Groundwater quality would be improved and impacts would be reduced by collection of shallow groundwater in the backyard, limited pumping of two deep aquifer monitoring/extraction wells, and treatment prior to discharge to the Town of Tonawanda POTW. The subsurface barrier wall around the backyard would be repaired and possible conduits in the rear of the main warehouse would be plugged to complete containment of the backyard. Unacceptable air emissions from site soils would be eliminated through soil treatment and capping.

The estimated total present worth cost for Alternative 4B is $3,000,000.

In addition to meeting the remedial objectives, Alternative 4B has the advantage of offering limited use of the backyard area during soil treatment, and possible unrestricted use following treatment.

SECTION 7

IDENTIFICATION AND SCREENING OF TECHNOLOGIES

The RI (Parsons Engineering Science, 1995) determined that soils, sediments, groundwater, and surface water at the Polymer Applications site are impacted by the past site activities. In this section, remedial action objectives (RAOs) are established for the media of concern at the site, following the presentation of applicable New York State Standards, Criteria, and Guidelines (SCGs). The remedial action objectives are based on cleanup goals, which incorporate the SCGs, results of the Baseline Risk Assessment, and future land use considerations. The estimated areas and volumes of contaminated media that must be remediated to achieve the RAOs are presented.

Once the remedial action objectives are presented, general response actions to achieve these objectives are identified and evaluated. Media-specific technologies to address general response actions are then identified and screened. The technologies are evaluated on the basis of effectiveness, implementability, and the ability to achieve media-specific remedial action objectives. If more than one technology per response type is judged to be potentially applicable, one representative technology type is carried into Section 8. Selecting a process option to best represent a response type simplifies the development of remedial alternatives.

7.1 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

RAOs are site-specific, qualitative, and, according to the National Contingency Plan (NCP), they should specify contaminants and media of concern, potential exposure pathways, and remediation goals. These objectives serve as the framework for the remainder of the FS and are used to develop and evaluate candidate remedial alternatives with respect to their ability to protect public health and the environment.

Fundamental to the development of RAOs is the identification of clean-up goals for contaminants in media of concern at the Polymer Applications site. The development of clean-up goals for the site are based on three elements: 1) New York State Standards, Criteria, and Guidelines (SCGs); 2) results of the Baseline Risk Assessment; and 3) consideration of future site use. Each of these three elements is discussed below, followed by a presentation of recommended clean-up goals. The RAOs are based on the recommended clean-up goals and are presented at the end of this section.

7.1.1 New York State Standards, Criteria, and Guidelines

The primary objective of the Feasibility Study is to identify and recommend the most environmentally-sound remedial action which will, among other things, protect public health and the environment by achieving and maintaining applicable Federal and State quality standards for groundwater, surface water, soils, sediments, and air. Guidelines may be also be applicable where standards do not exist.

The Superfund Amendments and Reauthorization Act (SARA) of 1986 stipulates that cleanup should achieve applicable or relevant and appropriate requirements (ARARs) under Federal or State laws. Applicable requirements are those cleanup or control standards and other substantive environmental protective requirements, criteria, or limitations promulgated under Federal or State laws which specifically address a hazardous substance, pollutant, contaminant, remedial action location, or other circumstances at the Superfund site. Relevant and appropriate requirements refer to those cleanup criteria or control standards and other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State laws that, while not applicable, per se, address problems or situations sufficiently similar to those encountered at the Superfund site.

The National Contingency Plan (NCP) (40 CFR Part 300) has been revised to reflect the changes necessitated by SARA. The NCP states that while applicable or relevant and appropriate requirements may be applicable to Superfund response actions, CERCLA exempts any on-site response action from having to obtain a Federal, State, or local permit. The NCP also states that advisories, criteria, or guidance values issued by Federal or State governments that do not meet the definition of an ARAR may still be considered in determining the level of cleanup necessary for the protection of human health and the environment. In addition, the NCP identifies circumstances for which ARARs can be waived. Such circumstances include interim remedies, greater risks to human health and the environment, technical impracticality, equivalent performance through other approaches, and incumbent application of State standards.

New York State does not use ARARs in its statutes, but instead uses the terms New York State Standards, Criteria and Guidelines (SCGs) as presented in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #HWR-90-4030 (NYSDEC, 1990). SCGs also include Federal standards which are more stringent than the New York State standards. NYSDEC has identified three types of SCGs: chemical-specific, action-specific, and location-specific. The standards and guidelines for these three types of SCGs are presented in the following sections. The SCGs provided in this subsection are considered during the formulation of remedial action objectives and the detailed analysis of alternatives. Compliance with the SCG values is one of the seven evaluation criteria considered in the detailed analysis of remedial alternatives.

7.1.1.1 SCG Identification Process

The SCGs for the site were identified based on site-specific chemicals, the alternatives being considered for site remediation, and the site location. The following environmental statutes and regulations were reviewed for sources of SCGs:

1. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),
2. Superfund Amendments and Reauthorization Act (SARA),
3. Clean Air Act (CAA),
4. Clean Water Act (CWA),

5. Safe Drinking Water Act,
6. Toxic Substances Control Act (TSCA),
7. Resource Conservation and Recovery Act (RCRA),
8. Department of Transportation Regulations, and
9. New York Code of Rules and Regulations Title 6.

Chemical-specific SCGs for compounds detected during the RI are presented in Table 7.1. Chemical-specific SCGs for detected compounds in soil are from cleanup guidelines outlined in the NYSDEC TAGM #HWR-94-4046, Determination of Soil Cleanup Objectives and Cleanup Levels (NYSDEC, 1994), modified for the site average subsoil organic carbon content of 2.8 percent. SCGs for groundwater are the New York State Ambient Water Quality Standards for Class GA groundwater. Sediment SCGs are from the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1993) calculated for a sediment organic carbon content of 2.8 percent based on subsoil data. Surface water and leachate SCGs are NYSDEC Ambient Water Quality Standards and Guidance Values (T.O.G. 1.1.1) last revised on October 22, 1993 for Class D Surface Water.

7.1.1.2 Chemical-Specific SCGs

Chemical-specific SCGs are limits on the allowable concentrations of contaminants in the media sampled on site. Chemical-specific SCGs were identified for groundwater, soil, sediments, and surface water at the site in Section 4.2.

7.1.1.3 Action-Specific SCGs

Action-specific SCGs are technology- or activity-based requirements or limitations on actions taken with respect to management of the remediation waste. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy.

An important factor in identifying action-specific SCGs is the determination of whether the site contaminants are RCRA hazardous wastes. For the purposes of this FS, NYSDEC decided to assume that the phenol and xylenes detected in site soils resulted from spills of commercial chemical products during operation and/or the 1988 fire. Therefore, an EPA Hazardous Waste Number of U188 and/or U239 for phenol- and xylene-contaminated soils, respectively, is assumed for excavated soils sent off site for disposal. In addition, one surface soil sample contained PCBs at a concentration greater than 50 ppm, which therefore becomes a NYSDEC listed hazardous waste with a DEC Hazardous Waste Number of B007 if excavated.

Potential action-specific SCGs that are applicable or relevant and appropriate to potential remedial activities at the site are listed in Table 7.2.

7.1.1.4 Location-Specific SCGs

Location-specific SCGs are restrictions placed on the concentration of hazardous substances or the conduct of remedial activities solely because they occur in special locations. Typical location restrictions include areas situated in locations requiring special precautions such as floodplains or because of seismic activity or areas with sensitive or unique characteristics such as wetlands or areas with historical significance.

No location-specific ARARs have been identified for the Polymer Applications site. The wet area adjacent to the property to the south is not a NYSDEC-listed wetlands, and the property does not fall within the New York State Coastal Zone which extends from the Niagara River, according to NYSDEC.

7.1.2 Baseline Risk Assessment

The Baseline Risk Assessment (Section 5) evaluated the contaminants detected at the site in the RI, and determined the contaminants and media that are of concern to human health and the environment.

The Baseline Human Health Evaluation (Section 5.1) concluded that the primary contaminants of concern that tended to result in significant non-carcinogenic hazards and carcinogenic risks were PCBs and metals. Concentrations of five metals are significant contributors to the Human Health Evaluation; however, due to the small number of samples analyzed for metals and the locations which were chosen (likely leading to a bias toward high concentrations), the contribution of metals to human health risk is likely to be lower than the calculated carcinogenic and non-carcinogenic risks. Risk of non-carcinogenic effects are present for current workers and residents and for hypothetical future workers and residents. The cancer risks for current and future hypothetical workers and residents exceeded the USEPA target range of 1E-06 to 1E-04. The risks are primarily attributed to exposures from dermal contact and ingestion of soil and groundwater.

The Fish and Wildlife Impact Assessment concluded that there was a low likelihood of population-level impacts to area wildlife and fish from exposure to phenols, PAHs, PCBs, and metals at the site. The probability and magnitude of impacts to target organisms are considered to be small or low because of low utilization of the site by wildlife. Low utilization is due to the highly disturbed nature and industrial use of the site. The assessment endpoint of population reduction caused by mortality or reduced reproductive success of small mammals was qualitatively assessed using comparisons of NOEL's to detected concentrations of contaminants at the site.

7.1.3 Future Site Use

The Polymer Applications site is in an area that is largely urban commercial and residential with scattered underdeveloped open-space areas. Industrial facilities dominate the landscape. It is anticipated that the site in the foreseeable future could be used as commercial/industrial property. Residential use is a possibility, but is unlikely given the proximity of industrial/commercial facilities.

7.1.4 Recommended Clean-up Goals

Remedial clean-up goals for the site were developed using chemical-specific SCGs, the results of the Baseline Human Health Evaluation (BHHE), and the results of the Fish and Wildlife Impact Assessment (FWIA). The recommended clean-up goals are based on an evaluation of the significant exposure pathways for the contaminants of concern at the site.

The BHHE examined a number of exposure pathways, and evaluated the risks associated with all exposure pathways that could potentially be completed. Several of the pathways that were evaluated as complete are not significant for the Polymer Applications site, however, such as the groundwater ingestion and dermal contact pathways. These are not significant pathways because all potable water in the area is supplied through a municipal water system, so the use of groundwater for drinking or other purposes in the future is unlikely. Another non-significant pathway is contact with surface water, because surface water is not a permanent or large feature on or near the site, and groundwater does not discharge to the surface at the site. Remediation of underlying soil and sediment would result in elimination of risk from potential exposure to surface water.

The significant human health exposure pathways for the Polymer Applications site therefore are ingestion of soil and dermal contact with soil and sediments.

The FWIA concluded that the potential for impacts to individual terrestrial and aquatic receptors is considered small due to low utilization because of the highly disturbed nature and industrial use of the site. The completed exposure pathways for wildlife and aquatic receptors include contact with and ingestion of surface water from groundwater discharge to the perimeter ditches and adjacent wet area, and contact with contaminated sediments and site surface soils.

The contaminants of concern at the site are those compounds that are there as a result of the presence of Polymer Applications, and that pose a risk as shown in the BHHE or by exceedence of SCGs. These include volatile and semivolatile organic compounds and PCBs. Recommended clean-up goals were developed for these compounds for the media of concern for which there are completed exposure pathways: soils, and sediments. Recommended clean-up goals were also developed for groundwater because remediation of groundwater to reduce degradation of water quality in the area is a goal. No clean-up standards are proposed for surface water because there are no significant exposure pathways for surface water, surface water is ephemeral, and remediation of sediments and groundwater would also remediate surface water.

Recommended cleanup goals for compounds of concern in soil were based on SCGs as presented in Table 7.3. For soils, the recommended cleanup goals for all compounds of concern are the NYSDEC Soil Cleanup Objectives and Cleanup Levels (TAGM HWR-94-4046) adjusted for a 2.8 percent average subsurface soil organic carbon content. The recommended cleanup goals for PCBs in onsite soils only is 10 ppm. This was deemed appropriate by the NYSDEC for a secure facility with limited access (Correspondence, 1995a). Offsite recommended cleanup goals of 1 ppm and 10 ppm PCBs for surface and subsurface soils respectively are applied in accordance with NYSDEC guidance (NYSDEC, 1994). Sediment recommended cleanup goals are the NYSDEC Sediment Criteria values (NYSDEC, 1993). The sediment recommended cleanup goal for the individual phenol compounds of concern is the NYSDEC sediment criteria value for total phenolic compounds. Recommended cleanup goals for groundwater are the New York State Class GA Groundwater Standards (T.O.G.S. 1.1.1, November 1993).

7.1.5 Remedial Action Objectives

The Remedial Action Objectives (RAOs) serve as a foundation for the evaluation of remedial alternatives. The RAOs are media-specific goals for protecting human health and the environment, and should include an acceptable contaminant level and exposure routes. Using the RAOs as guides, a range of alternatives can be developed that includes treatment/removal (to meet contaminant levels) or containment (to minimize or eliminate exposure). Based on preceding discussion of recommended clean-up goals, the following RAOs have been developed for the Polymer Applications site:

- Elimination of the contact threat posed by surface soil contamination.
- To the extent practicable, restoration of groundwater quality.
- Prevention, to the extent practicable, of the impact of contaminated soils on groundwater quality.
- Prevention, to the extent practicable, of the impact of contaminated soils and sediments on fish and wildlife.
- Prevention of air emissions that would pose an unacceptable level of risk to humans or exceed appropriate air quality guidelines.

The phrase "to the extent practicable" is used instead of the "meet the recommended clean-up goals" in recognition of the difficulty involved in practically achieving the cleanup goals. However, the clean-up goals presented in Table 7.4 remain a target for remediation.

7.2 ESTIMATED VOLUME AND AREA OF CONTAMINATION

The sample locations that exceed the recommended clean-up goals are listed in Table 7.4 for soil/sediment. These sample locations were used to determine the areas and depths of soil and sediments to be considered for remediation in this FS. The areas of soil contamination are shown in Figure 7.1. The depth of soil contamination was characterized as either shallow or deep. The areas where shallow soil/sediment contamination (0 to 1 foot deep) occurs are both on site and off site. The offsite areas are along the drainage ditches north and south of the property, and in the continuation of the southern ditch across River Road. The onsite areas where shallow soil contamination occurs are along the sides of the main warehouse and in the southern one-third of the rear yard (also called the backyard) area. The area of deeper soil contamination is the northern two-thirds of the rear yard. The depth of contaminated soil in the northern backyard is considered for the purposes of this FS to be 4 feet deep. Some soil samples collected in the 4 to 6 foot interval of soil borings in the northern backyard showed clean-up goal exceedences, but most of the exceedences occurred in the upper 4 feet. In discussion with the NYSDEC, the decision was made to restrict excavation or treatment to the upper 4 feet in the northern backyard. The surface areas and corresponding volumes are presented in Table 7.7.

There are two subsets of the shallow soils that would be treated differently from the majority of shallow soil. One subset is the soils that contain PCB concentrations above 50 ppm. These are of special concern because PCBs are regulated differently from RCRA hazardous wastes. PCB wastes with concentrations exceeding 50 ppm are regulated under the Toxic Substance Control Act (TSCA), and in New York State, are also regulated as hazardous wastes under RCRA. Therefore, any treatment, storage, and disposal of PCB wastes must conform with TSCA as well as RCRA regulations. One soil sample from the soil pile in the rear yard had a PCB concentration of 60 ppm. Another subset of contaminated soils is the so called "resinous material" that is on the soil surface in the rear yard area and along the sides of the main warehouse. This material is soft and odorous in warm weather, and it solidifies during cold weather. This material was not sampled during the RI, but is believed to have resulted from spills of raw materials. These resinous materials are considered separately because their consistency is different enough from soil that soil treatment technologies may not work for these materials.

The rear yard area also contains two piles; the soil pile and the debris pile. The soil pile contains soil dredged from the drainage ditch across River Road that was contaminated following the 1988 fire. The debris pile is a pile of discarded materials accumulated after the fires.

Table 7.4 also summarizes the exceedences of recommended clean-up goals for groundwater. Exceedences were found in shallow wells in the rear yard and in shallow wells downgradient of the property. Exceedences were also found in three deep monitoring wells. The contamination found in these wells may indicate contamination of the deep aquifer, or may indicate contamination is localized around these wells due to single case well construction which may be allowing allowed shallow aquifer contamination to enter the deep aquifer.

7.3 REMEDIAL TECHNOLOGIES FOR SOIL/SEDIMENT

7.3.1 General Response Actions for Soil/Sediment

General response actions were developed to address the remedial action objectives for soil and sediment. Soil and sediment will be evaluated as the same media because they have similar properties for the purpose of treatment and they are wet only seasonally. During the remainder of this feasibility study the term "soils" will be used to represent both soils and sediment at the Polymer Applications site. The general response actions that are potentially applicable for soil are:

Institutional Controls;

Containment;

Removal;

Disposal;

In situ Treatment;

Ex situ Treatment;

Enhancement; and

Other Processes.

7.3.2 Identification, Screening, and Evaluation of Technologies for Soil

The primary objective of this section was to identify and screen the technologies applicable to each medium of interest. The screening and evaluation of technologies were based on:

1. EPA 542-B-93-005, Remediation Technologies Screening Matrix and Reference Guide;
2. EPA 540/R-93/526, Superfund Innovative Technology Evaluation Program;
3. NYSDEC TAGM 4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites; and
4. The experience of Parsons Engineering Science, Inc. in assessing remediation technologies.

The results of the identification, screening, and evaluation of soil remedial technologies are presented in Table 7.6. The table identifies and describes technologies identified as being applicable to the remediation of soil at the Polymer Applications site. The screening step was conducted by examining the general applicability of each technology for use at the site. Technologies were retained for evaluation if they were applicable to treat the primary contaminants of concern: phenol, TEX, and other VOCs.

According to the NYSDEC and USEPA guidance (NYSDEC, 1990; USEPA, 1988) the technology types and process options that were retained through the initial screening were then evaluated on the basis of effectiveness, technical implementability, and the ability to achieve media-specific remedial action objectives. If more than one process option is judged to be applicable to remediation of soil at the site, all can be retained for incorporation into remedial alternatives, or one technology can be selected as representative of the response type. Use of a representative process option can effectively simplify the development and evaluation of remedial alternatives.

The following sections discuss the technologies and the results of the screening and evaluation.

7.3.2.1 Institutional Controls

The institutional controls considered for soils at the Polymer Applications site consist of deed restrictions and fencing/posting. Institutional controls limit disturbance to site soils and/or prevent human exposure to the contaminated soils. Deed restrictions limit the future use of the site. Fencing/posting around the property or around areas with contaminated soils would restrict public access to the site and reduce direct contact with contaminated soils.

Both controls are applicable. Deed restrictions may be difficult to implement because the NYSDEC cannot implement deed restrictions unilaterally. Fencing/posting is easily implementable. Both deed restrictions and fencing/posting can limit contact with the site, however, they do not address the media. Both controls are necessary for a No Action alternative and were retained for inclusion into the **other** remedial alternatives.

7.3.2.2 Containment

Two containment options are potentially applicable to minimize exposure to surficial soils and to reduce infiltration and leaching of contaminants into the groundwater. The technologies considered for containment of contaminated soils include a concrete or asphalt cap and a low-permeable cap. The following sections describe each containment option:

Concrete or Asphalt Cap

The concrete or asphalt cap consists of a reinforced concrete slab or asphalt pavement formed in place. The asphalt cap is easier to install and better suited to the industrial location of the site.

The asphalt cap is commonly used and does prevent direct contact with the contaminated soil. However, asphalt can crack and may not prevent precipitation from infiltrating into the contaminated soil. The asphalt cap containment option was retained.

Low Permeable Cap

The low permeable cap option consists of a multilayer cap with a low permeable membrane layer (permeability less than 10^{-7} cm/sec), drainage layer, and vegetative support layer. This type of cap prevents precipitation from infiltrating into contaminated soils and direct contact with contaminated soils.

The low permeable cap is commonly used, easily implementable, and can be effective at eliminating the direct contact threat and preventing impacts on the groundwater from contaminated soil. The low permeable cap has been retained.

7.3.2.3 Removal

Contaminated soils can be excavated through the use of conventional earthmoving equipment. Excavation is technically feasible at the site and is needed for any *ex situ* treatment, on-site consolidation, or disposal technology.

Excavation is easily implementable but does not meet the remedial action objectives by itself. However, excavation can be used as part of an alternative that is effective at meeting the remedial action objectives. Releases of VOCs during the excavation effort may require a fully enclosed tent or a winter construction timeframe to control air pollution. Removal of contaminated soils by excavation was retained and has been incorporated into the remedial alternatives.

7.3.2.4 Disposal

Contaminated soils can be excavated and disposed of at an appropriate off-site landfill.

This process removes soil from the site, is implementable, and effective at achieving the RAOs. Disposal has been retained and will be incorporated into the remedial alternatives.

7.3.2.5 *In situ* Treatment

Biodegradation

The activity of naturally-occurring microbes is stimulated by circulating water-based solutions through contaminated soils to enhance *in situ* biological degradation of organic contaminants. Nutrients, oxygen, or other amendments may be used to enhance biodegradation and contaminant desorption from subsurface materials.

Biodegradation is implementable and could potentially be effective in treating both soil and groundwater with low to moderate levels of phenol (less than 100 ppm) (USEPA, 1993a). However, biodegradation requires a circulation system created such that contaminants do not escape from zones of active bioremediation. This circulation system will be difficult to create due to the low-permeability, heterogeneous subsurface formations and could require a long time for complete treatment. Biodegradation has been retained, however, it will not be incorporated into a remedial alternative.

Bioventing

Oxygen is delivered to contaminated unsaturated soils by forced air movement (either extraction or injection of air) to increase oxygen concentrations and stimulate bioremediation. The system employs a low air flow rate (e.g., 0.25 to 0.5 SCFM per linear foot of screen) to provide only the amount of oxygen necessary for biodegradation while minimizing volatilization and release of contaminants to the atmosphere.

In situ bioventing is implementable and effective in treating low to moderate levels of phenol and TEX in the vadose zone. However, the backyard area must be dewatered before bioventing can be effective. Dewatering will be difficult due to the low-permeability, heterogeneous subsurface formations. Additionally, the effective radius of influence may be small. Bioventing has been retained and selected as the representative *in situ* soil treatment technology to be incorporated into the remedial alternatives.

Soil Vapor Extraction (SVE)

A vacuum is applied through extraction wells to create a pressure gradient that induces VOCs to diffuse through the soil to extraction wells. The process includes a system for handling and treating off-gasses, if necessary.

SVE is effective in treating VOCs in the vadose zone. The technology does not address the compounds of concern (e.g., phenol is not particularly volatile) and has not been retained.

Soil Flushing

Water, or water containing an additive to enhance contaminant solubility, is applied to the soil or injected into the groundwater to raise the water table into the contaminated soil zone. Contaminants are leached into the groundwater. The process includes extraction of the groundwater and capture/treatment/removal of the leached contaminants before the groundwater is re-circulated.

The effectiveness of soil flushing is limited by the low-permeability soil in the backyard area. The technology is not retained for further consideration because it is not effective for the treatment of phenol.

Solidification/Stabilization

Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).

This technology was not retained because it has not been demonstrated to be as effective for organic compounds as for inorganics.

Vitrification

Electrodes for applying electricity, or joule heating, are placed *in situ* and are used to melt contaminated soils and sludges, producing a glass and crystalline structure with very low leaching characteristics.

This technology is primarily used to encapsulate non-volatile inorganics. Vitrification is not implementable because of aboveground and underground structures at the site. Vitrification has not been retained.

Thermally Enhanced SVE

This process uses steam/hot-air injection or electric/radio frequency heating to increase the mobility of volatile and some semivolatile compounds and facilitate extraction. The process includes a system for handling and treating off-gasses, if necessary.

The target compounds for thermally enhanced SVE is volatiles and some semivolatiles. However, it does not target soil contaminated with phenol and other compounds of concern at the site. The technology has not been retained.

7.3.2.6 *Ex situ* Treatment

Slurry Phase Biological Treatment

An aqueous slurry is created by combining excavated soil with water and other additives in an above ground tank. The slurry is mixed to keep solids suspended and microorganisms in contact with the soil contaminants. Nutrients, oxygen, and pH in the bioreactor are controlled to enhance biodegradation. Upon completion of the process, the slurry is dewatered and the treated soil is disposed.

This technology is effective for both groundwater and soil with low to moderate levels of phenol and VOCs. Slurry phase biological treatment is more effective and quicker than solid phase biological treatment because of the increased contact with microorganisms and oxygen offered by the mixing. Slurry phase treatment is more difficult to implement than solid phase biological treatment, however, because it is more complex. For example, there are considerable materials handling requirements to produce a uniform-sized feed that is necessary for a mixable slurry. Non-homogeneous soils can create serious materials handling problems. Following treatment, the slurry must be dewatered. Dewatering the soil fines can be very expensive, and the wastewater must be disposed. Operation of the slurry-phase reactor is labor intensive.

Compared to the other non-biological *ex situ* treatment technologies, slurry phase biological treatment is less effective and takes more time to complete, but is comparable in terms of materials handling and O&M requirements (USEPA, 1993a). Slurry phase biological treatment has been retained but not incorporated into any remedial alternative.

Solid Phase Biological Treatment

Solid phase biological treatment involves the use of microorganisms in excavated soils to convert contaminants to less harmful species. Excavated soils are homogenized, dewatered and mixed with soil amendments, if necessary. The homogenized soil is then either placed in an above-ground enclosure or backfilled into the excavated hole. The excavation or enclosure includes leachate collection and some form of aeration. *Ex situ* bioremediation systems include prepared treatment beds, biotreatment cells, soil piles, and composting. Moisture, heat, nutrients, oxygen, and pH can be controlled to enhance the biodegradation.

It is anticipated that bioventing would be effective at significantly reducing concentrations of toluene, ethylbenzene, and xylenes (TEX), and the phenols at the site. Biological treatment of TEX is well documented from projects involving remediation of fuel hydrocarbons (USEPA, 1993a), and may result in a 80 percent removal in 18 to 24 months. Phenol removal rates are not as well documented, because if phenol is present, it is usually as an intermediate product and therefore is not monitored. However, phenol is recognized as being fairly easily biodegradable by naturally-occurring microorganisms as long as phenol concentrations are not too high. At phenol concentrations greater than 100 ppm, the microorganisms may be inhibited or killed (Arthur D. Little, Inc., 1987). The toxicity threshold is potentially of concern at this site, because some soil samples exceeded this concentration, but it is anticipated that the soil excavation and homogenization would reduce the phenol concentrations to below these levels.

Excavation, dewatering, and homogenization of the contaminated soil could overcome the physical limitations of *in situ* bioventing soil treatment. It is anticipated that the remedial action objectives could be achieved. Solid phase biological treatment has been retained and selected as one of the representative *ex situ* soil treatment technologies to be incorporated into the remedial alternatives.

Soil Washing

Contaminants sorbed onto soil particles are separated from soil in an aboveground aqueous-based system. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove semivolatile organic compounds.

The effectiveness of soil washing is limited due to the fine soil particles (silts and clays) which are difficult to remove from washing fluid. Soil washing also produces a concentrated waste stream that must be treated. Soil washing has been retained but not included into the remedial alternatives.

Chemical Reduction/Oxidation

Reduction/oxidation chemically converts hazardous inorganic contaminants to non-hazardous or less-toxic compounds that are more stable, less mobile, and/or inert. The reducing/oxidizing agents most commonly used for treatment of hazardous contaminants are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. A combination of these reagents, or combining them with ultraviolet (UV) oxidation, makes the process more effective.

The target compounds for this technology are inorganics and therefore, chemical reduction/oxidation has not been retained.

Low Temperature Thermal Desorption

Wastes are heated from 200-600°F to volatilize water and organic contaminants. A carrier gas or vacuum system transports volatilized water and organics to the gas treatment system. Low temperature thermal desorption systems are physical separation processes and are not designed to destroy organics, however, contaminants can be destroyed in an off-gas treatment. The bed temperatures and residence times designed into these systems will volatilize selected contaminants, but typically not oxidize them.

Low temperature thermal desorption is implementable, and has been demonstrated to be effective on treatment of volatile and semivolatile organics. The remedial action objectives could be achieved using this technology. Low temperature thermal desorption has therefore been retained and selected as one of the representative *ex situ* soil treatment technologies.

High Temperature Thermal Desorption

Wastes are heated to 600-1,000°F to volatilize organic contaminants. A carrier gas or vacuum system transports volatilized water and organics to the gas treatment system. High temperature thermal desorption systems are physical separation processes and are not designed to destroy organics, however, contaminants can be destroyed in an off-gas treatment. Bed temperatures and typical residence times will cause selected contaminants to volatilize, but not oxidize.

High temperature thermal desorption has varying degrees of effectiveness against the full spectrum of organic contaminants. However, it is effective at treating phenol. High temperature thermal desorption has been retained, but will not be included in the remedial alternatives because low temperature thermal desorption should be as effective and uses less energy.

Incineration

High temperatures (1,600 to 2,200°F) are used to volatilize and combust (in the presence of oxygen) organic constituents in hazardous wastes. The destruction and removal efficiency for properly operated incinerators exceeds the 99.99% requirements for hazardous wastes and can be operated to meet the 99.9999% requirement for PCBs and dioxins, if necessary.

Incineration could be used for treating "resin-like" materials at the surface of the "backyard" area and/or PCB contaminated soil. Incineration has been retained but has not been incorporated into the remedial alternatives.

Pyrolysis

Chemical decomposition is induced in organic materials by heat in the absence of oxygen. Organic materials are transformed into gaseous components and a solid residue (coke) containing fixed carbon and ash.

This technology requires a low soil moisture content and is currently only available at pilot scale. The target compounds are limited to some semivolatiles and does not target phenol. Pyrolysis is not retained for further consideration.

7.3.2.7 Enhancement

Pneumatic Fracturing

Pressurized air is injected beneath the surface to develop cracks in low-permeability and over-consolidated sediments. These newly developed passageways increase the effectiveness of many *in situ* processes and enhance extraction efficiencies.

Pneumatic fracturing is not retained for further consideration because of the proximity of buildings and underground utilities. Additionally, it will not be effective for the silty soil at the Polymer Applications site.

7.3.2.8 Other Processes

Natural Attenuation

Natural subsurface processes, such as diffusion, volatilization, biodegradation, and chemical reactions with subsurface materials are allowed over time to reduce contaminant concentrations to acceptable levels.

Natural attenuation is implementable but will not achieve the remedial action objectives and has therefore, not been retained.

7.4 REMEDIAL TECHNOLOGIES FOR GROUNDWATER

7.4.1 General Response Actions for Groundwater

General response actions were developed to address the remedial action objectives for shallow and deep groundwater at the Polymer Applications site. The general response actions that are potentially applicable are:

Institutional Controls;

Containment;

Extraction;

Discharge;

In situ Treatment;

Ex situ Treatment;

Enhancement; and

Other Processes.

7.4.2 Identification, Screening and Evaluation of Technologies for Groundwater

The primary objective of this phase of the FS is to identify and screen, in a cursory fashion, the technologies applicable to each medium of interest. The preliminary screening in the Phase I FS was based on:

1. EPA 542-B-93-005, Remediation Technologies Screening Matrix and Reference Guide;
2. EPA 540/R-93/526, Superfund Innovative Technology Evaluation Program;
3. NYSDEC TAGM 4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites; and
4. The experience of Parsons Engineering Science, Inc. in assessing remediation technologies.

The results of the preliminary identification, screening, and evaluation of groundwater treatment technologies are presented in Table 7.7. The table identifies and describes technologies identified as being applicable to the remediation of groundwater at the Polymer Applications site. The Phase I screening step was conducted by examining the general applicability of each technology for use at the site. Technologies were retained for evaluation if they were applicable to treat the contaminants of concern. The main contaminants of concern in groundwater are phenols, some VOCs (4-methyl-2-pentaone, and toluene, ethylbenzene, and xylenes (TEX)), and PCBs.

According to the NYSDEC and USEPA guidance (USEPA, 1988; NYSDEC, 1990), the technology types and process options that were retained through the initial screening are then evaluated on the basis of effectiveness, technical implementability, and ability to achieve media-specific remedial action objectives (RAOs). If more than one process option is judged to be applicable to remediation of groundwater at the site, all can be retained for incorporation into remedial alternatives, or one technology can be selected as representative of the response type. Use of a representative process option simplifies the development and evaluation of remedial alternatives.

The following sections discuss the technologies and the results of the Phase I screening and evaluation.

7.4.2.1 Institutional Controls

The institutional control that is potentially applicable to the remediation of groundwater at the Polymer Applications site is groundwater monitoring. Groundwater monitoring will document changes of contaminant concentrations at various locations.

This technology it is technically implementable at the site and is necessary for any No Action alternative. However, groundwater monitoring does not meet the RAOs, but is considered effective for observing future groundwater conditions. Groundwater monitoring has been retained and will be incorporated into the remedial alternatives.

7.4.2.2 Containment

The technology that is commonly used for groundwater containment is a subsurface barrier wall. In this technology a low permeable vertical barrier is used to separate contaminated groundwater from ambient groundwater.

The site already contains a partially effective concrete barrier wall that could be used in one or all of the alternatives. A clay layer beneath the site is available into which a barrier wall can be keyed for additional containment. The existing concrete barrier wall, an extension of the existing barrier wall, or construction of a new barrier wall can prevent ambient groundwater from being impacted by the contaminated soil. The subsurface barrier wall containment technology has been retained and will be incorporated into the remedial alternatives.

7.4.2.3 Extraction

Groundwater extraction has four primary functions: to remove contaminated groundwater, to provide hydraulic containment, to prevent contamination from migrating toward receptors, and to dewater contaminated soils. Groundwater extraction is usually accomplished with collection trenches or extraction wells.

Collection Trenches

A trench is excavated and backfilled with permeable material (usually stone) and groundwater is collected from a low point in the trench.

Collection trenches can be effective at removing shallow groundwater. Extraction of groundwater via trenches combined with groundwater and soil treatment, could result in hydraulic containment and potential removal of a significant mass of contaminants. Installation of collection trenches are commonly conducted, so they are implementable at the site. Collection trenches have been retained for incorporation into the remedial alternatives.

Extraction Wells

Groundwater is extracted by pumping it out of well(s).

Extraction of groundwater via wells combined with groundwater and soil treatment, could result in hydraulic containment and potential removal of a significant mass of contaminants. Installation of extraction wells are commonly conducted, so they are implementable at the site. However, due to the low permeable nature of the shallow site soil many extraction wells would be needed to effectively dewater the backyard area. Extraction wells could be effective to pump the deep groundwater and have been retained for incorporation into the remedial alternatives.

Dual Phase Extraction

A high vacuum system is applied to simultaneously remove liquid and gas from low permeability or heterogeneous formations. The vacuum extraction well includes a screened section in the zone of contaminated soils and groundwater. As the vacuum is applied to the well, soil vapor is extracted, and groundwater is entrained by the extracted vapors. Once aboveground, the extracted vapors and groundwater are separated and treated.

Dual phase extraction may have limited effectiveness depending upon the specific site geology. A pilot system would be necessary to demonstrate effectiveness. Dual phase extraction has been retained but will not be incorporated into any remedial alternative

Vacuum Vapor Extraction

Vacuum vapor extraction includes injecting air into a well, lifting contaminated groundwater in the well and allowing additional groundwater flow into the well. Once inside the well, some of the VOCs in the contaminated groundwater are transferred from a liquid phase in the water to air bubbles which rise and are collected at the top of the well by vapor extraction.

Vacuum vapor extraction is a pilot scale technology and full scale implementability is questionable at this site because of the shallowness of the groundwater. Vacuum vapor extraction has not been retained.

7.4.2.4 Discharge

The discharge technologies that are potentially applicable to the remediation of groundwater at the Polymer Applications site are to the publicly owned treatment works (POTW) owned by the Town of Tonawanda, to the Niagara River, and to an industrial wastewater treatment facility. Treated groundwater could potentially be discharged to either the Niagara River or the local POTW. Untreated groundwater could be transported to an industrial wastewater treatment facility for treatment.

Each of these options would achieve the remedial action objectives. All three technologies have been retained however, discharge to the local POTW has been selected as the representative form of discharge to be incorporated into the remedial alternatives.

7.4.2.5 *In situ* Treatment

Hydrogen Peroxide Circulation

A dilute solution of hydrogen peroxide is circulated throughout a contaminated groundwater zone to increase the oxygen content of groundwater and enhance the rate of aerobic biological degradation of organic contaminants by naturally occurring microbes.

The effectiveness of this technology is limited because of the groundwater circulation system needed such that contaminants do not escape from zones of active biodegradation. The heterogeneous subsurface **would** ~~will~~ prevent the circulation of hydrogen peroxide throughout portions of the contaminated zone. This technology has not been retained.

Co-Metabolic Processes

Water containing dissolved methane and oxygen is injected into groundwater to enhance methanotropic biological degradation. This class of microorganisms can degrade chlorinated solvents, such as vinyl chloride and TCE, by co-metabolism. Co-metabolism is one form of secondary substrate transformation in which enzymes produced for primary substrate oxidation are capable of degrading the secondary substrate fortuitously, even though the secondary substrates do not afford sufficient energy to sustain the microbial population.

The effectiveness of this technology is limited because of the heterogeneous subsurface. The subsurface formation would prevent the circulation of the methane solution throughout portions of the contaminated zone. This technology is still under development and does not target the compounds of concern. Co-metabolic processes have therefore not been retained.

Nitrate Enhancement

Solubilized nitrate is circulated throughout groundwater contamination zones to provide electron acceptors for biological activity and enhance the rate of degradation of organic contaminants by naturally occurring microbes.

Development of nitrate enhancement is still at the pilot scale level and has been found to be effective on only a narrow spectrum of contaminants to date. Nitrate enhancement has not been retained.

Air Sparging

Air is injected, under pressure, into saturated matrices creating an underground stripper that removes contaminants through volatilization. The technology is designed to operate at high air flow rates in order to effect volatilization and must be operated in tandem with soil vapor extraction to capture volatile contaminants stripped from the saturated zone. This process can be easily modified to increase groundwater oxygen concentrations and enhance the rate of biological degradation of organic contaminants by naturally occurring microbes. Air sparging also increases mixing in the saturated zone, which increases the contact between groundwater and soil.

Air sparging is not especially well suited to groundwater remediation at this site because of the low permeable heterogeneous subsurface formations. Additionally, sparging can push contaminated groundwater away from the injection point. Air sparging has not been retained.

Passive Treatment Walls

A permeable reaction wall is installed across the flow path of a contaminated plume, allowing the plume to passively move through the wall. The halogenated compounds are degraded by chemical reactions with a mixture of porous media and a metal catalyst.

Passive treatment walls are often only effective for short time because they lose their reactive capacity, requiring replacement of the reactive medium. Development of passive treatment walls to date has not been beyond the pilot scale level and does not target the compounds of concern. Passive treatment walls has not been retained.

Hot Water or Steam Flushing/Stripping

Steam is forced into an aquifer through injection wells to vaporize volatile and semivolatile contaminants. Vaporized components rise to the unsaturated zone where they are removed by vacuum extraction and then treated. This variety of processes includes Contained Recovery of Oily Waste (CROW), Steam Injection and Vacuum

Extraction (SIVE), *In situ* Steam Enhanced Extraction (ISEE), and Steam Enhanced Recovery Process (SERP).

The effectiveness of hot water or steam flushing/stripping will be impacted by the heterogeneous, low permeable soil in the backyard area. Additionally, it is only available to date at the pilot scale level. The technology has not been retained.

7.4.2.6 *Ex situ* Treatment

Bioreactors

Contaminants in extracted groundwater are put into contact with microorganisms through attached or suspended biological systems. In suspended growth systems, such as activated sludge, contaminated groundwater is circulated in an aeration basin where a microbial population aerobically degrades organic matter and produces new cells. The new cells form a sludge, which is settled out in a clarifier, and the sludge biomass is recycled to the aeration basin. In attached growth systems, such as rotating biological contractors and trickling filters, microorganisms are established on an inert support matrix to aerobically degrade groundwater contaminants. The microbial population may either be derived from the contaminant source or from an inoculum of organisms specific to a contaminant.

Bioreactor technology is implementable and could potentially be effective in treating the contaminants of concern. Biological treatment of nonchlorinated VOCs such as the TEX detected in site soils has been demonstrated at numerous remediation projects for fuel hydrocarbons. Biological treatment of phenol in soils is known to occur, but is difficult to document because the phenol usually occurs and is degraded as an intermediate product during biological treatment of other organic contaminants (Correspondence, 1995b). Biological treatment of phenols in wastewaters at concentrations of 500 ppm or less is widely employed and is in successful full-scale industrial use (Patterson, 1985). However, soil residuals from the sludge process may require treatment or disposal, skilled workers are required to start and maintain the biological systems, air pollution controls may need to be applied if there is volatilization from the activated sludge process, and low temperatures significantly decrease biodegradation rates resulting in longer clean-up times or increased costs for heating. The technology has been retained, however, it has not been selected as the representative *ex situ* groundwater treatment.

Air Stripping

Volatile organics are partitioned from groundwater by greatly increasing the surface area of the contaminated water exposed to air. Types of aeration methods include packed towers, diffused aeration, tray aeration, and spray aeration. Air stripping is a cost effective treatment for the removal of volatile organics and could be used as a pretreatment before disposal.

Air stripping is effective for treating VOCs, but is much less effective on semivolatile compounds such as phenols (USEPA, 1993a). Air stripping is readily implementable. Additionally, USEPA found that air stripping was effective in removing VOCs from the material left in tanks and run-off from the site. Air stripping has been retained, but it has not been selected for incorporation into a remedial alternative.

Carbon Absorption

Groundwater is pumped through a series of canisters containing activated carbon to which dissolved organic contaminants adsorb. This technology requires periodic replacement or regeneration of saturated carbon. Carbon absorption has been retained for further evaluation because it is effective for removal of organic contaminants and could be used as a pretreatment before disposal.

The technology is effective for treating organics and readily implementable. Additionally, USEPA found that carbon absorption was effective in removing organics from material left in tanks and run-off from the site. Carbon absorption has been retained and selected as the representative treatment technology.

Ultraviolet (UV) Oxidation

UV radiation, ozone, and/or hydrogen peroxide are used to destroy organic contaminants as water flows into a treatment tank. An ozone destruction unit is used to treat off-gas from the treatment tank.

The target compounds for the different forms of UV oxidation are halogenated volatile and semivolatile organic compounds. Because TEX and phenols are not as effectively treated by UV oxidation as other ex situ technologies (USEPA, 1993a), this technology has not been retained.

7.4.2.7 Enhancement

Hydrofracturing

Pressurized water is injected through injection wells to crack low permeability and over-consolidated sediments. Cracks are filled with porous media that serve as avenues for bioremediation or improved pumping efficiency.

Hydrofracturing is not retained for further consideration because the soil in the upper soil layer is silty and is not suitable for hydrofracturing.

7.4.2.8 Other Processes

Natural Attenuation

Natural subsurface process, such as dilution, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials are allowed over time and distance to reduce groundwater contaminant concentrations to acceptable levels. Target compounds for natural attenuation are non-halogenated volatile and semivolatile organics (USEPA, 1993a).

Natural attenuation has been retained as a possible treatment for deep and intermediate groundwater, however, it will not be incorporated into the remedial alternatives.

TABLE 7.1

CHEMICAL–SPECIFIC SCGs for DETECTED COMPOUNDS

POLYMER APPLICATIONS TONAWANDA, NY CAS NO.	COMPOUND	NYSDEC Class GA Groundwater Standards and Guidance(2) (ppm)	NYSDEC Class D Surface Water Standards and Guidance(2) (ppm)	NYSDEC Sediment Criteria(3) (ppm)	NYSDEC Soil Cleanup Objective (4)(9) (ppm)
	VOLATILES				
67–64–1	Acetone	–	–	NS	0.56
75–27–4	Bromodichloromethane	0.05 (G)	–	–	–
78–93–3	2–Butanone	0.05 (G)	–	NS	0.84
75–15–0	Carbon Disulfide	NS	NS	–	7.6
67–66–3	Chloroform	0.007	NS	NS	–
74–87–3	Chloromethane	NS	–	–	–
124–48–1	Dibromochloromethane	0.05 (G)	–	–	–
540–59–0	1,2–Dichloroethene (total)	–	–	–	0.84
78–87–5	1,2–Dichloropropane	–	–	NS	–
591–78–6	2–Hexanone	0.05 (G)	–	NS	NS
108–10–1	4–Methyl–2–Pentanone	NS	NS	–	2.8
75–09–2	Methylene Chloride	–	NS	–	0.28
79–34–5	1,1,2,2–Tetrachloroethane	–	–	–	1.7
127–18–4	Tetrachloroethene	–	–	NS	3.9
71–55–6	1,1,1–Trichloroethane	–	–	–	2.2
79–01–6	Trichloroethene	–	–	–	2.0
71–43–2	Benzene	0.0007	–	–	0.17
100–41–4	Ethylbenzene	0.005	NS	NS	15.4
108–88–3	Toluene	0.005	NS	NS	4.2
1330–20–7	Xylene (total)	0.005	NS	NS	3.4
	Total VOCs	–	–	–	10
	SEMIVOLATILES				
59–50–7	4–Chloro–3–Methylphenol	–	–	–	0.67
105–67–9	2,4–Dimethylphenol	0.001 (5)	0.005 (6)	–	NS
95–48–7	2–Methylphenol	0.001 (5)	0.005 (6)	0.014 (6)	0.28
106–44–5	4–Methylphenol	0.001 (5)	0.005 (6)	0.014 (6)	2.5
108–95–2	Phenol	0.001 (5)	0.005 (6)	0.014 (6)	0.084
91–20–3	Naphthalene	–	–	–	36.4
91–57–6	2–Methylnaphthalene	–	–	–	50
83–32–9	Acenaphthene	–	–	–	50
132–64–9	Dibenzofuran	–	–	–	17.4
85–01–8	Phenanthrene	–	–	–	50
120–12–7	Anthracene	–	–	–	50
86–74–8	Carbazole	–	–	–	NS
206–44–0	Fluoranthene	–	–	–	50
129–00–0	Pyrene	–	–	–	50
56–55–3	Benzo(a)anthracene	–	–	–	0.63
218–01–9	Chrysene	–	–	–	1.1
117–81–7	bis(2–Ethylhexyl)phthalate	–	–	–	50
205–99–2	Benzo(b)fluoranthene	–	–	–	3.1
207–08–9	Benzo(k)fluoranthene	–	–	–	3.1
50–32–8	Benzo(a)pyrene	–	–	–	0.17
193–39–5	Indeno(1,2,3–cd)pyrene	–	–	–	9.0
53–70–3	Dibenz(a,h)anthracene	–	–	–	0.039
191–24–2	Benzo(g,h,i)perylene	–	–	–	50
	Total SVOCs	–	–	–	500
	PCBs				
53469–21–9	Aroclor–1242	–	–	–	1.0 Surface 10.0 Subsurface
11097–69–1	Aroclor–1254	–	0.000001 (7)	0.54	1.0 Surface 10.0 Subsurface
11096–82–5	Aroclor–1260	0.0001 (7)	0.000001 (7)	0.54	1.0 Surface 10.0 Subsurface

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TABLE 7.1 Cont'd

CHEMICAL–SPECIFIC SCGs for DETECTED COMPOUNDS

POLYMER APPLICATIONS TONAWANDA, NY		NYSDEC Class GA Groundwater Standards and Guidance(2) (ppm)	NYSDEC Class D Surface Water Standards and Guidance(2) (ppm)	NYSDEC Sediment Criteria(3) (ppm)	NYSDEC Soil Cleanup Objective (4)(9) (ppm)
CAS NO.	COMPOUND				
	TOTAL METALS				
7429-90-5	Aluminum	NS	–	NS	SB (–)
7440-36-0	Antimony	0.003 (G)	–	2	SB (ND)
7440-38-2	Arsenic	0.025	0.360	6	7.5 OR SB (21.9)
7440-39-3	Barium	1	NS	NS	300 OR SB (124)
7440-41-7	Beryllium	0.003 (G)	–	–	0.16 OR SB (0.85)
7440-43-9	Cadmium	–	–	0.6	1.0 OR SB (ND)
7440-70-2	Calcium	NS	NS	NS	SB (–)
7440-47-3	Chromium	0.05	6.5 (8)	26	10 OR SB (66.3)
7440-48-4	Cobalt	NS	–	–	30 OR SB (9.6)
7440-50-8	Copper	0.2	0.81 (8)	16	25 OR SB (29.6)
7439-89-6	Iron	0.3	0.3	20000	2000 OR SB (418000)
7439-92-1	Lead	0.025	0.63 (8)	31	SB (79.3)
7439-95-4	Magnesium	35 (G)	NS	NS	SB (–)
7439-96-5	Manganese	0.3	NS	460	SB (409)
7439-97-6	Mercury	0.002	–	0.15	0.1 (0.2)
7440-02-0	Nickel	NS	–	16	13 OR (17.7)
7440-09-7	Potassium	NS	NS	NS	SB (–)
7782-49-2	Selenium	–	–	NS	2 OR SB (0.72)
7440-22-4	Silver	–	–	1	SB (ND)
7440-23-5	Sodium	20	NS	NS	SB (–)
7440-62-2	Vanadium	NS	–	–	150 OR SB (32.9)
7440-66-6	Zinc	0.300	1.2 (8)	120	20 OR SB (101)
	OTHER				
ES-5041	Phenols	0.001 (5)	NS	0.014 (6)	NS
7440-44-0	Total Organic Carbon	–	–	NS	NS
ES-5027	Alkalinity (CaCO3)	NS	–	–	–
16667-00-6	Chloride	0.25	–	–	–
11-02-9	Hardness	NS	NS	–	–
14806-79-8	Sulfate	0.25	–	–	–
10-32-2	Total Suspended Solids	NS	–	–	–

NOTES:
(1) Standards, criteria and guidelines listed only for compounds detected in each media.
(2) NYSDEC Ambient Water Quality Standards and Guidance Values (T.O.G.S. 1.1.1) November 1993.
(3) NYSDEC Technical Guidance for Screening Contaminated Sediments, November 22, 1993.
Sediment criteria for organics are based on aquatic toxicity assuming 2.8% organic carbon content.
Sediment criteria for metals are based on the lowest effect level.
(4) NYSDEC Determination of Soil Cleanup Objectives and Cleanup Levels (TAGM HWR-94-4046), January 24, 1994.
Adjusted based on 2.8 percent average subsurface soil organic carbon content.
(5) Value is for total phenolic compounds.
(6) Value is for total unchlorinated phenols.
(7) Value is for total PCBs and is below laboratory detection limits.
(8) Water hardness-dependent metal. An average hardness of 500 mg/l was used to calculate standard.
(9) Number in parenthesis is site background concentration. Not all metals were analysed in soil samples.
ND – Non detect.
NS – No Standard
(G) – Guidance Value
(SB) – Site Background
– Not Analyzed.

TABLE 7.2
POTENTIAL ACTION-SPECIFIC
STANDARDS, CRITERIA, AND GUIDELINES
POLYMER APPLICATIONS
TONAWANDA, NEW YORK

Site Action	Potential SCGs
Capping	RCRA Groundwater Protection Requirements require installation of a groundwater monitoring system if RCRA Hazardous wastes are left in place, 40 CFR 264.90-264.109.
	New York's regulations require a groundwater monitoring system to monitor releases from Solid Waste Management Units, 6 NYCRR373-2.6 and 373-2.11 through 2.14.
	RCRA Regulations governing capping of surface impoundments, waste piles and landfills, 40 CFR 264.228(a), 264.258(b), and 264.310(a); requirements for permeability, installation, and maintenance of cover; elimination of free liquids or solidification; and run-on and run-off damage control.
	RCRA post-closure care and groundwater monitoring, 40 CFR Subpart 264.90-264.109.
	New York's regulations establish closure and post-closure procedures and regulations in 6 NYCRR 373-2.
	New York's regulations establish criteria for caps for Solid Waste Management Facilities in 6 NYCRR 360.
	Toxic Substances Control Act (TSCA) establishes storage and disposal requirements for PCBs (40 CFR 761).
	New York's regulations defining soils with hazardous wastes in 6 NYCRR 371.4(e).
	OSHA regulations are established in 29 CFR 1910 for employers and employees engaged in hazardous site operations. These regulations specify requirements for medical surveillance, personnel protection, training and other health and safety issues.
Excavation	OSHA regulations for excavating and trenching are established in 29 CFR 1910.
Onsite Soil Treatment/Disposal	Resource Conservation and Recovery Act (RCRA) Identification and Listing of Hazardous Wastes identifies wastes considered to be hazardous wastes at the site (40 CFR Part 261).
	New York's regulations for the identification and listing of wastes considered to be hazardous at the site (NYCRR 6 Part 371).
	RCRA Groundwater Protection Requirements require installation of a groundwater monitoring system if RCRA Hazardous wastes are left in place, 40 CFR 264.90-264.109.
	New York's regulations require a groundwater monitoring system to monitor releases from Solid Waste Management Units, 6 NYCRR373-2.6 and 373-2.11 through 2.14.

TABLE 7.2
(CONTINUED)
POTENTIAL ACTION-SPECIFIC
STANDARDS, CRITERIA, AND GUIDELINES
POLYMER APPLICATIONS
TONAWANDA, NEW YORK

Site Action	Potential SCGs
Onsite Soil Treatment/Disposal (continued)	RCRA clean closure (removal) requirements triggered by removal of RCRA hazardous wastes; requirements include minimization of need for further maintenance and control, minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products, as well as the disposal or decontamination of equipment, structures and soils, 40 CFR 264.111. 264.228(a)(1) and 264.258 also require the removal or decontamination of all waste residues, containment system components (such as liners, dikes), contaminated subsoils, structures and equipment contaminated with waste and leachate, and management of these wastes as hazardous. Health-based levels at unit must also be met (40 CFR 264.111).
	RCRA minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste would be triggered by onsite treatment and storage (40 CFR Part 264 Subparts B through X).
	New York's regulations for treatment, storage, or disposal of hazardous wastes are contained in 6 NYCRR Part 373-2.
	New York and RCRA regulations allowing the designation of a Corrective Action Management Unit (CAMU) at facilities for the placement of remediation wastes. Placement of a remediation waste into or within a CAMU does not constitute land disposal or constitute creation of a unit subject to minimum technology standards.
	New York State DEC "contained in" policy states that soil, sediment, and groundwater contaminated by listed hazardous wastes may be managed as non-hazardous wastes if removed from their natural environment pursuant to a NYSDEC- or EPA-issued permit, order, approved closure plan, or approved corrective action plan and if the media contain hazardous constituent concentrations which are at or below action level concentrations (NYSDEC Technical Administrative Guidance Memorandum 3028).
	RCRA regulations governing transport, packaging and labeling, and manifesting of hazardous wastes (byproducts of treatment) and certain reporting requirements would be triggered by taking wastes to an offsite treatment/disposal facility (40 CFR 262.20-262.23; 262.30-262.33; 262.40).
	New York's regulations regarding transporting and manifesting wastes are outlined in 6 NYCRR 373-2.5. New York's regulations establish closure and post-closure procedures and regulations in 6 NYCRR 373-2.
	OSHA regulations (see description under "Capping").
Offsite Soil Treatment/Disposal	Resource Conservation and Recovery Act (RCRA) Identification and Listing of Hazardous Wastes identifies wastes considered to be hazardous wastes at the site (40 CFR Part 261).
	New York's regulations for the identification and listing of wastes considered to be hazardous at the site (NYCRR 6 Part 371).

TABLE 7.2
(CONTINUED)
POTENTIAL ACTION-SPECIFIC
STANDARDS, CRITERIA, AND GUIDELINES
POLYMER APPLICATIONS
TONAWANDA, NEW YORK

Site Action	Potential SCGs
Offsite Soil Treatment/Disposal (continued)	RCRA clean closure (removal) requirements triggered by removal of RCRA hazardous wastes; requirements include minimization of need for further maintenance and control, minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products, as well as the disposal or decontamination of equipment, structures and soils, 40 CFR 264.111. 264.228(a)(1) and 264.258 also require the removal or decontamination of all waste residues, containment system components (such as liners, dikes), contaminated subsoils, structures and equipment contaminated with waste and leachate, and management of these wastes as hazardous. Health-based levels at unit must also be met (40 CFR 264.111).
	RCRA regulations governing transport, packaging and labeling, and manifesting of hazardous wastes (byproducts of treatment) and certain reporting requirements would be triggered by taking wastes to an offsite treatment/disposal facility (40 CFR 262.20-262.23; 262.30-262.33; 262.40).
	Toxic Substance Control Act (TSCA) requirements for PCB storage and disposal are established in 40 CFR 761.60.
	New York's regulations regarding transporting and manifesting wastes are outlined in 6 NYCRR 373-2.5. New York's regulations establish closure and post-closure procedures and regulations in 6 NYCRR 373-2.
	New York State DEC "contained in" policy states that soil, sediment, and groundwater contaminated by listed hazardous wastes may be managed as non-hazardous wastes if removed from their natural environment pursuant to a NYSDEC- or EPA-issued permit, order, approved closure plan, or approved corrective action plan and if the media contain hazardous constituent concentrations which are at or below action level concentrations (NYSDEC Technical Administrative Guidance Memorandum 3028).
	OSHA regulations (see description under "Capping").
Ambient Air Emissions (Applicable for onsite remedial activities that may generate air emissions.)	6 NYCRR 373, 617, 257 and 201 stipulate air emissions guidelines. Part 617 is the State Environmental Quality Review Act (SEQRA) which requires an environmental and risk assessment for emissions anticipated for all remedial actions. Part 201 stipulates guidelines for emission points such as air strippers, etc. that might be associated with onsite water treatment activities.
	Clean Air Act, including National Ambient Air Quality Standards (40 CFR 50), sets National primary and secondary standards for six constituents for emissions to air from incinerators, surface impoundments, waste piles, landfills, and fugitive emissions.
	New York State Air Guide-1 provides guidance for the control of toxic ambient air contaminants.

TABLE 7.2
(CONTINUED)
POTENTIAL ACTION-SPECIFIC
STANDARDS, CRITERIA, AND GUIDELINES
POLYMER APPLICATIONS
TONAWANDA, NEW YORK

Site Action	Potential SCGs
Ambient Air Emissions (Applicable for onsite remedial activities that may generate air emissions.) (continued)	National Emission Standards for Hazardous Air Pollutants (40 CFR 61) regulate any air pollutant which causes or contributes to an increased mortality or serious illness. Currently these air standards have been applied to 8 air pollutants.
Wastewater Treatment and Disposal	Local (Town of Tonawanda) publicly owned treatment works (POTW) pretreatment standards for disposal to POTW.
	New York State Pollution Discharge Elimination System (SPDES) establishes site-specific effluent discharge limitations for direct discharge to surface water (NYCRR 6 Parts 750 through 758).
	Safe Drinking Water Act ("SDWA") Maximum Contaminant Levels ("MCLs"), 42 USC 300(f) et seq.
	Federal Water Quality Criteria ("FWQC") of Clean Water Act ("CWA") for Aquatic Life, 33 USC 1251 et seq.
	New York's regulations establish groundwater standards specified to protect ground waters for drinking water purposes, 6 NYCRR 703.
	New York's regulations establish surface water standards specified for protection of drinking water and aquatic life, 6 NYCRR 701 and 702.
	New York State Surface Water Guidance and Standards for toxic pollutants are established in the Division of Water Document TOGS 1.1.1.

NOTE: This table was prepared in accordance with provisions provided in TAGM #HWR-90-4030 (NYSDEC, 1990).

TABLE 7.3

RECOMMENDED CLEAN-UP GOALS
FOR COMPOUNDS OF CONCERN
POLYMER APPLICATIONS

Parameter	Media	Identified in: BHHE	Identified in: FWIA	Identified in: SCG Exceedance	SCG (ppm)[1]	Recommended Cleanup Goal[2] (ppm)
VOLATILES						
4-Methyl-2-pentanone	Soil			x	2.8	2.8
	GW	x			NS	NS
Toluene	Soil			x	4.2	4.2
	GW			x	0.005	0.005
Ethylbenzene	Soil			x	15.4	15.4
	GW			x	0.005	0.005
Xylenes	Soil			x	3.4	3.4
	GW			x	0.005	0.005
SEMIVOLATILES						
Phenol	Soil			x	0.84	0.84
	Sediment		x	x	0.014	0.014
	GW	x		x	0.001	0.001
2-Methlyphenol	Soil			x	0.28	0.28
	Sediment		x	x	0.014	0.014
	GW			x	0.001	0.001
4-Methylphenol	Sediment		x	x	0.014	0.014
	GW	x		x	0.001	0.001
2,4-Dimethlyphenol	GW			x	0.001	0.001
Total Phenols	Sediment		x	x	0.014	0.014
	GW			x	0.001	0.001
Benzo(a)pyrene	Soil	x	x	x	0.17	0.17
PCBs						
Total PCBs	Soil	x	x	x	1/10	10[3]
	Sediment	x	x	x	0.54	0.54
	GW	x		x	0.0001	0.0001

(1) SCGs from Table 7.1.
(2) Recommended Cleanup Goals are not given for groundwater. Groundwater remediation will be addressed in Section 8.
(3) For onsite soil only. The recommended cleanup goal for offsite surface soils is 1 ppm.

BHHE – Baseline Human Health Evaluation
FWIA – Fish and Wildlife Impact Assessment
GW – Groundwater
NS – No Standard

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TABLE 7.4

EXCEEDANCE SUMMARY
POLYMER APPLICATIONS

Parameter	Recommended Cleanup Goal (ppm) [1]	Maximum Detected Concentration (ppm)	No. Cleanup Goal Exceedances / No. Samples Analyzed	Exceedance Locations
SOIL				
4-Methyl-2-pentanone	2.8	25	6/38	TP1C, SB06, SB08, SB09, SB10
Toluene	4.2	150	6/38	TP1A, TP1C, SB06, SB08, SB09, SB10
Ethylbenzene	15.4	92	6/38	TP1C, SB02, SB06, SB07, SB08, SB10
Xylenes	3.4	440	8/38	TP1A, TP1C, SB02, SB06, SB07, SB08, SB09, SB10
Phenol	0.084	1400	21/38	TP1A, TP1C, SB02, SB05, SB06, SB07, SB08, SB09, SB10, SS01, SS02, SS03, SS04, SS05, SS06, SS07, SS08, SS09, SS10, MW08DD, WA01
2-Methylphenol	0.28	1.1	4/38	SB02, SB10, WA01, TP1A
Benzo(a)pyrene	0.17	0.59	1/2	SS08
PCBs	1 surface (offsite) 10 surface (onsite)	2 60	2/3 4/8	SS04, SS05 SS07, SS08, SS09, WA01
SEDIMENT				
2-Methylphenol	0.014	0.1	2/9	SD09, SD10
4-Methylphenol	0.014	1.1	3/9	SD08, SD09, SD11
Phenol	0.014	7	2/9	SD06, SD07, SD08, SD09, SD10, SD11, SD12, SD13
Total Phenols	0.014	11.7	2/4	SD12, SD13
PCBs	0.54	16.8	4/9	SD06, SD08, SD09, SD13
GROUNDWATER				
4-Methyl-2-pentanone	NS	16	N/A	N/A
Toluene	0.005	1.8	3/21	B5S, GW1DD, GW3S
Ethylbenzene	0.005	4.5	3/21	B5S, GW1DD, GW3S
Xylenes	0.005	31	9/34	B3D, B4S(2), B5S(2), GW1DD(2), GW3S(2)
Phenol	0.001	91	16/32	B3D(2), B4S(2), B5D(2), B5S(2), GW1DD(2), GW2DD(2), GW3S(2), GW4S(2)
2-Methylphenol	0.001	1	9/32	B4S, B5S(2), GW1DD(2), GW3S(2), GW4S(2)
4-Methylphenol	0.001	1.3	9/32	B4S(2), B5S(2), GW1DD(2), GW3S(2), GW4S
2,4-Dimethylphenol	0.001	0.63	6/32	B4S, B5S, GW1DD(2), GW3S(2)
Total Phenols	0.001	151	23/31	B3D(2), B4S(2), B5D, B5S(2), GW1DD(2), GW2DD(2), GW3S(2), GW4S(2), MW8DD, MW9DD, MW9S, MW10DD, MW11S, MW12S, MW13S, MW14S
PCBs	0.001	0.0013	1/20	GW3S

(1) Recommended Cleanup Goals apply to soil and sediment only. Values listed for groundwater are NYSDEC Class GA groundwater standards.

(2) Number of samples collected from the monitoring well in which an exceedance was recorded.

N / A – Not Applicable

TABLE 7.5

AREAS AND VOLUMES OF SOIL EXCEEDING CLEAN-UP GOALS

Location	Area (sf)	Volume (CY)
Shallow Soil (0-1 foot deep)		
Off Site	80,000	3,000
On Site	76,400	2,800
Backyard	54,000	2,000
Non-rear Yard	22,400	830
Deeper Soil (0-4 feet deep)		
Backyard	89,000	13,200
PCB-contaminated Soil		1,000
Resinous Material		1,000
Soil Pile		200
Debris Pile		300

TABLE 7.6
IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR SOIL

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
Institutional Controls	**Deed Restrictions**	Restricts access to the site and future site use.	Effectiveness depends on the selected alternative.	Implementability depends on legal requirements and authority, and agreement of property owner.	Necessary for the No Action alternative. Retained for incorporation in remedial alternatives.
	Fencing/Posting	Install a chain link fence around the property with limited, locked entrances, post "no trespassing" signs to restrict access to the site.	Effective at keeping public out of contaminated areas, but still leaves areas accessible to future site workers.	Implementable.	Necessary for the No Action alternative. Retained for incorporation in remedial alternatives.
Containment	**Concrete or Asphalt Cap**	Reinforced concrete slab or asphalt pavement formed in place.	Effective at eliminating contact with surface soils.	Implementable, proven technology.	Asphalt can crack, needs maintenance. Retained for incorporation in remedial alternatives.
	Low Permeable Cap	Multilayer cap with a low permeable membrane layer, drainage layer, and vegetative support layer.	Effective at eliminating contact with surface soil and preventing infiltration.	Implementable, proven technology.	Commonly used, easily implementable, and effective. Retained for incorporation in remedial alternatives.
Removal	**Excavation**	Physical removal of contaminated soils using conventional earth-moving equipment.	Effective when combined with ex-situ treatment or disposal.	Implementable, uses conventional earthmoving equipment.	Needed for any ex-situ treatment, onsite consolidation, or disposal alternative. A fully enclosed tent or winter construction may be required to control air pollition. Retained for incorporation in remedial alternatives.

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TABLE 7.6

(CONTINUED)

IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR SOIL

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
Disposal	**Offsite Landfill**	Disposal of excavated soils and wastes at an appropriately permitted landfill.	Effective, but does not reduce volume or toxicity of contaminants.	Implementable.	Removes soil from site and is effective at achieving RAOs. Retained for incorporation in remedial alternatives.
In-situ Treatment	**Biodegradation**	Treatment of wastes in-situ by enhancing biological degradation of organic contaminants. Water based solutions are circulated through contaminated soils.	Effectiveness may be limited due to the heterogeneous, low-permeable soil in the backyard area. May require a long time for complete treatment.	Implementable.	Could be an effective treatment for both contaminated soil and shallow groundwater with low to moderate contaminant levels. Retained, however, will not be incorporated into a remedial alternative.
	Bioventing	Oxygen is delivered to contaminated unsaturated soils by forced air movement (either extraction or injection of air) to increase oxygen concentration and stimulate biodegradation.	Effective treatment for soil contaminated with phenol.	Implementable but requires dewatering of saturated soils and effective radius of influence is small.	Could be effective in treating low to moderate levels of contaminated soil in the vadose zone. Retained and selected as the representative in-situ treatment technology.
	Soil Vapor Extraction (SVE)	Vacuum is applied through extraction wells to create a pressure gradient that induces volatiles to diffuse through soil to extraction wells.	Effectiveness is limited to the treatment of VOCs in the soil vadose zone.	Implementable but required dewatering of saturated soils and effective radius of influence is small.	SVE does not address the compounds of concern and has not been retained.
	Soil Flushing	Water or water with additives is applied to soil or injected into the groundwater. Contaminants are leached into the groundwater and extracted to capture/treat before being re-circulated.	Effectiveness is limited by the low-permeable soil in the backyard area.	Implementable.	Soil flushing does not address the compounds of concern and has not been retained.

TABLE 7.6
(CONTINUED)
IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR SOIL

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
In-situ Treatment (Cont'd)	Solidification Stabilization	Contaminants are physically bound or stabilized to reduce their mobility.	The target compounds for this technology is inorganics.	Implementable.	Technology is not effective for organic compounds and is not retained.
	Vitrification	Electrodes for applying electricity are used to melt contaminated soils and sludges producing a glass-like structure and thereby reducing mobility of contaminants.	The target compounds for this technology is inorganics.	Implementability is questionable because of aboveground and underground structures at the site.	Primarily used to encapsulate inorganics. Has not been retained.
	Thermally Enhanced SVE	Steam/hot-air injection or electric/radio frequency heating to increase the mobility of volatiles and facilitate extraction.	Effectiveness is limited to the treatment of soil contaminated with VOCs and some semivolatiles.	Implementable.	Technology is not targeted for the compounds of concern at the site. Not retained.
Ex-situ Treatment	**Slurry Phase Biological Treatment**	An aqueous slurry is created by combining soil or sludge with water and other additives. The slurry is mixed to keep solids suspended and microorganisms in contact with the soil contaminants thereby enhancing biodegradation.	Effective treatment for both contaminated soil and groundwater.	Implementable, but needs a large space for equipment and is labor intensive.	Treatment could be used for both groundwater and soil with low to moderate levels of contamination. Retained, however, it will not be incorporated into remedial alternatives.
	Solid Phase Biological Treatment	Excavated soils are homogenized and dewatered before being placed into a treatment cell. The treatment uses microorganisms to convert contaminants to less harmful species.	Effective treatment for contaminated soils.	Implementable.	Technology is effective for treating contaminated soils with low to moderate levels of contamination. Retained and selected as one of the representative ex-situ soil treatment technologies.

TABLE 7.6
(CONTINUED)
IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR SOIL

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
Ex-situ Treatment	**Soil Washing**	Excavated soils are washed with water containing a leaching agent, surfactant, pH adjustment, or chelating agent to remove organics or heavy metals from the contaminated soil.	Effectiveness may be limited because of the fine soil particles in the backyard area.	Implementable.	Technology may be effective for the contaminants of concern and has been retained, however, will not be included into the remedial alternatives.
	Chemical Reduction and/or Oxidation	Converts hazardous contaminants to non-hazardous or less-toxic compounds that are more stable, less mobile, and/or inert.	Effective for the treatment of soil contaminated with inorganics.	Implementable.	Not effective against the compounds of concern. Not retained.
	Low Temperature Thermal Desorption	Excavated soils are heated to 200-600°F to volatilize water and organic contaminants.	Can be effective for the contaminants of concern.	Implementable, but soils need to be dewatered to lower the moisture content.	Effective form of treatment for soils with low to high levels of organic contamination. Retained and selected as one of the representative ex-situ soil treatment technologies.
	High Temperature Thermal Desorption	Excavated soils are heated to 600-1,000°F to volatilize water and organic contaminants.	Varying degrees of effectiveness for the contaminants of concern.	Implementable, but soils need to be dewatered to lower the mositure content.	Potentially effective treatment for compounds of concern. Retained, but will not be incorporated into the remedial alternatives because low temperature thermal desorption should be as effective and uses less energy.
	Incineration	Excavated soils are heated to high temperatures (1,600-2,200°F) to volatilize water and organic contaminants.	Can be effective for the contaminants of concern.	Implementable.	Could be used to treat resin-like materials at the surface of the backyard. Retained, however, it will not be incorporated into the remedial alternatives.

TABLE 7.6
(CONTINUED)
IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR SOIL

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
Ex-situ Treatment (Cont'd)	Pyrolysis	Chemical decomposition is induced in organic materials by heat in the absence of oxygen. Organic materials are transformed into gaseous components and a solid residue containing fixed carbon and ash.	Can be effective for SVOCs. Does not target phenol.	Implementable, but not proven.	Technology requires a low soil moisture and is only available at pilot scale. Not retained.
Enhancement	Pneumatic Fracturing	Pressurized air is injected beneath the surface to develop cracks in low permeable soils, such as clay, to increase premeability.	Not effective for the site silty soils.	Implementable. Could be problematic due to proximity of buildings and underground utilities.	Not a proven technology for the site silty soils. Not retained.
Other Processes	Natural Attenuation	Contaminant concentrations are reduced to acceptable levels by natural subsurface processes such as dilultion, volatilization, biodegradation, adsorption and chemical reactions.	Not effective .	Implementable.	Technology will not achieve the remedial action objectives. Not retained.

(1) Bold type indicates that the technology has been retained for possible inclusion in alternative development.

TABLE 7.7
IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR GROUNDWATER

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
Institutional Controls	**Groundwater Monitoring**	Monitor groundwater to document changes in contaminant concentrations and locations.	Effective at documenting changes of contaminant concentrations.	Implementable.	Required for No Action or containment alternatives. Retained for incorporation in remedial alternatives.
Containment	**Subsurface Barrier Wall**	Low permeability vertical barrier to separate contaminated groundwater from ambient groundwater.	Can be effective to separate contaminated groundwater from ambient groundwater.	Implementable. A clay layer is available beneath the site to key wall into.	A concrete barrier wall already installed around most of the contaminated shallow groundwater. Retained for incorporation in remedial alternatives.
Extraction	**Collection Trench**	Groundwater is extracted with collection trenches.	Effective at removing shallow groundwater.	Implementable.	Combined with groundwater and soil treatment could result in hydraulic containment. Retained for incorporation in remedial alternatives.
	Extraction Wells	Groundwater is pumped out of a well(s).	Effective at removing deep groundwater.	Implementable.	Could be used to pump deep groundwater. Retained for incorporation into remedial alternatives.
	Dual Phase Extraction	A high vacuum is applied to simultaneously remove liquid and vapor from low permeability or hetergeneous formations.	Potentially effective at treating both soil and groundwater.	Implementable.	May have limited effectiveness depending upon the specific site geology. Retained but will not be incorporated into the remedial alternatives.
	Vacuum Vapor Extraction	Injected air lifts contaminants into the well and VOCs are stripped of the groundwater and collected at the top of the well.	Effective form of treatment for VOCs.	Implementable, at the pilot scale level. Questionable at full scale due to shallow-ness of groundwater.	Technology is a pilot scale technology and full scale implementability is questionable. Not retained.

TABLE 7.7
(CONTINUED)
IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR GROUNDWATER

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
Discharge	**Publicly Owned Treatment Works (POTW)**	Collected groundwater is pumped to a local sewer line to be treated at the POTW.	Effective.	Implementable. Pretreatment may be required.	Extracted groundwater could be pretreated and disposed of at the POTW. Discharge limits from local POTW are reasonable achievable. Retained and selected as the representative groundwater discharge technology.
	Niagara River	Collected groundwater is discharged to the Niagara River after ex-situ treatment.	Effective.	Implementable.	Possible alternate to discharge to the POTW. Retained, however, it will not be incorporated into a remedial action alternative.
	Industrial Wastewater Treatment Facility	Collected groundwater is transported to a permitted industrial wastewater treatment facility for disposal.	Effective.	Implementable.	Possible alternative to any onsite treatment and subsequent discharge. Retained, however, it will not be incorporated into a remedial action alternative.
In-situ Treatment	Hydrogen Peroxide Circulation	Hydrogen peroxide is circulated throughout a contaminated groundwater zone to increase the oxygen content thereby enhancing the rate of aerobic degradation of organic contaminants.	Effective for the compounds of concern.	Implementable. Heterogeneous subsurface will prevent the circulation of hydrogen peroxide throughout portions of the contaminated zone.	An adequate circulation system would be hindered due to the low permeable soil in the backyard area. Not retained.
	Co-Metabolic Process	Water containing dissolved methane and oxygen is injected into groundwater to enhance methanotropic biological degradation.	Not effective for the compounds of concern.	Implementable.	Effectiveness is limited due to the soil type in the backyard. Technology is still under development and does not target the compounds of concern. Not retained.

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TABLE 7.7
(CONTINUED)
IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR GROUNDWATER

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
In-situ Treatment (continued)	Nitrate Enhancement	Solubilized nitrate is circulated throughout groundwater contamination zones to provide electron acceptors for biological activity and enhance the rate of degradation of organic contaminants by naturally occuring microbes.	Effective on only a narrow spectrum of compounds.	Implementable.	Technology is still under development and does not target the compounds of concern. Not retained.
	Air Sparging	Air is injected, under pressure, into saturated matrices creating an underground stripper that removes contaminants through volatilization.	Effective for VOCs only.	Implementable. Can push contaminated groundwater away from injection point.	Technology is difficult to implement due to the low permeable heterogeneous subsurface formations. Not retained.
	Passive Treatment Walls	A permeable reaction wall is installed across the flow path of a contaminated plume, allowing the plume to passively move through the wall.	Not effective for the compounds of concern.	Implementable at the pilot scale level.	Technology is only effective for a short period of time, requires replacement of reactive medium. Not retained.
	Hot Water or Steam Flushing/Stripping	Steam is forced into an aquifer through injection wells to vaporize volatile and semivolatile compounds.	Effective for the compounds of concern.	Implementable at the pilot scale level.	Effectiveness will be impacted by the heterogeneous low permeable soil in the backyard area. Technology is only available at pilot scale. Not retained.

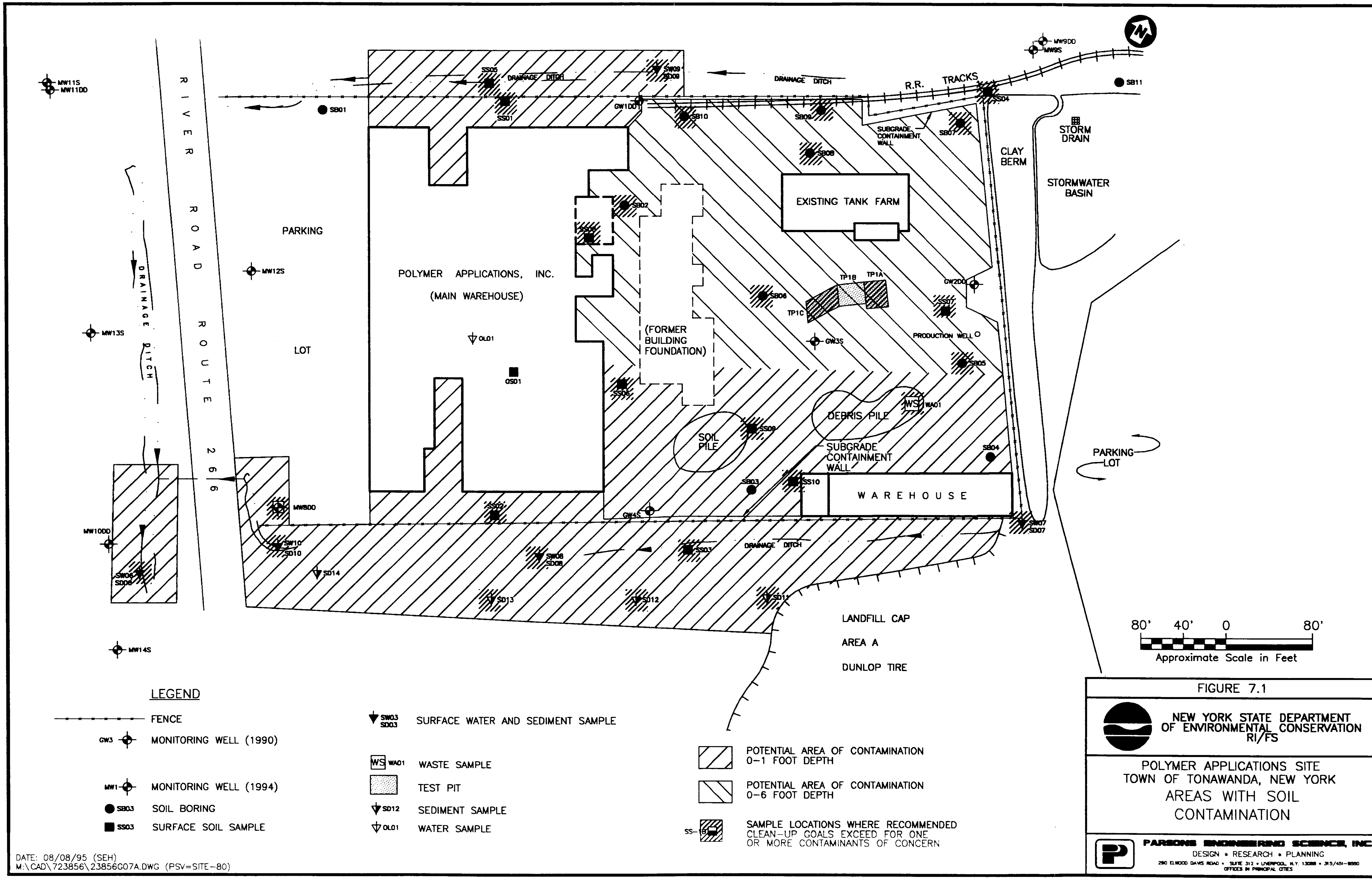
TABLE 7.7
(CONTINUED)
IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR GROUNDWATER

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
Ex-situ Treatment	**Bioreactors**	Contaminants in extracted groundwater are put into contact with microorganisms through attached or suspended biological systems.	Effective for the compounds of concern.	Implementable.	Technology could be used to treat both soil and groundwater. Retained, however, it will not be incorporated into remedial alternatives.
	Air Stripping	Volatile organics are partitioned from groundwater by greatly increasing the surface area of the contaminated water exposed to air.	Effective for VOCs only.	Implementable.	Technology is effective for removal of VOCs and could be used in combination with another treatment. Retained, but not incorporated into remedial alternatives.
	Carbon Absorption	Groundwater is pumped through a series of canisters containing activated carbon to which dissolved organic contaminants adsorb.	Effective for compounds of concern.	Implementable.	Technology is effective at removal of organics. Retained and selected as one of the representative ex-situ soil treatment technologies.
	Ultraviolet (UV) Oxidation	UV radiation, ozone, and/or hydrogen peroxide are used to destroy organic contaminants as water flows into a treatment tank.	Not effective for the compounds of concern.	Implementable.	Technology is not proven to treat VOCs. Not retained.

TABLE 7.7
(CONTINUED)
IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES FOR GROUNDWATER

Response Type	Technology (1)	Description	Effectiveness	Implementability	Evaluation Comments
Enhancement	Hydrofracturing	Pressurized water is injected through injection wells to crack low permeability and over consolidated sediments.	Effective for certain types of soil.	Implementable.	The soil in the backyard is silty and not suitable for hydrofracturing. Not retained.
Other Processes	**Natural Attenuation**	Contaminant concentrations are reduced to acceptable levels by natural subsurface processes such as dilution, volatilization, biodegradation, adsorption and chemical reactions.	Effective under some conditions.	Implementable.	Technology may be effective for deep and intermediate groundwater. Retained, however, it will not be incorporated into the remedial action alternatives.

(1) Bold type indicates that the technology has been retained for possible inclusion in alternative development.



RIVER ROAD
ROUTE 266
DRAINAGE DITCH
PARKING
LOT
POLYMER APPLICATIONS, INC.
(MAIN WAREHOUSE)
(FORMER BUILDING FOUNDATION)
EXISTING TANK FARM
R.R. TRACKS
SUBGRADE CONTAINMENT WALL
CLAY BERM
STORM DRAIN
STORMWATER BASIN
PRODUCTION WELL
SOIL PILE
DEBRIS PILE
WAREHOUSE
PARKING LOT
LANDFILL CAP
AREA A
DUNLOP TIRE
80' 40' 0 80'
Approximate Scale in Feet
LEGEND
FENCE
MONITORING WELL (1990)
MONITORING WELL (1994)
SOIL BORING
SURFACE SOIL SAMPLE
SURFACE WATER AND SEDIMENT SAMPLE
WASTE SAMPLE
TEST PIT
SEDIMENT SAMPLE
WATER SAMPLE
POTENTIAL AREA OF CONTAMINATION 0-1 FOOT DEPTH
POTENTIAL AREA OF CONTAMINATION 0-6 FOOT DEPTH
SAMPLE LOCATIONS WHERE RECOMMENDED CLEAN-UP GOALS EXCEED FOR ONE OR MORE CONTAMINANTS OF CONCERN
FIGURE 7.1
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
RI/FS
POLYMER APPLICATIONS SITE
TOWN OF TONAWANDA, NEW YORK
AREAS WITH SOIL CONTAMINATION
PARSONS ENGINEERING SCIENCE, INC.
DESIGN • RESEARCH • PLANNING
DATE: 08/08/95 (SEH)
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SECTION 8

DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

This section contains the development and screening of comprehensive remedial alternatives designed to achieve the remedial action objectives for soil and groundwater contamination at the Polymer Applications site. Each alternative is a different combination of potentially applicable technologies retained in Tables 7.6 and 7.7. These alternatives were developed and screened based upon compliance with NYSDEC SCGs, protection of human health and the environment, the ability to meet media-specific remedial action objectives, short-term and long-term effectiveness, and implementability. Effectiveness and implementability are evaluated in accordance with the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #HWR-90-4030 for the Selection of Remedial Actions at Inactive Hazardous Waste Sites (NYSDEC, 1990) and USEPA FS guidance (USEPA, 1988). These state and federal FS guidance procedures specify that the initial screening of alternatives be based solely on effectiveness and implementability, described as follows:

- Effectiveness refers to the short- and long-term effectiveness of the remedial alternative in protecting human health and the environment. Short-term effectiveness addresses the construction and implementation period, while long-term effectiveness considers the period after the remedial action is completed. Effectiveness is evaluated based on short-term risks to the community and environment, implementation time, permanence of the remedy, lifetime of the remedy, quantity and nature of the waste or residual remaining on-site, and the adequacy and reliability of controls.
- Implementability refers to both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative. Technical feasibility refers to the ability (1) to construct, reliably operate, and meet technology specific regulations and requirements for the process options until the remedial action is complete; and (2) to operate, maintain, replace, and monitor technical components, as necessary, once the remedial action is complete. Administrative feasibility considers the ability to obtain approvals from government agencies, the availability and capacity for treatment, storage, and disposal services, and the requirements for and availability of specific equipment and technical specialists.

In addition to evaluating each alternative based on its implementability and effectiveness, comparisons between similar alternatives were made during this screening process. The comparison process is used to screen out any alternatives that are similar to other alternatives but are less implementable or effective. Alternatives that meet the implementability and effectiveness criteria were retained following the comparative analysis and are evaluated in detail in Section 9.

8.1 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Five remedial alternatives were developed for the remediation of contaminated soil and groundwater at the Polymer Applications site. The alternatives cover a range of remedial actions from no action through permanent treatment of almost all contaminated media. The alternatives were developed from the potentially applicable technologies that were retained through screening and evaluation in Section 7. The technologies that were retained were the technologies that were judged to be the most appropriate to site conditions, of those technologies that were potentially applicable. Four of the remedial technology categories in the TAGM hierarchy of remedial technologies are represented in the alternatives: destruction, separation/treatment, control and isolation, and off-site land disposal. The five alternatives that were developed are:

Alternative 1 - No Further Action

Alternative 2 - Soil Consolidation and Multi-layer Cap

Alternative 3 - *In situ* Soil Treatment

Alternative 4 - Excavation and *Ex situ* Soil Treatment

Alternative 5 - Off-site Disposal of Soils

Table 8.1 lists the retained technologies and the alternative in which they occur. Remediation of groundwater was limited to collection trenches and *ex situ* treatment. *In situ* groundwater treatment technologies were judged to be difficult to implement at the Polymer Applications site based on technology evaluations in Section 7. Remediation technologies for soil have been limited to *in situ* treatment (bioventing) or *ex situ* treatment (solid phase biological treatment or low temperature thermal desorption).

It was determined with and agreed to by the NYSDEC that TAGM scoring per NYSDEC TAGM #HWR-90-4030 for development and detailed evaluation of alternatives would not be conducted for this RI/FS.

The alternatives are described and evaluated below.

8.1.1 Alternative 1 - No Further Action

Under the no further action alternative, conditions at the facility would remain essentially unchanged because the alternative does not include any soil or groundwater remedial measures. This alternative includes the decommissioning of three deep monitoring wells (GW1DD, GW2DD, and B1DD) and the production well at the eastern property boundary to reduce the potential for vertical migration of contamination. Periodic inspection and groundwater monitoring would be conducted to ensure that the site conditions do not worsen and to determine if naturally-occuring biodegradation and volatilization are reducing contamination.

Groundwater monitoring would be conducted during eight sampling events (after years 1,3,5,10,15,20,25, and 30) using five groundwater monitoring wells (MW11DD, MW12S, MW8DD, GW3S, and MW9S). All samples would be analyzed for volatile and semivolatile organic compounds (VOCs and SVOCs). Samples from MW12S would also be analyzed for PCBs.

Effectiveness: The no further action alternative does not provide long-term protection of human health due to the presence of contaminated soils and groundwater. This alternative would not meet the recommended clean-up goals.

Implementability: This alternative would be technically and administratively implementable.

Status: Although the no further action alternative would not meet the remedial action objectives, it is retained for detailed analysis to provide a baseline from which to evaluate the other alternatives.

8.1.2 Common Elements for Alternatives 2 through 5

There are a number of remedial elements that are common to Alternatives 2 through 5. Rather than describe these elements under each alternative, they will be presented in this section.

The common remedial elements are illustrated in Figure 8.1 and include the following activities:

1) Excavation of surface soils (0 to 1 foot depth) and sediments outside the backyard area that exceed clean-up goals. This includes off-site and on-site areas. This removes the off-site compounds and the most heavily contaminated soils, and moves it to the yard area.
2) Backfill of the excavated areas with clean soil and revegetate.
3) Skimming of the resinous material from the soil surface in the backyard and side areas of the main warehouse. Disposal off-site in an approved landfill.
4) Installation of a 300 foot long barrier wall along the property line north of the main warehouse;
5) Installation of a shallow groundwater collection pipe at the western side of the backyard. This would collect groundwater within the containment wall that has been impacted by yard area soil contamination.
6) Construction of a groundwater treatment system with discharge to the Town of Tonawanda POTW.
7) Abandonment of monitoring wells that are possible vertical conduits or would interfere with construction of the remedy.
8) Repair of the existing concrete containment wall around the backyard.

Common soil remedial measures include excavation of an estimated 3,800 CY of surface soil and sediments from off-site and on-site along the sides of the warehouse. The disposal of this soil differs depending on the alternative. The excavated areas would then be backfilled with clean soil, graded, and revegetated. Another soil remedial measure is the removal and disposal of an estimated 1,000 CY of resinous material from the surface of the soil in the backyard and sides around the warehouse. As explained in Section 7.2 for the purposes of this FS, it is assumed that the excavated soil and resinous material are RCRA-hazardous wastes and that they would be disposed of as such.

Common groundwater remedial measures include the installation of a shallow groundwater collection trench and a groundwater treatment system. The 180 foot long collection trench would be located near the eastern wall of the warehouse and would be buried approximately 6 feet deep. The trench would be constructed of perforated HDPE pipe sloped to a sump at the southern end. Collected groundwater would be pumped to a groundwater treatment plant located outside the southeastern corner of the warehouse. The estimated flow rate of the collected groundwater depends on the other remedial elements, and will be discussed in the context of each alternative. A likely groundwater treatment train would consist of filtration to remove solids followed by carbon adsorption to remove organic compounds. Treated water would be discharged to the Town of Tonawanda Wastewater Treatment Plant. Treated water would be sampled and analyzed regularly to ensure that the Town of Tonawanda pretreatment standards are being met.

There are two other common groundwater remedial elements. One is the repair of the existing subsurface concrete containment wall around the backyard area. The wall would be repaired near groundwater wells GW1DD and GW2DD where it is believed to be compromised due to the detection of contamination outside the containment wall. In addition, any utility or other pipes that extend from the backyard would be plugged per NYSDEC protocol. These activities in conjunction with shallow groundwater collection to maintain an inward hydraulic gradient would prevent the off-site migration of contaminated groundwater.

The final common element is the abandonment of monitoring wells that would interfere with the construction of remedial alternatives. Deep monitoring wells GW1DD and GW2DD are suspected of being vertical conduits. Monitoring wells GW4A and B3D both would be under an area to be capped and/or excavated in Alternatives 2 through 5.

The existing north concrete barrier wall would be extended approximately 300 feet west towards River Road. The extended barrier wall would divert ambient groundwater from passing under the existing main warehouse where potential contamination may exist.

8.1.3 Alternative 2 - Waste Soil Consolidation and Multi-layer Cap

Alternative 2 includes the following activities in addition to the common elements described previously:

1) Consolidation of contaminated offsite surface soil onto the backyard area;

2) Construction of a groundwater treatment system; and

3) Installation of a low-permeable, multi-layer cap over the backyard area.

The non-common elements of Alternative 2 are illustrated in Figure 8.2.

Site preparation would include modification of the existing fence, brush and tree clearing, installation of a temporary construction fence as needed, mobilization/demobilization of construction equipment, the razing of the existing tank farm and burned building, and demolition of the small warehouse and any additional structures in the backyard as needed. In addition, discharge and construction permits would need to be obtained.

The excavated surface soil from outside the backyard area would be consolidated onto the backyard area and sloped to meet the 2 percent minimum grade. A 2 percent grade is sufficient to maintain drainage when a cap is placed over soil. The minimum requirements of a 4 percent slope for closure of a solid waste landfill assumes cap will be placed over compacted solid ~~soil~~ waste, which will settle over time.

The cap would be placed in the backyard area and would consist of either:

A) Low-permeable soil cap including:

6 inches of topsoil (vegetative support layer) over;
18 inches of cover soil (protective layer) over;
60 mil HDPE (low permeable layer).

or

B) Low-permeable asphalt cap including:

6 inches of asphalt over;
6 inches of crushed stone base.

The shallow groundwater flow rate is estimated at one gallon per minute (GPM) or less. Groundwater flow would be the greatest immediately after the start-up of the collection system. The low permeability cap would reduce infiltration and thus the flow into the trench. This would result in the dewatering of the backyard area. Because the flow rate is anticipated to be low, the treatment system would be operated in a batch mode rather than continuously. Groundwater would be pumped from the collection trench sump into a storage tank. When full, the water would be treated and discharged.

Effectiveness: Capping of the backyard area would remove the potential of human health risks due to dermal contact or ingestion. Additionally, this alternative includes excavation of surface soils outside of the backyard area and consolidation of the excavated material inside the backyard area. Both capping scenarios would meet the RAO of preventing dermal contact with contaminated soils. However, the asphalt cap will be susceptible to cracking and will need more maintenance than the impermeable cap.

The groundwater collection and treatment system would be effective at achieving groundwater RAOs through the hydraulic containment of groundwater. The passive collection system would prevent the migration of contaminated groundwater out of the "backyard" area. The treatment system would be effective at treating collected groundwater to meet pretreatment standards.

Implementability: Alternative 2 uses proven technologies, capping and groundwater collection and treatment, and would be implementable.

Status: Both capping scenarios in Alternative 2 have been retained for detailed analysis because they can be effective and implemented.

8.1.4 Alternative 3 - *In situ* Soil Treatment

Alternative 3 includes the following activities in addition to the common elements:

1) Consolidation of excavated surface soil onto the backyard area;
2) Segregation of PCB-contaminated soils exceeding SCGs and their disposal off-site;
3) Installation of a network of 10 shallow groundwater/soil gas collection pipes, spaced 40 feet apart to dewater backyard in 2 years;
4) Installation of two new deep groundwater monitoring wells, one each in the vicinity of abandoned wells GW1DD and GW2DD;
5) Collection and treatment of deep groundwater;
6) Installation of an *in situ* bioventing treatment system; and
7) Installation of a geomembrane and soil cap over the backyard area.

The remedial elements of Alternative 3 are illustrated in Figure 8.3.

Surface soils outside the fence limits with PCB concentrations greater than 1 ppm and surface soils inside the fence limits with PCB concentrations greater than 10 ppm would be excavated and disposed of at an approved off-site hazardous waste disposal facility. All other excavated surface soils would be consolidated onto the backyard area.

A series of shallow groundwater/gas collection trenches and two new deep groundwater monitoring wells with pumps would be installed. The pumps would bring the deep groundwater to the surface for storage in tanks. The groundwater treatment system for Alternative 3 would treat shallow groundwater from the collection trench system and deep groundwater from the two new deep groundwater wells. The new deep groundwater wells will be located near and be to the same depth as existing monitoring wells GW1DD and GW2DD. The design flow rate is 25 GPM. Groundwater would be treated continuously as long as the deep wells are being pumped at 20 GPM. If groundwater flow drops significantly, groundwater would be treated on a batch basis.

Installation of an *in situ* bioventing soil treatment system would involve modifying the shallow groundwater collection trenches to allow extraction and proper distribution of air flow for bioventing. Off-gas from the bioventing system would be collected and treated prior to discharge if necessary. Soil samples would be collected to confirm that treatment objectives were being met.

A geomembrane and soil cap would be installed over the backyard area to prevent infiltration of precipitation. This step is needed because bioventing is only effective in unsaturated soils and the backyard area needs to be capped to prevent groundwater recharge.

<u>Effectiveness:</u> The soil remedial elements of this alternative would be effective at eliminating the risk to human health from dermal contact with and/or ingestion of contaminated surface and subsurface soils.

The groundwater pump and treat system would be effective at meeting groundwater RAOs through the collection of the contaminated groundwater.

Implementability: The technologies proposed for Alternative 3 would be implementable. Bioventing would require dewatering of saturated soils and the effective radius of influence may be small. The design of the pump and treat groundwater system and the soil remediation system would be based upon the results of pilot-scale testing.

Status: Alternative 3 is retained for detailed analysis because it is potentially effective at achieving the remedial action objectives that are protective of human health.

8.1.5 Alternative 4 - Excavation and *Ex situ* Soil Treatment

Alternative 4 includes the following activities in addition to the common elements:

1) Excavation of subsurface soils in the backyard that exceed recommended clean-up goals;
2) Consolidation of PCB-contaminated soils and their appropriate disposal;
3) Dewatering of surface and subsurface excavated soils;
4) Treatment of excavated/dewatered soils;
5) The backfilling of excavated areas with treated soil; and
6) Installation of new deep groundwater wells.

Alternative 4 includes excavation of shallow and deeper soils followed by onsite, *ex situ* soil treatment. This alternative contains two options (A and B), for two different *ex situ* soil treatment technologies: low temperature thermal desorption (Option 4A) and biological treatment via bioventing (Option 4B).

Both options, after starting with the demolition and site preparation described in Alternative 2, would include staged excavations of shallow offsite and onsite soils, and deeper soils in the northern two-thirds of the rear yard. The treatment in each option would differ from this point, however.

Soils to be treated by thermal desorption (Option 4A) would require extensive materials handling prior to treatment. Materials handling would take place in a soil pretreatment and handling area in the southern area of the backyard (Figure 8.4). Excavated soils would be dewatered via gravity to achieve the 10 to 20 percent moisture typically required for thermal desorption treatment. Filtrate would be collected, stored, and fed to the groundwater treatment system. Soil would then be sent through a pug mill to produce a uniform size feed. Feed would go through the thermal desorption unit for removal of VOCs and SVOCs. The thermal desorption unit would be set up on the rear warehouse foundation. Treated soil would be stockpiled until confirmatory sampling showed that treatment standards had been achieved. Treated soil would then be backfilled into the excavated areas on site. Offsite excavated areas would be backfilled with clean fill. Backfilled areas would be graded, seeded, and fertilized. Treatment residuals in thermal desorption off-gas would be treated onsite by combustion or would be condensed and transported offsite for ultimate destruction.

Option 4B (biological treatment) would not require as much materials handling as Option 4A. Soil would be mixed in a pug mill or similar equipment prior to placement in the treatment cell; this would homogenize the soil in terms of both permeability and concentrations of contaminants. Nutrients could also be added at this time. The *ex situ* treatment cell (Figure 8.5) would be constructed in the backyard shallow and deep excavation areas. This takes advantage of the limited space available on the site, provides fill for the excavated area prior to the completion of treatment, and eliminates the need to place treated soil following treatment. The treatment cell would consist of (from bottom to top) a geonet or crushed stone blanket drain with a perforated pipe network, a 1 to 7 foot layer of homogenized soil, another porous layer of geonet and crushed stone, covered by a geomembrane, and topped by a 6 inch asphalt or 12 inch clean soil cap.

The treatment cell would operate as follows. Soil water would first be removed via the lower blanket drain and the shallow collection pipe. Soil moisture would be kept above 15 percent, which is the minimum needed for biological activity. Then, low volume air flow would be induced in the treatment cell from the top porous layer through the soil to the blanket drain by extracting air from the lower blanket drain. The geomembrane and soil or asphalt cap would prevent infiltration into ~~most of~~ the treatment cell. The edges around the perimeter of the top porous layer would be kept open to the atmosphere to supply air to the treatment cell.

Treatability tests would be conducted before the final design is selected for either option.

Soil samples would be collected to confirm that the soil treatment objectives were being met. For Option A, samples would be collected prior to replacing treated soil in the excavation. For Option B, samples would be collected from the treatment cell during and following bioventing to monitor and confirm clean-up.

Flow to the groundwater treatment system is estimated at 25 gpm for Alternative 4. Flow would be from the two new deep wells, the dewatered soil, and the shallow groundwater collection trench. The groundwater would be treated continuously and discharged.

<u>Effectiveness:</u> The soil remedial elements of this alternative would be permanent and thus effective at eliminating the risk to human health from dermal contact with and/or ingestion of contaminated surface and subsurface soils.

The groundwater pump and treat system would be effective at protecting human health through the containment of the contaminated groundwater. The pump and treat system would be effective at achieving the groundwater remedial action objectives.

<u>Implementability:</u> The technologies proposed for Alternative 4 would be implementable, although not proven for *ex situ* bioremediation design. In addition, possible emissions from VOCs during excavation may prove problematic.

Status: Alternative 4 is retained for detailed analysis because it is potentially effective at achieving the remedial action objectives.

8.1.6 Alternative 5 - Off-site Disposal of Soils

Alternative 5 includes the following activities in addition to the common elements:

1) Excavation of subsurface soils in the northern backyard;
2) Disposal of excavated soils in an approved off-site landfill;
3) Installation of new deep groundwater wells; and
4) Extraction and treatment of deep groundwater.

Alternative 5 includes excavation and off-site disposal of all surface and subsurface soil exceeding recommended clean-up goals. The excavated soil would be transported off-site to an approved hazardous waste landfill. Because the soil has been excavated and would be placed in a landfill, the soil is subject to New York State and federal Land Disposal Restrictions (LDRs) if set concentrations of hazardous wastes are exceeded. The soil is considered, for the purpose of this FS, to be a hazardous waste due to the presence of spilled phenol (U188), xylenes (U239), and PCBs at concentrations greater than 50 ppm (B007). Approximately 11,600 CY of soil to be excavated for Alternative 5 exceed the Universal Treatment Standards (40 CFR 268.40) and NYS LDR concentrations (6 NYCRR 376.4(d)) of 6.2 mg/kg for phenol and 28 mg/kg for total xylenes. The areas that exceed these LDRs are located along the south drainage ditch and in the northwest area of the backyard. Soils subject to LDRs for phenol and/or xylene would need to be treated to meet the treatment standards prior to land disposal.

Collection of groundwater during the excavation and pumping into a storage tank.

Backfilling of excavated areas to original grade with a clean fill and 6-inches of top soil, seeding, and fertilizer.

Estimated groundwater flow for Alternative 5 is 21 GPM. Water would come from the shallow collection trench and the excavation dewatering (1 GPM), and the two new deep wells (20 GPM).

Effectiveness: Alternative 5 would be effective at protecting human health and the environment because soils and remedial measures would remove the human health risks currently associated with the site. In addition, the SCGs for soils would be achieved through excavation and removal of contaminated soils.

Groundwater would be extracted and treated to contain the contaminated groundwater.

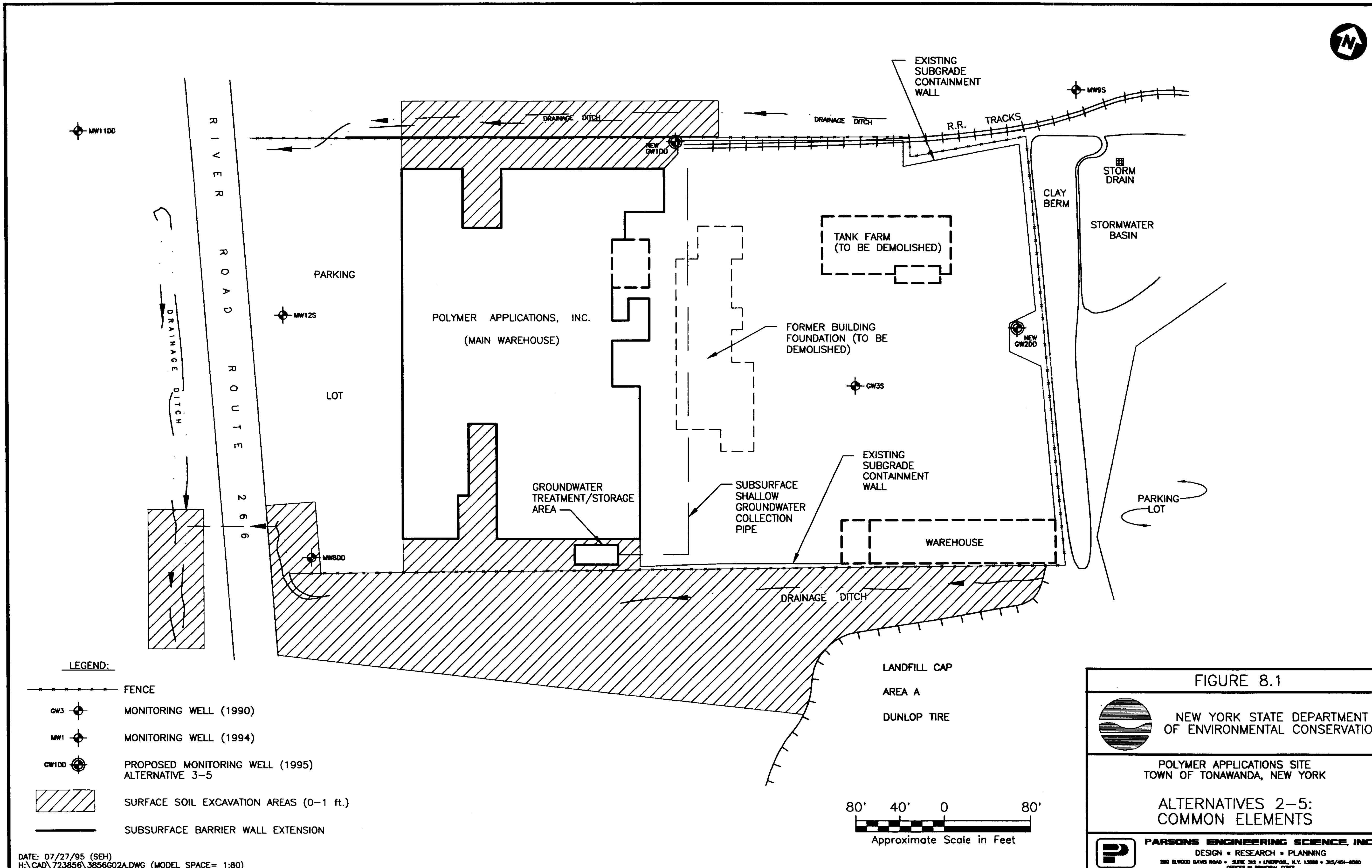
Implementability: The remedial activities of this alternative are proven technologies, and are technically and administratively feasible.

Status: Alternative 5 is retained for detailed analysis. It would meet remedial objectives for groundwater and soil.

TABLE 8.1

RETAINED TECHNOLOGIES USE IN ALTERNATIVES

	1 No Further Action	2 Soil Consolidation and Multi-layer Cap	3 In-situ Soil Treatment	4 Excavation and Ex-situ Soil Treatment	5 Off-site Disposal of Soils
SOIL TECHNOLOGIES					
Concrete Asphalt Cap		Option B		Option B	
Low Permeability SoilCap		Option A		Option B	
Surface Soil Excavation		X	X	X	X
Deeper Soil Excavation				X	X
Off-site Landfill			X	X	X
Bioventing			In-situ	Ex-situ (Option B)	
Low Temperature Thermal Desportion				Option A	
GROUNDWATER TECHNOLOGIES					
Groundwater Monitoring	X	X	X	X	X
Subsurface Barrier Wall Repair and Extension		X	X	X	X
Shallow Groundwater Collection Trench		X	X	X	X
Deep Groundwater Extraction Wells			X	X	X
Discharge to POTW		X	X	X	X
Groundwater Treatment by Carbon Adsorption		X	X	X	X
OTHER					
Resimous Material Collection and Offsite Treatment/Disposal		X	X	X	X
Demolition of Backyard Structures		X	X	X	X
Demolition of Rear Warehouse			X	X	X
Abandonment of Selected Wells		X	X	X	X


EXISTING
SUBGRADE
CONTAINMENT
WALL
MW9S
DRAINAGE DITCH
DRAINAGE DITCH
R.R. TRACKS
MW11DD
RIVER ROAD ROUTE 266
NEW GW1DD
STORM DRAIN
CLAY BERM
STORMWATER BASIN
TANK FARM
(TO BE DEMOLISHED)
PARKING
LOT
MW12S
POLYMER APPLICATIONS, INC.
(MAIN WAREHOUSE)
DRAINAGE DITCH
FORMER BUILDING
FOUNDATION (TO BE
DEMOLISHED)
NEW GW2DD
GW3S
EXISTING
SUBGRADE
CONTAINMENT
WALL
GROUNDWATER
TREATMENT/STORAGE
AREA
SUBSURFACE
SHALLOW
GROUNDWATER
COLLECTION
PIPE
PARKING
LOT
WAREHOUSE
MW6DD
DRAINAGE DITCH
LANDFILL CAP
AREA A
DUNLOP TIRE
LEGEND:
FENCE
GW3 MONITORING WELL (1990)
MW1 MONITORING WELL (1994)
GW1DD PROPOSED MONITORING WELL (1995)
ALTERNATIVE 3-5
SURFACE SOIL EXCAVATION AREAS (0-1 ft.)
SUBSURFACE BARRIER WALL EXTENSION
80' 40' 0 80'
Approximate Scale in Feet
FIGURE 8.1
NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION
POLYMER APPLICATIONS SITE
TOWN OF TONAWANDA, NEW YORK
ALTERNATIVES 2-5:
COMMON ELEMENTS
PARSONS ENGINEERING SCIENCE, INC.
DESIGN • RESEARCH • PLANNING
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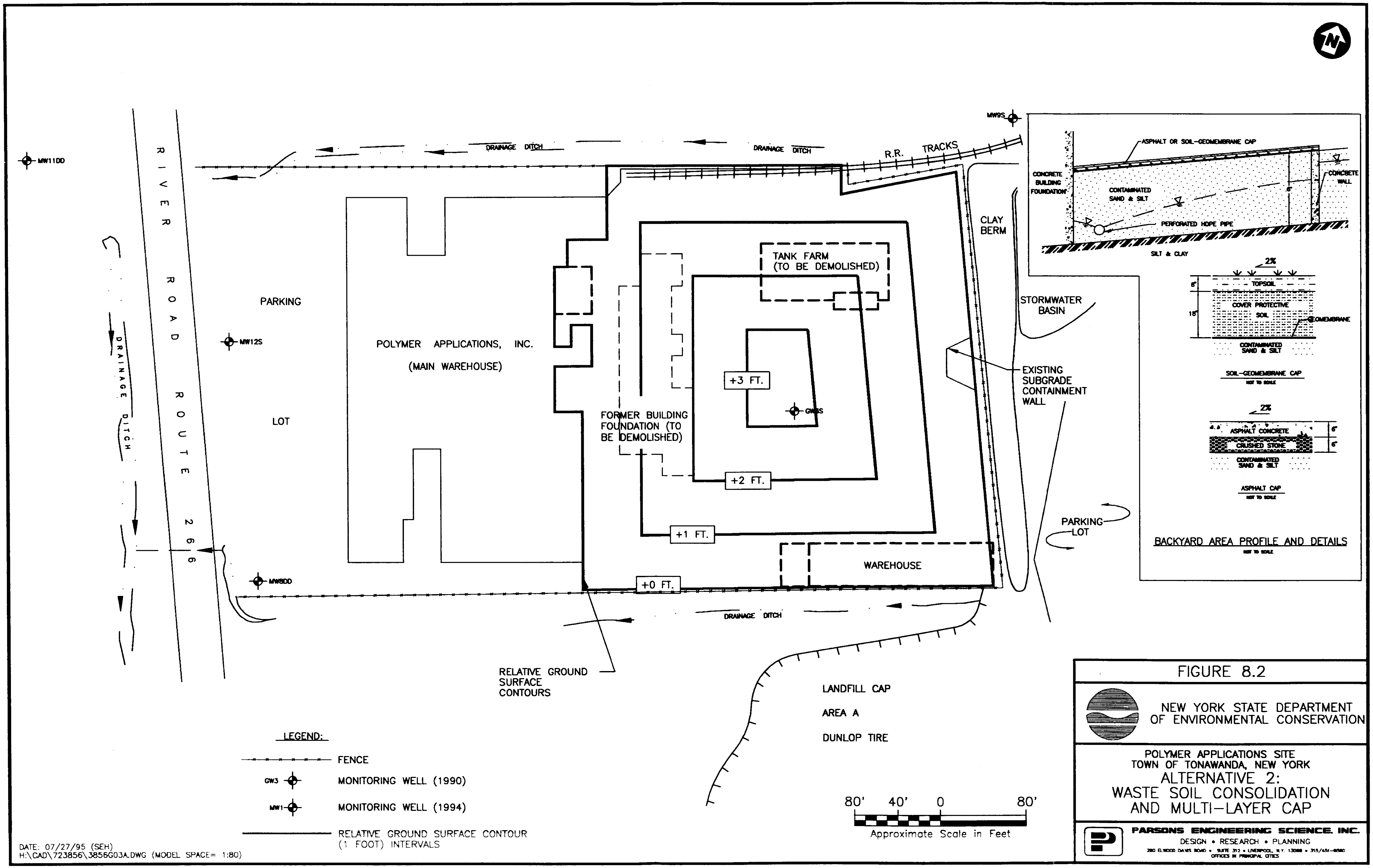
RIVER ROAD ROUTE 266
DRAINAGE DITCH
R.R. TRACKS
MW11DD
MW12S
MW8DD
MW9S
GW3S
PARKING LOT
POLYMER APPLICATIONS, INC.
(MAIN WAREHOUSE)
TANK FARM (TO BE DEMOLISHED)
FORMER BUILDING FOUNDATION (TO BE DEMOLISHED)
+3 FT.
+2 FT.
+1 FT.
+0 FT.
WAREHOUSE
CLAY BERM
STORMWATER BASIN
EXISTING SUBGRADE CONTAINMENT WALL
PARKING LOT
RELATIVE GROUND SURFACE CONTOURS
LANDFILL CAP
AREA A
DUNLOP TIRE
ASPHALT OR SOIL-GEOMEMBRANE CAP
CONCRETE BUILDING FOUNDATION
CONTAMINATED SAND & SILT
PERFORATED HDPE PIPE
CONCRETE WALL
SILT & CLAY
2%
TOPSOIL
COVER PROTECTIVE SOIL
GEOMEMBRANE
CONTAMINATED SAND & SILT
SOIL-GEOMEMBRANE CAP
NOT TO SCALE
ASPHALT CONCRETE
CRUSHED STONE
ASPHALT CAP
NOT TO SCALE
BACKYARD AREA PROFILE AND DETAILS
NOT TO SCALE
LEGEND:
FENCE
GW3 MONITORING WELL (1990)
MW1 MONITORING WELL (1994)
RELATIVE GROUND SURFACE CONTOUR (1 FOOT) INTERVALS
80' 40' 0 80'
Approximate Scale in Feet
DATE: 07/27/95 (SEH)
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FIGURE 8.2
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
POLYMER APPLICATIONS SITE
TOWN OF TONAWANDA, NEW YORK
ALTERNATIVE 2:
WASTE SOIL CONSOLIDATION AND MULTI-LAYER CAP
PARSONS ENGINEERING SCIENCE, INC.
DESIGN • RESEARCH • PLANNING

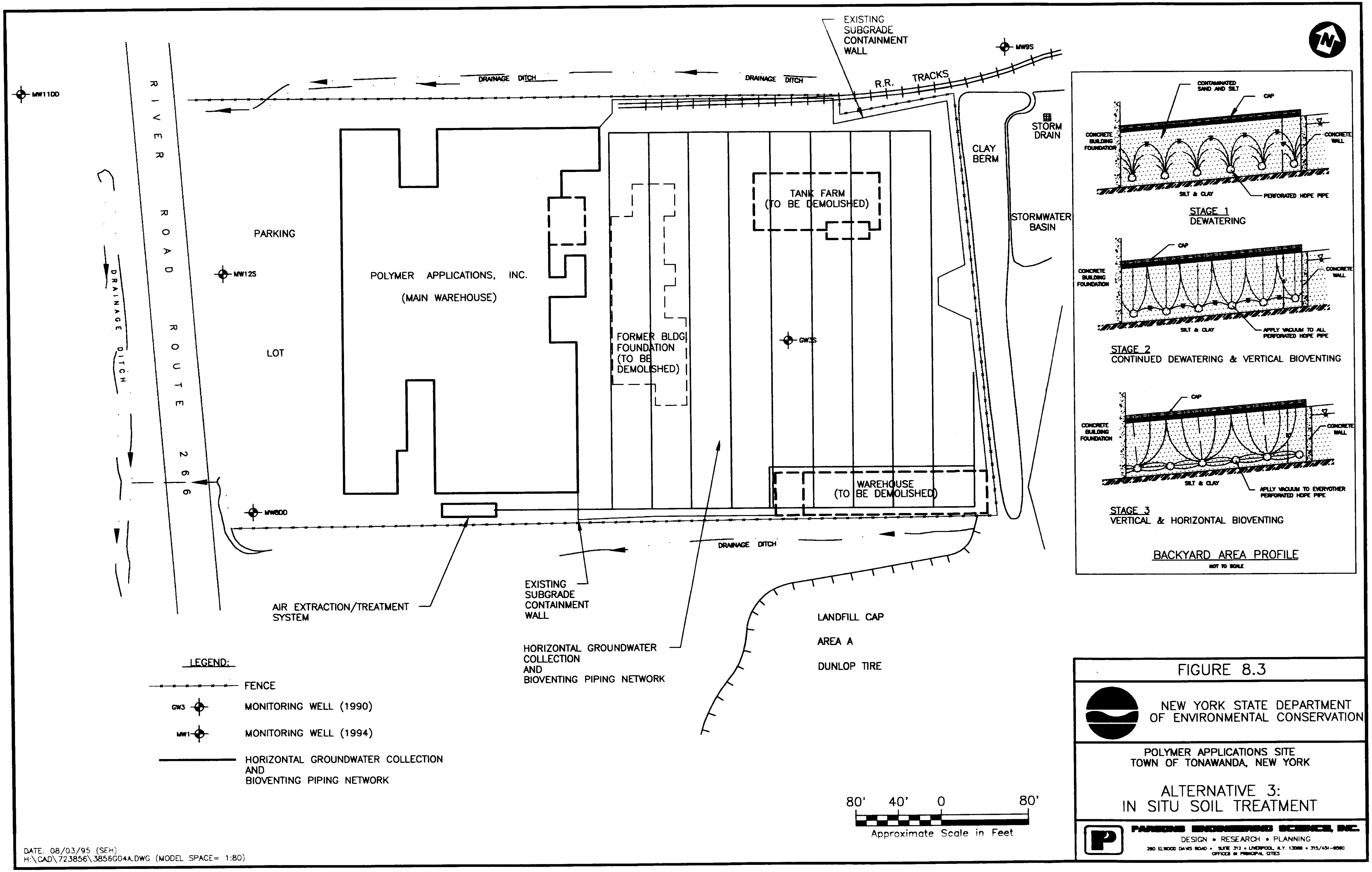
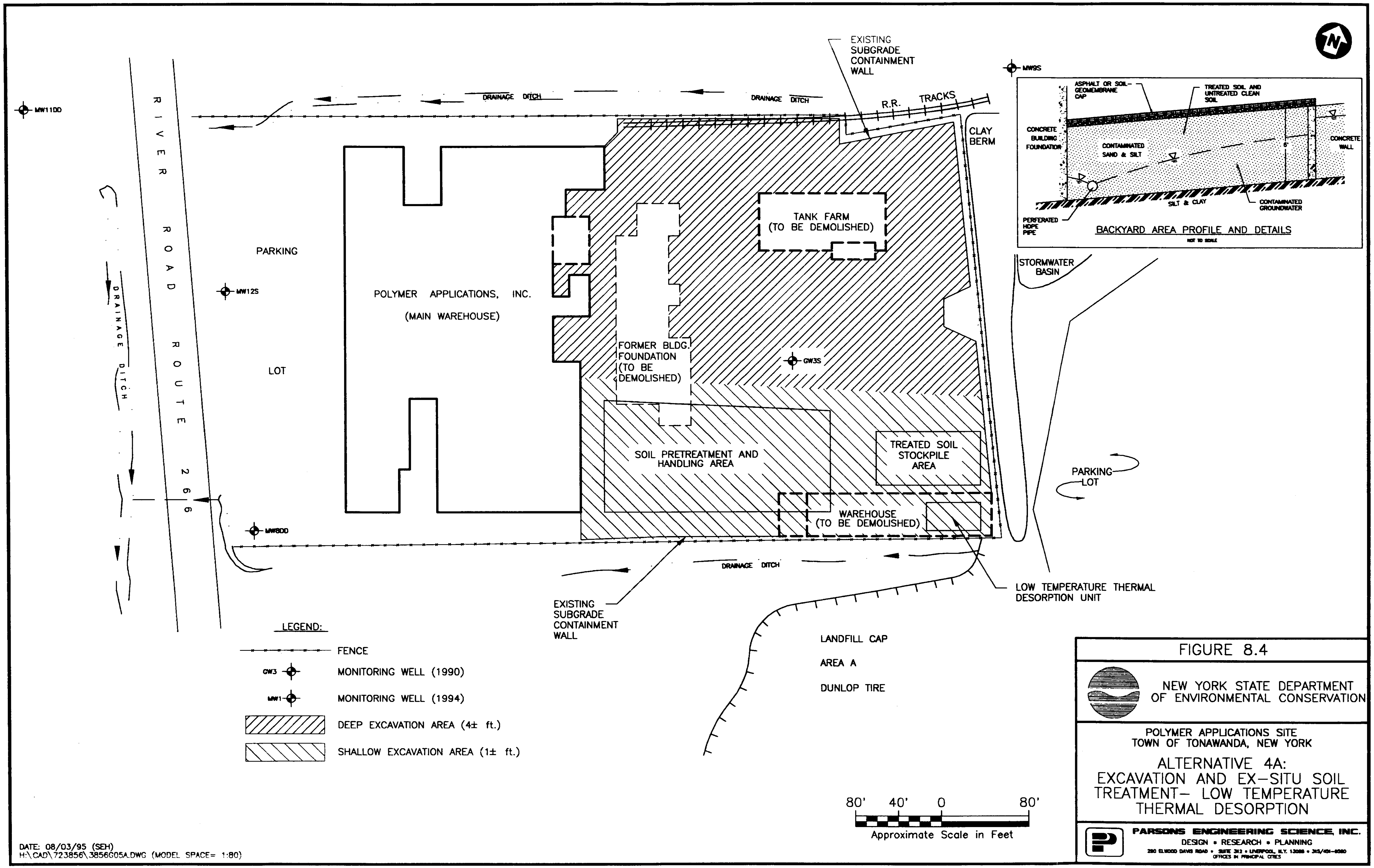


FIGURE 8.3

POLYMER APPLICATIONS SITE
TOWN OF TONAWANDA, NEW YORK

ALTERNATIVE 3:
IN SITU SOIL TREATMENT



EXISTING SUBGRADE CONTAINMENT WALL
MW9S
MW11DD
DRAINAGE DITCH
R.R. TRACKS
CLAY BERM
RIVER ROAD
ROUTE 266
DRAINAGE DITCH
PARKING
LOT
MW12S
POLYMER APPLICATIONS, INC.
(MAIN WAREHOUSE)
TANK FARM
(TO BE DEMOLISHED)
FORMER BLDG. FOUNDATION (TO BE DEMOLISHED)
GW3S
SOIL PRETREATMENT AND HANDLING AREA
TREATED SOIL STOCKPILE AREA
WAREHOUSE
(TO BE DEMOLISHED)
MW8DD
STORMWATER BASIN
PARKING LOT
LOW TEMPERATURE THERMAL DESORPTION UNIT
EXISTING SUBGRADE CONTAINMENT WALL
LANDFILL CAP
AREA A
DUNLOP TIRE
BACKYARD AREA PROFILE AND DETAILS
NOT TO SCALE
ASPHALT OR SOIL-GEOMEMBRANE CAP
TREATED SOIL AND UNTREATED CLEAN SOIL
CONCRETE BUILDING FOUNDATION
CONTAMINATED SAND & SILT
CONCRETE WALL
SILT & CLAY
CONTAMINATED GROUNDWATER
PERFORATED HDPE PIPE
LEGEND:
FENCE
GW3 MONITORING WELL (1990)
MW1 MONITORING WELL (1994)
DEEP EXCAVATION AREA (4± ft.)
SHALLOW EXCAVATION AREA (1± ft.)
80' 40' 0 80'
Approximate Scale in Feet
FIGURE 8.4
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
POLYMER APPLICATIONS SITE
TOWN OF TONAWANDA, NEW YORK
ALTERNATIVE 4A:
EXCAVATION AND EX-SITU SOIL TREATMENT- LOW TEMPERATURE THERMAL DESORPTION
PARSONS ENGINEERING SCIENCE, INC.
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DATE: 08/03/95 (SEH)
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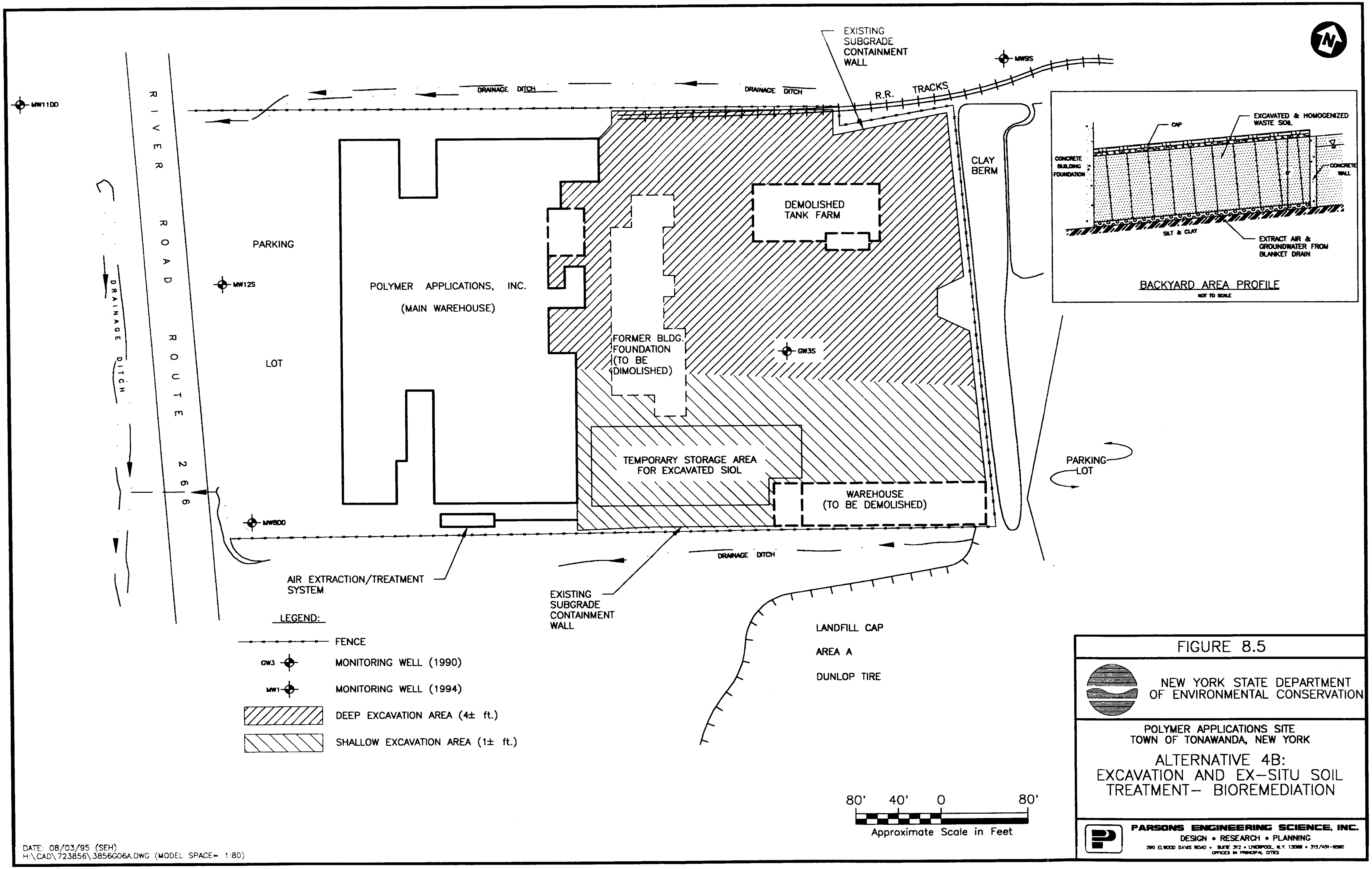
EXISTING
SUBGRADE
CONTAINMENT
WALL
MW9S
R.R. TRACKS
DRAINAGE DITCH
DRAINAGE DITCH
MW11DD
RIVER ROAD ROUTE 266
DRAINAGE DITCH
PARKING
LOT
MW12S
POLYMER APPLICATIONS, INC.
(MAIN WAREHOUSE)
DEMOLISHED
TANK FARM
FORMER BLDG.
FOUNDATION
(TO BE
DIMOLISHED)
GW3S
CLAY
BERM
TEMPORARY STORAGE AREA
FOR EXCAVATED SIOL
WAREHOUSE
(TO BE DEMOLISHED)
PARKING
LOT
MW8DD
DRAINAGE DITCH
AIR EXTRACTION/TREATMENT
SYSTEM
EXISTING
SUBGRADE
CONTAINMENT
WALL
LANDFILL CAP
AREA A
DUNLOP TIRE
CAP
EXCAVATED & HOMOGENIZED
WASTE SOIL
CONCRETE
BUILDING
FOUNDATION
CONCRETE
WALL
SILT & CLAY
EXTRACT AIR &
GROUNDWATER FROM
BLANKET DRAIN
BACKYARD AREA PROFILE
NOT TO SCALE
LEGEND:
FENCE
GW3 MONITORING WELL (1990)
MW1 MONITORING WELL (1994)
DEEP EXCAVATION AREA (4± ft.)
SHALLOW EXCAVATION AREA (1± ft.)
80' 40' 0 80'
Approximate Scale in Feet
FIGURE 8.5
NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION
POLYMER APPLICATIONS SITE
TOWN OF TONAWANDA, NEW YORK
ALTERNATIVE 4B:
EXCAVATION AND EX-SITU SOIL
TREATMENT– BIOREMEDIATION
PARSONS ENGINEERING SCIENCE, INC.
DESIGN • RESEARCH • PLANNING
DATE: 08/03/95 (SEH)
H:\CAD\723856\3856G06A.DWG (MODEL SPACE= 1:80)

SECTION 9

DETAILED ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

9.1 INTRODUCTION

This section presents the results of a detailed analysis of the remedial action alternatives developed and carried through the preliminary screening in Section 8 of this report. The purpose of Section 8 was to develop a set of alternatives that satisfy the overall goal of the FS and the remedial objectives for the site. The objective of the detailed analysis of the alternatives is to provide sufficient information for the NYSDEC to select an appropriate remedy for the project site.

This section is composed of a number of subsections. Section 9.1 contains a description of the criteria used for the detailed evaluation. Section 9.2 contains the detailed evaluations of the remedial alternatives with respect to the evaluation criteria. Section 9.3 is the comparison of alternatives for the Polymer Applications site.

During the detailed analysis, each alternative is assessed against the evaluation criteria described in NYSDEC TAGM #HWR-90-4030 (NYSDEC, 1990) and USEPA FS guidance (USEPA, 1988):

- Overall protection of human health and the environment
- Compliance with Standards, Criteria and Guidelines (SCGs)
- Short-term impacts and effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Implementability
- Cost

The community acceptance criterion included in the NYSDEC TAGM #HWR-90-4030 (NYSDEC, 1990) and the USEPA FS guidance (USEPA, 1988) will be evaluated by the NYSDEC for all alternatives following public review of the FS.

Protection of human health and the environment was evaluated by determining whether the alternative achieves the remedial action objectives (ROAs) presented in Section 7.1.5 and any other special issues regarding protection of human health and the environment.

The chemical-specific, and action-specific SCGs were presented in Tables 7.1, and 7.2 respectively. No location-specific SCGs were identified for the site. The major SCGs for the Polymer Application site are listed in Table 9.1

Short-term effectiveness evaluated the risk of exposure to compounds of concern, physical injury and damage to remedial workers, community residents, community structures, and the greater environment during the implementation of each alternative. It also evaluated how any short-term risks would be controlled, the effectiveness/reliability of the controls, and how long the alternative would take to achieve the RAOs. The assessment of long-term effectiveness and permanence includes the "durability" of actions after completion to block significant threats, exposure pathways, or risks to the community or environment. It also assessed the level of confidence that the alternative would work and whether the alternative includes permanent treatment. The evaluation of toxicity, mobility, and volume was based on the degree to which the contamination would be treated, the reversibility of the treatment, the reduction in mobility of contaminants, and whether the treatment residuals would pose any problems. Implementability was addressed based on the potential construction and O&M difficulties in applying the alternative to the site, including the availability of services and materials. Technical constraints at the Polymer Applications site included existing structures, space constraints, and adjoining properties. Administrative considerations included land use restrictions and long-term monitoring requirements.

A preliminary construction cost estimate was prepared for each alternative. The estimate is accurate within -30 percent to +50 percent for the assumptions provided in the discussion of each alternative. The costs were calculated for a 30 year time period at a 3 percent interest rate.

9.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

The remedial alternatives developed and retained through screening for contaminated soil and groundwater at the Polymer Applications site were evaluated using the criteria in this section. The alternatives that were evaluated are as follows:

- Alternative 1 - No Further Action,
- Alternative 2 - Soil Consolidation and Multi-layer Cap,
- Alternative 3 - *In situ* Soil Treatment,
- Alternative 4 - Excavation and *Ex situ* Soil Treatment, and
- Alternative 5 - Offsite Disposal of Soils

A summary of each alternative with results from the evaluation of each criteria is presented in Table 9.2.

9.2.1 Alternative 1 - No Further Action

Alternative 1 does not include any remedial activities; it is titled No Further Action rather than No Action because some remedial work was conducted as emergency actions by USEPA as described in Section 1.2.2.6.

The RAOs are not met for Alternative 1. The risk from contact with surface soil remains for onsite workers and residents exposed to offsite surface soil/sediment contamination. Subsurface soil contamination would still impact groundwater. Groundwater quality would not be improved, and impacts to fish and wildlife would remain at current levels.

Of the main SCGs identified for the FS, the two chemical-specific SCGs for soil and groundwater would not be met. The four action-specific SCGs are not applicable because this alternative does not have any remedial activities. Alternative 2 would not produce any emissions, and capping would eliminate emissions from site soils.

The No Further Action alternative is not protective of human health and the environment because the human health risks associated with the site would not be reduced. As calculated in the human health evaluation, there are carcinogenic risks that exceed USEPA's target range and non-carcinogenic exposure that may result in adverse health effects. The completed exposure pathways include contact with soils and groundwater, and ingestion of groundwater.

There are no short-term risks to the community or the environment associated with the No Further Action alternative because there are no remedial activities in this alternative.

This alternative is not effective in the long-term and does not meet NYSDEC's definition of a permanent remedy. As this alternative does not reduce concentrations of organics in groundwater and soil at the site that exceed the recommended cleanup goals, and potential exposure pathways to humans and the environment would continue, a long-term monitoring program would be needed.

No reduction in toxicity, mobility, and volume of contamination would be achieved with this alternative.

This alternative meets the minimum requirements for technical implementability because no construction is required. The services and materials required to implement well decommissioning and long-term monitoring for this alternative are readily available. No problems coordinating with other agencies are anticipated.

The total present worth cost for Alternative 1 is estimated at $70,000. A detailed breakdown of the cost components is presented in Appendix J.

9.2.2 Alternative 2 - Soil Consolidation and Multi-layer Cap

Alternative 2 would achieve most RAOs. The contact risk from surface soils and sediment would be eliminated through capping. Shallow groundwater quality would be improved through collection and treatment, although the source of shallow groundwater contamination would remain. Capping would also remove impacts to fish and wildlife and eliminate VOC emissions.

Protection of human health and the environment would be achieved, provided the cap was maintained, through the elimination of the significant site exposure pathways of dermal contact and ingestion of soil and sediment. Future land use would be restricted to protect cap integrity and ensure subsurface soils are not exposed.

Alternative 2 would not comply some of the major SCGs listed in Table 9.1 The chemical-specific SCGs for soil/sediment and groundwater would not be satisfied. Of the action-specific SCGs, the requirements for a cap on a solid waste landfill would be met by the soil-geomembrane cap of Option 2A, but only partially by the asphalt cap of Option 2B. Standards for treatment, storage, and disposal of hazardous waste are only applicable to soils that are excavated. These requirements would be met for the resinous material disposed off site, but would not be met for excavated shallow soils moved to the rear yard area and covered by the cap. However, for the purpose of implementing remedies, the NYSDEC may designate an area at the facility as a Corrective Action Management Unit (CAMU). Placement of remediation waste into or within a CAMU does not constitute land disposal of hazardous waste, and does not constitute creation of a unit subject to minimum technology requirements. Waste management activities associated with the CAMU must not create unacceptable risks to humans or the environment from exposure to hazardous waste. Areas within the CAMU where wastes remain in place after closure of the CAMU, must be managed and contained so as to minimize future releases, to the extent practicable. Extracted groundwater would be treated to meet Town of Tonawanda pretreatment standards. Other action-specific SCGs would also be met. Storm runoff during Alternative 2 implementation would be monitored in compliance with the NYSDEC general storm water permit for construction activities.

The short-term risk of injury to workers and the community or damage to the environment associated with construction and demolition activities would be low, provided that safety procedures are implemented. Health and safety measures such as careful excavation and use of appropriate personal protective equipment to prevent contact with surface soils or subsurface soils encountered during shallow trenching and barrier wall construction would be implemented. These controls would be effective at reducing risks. Alternative 2 would take less than 1 year to construct, and RAOs that can be met would be achieved with the completion of construction.

Completion of Alternative 2 would effectively block the significant threats and exposure pathways to the community or the environment from site contaminants through containment. Alternative 2 would minimize air emissions also. Alternative 2 would achieve RAOs with a good degree of confidence as long as the cap, containment wall, and groundwater treatment system are properly maintained and operated. Alternative 2 does not constitute a permanent remedy, although it would be effective for blocking exposure pathways as long as the cap was maintained. Because Alternative 2 is not a permanent solution, a periodic reevaluation of the remedial action would be necessary. Any breaching of the cap or subsurface excavation would reestablish the contact exposure pathways. The asphalt cap could be used for industrial activities or parking if the cap is regularly inspected and properly maintained.

The mobility of offsite and onsite soil and sediment contamination would be significantly reduced through excavation and removal to the rear yard, capping, and repair of the containment wall. The toxicity and volume of soil and sediment contamination would be unchanged. Shallow groundwater extraction and treatment would irreversibly reduce the mobility, toxicity, and volume of shallow groundwater contamination. The cap and subsurface containment wall would minimize generation of additional groundwater in the shallow zone.

All the technologies used in the construction of this alternative are widely used and readily available. O&M requirements include inspection and maintenance of the cap, and ongoing operation of the groundwater treatment system. These services are also commonly-used and available. A permit for discharge of pretreated water to the Town of Tonawanda POTW would need to be obtained.

The total present worth costs of Alternatives 2A (soil geomembrane cap) and 2B (asphalt cap) are estimated to be $2,100,000 and $2,000,000, respectively. A detailed breakdown of the cost components is presented in Appendix J. The following is a list of assumptions that are common to the cost estimates developed for Alternatives 2 through 5.

- An estimated 1,000 CY of resinous material would be skimmed from the backyard and along the sides of the main warehouse, and disposed of in an off site landfill.
- An estimated 3,800 CY of surface soil and sediment would be excavated from the north and south ditches, and from the ditch across River Road. This soil would be moved onto the backyard to be covered by the cap.
- Groundwater would be treated to meet Town of Tonawanda pretreatment limits.
- The subsurface barrier wall extension would extend 300 feet west of the existing wall, and it would be keyed into the clay layer beneath the site (estimated wall depth of 6 feet).
- All structures in the yard area except the rear warehouse would be leveled.

The following assumptions are specific to Alternative 2.

- A cap over the backyard would cover 14,400 SY, and would have a minimum 2 percent slope for surface drainage. The cap would be constructed of:

  A) 6 inches topsoil over
  18 inches cover soil over
  60 mil HDPE;

  or

  B) 6 inches asphalt over
  6 inches crushed stone base.

- Groundwater flow is estimated at 1 gpm.
- This alternative is estimated to take less than 1 year to implement once construction is initiated.

9.2.3 Alternative 3 - *In situ* Soil Treatment

Alternative 3 would achieve the RAOs by capping (for the short-term) and *in situ* soil treatment (for the long-term). Capping and shallow soil and sediment excavation would remove the surface soil and sediment contact threat. Groundwater quality would be improved through extraction and treatment, and *in situ* soil treatment would reduce the soil contamination that is the source of groundwater contamination. Capping and shallow soil/sediment excavation would also prevent impacts of contamination to fish and wildlife. The *in situ* biological soil treatment would produce a low-flow air stream, and this would be monitored to ensure that the emissions contain acceptable levels of contamination.

The significant exposure pathways of ingestion and dermal contact with soils and sediment would be removed through excavation and removal to the backyard, capping and, depending on its success, *in situ* biological treatment. Overall protection of human health and the environment would be achieved. Exposure pathways would be blocked by a combination of compound removal through treatment and containment. Future land use may or may not be restricted based on the level of soil treatment achieved through bioventing.

Alterative 3 would comply with the action-specific SCGs, but might not comply with chemical-specific SCGs. The *in situ* soil treatment in Alternative 3 would result in the reduction in concentrations of organic compounds at the site, but its treatment efficiency is uncertain given the soil heterogeneity and the organic compounds present at the site whether the soil SCGs could be achieved. Because the soil contaminants are a source of groundwater contamination, it is therefore also uncertain whether groundwater SCGs could be achieved. Shallow groundwater would be removed from the backyard and treated to meet pretreatment standards. Following cap installation and dewatering, there would not be shallow groundwater in the backyard. Deep groundwater would also be extracted from two deep monitoring wells and treated. Deep groundwater contamination remaining after 1 year of pumping would be evaluated to determine the extent of deep aquifer contamination. If concentrations drop during the year of pumping as expected, limited contamination due to deep well construction may be indicated, and groundwater SCGs may be achieved. If concentrations are not affected by 1 year of pumping, widespread contamination of the deep aquifer may be indicated (which is not indicated in existing data), at which point further investigation into the nature and extent of contamination and possible remediation would have to be conducted.

The action-specific SCGs that apply to Alternative 3 concern the excavation, handling, treatment, and disposal of shallow soils, some of which are RCRA hazardous wastes, and permit requirements for groundwater treatment. These SCGs would be met through proper remedial design, and designation of the rear yard area as a CAMU.

Short-term risk associated with Alternative 3 would be similar to, but greater than, Alternative 2 due to the trenching required to install the perforated pipe network. Some of the trenching would be through areas shown to have significant concentrations of VOCs. These risks would be mitigated by organic vapor monitoring, use of appropriate PPE, and engineering controls such as fans or foam. These risks would be very short in duration, would not extend beyond the facility, and would not cause a risk to the community or the environment. This alternative would take less than 1 year to construct and up to 10 years to implement.

Once implemented, the significant exposure pathways of contact or ingestion of site soils and sediment would be removed through containment (short-term) and *in situ* treatment (long-term). The *in situ* treatment element offers additional protection over the containment of Alternative 2 because the treatment that occurs is permanent. The degree to which soils would be treated is anticipated to be limited due to the heterogeneous nature of in-place soil and the distribution and concentrations of in-place contamination. Shallow groundwater would be removed through dewatering and not replenished because of installation of the cover and repair of the containment wall.

Controls may or may not be required following completion of *in situ* soil treatment, depending on the level of treatment achieved. If the level of treatment is not sufficient to achieve acceptable risk from direct contact with surface soils, periodic inspection and maintenance of the cover would be required for continued protection against direct contact. In this case, long-term monitoring would be required. Operation of the groundwater treatment and air extraction/treatment systems would not be required following implementation of this alternative.

Implementation of Alternative 3 would result in reduction of toxicity, mobility, and volume of soil, sediment, and groundwater contamination through treatment. The degree of treatment may be limited due to *in situ* soil conditions and distribution of organic compounds. All the soil and sediment in the rear yard area would potentially receive treatment. Extracted groundwater would be treated aboveground. Both of these treatments are irreversible. The only treatment residuals are anticipated to be used activated carbon from groundwater and extracted air treatment. Used carbon would be regenerated off site.

It is anticipated that *in situ* soil treatment via bioventing would be difficult to implement at the Polymer Applications site due to several factors:

- Soil in the backyard varies in permeability from 10^{-3} to 10^{-6} cm/sec. The tight soils would be more difficult to dewater and would be more difficult to move air through during bioventing, reducing treatment effectiveness.
- Biological treatment of phenols can be inhibited in soils with concentrations greater than approximately 100 mg/kg. Phenol concentrations exceeded this concentration in the soil sample from test pit TP1C, indicating that *in situ* biological treatment may not be effective in this area.
- Other phenolic compounds and organic compounds are assumed to be present, but were not quantified as explained in the RI. These compounds may affect how well biological treatment would work at the site.

Other aspects of Alternative 3 would be easily implementable. Services and materials are readily available.

Permits would be required for discharge of treated groundwater to the Town of Tonawanda POTW, and possibly for emissions from the air extraction/treatment system.

The total present worth cost to implement Alternative 3 is estimated at $2,900,000. A detailed cost breakdown is included in Appendix J. Assumptions for the Alternative 3 cost estimate that are common to Alternative 2 are presented in Section 9.2.2. The following assumptions are specific to Alternative 3:

- A network of 3,600 linear feet of 6-inch HDPE perforated pipe would be required to dewater and extract air from yard area soils.
- Extracted air would be treated using vapor-phase carbon to meet NYSDEC air emissions guidelines.

- The geomembrane cover over the backyard would include filter fabric, geonet, cushion geotextile, geomembrane, 12 inches of cover soil, 6 inches of topsoil, and vegetative cover.
- This alternative is estimated to take less than 1 year to construct, and 10 years to implement.

The following assumptions are common to Alternative 3 through 5.

- An estimated 100 CY of soil with PCB concentration > 50 ppm would be excavated and disposed of in an offsite landfill.
- Groundwater flow from dewatering is estimated at 1 gpm and from deep monitoring wells at 20 gpm.

9.2.4 Alternative 4 - Excavation and *Ex situ* Treatment

The RAOs would be satisfied for Alternative 4. The surface soil contact threat would be eliminated through removal and offsite disposal of resinous material and PCB-contaminated soils, and *ex situ* soil treatment (augmented by a cap in Option 4B). Groundwater quality would be restored as practicable through collection of shallow groundwater and limited pumping of deep groundwater, and subsequent treatment and discharge to the Town of Tonawanda POTW. Soil and sediment removal and treatment would also prevent the impact of contaminated soils in groundwater and on fish and wildlife. Excavation of rear yard soils containing significant concentrations of VOCs and *ex situ* soil treatment could result in VOC emissions, but these would be reduced or controlled during excavation, soils handling, and treatment. Treatment and capping of soils would also reduce any emissions from the site under baseline conditions.

Protection of human health and the environment would be achieved. Significant exposure pathways involving soil and sediment contamination would be blocked by *ex situ* treatment (Option 4A) or a combination of capping (for the short-term) and *ex situ* treatment (for the long-term) (Option 4B), and shallow groundwater removal and treatment. Future land use would be unrestricted for Option 4A, and for Option 4B, provided a sufficient level of treatment is achieved.

Most, if not all, chemical-specific SCGs for Alternative 4 would be met. The level of soil and sediment treatment that can be achieved using thermal desorption (Option 4A) or bioventing (Option 4B) would need to be investigated through treatability testing, but it is believed that treatment goals could be achieved by both types of treatment. Studies indicate that phenols and BTEX are amenable to biological treatment (USEPA, 1993a; Arthur D. Little, Inc., 1987), and the homogenization of excavated soils prior to placement in the treatment cell would improve the level of treatment, and at the same time, ~~would~~ remove some implementation difficulties associated with *in situ* bioventing. Mixing would produce a uniform permeability which would allow equal distribution of air flow through soils and would also break up pockets of high concentrations of contaminants. Class GA Groundwater Standards and Guidance Values may not be achieved, depending on the level of soil treatment achieved and on the degraded groundwater quality in the area.

The action-specific SCGs would also be met for Alternative 4. Because the soil is a listed hazardous waste, the hazardous waste designation would remain following treatment. The low levels of hazardous wastes remaining after completion of soil treatment would not pose a risk, however. By designating the rear yard as a CAMU, NYSDEC can set alternate standards for remediation waste that are tailored to site conditions, rather than requiring the LDR treatment standards and minimum technology requirements for new hazardous waste land disposal units. The alternative standards must be protective of human health and the environment.

The short-term risk of this alternative would be similar to Alternative 3 with the additional risk of a larger scale excavation in the backyard where high concentrations of VOCs are located. Actions taken to reduce VOC emissions might include scheduling excavation during late fall or winter to reduce volatilization, or use of fans, spray water, or foam during excavation. Organic vapor emissions would be closely monitored during excavation, and appropriate health and safety measures would be taken to protect worker and community health. Monitoring equipment on the thermal desorption unit, and appropriate health and safety PPE and procedures would be used by onsite workers to mitigate risk from onsite thermal treatment. The thermal desorption unit would be operated within appropriate parameters to protect community health.

Once implemented, no significant threats or exposure pathways would remain. The long-term effectiveness of Alternative 4 for blocking exposure pathways is greater than for Alternative 3 because *ex situ* soil treatment is anticipated to be more effective at reducing organic compound concentrations than *in situ* treatment. *Ex situ* treatment is a permanent remedy. Option 4A would be constructed and implemented in less than 1 year. Option 4B would be constructed in less than 1 year, but would take an estimated 5 years to implement. The level of confidence in Option 4A is higher than in Option 4B.

Through *ex situ* treatment and offsite disposal of resinous material and PCB-contaminated soils, the mobility, toxicity, and volume of compounds of concern in soils at the Polymer Applications site would be significantly and irreversibly reduced. Shallow groundwater would be removed and treated along with deep groundwater from two deep monitoring wells, reducing mobility, toxicity, and volume of site groundwater contamination. Treatment residuals from soil (Option 4A only) and groundwater treatment would be destroyed offsite.

The technical aspects of this Alternative would be implementable. Excavation of yard area soils for thermal desorption (Option 4A) or bioventing (Option 4B) would be staged because of space limitations. As discussed above, VOC emissions from the deeper soil excavation would need to be carefully monitored and controlled. Thermal desorption would require authorization from NYSDEC equivalent to obtaining a Part 373 permit for treatment of a hazardous waste. Because of questions being raised as to whether a thermal desorption unit with an afterburner is an incinerator or not, the permitting process may be extensive. No equivalent permit would be required for the Option 4B bioventing, but the level of treatment that could be achieved is less certain. The use of the excavation as a treatment cell and the use of the blanket drain for vapor extraction are innovative design aspects of Option 4B. The rear warehouse foundation and subsurface containment wall around the backyard would act as low-permeability barriers. The use of the crushed stone or geonet layer, imbedded with a perforated pipe network, for dewatering and vapor extraction is based on biopile construction techniques. This design would be tested during pre-design studies. Treatability testing, optimally on both composite and "hot spot" soils from the Polymer Applications site, would be required prior to remedial design to determine pretreatment requirements, operating parameters, and expected level of treatment. No special difficulties are anticipated for O&M of the groundwater collection and treatment systems, or the air extraction/treatment system (Option 4B only). The services and materials for all the remedial elements of Alternative 4 are readily available. A permit to discharge wastewater would be required from the Town of Tonawanda; it may be difficult to obtain because of previous problems from when Polymer Applications was active.

The total present worth costs to implement Option 4A and 4B are estimated to be $5,400,000 and $3,000,000, respectively. A detailed breakdown of the cost components is presented in Appendix J. The assumptions common to Alternatives 2 through 5 is included in Section 9.2.2. The assumptions common to Alternatives 3 through 5 are in Section 9.2.3. The following assumptions are specific to Alternative 4.

- An estimated 2,000 CY of surface soil would be excavated (+/- 1 foot depth) in the southern one-third of the backyard area.
- An estimated 13,200 CY of surface and subsurface soil would be excavated (+/- 4 foot depth) in the northern two-thirds of the backyard area.
- Low temperature thermal desorption (Option 4A) would be conducted in a mobile unit located on the rear warehouse pad. unit throughput would be 5 to 10 tons per hour. Off gas would be treated to meet NYSDEC emission guidelines.
- Biological treatment (Option 4B) would be conducted in a treatment cell in the backyard excavated areas consisting of a blanket drain and 6-inch diameter perforated collection piping, and excavated, homogenized soil, topped with a soil or asphalt cap over a drainage layer. The underlying blanket drain would be used both for dewatering the placed soil and for extracting air for bioventing. Extracted air would be treated using carbon adsorption as needed prior to release.
- Option 4A is estimated to take less than 1 year to complete. Option 4B is estimated to take 2 to 5 years to construct and fully implement.

9.2.5 Alternative 5 - Offsite Disposal of Soils

The RAOs would be satisfied for reasons discussed for Alternative 4. Excavation and offsite disposal of soils would eliminate the surface soil contact threat and would prevent impacts of contaminated soils on groundwater quality and on fish and wildlife. Groundwater quality would be improved to the extent practicable through collection of shallow groundwater and some deep groundwater, and treatment. Air emissions from the site under baseline conditions would be eliminated through soil removal, and any emissions that could potentially occur during soil excavation would be controlled as necessary to prevent unacceptable risk.

Protection of human health and the environment would be achieved through elimination of all significant exposure pathways. Some potential for exposure or spread of contamination during remedial site work exists, but this exposure would be minimized by the use of engineering controls. Future land use would be unrestricted.

Chemical-specific SCGs would be achieved, with the possible exception of the Class GA Groundwater Standards and Guidance Values. Because of the degraded groundwater quality in the area, meeting the SCGs may not be possible. Action-specific SCGs would also be achieved. Landfill closure and post-closure care would not be necessary because almost all contaminated soil would be removed. Soils would be handled, transported, and disposed according to applicable regulations. Collected and extracted groundwater would be treated to meet Town of Tonawanda pretreatment requirements. Air emissions would be monitored during excavation to ensure acceptable levels were not exceeded; engineering controls would be used as necessary.

The short-term risks for Alternative 5 would be the same excavation risks as for Alternative 4 without the limited, potential risks to workers from onsite treatment. Materials handling and road use would be carefully planned to control risks from loading and transportation of soils for offsite disposal. Traffic control would be an important aspect of Alternative 5. Assuming the use of 20 ton trucks to haul excavated soil and sediment, removal may require the use of approximately 1,200 truck loads. A similar number of trucks would also be needed to deliver clean fill to the site for backfilling. Traffic routes to the landfill would be carefully planned to avoid residential areas as much as possible, and to minimize disruptions to local traffic patterns. Alternative 5 would take less than 1 year to implement.

Following implementation of Alternative 5, almost no soil, sediments, or shallow groundwater exceeding clean-up goals would remain on site, so the remediation of the site would be permanent. Future land use would be unrestricted.

The treatment of soil that might occur in Alternative 5 would be the offsite, permanent treatment needed if soil concentrations of hazardous waste constituents exceeded Land Disposal Restrictions. With respect to the Polymer Applications site itself, mobility, toxicity, and volume of compounds of concern would be reduced. For the landfill soil, mobility would be reduced through containment at a RCRA- or TSCA-approved landfill. Toxicity would be reduced if soil is treated, but volume would remain unchanged. Shallow groundwater (from collection or excavation dewatering) would be permanently treated.

The technical and administrative aspects of Alternative 5 would be implementable. Some potential construction problems include the limited space at the site, and the possibility of VOC emissions during excavations. The excavation and backfilling would need to be staged. The time of excavation and/or engineering controls would be used to control VOC emissions, as discussed for Alternative 4. The only O&M requirements would be limited operation of the groundwater treatment plant for an estimated 10 years. Services and materials for both construction and O&M are readily available. The only problem that may occur in obtaining permits is the reluctance of the Town of Tonawanda to issue a discharge permit, due to past problems at the site when the facility was active.

The total present worth costs to implement Alternative 5 is estimated to be $11,000,000. A detailed breakdown of the cost components is presented in Appendix J. Assumptions common to Alternative 5 and other alternatives are included in Sections 9.2.2 and 9.2.3. The following assumptions are specific to Alternative 5.

- An estimated total of 19,000 CY would be excavated on site and off site and disposed off site in a RCRA- or TSCA-approved landfill. An estimated 11,600 CY would be treated to meet LDRs prior to landfilling.
- Excavations would be backfilled with clean fill and 6 inches of topsoil, and would be seeded.

9.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

There were five remedial action objectives developed for the Polymer Applications site. Alternative 1, the No Further Action alternative, would not meet any of the RAOs. Alternatives 2 through 5 would all achieve the RAOs of eliminating the surface soil contact threat, preventing the impact of contaminated soils and sediments on fish and wildlife, and preventing air emissions that would pose an unacceptable level of risk, depending on the definition of "to the extent practicable". Alternatives 4 and 5 would meet the RAOs of restoring groundwater quality to the extent practicable and preventing the impact of contaminated soils on groundwater. Alternative 3 would partially achieve these RAOs, but the level of *in situ* soil and groundwater treatment is anticipated to be less due to the variable soil permeability and heterogemerity. Alternative 2 would not achieve the RAO of restoring groundwater quality per se, but most contaminated shallow groundwater in the rear yard area would be removed through collection and treated. The cap, repaired containment wall, and induced inward hydraulic gradient of Alternative 2 would meet the RAO of preventing the impact of contaminated soils on groundwater. All the alternatives except Alternative 1 would be protective of human health and the environment. Alternatives 2 through 5 all block the most significant exposure pathways of contact with, or ingestion of, contaminated site soils and sediment. All the alternatives except Alternative 1 offer shallow groundwater collection and treatment in the rear yard area to prevent further shallow groundwater degradation in the area.

The major chemical-specific SCGs for the site are the soil cleanup objectives and the groundwater standards. Alternatives 4 and 5 would meet the soil cleanup objectives. (The effectiveness of biotreatment in Option 4B would need to be verified, but it is anticipated that soil cleanup objectives could be achieved). The *in situ* biological treatment of Alternative 3 is less certain to meet the soil cleanup objectives because of the soil heterogenerity, and the pockets of high concentrations of VOCs and SVOCs. Neither Alternative 2 or Alternative 1 would meet the soil cleanup objectives. None of the alternatives is expected to achieve the Class GA groundwater standards, although these remain a goal for Alternatives 3 through 5. Groundwater quality would improve through the shallow groundwater collection efforts and containment and/or soil treatment, but improvement to meet the groundwater SCGs is unlikely even if soil is treated or removed because of the degraded groundwater quality in the area due to the history of industrial use.

All applicable action-specific SCGs would be met by all alternatives. The caps and post-closure care for Alternatives 2 would generally comply with solid waste landfill closure regulations. Some modification would be allowed by NYSDEC because Alternative 2 does not include excavation of backyard contaminated soil, and therefore, settling of covered materials does not have to be taken into account. Alternatives 2, 3, 4, and 5 include the treatment and/or disposal of hazardous wastes, and all regulations would be complied with, accordingly. Hazardous waste disposal for Alternative 2 would be for resinous materials only; for Alternatives 3 and 4, hazardous waste disposal off site would be for resinous material and PCB materials; treatment would be on site. NYSDEC could designate a CAMU on the site, so minimal technology standards for land disposal of hazardous wastes would not be applicable, but the site remedies would be protective of human health and the environment. Clean closure standards may not be achieved, but for Alternative 4 and possibly Alternative 3, substantial compliance would be achieved. Groundwater collected or extracted in Alternatives 2 through 5 would be treated to meet Town of Tonawanda pretreatment permit parameters.

The most significant short-term risk to workers would be the excavation of soils with high concentrations of organic compounds. The degree of excavation depends on the alternative. Alternative 2 includes trenching to install the shallow collection trench, Alternative 3 includes more trenching to install the perforated pipe network, and Alternatives 4 and 5 include excavation of the northern two-thirds of the backyard. The risk is from volatilization of organic compounds; this would be handled for Alternatives 2 through 5 through scheduling, and staged excavation, use of PPE for workers, and engineering controls such as fans, tarps and forms. Because of the location of the site, short-term risks to the community and the environment are anticipated to be negligible. Erosion from offsite shallow excavation would be controlled through use of standard construction practices such as silt fences.

All the alternatives would be constructed in less than 1 year. The alternatives that do not include biological treatment (Alternatives 2, 4A, and 5) would also be totally implemented within the 1 year time frame. The biological treatment alternatives are anticipated to take longer to implement; up to 5 years for Option 4B and up to 10 years for Alternative 3. Option 4B is estimated to take less time than Alternative 3 because of the soil homogenization and augmented air flow available from the *ex situ* treatment are of Option 4B.

Alternatives 4 and 5 offer the best long-term effectiveness and permanence. The level of treatment afforded by *in situ* treatment (Alternative 3) is anticipated to be less than for Alternative 4, but the cover and cap (Alternative 2) combined with repair of the containment wall, would offer long-term effectiveness if properly maintained.

Alternatives 4 and 5 would treat irreversibly most of the soil and groundwater contamination at the site. The degree of treatment in Alternative 3 is less certain due to *in situ* conditions. Alternative 2 contains treatment of collected and extracted groundwater, but no soil treatment. Alternative 2 would reduce the mobility of site soil and groundwater through containment. Long-term inspection and maintenance would be required to ensure containment in Alternative 2. The thermal desorption treatment in Option 4A would produce some treatment residuals, as would groundwater treatment, but these would either be destroyed onsite or transported offsite for destruction.

The most difficult alternative to implement would be Alternative 3 because of the anticipated difficulties of *in situ* bioventing, including an extensive period of time for dewatering, uncertain treatment efficiency due to difficulty in delivering air to areas of low permeability soil, and pockets of high concentrations of organics that may be toxic. These operations problems would not occur in Option 4B bioventing because of soil mixing and use of the blanket drain for even distribution of air. The most difficult alternative to construct would be Option 4A, due to the deeper soil excavation required, the materials handling requirements to prepare the soil for thermal desorption, and the need to stage soil and treated soil because of space limitations. Option 4B would be less difficult to construct than Option 4A because an above-ground treatment unit is not used, and materials handling would not be as complicated. Alternative 5 would still require the deeper soil excavation, but no onsite materials handling or treatment would be needed. Alternative 2 would be the easiest of the alternatives to construct. Services and materials would be available for all alternatives.

A Town of Tonawanda discharge permit would be required for Alternatives 2 through 5. In Option 4A, the authorization to treat hazardous waste might require extensive effort.

The highest cost alternative ($11 MM) is Alternative 5, with offsite treatment and disposal. The next most expensive, at less than half the cost, are the Alternative 4 *ex situ* treatments, Option 4A ($5.4 MM) with thermal desorption and Option 4B ($3.0 MM) with bioremediation. *In situ* bioremediation (Alternative 3 - $2.9 MM) would be a little less costly than the *ex situ* bioremediation, but the level of treatment that *in situ* bioremediation can achieve is more questionable than the *ex situ* bioremediation. Alternative 2, the containment alternative, is the least closely ($2.1 or $2.0 MM) of the alternatives that meet the RAOs. Alternative 1, No Further Action, is the least costly of all the alternatives, but also is the least protective and would not achieve the RAOs.

Alternative 2 and Option 4B both offer good tradeoffs between achieving RAOs, and cost. Option 4B is a bit better than Alternative 2 in the level of protection offered in excavation of shallow soils and sediments, removal and offsite disposal of resinous materials, shallow groundwater collection and treatment, and containment of backyard soils and sediments through installation of a low-permeability cap and repair of the existing subsurface containment wall. Option 4B, however, in addition to this containment, includes permanent treatment of almost all of the contaminated soils and sediments remaining on the site through biological treatment. The difference in cost between Alternative 2A and Option 4B (both have asphalt caps) is $1.0 MM. Most of this additional cost is for the soil/sediment treatment in the biotreatment cell. The reasons why the soil treatment in Option 4B is a good tradeoff against the additional cost (≈ $0.9 MM) of Alternative 2 are as follows:

- O&M to maintain the cap and treat shallow groundwater would only be required for a relatively short period of time (5 to 10 years) with 4B compared to the long time needed to maintain the integrity of the containment and possibly treat shallow groundwater with 2.
- Future site use would be unlimited with 4B.
- Treatment included in 4B permanently blocks the significant exposure pathways, and eliminates the site as a possible source of groundwater degradation in the area.
- Treatment is desireable under the National Contingency Plan governing CERCLA, and NYSDEC guidance (TAGM-HWR-90-4030, 1990).

Option 4B is also the best tradeoff amongst the other alternatives that include onsite treatment:

- Option 4B is more expensive by $0.1 MM than Alternative 3, but the excavation and mixing of soils prior to replacement in the excavation would increase the treatment efficiency by:

  (1) creating a more uniform, higher porosity than is evident in some of the *in situ* soils;

  (2) eliminating pockets of high concentration of compounds, which may inhibit biological activity or be toxic; and

  (3) creating a means to increase air flow (and nutrient addition) through the entire treatment cell.

- Option 4B compared to Option 4A (low temperature thermal desorption) is less expensive by $2.4 MM; would not require the materials handling and feed and treated soil stockpiling under limited space constraints; and would not require as extensive permitting for hazardous waste treatment and air emissions.

Alternative 4B offers the best tradeoff between achieving RAOs, reducing site contamination through permanent treatment, and cost. The cap over the yard area and the biotreatment cell would allow some light industrial use of the backyard and would remove the direct contact risk while soil was being treated. Therefore, Alternative 4B is the recommended alternative for remediating the Polymer Applications site.

TABLE 9.1

MAJOR SCGs FOR DETAILED ANALYSIS
POLYMER APPLICATIONS SITE

Chemical-specific SCGs

- NYSDEC Soil Cleanup Objectives (TAGM HWR-94-4046, January 24, 1994)
- 6 NYCRR Parts 700-705 Water Quality Standards

Action-specific SCGs

- 6 NYCRR Part 360-2 Solid Waste Landfill Closure and Post Closure Criteria
- 6 NYCRR Part 373-2 Standards for Treatment, Storage, and Disposal of Hazardous Wastes
- NYSDEC Air Guide-1, Guidelines for the Control of Toxic Ambient Air Contaminants

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DETAILED ANALYSIS OF ALTERNATIVES

Alternative	Remedial Action Objectives	Compliance with SCGs	Short-term Effectiveness	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Implementability	Protection of Human Health and Environment	Present Worth Cost (3% interest rate for 30 years)
1 - No Further Action	Not met.	Chemical-specific SCGs not met for soil, sediment, or groundwater. Action-specific and location-specific SCGs not relevant because there are no remedial activities.	Not applicable because there are no remedial activities.	Not effective long term. No permanent treatment.	No reduction in toxicity, mobility, or volume.	Implementable, No remedial actions to implement.	Risks to human health and the environment identified in the Baseline Risk Assessment remain.	$0.07 MM
2 - Waste Soil Consolidation and Multi-layer Cap	Met.	Chemical-specific SCGs met for sediment and soils outside fence. Chemical-specific SCGs not met for soil inside fence or groundwater. Most action specific SCGs met. Hazardous waste land disposal requirements not met. Location-specific SCGs met.	Minimal threats to workers or the environment during construction and implementation that can be mitigated. Time to implement < 1 year.	No permanent soil treatment. Most contamination left on-site. Operation and maintenance required. Controls are adequate and reliable.	Mobility reduced through containment and shallow groundwater collection. No reduction in toxicity or volume.	Implementable. Both capping and groundwater collection/treatment are proven technologies. No problems anticipated in ability to construct, reliability, or availability of services and materials.	Eliminates direct contact risks, but future site use cannot disturb cap or subsurface soils.	2A - $2.1MM 2B - $2.0 MM
3 - In-situ Soil Treatment	Met.	Chemical - specific SCGs for soil, sediment, and groundwater may be achieved through treatment. Most action-specific SCGs met. Hazardous waste land disposal requirements not met. Location-specific SCGs met.	Possible impact from VOCs released during trenching can be mitigated. Time to construct < 1 year. Time to implement > 10 years.	Permanent on-site treatment of most soils and groundwater. Quality of residuals remaining cannot be predicted due to types of contaminants, and soil heterogeneity. O&M required. Moderate confidence that controls are adequate and reliable.	Some reduction in toxicity, mobility and volume of contamination through irreversible biotreatment.	Low implementability due to unknown reliability of in-situ biotreatment in low permeability and heterogeneous soils. Services and materials available.	Human health and environmental exposure pathways controlled with treatment. Future unrestricted use may be possible.	$3.0 MM

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DETAILED ANALYSIS OF ALTERNATIVES

Alternative	Remedial Action Objectives	Compliance with SCGs	Short-term Effectiveness	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Implementability	Protection of Human Health and Environment	Present Worth Cost (3% interest rate for 30 years)
4 - Excavation and Ex-situ Soil Treatment	Met.	Chemical-specific SCGs met for treated soil and sediment, and eventually met for groundwater. Most action-specific SCGs met. Hazardous waste land disposal requirements not met. Location-specific SCGs met.	Possible impact from VOCs and dust released during subsurface soil excavation and soil treatment can be mitigated. Time to construct and implement alternative 4A < 1 year. Time to construct and implement alternative 4B is 10 year.	Permanent on-site treatment of soils and groundwater. Minimal residues following treatment. Limited O&M required for groundwater and for biotreatment (4B). Controls during O&M are adequate and reliable. No controls required following end of treatment.	Most soils exceeding SCGs permanently treated, reducing toxicity, mobility and volume. Quantity of residuals may be higher with alternative 4B.	Implementable. Ex-situ LTTD available and reliable, but may have extensive permitting requirements. Biotreatment available, but level of treatment less reliable than LTTD. Treatability testing required for both technologies.	Human health and environmental exposure pathways controlled with treatment. Future unrestricted use possible.	4A - $5.5 MM 4B - $3.3 MM
5 - Off-site Disposal of Soils	Met.	Chemical-specific SCGs met for soil and sediment, and eventually met for groundwater. Action- and location-specific SCGs met.	Possible impact from VOCs and dust released during subsurface soil excavation can be mitigated. Time to construct and implement < 1 year.	Effective due to removal of contamination from the site. Soil treated as required to meet LDRs. Minimal residual waste following removal. Limited O&M in groundwater. No controls required following end of groundwater treatment.	Mobility reduced through removal and off-site disposal of soils exceeding SCGs. Toxicity or volume not reduced but these no longer impact site.	Implementable. Technologies, services, materials and landfill capacity available and reliable.	Human health and environmental exposure pathways controlled. Future unrestricted use possible.	$11.0 MM

SECTION 10

CONCEPTUAL PLAN FOR THE RECOMMENDED ALTERNATIVE

10.1 INTRODUCTION

This final section of the feasibility study presents the recommended action for the Polymer Applications Site. The key factors affecting the recommendation process and the recommendations themselves are summarized in Table 10.1 and described in Section 10.2 (description), 10.3 (rationale), and 10.4 (cost and schedule). The preferred alternative was selected from a comparative analysis of all alternatives evaluated in Section 9. This section describes and outlines the rationale for each recommendation and presents a conceptual design of the selected alternative, along with the estimated cost and schedule. Recommendations for pre-design activities are also presented.

In the unlikely event that the proposed treatability study indicates that bioventing would not be effective, the following recommended alternative could be easily modified into Alternative 2 - Onsite Containment.

10.2 DESCRIPTION OF RECOMMENDED ALTERNATIVE

The alternative recommended for implementation to remediate the contaminated site soil and groundwater is Alternative 4B - Excavation and Ex-situ Soil Treatment - Biological. This alternative would involve removal of most site contaminated soils that exceed the recommended cleanup levels, offsite disposal of the resinous material and soil with PCBs over 10 ppm, and onsite treatment of the remaining excavated soil with soil bioventing (Figures 10.1 and 10.2). Contaminated shallow and deep groundwater and wastewater (generated from the material handling and treatment process) would be collected, pretreated (if necessary) and disposed to the Town of Tonawanda publicly owned treatment works (POTW).

The contaminated soil would be excavated with conventional soil moving equipment such as a backhoe. The PCB contaminated soil (PCB concentration > 50 ppm) and resinous materials, which are located at the surface of the backyard area and are not suitable for the proposed biological treatment, would be excavated first and trucked to RCRA- and/or TSCA- permitted landfill(s) for disposal. The resinous material would be considered as RCRA hazardous due to spilled phenol and xylenes. The PCB contaminated soils would be classified as a hazardous waste per 6 NYCRR Part 371. This hazardous PCB waste would require a TSCA-permitted landfill for disposal. The resinous material would be disposed in a RCRA-permitted landfill. There are many landfills located nationwide that are permitted to receive TSCA and/or RCRA wastes, such as the Chemical Waste Management hazardous waste landfill (TSCA-regulated) in Model City, near Niagara Falls, NY and Michigan Disposal's landfill in Belfountaine, OH RCRA regulated, not for PCBs > 50 ppm).

The remaining excavated soil would be homogenized with mixing equipment such as counter-feeding conveyor belts or a pugmill. This mixing would provide a uniform material for subsequent biological treatment. Nutrients, if necessary, could be added during the mixing to enhance the treatment.

The homogenized soil would be placed into an approximately 320' x 240' treatment cell for bioventing treatment. To construct the treatment cell, the proposed excavation in the northern backyard area would be utilized by lining with a porous blanket for drainage and venting (Figures 10.1 and 10.2). Therefore, the treatment cell would be mostly below grade. The homogenized soil would then be placed or backfilled into the excavation for treatment.

At the completion of the backfilling, the area would be covered with another porous blanket and a geomembrane. The blanket system would be similar to that of the lining system but would serve for venting purposes only. The geomembrane would be extended over the existing concrete wall and to the main warehouse foundation to cover the entire backyard area. The geomembrane would serve as a hydraulic barrier to prevent precipitation infiltration into the treatment cell. For protection of the geomembrane, a 6" asphalt or 12" clean soil cap would be placed over the geomembrane. The additional cover material would not only allow general use of the backyard area during soil treatment but also provide a physical barrier for dermal contact.

To effectively utilize the limited site area for the remediation activities, mixing and backfilling would be conducted in stages.

Soil in the treatment cell would be dewatered initially by gravity prior to treatment. Although some of the water in the soil would have been removed during the excavation and handling, there could still be significant amount of water remaining in the soil. The remaining water could saturate the soil at the bottom of the cell unless the soil is allowed to drain freely as in the proposed design. A saturated soil would not allow vertical air movement for the bioventing treatment.

Once the soil became unsaturated, air would be withdrawn from the bottom drainage and venting layer. This air movement would provide oxygen for biological degradation of the organic contaminants in the soil. The extracted air would be collected and treated with activated carbon to remove air pollutants in the early stage of the treatment. This air treatment would not be necessary at the later stage when biological activities dominate the soil treatment and volatilization diminishes.

The proposed soil remediation would also address the elevated metals contamination at the site in two ways. First, the removal and offsite disposal of PCB-contaminated soil and resinous material from the backyard area would remove a significant portion of the suspected metals contamination from the site. Second, homogenization of the remaining soil would control any areas of localized elevated metals concentrations. This would essentially eliminate potential human risks associated with dermal contact with metals.

Shallow groundwater in the backyard area including the treatment cell would be drained by gravity into the drainage blanket and collected for pretreatment (if necessary) and disposal to the Town of Tonawanda POTW or a wastewater treatment facility. There is a POTW sewer line and manhole at the northwestern corner of the site. The sewer has been used by the USEPA for disposal of the pretreated wastewater during the IRM. During soil treatment, the shallow contaminated groundwater in the backyard area would be continuously collected, pretreated and disposed as part of the soil treatment. It is estimated that the average collection rate would be less than one gallon per minute.

Shallow groundwater under the main warehouse may be contaminated with similar organic contaminants as in the backyard area. To minimize migration of this contaminated groundwater, the northern part of the existing shallow subsurface barrier wall would be extended approximately 300 feet from the backyard to the front of the warehouse. In addition, the foundation wall along the backside of the warehouse would be repaired and underground pathways (e.g., utilities, sewer, etc.) would be sealed, if necessary, during the soil excavation. This barrier wall extension and the foundation wall improvements would eliminate any differential hydraulic gradient across the warehouse. This gradient control would provide an effective hydraulic containment of the contaminated groundwater. Hydraulic containment in combination with the naturally occurring biodegradation should control any offsite migration of the groundwater contaminants.

To remediate the deep groundwater aquifer, two deep (>40 feet bgs) groundwater extraction/monitoring wells would be installed. Pumping at the rate of 10 gpm per well would be conducted for one year. Results of the pumping would then be evaluated to determine if the deep aquifer contamination is localized (concentrations decrease), or wide-spread (concentrations remain constant). A decision would be made after the evaluation as to how deep groundwater remediation would continue. Similar to the shallow groundwater, the collected deep groundwater would be pretreated, if necessary, and disposed to local POTW for final treatment.

10.3 RATIONALE FOR SELECTING ALTERNATIVE

This alternative would be protective of human health and the environment. The more contaminated waste, including soils with PCBs over ~~1~~50 ppm and resinous material would be removed and disposed at offsite landfill(s). The rest of the contaminated soil would be treated onsite with soil bioventing to reduce the organic contamination. Both the shallow and deep contaminated groundwater would be collected, pretreated (if necessary), and disposed to the local POTW for final treatment.

Alternative 4B is technically feasible and cost-effective. Similar organic contaminants in similar soils have been treated successfully with the bioventing technology. It is anticipated that the concentrations of toluene, ethylbenzene, and xylene (TEX), and phenols would be reduced significantly. Biological treatment of TEX is well documented, may result in 80 percent removal in less than 24 months. In many cases, reduction of these contaminants to below detection limits have been observed. Phenol removal rates are not as well documented, because if phenol is present, it is usually as an intermediate product and therefore is not monitored. However, phenol is recognized as being fairly easily biodegradable by naturally-occurring microorganisms as long as phenol concentrations are not too high. At phenol concentrations over 100 ppm, the microorganism may be inhibited or killed. The toxicity threshold is potentially of concern at this site, because some soil samples exceed this concentration, but it is anticipated that the excavation and offsite disposal of the resinous and PCB-contaminated materials and homogenization of the remaining soil would reduce the phenol concentrations to below these levels.

This alternative would require a similar level of material handling as the other treatment or disposal alternatives. This alternative would require less operation and maintenance for soil treatment than the other ex-situ treatment alternatives. As the cost estimates show in Section 9, this alternative is less expensive than the other ex-situ treatment or disposal alternatives.

10.4 REMEDIATION COST AND SCHEDULE

The total cost related to the remedial construction and subsequent treatment operation and maintenance is estimated at $3.3 million for Alternative 4B. This cost is summarized in Table 10.1. Key remedial items and their costs are summarized in 10.2. Detailed cost estimates are included in Appendix J.

For costing purposes, it was assumed that annual operation and maintenance would be required for 5 years for the soil and groundwater treatment. In addition, it was assumed that the collection and treatment of deep groundwater would be conducted for the first three years.

Figure 10.3 shows a preliminary schedule that has been developed for implementing Alternative 4B following the issuance of the Record of Decision (ROD) and a Notice to Proceed. This schedule was developed based on Parsons ES experience on similar projects. The schedule shows that the predesign activities would require a 6-month duration, the design including NYSDEC review and contractor procurement would require a 12-month duration, and the construction would require a 6-month duration.

10.5 DESIGN CONCEPTUAL PLAN

Based on the remedial elements required in Alternative 4B, the remediation would be implemented in the following sequence:

1. Mobilization and Site Preparation

The mobilization would involve mobilizing all necessary equipment and personnel to conduct the remedial construction per Alternative 4B. The site preparation would involve preparing access roads, setting up restriction fences, installing a wastewater pretreatment system, erosion and sedimentation control, preparing for health and safety, and air monitoring.

2. Removal of PCB Soil and Resinous Material

The PCB soil and resinous material would be removed first for offsite disposal. These materials are not amendable to biological treatment. These wastes would be excavated with conventional soil removal equipment such as a backhoe. The excavated materials would subsequently be trucked offsite and disposed at permitted landfill(s). The trucks would be lined and covered with plastic to prevent spills and contaminating the trucks. The total in-place volume of these materials is estimated at 1,000 CY for the resinous material and 100 CY for the PCB soil. The resinous material and the PCB soil would be classified as hazardous waste.

Upon excavation to the proposed or design depths, confirmatory soil sampling with field PCB test kits would be used to determine if cleanup has been achieved and if additional excavation would be required for the PCB removal. The excavation limits for resinous material removal would be based on visual observation. The resinous material has been identified as dark colored, soft resin-like, sticky material under normal temperatures. This material becomes stiffer under low temperature such as below 40 degrees Fahrenheit. There is also less volatilization when temperature is low. Therefore, it would be advantageous to conduct the removal of the resinous material during cold weather.

3. Excavation and Homogenization of Remaining Contaminated Soil

The remaining less-contaminated soil that exceeds the cleanup levels established in Section 7 would be excavated and homogenized for on site treatment. This soil is located in the ditches and south of the property and across River Road, along sides of the main warehouse and in the backyard area. Similar to the PCB and resinous material removal, the excavation would be conducted with conventional earth moving equipment such as a backhoe. Upon excavation to the proposed or design depths, confirmatory soil sampling would be conducted to determine if the clean-up goals were achieved and if additional excavation would be required.

Temporary dewatering with sump pumps would be required during excavation due to high groundwater conditions. However, the quantity of water to be collected would be small due to limited excavation depth, relatively fine grained soil (i.e., fine sand), and the concrete wall existing around the backyard. The groundwater would be pretreated and discharged to the local POTW.

The excavated soil would be homogenized with a mixer such as counter feeding conveyor belts or a pugmill. The homogenization would uniformly distribute the contaminants in the soil. It would also increase the hydraulic conductivity of the soil due to formation of a looser soil structure. All of these changes would improve the efficiency of biological treatment discussed later in this section.

Due to limited working space available, the excavation, mixing, and treatment cell construction (to be discuss next) would need to be conducted in stages or cycles. The site area that requires excavation would be divided into several subareas. The remedial construction would be conducted so as to complete one area at a time to effectively use the site space.

4. Construction of Treatment Cell and Soil Backfill

The homogenized soil would be treated onsite with bioventing. Due to space limitation at the site, the excavation in the backyard area would be utilized for construction of the treatment cell. The bottom of the excavation would be graded to allow positive drainage to the point(s) of proposed collection. The graded bottom would then be lined with a porous blanket to allow for effective removal of water and air. The blanket would be constructed with a 6 inch crushed stone sandwiched between filter fabric or with a 1/4 inch thick composite geonet. The perforated piping network would be embedded in the blanket for enhanced drainage effect. The pipe system would be constructed with interconnected 1 to 2 inch diameter, perforated HDPE or PVC pipe. The piping network would lead to collection point(s) where both sump pumping and vacuum air extraction could be applied.

Once the drainage blanket system were laid at the bottom, the homogenized soil would be used to backfill the excavation. No compaction of the backfill would be allowed beyond that created by the grading equipment. The top of the backfill would be graded to provide positive drainage. Steep (> 15 percent) or very flat (4 percent) slopes should be avoided, if possible, to minimize erosion or ponding.

5. Covering the Backfill

To prevent precipitation infiltration and to allow air venting, the completed backfill would be covered with a special temporary cap. This cap would consist of another porous blanket overlaid by an impermeable geomembrane. The blanket would be constructed similar to that of the bottom drainage system. The edges of this blanket would be left open to allow air inflow. The geomembrane would cover up the entire backyard area bound by the existing subsurface barrier wall to prevent seepage infiltration from adjacent areas. Additional cover materials such as a 6 inch asphalt or 12 inch clean soil would be placed above the geomembrane for protection and for potential limited land use such as parking.

6. Treatment of Soil

The homogenized soil that contains primarily biodegradable organic contaminants would be treated with bioventing. A vacuum pump and air emission control would be constructed for the soil treatment. The soil would be dewatered initially by gravity to form a vadose zone above the drainage blanket to allow vertical air flow. As soon as the soil became unsaturated, bioventing would be applied via a low rate of air extraction from the highly permeable bottom blanket layer. This would pull in fresh air from above the soil to provide oxygen to the indigenous bacteria that degrade the organic contaminants. In the early stage of the treatment, the extracted air would contain volatilized organic contaminants and therefore would have to be treated. Air emission control would consist of granular activated carbon vessels. A NYSDEC emission permit may be required.

For costing purposes, it is assumed that the soil treatment system would be operated for an estimated duration of **5** ~~10~~ years. The actual time of treatment required would be estimated based on the results of the pilot-scale treatability study (see Section 10.6). During the treatment, soil sampling would be conducted periodically to document treatment progress and to determine when the treatment could be terminated.

7. Collection and Treatment of Groundwater

Contaminated shallow groundwater would be collected from the backyard area during construction and during the soil treatment. The collection would consist of pumping the sump to remove water drained into the excavation and into the drainage blanket underlying the soil treatment cell.

Two deep (>40 feet bgs) wells would be installed, one each in the vicinity of decommissioned wells GW1DD and GW2DD, for monitoring and extraction of deep groundwater. Contaminated deep groundwater would be collected at the rate of 20 GPM via pumping from the wells.

The collected shallow and deep groundwater would be pretreated with granular activated carbon filtration and subsequently discharged into the onsite POTW sewer. A discharge permit from the Town of Tonawanda would be required for this disposal.

Periodic monitoring, operation and maintenance of the collection and pretreatment system would be required. Most of the groundwater (20 GPM) would come from the deep groundwater extraction. The need for continued deep groundwater extraction and treatment would be evaluated at the end of a one year pumping period. The shallow groundwater collection and treatment (< 1 GPM) would be terminated upon completion of soil treatment.

8. Containment of Shallow Groundwater Under the Main Warehouse

The shallow groundwater under the main warehouse is suspected to contain similar contaminants as in the backyard area. To contain this groundwater, a shallow barrier wall along the north and the backyard foundation wall along the south would be utilized to keep high groundwater tables from creating a lateral hydraulic gradient across the soil beneath the warehouse.

The shallow subsurface barrier wall would consist of a bentomat or geomembrane curtain installed in a 6-foot deep trench. This depth would key into the clay layer beneath the site. Either of these materials is relatively easy to install than most other materials such as concrete or soil-bentonite slurry. The proposed materials can also achieve very low permeability, i.e., less than $1x10^{-9}$ cm/sec. The trench would be excavated with a backhoe and supported with shoring devices, if necessary, during the curtain installation. The trench would be subsequently backfilled with the excavated soil.

It is believed that the foundation wall along the backyard of the warehouse extends to the clay and silt layer and thus could function as a vertical hydraulic barrier. It is suspected that there are underground conduits running through the foundation wall that may currently offer preferential flow for shallow groundwater from the backyard area. These conduits would be uncovered and sealed during the soil excavation.

9. Site Cleaning and Restoration

Upon completion of the treatment cell construction and backfilling, the areas of shallow excavation left from soil removal would be backfilled with clean fill and topsoil and seeded. These areas are located outside of the treatment cell and include the areas along the sides of the warehouse, and in offsite ditches.

Upon completion of the soil treatment, the above-ground remediation systems, including storage tanks and activated carbon columns, would be removed from the site. Unrestricted use of the site, including regrading, would be allowed. The below-ground remediation system, including porous blankets and piping, would be left in place. However, no further collection and treatment of water or air would be required.

10.6 RECOMMENDATIONS FOR PREDESIGN ACTIVITIES

This RI/FS has identified that soils contaminated with PCBs over 10 ppm would need to be removed as part of the recommended alternative. To more accurately define the limits of this contamination, additional investigation is recommended as described herein. This additional investigation would facilitate a cost-effective design to avoid potential over-excavation and save remediation cost. In addition, a pilot-scale treatability study is also recommended to determine the effectiveness and optimum operating conditions for the proposed bioventing on the site soil.

1. Delineation of PCB Contamination

Based on the current locations of PCB data at the site, approximately 20 soil samples will be required for analysis to adequately define the limits of PCB contamination. Most of these soil samples should be collected from the surface in the areas adjacent to the known PCB contamination. A few subsurface soil samples should be collected at one foot depth below any detected "hot spots" where the PCB levels are the highest based on the surface sampling.

These samples can be analyzed in the field with field PCB test kits for real time sampling. Currently, there are several similar PCB test kits available on the market, including Ensys, Omicron, and Millipore. These test kits can provide a turn-around-time of less than one hour. Therefore, the results can be used to optimize the sample locations during the sampling.

Parsons ES estimates that this task would require approximately one day of field work for a two-person crew.

2. Pilot-Scale Bioventing Treatability Study

To evaluate the treatability of the site soil with bioventing, a pilot-scale biological treatment pile would be constructed. This study would provide information on the speed of biological degradation due to venting and therefore the duration required for the full-scale treatment. The effect of nutrient supply could also be determined.

The biopile study would consist of a 9.5 CY (8 feet by 8 feet by 4 feet high) soil stockpile onsite, with the following elements, from the bottom up:

- An 8-mil reinforced polyethylene liner with 3 inches of sand for the base;
- A 6-inch gravel layer with 2-inch diameter schedule 80 factory slotted PVC piping to draw atmospheric air through the soils to be treated;
- A filter fabric layer for separation between the soil and gravel;
- 2 feet of study soil graded to drain away from the pile;
- A straw mat overlaid by a 8-mil plastic cover with venting holes; (The mat would serve for lateral venting purposes below the plastic). and
- An explosion proof, 1-hp blower to supply atmospheric air to the soil pile.

This biopile would be set up in the backyard warehouse to minimize the impact of wind and other extreme weather conditions.

Based on Parsons ES experience on similar projects, the pilot system would be operated and monitored for a period of six months to allow for adequate data collection. The system would be run without continued attendance. Periodic checking and soil and air sampling such as once every two weeks would be conducted.

The soil samples collected during the treatment would be analyzed for target organic contaminants. Other parameters such as O_2 and CO_2 levels, and moisture content and temperature of the biopile would also be monitored.

The possibility for a bench- or laboratory-scale treatability study was evaluated and determined not adequate for simulating a full-scale treatment conditions. In a bench-scale bioventing test, there would be too many parameters to be controlled.

Upon completion of the field and laboratory analysis, a report would be prepared to summarize the study process and results. The report would be used as the basis for the full-scale bioventing design.

TABLE 10.1

SUMMARY ESTIMATED COST FOR ALTERNATIVE 4B - EXCAVATION AND BIOREMEDIATION

Capital Costs

	Item Description	Cost
1.	Mobilization/Demobilization	$20,000
2.	Site Preparation	$126,000
2a.	Optional Tank Removal (not included in totals)	($75,000)
3.	Soil Excavation/Limited Offsite Disposal	$662,000
4.	Concrete Barrier Wall Repair	$5,000
5.	Barrier Wall Extension	$27,000
6.	Soil Treatment System	$262,000
7.	Asphalt Cover System	$266,000
8.	Deep Groundwater Collection Pumps and Piping	$9,000
9.	Groundwater Treatment System	$92,000
10.	Groundwater Wells-Decommission Existing Wells and Install New Wells	$17,000
11.	Pilot Soil Treatment	$ 50,000
	Subtotal Capital Costs	$1,536,000
	Engineering & Contingency (37%)	$607,000
	Total Capital Costs	$2,100,000

Annual Operation and Maintenance Costs

	Item Description	Cost
1.	Site Inspection and Maintenance (included in Items 2 & 3)	$0
2.	Groundwater Sampling and Analysis (after year 1, 3, 5, 10, 15, 20, 25, 30)	$7,000
3.	Deep Groundwater Treatment O&M (year 1-3)	$129,000
	Shallow Groundwater Treatment O&M (year 1-3)	$7,000
	Shallow Groundwater Treatment O&M (year 4-10)	$48,000
4.	Soil Treatment O&M (year 1-5)	$39,000
	Annual O&M Costs for Years 1-3	$180,000
	Annual O&M Costs for Years 4-5	$95,000
	Annual O&M Costs for Years 6-10	$55,000
	Annual O&M Costs for Years 11-30	$1,000
	Alternative 4B Total Present Worth Costs	**$3,000,000**

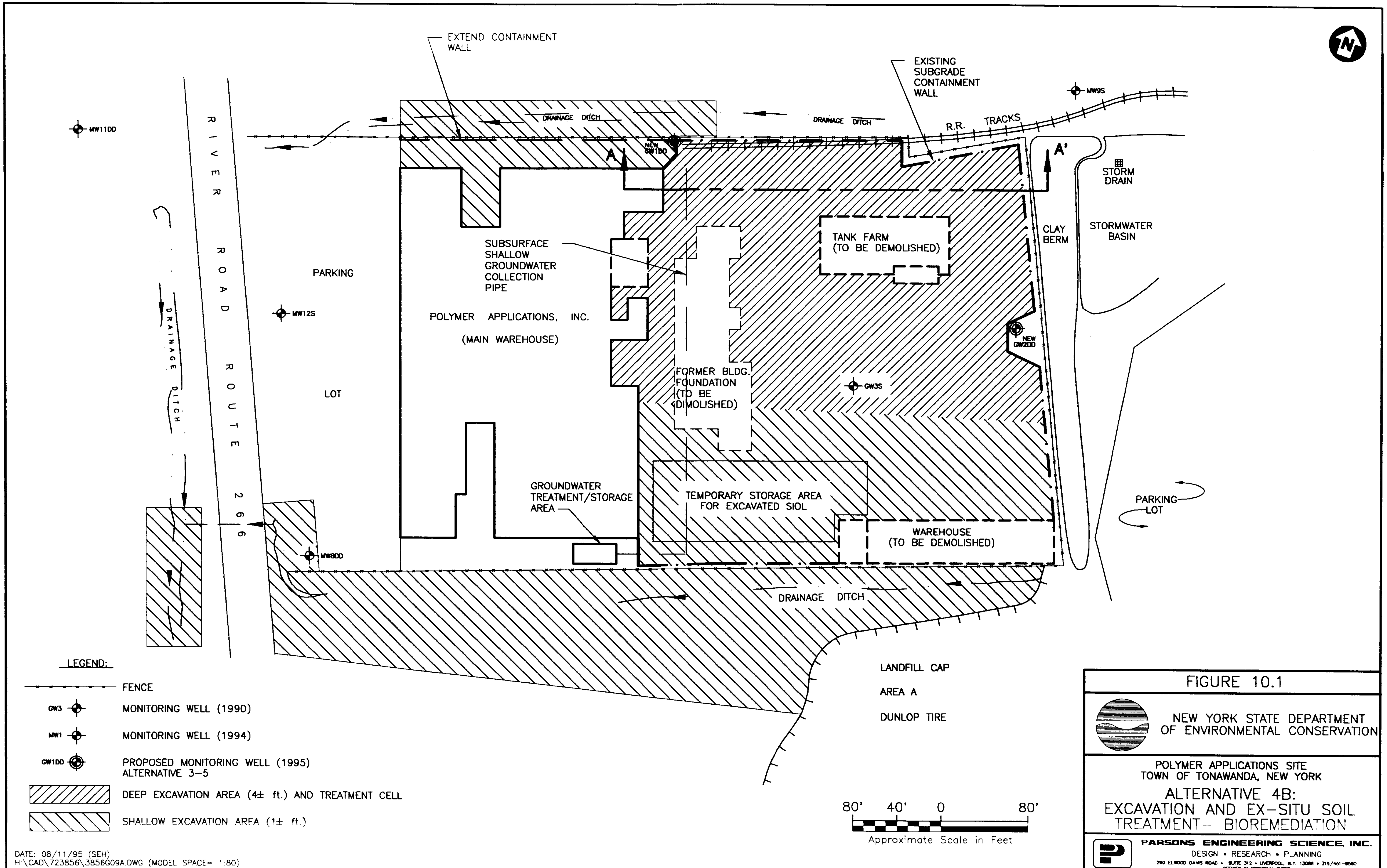


FIGURE 10.1

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

POLYMER APPLICATIONS SITE
TOWN OF TONAWANDA, NEW YORK

ALTERNATIVE 4B:
EXCAVATION AND EX-SITU SOIL TREATMENT– BIOREMEDIATION

PARSONS ENGINEERING SCIENCE, INC.
DESIGN • RESEARCH • PLANNING
290 ELWOOD DAVIS ROAD • SUITE 312 • LIVERPOOL, N.Y. 13088 • 315/451-9560
OFFICES IN PRINCIPAL CITIES

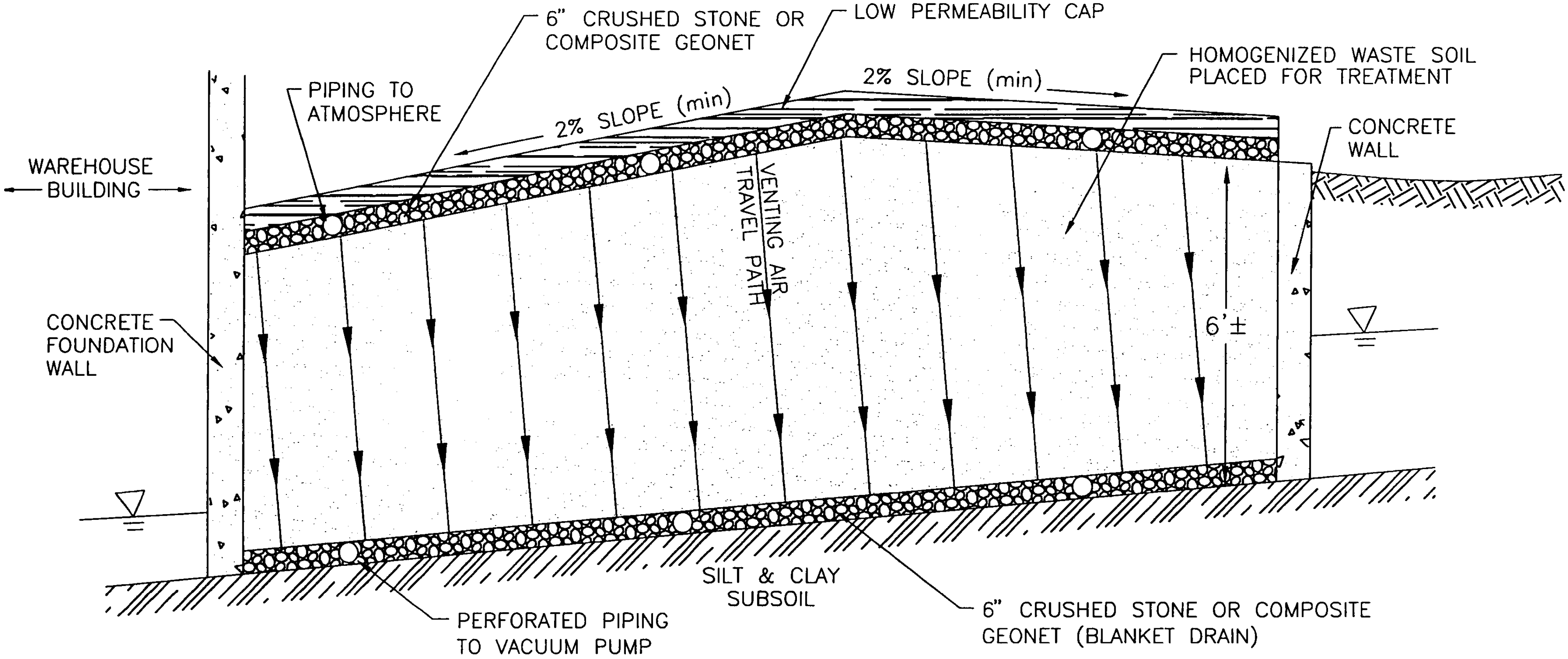


FIGURE 10.2

POLYMER APPLICATIONS

ALTERNATIVE B
CONCEPTUAL DESIGN
BACKYARD AREA PROFILE

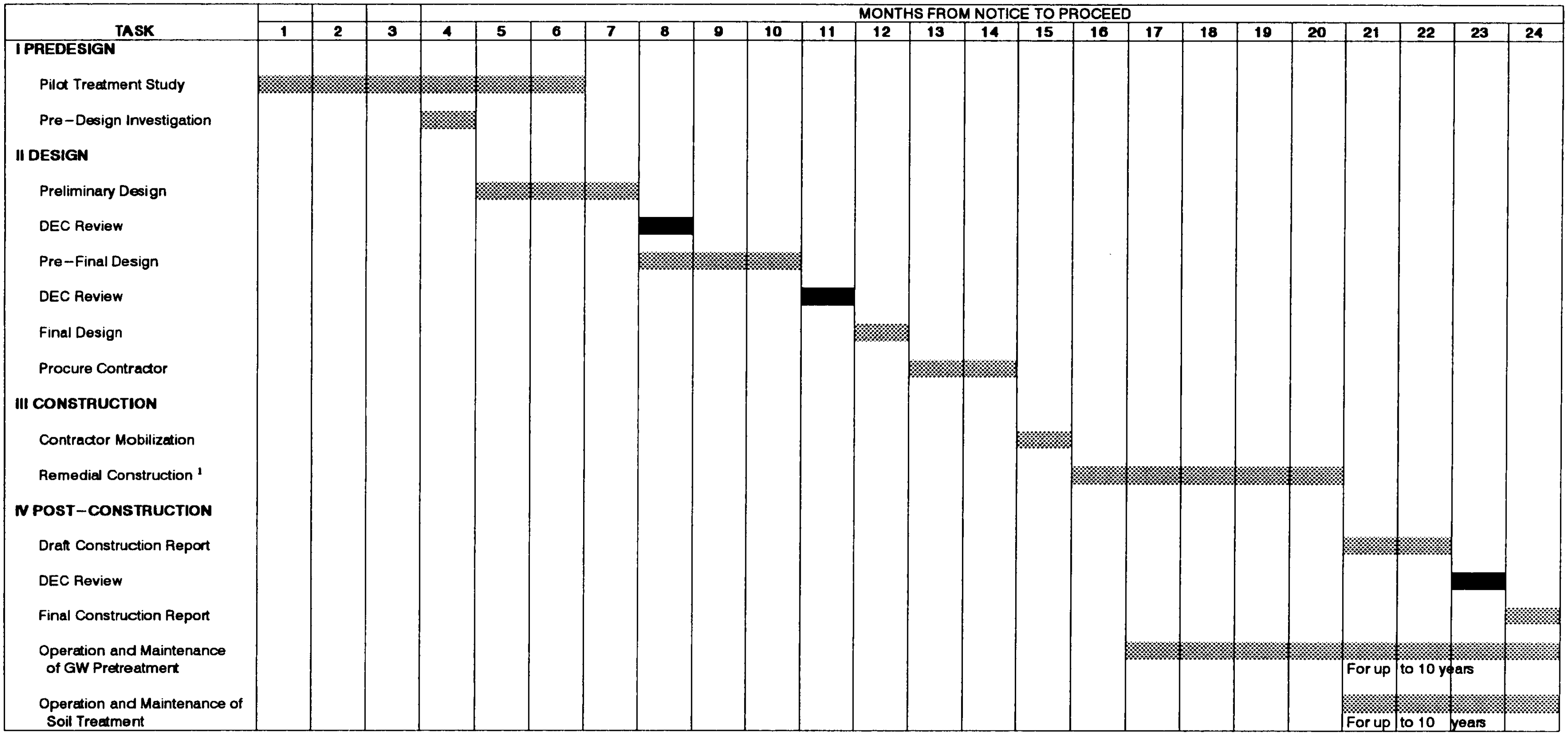
PARSONS ENGINEERING SCIENCE, INC.
DESIGN * RESEARCH * PLANNING
290 ELWOOD DAVIS ROAD • SUITE 312 • LIVERPOOL, N.Y. 13088 • 315/451-9560
OFFICES IN PRINCIPAL CITIES

NOT TO SCALE

DATE: 10/19/95
H:\CAD\723856\23856G04.DWG (MODEL/PAPER SPACE)

FIGURE 10.3

REMEDIATION SCHEDULE
POLYMER APPLICATIONS SITE



(1) Somewhat dependent on the time of the year construction could first commence.

R:\WP\723856\FIGURE10.WK3

APPENDIX J

ALTERNATIVE COST ESTIMATE

ALTERNATIVE 1 – NO FURTHER ACTION / LONG-TERM MONITORING

Capital Costs Pc = 0 (No Construction Required)

Annual Operation and Maintenance Costs

Cost Estimate Section	Description	Source of Unit Cost	ES Reference Page #	Unit	Quantity	Unit Cost	Total Cost
I	SITE INSPECTION AND MAINTENANCE • Fence, walls, wells, etc.	ES		Day	1	$1,420	$1,420
	Subtotal (A1)						$1,420
II	GROUNDWATER SAMPLING AND ANALYSIS (after years 1,3,5,10, 15,20,25, and 30)	ES					
	a. Sampling: 2 man crew @ $35/hr/man plus travel time, expenses, and ODCs			Days	2	$800	$1,600
	b. Analysis: 5 samples for volatiles and semivolatiles (at 5 monitoring wells MW1DD, MW12S, MW8DD, GW3S, and MW9S) and one sample for PCBs (MW12s)			Round	1	$2,500	$2,500
	c. Data reviews, reporting, and administration			Hrs.	40	$70	$2,800
	Subtotal (A2)						$6,900
	TOTAL ANNUAL O & M COSTS (Po+m)						$8,320
	ALTERNATIVE 1 TOTAL PW COSTS (Pt = Pc + 5.58*A2 + 19.60*A1) (based on a 3% interest rate)						$66,000

ALTERNATIVE 2B – WASTE SOIL CONSOLIDATION AND ASPHALT CAP

Capital Costs

Cost Estimate Section		Description	Source of Unit Cost	ES Reference Page #	Unit	Quantity	Unit Cost	Total Cost
I		MOBILIZATION / DEMOBILIZATION	ES / Means					
	a.	Excavation Equipment			LS	1	$5,000	$5,000
		• backhoe, bulldozer, vibratory roller, water truck						
	b.	Misc. Construction Expenses			LS	1	$10,000	$10,000
		• coordination, travel, physical exams						
		• permits: air, discharge, and construction						
		Subtotal						$15,000
II		SITE PREPARATION	ES / Means					
	a.	Set-up of trailers, decon, etc.	015-900		LS	1	$7,500	$7,500
	b.	Site Clearing	021-116		LS	1	$5,000	$5,000
		• brush, trees, and debris						
	c.	Demolition of other structures in "backyard" area	020-604		LS	1	$10,500	$10,500
	d.	Fencework	ES					
		• modify existing fence			LF	200	$20	$4,000
		• install temporary construction fence			LF	200	$5	$1,000
	e.	Equipment rental, supplies, phone, and power	ES		Month	6	$1,500	$9,000
	f.	Health and safety equipment, disposals	ES		Month	6	$1,000	$6,000
	g.	Air monitoring	ES		Month	6	$3,000	$18,000
	h.	Survey (construction and records)	ES		Day	5	$800	$4,000
	i.	Work Plan / Health and Safety Plan	ES		LS	1	$10,000	$10,000
	j.	Meetings	ES		Each	5	$1,000	$5,000
	k.	Security Guard (24 hours on weekends / 16 hours on weekdays)	ES		Week	26	$1,660	$43,160
		Subtotal						$123,160
III		SURFACE SOIL EXCAVATION	ES / Means					
	a.	Excavate top 12" (in-place volume)	022-242		CY	4,000	$6	$24,000
	b.	Resinous material (off-site disposal at hazardous material landfill)	Vendor		CY	1,000	$450	$450,000
	c.	Consolidate remaining soil onto "backyard" area	022-262		CY	3,000	$3	$9,000
	d.	Backfill excavated areas with a clean fill	Vendor		CY	1,500	$20	$30,000
	e.	Backfill excavated areas with 6" of topsoil	Vendor		CY	1,500	$25	$37,500
	f.	Seed and fertilize	029-308		Acre	2.5	$1,700	$4,250
		Subtotal						$554,750
IV		CONCRETE CONTAINMENT WALL						
	a.	Excavate, repair, plug, and backfill	ES		LS	1	$5,000	$5,000
		Subtotal						$5,000
V		BARRIER WALL	Vendor					
	a.	Extend north barrier wall (300' x 6')			SF	1,800	$15	$27,000
		• Install a bentomat curtain						
		• Excavate a trench						
		Subtotal						$27,000
VI		CAP OVER "BACKYARD" AREA (3 ACRES)	ES / Vendor					
	a.	Asphalt with appropriate base						
		• Fine Grade and Compaction (subgrade and base)			SY	14,400	$1	$14,400
		• Stone Base (6")			SY	14,400	$5	$73,440
		• Asphalt Binder (4")			SY	14,400	$7	$99,360
		• Asphalt Top (2")			SY	14,400	$4	$58,176
		Subtotal						$245,376
VII		SHALLOW GROUNDWATER COLLECTION PIPE	ES					
	a.	Excavate and backfill shallow trench (360' x 5')			LF	360	$15	$5,400
	b.	Collection pipe (4" HDPE)			LF	360	$2	$720
	c.	Collection sump & cleanout	Means		LS	1	$2,000	$2,000
	d.	Pump and controls	671-4120		LS	1	$5,000	$5,000
		Subtotal						$13,120
VIII		GROUNDWATER TREATMENT SYSTEM (1 GPM)	ES					
	a.	Pump and piping			EA	1	$3,000	$3,000
	b.	GW Treatment System – Pad / Shelter / Tanks			LS	1	$49,000	$49,000
	c.	GW Treatment System – GAC Filtration Installed			LS	1	$12,000	$12,000
		Subtotal						$64,000

ALTERNATIVE 2B (CONTINUED) – WASTE SOIL CONSOLIDATION AND ASPHALT CAP

IX		GROUNDWATER MONITORING WELLS	ES				
	a.	Decommission all GW monitoring wells which are effected by construction or are vertical conduits of the alternative by over–drilling and grouting		Each	4	$1,000	$4,000
	b.	Decommision the production well		Each	1	$3,000	$3,000
		Subtotal					$7,000
		SUBTOTAL CAPITAL COSTS					$1,054,406
		Engineering (for design and construction mgmt.)					$250,000
		Contingency		20.0 %			$210,881
		TOTAL CAPITAL COSTS (Pc)					$1,500,000

Annual Operation and Maintenance Costs

Item		Description		Unit	Quantity	Unit Cost	Total Cost
I		SITE INSPECTION AND MAINTENANCE	ES				
	a.	Fence, cap, and wells		Included in items II and III			$0
		Subtotal (A1)					$0
II		GROUNDWATER SAMPLING AND ANALYSIS (after years 1,3,5,10, 15,20,25, and 30)	ES				
	a.	Sampling: 2 man crew @ $35/hr/man plus travel time, expenses, and ODCs		Days	2	$800	$1,600
	b.	Analysis: 5 samples for volatiles and semivolatiles (at 5 monitoring wells MW1DD, MW12S, MW8DD, GW3S, and MW9S) and one sample for PSBs (MW12s)		Round	1	$2,500	$2,500
	c.	Data reviews, reporting, and administration		Hrs.	40	$70	$2,800
		Subtotal (A2)					$6,900
III		GROUNDWATER TREATMENT SYSTEM (first 10 years) SHALLOW GROUNDWATER	ES				
	a.	Operation of System – Labor		Hrs	416	$50	$20,800
		Operation of System – Carbon Changeout		Changes	25	$700	$17,500
		Operation of System – Electrical Power		Month	12	$200	$2,400
	b.	Effluent Monitoring		EA	52	$300	$15,600
		Subtotal (A3)					$56,300
		TOTAL ANNUAL O & M COSTS FOR YEARS 1 THROUGH 10 (Po+m)					$83,900
		TOTAL ANNUAL O & M COSTS FOR YEARS 11 THROUGH 30 (Po+m)					$27,600
		ALTERNATIVE 2B TOTAL PW COSTS (Pt = Pc + (19.60 * A1) + (5.58 * A2) + (8.53 * A3)) (based on a 3% interest rate)					$2,000,000

ALTERNATIVE 2A – WASTE SOIL CONSOLIDATION AND SOIL–GEOMEMBRANE CAP

Capital Costs

Cost Estimate Section		Description	Source of Unit Cost	ES Reference Page #	Unit	Quantity	Unit Cost	Total Cost
I		MOBILIZATION / DEMOBILIZATION	ES / Means					
	a.	Excavation Equipment	022–274		LS	1	$5,000	$5,000
		• backhoe, bulldozer, vibratory roller, water truck						
	b.	Misc. Construction Expenses	ES		LS	1	$10,000	$10,000
		• coordination, travel, physical exams						
		• permits: air, discharge, and construction						
		Subtotal						$15,000
II		SITE PREPARATION	ES / Means					
	a.	Set–up of trailers, decon, etc.	015–900		LS	1	$7,500	$7,500
	b.	Site Clearing	021–116		LS	1	$5,000	$5,000
		• brush, trees, and debris						
	c.	Demolition of other structures in "backyard" area	020–604		LS	1	$10,500	$10,500
	d.	Fencework	ES					
		• modify existing fence			LF	200	$20	$4,000
		• install temporary construction fence			LF	200	$5	$1,000
	e.	Equipment rental, supplies, phone, and power	ES		Month	6	$1,500	$9,000
	f.	Health and safety equipment, disposals	ES		Month	6	$1,000	$6,000
	g.	Air Monitoring	ES		Month	6	$3,000	$18,000
	h.	Survey (Construction and Records)	ES		Day	5	$800	$4,000
	i.	Work Plan / Health and Safety Plan	ES		LS	1	$10,000	$10,000
	j.	Meetings	ES		Each	5	$1,000	$5,000
	k.	Security Guard (24 hours on weekends / 16 hours on weekdays)	ES		Week	26	$1,660	$43,160
		Subtotal						$123,160
III		SURFACE SOIL EXCAVATION	ES / Means					
	a.	Excavate top 12" (in–place volume)	022–242		CY	4,000	$6	$24,000
	b.	Resinous material (off–site disposal at hazardous material landfill)	Vendor		CY	1,000	$450	$450,000
	c.	Consolidate remaining soil onto "backyard" area	022–262		CY	3,000	$3	$9,000
	d.	Backfill excavated areas with a clean fill	Vendor		CY	1,500	$20	$30,000
	e.	Backfill excavated areas with 6" of topsoil	Vendor		CY	1,500	$25	$37,500
	f.	Seed and fertilize	029–308		Acre	2.5	$1,700	$4,250
		Subtotal						$554,750
IV		CONCRETE CONTAINMENT WALL	ES					
	a.	Excavate, repair, plug, and backfill			LS	1	$5,000	$5,000
		Subtotal						$5,000
V		BARRIER WALL	ES / Vendor					
	a.	Extend north barrier wall (300' x 6')			SF	1,800	$15	$27,000
		• Install a bentomat curtain						
		• Excavate a trench						
		Subtotal						$27,000
VI		CAP OVER "BACKYARD" AREA (3 ACRES)	ES / Vendor					
	a.	Geo–membrane with soil cover						
		• Fine grade and compaction (subgrade and base)			SY	14,400	$1	$14,400
		• 60 mil HDPE			SY	14,400	$7	$100,800
		• Protective Soil (18")			SY	14,400	$10	$144,000
		• Top Soil (6")			SY	14,400	$5.25	$75,600
		• Seed and Fertilize			SY	14,400	$1.45	$20,880
		Subtotal						$355,680
VII		SHALLOW GROUNDWATER COLLECTION PIPE	ES					
	a.	Excavate and backfill shallow trench			LF	360	$15	$5,400
	b.	Collection pipe (4" HDPE)			LF	360	$2	$720
	c.	Collection sump & cleanout	Means		LS	1	$2,000	$2,000
	d.	Pump and controls	671–4120		LS	1	$5,000	$5,000
		Subtotal						$13,120
VIII		GROUNDWATER TREATMENT SYSTEM (1 GPM)						
	a.	Pump and piping	ES		LS	1	$3,000	$3,000
	b.	GW Treatment System – Pad / Shelter / Tanks	ES / Vendor		LS	1	$49,000	$49,000
	c.	GW Treatment System – GAC Filtration Installed	ES / Vendor		LS	1	$12,000	$12,000
		Subtotal						$64,000

ALTERNATIVE 2A (CONTINUED) – WASTE SOIL CONSOLIDATION AND SOIL–GEOMEMBRANE CAP

Item	Description		Unit	Quantity	Unit Cost	Total Cost
IX	GROUNDWATER MONITORING WELLS	ES				
a.	Decommission all GW monitoring wells which are effected by construction or are vertical conduits of the alternative by over–drilling and grouting		Each	2	$1,000	$2,000
b.	Decommission the production well		Each	1	$3,000	$3,000
	Subtotal					$5,000
	SUBTOTAL CAPITAL COSTS					$1,162,710
	Engineering (for design and construction mgmt.)					$250,000
	Contingency		20.0 %			$232,542
	TOTAL CAPITAL COSTS (Pc)					$1,600,000

Annual Operation and Maintenance Costs

Item	Description		Unit	Quantity	Unit Cost	Total Cost
I	SITE INSPECTION AND MAINTENANCE	ES				
a.	Fence, cap, and wells		Included in Items II and III			$0
	Subtotal (A1)					$0
II	GROUNDWATER SAMPLING AND ANALYSIS (after years 1,3,5,10, 15,20,25, and 30)	ES				
a.	Sampling: 2 man crew @ $35/hr/man plus travel time, expenses, and ODCs		Days	2	$800	$1,600
b.	Analysis: 5 samples for volatiles and semivolatiles (at 5 monitoring wells MW1DD, MW12S, MW8DD, GW3S, and MW9S) and one sample for PSBs (MW12s)		Round	1	$2,500	$2,500
c.	Data reviews, reporting, and administration		Hrs.	40	$70	$2,800
	Subtotal (A2)					$6,900
III	GROUNDWATER TREATMENT SYSTEM (first 10 years) SHALLOW GROUNDWATER	ES / Vendor				
a.	Operation of System – Labor		Hrs	416	$50	$20,800
	Operation of System – Carbon Changeout		Changes	25	$700	$17,500
	Operation of System – Electrical Power		Month	12	$200	$2,400
b.	Effluent Monitoring		EA	52	$300	$15,600
	Subtotal (A3)					$56,300
	TOTAL ANNUAL O & M COSTS FOR YEARS 1 THROUGH 10 (Po+m)					$63,900
	TOTAL ANNUAL O & M COSTS FOR YEARS 11 THROUGH 30 (Po+m)					$27,600
	ALTERNATIVE 2A TOTAL PW COSTS (Pt = Pc + (19.60 * A1) + (5.58 * A2) + (8.53 * A3)) (based on a 3% interest rate)					$2,100,000

ALTERNATIVE 3 – IN-SITU SOIL TREATMENT

Capital Costs

Cost Estimate Section	Description	Source of Unit Cost	ES Reference Page #	Unit	Quantity	Unit Cost	Total Cost
I	MOBILIZATION / DEMOBILIZATION	ES / Means					
	a. Excavation Equipment	022-274		LS	1	$5,000	$5,000
	• backhoe, bulldozer, vibratory roller, water truck						
	b. Misc. Construction Expenses	ES		LS	1	$15,000	$15,000
	• coordination, travel, physical exams						
	• permits: discharge, air, construction						
	Subtotal						$20,000
2							
II	SITE PREPARATION	ES / Means					
	a. Set-up of trailers, decon, etc.	015-900		LS	1	$7,500	$7,500
	b. Site Clearing	021-116		LS	1	$5,000	$5,000
	• brush, trees, and debris						
	c. Demolition of Warehouse & other structures in "backyard" area	020-604		LS	1	$13,500	$13,500
	d. Fencework	ES					
	• modify existing fence			LF	200	$20	$4,000
	• install temporary construction fence			LF	200	$5	$1,000
	e. Equipment rental, supplies, phone, and power	ES		Month	6	$1,500	$9,000
	f. Health and safety equipment, disposals	ES		Month	6	$1,000	$6,000
	g. Air Monitoring	ES		Month	6	$3,000	$18,000
	h. Survey	ES		Day	5	$800	$4,000
	i. Work Plan / Health and Safety Plan	ES		LS	1	$10,000	$10,000
	j. Meetings	ES		Each	5	$1,000	$5,000
	k. Security guard (24 hours on weekends / 16 hours on weekdays)	ES		Week	26	$1,660	$43,160
	Subtotal						$126,160
III	SURFACE SOIL EXCAVATION / HANDLING						
	a. Excavation and off-site disposal of surface soils with PCB concentrations > 50 ppm	ES / Means 022-242		CY	100	$450	$45,000
	b. Excavation and off-site disposal of resinous material	Vendor		CY	1,000	$450	$450,000
	c. Excavation of remaining surface soils outside of fence limits exceeding NYS SCGs, place and grade soils in "backyard" area	ES		CY	3,300	$6	$19,800
	d. Backfill excavated areas with cleanfill and 6" of topsoil	029-308		CY	3,000	$20	$60,000
	e. Seed and fertilize topsoil	ES		Acre	2.5	$1,700	$4,250
	Subtotal						$579,050
IV	CONCRETE CONTAINMENT WALL	ES					
	a. Excavate, repair, plug, and backfill			LS	1	$5,000	$5,000
	Subtotal						$5,000
V	BARRIER WALL	ES / Vendor					
	a. Extend north barrier wall (300' x 6')			SF	1,800	$15	$27,000
	• install a bentomat curtain						
	• excavate a trench						
	Subtotal						$27,000
VI	GROUNDWATER COLLECTION TRENCHES	Means					
	a. Excavate shallow groundwater collection trenches	671-4120		LF	3,600	$10	$36,000
	b. Install collection piping (6" HDPE)			LF	3,600	$2	$7,200
	d. Collection sump and cleanout			LS	1	$2,000	$2,000
	e. Pump and controls			LS	1	$5,000	$5,000
	Subtotal						$50,200
VII	GEOMEMBRANE COVER	ES / Vendor					
	a. Filter Fabric			SY	14,400	$1.35	$19,440
	b. Geonet or 6" gravel layer for draining purposes			SY	14,400	$6.00	$86,400
	c. Cushion Geotextile			SY	14,400	$1.35	$19,440
	d. Geomembrane (20-mil) PVC			SY	14,400	$3.00	$43,200
	e. 12" cover soil			SY	14,400	$5.60	$80,640
	f. 6" of topsoil			SY	14,400	$5.25	$75,600
	g. Seed and fertilize			SY	14,400	$1.45	$20,880
	Subtotal						$345,600
VIII	SOIL VAPOR EXTRACTION / BIOVENTING SYSTEM	ES / Vendor					
	a. Installation			LS	1	$5,200	$5,200
	b. Piping			LS	1	$2,000	$2,000
	c. Blower			LS	1	$4,580	$4,580
	d. Air / Water Separator			LS	1	$1,000	$1,000
	e. Instrumentation / Electrical			LS	1	$5,300	$5,300
	f. Carbon treatment unit for off-gas emissions			LS	1	$3,500	$3,500
	g. Air Sampling (Start-up)			LS	1	$3,200	$3,200
	h. System Installation & Start-up			LS	1	$19,200	$19,200
	Subtotal						$43,980
IX	COLLECTION SYSTEM FOR DEEP AQUIFER	ES					
	a. Pumps			EA	2	$3,000	$6,000
	b. Piping and Electrical Wiring			LS	1	$3,000	$3,000
	Subtotal						$9,000

ALTERNATIVE 3 (CONTINUED) – IN-SITU SOIL TREATMENT

X		GROUNDWATER TREATMENT SYSTEM (21 GPM)	ES / Vendor				
	a.	Pumps and Piping		EA	2	$5,000	$10,000
	b.	Pad / Shelter / Tanks		LS	1	$63,600	$63,600
	c.	GAC Unit Installed		LS	1	$18,200	$18,200
		Subtotal					**$91,800**
XI		GROUNDWATER MONITORING WELLS	ES				
	a.	Decommission all GW monitoring wells which are effected by construction or are vertical conduits of the alternative by over-drilling and grouting		EA	4	$1,000	$4,000
	b.	Decommission the production well		EA	1	$3,000	$3,000
	c.	Install two new deep groundwater monitoring wells (4" dia.) in the area GW1DD and GW2DD		LF	100	$100	$10,000
		Subtotal					**$17,000**
X		PILOT BIOTREATMENT TEST	ES	LS	1	$50,000	$50,000
		Subtotal					**$50,000**
		SUBTOTAL CAPITAL COSTS					**$1,364,790**
		Engineering (for design and construction mgmt.)					**$300,000**
		Contingency		20.0 %			**$272,958**
		TOTAL CAPITAL COSTS (Pc)					**$1,900,000**

Annual Operation and Maintenance Costs

Item		Description		Unit	Quantity	Unit Cost	Total Cost
I		SITE INSPECTION AND MAINTENANCE	ES				
	a.	Fence, cap, wells, and pump		Included in Items II and III			$0
		Subtotal (A1)					**$0**
II		GROUNDWATER SAMPLING AND ANALYSIS (after years 1,3,5,10, 15,20,25, and 30)	ES				
	a.	Sampling: 2 man crew @ $35/hr/man plus travel time, expenses, and ODCs		Days	2	$800	$1,600
	b.	Analysis: 5 samples for volatiles and semivolatiles (at 5 monitoring wells MW1DD, MW12S, MW8DD, GW3S, and MW9S) and one sample for PSBs (MW12s)		Round	1	$2,500	$2,500
	c.	Data reviews, reporting, and administration		Hrs.	40	$70	$2,800
		Subtotal (A2)					**$6,900**
IIIA		GROUNDWATER TREATMENT SYSTEM (first 3 years, 20 gpm) DEEP GROUNDWATER TREATMENT	ES / Vendor				
	a.	Operation of System – Labor		Hrs	416	$50	$20,800
		Operation of System – Carbon Changeout		Changes	46	$1,800	$82,800
		Operation of System – Electrical Power		Month	12	$840	$10,080
	b.	Effluent Monitoring		EA	52	$300	$15,600
		Subtotal (A3a)					**$129,280**
IIIB		GROUNDWATER TREATMENT SYSTEM (years 1-10, 1 gpm) SHALLOW GROUNDWATER TREATMENT (items a1, a3, b, years 4-10 only)	ES / Vendor				
	a.	Operation of System – Labor		Hrs	416	$50	$20,800
		Operation of System – Carbon Changeout		Changes	4	$1,800	$7,200
		Operation of System – Electrical Power		Month	12	$400	$4,800
	b.	Effluent Monitoring		EA	52	$300	$15,600
		Subtotal (A3b)					**$48,400**
IV		MAINTENANCE OF SVE / BIOVENTING SYSTEM (first 10 years)	ES / Vendor				
	a.	Operation of System – Labor		Hrs	120	$50	$6,000
		Operation of System – Carbon Changeout		Changes	20	$1,100	$22,000
		Operation of System – Electrical Power		KWH	20000	$0.12	$2,400
	b.	Air Sampling – Analysis		EA	20	$200	$4,000
	c.	Confirmatory sampling of soil – analyze for volatiles and semi-volatiles		Round	1	$5,000	$5,000
		Subtotal (A4)					**$39,400**
		TOTAL ANNUAL O & M COSTS FOR YEARS 1 THROUGH 3 (Po+m)					**$189,680**
		TOTAL ANNUAL O & M COSTS FOR YEARS 4 THROUGH 10 (Po+m)					**$101,600**
		TOTAL ANNUAL O & M COSTS FOR YEARS 11 THROUGH 30 (Po+m)					**$27,600**

ALTERNATIVE 3 TOTAL PW COSTS (Pt = Pc + (5.58 * A2) + (2.83 * (A3a+IIIBa2) + 5.7 * A3b) + (8.53 * (A1+A4))) **$2,900,000**
(based on a 3% interest rate)

ALTERNATIVE 4A – EXCAVATION AND THERMAL DESORPTION

Capital Costs

Cost Estimate Section		Description	Source of Unit Cost	ES Reference Page #	Unit	Quantity	Unit Cost	Total Cost
I		MOBILIZATION/DEMOBILIZATION	ES / Means					
	a.	Excavation Equipment	022–274		LS	1	$5,000	$5,000
		• backhoe, bulldozer, vibratory roller, water truck						
	b.	Thermal Treatment Equipment			LS	1	$500,000	$500,000
	c.	Misc. Construction Expenses	ES		LS	1	$25,000	$25,000
		• coordination, travel, physical exams						
		• permits: air, discharge, and construction						
		Subtotal						**$530,000**
II		SITE PREPARATION	ES / Means					
	a.	Set-up of trailers, decon, etc.	015–900		LS	1	$7,500	$7,500
	b.	Site Clearing	021–116		LS	1	$5,000	$5,000
		• brush, trees, and debris						
	c.	Demolition of Warehouse & other structures in "backyard" area	020–604		LS	1	$13,500	$13,500
	d.	Fencework	ES					
		• modify existing fence			LF	200	$20	$4,000
		• install temporary construction fence			LF	200	$5	$1,000
	e.	Equipment rental, supplies, phone, and power	ES		Month	6	$1,500	$9,000
	f.	Health and safety equipment, disposals	ES		Month	6	$1,000	$6,000
	g.	Air Monitoring	ES		Month	6	$3,000	$18,000
	h.	Survey (Construction and Records)	ES		Day	6	$800	$4,800
	i.	Work Plan / Health and Safety Plan	ES		LS	1	$10,000	$10,000
	j.	Meetings	ES		Each	5	$1,000	$5,000
	k.	Security guard (24 hours on weekends / 16 hours on weekdays)	ES		Week	26	$1,660	$43,160
		Subtotal						**$126,960**
III		SOIL EXCAVATION	ES / Means					
	a.	Excavation and off-site landfill of surface soils outside and inside of fence limits with PCB concentrations > 10 ppm	022–242		CY	500	$450	$225,000
	b.	Excavation and off-site landfill of resinous material material inside the fence limits	Vendor		CY	1,000	$450	$450,000
	c.	Excavation of remaining surface soils exceedomg NYS SCGs, and placement onto dewatering pad	ES		CY	5,500	$6	$33,000
	d.	Excavation of subsurface soils exceedomg NYS SCGs, and placement onto dewatering pad	ES		CY	10,000	$6	$60,000
	e.	Backfill off-site excavated areas with 6" of cover	ES / Vendor		CY	1,200	$20	$24,000
	f.	Backfill off-site excavated areas with 6" of topsoil	ES / Vendor		CY	1,200	$25	$30,000
	g.	Seed / fertilize topsoil	029–308		Acre	2.5	$1,700	$4,250
		Subtotal						**$826,250**
IV		BARRIER WALL	ES / Vendor					
	a.	Extend north barrier wall (300' x 6')			SF	1,800	$15	$27,000
		• Install a bentomat curtain						
		• Excavate a trench						
		Subtotal						**$27,000**
V		GRAVITY DEWATERING	ES					
	a.	Prepare gravity dewatering area and cover			SY	2,500	$10	$25,000
	b.	Dewatering with periodic mechanical disturbance			CY	15,000	$15	$225,000
		Subtotal						**$250,000**
VI		GROUNDWATER COLLECTION PIPE	ES					
	a.	Excavate shallow groundwater collection trenches			LF	160	$15	$2,400
	b.	Install collection piping (6" HDPE)			LF	160	$2	$320
	d.	Collection sump and cleanout	Means		LS	1	$2,000	$2,000
	e.	Pump and controls	671–4120		LS	1	$5,000	$5,000
		Subtotal						**$9,720**
VII		THERMAL DESORPTION TREATMENT PROCESS	Vendor					
	a.	Soil homogenization			CY	15,500	$5	$77,500
	b.	Treatment			CY	15,500	$100	$1,550,000
	c.	Sample soil and analyze for soil treatment objectives			LS	1	$10,000	$10,000
		Subtotal						**$1,637,500**
VIII		BACKYARD AREA	ES / Means					
	a.	Place, grade and compact treated soil onto "backyard" area			CY	15,500	$2	$31,000
	b.	Add 6" of topsoil			CY	600	$25	$15,000
	c.	Seed and fertilize			Acre	3	$1,700	$5,100
		Subtotal						**$51,100**

ALTERNATIVE 4A (CONTINUED) – EXCAVATION AND THERMAL DESORPTION

Item		Description	Source	Unit	Quantity	Unit Cost	Total Cost
IX		COLLECTION SYSTEM FOR DEEP AQUIFER	ES / Means				
	a.	Pumps		EA	2	$3,000	$6,000
	b.	Piping and electrical wiring		LS	1	$3,000	$3,000
		Subtotal					$9,000
X		GROUNDWATER TREATMENT SYSTEM (25 GPM)	ES / Vendor				
	a.	Pumps and piping		EA	2	$5,000	$10,000
	b.	Pad / Shelter		LS	1	$63,600	$63,600
	c.	GAC Unit		LS	1	$18,200	$18,200
		Subtotal					$91,800
XI		GROUNDWATER MONITORING WELLS	ES				
	a.	Decommission all GW monitoring wells which are effected by construction or are vertical conduits of the alternative by over-drilling and grouting		EA	4	$1,000	$4,000
	b.	Decommission the production well		EA	1	$3,000	$3,000
	c.	Install two new deep groundwater monitoring wells (4" dia.) in the area GW1DD and GW2DD		LF	100	$100	$10,000
		Subtotal					$17,000
		SUBTOTAL CAPITAL COSTS					$3,576,330
		Engineering (for design and construction mgmt.)					$250,000
		Contingency		20.0 %			$715,266
		TOTAL CAPITAL COSTS (Pc)					$4,500,000

Annual Operation and Maintenance Costs

Item		Description	Source	Unit	Quantity	Unit Cost	Total Cost
I		SITE INSPECTION AND MAINTENANCE	ES				
	a.	Fence, cap, wells, and pump		Included in Items II and III			$0
		Subtotal (A1)					$0
II		GROUNDWATER SAMPLING AND ANALYSIS (after years 1,3,5,10, 15,20,25, and 30)	ES				
	a.	Sampling: 2 man crew @ $35/hr/man plus travel time, expenses, and ODCs		Days	2	$800	$1,600
	b.	Analysis: 5 samples for volatiles and semivolatiles (at 5 monitoring wells MW1DD, MW12S, MW8DD, GW3S, and MW9S) and one sample for PSBs (MW12s)		Round	1	$2,500	$2,500
	c.	Data reviews, reporting, and administration		Hrs.	40	$70	$2,800
		Subtotal (A2)					$6,900
IIIa		GROUNDWATER TREATMENT SYSTEM (first 3 years, 20 gpm) DEEP GROUNDWATER TREATMENT	ES / Vendor				
	a.	Operation of System – Labor		Hrs	416	$50	$20,800
		Operation of System – Carbon Changeout		Changes	46	$1,800	$82,800
		Operation of System – Electrical Power		Month	12	$840	$10,080
	b.	Effluent Monitoring		EA	52	$300	$15,600
		Subtotal (A3a)					$129,280
IIIb		GROUNDWATER TREATMENT SYSTEM (years 1 to 10, 5 gpm) SHALLOW GROUNDWATER TREATMENT (Items a1, a3, b, years 4–10 only)	ES / Vendor				
	a.	Operation of System – Labor		Hrs	416	$50	$20,800
		Operation of System – Carbon Changeout		Changes	15	$1,800	$27,000
		Operation of System – Electrical Power		Month	12	$400	$4,800
	b.	Effluent Monitoring		EA	52	$300	$15,600
		Subtotal (A3b)					$68,200
		TOTAL ANNUAL O & M COSTS FOR YEARS 1 THROUGH 3 (Po+m)					$160,880
		TOTAL ANNUAL O & M COSTS FOR YEARS 4 THROUGH 10 (Po+m)					$70,500
		TOTAL ANNUAL O & M COSTS FOR YEARS 11 THROUGH 30 (Po+m)					$1,380
		ALTERNATIVE 4A TOTAL PW COSTS (Pt = Pc + (19.60 * A1) + (2.83 * (A3a+IIIBa2) + 5.7 * A3b)+(5.58 * A2)) (based on a 3% interest rate)					$5,400,000

ALTERNATIVE 4B – EXCAVATION AND BIOREMEDIATION

Capital Costs

Cost Estimate Section		Description	Source of Unit Cost	ES Reference Page #	Unit	Quantity	Unit Cost	Total Cost
I		MOBILIZATION/DEMOBILIZATION	ES / Means					
	a.	Excavation Equipment • backhoe, bulldozer, vibratory roller, water truck	022–274		LS	1	$5,000	$5,000
	b.	Misc. Construction Expenses • coordination, travel, physical exams • permits: air, discharge, and construction			LS	1	$15,000	$15,000
		Subtotal						$20,000
II		SITE PREPARATION	ES / Means					
	a.	Set-up of trailers, decon, etc.	015–900		LS	1	$7,500	$7,500
	b.	Site Clearing • brush, trees, and debris	021–116		LS	1	$5,000	$5,000
	c.	Demolition of Warehouse & other structures in "backyard" area	020–604		LS	1	$13,500	$13,500
	d.	Fencework	ES					
		• modify existing fence			LF	200	$20	$4,000
		• install temporary construction fence			LF	200	$5	$1,000
	e.	Equipment rental, supplies, phone, and power	ES		Month	6	$1,500	$9,000
	f.	Health and safety equipment, disposals	ES		Month	6	$1,000	$6,000
	g.	Air Monitoring	ES		Month	6	$3,000	$18,000
	h.	Survey	ES		Day	5	$800	$4,000
	i.	Work Plan / Health and Safety Plan	ES		LS	1	$10,000	$10,000
	j.	Meetings	ES		Each	5	$1,000	$5,000
	k.	Security guard (24 hours on weekends / 16 hours on weekdays)	ES		Week	26	$1,660	$43,160
		Subtotal						$126,160
III		SOIL EXCAVATION	ES / Means					
	a.	Excavation and off-site landfill of surface soils with PCB concentrations > 50 ppm	022–242		CY	100	$450	$45,000
	b.	Excavation and off-site landfill of resinous material material inside the fence limits	Vendor		CY	1,000	$450	$450,000
	c.	Excavation of remaining surface soils exceeding NYS SCGs, and placement onto blanket drain in excavation	ES		CY	5,900	$6	$35,400
	d.	Excavation of remaining surface soils exceeding NYS SCGs, and placement onto blanket drain in excavation	ES		CY	10,000	$6	$60,000
	e.	Backfill off-site excavated areas with 6" of cover	ES / Vendor		CY	1,500	$20	$30,000
	f.	Backfill off-site excavated areas with 6" of topsoil	ES / Vendor		CY	1,500	$25	$37,500
	g.	Seed / fertilize topsoil	ES		Acre	2.5	$1,700	$4,250
		Subtotal						$662,150
IV		CONCRETE CONTAINMENT WALL	ES					
	a.	Excavate, repair, plug, and backfill			LS	1	$5,000	$5,000
		Subtotal						$5,000
V		BARRIER WALL	ES / Vendor					
	a.	Extend north barrier wall (300' x 6') • Install a bentomat curtain • Excavate a trench			SF	1,800	$15	$27,000
		Subtotal						$27,000
VI		GROUNDWATER EXTRACTION AND BIOREMEDIATION SYSTEM	ES / Vendor					
	a.	Soil Homogenization			CY	16,900	$5	$84,500
	b.	Composite geonet or 6" crushed stone blanket drain			SY	14,400	$8	$115,200
	c.	Collection piping (6" HDPE) (4 x 360')			LF	1,440	$2	$2,880
	d.	Collection sump and cleanout			LS	1	$2,000	$2,000
	e.	Pumps and controls			LS	1	$20,000	$20,000
	f.	Air Sampling (initial)			LS	1	$3,200	$3,200
	g.	Vapor Treatment Unit			LS	1	$3,500	$3,500
	h.	Blower and Air/Water Separator			LS	1	$6,000	$6,000
	i.	Instrumentation and Electrical			LS	1	$5,300	$5,300
	j.	System Installation / Start-up			LS	1	$19,200	$19,200
		Subtotal						$261,780
VII		ASPHALT COVER	ES / Vendor					
	a.	Filter Fabric			SY	14,400	$1.35	$19,440
	b.	Geonet or 6" gravel layer for draining purposes			SY	14,400	$6.00	$86,400
	c.	Collection piping (6" HDPE) (4 x 360')			LF	1,440	$2	$2,880
	e.	Asphalt Binder (4")			SY	14,400	$7	$99,360
	f.	Asphalt Top (2")			SY	14,400	$4	$58,176
		Subtotal						$266,256

ALTERNATIVE 4B (CONTINUED) – EXCAVATION AND BIOREMEDIATION

VIII	COLLECTION SYSTEM FOR DEEP AQUIFER	ES					
	a. Pumps		EA	2	$3,000	$6,000
	b. Piping and electrical wiring		LS	1	$3,000	$3,000
	Subtotal					**$9,000**
IX	GROUNDWATER TREATMENT SYSTEM (25 GPM)	ES / Vendor				
	a. Pumps and piping		EA	2	$5,000	$10,000
	b. Pad / Shelter		LS	1	$63,600	$63,600
	c. GAC Unit		LS	1	$18,200	$18,200
	Subtotal					**$91,800**
X	GROUNDWATER MONITORING WELLS	ES				
	a. Decommission all GW monitoring wells which are effected by construction or are vertical conduits of the alternative by over-drilling and grouting		EA	4	$1,000	$4,000
	b. Decommision the production well		EA	1	$3,000	$3,000
	c. Install two new deep groundwater monitoring wells (4" dia.) in the area GW1DD and GW2DD		LF	100	$100	$10,000
	Subtotal					**$17,000**
XI	BIOTREATMENT PILOT TEST	ES	LS	1	$50,000	$50,000
	Subtotal					**$50,000**
	SUBTOTAL CAPITAL COSTS					$1,536,146
	Engineering (for design and construction mgmt.)					$300,000
	Contingency		20.0 %			$307,229
	TOTAL CAPITAL COSTS (Pc)					$2,100,000

Annual Operation and Maintenance Costs

Item	Description		Unit	Quantity	Unit Cost	Total Cost
I	SITE INSPECTION AND MAINTENANCE	ES				
	a. Fence, cap, wells, and pump		Included in Items II and III			$0
	Subtotal (A1)					$0
II	GROUNDWATER SAMPLING AND ANALYSIS (after years 1,3,5,10, 15,20,25, and 30)	ES				
	a. Sampling: 2 man crew @ $35/hr/man plus travel time, expenses, and ODCs		Days	2	$800	$1,600
	b. Analysis: 5 samples for volatiles and semivolatiles (at 5 monitoring wells MW1DD, MW12S, MW8DD, GW3S, and MW9S) and one sample for PSBs (MW12s)		Round	1	$2,500	$2,500
	c. Data reviews, reporting, and administration		Hrs.	40	$70	$2,800
	Subtotal (A2)					**$6,900**
IIIA	GROUNDWATER TREATMENT SYSTEM (first 3 years, 20 gpm) DEEP GROUNDWATER	ES				
	a. Operation of System – Labor		Hrs	416	$50	$20,800
	Operation of System – Carbon Changeout		Changes	46	$1,800	$82,800
	Operation of System – Electrical Power		Month	12	$840	$10,080
	b. Effluent Monitoring		EA	52	$300	$15,600
	Subtotal (A3a)					**$129,280**
IIIB	GROUNDWATER TREATMENT SYSTEM (years 1-10, 1 gpm) SHALLOW GROUNDWATER TREATMENT (items a1, a3, b, years 4-10 only)	ES				
	a. Operation of System – Labor		Hrs	416	$50	$20,800
	Operation of System – Carbon Changeout		Changes	4	$1,800	$7,200
	Operation of System – Electrical Power		Month	12	$400	$4,800
	b. Effluent Monitoring		EA	52	$300	$15,600
	Subtotal (A3b)					**$48,400**
IV	MAINTENANCE OF SVE / BIOVENTING SYSTEM (first 5 years)	ES				
	a. Operation of System – Labor		Hrs	120	$50	$6,000
	Operation of System – Carbon Changeout		Changes	20	$1,100	$22,000
	Operation of System – Electrical Power		KWH	20,000	$0.12	$2,400
	b. Air Sampling – Analysis		EA	20	$200	$4,000
	c. Confirmatory sampling of soil – analyze for volatiles and semi-volatiles		Round	1	$5,000	$5,000
	Subtotal (A4)					**$39,400**
	TOTAL ANNUAL O & M COSTS FOR YEARS 1 THROUGH 3 (Po+m)					**$180,480**
	TOTAL ANNUAL O & M COSTS FOR YEARS 4 AND 5 (Po+m)					**$94,700**
	TOTAL ANNUAL O & M COSTS FOR YEARS 6 THROUGH 10 (Po+m)					**$55,300**
	TOTAL ANNUAL O & M COSTS FOR YEARS 11 THROUGH 30 (Po+m)					**$1,380**

ALTERNATIVE 4B TOTAL PW COSTS (Pt = Pc + (5.58*A2) + (2.83*(A3a+IIIBa2)) + (4.58*A4) (based on a 3% interest rate) — **$3,000,000**

ALTERNATIVE 5 – OFF-SITE DISPOSAL OF SOILS

Capital Costs

Cost Estimate Section		Description	Source of Unit Cost	ES Reference Page #	Unit	Quantity	Unit Cost	Total Cost
I		MOBILIZATION/DEMOBILIZATION	ES / Means					
	a.	Excavation Equipment	022-274		LS	1	$5,000	$5,000
		• backhoe, bulldozer, vibratory roller, water truck						
	b.	Misc. Construction Expenses			LS	1	$15,000	$15,000
		• coordination, travel, physical exams						
		• permits: air, discharge, and construction						
		Subtotal						$20,000
II		SITE PREPARATION	ES / Means					
	a.	Set-up of trailers, decon, etc.	015-900		LS	1	$7,500	$7,500
	b.	Site Clearing	021-116		LS	1	$5,000	$5,000
		• brush, trees, adn debris						
	c.	Demolition of Warehouse & other structures in "backyard" area	020-604		LS	1	$13,500	$13,500
	d.	Fencework	ES					
		• modify existing fence			LF	200	$20	$4,000
		• install temporary construction fence			LF	200	$5	$1,000
	e.	Equipment rental, supplies, phone, and power	ES		Month	6	$1,500	$9,000
	f.	Health and safety equipment, disposals	ES		Month	6	$1,000	$6,000
	g.	Air Monitoring	ES		Month	6	$3,000	$18,000
	h.	Survey (Construction and Records)	ES		Day	5	$800	$4,000
	i.	Work Plan / Health and Safety Plan	ES		LS	1	$10,000	$10,000
	j.	Meetings	ES		Each	5	$1,000	$5,000
	k.	Security guard (24 hours on weekends / 16 hours on weekdays)	ES		Week	26	$1,660	$43,160
		Subtotal						$126,160
III		SOIL EXCAVATION / DISPOSAL	ES / Means					
	a.	Excavation of surface and subsurface soils exceeding NYSDEC SCGs	022-242		CY	17,000	$4	$68,000
	b.	Off-site landfill as hazardous waste	Vendor		CY	17,000	$450	$7,650,000
	c.	Collect and treat groundwater during excavation and pump into groundwater storage tank	ES		1000 gal	4,000	$20	$80,000
	d.	Backfill excavated areas with a clean fill	Vendor		CY	15,800	$20	$316,000
	e.	Backfill excavated areas with 6" of topsoil	Vendor		CY	1,200	$25	$30,000
	f.	Seed / fertilize topsoil	ES		Acre	6	$1,700	$9,350
		Subtotal						$8,153,350
IV		BARRIER WALL	ES / Vendor					
	a.	Extend north barrier wall (300' x 6')			SF	1,800	$15	$27,000
		• Install a bentomat curtain						
		• Excavate a trench						
		Subtotal						$27,000
V		GROUNDWATER COLLECTION SYSTEM	ES / Means					
	a.	Excavate shallow groundwater collection trenches	671-4121		LF	360	$15	$5,400
	b.	Install piping			LF	360	$2	$720
	b.	Collection sump and cleanout			LS	1	$2,000	$2,000
	c.	Pump and controls			LS	1	$5,000	$5,000
		Subtotal						$13,120
VI		GROUNDWATER MONITORING WELLS	ES					
	a.	Decommission all GW monitoring wells which are effected by construction or are vertical conduits of the alternative by over-drilling and grouting			EA	4	$1,000	$4,000
	b.	Decommission the production well			EA	1	$3,000	$3,000
	c.	Install two new deep groundwater monitoring wells (4" dia.) in the area GW1DD and GW2DD			LF	100	$100	$10,000
		Subtotal						$17,000
VII		COLLECTION SYSTEM FOR DEEP AQUIFER	ES					
	a.	Pumps			EA	2	$3,000	$6,000
	b.	Piping and electrical wiring			LS	1	$3,000	$3,000
		Subtotal						$9,000

ALTERNATIVE 5 (CONTINUED) – OFF–SITE DISPOSAL OF SOILS

VIII	GROUNDWATER TREATMENT SYSTEM (20 GPM) DEEP GROUNDWATER	ES / Vendor					
	a. Pumps and piping		EA	2	$5,000	$10,000
	b. Pad / Shelter		LS	1	$63,600	$63,600
	c. Filtration unit (GAC)		LS	1	$18,200	$18,200
	Subtotal					$91,800
	SUBTOTAL CAPITAL COSTS					$8,457,430
	Engineering (for design and construction mgmt.)					$250,000
	Contingency		20.0 %			$1,691,486
	TOTAL CAPITAL COSTS (Pc)					$10,000,000

Annual Operation and Maintenance Costs

Item	Description		Unit	Quantity	Unit Cost	Total Cost
I	SITE INSPECTION AND MAINTENANCE	ES				
	a. Fence, cap, wells, and pump		Included in Items II and III			$0
	Subtotal (A1)					$0
II	GROUNDWATER SAMPLING AND ANALYSIS (after years 1,3,5,10, 15,20,25, and 30)	ES				
	a. Sampling: 2 man crew @ $35/hr/man plus travel time, expenses, and ODCs		Days	2	$800	$1,600
	b. Analysis: 5 samples for volatiles and semivolatiles (at 5 monitoring wells MW1DD, MW12S, MW8DD, GW3S, and MW9S) and one sample for PSBs (MW12s)		Round	1	$2,500	$2,500
	c. Data reviews, reporting, and administration		Hrs.	40	$70	$2,800
	Subtotal (A2)					$6,900
IIIa	GROUNDWATER TREATMENT SYSTEM (first 3 years, 20 gpm) DEEP GROUNDWATER	ES / Vendor				
	a. Operation of System – Labor		Hrs	416	$50	$20,800
	Operation of System – Carbon Changeout		Changes	46	$1,800	$82,800
	Operation of System – Electric Power		Month	12	$840	$10,080
	b. Effluent Monitoring		EA	52	$300	$15,600
	Subtotal (A3a)					$129,280
IIIb	GROUNDWATER TREATMENT SYSTEM (years 1 to 10, 5 gpm) SHALLOW GROUNDWATER (ITEMS a1, a3, b, years 4 – 10 only)	ES / Vendor				
	a. Operation of System – Labor		Hrs	416	$50	$20,800
	Operation of System – Carbon Changeout		Changes	15	$1,800	$27,000
	Operation of System – Electrical Power		Month	12	$400	$4,800
	b. Effluent Monitoring		EA	52	$300	$15,600
	Subtotal (A3b)					$68,200
	TOTAL ANNUAL O & M COSTS FOR YEARS 1 THROUGH 3 (Po+m)					$162,680
	TOTAL ANNUAL O & M COSTS FOR YEARS 4 THROUGH 10 (Po+m)					$71,400
	TOTAL ANNUAL O & M COSTS FOR YEARS 11 THROUGH 30 (Po+m)					$1,920
	ALTERNATIVE 5 TOTAL PW COSTS (Pt = Pc + (19.60 * A1) + (5.58 * A2) + (2.83 * A3a) + (2.83*IIIa2+5.70 * A3b)) (based on a 3% interest rate)					$10,900,000

PARSONS ENGINEERING SCIENCE, INC.

Client: NYSDEC | Job No. 723855.07 | Sheet 1 of 2

Subject: POLIMER APPLICATION SITE GROUNDWATER EXTRACTION | By: WX | Date: 5/25/95

Checked: PWP | Rev. 5/25/95

1. SHALLOW AQUIFER IN BACKYARD

Assumptions:

1. Size: 3 acres (~360' × 360')
2. Avg. water depth: 3 feet
3. Type: perched & unconfined
4. Soil: fine sand
5. Aquifer storage/release coeff. = 10%
6. Surrounded by a subsurface barrier wall.

Find: Extraction rates:
- short term
- Long term
- w/ a low permeability cap.
- w/o a cap

Solution:

1. Current extractable storage:

$3 \text{ acres} \times 43{,}560 \text{ ft}^2/\text{acre} \times 3 \text{ ft} \times 10\%$

$= 39{,}204 \text{ ft}^3$

$= 294{,}030 \text{ gal}$ ⇒ For 1 year extraction:

$294{,}030 / 365 \times 24 \times 60$

$\approx 0.5 \text{ gpm}$

2. Long-term extraction rates:

w/o a cap ~200,030 gal/yr (see HELP model results)

$\approx 0.4 \text{ gpm}$

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC | Job No. 723856.07 | Sheet 2 of 2
Subject POLYMER APPLICATION SITE GW Extraction Rates | By WX | Date 5/25/95
Checked PWP | Rev. 5/25/95

w/ a low permeability cap: ~ 0 gal/yr
= 0 gpm (See HELP model data)

Therefore:

Short term extraction rate:
0.9 gpm w/o cap
0.5 gpm w/ cap

Long term extraction rate:
0.4 gpm w/o cap
0 gpm w/ cap

Design Recommendations:

- Use 5 gpm for non-capped condition to account for seasonal fluctuation and infiltration from surrounding areas.
- Use 1 gpm for short term capped condition.

2. DEEP AQUIFER EXTRACTION

Assumptions:
1. Sand & gravel aquifer > 10' thick
2. Two extraction wells
3. Control pumping rate @ 10 gpm/well

Extraction rate:

2 wells x 10 gpm/well = 20 gpm

TOTAL GW EXTRACTION RATE: 20 + 5 = 25 gpm if w/o a cap

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC | Job No. 723856.06000 | Sheet 1 of 2
Subject POLYMER APPLICATIONS | By WX | Date 5/16/95
Present Worth Factor | Checked | Rev

ASSUMPTIONS:

1. Annual interest rate $i = 3\%$

[based on a 30-year treasury bound rate (~7%) before taxes and after inflation (~4%)]

$7\% - 4\% = 3\%$

FIND: Equivalent Present Worth Factor for

a. Annual O&M for 30 years;

b. O&M at year 1, 3, 5, 10, 15, 20, 25, 30;

c. Annual O&M for 10 years

d. Annual O&M for 5 years.

e. Annual O&M for 4-10 years

SOLUTION:

From the attached reference table:

a. For 30-year O&M, $PWF = (P/A)_{30} = \underline{19.60}$

b. O&M at yr 1, 3, 5, 10, 15, 20, 25, 30:

$$PWF = (P/F)_1 + (P/F)_3 + (P/F)_5 + \cdots + (P/F)_{30}$$

$$= 0.97 + 0.91 + 0.86 + 0.74 + 0.64 + 0.55 + 0.47 + 0.41$$

$$= \underline{5.58}$$

c. For 10-year O&M, $PWF = (P/A)_{10} = \underline{8.53}$

d. For 5-year O&M, $PWF = (P/A)_5 = \underline{4.58}$

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC — Job No. 723856.06000 — Sheet 1A of 27
Subject POLYMER APPLICATIONS Present Worth Factor — By JLS — Date 11/6/95
Checked — Rev.

e. For 4-10 year O&M

$$PWF = (P/A)_7 \times (P/F)_3$$

$$= 6.2303 \times 0.9151$$

$$= \underline{\underline{5.70}}$$

PESI-COR-8 (12/94)

= ナ 2:

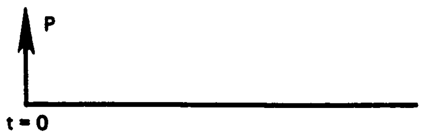
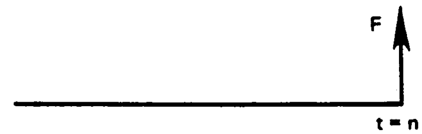
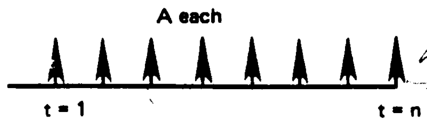
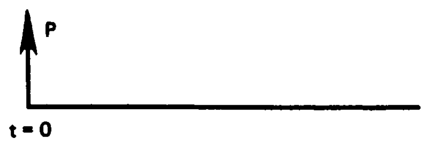
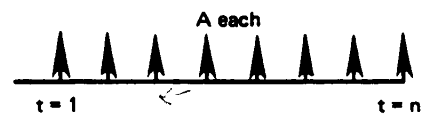
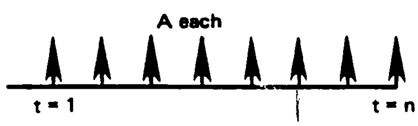
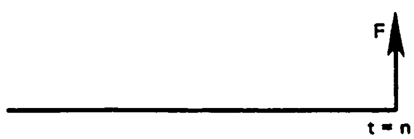
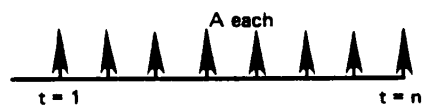
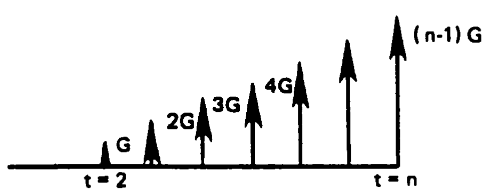
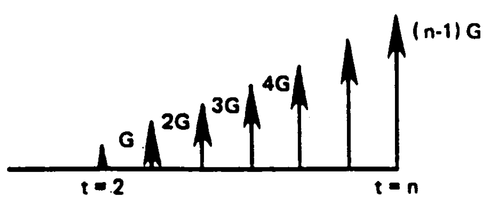
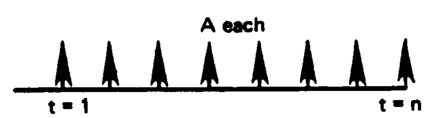
CIVIL ENGINEERING REFERENCE MANUAL

Fifth Edition

Michael R. Lindeburg, P.E.

PROFESSIONAL PUBLICATIONS, INC.
Belmont, CA 94002

STANDARD CASH FLOW FACTORS

MULTIPLY		*BY*	*TO OBTAIN*	
	F	(P/F, i%, n)	P	
	P	(F/P, i%, n)	F	
	A	(P/A, i%, n)	P	
	P	(A/P, i%, n)	A	
	A	(F/A, i%, n)	F	
	F	(A/F, i%, n)	A	
	G	(P/G, i%, n)	P	
	G	(A/G, i%, n)	A	

I = 3.00 %

N	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	(A/G)	N
1	.9709	0.9709	-0.0000	1.0300	1.0000	1.0300	1.0000	-0.0000	1
2	.9426	1.9135	0.9426	1.0609	2.0300	0.5226	0.4926	0.4926	2
3	.9151	2.8286	2.7729	1.0927	3.0909	0.3535	0.3235	0.9803	3
4	.8885	3.7171	5.4383	1.1255	4.1836	0.2690	0.2390	1.4631	4
5	.8626	4.5797	8.8888	1.1593	5.3091	0.2184	0.1884	1.9409	5
6	.8375	5.4172	13.0762	1.1941	6.4684	0.1846	0.1546	2.4138	6
7	.8131	6.2303	17.9547	1.2299	7.6625	0.1605	0.1305	2.8819	7
8	.7894	7.0197	23.4806	1.2668	8.8923	0.1425	0.1125	3.3450	8
9	.7664	7.7861	29.6119	1.3048	10.1591	0.1284	0.0984	3.8032	9
10	.7441	8.5302	36.3088	1.3439	11.4639	0.1172	0.0872	4.2565	10
11	.7224	9.2526	43.5330	1.3842	12.8078	0.1081	0.0781	4.7049	11
12	.7014	9.9540	51.2482	1.4258	14.1920	0.1005	0.0705	5.1485	12
13	.6810	10.6350	59.4196	1.4685	15.6178	0.0940	0.0640	5.5872	13
14	.6611	11.2961	68.0141	1.5126	17.0863	0.0885	0.0585	6.0210	14
15	.6419	11.9379	77.0002	1.5580	18.5989	0.0838	0.0538	6.4500	15
16	.6232	12.5611	86.3477	1.6047	20.1569	0.0796	0.0496	6.8742	16
17	.6050	13.1661	96.0280	1.6528	21.7616	0.0760	0.0460	7.2936	17
18	.5874	13.7535	106.0137	1.7024	23.4144	0.0727	0.0427	7.7081	18
19	.5703	14.3238	116.2788	1.7535	25.1169	0.0698	0.0398	8.1179	19
20	.5537	14.8775	126.7987	1.8061	26.8704	0.0672	0.0372	8.5229	20
21	.5375	15.4150	137.5496	1.8603	28.6765	0.0649	0.0349	8.9231	21
22	.5219	15.9369	148.5094	1.9161	30.5368	0.0627	0.0327	9.3186	22
23	.5067	16.4436	159.6566	1.9736	32.4529	0.0608	0.0308	9.7093	23
24	.4919	16.9355	170.9711	2.0328	34.4265	0.0590	0.0290	10.0954	24
25	.4776	17.4131	182.4336	2.0938	36.4593	0.0574	0.0274	10.4768	25
26	.4637	17.8768	194.0260	2.1566	38.5530	0.0559	0.0259	10.8535	26
27	.4502	18.3270	205.7309	2.2213	40.7096	0.0546	0.0246	11.2255	27
28	.4371	18.7641	217.5320	2.2879	42.9309	0.0533	0.0233	11.5930	28
29	.4243	19.1885	229.4137	2.3566	45.2189	0.0521	0.0221	11.9558	29
30	.4120	19.6004	241.3613	2.4273	47.5754	0.0510	0.0210	12.3141	30
31	.4000	20.0004	253.3609	2.5001	50.0027	0.0500	0.0200	12.6678	31
32	.3883	20.3888	265.3993	2.5751	52.5028	0.0490	0.0190	13.0169	32
33	.3770	20.7658	277.4642	2.6523	55.0778	0.0482	0.0182	13.3616	33
34	.3660	21.1318	289.5437	2.7319	57.7302	0.0473	0.0173	13.7018	34
35	.3554	21.4872	301.6267	2.8139	60.4621	0.0465	0.0165	14.0375	35
36	.3450	21.8323	313.7028	2.8983	63.2759	0.0458	0.0158	14.3688	36
37	.3350	22.1672	325.7622	2.9852	66.1742	0.0451	0.0151	14.6957	37
38	.3252	22.4925	337.7956	3.0748	69.1594	0.0445	0.0145	15.0182	38
39	.3158	22.8082	349.7942	3.1670	72.2342	0.0438	0.0138	15.3363	39
40	.3066	23.1148	361.7499	3.2620	75.4013	0.0433	0.0133	15.6502	40
41	.2976	23.4124	373.6551	3.3599	78.6633	0.0427	0.0127	15.9597	41
42	.2890	23.7014	385.5024	3.4607	82.0232	0.0422	0.0122	16.2650	42
43	.2805	23.9819	397.2852	3.5645	85.4839	0.0417	0.0117	16.5660	43
44	.2724	24.2543	408.9972	3.6715	89.0484	0.0412	0.0112	16.8629	44
45	.2644	24.5187	420.6325	3.7816	92.7199	0.0408	0.0108	17.1556	45
46	.2567	24.7754	432.1856	3.8950	96.5015	0.0404	0.0104	17.4441	46
47	.2493	25.0247	443.6515	4.0119	100.3965	0.0400	0.0100	17.7285	47
48	.2420	25.2667	455.0255	4.1323	104.4084	0.0396	0.0096	18.0089	48
49	.2350	25.5017	466.3031	4.2562	108.5406	0.0392	0.0092	18.2852	49
50	.2281	25.7298	477.4803	4.3839	112.7969	0.0389	0.0089	18.5575	50
51	.2215	25.9512	488.5535	4.5154	117.1808	0.0385	0.0085	18.8258	51
52	.2150	26.1662	499.5191	4.6509	121.6962	0.0382	0.0082	19.0902	52
53	.2088	26.3750	510.3742	4.7904	126.3471	0.0379	0.0079	19.3507	53
54	.2027	26.5777	521.1157	4.9341	131.1375	0.0376	0.0076	19.6073	54
55	.1968	26.7744	531.7411	5.0821	136.0716	0.0373	0.0073	19.8600	55
60	.1697	27.6756	583.0526	5.8916	163.0534	0.0361	0.0061	21.0674	60
65	.1464	28.4529	631.2010	6.8300	194.3328	0.0351	0.0051	22.1841	65
70	.1263	29.1234	676.0869	7.9178	230.5941	0.0343	0.0043	23.2145	70
75	.1089	29.7018	717.6978	9.1789	272.6309	0.0337	0.0037	24.1634	75
80	.0940	30.2008	756.0865	10.6409	321.3630	0.0331	0.0031	25.0353	80
85	.0811	30.6312	791.3529	12.3357	377.8570	0.0326	0.0026	25.8349	85
90	.0699	31.0024	823.6302	14.3005	443.3489	0.0323	0.0023	26.5667	90
95	.0603	31.3227	853.0742	16.5782	519.2720	0.0319	0.0019	27.2351	95
100	.0520	31.5989	879.8540	19.2186	607.2877	0.0316	0.0016	27.8444	100

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC | Job No. 7_ _ 35_ | Sheet 3 of 27
Subject POLYMER APPLICATIONS | By WX | Date 5/22/95
Checked | Rev.

	SOURCE
ALTERNATIVE 1 – NO ACTION	
I. ANNUAL SITE INSPECTION AND MAINTENANCE	ES
1. Labor: 2 men @ \$35/hr/man for 8 hrs	
2 × \$35 × 8 = \$560/day	
2. Equipment & Supplies: Assume \$200/day	
3. Travel + ODCs: Assume \$100/day	
4. Administration: 8 hrs @ \$70/hr = \$560	
Total \$1,420/day	
II. GROUNDWATER SAMPLING AND ANALYSIS	ES
a. Sampling:	
a1. Labor 2 men × \$35/hr/man	
= \$70/hr × 8 hr/day	
= \$560/day	
a2. Travel, Expenses, & ODCs. Assume \$240/day	
a. Total \$800/day	
b. Analysis:	
– 5 GW samples + 3 QA/QC samples	
= 8 samples × \$300/VOCs + SVOCs = \$2,400	VENDOR
– 1 GW sample × \$200/PCBs = \$200	

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC Job No. 722853.[illegible] Sheet 6 of 27

Subject POLYMER APPLICATIONS By [illegible] Date 5/15/95

COST ESTIMATE BACKUP Checked Rev.

ALTERNATIVE 2

		SOURCE
I. MOBILIZATION/DEMOB		
a. GENERAL EQUIPMENT		
• Excavator	1	
• Loader	1	
• Water Truck	1	
• Dozer	1	
• Roller	1	
• Street Sweeper	1	
	6	
	@ $500 (Assume $500 for longer dist.)	ES/MEANS
	$3,000	022-274
MISC. EQUIP.	$2,000	($300 @ 25 miles)
	$5,000	
b. MISC. CONSTRUCTION EXPENSES		ES

• Coordination/Travel (@ $400/day × 10 days/month = $4,000

• Physical Exam – Assume $2,000 (for time & exam fee) for 10 people @ $200/person

• Permits

– Effluent Discharge: Assume $2,500

– Trucking & Disposal: Assume $2,000

– Air Emissions: Assume $5,000 (for treatment only)

Totals: $15,000 (w/o air permit)

$20,000 (w/ air permit)

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC | Job No. [illegible] | Sheet 7 of 27
Subject POLYMER APPLICATIONS | By KJM | Date 5/17/95
Checked [illegible] 5/18/95 | Rev.

ALTERNATIVE 2A: | SOURCE

II SITE PREPARATION:

a. SET-UP — ES/MEANS 015-900

- TRAILERS (x 6 mos.)
  - 2 office trailers @ $350/mo. — $4200
  - 2 storage trailers @ $150/mo. — $1800
  - Hookups, mobilization @ $100/mo. — $600
  - Supplies $50/mo. — $300
  - **$6,900**
- PERSONNEL DECON. AREA
  - Assume $600 for miscellaneous expenses (i.e. brushes, poly, water, etc.)

($7,500)

b. SITE CLEARING — ES/MEANS 021-116

- brush, trees & debris removal
  - approximately 3 acres must be [illegible], however [illegible] [illegible] [illegible]

~$1600/acre × ~3 acres ⇒ **($5,000)**

c. DEMOLITION OF WAREHOUSE & OTHER STRUCTURES — MEANS 020-604

- EQUIPMENT: -1 backhoe w/ a hydraulic hammer, -1 bulldozer } RATE ESTIMATED @ $1500/day
- WAREHOUSE: 2 days for demolition ⇒ $3,000
- TANK AREA: 2 days ⇒ $3,000
- FORMER BUILDING FOUNDATION REMAINS: 3 days ⇒ $4,500
- MISCELLANEOUS STRUCTURES: 2 days ⇒ $3,000 — **($13,500)**
- DISPOSE DEBRIS ON SITE
- ASSUME USEPA WILL REMOVE ALL DRUMS & TANK RESIDUE AWAY FROM SITE AS PART OF THE INTERIM REMEDIAL MEASURES (IRM)

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC — Job No. [illegible] — Sheet 8 of 27
Subject [illegible] — By [illegible] — Date 5/17/95
Checked [illegible] — Rev.

SOURCE

d. FENCEWORK — ES

- dismantle & reinstall portion of original site fence for access & construction – ~200 ft of fence @ $20/LF ⇒ $4,000
- install a temporary construction fence for access restriction – 200 ft. of 4' orange plastic fence @ $5/LF ⇒ $1,000

$5,000

e. EQUIPMENT RENTAL & MISCELLANEOUS — ES

× 6 mos.

- Rental of tools, pumps, etc. ~$500/mo ⇒ $3,000
- phone ~$300/mo. ⇒ $1,800
- Power for trailers, pumps, decon, etc. ~$500/mo. ⇒ $3,000
- Supplies & misc. ~$200/mo. ⇒ $1,200

$9,000

f. HEALTH & SAFETY EQUIPMENT — ES

- mostly Level D work, however residue material removal may require Level B
- disposal of select protective wear + rental

× 6 months (180 days)

Level "D" @ $20/day × 4 people ⇒ $14,400

Level "B" @ $100/day × 2 people ⇒ $4,800 ← only 30 days use assumed
(saranex & disposals increase costs)

$19,200

g. AIR MONITORING — ES

- Perimeter & breathing zone, real time
- Instrument & part time H&S officer (2 hrs./day)

$75/hr × 2 hr/day = $150/day ⇒ 3,000/month × 6 mos.

$18,000

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC
Subject POLYMER APPLICATIONS
Job No. 723256.36000
By KCH
Checked JJX 5/12/95
Sheet 9 of 27
Date 5/17/95
Rev.

SOURCE

h. SURVEY

- 2 man survey crew @ $100/hour & an 8hr. day* — ES
- approximately 5 days for survey work onsite & in office*

$100/hr · 8hr/day · 5 days ⇒ $4,000

*including travel expenses & ODCs

i. WORK PLAN

- Average cost for work plan & site health & safety plan (including daily reference & use of...) — ES

$10,000

j. MEETINGS — ES

- Estimate 5 meetings throughout work schedule of 6 months
- Assumes 2 people for 8hrs @ $500/day/person including travel ⇒ $1,000/mtg

5 mtgs. @ $1000/mtg ⇒ $5,000

K. SECURITY GUARD — ES

- Full time security on weekends ⇒ 24hrs/day * 2day/wk = 48 hrs/wk
- Only "off-hours" security on weekdays ⇒ 16hrs/day * 5day/wk = 80 hrs/wk

  on average $13/hr · (48+80) hrs/wk ⇒ $1664/wk × 26wks
  (including fringe & benefits & profit)

$43264

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC | Job No. [illegible] | Sheet 10 of 27

Subject POLYMER APPLICATIONS | By KTM | Date 5/17/95

Checked WX 5/18/95 | Rev.

	SOURCE
III SURFACE SOIL EXCAVATION:	
a. Excavate top 12" (in-place volume) from outside backyard*	ES-MEANS 022-242
- estimated area of excavation is 2.5 acres	

$$\frac{2.5\text{ acres} \mid 43{,}560\text{ ft}^2 \mid 1\text{ ft deep}}{\mid \text{acre} \mid} = \frac{108,900\text{ ft}^3 \mid \text{CY}}{\mid 27\text{ ft}^3}$$

* soil excavated
(1) above SCGs or
(2) Resinous material

= ~4,000 CY of soil to excavate @ $6/CY

- Stockpile excavated material => $24,000
- confirmatory sampling
- further excavation if necessary

b. RESINOUS MATERIAL DISPOSAL — VENDOR

- Only portions of excavated material contain resinous material
- resinous material must be treated as a hazardous material including Level B protection & off-site disposal at hazardous material landfill
- ~1,000 CY of material @ $450/CY to dispose (based on $300/ton, including transportation to Model City, NY & Chemical Waste Management Facility) → $450,000

c. CONSOLIDATE REMAINING SOIL ONTO "BACKYARD" AREA — ES MEANS 022-262-0170

- consolidation includes transportation to backyard area of site (3,000 CY @ $1.00/CY) => $3,000
- Placement of soils (w/ a bulldozer & a vibrating roller compactor) (3,000 CY @ $2.00/CY) = $6,000

$9,000

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client NYCDEC | Job No. [illegible] | Sheet 11 of 27
Subject POLYMER APPLICATIONS | By [illegible] | Date 5/17/95
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	SOURCE
d. BACKFILL EXCAVATED AREAS WITH A CLEAN FILL	
• select clean material chosen for delivery and backfill of 1,500 CY @ $15/CY ⇒ $22,500	ES/VENDOR
- fill delivered @ $8-10/ton	
- grade & compact @ $2/CY	
e. BACKFILL EXCAVATED AREAS WITH 6" OF TOPSOIL	ES/VENDOR
• higher grade of material used for surface layer - delivered & backfilled 1,500 CY @ $25/CY	
- topsoil delivered @ $15/ton ⇒ $37,500	
- grade & compact @ $3/CY	
f. SEED & FERTILIZE	MEANS
• ESTIMATED ~$1,700/acre to seed & fertilize	029-302
• 2.5 acres × $1,700/acre ⇒ $4,000	

IV CONCRETE CONTAINMENT WALL (1000ft'):	
	ES
• Excavate portions of wall	
• Repair portions of wall	
• Plug portions of wall	
• Backfill portions of wall } estimated ~$1,250/day × 4 days ⇒ ~$5,000	
- 1 backhoe + 1 operator	
- 1 laborer + material > $1,250/day	

V BARRIER WALL (300'×6'):	
	ES/VENDOR
• EXTEND THE NORTH BARRIER WALL	
300'×6' = 1800 ft² @ $15/ft² wall ⇒ $27,000	
- Excavate trench, ~3' wide	
- Remove water from excavation	
- Backfill trench & compact	
- Place a geomat curtain in trench ($2/SF)	
- Restore disturbed area & seed	

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC | Job No. 723856.36000 | Sheet 13 of 27
Subject POLYMER APPLICATIONS | By KJM | Date 5/17/95
Checked WX 5/18/95 | Rev.

	SOURCE
VI CAP OVER BACKYARD AREA (3 ACRES):	
a. ASPHALT CAP WITH APPROPRIATE BASE	ES/VENDOR
• Backyard area is estimated to be 3500 SY	MEANS
- Fine grade & compaction @ $1.50/SY → $5,250	
- Stone base (6") @ $10/SY → $35,000	
- Asphalt binder (4") @ $7/SY → $24,500	
- Asphalt top (2") @ $4/SY → $14,000	
$78,750	
VII SHALLOW GROUNDWATER COLLECTION PIPE:	ES
a. Pipe placed on NE side of main warehouse, bordering backyard area	
• Excavate to 5' depth & 360' in length + Backfill + Compact	
- $15/LF for 360 LF => $5,400	
• Collection pipe (4" HDPE corrugated & perforated, wrapped in filter fabric)	
- $2/LF for 360 LF => $720	
• Collection sump & cleanouts (2 of them)	
- estimated at $1,000 each => $2,000	
• Appropriate pumps & controls, wiring & piping estimated @ $5,000	MEANS 671-4120
$13,120	
VIII GROUNDWATER TREATMENT SYSTEM:	ES
a. Pump & piping, again estimated @ $3,000	
b. SW Setup: Pad - 20'×60'×1' concrete pad; Shelter -; Tanks - } $49,000	
c. GAC Filtration installed - $12,000	
$64,000	

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client: NYSDEC
Job No.: 723856
Sheet 13 of 27
Subject: Polymer Applications Site
By: JLS
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(CONT'D)

VIII ↑ GROUNDWATER TREATMENT SYSTEM

		SOURCE
a. Pump & piping from influent tank to GW treatment system, estimated @	**$3000**	ES
b. System setup:		
Pad: 20'×20'×1' deep ⇒ 15 CY		
15 CY @ $364/CY =	$5460	Means
Shelter: 400 sf @ $60/sf =	$24,000	ES
Tanks: 1 5000 gal influent @	$12,500	Vendor
1 2000 gal treated wtr @	$7000	Vendor
	$48,960	
⇒	**$49,000**	
c. System components		
2 bag filters est. @ $1000 ea =	$2000	ES
6 Calgon Flowsorb units @ $630 ea = (incl. transportation)	$3780	Vendor
Carbon acceptance charge =	$2500	Vendor
Installation: 2 person crew for 1 wk 2 × 40hr/wk × $50/hr =	$4000	ES
	$12,280	
→	**$12,000**	

$64,000

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC	Job No. 723856	Sheet 14 of 27
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Annual O&M Costs

III GROUNDWATER TREATMENT SYSTEM (First 10 years)

SOURCE

a. Operation of System

ES — Labor - estimate 8 hrs/week × 52 weeks/yr × $50/hr = $20,800

Vendor, ES — Carbon Changeout

Carbon usage = 11.4 lb carbon/day

Each unit has 165 lb carbon

$\frac{165 \text{ lb}}{11.4 \text{ lb/day}} = 14.5$ days/unit

Annual usage: $\frac{365 \text{ days/yr}}{14.5 \text{ day/unit}} = 25$ units/yr.

25 units @ $700/unit (incl. transport.) = $17,500

ES — Electrical Power est. @ $200/mo × 12 mo/yr = $2,400

b. Effluent monitoring

ES — Assume sample weekly for selected VOCs, phenol, TSS, and TOC @ $300/sample

Assume sample conducted by operating personnel ⇒ no additional labor cost needed

$300/sample × 52 wks/yr = $15,600

$56,300

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC | Job No. 723256.06000 | Sheet 15 of 27
Subject Collimated Applications | By KJM | Date 5/17/95
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	SOURCE
IX GROUNDWATER MONITORING WELLS:	
a. Decommission all GW monitoring wells which are not part of long term monitoring plan by overdrilling (>40'/well), grouting, and disposing of materials (15 wells @ $1,000/well)	ES
b. Decomission production well ($3,000)	
($18,000)	
ALTERNATIVE 2B: SEE PAGES 22-27	
~~CAP OVER BACKYARD AREA: (14,400 yd² = 3 acres)~~	ES/VENDOR
~~a. GEOMEMBRANE WITH SOIL COVER~~	
~~• Grade & compact 14,400 yd² @ $1.50/SY ⇒ $21,600~~	
~~• 60 mil HDPE geomembrane layer @ $7/SY ⇒ $100,800~~	VENDOR
~~• 18" of protective soil not superior quality @ $10/SY ⇒ $144,000~~	
~~• 6" of topsoil @ $4/SY ⇒ $57,600~~	
~~• Seed & Fertilize @ ~$1,700/acre × 3 acres ⇒ ~$5,100 ($40/1,000 SF)~~	MEANS
~~($329,100)~~	
ALTERNATIVE 3:	
GEOMEMBRANE COVER: (3500 yd² = 0.7 Acres)	ES/VENDOR
a. Cover backyard area with a more elaborate geomembrane which will allow venting	
• Filter fabric, 3500 SY @ $1.35/SY ⇒ $4,725	VENDOR
• Geonet or 6" gravel layer for venting purposes 3500 yd² @ $4.50/SY ⇒ $15,750	"
• Cushion geotextile 3500 SY @ $1.35/SY ⇒ $4,725	
• Geomembrane (20-mil PVC) for 3500 yd² @ $4.50/SY ⇒ $15,750	
• 12" of cover soil for 3500 yd² @ $5.00/SY ⇒ $17,500	
• 6" of topsoil @ $4/SY ⇒ $14,000	
• Seed & fertilize $1700/Acre × 0.7 Acres ⇒ $1,229	
$73,679	

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC | Job No. 723856.36000 | Sheet 110 of 217

Subject POLYMER APPLICATIONS | By KJM | Date 5/17/95

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ALTERNATIVE 3:

SOIL VAPOR EXTRACTION / BIOVENTING SYSTEM:

	Unit	Quantity	Unit Cost	Ext. Cost	SOURCE
a. INSTALLATION					ES/VENDOR
• MOB/DEMOB	LS	1	$250	$250	
• ATV/RIG SURCHARGE	LS	1	$500	$500	
• WATER TRUCK	DAY	1	$100	$100	
• STEAM CLEANER	DAY	1	$90	$90	
• 6.25" HSA	FT	(20×4) 80	$20	$1600	
• 3" diam. SPLIT SPOON SAMPLING	EA	(80/2) 40	$10	$400	
• ½" PVC SCH 80 RISER INST.	FT	(20×4') 80	$3	$240	
• ½"×6" 0.02" SLOT SCREEN	FT	20	$2	$40	
• 12" FLUSH MOUNT COVER	EA	20	$100	$2000	
				$5,200	
b. PIPING					ES
• 4" SCH 40 PVC PIPE	FT	200	$6	$1200	
• 4" PVC BALL VALVES	EA	3	$200	$600	
• 4" PVC JOINTS (90° CLIP)	EA	4	$10	$400	
				$2,000	
c. BLOWER					
• 3-hp rotary vane vacuum blower explosion proof	EA	1	$2,000	$2,000	ES
• 3hp motor starter	EA	1	$500	$500	
• air filter	EA	1	$80	$80	
• electrical subcontract				$2,000	
				$4580	

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC Job No. 732256.02000 Sheet 17 of 27
Subject Polymer Applications By KJM Date 5/17/95
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	UNIT	QUANTITY	UNIT COST	TOT. COST
d. AIR/WATER SEPARATOR				
• ASME code air tank for entrained water knockout	EA	1	$300	$300
• 0.5hp pump & piping	EA	1	$700	$700
				$1000
e. INSTRUMENTATION				
• vacuum guage (Magnehelic)	EA	3	$75	$225
• flow meter	EA	4	$325	$1300
• temperature guage	EA	3	$75	$225
• bleed valve	EA	1	$40	$40
• vacuum release valve	EA	1	$150	$150
• sampling port (brass "T")	EA	20	$20	$400
• air monitoring system	EA	1	$3,000	$3,000
				$5,340 ≃ $5,300
f. VAPOR TREATMENT				
• carbon adsorption	CANISTER	2	$980	$1960
• housing for canisters & blower	EA	1	$1500	$1500
				$3460 ≃ $3500
g. AIR SAMPLING / START UP				
• 2 samples/wk. from EW, header, & stack	EA	20	$160	$3200

h. SYSTEM INSTALLATION & START UP (2 men @ $60/hr./man)

- Installation of horizontal piping ⇒ 5 days
- Installation of blower system ⇒ 10 days
- System Startup ⇒ 5 days

20 days · $\frac{8 hr.}{day}$ · $\frac{\$60}{hr}$ x 2 men

$19,200

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC Job No. 723856.06000 Sheet 18 of 27

Subject POLYMER APPLICATIONS By KJM Date 5/17/95

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ALTERNATIVE III CONT'D

ANNUAL O&M COSTS

MAINTENANCE OF SVE / BIOVENTING SYSTEM (1st 10 YEARS):

a. Operation of System

Labor - 1 MAN @ $50/hr

- approximately 120 hours => $6,000

Carbon Changeout - estimated 20 carbon unit changes @ $1100/change => $22,000

Electrical Power - 20,000 KWH @ 0.12¢/KWH => $2,400

b. AIR SAMPLING & ANALYSIS => $4,000

- Estimate 20 samplings taken (2x a year) @ $200/sample

c. SOIL SAMPLING FOR VOLATILES / SEMI-VOLATILES

A "ROUND" INCLUDES

- 10 SAMPLES @ $300/sample => $3,000
- each sample analyzed for
  - BTEX
  - phenols
  - VOCs
  - & semivolatiles
- Labor (2 men @ $50/hr for 3 days) => $2400

+ MATERIAL & EQUIPMENT

} $5,000

$39,400

PARSONS ENGINEERING SCIENCE, INC.

Client NYSDEC | Job No. 723256.06000 | Sheet 19 of 27
Subject POLYMER APPLICATIONS | By KJM | Date 5/17/95
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	SOURCE
ALTERNATIVES 3 THROUGH 5	
COLLECTION SYSTEM FOR DEEP AQUIFER:	ES
a. Pumps (2 pumps @ $3,000/pump) ⇒ $6,000	
b. Piping & electrical wiring ⇒ $3,000	
– submersible pump, 10 gpm/each, 40' head — $9,000	
– heat tracing	
ALTERNATIVE 4A	
THERMAL DESORPTION:	ES
a. Soil homogenization	
•mixing, sifting process of 15,000 CY of soil @ $5/CY ⇒ $75,000	
b. soil treatment using mobile thermal desorption unit	VENDOR
5~10 tons/hr — 15,000 CY @ $100/CY ⇒ $1,500,000	$30 – $70/ton
c. Perform soil sample analysis to test for treatment objectives	
$200/sample, 1 sample/300 CY ⇒ $10,000	
= 50 samples × $200/sample	
$1,585,000	
ALTERNATIVE 4B	
GROUNDWATER EXTRACTION & BIOREMEDIATION SYSTEM:	ES
a. Soil Homogenization	
•mixing, sifting process of 15,000 CY of soil @ $5/CY ⇒ $75,000	
b. Composite geonet layer or 6" gravel & geotextile drainage ⇒ $115,200	VENDOR
@ $8/SY × 14,400 SY	
c. Collection piping	
using 6" HDPE corrugated & perforated	
4 × 360' — 1440 LF @ $2/LF ⇒ $2880	
d. Collection sump & cleanouts (10 @ $200/ea) ⇒ $2,000	
e. Bioremediation System	
Blower ⇒ $4,530	
Electrical ⇒ $2,000	
Instrumentation ⇒ $5,300	
$206,960	

PARSONS ENGINEERING SCIENCE, INC.

Client: NYSDEC | Job No. 723856 | Sheet 20 of 27
Subject: Polymer Application Site | By: JLS | Date: 5/22/95
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ALTERNATIVES 3-5 CONTINUED		SOURCE
X GROUNDWATER TREATMENT SYSTEM (21-25 GPM)		
a. Pumps and piping from influent tank to treatment system. Assume need 2 pumps & piping. Estimate @ $5000 ea	= $10,000	ES
b. System setup		
Pad: 20' × 30' × 1' deep ⇒ 22.2 CY		
15 CY @ $364/CY	= $8,100	Means
Shelter: 600 sf @ $60/sf	= $36,000	ES
Tanks: 1 5000 gal influent @	= $12,500	Vendor
1 2000 gal treated water @	= $7,000	Vendor
	$63,600	
c. System components		
2 bag filters est. @ $1000 ea.	= $2000	ES
2 Calgon Cyclesorb FP1 units @ $1800/unit	= $3600	Vendor
Carbon acceptance fee	= $2500	Vendor
Installation & startup: 3 person crew for 1 week, 2 person crew for 1 week — 200 hrs × $50/hr	= $10,000	ES
	$18,100	

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client: NYSDEC | Job No. 723856 | Sheet 21 of 27
Subject: Polymer Applications Site | By: JLS | Date: 5/22/95
Checked: | Rev.:

SOURCE

Annual O&M Costs

IIIa GROUNDWATER TREATMENT SYSTEMS (First 3 yrs, 25 gpm)

a. Operation of System
Labor: estimate 8 hrs/wk × 52 weeks × $50/hr = $20,800 — ES
Carbon changeout — Vendor
Carbon usage rate = 162 lb/day
Each unit has 1000 lbs carbon
1000 lbs / 162 lb/day = 6 days/unit
Annual usage: 365 days / 6 days = 61 units/yr
61 units @ $1800/unit (incl. transport) = $109,800
Electrical power estimated @ $400/mo × 12 mo = $4,800 — ES
b. Carbon vessel rental: 2 units × $420/mo × 12 mo = $10,100 — Vendor
c. Effluent monitoring — ES
Assume weekly sampling for selected VOCs, phenol, TSS and TOC @ $300/sample
No additional labor because samples taken during weekly operation visit
$300/sample × 52 wks/yr = $15,600

$161,100

IIIb GROUNDWATER TREATMENT SYSTEM (years 5 to 10, 5 gpm)
a. Operation of System
Labor: 8 hrs/wk × 52 weeks × $50/hr = $20,800 — ES
Carbon changeout: Carbon usage = 28.5 lb/day — Vendor
1000 lbs / 28.5 lbs/day = 35.1 days/unit
365 days / 17.5 days/unit = 10.4 units/yr.
10 units/yr @ $1800/unit = $18,000
b. Carbon vessel rental: 2 units × $480/mo × 12 mo = $10,100 — Vendor
c. Effluent monitoring: $300/wk × 52 weeks = $15,600 — ES

$66,100

PESI-COR-8 (12/94)

ENGINEERING-SCIENCE

COST ESTIMATE

SHEET NO. 22 OF 27

JOB NO. 723856

Polymer Applications Site

BY WX DATE 10/18/95

CHKD. BY JLS DATE 11/6/95

ITEM	DESCRIPTION	UNIT	QUANT.	UNIT COST	TOTAL COST
A.	ASPHALT CAP				
1.	Subgrade Preparation	SY		1.00	
	(Unit Cost Source: MEANS 022304)				
2.	6" Base Stone	SY		5.10	
	(Unit Cost Source: MEANS 022308				
3.	4" Binder Course	SY		6.90	
	(Unit Cost Source: MEANS 025104)				
4.	2" Wearing Course	SY		4.04	
	(Unit Cost Source: MEANS 025104)				
	Subtotal	SY		$17.04	
	See attached copy of MEANS				

ENGINEERING-SCIENCE

COST ESTIMATE

SHEET NO. 23 OF 27

JOB NO. 723856

Polymer Applications Site

BY WX DATE 10/18/95

CHKD. BY JW DATE 10/6/95

ITEM	DESCRIPTION	UNIT	QUANT.	UNIT COST	TOTAL COST
B	SOIL/GEOMBRANE CAP				
1.	Subgrade Preparation	SY		1.00	
	MEANS 022304				
2.	Composite Geonet Blanket	SY		6.00	
	w/ geotextile on one side				
	Vendor: $5/SY material + 20% labor] Southdown Landfill No. 6				
3.	20-mil PVC	SY		3.00	
	GFIM Landfill 40-mil PVC				
	Cost $0.40/SF installed				
4.	Cover Soil (12")	SY		5.60	
	NYSDEC Schatz Landfill Bid:				
	$11.25/SY for 24" soil				
	GFIM and Southdown No. 6				
	Landfills' costs were lower.				
5.	Topsoil (6")	SY		5.25	
	NYSDEC Schatz Landfill Bid				
	Price: $5.25/SY				
6.	Seeding & Mulching	SY		1.45	
	NYSDEC Schatz Landfill Bid				
	Price: $1.45/SY				
	Subtotal	SY		$22.30	

022 200 | Excav, Backfill, Compact

Ref	Line	Description	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	1993 BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
278	2600	Very hard, 460 HP dozer, ideal conditons	B-10X	360	.033	C.Y.		.74	3.34	4.08	4.82
	2700	Adverse conditions	"	320	.038			.83	3.76	4.59	5.40
	2800	Till, boulder clay/hardpan, soft, 200 H.P. dozer, ideal conditions	B-10B	1,400	.009			.19	.59	.78	.94
	2810	Adverse conditions	"	1,315	.009			.20	.63	.83	1.01
	2815	Grader rear ripper, 180 H.P. ideal conditions	B-11L	1,500	.011			.23	.37	.60	.76
	2816	Adverse conditions	"	1,275	.013			.27	.44	.71	.89
	2820	Medium hard, 300 H.P. dozer, ideal conditions	B-10M	1,200	.010			.22	.77	.99	1.19
	2830	Adverse conditions	"	1,080	.011			.25	.86	1.11	1.32
	2835	Grader rear ripper, 180 H.P. ideal conditions	B-11L	1,300	.012			.26	.43	.69	.88
	2836	Adverse conditions	"	1,100	.015			.31	.51	.82	1.04
	2840	Very hard, 460 H.P. dozer, ideal conditions	B-10X	600	.020			.44	2.01	2.45	2.89
	2850	Adverse conditions	"	530	.023			.50	2.27	2.77	3.27
	3000	Dozing ripped material, 200 HP, 100' haul	B-10B	700	.017			.38	1.19	1.57	1.90
	3050	300' haul	"	250	.048			1.07	3.33	4.40	5.30
	3200	300 HP, 100' haul	B-10M	1,150	.010			.23	.81	1.04	1.25
	3250	300' haul	"	400	.030			.67	2.32	2.99	3.58
	3400	460 HP, 100' haul	B-10X	1,680	.007			.16	.72	.88	1.03
	3450	300' haul	"	600	.020	↓		.44	2.01	2.45	2.89
286	0010	**LOAM OR TOPSOIL** Remove and stockpile on site									
	0020	200 H.P. dozer, 6" deep, 200' haul	B-10B	865	.014	C.Y.		.31	.96	1.27	1.53
	0100	300' haul		520	.023			.51	1.60	2.11	2.55
	0150	500' haul		225	.053	↓		1.19	3.70	4.89	5.90
	0200	Alternate method: 6" deep, 200' haul		5,090	.002	S.Y.		.05	.16	.21	.26
	0250	500' haul	↓	1,325	.009	"		.20	.63	.83	1
	0400	Spread from pile to rough finish grade, with 1.5 C.Y. F.E. loader	B-10S	200	.060	C.Y.		1.34	1.65	2.99	3.86
	0500	Up to 200' radius, by hand	1 Clab	14	.571			10.60		10.60	16.65
	0600	Top dress by hand, 1 C.Y. for 600 S.F.	"	11.50	.696	↓	17	12.90		29.90	38.50
	0700	Furnish and place, truck dumped @ $17.00 per C.Y., 4" deep	B-10S	1,300	.009	S.Y.	1.87	.21	.25	2.33	2.66
	0800	6" deep	"	820	.015	"	2.82	.33	.40	3.55	4.04
	0900	Fine grading and seeding, incl. lime, fertilizer & seed,									
	1000	With equipment	B-14	1,000	.048	S.Y.	.18	.94	.20	1.32	1.89

022 300 | Pavement Base

Ref	Line	Description	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
304	0010	**BASE** Prepare and roll sub-base, small areas to 2500 S.Y.	B-32A	1,500	.016	S.Y.		.36	.62	.98	1.23
	0100	Large areas over 2500 S.Y.	B-32	3,700	.009	"		.20	.44	.64	.78
308	0010	**BASE COURSE** For roadways and large paved areas									
	0050	3/4" stone compacted to 3" deep	B-36	4,000	.010	S.Y.	2.02	.21	.28	2.51	2.86
	0100	6" deep		3,900	.010		4.05	.22	.29	4.56	5.10
	0200	9" deep		2,875	.014		6.05	.29	.39	6.73	7.55
	0300	12" deep		2,350	.017		8.05	.36	.48	8.89	9.95
	0301	Crushed 1-1/2" stone base, compacted to 4" deep		5,225	.008		2.60	.16	.21	2.97	3.35
	0302	6" deep		3,900	.010		3.90	.22	.29	4.41	4.95
	0303	8" deep		3,000	.013		5.20	.28	.37	5.85	6.55
	0304	12" deep	↓	1,800	.022	↓	7.80	.47	.62	8.89	10
	0350	Bank run gravel, spread and compacted									
	0370	6" deep	B-32	6,000	.005	S.Y.	1.60	.12	.27	1.99	2.25
	0390	9" deep		44,000	.001		2.40	.02	.04	2.46	2.71
	0400	12" deep	↓	3,600	.009		3.20	.20	.45	3.85	4.32
	0500	Bituminous concrete, 4" thick	B-25	4,545	.019		6	.39	.35	6.74	7.60
	0550	6" thick		3,700	.024		8.85	.48	.43	9.76	11
	0560	8" thick		3,000	.029		11.90	.59	.53	13.02	14.60
	0570	10" thick	↓	2,545	.035	↓	14.70	.70	.63	16.03	17.95
	0600	Cold laid asphalt pavement, see div. 025-116									
	0601										
	0700	Liquid application to gravel base, asphalt emulsion	B-45	6,000	.003	Gal.	1.24	.06	.11	1.41	1.57

Ref: 1993 MEANS Site Work & Landscape Cost Data.

See the Reference Section for reference number information, Crew Listings and City Cost Inde

2 SITE WORK

024 | Railroad and Marine Work

024 880 | Docks & Facilities

	Line	Description	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	1993 BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
892	0200	Treated piles, not including mobilization									
	0210	50' long, 20 lb. creosote, shore driven	B-19	540	.119	V.L.F.	8.75	2.81	2.46	14.02	17
	0220	Barge driven	B-76	320	.225		8.75	5.35	5.75	19.85	25
	0230	2.5 lb. CCA, shore driven	B-19	540	.119		7.75	2.81	2.46	13.02	15.90
	0240	Barge driven	B-76	320	.225		7.75	5.35	5.75	18.85	24
	0250	30' long, 20 lb. creosote, shore driven	B-19	540	.119		6	2.81	2.46	11.27	13.95
	0260	Barge driven	B-76	320	.225		6	5.35	5.75	17.10	22
	0270	2.5 lb. CCA, shore driven	B-19	540	.119		4.25	2.81	2.46	9.52	12.05
	0280	Barge driven	B-76	320	.225	↓	4.25	5.35	5.75	15.35	19.90
	0300	Mobilization, barge, by tug boat	B-83	25	.640	Mile		13.65	19.30	32.95	42
	0350	Standby time for shore pile driving crew				Hr.				365	
	0360	Standby time for barge driving rig				"				450	

025 | Paving and Surfacing

025 100 | Walk/Rd/Parkng Paving

	Line	Description	CREW	DAILY OUTPUT	MAN-HOURS	UNIT	1993 BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
104	0010	**ASPHALTIC CONCRETE PAVEMENT** for highways R025-110									
	0020	and large paved areas									
	0080	Binder course, 1-1/2" thick	B-25	7,725	.011	S.Y.	2	.23	.21	2.44	2.79
	0120	2" thick		6,345	.014		2.67	.28	.25	3.20	3.65
	0160	3" thick		4,905	.018		3.95	.36	.33	4.64	5.25
	0200	4" thick	↓	4,140	.021		5.30	.43	.39	6.12	6.90
	0300	Wearing course, 1" thick	B-25B	10,575	.009		1.44	.19	.17	1.80	2.06
	0340	1-1/2" thick		7,725	.012		2.19	.26	.24	2.69	3.07
	0380	2" thick		6,345	.015		2.95	.31	.29	3.55	4.04
	0420	2-1/2" thick		5,480	.018		3.63	.36	.33	4.32	4.93
	0460	3" thick	↓	4,900	.020	↓	4.33	.40	.37	5.10	5.80
	0800	Alternate method of figuring paving costs									
	0810	Binder course, 1-1/2" thick	B-25	630	.140	Ton	26	2.83	2.54	31.37	36
	0811	2" thick		690	.128		26	2.58	2.32	30.90	35.50
	0812	3" thick		800	.110		26	2.23	2	30.23	34.50
	0813	4" thick	↓	900	.098		26	1.98	1.78	29.76	34
	0850	Wearing course, 1" thick	B-25B	575	.167		26.50	3.43	3.17	33.10	38.50
	0851	1-1/2" thick		630	.152		26.50	3.13	2.90	32.53	37.50
	0852	2" thick		690	.139		26.50	2.86	2.64	32	37
	0853	2-1/2" thick		745	.129		26.50	2.65	2.45	31.60	36.50
	0854	3" thick	↓	800	.120	↓	26.50	2.47	2.28	31.25	36
108	0010	**ASPHALTIC CONCRETE** At the plant (145 lb. per C.F.) R025-110				Ton	25.50			25.50	28.50
	0200	All weather patching mix					27.50			27.50	30.50
	0300	Berm mix					27.50			27.50	30.50
	0400	Base mix					25.50			25.50	28.50
	0500	Binder mix					25.50			25.50	28.50
	0600	Sand or sheet mix					27.50			27.50	30.50
	2000	Reclaimed pavement in stockpile					9.55			9.55	10.50
	2100	Recycled pavement, at plant, ratio old: new, 70:30					19			19	21
	2120	Ratio old: new, 30:70				↓	23.50			23.50	26
112	0010	**CALCIUM CHLORIDE** Delivered, 100 lb. bags, truckload lots				Ton	300			300	330
	0200	Solution, 4 lb. flake per gallon, tank truck delivery				Gal.	.62			.62	.68

See the **Reference Section** for reference number information, Crew Listings and City Cost Inde

NYSDEC Schatz Landfill
Broken-Down Bid Cost
submitted by All-State
Power Vac. in Sept. 1995

Remedial Construction
Napanoch Paper Mill Site
Napanoch, New York
Schatz Plant/ Federal Bearing Sites
Poughkeepsie, New York
Schedule of Values

Description	Bid Item#	Unit	Unit Price	Labor	Material	Equipment	Subcontractor	Subtotals	Totals	Site Tota
Low Permeability Soil	SF-UC-6	5,000 S.Y	11.50	31,500.00	233,000.00	23,000.00		287,500.00	287,500.00	
Geo Membrance 60-mil HDPE	SF-UC-7	5,000 S.Y	7.75	17,500.00	5,000.00		171,250.00	193,750.00	193,750.00	
Drainage Sand Sayer	SF-UC-8	5,000 S.Y	3.75	20,000.00	66,000.00	7,750.00		93,750.00	93,750.00	
Geo Textile - Filter	SF-UC-9	5,000 S.Y	1.50	6,500.00	29,500.00	1,500.00		37,500.00	37,500.00	
Barrier Protection Layer 24"	SF-UC-10	5,000 S.Y	11.25 $5.60/12"	61,000.00	162,000.00	58,250.00		281,250.00	281,250.00	
Geo Grid	SF-UC-11	1,000 S.Y	3.00	5,000.00	28,000.00			33,000.00	33,000.00	
Topsoil Layer 6"	SF-UC-12	5,000 S.Y	5.25	30,000.00	78,000.00	23,250.00		131,250.00	131,250.00	
Erosion Control Mat	SF-UC-13	5,000 S.Y	1.50	8,000.00	28,000.00	1,500.00		37,500.00	37,500.00	
Seeding	SF-UC-14	5,000 S.Y	1.45				36,250.00	36,250.00	36,250.00	
Access Road	SF-UC-15	2,600 L.F.	37.50	10,500.00	54,000.00	33,000.00		97,500.00	97,500.00	
Underdrain	SF-UC-16	2,000 L.F.	21.50	7,500.00	33,500.00	2,000.00		43,000.00	43,000.00	
Drainage Ditches	SF-UC-17	3,000 L.F.	21.00	19,000.00	31,500.00	12,500.00		63,000.00	63,000.00	
Culverts	SF-UC-18	200 L.F.	54.00	3,200.00	6,400.00	1,200.00		10,800.00	10,800.00	

207500

GFIM BID [illegible]TS
JUNE 8, 1993

BID ITEM	DESCRIPTION	#1 H.E. Sargent	#2 Metcalf & Eddy / Anderson	#3 GeoCon	#4 AWD Tech	#5 Yolam Const	#6 Marcy Exc	#7 Haseley	#7A Haseley (Alt)	AVERAGE BID	Engineering-Science Estimate
		(5)	(1)	(4)	(6)	(7)	(2)	(3)			
Lump Sum Item 1	Mob, Gen Req, Cleanup	756,000	656,038	1,042,900	1,128,733	955,000	488,000	200,000	200,000	746,667	420,800
2a	Gas Venting / Cushion Sand	1,770,000	962,309	1,362,300	1,677,460	1,600,000	1,190,000	1,270,000	1,270,000	1,404,581	2,462,900
2b	On-site Fill Layer	250,000	204,634	267,020	392,965	400,000	444,000	366,000	366,000	332,088	1,098,600
2c	General Grading	536,000	355,652	178,435.52	531,191	500,000	148,000	400,000	400,000	378,468	144,600
2d	Surveying	126,000	31,000	169,100	57,893	60,000	60,000	135,000	135,000	91,285	125,000
3	Topsoil, Seeding, Erosion Cntrl	649,000	413,102	562,200	608,822	650,000	376,000	740,000	740,000	571,303	915,400
40 Acres 4	Stone Fill Erosion Protection	1,000	70,290	89,120	119,454	170,000	60,000	87,000	87,000	85,266	41,900
5	Drainage Piping	132,000	82,995	116,975.93	112,131	250,000	85,600	130,000	130,000	129,957	127,000
6	Geomembrane 40-mil PVC	448,000	$0.26/SF 449,566	459,978.48	446,970	500,000	474,000	470,000	420,000	464,073	1,137,200
7	Fencing	65,000	78,000	101,251	70,165	60,000	66,000	70,000	70,000	72,917	125,500
8	Gas Collection & Venting	50,000	61,864	107,278.92	88,374	150,000	23,500	77,000	77,000	79,717	48,400
Unit Price Item 1	Leachate Collection & Disposal	120,000	204,000	180,000	189,000	150,000	90,000	60,000	60,000	141,857	652,900
2	GW Monitoring Wells	60,000	50,160	67,646.40	40,326.24	62,400	76,800	67,200	67,200	60,648	93,100
3	Refuse Relocation	259,000	264,180	231,620	294,668	888,000	444,000	414,400	414,400	399,410	876,300
4	Industrial Sludge Relocation	7,200	5,728	4,464	63,710.40	19,200	6,400	8,960	8,960	16,523	14,500
TOTAL BID PRICE		$5,229,200	$3,889,518	$4,940,290.25	$5,821,862.64	$6,414,600	$4,028,300	$4,495,560	$4,445,560	$4,974,190	$8,284,100
Alternate 1	Pollution Insurance	188,000	250,000	170,500	$175,000	215,000	110,000	54,000	54,000	166,071	
TOTAL BID PRICE + ALT 1		$5,417,200	$4,139,518	$5,110,790.25	$5,996,862.64	$6,629,600	$4,138,300	$4,549,560	$4,499,560	$5,140,262	
Acknowledgement for Construction Addendum Acknowledged Bid Security - (Bond/Deposit) - Amount - Bonding Company Non-Collusion Certificate		Attached 1,2,3 Bond 5% Reliance Attached	Attached 1,2,3 Bond 5% Reliance Attached	Attached 1,2,3 Bond 5% CIGNA Attached	Attached 1,2,3 Bond 5% Ins Co of Penn Attached	Attached 1,2,3 Bond 5% Reliance Attached	Attached 1,2,3 Bond 5% Reliance Attached	Attached 1,2,3 Bond 5% S.H. Gow Attached	Attached 1,2,3 Bond 5% S.H. Gow Attached		

NOTES:

1. Metcalf & Eddy / Anderson : Statement of Surety's Consent (Article 2(b)) not included. Alternate Consent of Surety included.
2. AWD Technologies : Statement of Surety's Consent (Article 2(b)) not included.
3. Marcy Excavation : Total bid price does not add up ($4,000 disprepancy --- Adding lump sum & unit price items = $4,032,300 / plus Alt 1 = $4,142,300)
4. Haseley Consult / Constr : Alternate price for HDPE or VLDPE geomembrane.

Engineering-Science, Inc. - Syracuse, NY

GFIMBIDS

2 of 2

SUMMARY OF HELP MODELING RESULTS FOR THE POLIMER APPLICATION SITE

The purpose of HELP modeling for the remedial alternatives is to determine the quantity of groundwater collection in the shallow aquifer of the site backyard area (3 acres). Three different caps were modeled: asphalt cap (Alternative 2A), geomembrane cap (Alternatives 2B and 4B), and no cap (Alternatives 3, 4A, and 5). The conditions assumed for each cap are shown in the sketch drawn on the beginning sheet of each output set.

The model output results show that under any of the capped conditions there is little groundwater to collect from the shallow aquifer. This is partly due to a significantly reduced infiltration and partly due to the existence of a semi-permeable silt and clay bottom. It appears that any water that leaks through the cap will leak through the semi-permeable bottom as well.

Under the no cap condition, however, there is a modest amount of groundwater available for collection in the shallow aquifer (approx. 200,000 gal/yr). This result agrees well with the current observed site groundwater conditions. Although under the no cap condition, the bottom is also leaking, the amount of infiltration significantly exceeds the leakage rate.

RECOMMENDATIONS

Based on the HELP model results, it appears that under a capped condition it may not be necessary to collect groundwater in order to control offsite lateral migration of contaminated shallow groundwater. Although vertical migration of this groundwater will continue, contaminants are essentially filtered out by the thick silt and clay soil layer under the site long before reaching the deep aquifer. To account for possible leakage through the subsurface concrete wall and for the residue shallow groundwater currently in the backyard area, short term groundwater extraction can be applied. This will avoid potential uplift pressure from rising groundwater level at the downgradient location of the capped area which is presumably surrounded partialy with a subsurface barrier wall and partially with a foundation wall.

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.03 (31 DECEMBER 1994)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**               FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
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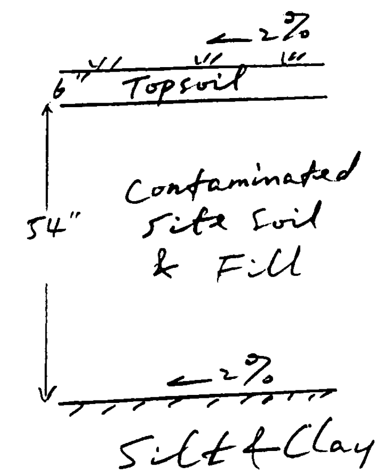
PRECIPITATION DATA FILE: C:\HELP3\DA1.D4
TEMPERATURE DATA FILE: C:\HELP3\da2.D7
SOLAR RADIATION DATA FILE: C:\HELP3\da3.D13
EVAPOTRANSPIRATION DATA: C:\HELP3\da4.D11
SOIL AND DESIGN DATA FILE: C:\HELP3\data2.D10
OUTPUT DATA FILE: C:\HELP3\ou2.OUT

Alternatives 4A&5
(No Cap, GW collectio

TIME: 11:20 DATE: 5/4/1995



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TITLE: Polymer Appl - Alternatives 4 & 5 (No Cap)

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4306 VOL/VOL

EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90

FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 10

THICKNESS = 54.00 INCHES

POROSITY = 0.3980 VOL/VOL

FIELD CAPACITY = 0.2440 VOL/VOL

WILTING POINT = 0.1360 VOL/VOL

INITIAL SOIL WATER CONTENT = 0.3950 VOL/VOL

EFFECTIVE SAT. HYD. COND. = 0.119999997000E-03 CM/SEC

SLOPE = 2.00 PERCENT

DRAINAGE LENGTH = 180.0 FEET

LAYER 3

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS = 60.00 INCHES

POROSITY = 0.4270 VOL/VOL

FIELD CAPACITY = 0.4180 VOL/VOL

WILTING POINT = 0.3670 VOL/VOL

INITIAL SOIL WATER CONTENT = 0.4270 VOL/VOL

EFFECTIVE SAT. HYD. COND. = 0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT

SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A

FAIR STAND OF GRASS, A SURFACE SLOPE OF 2.%

AND A SLOPE LENGTH OF 180. FEET.

SCS RUNOFF CURVE NUMBER = 65.30

FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT

AREA PROJECTED ON HORIZONTAL PLANE = 3.000 ACRES

EVAPORATIVE ZONE DEPTH = 20.0 INCHES

INITIAL WATER IN EVAPORATIVE ZONE = 8.098 INCHES

UPPER LIMIT OF EVAPORATIVE STORAGE = 8.314 INCHES

LOWER LIMIT OF EVAPORATIVE STORAGE = 2.252 INCHES
INITIAL SNOW WATER = 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS = 49.532 INCHES
TOTAL INITIAL WATER = 49.532 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BUFFALO NEW YORK

MAXIMUM LEAF AREA INDEX = 4.00
START OF GROWING SEASON (JULIAN DATE) = 126
END OF GROWING SEASON (JULIAN DATE) = 285
AVERAGE ANNUAL WIND SPEED = 12.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 76.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 72.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR SYRACUSE NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK

STATION LATITUDE = 42.93 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.02	1.97	3.59	3.67	3.71	4.61
	6.32	4.98	5.35	3.91	3.29	3.54
STD. DEVIATIONS	1.57	0.89	0.85	2.56	2.79	1.66
	2.98	1.25	2.22	1.95	1.85	1.07
RUNOFF						
TOTALS	2.294	0.943	3.261	1.854	0.563	0.000
	0.026	0.000	0.742	0.807	0.882	1.669
STD. DEVIATIONS	1.983	0.777	1.203	1.381	1.260	0.001
	0.057	0.000	1.658	1.033	0.996	1.371
EVAPOTRANSPIRATION						
TOTALS	0.617	0.745	1.293	2.185	3.152	6.032
	5.528	4.087	3.278	1.889	1.013	0.623
STD. DEVIATIONS	0.106	0.145	0.267	0.511	1.986	0.249
	2.270	0.246	0.703	0.050	0.113	0.090
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.0793	0.0663	0.0688	0.1038	0.2682	0.1517
	0.1506	0.1093	0.2703	0.3713	0.5224	0.3323
STD. DEVIATIONS	0.0016	0.0007	0.0007	0.0482	0.2202	0.0848
	0.0646	0.0322	0.1791	0.2373	0.2671	0.1809
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.1739	0.1536	0.1675	0.1699	0.1974	0.1863
	0.1850	0.1840	0.1854	0.1982	0.1946	0.1880
STD. DEVIATIONS	0.0026	0.0004	0.0004	0.0101	0.0082	0.0065
	0.0103	0.0116	0.0172	0.0137	0.0157	0.0092

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 3

AVERAGES 38.3031 36.7682 35.2864 39.9156 52.3289 49.5684
45.2416 44.6689 49.0186 52.9009 54.3960 4[illegible].9859

STD. DEVIATIONS 0.2361 0.2254 0.2190 5.9422 4.6857 3.8329
5.8828 6.6000 10.1225 7.7771 9.2187 5.2538

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.97 (8.723)	522393.3	100.00
RUNOFF	13.043 (4.7472)	142038.48	27.190
EVAPOTRANSPIRATION	30.442 (4.5511)	331510.84	63.460
LATERAL DRAINAGE COLLECTED FROM LAYER 2	2.49419 (0.97441)	27161.734	5.19948
PERCOLATION/LEAKAGE THROUGH LAYER 3	2.18379 (0.09086)	23781.473	4.55241
AVERAGE HEAD ACROSS TOP OF LAYER 3	45.440 (4.328)		
CHANGE IN WATER STORAGE	-0.193 (1.1429)	-2099.22	-0.402

GW collection Vol.
≈200,000 gal.

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.90	42471.000
RUNOFF	2.803	30525.9336
DRAINAGE COLLECTED FROM LAYER 2	0.02648	288.33521
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.006803	74.08499
AVERAGE HEAD ACROSS LAYER 3	60.000	
SNOW WATER	3.75	40865.2578
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4157	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1065	

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.5659	0.2610
2	21.3822	0.3960
3	25.6200	0.4270

SNOW WATER 0.000

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**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**          HELP MODEL VERSION 3.03 (31 DECEMBER 1994)                      **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                           **
**          USAE WATERWAYS EXPERIMENT STATION                               **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                 **
**                                                                          **
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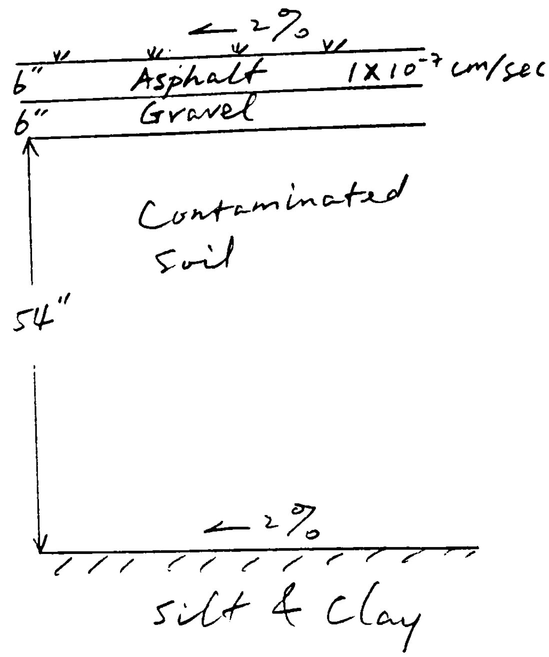
Alternative 2A
(Asphalt Cap)

PRECIPITATION DATA FILE: C:\HELP3\DA1.D4
TEMPERATURE DATA FILE: C:\HELP3\da2.D7
SOLAR RADIATION DATA FILE: C:\HELP3\da3.D13
EVAPOTRANSPIRATION DATA: C:\HELP3\da4.D11
SOIL AND DESIGN DATA FILE: C:\HELP3\data3.D10
OUTPUT DATA FILE: C:\HELP3\ou3.OUT



TIME: 13:28 DATE: 5/ 4/1995

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TITLE: Polymer Appl - Alternative 2A (Asphalt Cap)

****

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3411 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06 CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 21

THICKNESS = 6.00 INCHES
POROSITY = 0.3970 VOL/VOL
FIELD CAPACITY = 0.0320 VOL/VOL
WILTING POINT = 0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0608 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.300000012000 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 10

THICKNESS = 54.00 INCHES
POROSITY = 0.3980 VOL/VOL
FIELD CAPACITY = 0.2440 VOL/VOL
WILTING POINT = 0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2262 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.119999997000E-03 CM/SEC
SLOPE = 2.00 PERCENT
DRAINAGE LENGTH = 180.0 FEET

LAYER 4

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS = 60.00 INCHES
POROSITY = 0.4270 VOL/VOL
FIELD CAPACITY = 0.4180 VOL/VOL
WILTING POINT = 0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #16 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 180. FEET.

SCS RUNOFF CURVE NUMBER = 96.80
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 3.000 ACRES
EVAPORATIVE ZONE DEPTH = 20.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE = 3.401 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE = 8.128 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE = 3.368 INCHES
INITIAL SNOW WATER = 0.000 INCHES
INITIAL WATER IN LAYER MATERIALS = 40.245 INCHES
TOTAL INITIAL WATER = 40.245 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BUFFALO NEW YORK

MAXIMUM LEAF AREA INDEX = 4.00
START OF GROWING SEASON (JULIAN DATE) = 126
END OF GROWING SEASON (JULIAN DATE) = 285
AVERAGE ANNUAL WIND SPEED = 12.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 76.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 72.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR SYRACUSE NEW YORK WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BUFFALO NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK

STATION LATITUDE = 42.93 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.02	1.97	3.59	3.67	3.71	4.61
	6.32	4.98	5.35	3.91	3.29	3.54
STD. DEVIATIONS	1.57	0.89	0.85	2.56	2.79	1.66
	2.98	1.25	2.22	1.95	1.85	1.07
RUNOFF						
TOTALS	2.448	1.087	3.667	3.035	2.576	3.172
	4.939	3.795	4.333	3.179	2.522	2.682
STD. DEVIATIONS	1.979	0.775	1.097	2.306	2.318	1.266
	2.769	1.141	2.078	1.832	1.766	0.980
EVAPOTRANSPIRATION						
TOTALS	0.528	0.546	0.629	0.752	1.126	1.430
	1.386	1.190	1.017	0.729	0.622	0.541
STD. DEVIATIONS	0.071	0.106	0.136	0.209	0.534	0.426
	0.378	0.345	0.186	0.115	0.156	0.045
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS 0.0000 0.0000 0.0000 0.0001 0.0008 0.0009
0.0006 0.0009 0.0009 0.0010 0.0010 0.0002

STD. DEVIATIONS 0.0000 0.0000 0.0000 0.0002 0.0007 0.0006
0.0002 0.0006 0.0004 0.0003 0.0004 0.0003

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

AVERAGES 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

STD. DEVIATIONS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.97 (8.723)	522393.3	100.00
RUNOFF	37.435 (7.6808)	407663.00	78.038
EVAPOTRANSPIRATION	10.495 (1.3685)	114292.66	21.879
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.00000 (0.00000)	0.002	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00650 (0.00111)	70.759	0.01355
AVERAGE HEAD ACROSS TOP OF LAYER 4	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.034 (0.9879)	366.90	0.070

≈ 0 gal GW collection

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.90	42471.000
RUNOFF	3.734	40660.3125
DRAINAGE COLLECTED FROM LAYER 3	0.00000	0.00072
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.001353	14.73916
AVERAGE HEAD ACROSS LAYER 4	0.001	
SNOW WATER	3.75	40865.2578
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2337	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1676	

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	2.1929	0.3655
2	0.3862	0.0644
3	12.2140	0.2262
4	25.6200	0.4270

SNOW WATER 0.000

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                 HELP MODEL VERSION 3.03 (31 DECEMBER 1994)               **
**                DEVELOPED BY ENVIRONMENTAL LABORATORY                     **
**                  USAE WATERWAYS EXPERIMENT STATION                       **
**            FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************
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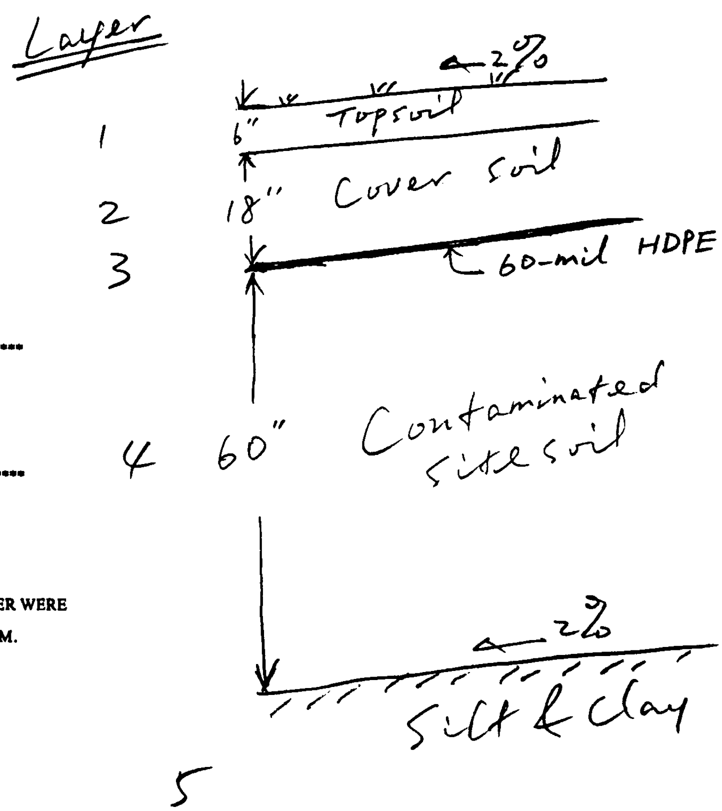
Alternatives 2B, 3 & 4B

Soil - Geomembrane Cap

PRECIPITATION DATA FILE: C:\HELP3\DA1.D4
TEMPERATURE DATA FILE: C:\HELP3\da2.D7
SOLAR RADIATION DATA FILE: C:\HELP3\da3.D13
EVAPOTRANSPIRATION DATA: C:\HELP3\da4.D11
SOIL AND DESIGN DATA FILE: C:\HELP3\DATA1.D10
OUTPUT DATA FILE: C:\HELP3\ou1.OUT

TIME: 8:50 DATE: 5/2/1995

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TITLE: polymer1

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4332 VOL/VOL

EFFECTIVE SAT. HYD. COND. = 0.100000005000E-02 CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.90

FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 10

THICKNESS = 18.00 INCHES

POROSITY = 0.3980 VOL/VOL

FIELD CAPACITY = 0.2440 VOL/VOL

WILTING POINT = 0.1360 VOL/VOL

INITIAL SOIL WATER CONTENT = 0.3943 VOL/VOL

EFFECTIVE SAT. HYD. COND. = 0.119999997000E-03 CM/SEC

SLOPE = 2.00 PERCENT

DRAINAGE LENGTH = 180.0 FEET

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 35

THICKNESS = 0.06 INCHES

POROSITY = 0.0000 VOL/VOL

FIELD CAPACITY = 0.0000 VOL/VOL

WILTING POINT = 0.0000 VOL/VOL

INITIAL SOIL WATER CONTENT = 0.0000 VOL/VOL

EFFECTIVE SAT. HYD. COND. = 0.199999996000E-12 CM/SEC

FML PINHOLE DENSITY = 10.00 HOLES/ACRE

FML INSTALLATION DEFECTS = 1.00 HOLES/ACRE

FML PLACEMENT QUALITY = 3 - GOOD

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 10

THICKNESS = 60.00 INCHES

POROSITY = 0.3980 VOL/VOL

FIELD CAPACITY = 0.2440 VOL/VOL

WILTING POINT = 0.1360 VOL/VOL

INITIAL SOIL WATER CONTENT = 0.2441 VOL/VOL

EFFECTIVE SAT. HYD. COND. = 0.119999997000E-03 CM/SEC

SLOPE = 2.00 PERCENT

DRAINAGE LENGTH = 180.0 FEET

LAYER 5

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS = 60.00 INCHES

POROSITY = 0.4270 VOL/VOL

FIELD CAPACITY = 0.4180 VOL/VOL

WILTING POINT = 0.3670 VOL/VOL

INITIAL SOIL WATER CONTENT = 0.4270 VOL/VOL

EFFECTIVE SAT. HYD. COND. = 0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 180. FEET.

SCS RUNOFF CURVE NUMBER = 65.30

FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT

AREA PROJECTED ON HORIZONTAL PLANE = 3.000 ACRES

EVAPORATIVE ZONE DEPTH = 20.0 INCHES

INITIAL WATER IN EVAPORATIVE ZONE = 8.118 INCHES

UPPER LIMIT OF EVAPORATIVE STORAGE = 8.314 INCHES

LOWER LIMIT OF EVAPORATIVE STORAGE = 2.252 INCHES

INITIAL SNOW WATER = 0.000 INCHES

INITIAL WATER IN LAYER MATERIALS = 49.961 INCHES

TOTAL INITIAL WATER = 49.961 INCHES

TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BUFFALO NEW YORK

MAXIMUM LEAF AREA INDEX = 4.00

START OF GROWING SEASON (JULIAN DATE) = 126

END OF GROWING SEASON (JULIAN DATE) = 285

AVERAGE ANNUAL WIND SPEED = 12.10 MPH

AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 76.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 72.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 76.00 %

NOTE: PRECIPITATION DATA FOR SYRACUSE NEW YORK
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK

STATION LATITUDE = 42.93 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.02	1.97	3.59	3.67	3.71	4.61
	6.32	4.98	5.35	3.91	3.29	3.54
STD. DEVIATIONS	1.57	0.89	0.85	2.56	2.79	1.66
	2.98	1.25	2.22	1.95	1.85	1.07
RUNOFF						
TOTALS	2.347	0.951	3.269	2.031	0.747	0.014
	0.176	0.001	0.897	1.301	1.351	1.849

STD. DEVIATIONS 1.979 0.773 1.202 1.759 1.401 0.031
0.390 0.001 1.930 1.526 1.288 1.442

EVAPOTRANSPIRATION

TOTALS 0.616 0.742 1.289 2.159 3.179 6.118
6.189 4.078 3.252 1.943 1.053 0.643

STD. DEVIATIONS 0.103 0.143 0.265 0.534 1.948 0.241
1.836 0.234 0.683 0.140 0.082 0.115

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS 0.0043 0.0037 0.0040 0.0547 0.1880 0.0846
0.0514 0.0352 0.1761 0.2127 0.2819 0.1536

STD. DEVIATIONS 0.0001 0.0000 0.0000 0.0438 0.1094 0.0480
0.0431 0.0401 0.1533 0.1393 0.1574 0.1008

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS 0.0183 0.0159 0.0171 0.0383 0.0868 0.0719
0.0462 0.0473 0.0674 0.0804 0.0825 0.0535

STD. DEVIATIONS 0.0003 0.0001 0.0001 0.0206 0.0110 0.0097
0.0249 0.0272 0.0370 0.0326 0.0361 0.0176

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

STD. DEVIATIONS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS 0.0243 0.0159 0.0171 0.0374 0.0817 0.0759
0.0480 0.0469 0.0611 0.0747 0.0719 0.0712

STD. DEVIATIONS 0.0103 0.0001 0.0001 0.0207 0.0054 0.0139
0.0277 0.0268 0.0314 0.0290 0.0301 0.0229

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 3

AVERAGES 3.8270 3.6900 3.5577 8.8769 19.9598 17.2137
10.5337 10.8301 15.8562 18.3664 19.3594 12.0415

STD. DEVIATIONS 0.0203 0.0193 0.0188 5.0461 2.4240 2.2832
5.9332 6.5258 8.8654 7.5650 8.6203 3.9782

DAILY AVERAGE HEAD ACROSS LAYER 5

AVERAGES 0.0046 0.0005 0.0004 0.0009 0.0018 0.0022
0.0011 0.0010 0.0014 0.0017 0.0017 0.0167

STD. DEVIATIONS 0.0086 0.0000 0.0000 0.0005 0.0001 0.0013
0.0006 0.0005 0.0007 0.0006 0.0007 0.0137

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.97 (8.723)	522393.3	100.00
RUNOFF	14.933 (5.5354)	162624.39	31.131
EVAPOTRANSPIRATION	31.260 (3.7015)	340422.28	65.166
LATERAL DRAINAGE COLLECTED FROM LAYER 2	1.25028 (0.66561)	13615.550	2.60638
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.62546 (0.18756)	6811.295	1.30386
AVERAGE HEAD ACROSS TOP OF LAYER 3	12.009 (3.702)		
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00008 (0.00006)	0.820	0.00016
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.62601 (0.18932)	6817.202	1.30499
AVERAGE HEAD ACROSS TOP OF LAYER 5	0.003 (0.002)		
CHANGE IN WATER STORAGE	-0.100 (1.0647)	-1087.02	-0.208

← Leachate / GW collection

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.90	42471.000
RUNOFF	2.879	31357.0371
DRAINAGE COLLECTED FROM LAYER 2	0.01348	146.77351
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.003408	37.11742
AVERAGE HEAD ACROSS LAYER 3	24.000	
DRAINAGE COLLECTED FROM LAYER 4	0.00001	0.10396
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.003409	37.12056
AVERAGE HEAD ACROSS LAYER 5	0.126	
SNOW WATER	3.75	40865.2578
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4157	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1017	

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	2.0268	0.3378
2	7.1746	0.3986
3	0.0000	0.0000
4	14.6402	0.2440
5	25.6200	0.4270

SNOW WATER 0.000

PARSONS ENGINEERING SCIENCE, INC.

290 Elwood Davis Road, Suite 312 • Liverpool, New York 13088 • (315) 451-9560 • Fax (315) 451-9570

Letter of Transmittal

To:	NYSDEC Division of Hazardous Waste Remediation 50 Wolf Road Albany, New York 12233	Date:	November 13, 1995
		File No.:	723856 #3
		Subject:	Polymer Application FS Report
Attn:	Mr. Michael DiPietro		

We are sending you the following items: X Enclosed   __ Under Separate Cover

1 copy - letter addressing department comments on the Draft RI Report.

6 copies - Volume II - Feasibility Study, Appendix J

These are transmitted as checked below:

__ For Your Information	X For Your Use	__ Approved as Noted
__ As Requested	__ For Approval	__ For Review

Remarks: ______________________________

Copy To: DBB
JLS
File #3

Signed: [signature]
Peter M. Petrone, P.E., D.E.E.
Project Manager

PARSONS ENGINEERING SCIENCE, INC.

290 Elwood Davis Road, Suite 312 • Liverpool, New York 13088 • (315) 451-9560 • Fax (315) 451-9570

November 13, 1995

Mr. Michael J. DiPetro
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233-7010

RE: Responses to Polymer Applications (9-15-044) FS Comments

Dear Mr. DiPetro:

Parsons Engineering Science, Inc. (Parsons ES) has reviewed your letter of October 3, 1995, and has prepared the following responses to your comments on the Polymer Applications Site (9-14-044) Draft Feasibility Study (FS). Your comments are typed below in bold print, and our responses follow in regular type.

1. **Section 7.1.4, Page 7-5**

   A. **The discussion of metals in paragraph 2 does not make sense. The Baseline Human Health Evaluation (BHHE) in Section 7.1.2 states that the primary contaminants of concern at the site are PCB and metals while section 7.1.4 states that metals are not considered primary contaminants of concern. Section 7.1.4 should have a more general discussion than Section 7.1.2 and should address remedial goals from all perspectives (i.e., human health, environmental, etc.).**

   B. **Paragraph 3 is inconsistent because groundwater SCGs are listed elsewhere in the RI/FS. Also, several of the alternatives address groundwater contamination. Groundwater standards should be listed as goals. Please rewrite the groundwater discussion to make it consistent with the text in Section 7.1.5.**

   C. **Deep groundwater clean-up goals should be the same as shallow groundwater goals. The exceedances are not <u>limited</u>. It would be better to say that the contaminant concentrations are significant but the size of the impacted area is unknown. If we decide that addressing the exceedances is not practicable, then we will have to justify that decision.**

1A. Section 7.1.4 has been revised to include a more general discussion of the significant exposure pathways for human health and the environment. The discussion of contaminants of concern has been focused on the contamination caused during the time Polymer Applications has been at the site.

1B., C. Section 7.1.4 has been revised to include recommended clean-up goals for groundwater, on the basis that anti-degradation of area groundwater is a goal. No distinction has been made at this point between shallow and deep groundwater. Table 7.3 has been revised to include recommended cleanup goals for groundwater. Table 7.4 has been revised to add a groundwater exceedences summary.

2. **Section 7.1, page 7-6**

The text in this section is very difficult to follow. Please tie it in with the information presented in Figure 7.1. In addition, were the debris piles included in these volume estimates and in the cost summaries?

Section 7.2 has been clarified by completely rewriting the text and adding Table 7.7 of soil areas and volumes. The volumes of the soil and debris piles are called out, as well as the estimated volume of resinous material and soils containing PCBs greater than 50 ppm. The soil volumes in the cost tables were rounded up to include the volumes of the soil and debris piles.

3. **Section 7.3.2.1, page 7-8**

The statement deed restrictions are easily implementable is inaccurate. The DEC cannot unilaterally implement these.

The text has been revised to read "Deed restrictions may be difficult to implement because the NYSDEC cannot implement deed restrictions unilaterally."

4. **Section 7.3.2.6, page 7-11**

It is difficult to believe that a slurry phase biological treatment system would not be more effective then solid phase. Please give reasons and defend this statement.

The explanation of the effectiveness of slurry phase biological treatment in Section 7.3.2.6 has been expanded as follows:

> "This technology is effective for both groundwater and soil with low to moderate levels of phenol and VOCs. Slurry phase biological treatment is more effective and quicker than solid phase biological treatment because of the increased contact with microorganisms and oxygen offered by the mixing. Slurry phase treatment is more

> difficult to implement than solid phase biological treatment, however, because it is more complex. For example, there are considerable materials handling requirements to produce a uniform-sized feed that is necessary for a mixable slurry. Non-homogeneous soils can create serious materials handling problems. Following treatment, the slurry must be dewatered. Dewatering the soil fines can be very expensive, and the wastewater must be disposed. Operation of the slurry phase reactor is labor intensive. Compared to the other non-biological *ex situ* treatment technologies, slurry phase biological treatment is less effective and takes more time to complete, but is comparable in terms of materials handling and O&M requirements (USEPA, 1993a). Slurry phase biological treatment has been retained but not incorporated into any remedial alternative."

5. **Section 7.4.2, page 7-14**

   Although this section pertains to the screening and evaluation of groundwater remediation technologies, remediation of soil is referenced in the last two paragraphs.

   The references to soil have been changed to groundwater.

6. **Section 7.4.2.2, page 7-15**

   The existing barrier wall should be described as partially effective. Also you should mention the proposed extension of the wall.

   The second paragraph of Section 7.4.2.2 has been revised as follows:

   > "The site already contains a partially effective concrete barrier wall that could be used in one or all of the alternatives. A clay layer beneath the site is available into which a barrier wall can be keyed for additional containment. The existing concrete barrier wall, an extension of the existing barrier wall, or construction of a new barrier wall can prevent ambient groundwater from being impacted by the contaminated soil. The subsurface barrier wall containment technology has been retained and will be incorporated into the remedial alternatives."

7. **Section 7.4.2.3, page 7-15**

   A. **In the first paragraph change, "three primary functions" to four, since four are listed.**

   B. **The last sentence in the first paragraph under "Collection Trenches" and the last sentence on the page should be deleted and replaced in the introductory paragraph under "Extraction."**

   Section 7.4.2.3 has been revised to incorporate both comments A and B.

8. **Section 7.4.2.5, page 7-17**

   The use of hydrogen peroxide is referenced as an amendment to increase biological activity. Can it therefore be used to enhance activity in an *ex situ* system?

   The use of hydrogen peroxide in an *ex situ* system is already mentioned in Section 7.4.2.6 under ultraviolet (UV) oxidation, so no revisions were made to address this comment.

9. **Section 7.4.2.6, page 7-19**

   A. **Discuss the effectiveness of air stripping on phenols since they are major components of groundwater contamination at Polymer Applications.**

   B. **Ultraviolet oxidation is effective for many VOCs. Correct, or qualify, the statement to the contrary.**

9A. The first sentence of the second paragraph in Section 7.4.2.6 Air Stripping has been expanded as follows:

> "Air stripping is effective for treating VOCs, but is much less effective on semivolatile compounds such as phenols (USEPA, 1993a)."

9B. The second paragraph of Section 7.4.2.6 Ultraviolet (UV) Oxidation has been revised as follows:

> "The target compounds for the different forms of UV oxidation are halogenated volatile and semivolatile organic compounds. Because

TEX and phenols are not as effectively treated by UV oxidation as other *ex situ* technologies (USEPA, 1993a), this technology has not been retained."

10. **Section 8.1.2, page 8-4**

Due to the additional investigations being conducted in the area of the site and the need to determine the effectiveness of the eventual site remedy, only those well identified as possible vertical conduits and those which interfere with the remedy will be decommissioned.

Section 8.1.2 has been revised to limit the number of monitoring wells to be abandoned. The FS now recommends that monitoring wells GW1DD and GW2DD be abandoned because they are possible vertical conduits, and monitoring wells GW4A and B3D be abandoned because they would be in the way of capping or other construction for Alternatives 2 through 5.

11. **Section 8.1.3, page 8-5**

The appropriate slope for a geomembrane would be 4% not 2%.

As discussed with NYSDEC following receipt of this comment, Parsons ES believes that a 2% slope is sufficient for this application. The 4% slope requirement is from the solid waste landfill closure regulations (6 NYCRR Part 360-2.13(q)(2)(ii)) to promote positive drainage. In a landfill, however, large differential ground surface settlement is expected as the landfill contents compact over time, and the 4% slope requirement ensures that positive drainage will continue after settlement. At the Polymer Applications site, the Alternative 2 soil geomembrane cap would be placed over undisturbed or compacted soils that would have little settlement. A 2% slope would offer sufficient drainage. In addition, constructing a 4% slope for the geomembrane would require the importation of clean fill because the excavated offsite and onsite shallow soils amd sediment would not provide sufficient fill.

12. **Section 8.1.3, Alternative 3, page 8-6**

This section is incorrectly designated; it should be 8.1.4. As a result, all following sections must be renumbered.

The sections have been renumbered.

13. Section 8.1.4, page 8-7

Under Part B of Alternative 4, provide a description of the "blanket drain." The text is unclear with regard to structure and implementation. Also, if the excavated soils will be dewatered, as previously indicated, why discuss dewatering with the "blanket drain'? Furthermore, if you are capping the cell with an impermeable cover, how will air be introduced into the system?

The description of Alternative 4 in renumbered Section 8.1.5 has been rewritten to clarify the different materials handling requirements for Option 4A and 4B, including dewatering, and to give more detail about how the Option 4B treatment cell would be constructed and operated.

14. Figure 8.3

Is warehouse to be demolished? If so, indicate in figure.

The caption (TO BE DEMOLISHED) has been added to the rear warehouse in Figure 8.1.

15. Figure 8.5

Please provide a page size representation of the "Backyard Area Profile" and give details of blanket drain and other components as indicated in earlier comments.

As discussed with NYSDEC, the existing full page figure of the *ex situ* biotreatment cell in Section 10 has been revised to show additional detail rather than adding a figure to Section 8. Adding figures for all the insets in Section 8 figures would require figure renumbering and changing figure references in the text.

16. All Appropriate Figures

Show the location of the subgrade wall extension.

The subgrade wall extension has been removed from Figure 8.2 (Alternative 2) and added to the common elements Figure 8.1, because the subgrade wall extension is part of Alternatives 2 through 5.

17. **Table 8.1**

    Add a list of common elements. Include demolition. Was the cost of demolition included in the price estimates?

    Table 8.1 has been expanded to add the common elements, including demolition of backyard structures and the rear warehouse. The cost of demolition of backyard structures is included in the cost estimates.

18. **Section 9.1, page 9-1**

    The criteria descriptions at the bottom of the page are incomplete. Please refer to the attached generic PRAP excerpt for more complete descriptions.

    The descriptions of the detailed analysis criteria have been expanded using the generic PRAP information.

19. **Section 9.2.1, page 9-2**

    A. **Briefly explain why Alternative I is "No Further Action" rather than "No Action".**

    B. **In paragraph 1, add the subsurface soil contamination would still impact groundwater under this alternative.**

    Both revisions have been made as indicated.

20. **Evaluation of each alternative, pages 9-1 through 9-9**

    The following criteria must be met:

    - **define the five main SCGs and evaluate compliance of the alternative with them.**

    - **clarify from the HHE, which exposure pathways present a risk. Contact with, and ingestion of, groundwater is listed as a pathway. This seems a very unlikely pathway.**

    - **format this section to conform with the questions on the attached checklist. Answer the questions on the checklist.**

    The detailed evaluations of each retained alternative have been expanded to include the above points. Table 9.1 listing the main SCGs for the site was added. A discussion of the significant exposure pathways, and the effects of each alternative on blocking the pathway, has been expanded. Each section has been arranged to answer the checklist questions in order.

21. Section 9.2.2, page 9-3

A. Paragraph 1 - Why wouldn't Alternative 2A meet solid waste capping requirements? A geocomposite cover would not necessarily be required.

B. Paragraph 4, line 4 - Replace "5 year" with "periodic".

C. Page 9-4, paragraph 4 - It seems improbably that an asphalt cap and a low permeability cap would have the same total cost. Please provide documentation for this estimate.

21A. Parsons ES thought that the Alternative 2A soil-geomembrane cover would not meet solid waste capping requirements because of the proposed thickness (18 inches) of the soil barrier layer. This was discussed with the NYSDEC, and the Department decided that 18 inches of soil barrier layer could meet the solid waste capping requirements.

2B. The change has been made.

2C. The costs for the soil-membrane cover and asphalt cap have been checked and revised slightly. Documentation is included on Attachment 1 to this letter. The revised unit cost for the soil geomembrane cap is $22.30/SY and for the asphalt cap is $17.04/SY. With these revised costs, the present worth cost of Option 2A with the soil-geomembrane cap is $2,100,000 and of Option 2B with the asphalt cap is $2,000,000.

22. Page 9-4, bullet 6

You should assume a 2% slope for the asphalt cap.

This change has been made.

23. Section 9.2.4, page 9-7

A. Paragraph 2 - This remedy would comply with LDR regulations through the use of a CAMU.

B. Paragraph 3, last line - Change "permit" to "appropriate".

23A. The discussion of SCGs in Section 9.2.4 has been expanded to include the discussion of a CAMU.

23B. This change has been made.

24. Section 9.2.4, page 9-8

Is there precedent for using a blanket drain to remove soil vapor? How is air introduced into the system? Please provide these details per comments number 13 and 15.

The description of Option 4B has been expanded to include more details on operation of the biotreatment cell, which describe how air flow occurs through the cell. Soil vapor would be removed via a perforated pipe network in the blanket drain. A drainage layer is common in biopiles, but the use of the drainage layer with a perforated pipe network for soil vapor removal is a new modification. This would be tested during pilot-scale biological treatment tests.

25. Section 9.3, page 9-9

Alternative 4 would comply with SCGs through the application of a CAMU (per comment 23A). It may not achieve the "clean closure standard", but it will be in substantial compliance.

Section 9.3 has been rewritten, and this comment has been incorporated.

26. Section 9.3, pages 9-9 and 9-10

The comparative analysis does not make a strong enough case for Alternative 4B over Alternative 2B. Please expand and elaborate the comparative analysis to make a more convincing argument.

Section 9.3 has been expanded based on the checklist referenced in comment 20. The case for Alternative 4B has been strengthened.

27. **Section 10.2, page 10-1, paragraph 1**

    Modify the statement that "all site contaminated soils" would be removed. This is inaccurate.

    The statement has been modified to read "most site contaminated soils."

28. **Section 10.6, page 10-9**

    The pilot study test pile should be 8 x 8 x 4 feet in size. This will allow for easy construction with standard materials. The system should be structured to draw air through the test materials.

    The pilot study test pile dimensions of 8 feet by 8 feet by 4 feet have been added, as well as wording to describe that air will be drawn through the test soils.

29. **Section 10.6, page 10-9**

    The determination of wetland status must be done now, before the end of the FS.

    Based on a NYSDEC review of state wetlands inventory maps, the wet area adjacent to the site to the south was determined not to be a NYS regulated wetland. Therefore, the possible location-specific SCGs based on the presence of a wetland have been removed from the FS, and the need for wetland delineation (Item 3 in Section 10.6) has been removed.

30. **Cost estimates and assumptions**

    A. **Please break out the costs involved in the deep groundwater pump and treat. This will help us to determine the reasonableness of conducting deep groundwater remediation.**

    B. **The O&M costs for Alternative 4B are carried out 10 years. It is reasonable to do this when 80% of the contamination is expected to be recovered in the first 2 years?**

30A. The detailed cost tables have been revised to separate O&M costs for deep groundwater and shallow groundwater treatment. During the time of both deep and shallow groundwater treatment, the only shallow groundwater costs that are included are for carbon changeout; the other O&M line items are already included under deep groundwater treatment. The costs for construction of the shallow groundwater and deep groundwater collection systems are already separate.

30B. Following discussion with NYSDEC, the O&M costs for soil treatment in Alternative 4B have been reduced to 5 years.

Please review our responses. If you have any questions or comments, please call me at (315) 451-9560.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Peter M. Petrone, P.E., D.E.E.
Project Manager

PMP/lmb

cc: D.B. Babcock, Parsons ES
J.L. Swanger, Parsons ES

ATTACHMENT 1

ENGINEERING-SCIENCE

COST ESTIMATE

SHEET NO. 1 OF ____

JOB NO. 723856

Polymer Applications Site

BY WX DATE 10/18/85

CHKD. BY ____ DATE ____

ITEM	DESCRIPTION	UNIT	QUANT.	UNIT COST	TOTAL COST
A.	ASPHALT CAP				
1.	Subgrade Preparation	SY		1.00	
	(Unit Cost Source: MEANS 022304)				
2.	6" Base Stone	SY		5.10	
	(Unit Cost Source: MEANS 022308				
3.	4" Binder Course	SY		6.90	
	(Unit Cost Source: MEANS 025104)				
4.	2" Wearing Course	SY		4.04	
	(Unit Cost Source: MEANS 025104)				
	Subtotal	SY		$17.04	
	See attached copy of MEANS				

ENGINEERING-SCIENCE

COST ESTIMATE

SHEET NO. ______ OF ______
JOB NO. 723856

Polymer Applications Site

BY WX DATE 10/18/95
CHKD. BY ____ DATE ____

ITEM	DESCRIPTION	UNIT	QUANT.	UNIT COST	TOTAL COST
B	SOIL/GEOMBRANE CAP				
1.	Subgrade Preparation	SY		1.00	
	MEANS 022304				
2.	Composite Geonet Blanket	SY		6.00	
	w/ geotextile on one side				
	Vendor: $5/SY material + 20% labor] Southdown Landfill No. 6				
3.	20-mil PVC	SY		3.00	
	GFIM Landfill 40-mil PVC				
	Cost $0.40/SF installed				
4.	Cover Soil (12")	SY		5.60	
	NYSDEC Schatz Landfill Bid:				
	$11.25/SY for 24" soil				
	GFIM and Southdown No. 6				
	Landfills' costs were lower.				
5.	Topsoil (6")	SY		5.25	
	NYSDEC Schatz Landfill Bid				
	price: $5.25/SY				
6.	Seeding & Mulching	SY		1.45	
	NYSDEC Schatz Landfill Bid				
	price: $1.45/SY				
	Subtotal	SY		$22.30	

022 | Earthwork

022 200 | Excav, Backfill, Compact

Ref	Line	Description	Crew	Daily Output	Man-Hours	Unit	Mat. (1993 Bare Costs)	Labor	Equip.	Total	Total Incl O&P
278	2600	Very hard, 460 HP dozer, ideal conditons	B-10X	360	.033	C.Y.		.74	3.34	4.08	4.82
	2700	Adverse conditions	"	320	.038			.83	3.76	4.59	5.40
	2800	Till, boulder clay/hardpan, soft, 200 H.P. dozer, ideal conditions	B-10B	1,400	.009			.19	.59	.78	.94
	2810	Adverse conditions	"	1,315	.009			.20	.63	.83	1.01
	2815	Grader rear ripper, 180 H.P. ideal conditions	B-11L	1,500	.011			.23	.37	.60	.76
	2816	Adverse conditions	"	1,275	.013			.27	.44	.71	.89
	2820	Medium hard, 300 H.P. dozer, ideal conditions	B-10M	1,200	.010			.22	.77	.99	1.19
	2830	Adverse conditions	"	1,080	.011			.25	.86	1.11	1.32
	2835	Grader rear ripper, 180 H.P. ideal conditions	B-11L	1,300	.012			.26	.43	.69	.88
	2836	Adverse conditions	"	1,100	.015			.31	.51	.82	1.04
	2840	Very hard, 460 H.P. dozer, ideal conditions	B-10X	600	.020			.44	2.01	2.45	2.89
	2850	Adverse conditions	"	530	.023			.50	2.27	2.77	3.27
	3000	Dozing ripped material, 200 HP, 100' haul	B-10B	700	.017			.38	1.19	1.57	1.90
	3050	300' haul	"	250	.048			1.07	3.33	4.40	5.30
	3200	300 HP, 100' haul	B-10M	1,150	.010			.23	.81	1.04	1.25
	3250	300' haul	"	400	.030			.67	2.32	2.99	3.58
	3400	460 HP, 100' haul	B-10X	1,680	.007			.16	.72	.88	1.03
	3450	300' haul	"	600	.020			.44	2.01	2.45	2.89
286	0010	**LOAM OR TOPSOIL** Remove and stockpile on site									
	0020	200 H.P. dozer, 6" deep, 200' haul	B-10B	865	.014	C.Y.		.31	.96	1.27	1.53
	0100	300' haul		520	.023			.51	1.60	2.11	2.55
	0150	500' haul		225	.053			1.19	3.70	4.89	5.90
	0200	Alternate method: 6" deep, 200' haul		5,090	.002	S.Y.		.05	.16	.21	.26
	0250	500' haul		1,325	.009	"		.20	.63	.83	1
	0400	Spread from pile to rough finish grade, with 1.5 C.Y. F.E. loader	B-10S	200	.060	C.Y.		1.34	1.65	2.99	3.86
	0500	Up to 200' radius, by hand	1 Clab	14	.571			10.60		10.60	16.65
	0600	Top dress by hand, 1 C.Y. for 600 S.F.	"	11.50	.696		17	12.90		29.90	38.50
	0700	Furnish and place, truck dumped @ $17.00 per C.Y., 4" deep	B-10S	1,300	.009	S.Y.	1.87	.21	.25	2.33	2.66
	0800	6" deep	"	820	.015	"	2.82	.33	.40	3.55	4.04
	0900	Fine grading and seeding, incl. lime, fertilizer & seed,									
	1000	With equipment	B-14	1,000	.048	S.Y.	.18	.94	.20	1.32	1.89

022 300 | Pavement Base

Ref	Line	Description	Crew	Daily Output	Man-Hours	Unit	Mat.	Labor	Equip.	Total	Total Incl O&P
304	0010	**BASE** Prepare and roll sub-base, small areas to 2500 S.Y.	B-32A	1,500	.016	S.Y.		.36	.62	.98	1.23
	0100	Large areas over 2500 S.Y.	B-32	3,700	.009	"		.20	.44	.64	.78
308	0010	**BASE COURSE** For roadways and large paved areas									
	0050	3/4" stone compacted to 3" deep	B-36	4,000	.010	S.Y.	2.02	.21	.28	2.51	2.86
	0100	6" deep		3,900	.010		4.05	.22	.29	4.56	5.10
	0200	9" deep		2,875	.014		6.05	.29	.39	6.73	7.55
	0300	12" deep		2,350	.017		8.05	.36	.48	8.89	9.95
	0301	Crushed 1-1/2" stone base, compacted to 4" deep		5,225	.008		2.60	.16	.21	2.97	3.35
	0302	6" deep		3,900	.010		3.90	.22	.29	4.41	4.95
	0303	8" deep		3,000	.013		5.20	.28	.37	5.85	6.55
	0304	12" deep		1,800	.022		7.80	.47	.62	8.89	10
	0350	Bank run gravel, spread and compacted									
	0370	6" deep	B-32	6,000	.005	S.Y.	1.60	.12	.27	1.99	2.25
	0390	9" deep		44,000	.001		2.40	.02	.04	2.46	2.71
	0400	12" deep		3,600	.009		3.20	.20	.45	3.85	4.32
	0500	Bituminous concrete, 4" thick	B-25	4,545	.019		6	.39	.35	6.74	7.60
	0550	6" thick		3,700	.024		8.85	.48	.43	9.76	11
	0560	8" thick		3,000	.029		11.90	.59	.53	13.02	14.60
	0570	10" thick		2,545	.035		14.70	.70	.63	16.03	17.95
	0600	Cold laid asphalt pavement, see div. 025-116									
	0601										
	0700	Liquid application to gravel base, asphalt emulsion	B-45	6,000	.003	Gal.	1.24	.06	.11	1.41	1.57

Ref: 1993 MEANS Site Work & Landscape Cost Data.

024 | Railroad and Marine Work

024 880 | Docks & Facilities

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	1993 BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
892	0200	Treated piles, not including mobilization									
	0210	50' long, 20 lb. creosote, shore driven	B-19	540	.119	V.L.F.	8.75	2.81	2.46	14.02	17
	0220	Barge driven	B-76	320	.225		8.75	5.35	5.75	19.85	25
	0230	2.5 lb. CCA, shore driven	B-19	540	.119		7.75	2.81	2.46	13.02	15.90
	0240	Barge driven	B-76	320	.225		7.75	5.35	5.75	18.85	24
	0250	30' long, 20 lb. creosote, shore driven	B-19	540	.119		6	2.81	2.46	11.27	13.95
	0260	Barge driven	B-76	320	.225		6	5.35	5.75	17.10	22
	0270	2.5 lb. CCA, shore driven	B-19	540	.119		4.25	2.81	2.46	9.52	12.05
	0280	Barge driven	B-76	320	.225		4.25	5.35	5.75	15.35	19.90
	0300	Mobilization, barge, by tug boat	B-83	25	.640	Mile		13.65	19.30	32.95	42
	0350	Standby time for shore pile driving crew				Hr.				365	
	0360	Standby time for barge driving rig				"				450	

025 | Paving and Surfacing

025 100 | Walk/Rd/Parkng Paving

			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	1993 BARE COSTS MAT.	LABOR	EQUIP.	TOTAL	TOTAL INCL O&P
104	0010	**ASPHALTIC CONCRETE PAVEMENT** for highways R025-110									
	0020	and large paved areas									
	0080	Binder course, 1-1/2" thick	B-25	7,725	.011	S.Y.	2	.23	.21	2.44	2.79
	0120	2" thick		6,345	.014		2.67	.28	.25	3.20	3.65
	0160	3" thick		4,905	.018		3.95	.36	.33	4.64	5.25
	0200	4" thick		4,140	.021		5.30	.43	.39	6.12	6.90
	0300	Wearing course, 1" thick	B-25B	10,575	.009		1.44	.19	.17	1.80	2.06
	0340	1-1/2" thick		7,725	.012		2.19	.26	.24	2.69	3.07
	0380	2" thick		6,345	.015		2.95	.31	.29	3.55	4.04
	0420	2-1/2" thick		5,480	.018		3.63	.36	.33	4.32	4.93
	0460	3" thick		4,900	.020		4.33	.40	.37	5.10	5.80
	0800	Alternate method of figuring paving costs									
	0810	Binder course, 1-1/2" thick	B-25	630	.140	Ton	26	2.83	2.54	31.37	36
	0811	2" thick		690	.128		26	2.58	2.32	30.90	35.50
	0812	3" thick		800	.110		26	2.23	2	30.23	34.50
	0813	4" thick		900	.098		26	1.98	1.78	29.76	34
	0850	Wearing course, 1" thick	B-25B	575	.167		26.50	3.43	3.17	33.10	38.50
	0851	1-1/2" thick		630	.152		26.50	3.13	2.90	32.53	37.50
	0852	2" thick		690	.139		26.50	2.86	2.64	32	37
	0853	2-1/2" thick		745	.129		26.50	2.65	2.45	31.60	36.50
	0854	3" thick		800	.120		26.50	2.47	2.28	31.25	36
108	0010	**ASPHALTIC CONCRETE** At the plant (145 lb. per C.F.) R025-110				Ton	25.50			25.50	28.50
	0200	All weather patching mix					27.50			27.50	30.50
	0300	Berm mix					27.50			27.50	30.50
	0400	Base mix					25.50			25.50	28.50
	0500	Binder mix					25.50			25.50	28.50
	0600	Sand or sheet mix					27.50			27.50	30.50
	2000	Reclaimed pavement in stockpile					9.55			9.55	10.50
	2100	Recycled pavement, at plant, ratio old: new, 70:30					19			19	21
	2120	Ratio old: new, 30:70					23.50			23.50	26
112	0010	**CALCIUM CHLORIDE** Delivered, 100 lb. bags, truckload lots				Ton	300			300	330
	0200	Solution, 4 lb. flake per gallon, tank truck delivery				Gal.	.62			.62	.68

See the Reference Section for reference number information, Crew Listings and City Cost Inde

NYSDEC Schatz Landfill
Broken-Down Bid Cost
submitted by All-State
Power Vac. in Sept. 1995

Remedial Construction
Napanoch Paper Mill Site
Napanoch, New York
Schatz Plant/ Federal Bearing Sites
Poughkeepsie, New York
Schedule of Values

Description	Bid Item#	Unit	Unit Price	Labor	Material	Equipment	Subcontractor	Subtotals	Totals	Site Tota
Low Permeability Soil	SP-UC-6	5,000 S.Y	11.50	31,500.00	233,000.00	23,000.00		287,500.00	287,500.00	
Geo Membrance 60-mil HDPE	SP-UC-7	5,000 S.Y	7.75	17,500.00	5,000.00		171,250.00	193,750.00	193,750.00	
Drainage Sand Sayer	SP-UC-8	5,000 S.Y	3.75	20,000.00	66,000.00	7,750.00		93,750.00	93,750.00	
Geo Textile - Filter	SP-UC-9	5,000 S.Y	1.50	6,500.00	29,500.00	1,500.00		37,500.00	37,500.00	
Barrier Protection Layer 24"	SP-UC-10	5,000 S.Y	11.25 $5.60/12"	61,000.00	162,000.00	58,250.00		281,250.00	281,250.00	
Geo Grid	SP-UC-11	1,000 S.Y	3.00	5,000.00	28,000.00			33,000.00	33,000.00	
Topsoil Layer 6"	SP-UC-12	5,000 S.Y	5.25	30,000.00	78,000.00	23,250.00		131,250.00	131,250.00	
Erosion Control Mat	SP-UC-13	5,000 S.Y	1.50	8,000.00	28,000.00	1,500.00		37,500.00	37,500.00	
Seeding	SP-UC-14	5,000 S.Y	1.45				36,250.00	36,250.00	36,250.00	
Access Road	SP-UC-15	2,600 L.F.	37.50	10,500.00	54,000.00	33,000.00		97,500.00	97,500.00	
Underdrain	SP-UC-16	2,000 L.F.	21.50	7,500.00	33,500.00	2,000.00		43,000.00	43,000.00	
Drainage Ditches	SP-UC-17	3,000 L.F.	21.00	19,000.00	31,500.00	12,500.00		63,000.00	63,000.00	
Culverts	SP-UC-18	200 L.F.	54.00	3,200.00	6,400.00	1,200.00		10,800.00	10,800.00	

207,500

GFIM BI[illegible]ULTS
JUNE 8, 1993

BID ITEM	DESCRIPTION	(5) #1 H.E. Sargent	(1) #2 Metcalf & Eddy / Anderson	(4) #3 GeoCon	(6) #4 AWD Tech	(7) #5 Yolam Const	(2) #6 Marcy Exc	(3) #7 Haseley	#7A Haseley (Alt)	AVERAGE BID	Engineering-Science Estimate
Lump Sum Item 1	Mob, Gen Req, Cleanup	756,000	656,038	1,042,900	1,128,733	955,000	488,000	200,000	200,000	746,667	420,800
2a	Gas Venting / Cushion Sand	1,770,000	962,309	1,362,300	1,677,460	1,600,000	1,190,000	1,270,000	1,270,000	1,404,581	2,462,900
2b	On-site Fill Layer	250,000	204,634	267,020	392,965	400,000	444,000	366,000	366,000	332,088	1,098,600
2c	General Grading	536,000	355,652	178,435.52	531,191	500,000	148,000	400,000	400,000	378,468	144,600
2d	Surveying	126,000	31,000	169,100	57,893	60,000	60,000	135,000	135,000	91,285	125,000
3	Topsoil, Seeding, Erosion Cntrl (40 Acres)	649,000	413,102	562,200	608,622	650,000	376,000	740,000	740,000	571,303	915,400
4	Stone Fill Erosion Protection	1,000	70,290	89,120	119,454	170,000	60,000	87,000	87,000	85,266	41,900
5	Drainage Piping	132,000	82,995	116,975.93	112,131	250,000	85,600	130,000	130,000	129,957	127,000
6	Geomembrane 40-mil PVC	448,000	$0.26/SF 449,566	459,978.48	446,970	500,000	474,000	470,000	420,000	464,073	1,137,200
7	Fencing	65,000	78,000	101,251	70,165	60,000	66,000	70,000	70,000	72,917	125,500
8	Gas Collection & Venting	50,000	61,864	107,278.92	88,374	150,000	23,500	77,000	77,000	79,717	48,400
Unit Price Item 1	Leachate Collection & Disposal	120,000	204,000	180,000	189,000	150,000	90,000	60,000	60,000	141,857	652,900
2	GW Monitoring Wells	60,000	50,160	67,646.40	40,326.24	62,400	76,800	67,200	67,200	60,648	93,100
3	Refuse Relocation	259,000	264,180	231,620	294,668	888,000	444,000	414,400	414,400	399,410	876,300
4	Industrial Sludge Relocation	7,200	5,728	4,464	63,710.40	19,200	6,400	8,960	8,960	16,523	14,500
TOTAL BID PRICE		$5,229,200	$3,889,518	$4,940,290.25	$5,821,862.64	$6,414,600	$4,028,300	$4,495,560	$4,445,560	$4,974,190	$8,284,100
Alternate 1	Pollution Insurance	188,000	250,000	170,500	$175,000	215,000	110,000	54,000	54,000	166,071	
TOTAL BID PRICE + ALT 1		$5,417,200	$4,139,518	$5,110,790.25	$5,996,862.64	$6,629,600	$4,138,300	$4,549,560	$4,499,560	$5,140,262	
Acknowledgement for Construction Addendum Acknowledged Bid Security – (Bond/Deposit) – Amount – Bonding Company Non-Collusion Certificate		Attached 1,2,3 Bond 5% Reliance Attached	Attached 1,2,3 Bond 5% Reliance Attached	Attached 1,2,3 Bond 5% CIGNA Attached	Attached 1,2,3 Bond 5% Ins Co of Penn Attached	Attached 1,2,3 Bond 5% Reliance Attached	Attached 1,2,3 Bond 5% Reliance Attached	Attached 1,2,3 Bond 5% S.H. Gow Attached	Attached 1,2,3 Bond 5% S.H. Gow Attached		

NOTES:

1. Metcalf & Eddy / Anderson : Statement of Surety's Consent (Article 2(b)) not included. Alternate Consent of Surety included.
2. AWD Technologies : Statement of Surety's Consent (Article 2(b)) not included.
3. Marcy Excavation : Total bid price does not add up ($4,000 dispreancy --- Adding lump sum & unit price items = $4,032,300 / plus Alt 1 = $4,142,300)
4. Haseley Consult / Constr : Alternate price for HDPE or VLDPE geomembrane.