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Feasibility Study

To Comply With:

Work Plan for Utility Manufacturing/Wonder King Site

Dated: November 1997

Site ID No: 1-30-043H

Site Location:

700-712 Main Street
Westbury, New York 11590

Prepared by:

Anson Environmental Ltd.

for:

New York State Department of Environmental Conservation
Division of Environmental Remediation
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STATE OF NEW YORK
DARREL J. KOST

March 4, 1999

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1.0 Introduction

1.1 Purpose and Organization of Report

Utility Manufacturing Inc. retained Anson Environmental Ltd. (AEL) to prepare this Feasibility Study (FS) for its Westbury site. The purpose of this FS is to identify, develop, screen and evaluate remedial alternatives which relate to the conditions at the Utility Manufacturing site and to support an informed decision regarding appropriate site-specific remedial actions.

This FS report has been prepared with guidance of the United States Environmental Protection Agency (USEPA) "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (October 1988). The report is organized into the following four sections: Introduction (1.0), Identification and Screening of Technologies (2.0), Development and Screening of Remedial Alternatives (3.0). These sections are described below:

1.1.1 Introduction

The FS introduction provides background information from the 1998 draft Remedial Investigation report prepared by AEL which includes site descriptions and history, a discussion of the nature and extent of contamination, and contaminant fate and transport information. The introduction also describes soil and groundwater investigations that were conducted by H2M in 1989 and AEL in 1995 and 1998.

1.1.2 Identification and Screening of Technologies

The identification and screening of technologies begins by identifying remedial action objectives (RAOs). These objectives are established in Section 2.0 of this FS. General response actions that may achieve the RAOs for the site, which may include monitoring only, treatment, containment, excavation, disposal, institutional actions, other technologies, alone or in combination, are also identified. The technologies applicable to the general response actions and associated process options, which are different processes that fall within a technology, are identified and screened in Section 2.0. At least one representative process option from each technology is retained, where practicable for further consideration in this FS.

1.1.3 Development and Screening of Remedial Alternatives

In Section 3.0, the remaining technologies and process options are assemble into alternatives that define a range of remedial possibilities. A "no action" alternative, as required by the National Oil and Hazardous Substances Contingency Plan (NCP), is also included. Groundwater remedial alternatives are developed and screened in Section 3.0 based upon general effectiveness, implementability and cost. Where appropriate, this general alternative screening reduces the number of alternatives to be analyzed in detail in Section 4.0.

1.1.4 Detailed Analysis of Remedial Alternatives

The alternatives carried through Section 4.0 are then analyzed in detail, based on the criteria contained in the NCP. The purpose of this detailed evaluation is to provide the decision-maker with the information needed to select an appropriate, cost-effective alternative consistent with site conditions and risks.

1.1.5 Comparative Analysis of Remedial Alternatives

In Section 5.0, the remedial alternatives are compared to each other based on the CERCLA evaluation criteria.

1.2 Site Background

1.2.1 Site Description and History

The Utility Manufacturing/Wonder King site is approximately one acre in size and is comprised of one building with pavement on three of four sides, a fence to the west and south sides with a gate on the north. Trailers used for the storage of packaging materials, plastic product containers and old machinery are located along the fence on the southern perimeter.

The original one-story brick building located at 700 Main Street was constructed in 1967. The property was leased to Radalabs. Radalabs manufactured telephones and communications equipment for U.S. Department of Defense programs. Radalabs occupied the building for five years and sublet the building to International Textile Machinery (ITM). ITM rebuilt and sold textile knitting machinery. Utility Manufacturing became the subleases to ITM in October 1975. In February 1976, Utility Manufacturing moved into the building and ITM moved out. Utility purchased the building in March 1978. In October 1975, Utility Manufacturing had acquired the company, Wonder King and sold products under the combined name of Utility/Wonder King. In 1989, a second story was built onto the existing building.

Currently, the Utility Manufacturing facility consists of a 20,000 square foot main floor manufacturing and storage facility, a 10,000 square foot second floor for offices, a technical laboratory, silk screening operation and storage area. The company manufactures a variety of cleaning and lubricating products primarily for commercial and industrial customers. According to building on file with the Town of North Hempstead, two floor drains are located inside the Utility Manufacturing Building.

The company utilizes a number of hazardous materials as the raw material components of their product line. These materials are inventoried annually for the Nassau County Department of Health (NCDH). Periodic inspections of the premises are made by NCDH. Accurate and complete inventory records are maintained as verified by NCDH inspections.

There are two 4000-gallon underground storage tanks that are registered with the NCDH. The tanks passed the tightness test for structural integrity in 1996. The raw materials which are stored in above ground storage tanks within the facility are also registered and inspected periodically. There is an explosion-proof room with air-driven mixers and filling machines for the methyl ethyl ketone products.

Utility Manufacturing utilizes Safety Kleen for disposal and recycling of the mineral spirits used to clean the silk screens. This is the only chemical waste generated by Utility Manufacturing, and it is not found in the contaminated groundwater flowing beneath the site.

1.3 Nature and Extent of Contamination

The draft RI was conducted to determine the nature and extent of contamination at the Utility site. The general findings are summarized below.

1.3.1 Groundwater

The groundwater beneath the site is contaminated with volatile organic compounds. It appears that the concentrations are uniform across the site, traveling in the general direction of the regional groundwater flow from northeast to southwest. The impediment to continuous flow is the likely existence of the terminus of the clay layer near the southern portion of the site with intermittent pockets of clay and fine, silty sand. This clay layer creates a layer of perched water, which has possibly been contaminated from properties located to the southwest of Utility Manufacturing. This contaminated perched water is believed to flow to the terminus of the clay and into the sandy soil of the groundwater, thereby creating a small plume of contamination near the southwestern corner of Utility Manufacturing.

1.3.2 Soils

There was no on-site soil contamination identified in the NYSDEC-approved Phase One Remedial Investigation. Soil samples were taken using continuous split spoon sampling from ground surface to groundwater.

1.3.3 Interim Remedial Measure

Given the lack of identification of the source of the contamination in the soil at the Utility Manufacturing site, there is no interim remedial measure recommended at this time.

1.4 Contaminant Fate and Transport

The RI did not identify any source areas at the Utility site. Therefore, the primary route for contaminant migration is groundwater advection. No wetlands and surface water bodies have been identified on or within .25 miles of the site, and groundwater to surface water discharge is not considered a route for contaminant migration. Volatilization of VOCs into soil vapor and air is negligible due to the depth to groundwater of greater than 50 feet below grade.

1. 5 Habitat Assessment

Section 1.2.1 presents a description of the Utility site. The property is entirely covered by the footprint of the building, paved parking and driveway areas and sea container storage units. No wetlands or surface water bodies have been identified on or within 0.25 miles of the site. Surrounding land use is industrial/commercial on all four sides.

The draft RI determined that the on-site soils are not a source of contamination. There is no overland flow component of contaminant transport. The soil samples taken 30 feet below the bottom of the drywells exhibited no evidence of contamination. The groundwater is the only contaminant transport medium. Groundwater at the site is encountered more than 50 feet below grade. Due to downward hydraulic gradients, groundwater does not recharge any surface water bodies within one mile of the facility. Potential receptors of groundwater include public water supply wells in the Bowling Green Water District to the southwest. The private well survey in Section 1.8 will ensure that groundwater with VOC contamination above drinking water standards is not extracted for potable use.

A fish and wildlife impact analysis is not required for the Utility site because there are no receptors via overland flow or groundwater recharge, and any surface removal of contaminated groundwater (concentrations above the drinking water standards) would be treated to meet applicable standards prior to use or discharge.

1.6 Risk Assessment

A screening level evaluation was conducted to determine the risks posed by compounds detected in the groundwater. The following hypothetical exposure scenario was evaluated:

The receptor is exposed (via ingestion and inhalation) to the maximum VOC concentrations detected in groundwater during the site investigation.

The compounds that were not detected in the groundwater samples are assumed not to be present.

The receptor ingests two liters of groundwater per day, 365 days per year for 70 years. This scenario is not representative of actual conditions because groundwater is not recovered from the monitoring wells for potable use.

The available health effects criteria for each chemical of potential concern were obtained from the Integrated Risk Information System (IRIS), USEPA's
chemical toxicity database. Known or suspected carcinogens and non-carcinogens were addressed independently. Risk characterization integrates exposure and toxicity assessments into a measurable expression of risk. The carcinogenic risk is expressed as a probability of a person developing cancer over the course of their lifetime. According to the USEPA, a carcinogenic risk range of 1.0E-04 to 1.0E-06, which represents one occurrence of cancer in ten thousand to one million people, is considered a reference level for evaluating acceptable risk at Superfund sites. The non-carcinogenic risk is represented as a hazard index. A hazard index greater than one indicates that there may be concern for potential health effects resulting from exposure to non-carcinogens.

The calculated risk and hazard indices are expected to decrease with time because there are no continuing on-site sources, and natural attenuation and dilution may reduce the volume of contaminants present in the groundwater. In addition, a private well survey will be conducted as described in Section 1.8 to confirm that there are no domestic wells in use in the study area and to preclude potable use of VOC-contaminated groundwater.

1.7 Public Well Inventory

The draft RI presented an inventory of public water supply wells located within a one mile radius of the Utility site. The information is supplied by Nassau County Department of Health (NCDH) and compiled by Lawler, Matusky and Skelly Engineers, Inc. (LMS).

According to the NYSDEC Public Information Sheet, dated September 1996, the Westbury and Bowling Green Water Districts have supply wells in the area. All Westbury and Bowling Green Water Districts customers are provided with drinking water from wells which are routinely monitored to ensure continued safety. In April 1996, a supplemental water treatment system was approved for the Bowling Green Water District wells. The supplemental water treatment system uses air strippers to remove the contaminants, followed by carbon polishing, if necessary, to achieve drinking water standards.

These supply wells continue to be monitored as they have been since the late 1970s to ensure that the water supplied to the community meets New York State drinking water standards.

1.8 Private Well Inventory

The private well survey was conducted during the draft RI covered the area within a one mile radius of the site where groundwater sampling indicated that VOC concentrations exceeded the NYSDEC groundwater standards. Based on the initial survey and Nassau County Department of Public Works (NCDPW) public water supply system information, Utility has verified that no private wells are being used to supply potable water within a one-mile radius.

2.0 Identification and Screening of Technologies

2.1 Introduction

Section 2.0 presents the remedial action objectives, identifies general response actions, and screens potentially applicable technology types and process options to remediate groundwater at the site. The remedial action objectives are presented in Section 2.2 and specify the contaminants of concern, potential exposure pathways and remediation goals. General response actions that satisfy the remedial action objectives are developed in Section 2.3. The remedial technologies that may be applicable to the general response action are identified in Section 2.4.

Process options for each remedial technology type are identified and screened in Section 2.4 using a two step procedure. In step one, technologies and process options that are not technically feasible because of contaminant conditions, material types and site characteristics are eliminated (Section 2.4.1). Potentially applicable technologies and process options are evaluated and screened in step two (Section 2.4.2) based on effectiveness, implementability and cost with the primary focus on probable effectiveness. The second screening evaluation (Section 2.4.2) considers the potential human health and environmental impacts, prior success and reliability of the process options at similar sites, and their applicability to the Utility Manufacturing site. The objective of the second screening evaluation is to identify at least one process option within each remedial technology type to be incorporated in the remedial alternatives presented in Section 3.0.

2.2 Remedial Action Objectives

The remedial action objectives (RAOs) for the Utility Manufacturing site were developed based on the results of the RI and risk evaluation. The RAOs are listed below.

- Mitigate the impacts of VOC contaminated groundwater to public health and the environment.
- Provide for the attainment of all standards, criteria, and guidance for groundwater quality to the extent that is feasible.

The remedial alternatives evaluated in this FS will be compared based on their ability to achieve the RAOs. The first RAO relates to relates to protection of public health by ensuring that contaminated groundwater is not ingested or otherwise used as potable water. Both RAOs relate to long term protection of the environment by restoring contaminant concentrations in groundwater to the lowest levels possible. The detected concentrations of contaminants in the groundwater that exceed standards imply potential impacts to the drinking water supply. No additional threats to human health or the environment, such as surface water impacts, have been identified. Therefore, the issue with the off-site groundwater contamination plume can be addressed by ensuring that drinking water is protected.

2.3 General Response Actions

General response actions applicable to achieve the RAOs established for the Utility Manufacturing site are listed as follows:

- Monitor the local drinking water supply for contamination with volatile organic compounds.
- Investigate the possible containment of the on-site contaminated groundwater.
- Provide a method for collecting the contaminated water for treatment and discharge or provide for in-situ groundwater treatment.

2.4 Identification and Screening of Technology Types and Technology Options

Table 1 lists the remedial technologies and their process options for remediating the on-site groundwater contamination plume.

Table 1

Remedial Technologies and Process Options for Remediating Groundwater

Site: Utility Manufacturing

Remedial Technology	Process Options
Monitoring and Analysis	
Vertical Barriers	(1) Slurry Walls (1) Sheet Pilings
Hydraulic Barriers	(1) Injection Wells/Trenches
Extraction	(1) Extraction Wells (2) Interceptor Trenches
Biological Treatment	(1) In-Situ Bioremediation (2) Anaerobic Digestion
Physical Treatment	(1) Passive Treatment (2) Air Stripping (3) Activated Carbon Adsorption (4) Steam Stripping

Chemical Treatment	(1) Ultraviolet Photolysis/Ozonation (2) Chemical Reduction/Oxidation
Discharge	(1) Groundwater Recharge (2) Use in Plant Operations (3) Groundwater Reinjection

2.4.1 Identification and Screening of Technology Types and Technology Options

All process options associated with the groundwater remedial technologies presented in Table 1 that appeared to be technically appropriate and applicable to the Utility Manufacturing site conditions were evaluated. A preliminary screening was performed to reduce the number of remedial technologies and options evaluated in this section to eliminate those options that would not be appropriate or implementable to remediate the on-site groundwater.

2.4.2 Screening of Potentially Applicable Remediation Technologies and Options

The technologies and their options that survived the initial screening in Section 2.4 are further screened in the following subsections. The screening is based on the remediation technology effectiveness, implementability and cost. The technology types that AEL considers potentially applicable to groundwater remediation at the Utility Manufacturing site are identified and discussed in this section.

The technology types are subdivided into the process options for each technology application. Each option is described and evaluated based on effectiveness, implementability and cost. The process options within each technology are compared and evaluated at the end of each technology type section. The appropriate technology option to remediate the on-site groundwater are retained in Section 2.0 and developed into the alternatives that are described and screened in Section 3.0.

2.4.2.1 Technology Type - Groundwater Monitoring and Sample Analysis

- Description: Samples of groundwater are periodically collected from on-site groundwater monitoring wells. The collected samples are delivered to a New York State certified laboratory where they are analyzed for concentrations of volatile organic compounds (VOCs) to determine if the VOCs concentrations have reduced to acceptable levels. Depth to groundwater can be used to calculate direction of groundwater flow which is subject to seasonal conditions.
- Effectiveness: The laboratory analysis of groundwater samples collected from monitoring wells is an effective method for determining changes in contaminant concentrations. Monitoring can also used to track the effectiveness of other remedial activities.

- Implementability: Groundwater monitoring can be performed using the five groundwater monitoring wells already installed on-site. No additional monitoring wells are required at this time.
- Cost Considerations: Assuming that monitoring well sampling will be performed annually, the major costs will be associated with the labor required to collect the samples and the laboratory fees for sample analysis.
- Evaluation of Technology Option: Groundwater monitoring and sample analysis will be retained for further evaluation in developing alternatives, track groundwater contaminant levels and evaluate the effectiveness of remedial alternatives.

2.4.2.2 Technology Type - Vertical Barriers

2.4.2.2.1 Technology Type - Vertical Barriers: Process Option - Slurry Walls

- Description: Contaminant migration in groundwater can be controlled using subsurface barriers that are low permeability cut-off or diversion walls that are installed below ground to contain or redirect groundwater flow. Slurry walls are generally accompanied with a pumping program to preclude the movement of contaminated groundwater around, over, or through the installed wall. Slurry walls are usually constructed by excavating a trench and introducing a slurry made of bentonite or concrete immediately after the trench is opened. For added wall strength, a mixture of Portland cement, bentonite and water can be used and left in the trench to set and form the barrier wall. To provide an effective barrier to groundwater flow, the slurry wall must have the following characteristics:
  - The wall must have complete physical integrity (no voids).
  - The slurry must be chemically compatible with surrounding groundwater and any contaminants that the groundwater may contain.
  - The slurry mixture must have a sufficiently low permeability.
  - The wall must be of sufficient thickness to ensure future integrity.
  - To minimize underflow of groundwater at the base of the wall, the wall must be set into a stable horizontal layer (aquaclude).
- Effectiveness: Slurry walls can effectively redirect or contain the flow of contaminated groundwater in connection with a pumping program. Effectiveness may be reduced if underflow occurs through the layer anchoring the wall. The build up of head behind the slurry wall barrier may increase contaminant conditions in the underlying layers if not relieved by groundwater extraction. The long term effectiveness of slurry walls depends on the types and concentrations of the contaminants in the groundwater. Laboratory tests are required during design to determine the chemical compatibility of the slurry mixture with the groundwater and soil.
- Implementability: Slurry wall installation is restricted if an impermeable horizontal layer or groundwater is very deep. A slurry wall is not practical at the Utility

Manufacturing site because the groundwater aquifer is located approximately 60 feet below grade and extends a approximately 200 feet to the Magothy aquifer from which drinking water is pumped.

- Cost Considerations: Since the slurry wall construction is not practical at the Utility Manufacturing site, the costs for installing a wall will not be considered in this FS.

2.4.2.2.2 Technology Type - Vertical Barriers: Process Option - Sheet Pilings

- Description: Sheet piling walls may be installed to contain or divert contaminated groundwater away from a drinking water intake, or to divert uncontaminated groundwater around a potentially contaminated area. Sheet piling cutoff walls are constructed by pile-driving interlocked sections of sheet piling into the ground. The sheet piling material may be steel, concrete or wood. Sheet piling is typically used in loosely packed sand or gravel soil at depths up to 50 feet. However, the installation costs and integrity of sheet piling walls are often unpredictable. Therefore, these walls are infrequently used except for temporary dewatering or erosion control.
- Effectiveness: Sheet piling walls may effectively redirect or contain contaminated groundwater if the walls are properly installed.
- Implementability: Sheet piling walls are not practical at the Utility Manufacturing site because the groundwater aquifer is approximately 60 feet below grade and is approximately 200 feet thick.
- Cost Considerations: Since sheet piling wall construction is not practical at the Utility Manufacturing site, the costs for installing a sheet piling wall will not be considered in this FS.

Evaluation of Vertical Barriers Remediation Process Options

The significant depth and thickness of the groundwater table aquifer at the Utility Manufacturing site causes the installation of barrier walls to be impractical. Consequently, slurry walls or sheet piling barriers will not be retained for further evaluation in this FS.

2.4.2.3 Technology Type - Hydraulic Barriers: Process Option - Injection Wells/Infiltration Trenches

- Description: Injection wells and infiltration trenches may be used to input clean water directly into the subsurface to create a groundwater mound and to form an hydraulic barrier to natural groundwater flow. Hydraulic barriers can be located downgradient of a contamination source to block or divert groundwater flow or contaminant migration. The inputting of water may be used to expedite the flushing of contaminants downgradient of the input area and to prevent aquifer depletion. When injection wells are used, water is injected under pressure into the subsurface material. Injection wells can be used to divert groundwater in both unconsolidated material and bedrock. Infiltration trenches are normally used to divert groundwater flow through saturated soils. Infiltration trenches are used to introduce water into highly permeable galleries constructed in shallow unconsolidated materials.

- Effectiveness: Injection wells and infiltration trenches may effectively contain or divert groundwater contaminants in the saturated zone, and may prevent aquifer depletion.
- Implementability: The feasibility of using infiltration trenches and/or injection wells to contain or divert groundwater flow at the Utility Manufacturing site is limited by the significant depths to groundwater at the site.
- Cost Considerations: Injection well installation costs are approximately $20,000 per well with annual operation and maintenance (O&M) costs estimated at 30-40 percent of the installation cost. The cost to construct an infiltration trench is approximately $10 per cubic yard with O&M costs estimated at 10 percent of installation costs. High maintenance costs are associated with required screen and piping maintenance.

Evaluation of Hydraulic Barriers Remediation Process Options
The significant depth and thickness of the groundwater table aquifer at the Utility Manufacturing site would make the installation of hydraulic barriers impractical. Consequently, hydraulic barriers will not be retained for further evaluation in this FS.

2.4.2.4 Technology Type - Extraction

2.4.2.4.1 Technology Type - Extraction: Process Option - Extraction Wells

- Description: Extraction wells are used to recover groundwater to be treated and/or discharged at the surface. Extraction is a highly reliable, proven technology that is commonly used to remediate contaminated groundwater. Extraction wells are also used to reduce downgradient contaminant migration in groundwater through plume containment. Groundwater flow conditions, drawdown at the well, and the radius of pumping influence would depend on hydrogeological characteristics, extraction well size and depth, and pump specifications. Assumptions can be made to estimate the number of wells, well spacing, and pumping rates that would be required to control contaminant migration in groundwater and/or recover contaminants. A groundwater monitoring program would be necessary to demonstrate the effectiveness of the extraction wells.
- Effectiveness: Extraction wells can be used to recover contaminated groundwater from the aquifer for treatment and discharge. Extraction wells can also be used to contain contaminated groundwater, however there is no guarantee that downgradient migration would be prevented.
- Implementability: Materials and contractors are readily available to install extraction wells. Extraction wells require long term operation and maintenance. The number of extraction wells and the well pumping rate is depends on the size of the contamination plume to be remediated.

- Cost Considerations: The installation costs for extraction wells and pumps at the Utility Manufacturing site will depend on the size and depth of the extraction well (s). Long term operation and maintenance costs are estimated at 10 to 15 percent of the installation costs.

2.4.2.4.2 Technology Type - Extraction: Process Option - Interceptor Trenches

- Description: Interceptor trenches are used to extract groundwater from shallow unconsolidated material when extraction well systems would not be as efficient (i.e. low permeability soils). Trenches are normally excavated to the bottom of the aquifer and filled with porous media, such as gravel. Aquifer thickness greater than 30 feet interferes with this approach. Groundwater is removed by a series of sumps placed within the trench during construction.
- Effectiveness: The installation of interceptor trenches at the Utility Manufacturing site is not practical because of the significant depth to the top of the groundwater aquifer (approximately 60 feet).
- Implementability: Interceptor trenches can not be installed at the Utility Manufacturing site. The on-site building occupies most of the site property.
- Cost Considerations: Interceptor trench installation costs will not be estimated in this FS because the trenches are not applicable to the Utility Manufacturing site.

Evaluation of Extraction Technology Remediation Process Options

Extraction wells are an efficient, effective and readily implementable method for recovering contaminated groundwater. Extraction wells may also be used for plume containment. The extraction well technology will be retained for further evaluation in this FS. Interceptor trenches are eliminated from further consideration because of the depth to the aquifer and its thickness renders the trenches impractical.

2.4.2.5 Technology Type - Biological Treatment

2.4.2.5.1 Technology Type - Biological Treatment: Process Option - In-Situ Bioremediation

- Description: Bioremediation treats contamination using microbial degradation. The process alters environmental conditions to enhance microbial activity that may accelerate the decomposition of organic compounds into carbon dioxide and water. The technology has developed rapidly in recent years. Laboratory, pilot and field studies at various sites have demonstrated that contaminated groundwater can be reclaimed using in-situ biological treatment. The in-situ bioremediation technology relies on aerobic (oxygen-requiring) microbial processes. This method optimizes environmental conditions by delivering an oxygen source and nutrients to saturated soils using injection wells or an infiltration system to enhance microbial activity. The feasibility of bioremediation as an in-situ treatment technique depends on the biodegadability of the organic contaminants present and environmental factors that affect microbial activity, such as pH, temperature, and nutrient levels. Research has confirmed that, under anaerobic conditions, microorganisms may breakdown organic compounds such as PCE, TCE and TCA. Chlorinated solvents such as TCA and TCE appear to be resistant to biological degradation in the presence of oxygen; however, breakdown of these compounds, has been observed in the presence of natural gas or methane and air. The more heavily chlorinated compounds are degraded more slowly than less chlorinated compounds, and sometimes no biological degradation occurs.

- Effectiveness: In-situ bioremediation may effectively degrade organic compounds present in groundwater at the Utility Manufacturing site. The halogenated organics (i.e. - TCE, PCE, and TCA) may be degraded under anaerobic conditions or in the presence of natural gas, methane and air. A field test would be required to determine whether bioremediation is an effective option to remediate groundwater at the Utility Manufacturing site.
- Implementability: Microorganisms are very sensitive to slight changes in their environment. Small fluctuations in pH or temperature may interfere with biodegradation processes or reduce biodegradation rates. Biodegradation time frames depend on oxygen availability and contaminant levels in the saturated zone. A small-scale test would be required to determine the feasibility of biologically treating groundwater at the site.
- Cost Considerations: In-situ bioreclamation costs depend on the site geology and hydrology, the extent of contamination, the types and concentrations of contaminants and the volume of groundwater to be treated. These costs could only be estimated upon completion of a field test.

2.4.2.5.2 Technology Type - Extraction: Biological Treatment: Process Option – Anaerobic Digestion

- Description: Anaerobic biological treatment processes reduce organic matter to methane and carbon dioxide in an oxygen-free environment. High organic degradation efficiencies can be achieved. Available anaerobic treatment concepts are based on approaches such as the classic well-mixed system, the two-stage system, and the fixed bed. The well-mixed digester system typically requires long retention times and is easily upset. In the two-stage approach, two vessels are used to maintain separate environments optimized for different types of bacteria. Retention times are significantly lower and upsets are uncommon in this approach. The fixed bed approach (for single or two-stage systems) uses an inert solid media to which the bacteria attach and aqueous wastes are pumped through columns of bacteria-rich media. Use of such supported cultures allows reduced retention times, and bacterial loss through washout is minimized. A number of proprietary anaerobic digestion processes are being actively marketed, each with distinct features but all utilizing the fundamental anaerobic conversion to methane and carbon dioxide. This process may be used to treat high strength organic wastes. Wastewater that contains low levels of organics, such as groundwater at the Utility Manufacturing site, generally cannot support a biological system. Anaerobic digestion can handle certain halogenated organics better than aerobic treatment. Stable, consistent operating conditions must be maintained. Since methane and carbon dioxide gases are formed, it is common to vent the gases or burn them in flare systems, although volatile hazardous materials could escape from such systems. Controlled off-gas burning may be required.

- Effectiveness: Anaerobic digestion may effectively degrade organics, including halogenated organics in groundwater at the site. The organics would be reduced to methane and carbon dioxide gases that may require treatment to ensure allowable emissions.
- Implementability: Anaerobic digestion must be performed in a controlled, oxygen-free environment. Several types of anaerobic digesters are commercially available and some require long detention times to achieve degradation of the organics in groundwater.
- Cost Considerations: Anaerobic biodegradation costs depend on the volume of groundwater requiring treatment, the number and types of microorganisms used, and the system detention time. A gas emissions control system would further increase the treatment costs.

Evaluation of Biological Treatment Process Options

In-situ bioremediation will not be retained for further consideration in this FS. Biodegradation generally requires substantially increased groundwater remediation times compared with other treatment options available. Biodegradation is a difficult process to control and monitor. Other processes, such as the physical treatment options described in the following section would be more effective in treating groundwater at the Utility Manufacturing site.

Anaerobic biodegradation will not be retained for further evaluation in this FS. Anaerobic systems are subject to technical problems. Anaerobic degradation processes also have low throughput rates, that can significantly increase the remediation time when compared with other groundwater treatment options.

2.4.2.6 Technology Type - Physical Treatment

2.4.2.6.1 Technology Type - Physical Treatment: Process Option - Passive Aeration

- Description: Aeration effectively removes volatile organics from water. The degree to which a contaminant enters the gaseous phase depends on a combination of physical/chemical characteristics such as diffusivity, molecular weight, solubility and vapor pressure, and can be expressed as a physical constant known as Henry's Law constant. The greater the Henry's Law constant for a particular VOC, the easier it is to remove a particular VOC from water by aeration. Because the Henry's Law constant increases with temperature, the water temperature also affects the efficiency of contaminant removal by aeration. A passive aeration system, such as a cascade aerator, transfers VOCS, including PCE, TCA and TCE from water to air. Water flows by gravity down a structure designed to create turbulence, which aerates the water. As the water is mixed with air, the VOCs are stripped from the water to a gaseous phase. The quantity of VOC emissions would be estimated during design, and emission controls and/or treatment would be provided, if necessary, to comply with NYSDEC air quality regulations.

- Effectiveness: Passive aeration systems such as cascade aerators can remove VOCs including TCE, TCA and PCE from groundwater extracted at the Utility Manufacturing site. However, passive aeration systems will not adequately remove these compounds to comply with regulatory discharge limits. VOCs would be transferred from the groundwater to the atmosphere, and emissions controls would be used, if necessary, to comply with NYSDEC regulations.
- Implementability: Passive aeration systems can be readily constructed and used at the point of groundwater extraction or discharge. Passive aeration systems are simple to design and implement.
- Cost Considerations: The estimated cost to install a passive aeration system is on the order of approximately $10,000. The cost depends on the volume of water to be treated and the aerator design required to achieve desired VOC removals.

2.4.2.6.2 Technology Type - Physical Treatment: Process Option – Air Stripping

- Description: Aeration effectively removes VOCs from groundwater. The degree to which a contaminant enters the gaseous phase depends on a combination of physical and chemical characteristics such as diffusivity, molecular weight, solubility and vapor pressure and can be expressed as a physical constant known as Henry's Law constant. The greater the Henry's Law constant for a particular VOC, the easier it is to remove a particular VOC from groundwater by aeration. Because the Henry's Law constant increases with temperature, the groundwater temperature also affects the efficiency of contaminant removal by aeration. Aeration is available in various forms including tower aeration, diffused aeration, and spray aeration. Air stripping contacting systems provide mass transfer of organic contaminants from the liquid phase into an air stream. An air stripping unit can be designed in a number of configurations, the most common being the countercurrent packed and tray towers. In packed and tray tower aeration, mass transfer of VOCs from the water to the air is facilitated by mixing contaminated water and uncontaminated air in a countercurrent flow pattern. Contaminated water is pumped to the top of the column, distributed, and trickled down through a bed of packing material or over trays. Uncontaminated air is blown in or drawn into the bottom of the column. The packing material and trays provide a large surface area to mix air and water, contact time for the VOC molecules to transfer from water to air, and a large void volume to reduce the air system energy loss. Air containing VOCs is then released to the atmosphere at the top of the column. If necessary, VOC emissions from air strippers may be captured and treated, using vapor phase carbon adsorption. Emissions controls requirements can be determined during design of the air stripper system. Packed stripping towers frequently require periodic cleaning to remove iron and manganese scale that may form inside the tower and small quantities of metal (e.g., iron) sludge. These materials should be shipped off site for proper disposal.

- Effectiveness: Air stripping is an effectively removes VOCs from groundwater. Air stripping is commonly used by Long Island water districts to remove VOC concentrations in drinking water supplies. Groundwater contaminants such as TCE, TCA and PCE can be effectively removed by air stripping to meet drinking water standards or groundwater discharge limits. VOC removal efficiencies greater than 99% can be achieved by air stripping. VOC air emissions are not expected to be significant based on the concentrations found in groundwater at the Utility Manufacturing site. The air stripper towers can be designed with the diameter and packing height specified according to the groundwater flow rate and desired percent removal.
- Implementability: Air stripping is a proven method to remove VOCs from groundwater. Air stripping can be readily implementable and many vendors are available to supply air stripping towers to the site.
- Cost Considerations: Air stripping costs depend on the specific design and number of towers required to treat the groundwater at the Utility Manufacturing site.

2.4.2.6.3 Technology Type - Physical Treatment: Activated Carbon Adsorption

- Description: Carbon adsorption removes soluble contaminants from an aqueous or gaseous waste stream and binds the contaminants to the surface of a solid activated carbon adsorbent. The adsorbent can be powdered or granular carbon. The activated carbon adsorbs VOCs including TCE, TCA and PCE. Factors affecting adsorption include carbon pore structure and surface area, carbon contact time, temperature and pH. Mixtures of organics can reduce adsorptive capacity for certain compounds because compounds are adsorbed preferentially. Carbon adsorption is not recommended for wastewaters having a high solids content or unassociated metals. Carbon adsorption effectiveness is limited by constituents having low molecular weights, high polarities and/or high solubilities.

  Carbon adsorption treatment produces treated effluent and contaminated spent carbon. The spent carbon contains the waste constituents removed from the aqueous streams and must be either regenerated on or off-site, or disposed of in a secure landfill. Thermal regeneration of the used carbon is the most common method currently used. Other regeneration methods employed are solvent and steam regeneration.

  Several carbon adsorption contacting methods are available. In granular activated carbon systems, the aqueous stream contacts the carbon as it flows through a fixed or moving bed. As the carbon adsorption capacity is spent, it is replaced with new or regenerated carbon. Biological activity sometimes occurs in the carbon system and can contribute positively, via biodegradation, or negatively, via clogging.

Carbon contacting beds can be skid-mounted and placed on flat bed trucks or railcars and transported to various sites.

- Effectiveness: Activated carbon adsorption can effectively remove low concentrations of organics such as TCA, TCE and PCE from groundwater at the Utility Manufacturing site. In general, activated carbon adsorption can provide over 99% contaminant removal efficiency. The spent carbon may be disposed of or regenerated. Carbon adsorption is often employed as a secondary wastewater treatment process following air stripping, when organic removal efficiencies greater than 99% are desired.
- Implementability: Activated carbon adsorption is a proven method to treat groundwater contaminated with VOCs. Many commercial service companies supply mobile carbon adsorption systems.
- Cost Considerations: Activated carbon adsorption costs would depend on many factors, including the volume of groundwater requiring treatment, desired removal efficiencies, and carbon usage rate. There is also a substantial cost associated with the periodic carbon replacement and disposal/regeneration; annual O&M costs may be 10% to 20% of the initial installation cost.

2.4.2.6.4 Technology Type - Physical Treatment: Steam Stripping

- Description: Steam stripping uses hot steam to extract organic contaminants such as the compounds in the groundwater at the Utility Manufacturing site (i.e. TCE and TCA) from a liquid or slurry. Direct hot steam injection and multiple pass heat exchanging are the two most common steam stripping methods. Steam stripping by steam injection, usually into a tray or packed distillation column, removes VOCs from aqueous streams. This unit operation is most effectively applied to remove VOCs with low boiling points. Steam stripping is more costly than air stripping and carbon adsorption treatment when applied to organic waste streams with less than 10,000 ppm organics. Steam stripper design depends on the waste characteristics, throughput, and desired residual characteristics.
- Effectiveness: Steam stripping effectively removes organics with low boiling points and which are present at much higher concentrations (greater than 10,000 ppm) than those concentrations found in groundwater at the Utility Manufacturing site. Therefore, steam stripping would not efficiently remove organics from groundwater at the site.
- Implementability: Steam stripping can be implemented at the site; however, the groundwater contaminant concentrations are not suitable for treatment using this option.

♦ Cost Considerations: Steam stripping costs would be higher than air stripping or carbon adsorption costs. The costs depend on the groundwater flow rate and desired removal efficiency.

Evaluation of Physical Treatment Process Options

Passive aeration will not effectively achieve the required VOC removals to treat groundwater at the Utility Manufacturing site. Passive aeration will not be retained for further evaluation in this FS.

Air stripping is a proven, effective technology to treat the organics at the concentrations found in groundwater at the site and will be retained for further evaluation in this FS.

Activated carbon adsorption can be effective and will also be retained for further evaluation.

Steam stripping will not be retained because this process would not efficiently remove the levels of VOCs in the groundwater as compared to air stripping.

2.4.2.7 Technology Type - Chemical Treatment

2.4.2.7.1 Technology Type - Chemical Treatment: Ultraviolet Photolysis/Ozonation

♦ Description: Ultraviolet (UV) photolysis uses UV radiation to destroy or detoxify hazardous chemicals in aqueous solutions. Ozonation has been combined with UV photolysis to enhance the efficiency of oxidation reactions for compounds that are difficult to oxidize such as halogenated organics.

  The influent to the UV photolysis/ozone treatment system is mixed with ozone and flows past numerous ultraviolet lamps in the reaction chamber. Flow patterns and configurations are designed to maximize exposure to the high energy UV radiation. Industrial systems are generally equipped with recycle capacity. Gases from the reactor are passed through a catalyst unit where volatiles are destroyed and the gases are replenished with ozone, and recycled to the reactor. The system has no gas emissions.

  UV/ozonation is typically used to treat aqueous streams containing less than one percent oxidizable material. The presence of oxidizable materials, other than target pollutants, increases treatment costs.

  UV photolysis/ozonation may effectively oxidize halogenated organics (i.e. - PCE, TCE, and TCA) in the groundwater at Utility Manufacturing site.

♦ Effectiveness: UV photolysis/ozonation can effectively destroy or detoxify organics in aqueous streams. The UV light increases oxidation of contaminants by ozone. UV photolysis/ozonation can effectively treat organics such as PCE, TCE and TCA in groundwater at the Utility Manufacturing site. The process produces no gas emissions; however, the contaminated groundwater may require pretreatment to prevent fouling of the UV lamps.

- Implementability: UV photolysis/ozonation, although not widely used, is implementable at the site and produces no hazardous air emissions.
- Cost Considerations: UV photolysis/ozonation unit installation costs are approximately \$200,000 and annual O&M costs are approximately 30% of the installation cost. These costs are much higher than physical treatment technology (i.e. - air stripping and activated carbon) costs.

2.4.2.7.2 Technology Type - Chemical Treatment: Chemical Reduction/Oxidation

- Description: Reduction/oxidation raises the oxidation state of one reactant while the other is lowered. This process reduces the toxicity of organics and metals. Reduction reacts a reducing agent with water to lower the oxidation state of the waste constituent. Typical reducing agents are ferrous sulfate, sulfur dioxide and sodium chlorohydride.

  Chemical oxidation raises the oxidation state of a compound. Oxidation agents include ozone, hypochlorite, hydrogen peroxide, chlorine and potassium permanganate. Oxidation of halogenated organics, such as TCA, TCE and PCE at the low concentrations found in groundwater at the Utility Manufacturing site may be effective. The theoretical decomposition products of organic compound oxidation are carbon dioxide and water; however, the reactions are generally incomplete and yield intermediate organic compounds.
- Effectiveness: Chemical reduction/oxidation may effectively reduce the toxicity of organics by altering the oxidation state of the compound. Oxidation may effectively remove PCE, TCE, TCA from the groundwater.
- Implementability: Chemical reduction/oxidation is implementable at the Utility Manufacturing site.
- Cost Considerations: The chemical reduction/oxidation capital and operating costs are estimated at approximately \$50,000 for small treatment systems (< 100 gpm). The costs would increase significantly if higher flows must be treated.

Evaluation of Chemical Treatment Process Options

Neither UV photolysis/ozonation nor chemical reduction/oxidation will be retained for further evaluation in this FS. Physical treatment processes such as air stripping and activated carbon adsorption would remove organics including TCE, TCA and PCE from groundwater at the Utility Manufacturing site at higher efficiency and lower cost than the chemical treatment options.

2.4.2.8 Technology Type - Discharge

2.4.2.8.1 Technology Type - Discharge: Groundwater Recharge

- Description: Treated groundwater that meets New York groundwater quality standards may be percolated through subsurface soils to recharge the underlying groundwater. Soils at the Utility Manufacturing site are primarily sands and gravels; therefore, water would infiltrate to groundwater at a moderate rate. Leaching pools could be constructed to distribute water, which would seep into surrounding soils and percolate through the soil to groundwater. Another method for delivering treated groundwater to the subsurface soils uses recharge basins. The size of the Utility Manufacturing site and available space precludes the installation of a recharge basin for returning treated groundwater to the subsurface soils.
- <u>Effectiveness</u>: Treated groundwater could be effectively recharged using recharge basins or leaching pools. The groundwater recharge area required would be determined during design based on groundwater flow rates and site-specific geologic conditions.
- <u>Implementability</u>: Existing leaching chambers could be used to implement this groundwater discharge option. New leaching pools could also be constructed on-site with some difficulty. There are no recharge basins at the Utility Manufacturing site.
- <u>Cost Considerations</u>: Leaching pool installation costs would depend on the quantity of groundwater to be discharged. If existing leaching pools can be used for groundwater recharge, the only capital costs associated with this discharge option would be the cost to lay piping from the groundwater treatment system to the discharge points. A recharge basin could be installed, however, open land is not available. Costs associated with obtaining approvals and purchasing open land for the recharge basin could be significant. However, the availability of open land near the Utility Manufacturing site seems remote.

2.4.2.8.2 Technology Type - Discharge: Use in Plant Operations

- <u>Description</u>: Sometimes recovered groundwater may be used as plant process water in a plant facility non-contact cooling systems. The groundwater would be treated either before or after being used in the cooling systems, and then discharged to on-site diffusion wells along with other non-contact process water from the plant. Additional treatment to deaerate the water may be required to prevent scale formation in the non-contact cooling systems.
- <u>Effectiveness</u>: Using treated groundwater as process water in the plant and discharging it to on-site diffusion wells is sometimes an effective way to discharge the water and reduce the plant's water demands.
- <u>Implementability</u>: This discharge process option may be implementable at the Utility Manufacturing site, depending on the volume of groundwater to be recovered and the amount of water now being used for in-plant manufacturing operations.

- Cost Considerations: If recovered groundwater can be used as process water, the only significant capital costs associated with this discharge option will be the cost to lay piping from the groundwater treatment system to the appropriate process unit in the plant and to deaerate the water, if necessary.

2.4.2.8.3 Technology Type - Discharge: Groundwater Reinjection

- Description: Injection wells may be used to discharge treated groundwater directly into the saturated zone. The wells would be screened so that treated groundwater would be reinjected below the water table. Reinjection would replenish the aquifer, however, there is a limit on the volume of groundwater that can be reinjected due to hydrogeologic conditions. Aquifers typically yield significantly more groundwater to extraction than they accept through reinjection.
- Effectiveness: Treated groundwater may be effectively discharged into the water table through injection wells. Groundwater discharge in this manner may prevent aquifer depletion.
- Implementability: The feasibility of discharging treated groundwater using injection wells would depend on the volume of water to be discharged.
- Cost Considerations: The capital cost to install injection wells would be approximately $20,000 per well. High maintenance costs would be associated with screen and piping rehabilitation that would be required.

Evaluation of Groundwater Discharge Options

Except for discharging treated groundwater into a recharge basin, the following groundwater discharge options will be retained for further evaluation, namely: recharge, using recovered groundwater as non-contact process water, and reinjection, would be effective and implementable, provided that New York groundwater quality standards are met prior to discharge. Depending upon the residual concentrations of VOCs in the groundwater after treatment, another process option may be available. If the concentrations of VOCs in the treated groundwater are low enough, the local sewer district may allow the treated groundwater to be discharged into their system.

2.5 Selection of Applicable Remedial Technologies/Process Options

Based on the technology screening, the following options have been retained for further evaluation:

- Groundwater monitoring
- Groundwater extraction
- Groundwater treatment by air stripping
- Groundwater treatment by carbon adsorption
- Discharge to non-contact cooling water system
- Discharge to injection wells

The primary remedial objective is to protect human health. The screening level risk assessment calculations described in Section 1.6 indicate that risks greater than the levels accepted by USEPA would be posed by the hypothetical scenario where groundwater with the highest VOC concentrations in the study area would be used as potable water. The calculated risks are expected to decrease with time because there are no continuing on-site sources, and natural attenuation and dilution may reduce the volume of contaminants in groundwater. Public water supplies are protected by existing regulations which require monitoring and actions to mitigate exceedances of drinking water standards. The long-term goal is to protect the environment by restoring the aquifer to groundwater standards. The following options are evaluated in this section:

- The "no action" alternative will be carried through this FS as a baseline for comparison.
- Groundwater monitoring will be conducted as part of each alternative to track VOC concentrations and migration in groundwater.
- Extraction wells may be used to recover contaminated groundwater for treatment by air stripping or carbon adsorption to reduce VOC concentrations prior to discharge.
- Extraction wells may be used to minimize downgradient migration of VOCs in groundwater through plume containment.

2.5. 1 Extraction

The effectiveness of the pumping system will depend on the placement of the extraction wells. A pumping system designed to recover contaminated groundwater and minimize downgradient migration of the plume requires the installation of extraction wells along the perimeter of the plume, treatment of the groundwater, and discharge of the treated groundwater.

The highest concentrations of VOCs were detected in the groundwater sample collected from MW-5 located at the southwest corner of the site. Based on the data summarized in the draft RI and supplemental RI reports, it appears that a concentrated mass of VOCs is passing through the groundwater aquifer at this location. Therefore, it is expected that a significant mass of VOCs would be recovered from the groundwater by pumping at this area.

VOC concentrations in groundwater that is not recovered by pumping would be reduced over time through natural attenuation.

2.5.2 Treatment

Air stripping and carbon adsorption are both proven and reliable technologies to remove VOCs from aqueous wastes. If the groundwater extracted from the aquifer below the site requires treatment an air stripping system would be designed and constructed. Air stripping was selected based on familiarity with equipment and operation and maintenance costs. Air stripping is commonly used by Long Island water districts to mitigate VOC impacts on drinking water supplies to meet drinking water standards or groundwater discharge limits. The operation and maintenance costs for the treatment of large volumes of water are lower for air stripping than activated carbon, because activated carbon requires periodic changeouts of spent carbon. The difference in O&M costs can be significant for long-term operation.

Air stripping and activated carbon adsorption would be effective to treat groundwater extracted by pump and treat alternatives to meet discharge limits. Both of these technologies may be incorporated into one or more of the remedial alternatives evaluated in Section 3.0. The actual treatment system specifications will be determined during the design phase.

2.5.3 Discharge

Three options are available to discharge treated groundwater, namely: discharge to the plant's non-contact cooling water system, and discharge to injection wells and discharge into the local sewer system.

The discharge of treated groundwater may not be technically feasible based on the following:

- Studies conducted by the USGS indicate that the rate of recharge or injection back into an aquifer is less than the rate of extraction from the same aquifer. As a result, the surplus of groundwater would require storage.
- More injection wells than extraction wells would be required to reinject the groundwater.
- Recharging or reinjecting a large volume of water in a small geographical area may create undesired mounding conditions which can change groundwater flow patterns and plume capture efficiency.

Utility Manufacturing does not utilize a non-contact cooling water system. At some sites a cooling water system could be modified to accommodate some of the groundwater that is recovered and treated by the remedial alternatives. This option would be cost effective if the remediation system recovers more than 70 gpm (approximately 100,000 gpd), because at this flow rate, one of the plant's supply wells could be taken off-line, reducing the plant's water demand. The cost associated with the modification to the non-contact cooling system would be low. However, if pre-treatment to prevent scaling is required, the cost could be significantly higher. Since this technique can not be applied to the Utility Manufacturing site, this option will not be retained for further evaluation in this FS.

The treated groundwater can be re-injected into the water table through injection wells. This option would require installation of large diameter wells upgradient of extraction wells. Additional treatment to deaerate the water may be required to prevent fouling of injection well screens. The capital cost to install injection wells is moderate, and operation and maintenance costs are high. The use of deep injection wells appears to be infeasible based on the significant maintenance that would be required. Therefore, reinjection will not be retained for further evaluation in the FS.

Depending upon the success of the groundwater treatment, the local sewer system may accept the treated groundwater. Groundwater recharge through the local sewer system will be retained for further evaluation in this FS.

2.5.4 Summary

Based on the screening presented above, the following options will be combined to develop remedial alternatives that are described and evaluated in Section 3.0:

- No action
- Groundwater monitoring
- Groundwater extraction
- Air stripping
- Activated Carbon Adsorption
- Recharge

3.0 Development and Screening of Remedial Alternatives

3.1 Introduction

The remedial action alternatives listed below were developed using the process options carried through the Section 2.0 screening.

- Alternative 1 - No Action
- Alternative 2 - Groundwater Monitoring
- Alternative 3 - Pump and Treat Groundwater from Hotspot at Southwest Corner of Site; Discharge to Local Sewer System; Groundwater Monitoring

The groundwater alternatives developed in this FS present a range of methods to achieve the RAOs. Each alternative is described and then screened based on effectiveness, implementability and cost to reduce the number of alternatives to be carried through the detailed analysis in Section 4.0, where appropriate. Alternatives that are similar in terms of effectiveness, implementability, and cost are compared during this screening, and the most promising alternatives are carried forward for further analysis. The three screening criteria are briefly described below:

1. Effectiveness - Each alternative is evaluated in terms of its effectiveness in protecting the public and the environment. This criterion focuses on the degree to which an alternative reduces contaminant toxicity, mobility, or volume through treatment; controls residual risks; affords longterm protection; complies with ARARS; and achieves the RAOs in a reasonable timeframe.

2. Implementability - Each alternative is evaluated in terms of the ability to obtain the equipment, construct and reliably operate the alternative while meeting any technology- or site-specific restrictions until the remedial action is complete.

3. Cost - The capital and present worth operating and maintenance costs associated with each alternative are estimated to allow cost comparisons among similar alternatives. The cost estimates presented in Section 3.0 are based on information from vendors, costing guides, and other sources. The planned remedial lifetime assumed for costing purposes does not exceed 30 years in accordance with USEPA's RI/FS guidance document (October 1988). Cost estimate calculations for the remedial alternatives are presented in Appendix B.

Section 3.2 presents the applicable or relevant and appropriate requirements that may apply to the remedial alternatives. Section 3.3 describes and evaluates the groundwater remedial alternatives.

3.2 ARARs

Applicable or relevant and appropriate requirements (ARARS) are remedial action standards at CERCLA sites defined by public health statutes and environmental regulations. The alternatives and remedial action objectives presented in this FS were developed within the framework of the ARARS, based on information presented in the RI and previous investigations.

CERCLA Section 121 requires that any long-term clean-up conducted under Superftind must attain (or justify waiver of) federal and more stringent state ARARS. ARARs consist of two sets of requirements, those that are applicable and those that are relevant and appropriate.

ARARs are more specifically defined by the USEPA as follows:
"Applicable requirements" are cleanup standards, and other substantive environmental protection requirements, criteria, limitations or variances promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

"Applicability" implies that the remedial action or the circumstances at the CERCLA site satisfy all of the jurisdictional prerequisites of a requirement. For example, the federal and/or state landfill regulations would apply if a landfill was constructed at a CERCLA site.

"Relevant and appropriate requirements" are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations similar enough to those encountered at the CERCLA site so that their use is well suited to the particular site. A requirement that is relevant and appropriate must be complied with to the same degree as if it were applicable; however, there is more discretion in this determination, and only part of a requirement may be considered relevant and appropriate with the rest dismissed if it is irrelevant or inappropriate to the site specific conditions. Non-promulgated advisories or guidance documents issued by federal or state governments are not ARARS, but are "to be considered (TBCs)" when developing and evaluating alternatives. TBCs are meant to complement ARARS.

USEPA classifies ARARs into three types: chemical-specific, action-specific, and location-specific. Chemical-specific ARARs are usually health-based or risk-based chemical concentration limits or ranges in environmental media (e.g. - the Safe Drinking Water Act Maximum Contaminant Levels or the National Ambient Air Quality Standards). Location-specific ARARs set limits on activities based on the site location.

Requirements addressing wetlands, historic places, or sensitive ecosystems are potential location-specific ARARS. Action-specific ARARs usually are restrictions on the conduct of certain activities or technologies at a site. Regulations that dictate the design and construction of incinerators, air stripping units, or landfills are examples of action specific ARARS. Chemical- and location specific ARARs are generally identified during the site investigation stage of the process, while action-specific ARARs are usually identified during the FS.

The following ARARs are of particular significance as constraints on groundwater remedial actions at the Utility Manufacturing site:

- Clean Water Act
- New York Water Quality Standards
- New York State Pollution Discharge Elimination System Regulations
- New York Air Quality Standards

A detailed discussion of these ARARs follows. Other requirements may also apply, depending on the alternative selected.

3.2.1 Groundwater Remediation Levels

The New York State Groundwater Classification standards (6 NYCRR 703) establishes maximum contaminant levels (MCLS) for various classes of groundwater in the State. The standards in Table 2 apply to VOCs in Class GA groundwater. The New York State Sanitary Code Subpart 5-1 establishes MCLs for principal and unspecified organic contaminants and specific organics for community and non-community water systems. The code defines a community water system as a public water system which serves at least five service connections by year-round residents. A non-community water system is defined as a public water system that is not a community water system.

The federal government has established MCLs for various parameters pursuant to the Safe Drinking Water Act. Although proposed MCLs are not established requirements, they are potential ARARS. If the federal government has not established MCLs for a parameter, other risk-based approaches are used to establish acceptable levels (Interim Guidance on Compliance with Other Applicable or Relevant and Appropriate Requirements, 52 Fed. Reg., pp. 32496-32499, August 27, 1987; also in Memorandum from J. Winston Porter to Regional Administrators regarding Interim Guidance on Compliance with ARARS, July 9, 1987). For non-carcinogens, the acceptable health limits are called reference doses (RfDs). The RfD is an estimate of the daily dose of a substance which will not result in adverse effects over a lifetime of such exposure. USEPA has explained:

> For each non-carcinogen there is some low level of exposure which has no effect on humans. Protection against a chronic toxic effect for a non-carcinogen is achieved by keeping exposure levels at or below the reference dose. . .
>
> The experimental method for estimating the RfD is to measure the highest test dose of a substance which causes no statistically or biologically significant effect in an appropriately conducted animal bioassay test. This experimental no observed-adverse-effect-level (NOAEL) is an estimate of the animal population's physiological threshold. The RfD is derived by dividing the NOAEL by a suitable scaling or uncertainty factor. (51 Fed. Reiz., pp. 21648 - 21665, June 13, 1986).

3.2.2 Groundwater Treatment

Groundwater restoration may involve withdrawal and treatment of contaminated water, followed by the discharge of treated water into the local sewer district drainage system. A portion of the treated groundwater may be discharged into on-site leaching chambers. Discharging treated groundwater into a leaching chamber is considered as a direct discharge to surface waters. On-site discharges from surface waters must meet the substantive requirements of a SPDES permit, but it is not necessary to obtain a SPDES permit or comply with the administrative requirements of the permitting process, consistent with CERCLA 121(e)(1). Alternatively, an off-site discharge to the local sewer district drainage system will require approval by the management of that system, and may require a SPDES permit and must meet both substantive and administrative SPDES requirements.

3.2.3 Air Remediation Levels

The possibility that contaminants in the groundwater would migrate into the atmosphere is remote. However, contaminants may be released to the air during groundwater extraction and treatment, and implementation of an ambient air monitoring program may be required. Presently, there are no numerical standards in New York State for VOC air emissions resulting from groundwater remediation. New York Air Pollution Control Regulations Parts 212-222 states that "the degree of air cleaning required will be specified by the commissioner".

3.3 Description and Screening of Groundwater Remedial Alternatives

This section presents the screening evaluations of groundwater remedial alternatives based on effectiveness, implementability, and cost, as described in Section 3. 1. The descriptions presented in this FS contain preliminary information about conceptual remedial systems. The alternatives and remedial scenarios are evaluated based on these preliminary concepts. The actual remedial system specifications and monitoring locations would be determined during the design phase.

3.3.1 Alternative 1 - No Action

The no action alternative is carried through the FS evaluation to provide a baseline for comparison with other remedial alternatives.

No remedial action would be performed under this alternative. The reduction of contaminant concentrations in the plume would be reduced by natural attentuation. Existing public water supply regulations at the Bowling Green Water District provide for wellhead treatment if necessary to meet drinking water standards.

Long-term groundwater monitoring would be conducted to evaluate the effectiveness of the no action alternative. This FS assumes that the five existing monitoring wells would be used to monitor groundwater quality and water table levels to track plume migration and the decreases in VOC concentrations achieved by natural attenuation.

The wells would be monitored for VOCs including the indicator parameters (PCE, TCE and TCA). Groundwater monitoring would be conducted semi-annually for the first year and annually thereafter until the long-term remedial goal to restore VOCs concentrations in the aquifer to the groundwater standards or to the minimum achievable levels is reached. The actual groundwater monitoring program would be established during the remedial design phase. NYSDEC approval of the monitoring program (monitoring locations, frequency, and analytical parameters) would be required.

- Effectiveness: Public health would be protected under the no action alternative. The existing Bowling Green Water District wellhead treatment system would provide long-term, permanent protection of the drinking water supplied by these wells. Natural attenuation may reduce VOC concentrations in groundwater to the NYSDEC standards over time. The long-term monitoring program would effectively track VOC migration in groundwater. Worker exposure to VOCs during groundwater monitoring would be minimized and controlled in accordance with the site specific health and safety plan developed prior to implementation.
- Implementability: The no action alternative is readily implementable. The long-term groundwater monitoring program would utilize the existing five on-site groundwater monitoring that were installed before and during the RI.
- Cost: The estimated costs for this alternative are summarized in Table 3. There is no additional capital cost associated with the no action alternative. The estimated annual O&M cost is $14,000 for the first year of groundwater monitoring and $9,000 for each following year. Assuming that the groundwater monitoring continues for a ten year period, the estimated present worth is approximately $77,000.

3.3.2 Alternative 2 – Groundwater Monitoring

This alternative is essentially the same as Alternative 1. Groundwater samples will be collected from the five on-site monitoring wells at least once per year during a ten year period. The collected samples will be delivered to a New York State certified laboratory where they will be analyzed for concentrations of VOCs.

No remedial action would be performed under this alternative. The reduction of contaminant concentrations in the plume would be reduced by natural attentuation. Existing public water supply regulations at the Bowling Green Water District provide for wellhead treatment if necessary to meet drinking water standards.

Long-term groundwater monitoring would be conducted to evaluate the effectiveness of the this no remediation action alternative. This FS assumes that the five existing monitoring wells would be used to monitor groundwater quality and water table levels to track plume migration and the decreases in VOC concentrations achieved by natural attenuation.

The wells would be monitored for VOCs including the indicator parameters (PCE, TCE and TCA). Groundwater monitoring would be conducted semi-annually for the first year and annually thereafter until the long-term remedial goal to restore VOCs concentrations in the aquifer to the groundwater standards or to the minimum achievable levels is reached. The actual groundwater monitoring program would be established during the remedial design phase. NYSDEC approval of the monitoring program (monitoring locations, frequency, and analytical parameters) would be required.

- Effectiveness: Public health would be protected under the groundwater monitoring alternative. The existing Bowling Green Water District wellhead treatment system would provide long-term, permanent protection of the drinking water supplied by these wells. Natural attenuation may reduce VOC concentrations in groundwater to the NYSDEC standards over time. The long-term monitoring program would effectively track VOC migration in groundwater. Worker exposure to VOCs during groundwater monitoring would be minimized and controlled in accordance with the site specific health and safety plan developed prior to implementation.
- Implementability: This no remediation action groundwater monitoring alternative is readily implementable. The long-term groundwater monitoring program would utilize the existing five on-site groundwater monitoring that were installed before and during the RI.
- Cost: The estimated costs for this alternative are summarized in Table 4. There is no additional capital cost associated with the no action alternative. The estimated annual O&M cost is $14,000 for the first year of groundwater monitoring and $7,000 for each following year. Assuming that the groundwater monitoring continues for a ten year period, the estimated present worth is approximately $77,000.

This no remediation action groundwater monitoring alternative could be extended beyond the 10 year period if natural attenuation of the contaminants in the plume do not decrease as rapidly as predicted.

3.3.3 Alternative 3 - Pump and Treat the On-Site Contaminated Groundwater
This alternative would require the installation of an extraction well, a stripping tower and an activated carbon adsorption system. The extraction well would be installed to recover groundwater near the southwest corner of the site. The extraction well would be screened at the same elevation as the well screen of monitoring well MW-5. The groundwater extraction rate, expected to be on the order of 20 gpm, would be determined after conducting a pump test at the new well. The extracted groundwater would be treated by air stripping and/or activated carbon adsorption. The actual treatment option would be selected during the remedial design phase. The treated groundwater would be discharged to the on-site local sewer system. Discharging treated water into the local sewer system will require receiving permission from the sewer system management.

The groundwater treatment system would be set up near the extraction well to be installed at the rear of the Utility Manufacturing site. The treatment system would be designed to remove VOCs from the groundwater while meeting the concentrations limits required for discharge to the local sewer system. These discharge limits would be established based on the SPDES regulations.

The highest VOC concentrations at the Utility Manufacturing site were found in the groundwater sample collected from MW-5, at the southwest corner of the site. Based on the data summarized in the RI report, it appears that a concentration plume of VOCs is passing through the groundwater aquifer at this location. Therefore, it is expected that a significant mass of VOCs would be recovered from the groundwater by pumping at this area. The air stripping system would be designed based on an estimated flow of approximately 20 gpm from the new extraction well and the current VOC concentrations at MW-5 (about 1,000 ppb total) to achieve the required removal efficiencies.

VOC emission controls may be required on the stripper to comply with NYSDEC air regulations. The activated carbon adsorption system may use one or two carbon vessels in series. The second unit in series would act as a polishing step to ensure that the desired VOC removals are met when breakthrough occurs. The actual treatment system specifications would be determined during the remedial design phase.

Influent and effluent sampling would be conducted in accordance with SPDES requirements and to evaluate the performance of the remediation system. The treatment system influent and effluent samples would be analyzed for PCE, TCE, TCA, and any additional parameters determined to be necessary during the remedial design phase. This FS assumes that samples would be taken weekly for the first four weeks, every two weeks during the second and third month, monthly after three months, and quarterly after one year. The sampling results would be evaluated to determine the effectiveness of VOC removal from the plume of contamination.

Long-term groundwater monitoring would be performed as outlined in Section 3.3.2.

Effectiveness - This alternative would protect the drinking water supply by combining long-term monitoring with an active remediation of the on-site groundwater. Natural attenuation and hotspot pumping should reduce VOC concentrations in groundwater to NYSDEC standards over time. The existing Bowling Green Water District wellhead treatment would provide permanent, long-term protection of the drinking water supply.

Groundwater remediation at the on-site plume of contamination would remove VOCs from the aquifer to improve groundwater quality and reduce the remedial timeframe. Once the remediation system is installed, modifications such as increased groundwater extraction rates may be made if short term monitoring indicates that changes are necessary to increase the effectiveness of remediation.

Implementability - This alternative is readily implementable. The pump and treat system would be installed and operated on-site, eliminating restrictions associated with off-site implementation. The long-term groundwater monitoring program would consist of wells from the monitoring well network installed prior and during the RI. The need for air emission controls on the strippers would be determined during remedial design.

Cost - The estimated costs for this alternative are summarized in Tables 5. The estimated capital cost of this alternative with air stripping at the hotspot is approximately $100,000. The estimated annual O&M cost for the first year, including groundwater monitoring of the five site wells, is $128,000. The estimated annual O&M for each of the next nine years is $61,000. The estimated present worth of the capital costs plus O&M cost is approximately $777,000. This estimate does not include the cost of adding an activated carbon adsorption system. The addition of such a system could very well double the aforementioned estimates. Air stripping emission controls, if necessary, would also significantly increase the capital and O&M costs.

3.4 Summary

This Feasibility Study has determined that the contaminated groundwater below the site presents no immediate threat to health and safety through inhalation or ingestion because the groundwater table is more than 50-feet below grade. The FS identified no source of on-site contamination that could be contributing to the groundwater contamination.

Alternative 2, a groundwater monitoring program, is recommended to periodically sample and analyze the on-site groundwater for an extended duration. Such a program has already been approved for other sites in the western section of the New Cassel Industrial Area (NCIA). AEL believes that the on-site groundwater contamination has a low probability for impacting the downgradient Bowling Green public water supply wells. The clay layer that is located below grade on-site and downgradient of the site tends to retard the transport of the contamination plume toward those wells. Additionally, The Bowling Green Water District already has installed enhanced treatment and testing facilities to protect the quality of their drinking water wells.

Alternative 3, the installation of a pump and treat system, was considered for remediating the on-site groundwater contamination, but the high estimated installation and operation/maintenance cost does not justify the minor impact such a cleanup effort might have in the NCIA.

Table 2

Utility Manufacturing
Westbury, New York

NYSDEC Standards for Volatile Organic Compounds in Groundwater (GA)

Detected Compound (ug/L)	6 NYCRR 703 Groundwater Quality Standard (Class GA) (ug/L)
Tetrachloroethene	5
Trichloroethene	5
1,1- Dichloroethene	5
c-1,2- Dichloroethene	5
t-1,2-Dichloroethene	5
1,1,1 Trichloroethane	5
1,1-Dichloroethane	5
Napthalene	10

Detected compounds = those compounds detected in on-site groundwater samples

Table 3

Utility Manufacturing
Westbury, New York

Alternative 1: No Action - Sample Monitoring Wells

Preliminary Operation and Maintenance Cost Estimate

	6th month	12th month	years 2-10
1. Sample collection - 2 men @ 8 hours	$1,400	$1,400	$12,600
2. Laboratory analysis - 5 samples	$1,750	$1,750	$15,750
3. Data review, report preparation	$2,500	$2,500	$22,500
4. Contingencies	$1,350	$1,350	$12,150
Sum =	$7,000	$7,000	$63,000

Total Cost = $77,000

Table 4

Utility Manufacturing
Westbury, New York

Alternative 2: Groundwater Monitoring

Preliminary Operation and Maintenance Cost Estimate

	6th month	12th month	years 2-10
1. Sample collection - 2 men @ 8 hours	$1,400	$1,400	$12,600
2. Laboratory analysis - 5 samples	$1,750	$1,750	$15,750
3. Data review, report preparation	$2,500	$2,500	$22,500
4. Contingencies	$1,350	$1,350	$12,150
Sum =	$7,000	$7,000	$63,000

Total Cost = $77,000

Table 5

Utility Manufacturing
Westbury, New York

Alternative 3: Pump and Treat the On-Site Groundwater

Preliminary Operation and Maintenance Cost Estimate

	Year 1	Year 2-10
1. Air Stripping:		
Maintenance (@ 10% of equipment cost)	$10,000	$90,000
Electrical power (@ $0.18/KW-hr)	$14,000	$126,000
Operating labor (3 hrs per week)	$11,700	
Operating labor (3 hrs per month)		$24,300
Influent/Effluent sampling (1 hr per week)	$3,900	
Influent/Effluent sampling (1 hr per month)		$8,100
Influent/Effluent analysis - 2 samples	$36,400	
Influent/Effluent analysis - 2 samples		$75,600
2. Groundwater Monitoring		
Sample Collection - every 3 months; 2 man days	$4,800	
Sample Collection - every 6 months; 2 man days		$21,600
Laboratory analysis - 5 samples; 4 times/yr	$7,000	
Laboratory analysis - 5 samples; 2 times/yr		$31,500
Data review, Report preparation - 4 reports	$10,000	
Data review, Report preparation - 2 reports/yr		$45,000
3. Subtotal A	$97,800	$422,100
4. Contingencies (@ 20%)	$20,000	$85,000
5. Project Management and Administration (@ 10%)	$10,000	$42,000
6. Subtotal B	$127,800	$549,100
7. Total Estimated Cost for 10 Year Operation		**$676,900**

Notes:

1. Installed euipment cost includes well, well pump, and stripper does not include piping, electrical installation or buildings
2. Costs do not include emission controls